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2025

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Project ID:	Project Acronym:	Evaluation Panel:
101040138	**cofacTau**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Yann Fichou**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Cofactors at the core of tau prion behaviour

Tau is an intrinsically disordered protein that regulates microtubule activity in neurons. Aggregation of tau into amyloid fibrils is diagnostic of several diseases, termed tauopathies, that include Alzheimer's disease. Distinct amyloid aggregate structures, so-called "strains", are involved in different tauopathies. These assemblies can spread and recapitulate pathological phenotypes when injected in cells and animals. This is the hallmark that tau aggregates follow a prion behaviour. To date, the factors guiding the formation or propagation of specific strains are unknown. Showcasing this crucial gap in knowledge is the fact that none of the brain-extracted tau amyloid structures has been reproduced in vitro. This project intends to establish a paradigm shift for the very definition of tau strain. I propose the novel hypothesis that the co-aggregation of tau with other biomolecules such as lipids or polyanions, so-called cofactors, is a defining property of tau prion strains. To demonstrate this hypothesis, I will test that the tau-cofactor interactions (i) dictate the structure of tau aggregates, (ii) enable structure replication through seeding and (iii) dictate the neuropathology developed in cells and mice after inoculation of tau seeds. My approach is to study the pathological properties and the conformational evolution of tau aggregates in the presence of biologically-relevant cofactors possessing different physico-chemical properties. By mapping the interactions between tau and cofactors, my goal is also to establish the canonical rules governing tau structural differentiation. This proposal combines multiple methods including EPR and NMR spectroscopy, AFM-based nanospectroscopy, biochemistry, cell biology and animal histology. The proposed paradigm shift would have a very high impact in the field of tauopathies, for example by enabling accurate structure-based drug discovery, revealing new drug targets and pinpointing key deleterious metabolic pathways.

Link to the ERC project webpage: www.fichou-lab.cnrs.fr/home

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: Tau protein, amyloid, EPR, SAXS, LLPS

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Project ID:	Project Acronym:	Evaluation Panel:
101078838	**CENTROFUN**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Simona Giunta**
Host Institution:	UNIVERSITA DEGLI STUDI DI ROMA LA SAPIENZA - ITA

Sequence-structure-function: uncovering how genetic variation at human centromere drives cellular phenotypes

The last decades have seen an extraordinary leap in our knowledge of the human genome and its role in health and disease. Yet, approximately 5% of our DNA still lacks sequence annotation and has been largely excluded from functional and disease-association studies. These genomic gaps include DNA repeats such as centromeres, which are large tandem arrays of alpha-satellite DNA. Centromere's chromatin is functionally essential for chromosome segregation serving as the basal template for the mitotic kinetochore. A recent breakthrough has been the complete genome assembly, including centromeres, of a haploid cell line derived from fetoplacental growth of a molar pregnancy. However, centromeres sequence and size vary across tissues, between individuals and in disease states. The main challenges are to understand how is centromere variation generated and especially, the consequences at a functional level. The specific objectives of my project are: (1) Identify the mutagenic processes and DNA repair responses operating at centromeres; (2) Determine the impact of centromeres' sequence variation on chromatin structure, kinetochore function and chromosome behavior; and (3) Understand how these changes contribute to genome instability, cellular phenotypes and disease predisposition. The originality of this project is to follow a multidisciplinary approach that combines experimental studies – spanning structural biochemistry to cell biology – and bioinformatic analyses, that will benefit from the information on centromere reference already available and soon to be generated. The proposed research therefore represents a very appropriate and timely contribution to provide an integrated view of human centromere variation and its role in determining phenotypic traits. Furthermore, it will provide important insight on the functional role of the "missing genome" in human diseases and promises to yield key information and tools for expanding this novel field.

Link to the ERC project webpage:

Keywords of the ERC project: human genomics; AI; computational genetics; repetitive DNA; chromosome dynamics; genome stability

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101087140	**FuncAmyloid**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Meytal Landau**
Host Institution:	DEUTSCHES ELEKTRONEN-SYNCHROTRON DESY - DEU

Structure, Function and Regulation of Antimicrobial and Virulent Amyloids at High-resolution

Self-assembly of proteins and peptides into amyloid fibrils produced across kingdoms of life is associated with antimicrobial activity, microbial pathogenicity, and a wide range of diseases. The correlation of fibrillation and morphology to function is poorly understood, and high-resolution structural information and mechanistic models are lacking. Our lab pioneered the atomic-level analysis of bacterial amyloids and eukaryotic functional fibrils involved in cytotoxicity, biofilm structuring, and antibacterial activity. We revealed novel morphologies extending beyond canonical amyloid cross-β structures of tightly mated β-sheets, to include, for example, cross-α fibrils composed on amphipathic α-helices. In addition, we exposed a unique lipid-induced cross-α/β secondary structure switch in fibrils of the same sequence. Here we investigate amyloid fibrils which serve as key virulence determinants in S. aureus and Pseudomonas acting as cytotoxins and in biofilm scaffolding, and as antimicrobials produced across different species. We will leverage the knowledge and expertise, and newly emerging methods in electron, light and force microscopy, to understand how fibrillation propensity, fibril morphology and structural switches are connected to function, membrane interactions and toxicity mechanisms at high resolution. The findings are expected to identify structural features that underlie the formation, regulation, and activity of these fibrils, providing advantages in specific environments. Understanding these structure-function relationships will help to clarify the link between amyloid formation and antimicrobial activity. We will use the insights gained from these studies for the rational design of antimicrobial peptides and small molecules targeting virulent determinants towards potential applications in the management of infectious diseases. Our findings on functional amyloids can overall advance life, material, medical and environmental sciences.

Link to the ERC project webpage:

Keywords of the ERC project: amyloid, AMPs, fibrils, virulence,

Keywords that characterize the scientific profile of the potential visiting researcher/s: AFM, biofilms, X-rays, Cryo-CLEM, brains,

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Project ID:	Project Acronym:	Evaluation Panel:
101087582	**ADProbe**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Gerbrand Van Der Heden Van Noort**
Host Institution:	ACADEMISCH ZIEKENHUIS LEIDEN - NLD

ADPribosylation and Ubiquitination; post-translational interplay

Post-translational modification of proteins is essential in regulating proper cellular homeostasis. The attachment and removal of the small protein Ubiquitin (Ub) is amongst others involved in regulating immune response, cell cycle progression and proteasome mediated protein degradation. The (de)conjugation of adenosine-di-phosphate ribose (ADPr) on the other hand is essential in regulating DNA damage responses and apoptosis. ADPribosylation and ubiquitination both dictate a highly complex signaling code and intriguingly these two PTM systems also communicate, as Ub was recently found to be ADPribosylated on multiple different positions. This new layer of controlling ubiquitination plays important roles in intracellular bacterial replication, DNA damage repair and tumor development. Understanding this fascinating post-translational interplay and the role the different UbADPr-isotypes play in cell biology is crucial to develop novel strategies for therapeutic intervention in diseases such as infection diseases and cancers. What are the mechanisms, biochemical scope of protein-protein interactions, cell biological consequences and differences between these non-studied UbADPr linkages? I propose to study the entire system of dynamic ADPribosylation of Ub and explain the molecular details of the (de)conjugating enzymes, explore the cell biological networks involved and exploit the key enzymes for inhibitor discovery en-route to future therapeutic intervention. I will develop novel chemical methodologies and create a set of new substrates, activity-based probes and assay reagents and use them to profile specificity and preferences of the involved enzymes, study the interactions and pathways in cells and screen for small molecule inhibitors. Using my expertise in protein synthesis and chemical- and structural biology I aim to unveil the details of this until now poorly studied, but crucial, hidden layer of post-translational interplay in an unbiased manner.

Link to the ERC project webpage:

Keywords of the ERC project: post-translational modificatoin, ubiquitin, adp-ribose, ADPr

Keywords that characterize the scientific profile of the potential visiting researcher/s: chemical biology, protein chemistry

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Project ID:	Project Acronym:	Evaluation Panel:
101116284	**CONDEVO**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Agnes Toth-Petroczy**
Host Institution:	MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV - DEU

Evolution of Biomolecular Condensates

Cells organize billions of protein molecules into membrane-bound and membrane-less compartments, called biomolecular condensates. Previous research on condensates focused on identifying their components, material properties, and function in homeostasis and disease. In contrast to our relatively precise understanding of membrane-bound compartments, we lack a comprehensive picture of the mechanisms that target proteins into condensates and how condensates emerged during evolution. I hypothesize that localization into condensate is encoded in protein sequences, and that functional condensates are under selection pressure and therefore conserved. I propose a comprehensive research program including both theoretical and experimental approaches to reveal how and when protein condensates emerged during evolution.

I propose to:

1. Map proteomes of condensates across the tree of life,
2. Reconstruct the history of condensates,
3. Follow trajectories of condensate evolution.

Specifically, I will:

1. Investigate what conserved sequence features drive localization to condensates by developing computational tools to predict the proteome of specific condensates across the tree of life; and by testing partitioning of proteins into condensates experimentally.
2. Reconstruct the evolutionary history of the protein components of conserved condensates, and thereby trace their evolutionary origin. Analogous to protein families, we will define condensate families based on shared properties of their proteins and function by developing similarity metrics. We will reconstruct the phylogeny of condensate families and compare to organism and organelle evolution.
3. Perform directed evolution of ancestral non-condensate-forming proteins towards condensate partitioning and follow their mutational trajectories.

Building on our already developed tools and the new algorithms proposed here combined with experiments, we will be able to map the molecular history of condensates on the Tree of Life.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101117619	**Organelloids**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Alexander Von Appen**
Host Institution:	MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV - DEU

Mechanisims of nuclear self-assembly

Shape and function of the vertebrate nucleus depend on the choreographed interplay between lipids, proteins, and DNA to form the nuclear envelope. Even small molecular changes, such as point mutations in the proteins of the nuclear envelope (the lamina) cause detrimental human diseases including premature aging, cancer, and heart disease. To date, a clear, mechanistically compelling explanation for the dynamic coupling of lipids, proteins, and DNA to safeguard nuclear shape and function is still missing. We here propose to build minimal, synthetic nuclei ('Organelloids') bottom-up as a tool to study the self-assembly of a functional nucleus. We recently discovered the conserved molecular machinery that ensures the assembly of the nuclear envelope in open vertebrate mitosis. Our data point to uncharacterized fundamental mechanisms that couple the fusion of lipid-membrane sheets into a continues nuclear membrane to the formation of the lamina, and the organization of chromatin in the same chain of events. In this proposal, we will leverage our recent advances in reconstitution to build 'Organelloids' to recapitulate shape and function of the membrane-lamina-chromatin confluence. Using these nuclear Organelloids we will resolve the nuclear assembly process in high resolution by applying integrated structural biology and determine the unknown biophysical principles that drive the self-organization of individual molecules into one functional organelle. Our strategy will reveal the unknown hierarchical relationship between lipids, proteins, and DNA and produce detailed mechanistic models for the formation and coupling of functional subdomains that are commonly observed in the nuclear membrane, the lamina and chromatin. With cell models and top-down approaches we ultimately aim to define the fundamental principles that govern nuclear biogenesis with implications for health and disease.

Link to the ERC project webpage:

Keywords of the ERC project: Reconstitution of synthetic nucleus.

Keywords that characterize the scientific profile of the potential visiting researcher/s: Biochemistry, cryo electron tomogrpahy, optical tweezer

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Project ID:	Project Acronym:	Evaluation Panel:
101125437	**BacFilm**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Petya Krasteva**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Structure and Regulation of Bacterial Biofilm-Promoting Exopolysaccharide Secretion Systems

Bacteria are commonly defined as unicellular organisms; however, they constantly exchange substances and information with their confrères and the environment, and can efficiently shelter themselves and achieve homeostasis by building multicellular collaborative macrocolonies called biofilms. Members of these sessile communities can undergo significant functional differentiation and are typically embedded in complex extracellular matrix that secures both mechanical protection and a medium for intercellular exchange. Importantly, the switch between sessile and motile life-styles in pathogenic bacteria can correlate directly with the development of chronic vs. acute infections, whereas extracted bacterial matrix components can find a variety of beneficial biotechnological applications. Exopolysaccharides (EPS) are a major biofilm matrix component and are typically produced by trans-envelope secretion nanomachines, many of which are controlled at multiple levels by the intracellular second messenger c-di-GMP. Here, we will consolidate our expertise in biofilm formation, cyclic dinucleotide signaling, bacterial secretion and integrative structural biology to decipher EPS secretion system assembly and function in several medically and industrially relevant species. We will use complementary recombinant and in situ structural biology approaches together with established genetic and imaging techniques to decipher the molecular events controlling EPS biogenesis from transcription initiation, interdependent protein folding and cooperative subunit interactions; through secretion system assembly, formation of supramolecular secretory nanoarrays and EPS modifications; to harnessing the biosynthetic processes for the engineering of novel anti-infectives or beneficial EPS superproducers. Over the last years we have spearheaded these studies by unprecedented mechanistic insights into several secretion systems and have demonstrated the feasibility of such an ambitious project.

Link to the ERC project webpage: www.krasteva-lab.com

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101140447	**UBICODEWRITERS**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Helle Ulrich**
Host Institution:	INSTITUT FUR MOLEKULARE BIOLOGIE GGMBH - DEU

(Re-)Writing the Ubiquitin Code – Manipulating Polyubiquitin Chain Linkage to Investigate Ubiquitin Signalling in Genome Maintenance and Beyond

Ubiquitylation is an essential posttranslational modification that governs the activities and interactions of cellular proteins. The structural diversity of polyubiquitin chains, collectively called the 'ubiquitin code', is thought to determine the fate of the modified proteins. Although many analytical and inhibitory ubiquitin-specific reagents exist, we lack the tools to create polyubiquitin chains of defined linkage on a protein of interest in cells to investigate their signalling functions. We recently established a method to induce substrate-specific polyubiquitylation via three major linkages, M1, K48, and K63. Based on this technology, we now propose to develop a new generation of research tools for the scientific community. This will include the identification and design of custom enzymes for assembling the rarer, still poorly characterised non-canonical linkages and a functionalisation with modules for chain editing, branching, and the identification of effectors. In a combination of biochemical, cell biological, and proteomic approaches, we will then apply these tools to major genome maintenance pathways with prominent roles in the defence against disorders such as cancer and premature ageing. Specifically, we will analyse the significance of non-canonical polyubiquitylation in the response to DNA double-strand breaks and the interplay between degradative and non-degradative ubiquitylation in the regulation of essential DNA replication and repair factors. We envision that our research will not only provide new insight into ubiquitin signalling in genome maintenance, but the new technology developed in this project will facilitate future investigations of polyubiquitin chains, their readers, and their writers in other signalling pathways. Situated at the interface between proteostasis and genome maintenance, this project will thus advance our understanding of two essential cellular surveillance systems with critical functions in human health and well-being.

Link to the ERC project webpage:

Keywords of the ERC project: ubiquitin / genome stability

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101141396	**ImmunoMachines**	**LS1** Molecules of Life: Biological Mechanisms, Structures and Functions

Principal Investigator:	**Dr Robert Tampé**
Host Institution:	JOHANN WOLFGANG GOETHE-UNIVERSITAET FRANKFURT AM MAIN - DEU

Unraveling the Supramolecular Architecture of Molecular Machineries in Adaptive Immunity

To combat daily threats of pathogens and abnormal cells, the human organism features a sophisticated defense mechanism called the adaptive immune system. In broad terms, this intricate mechanism is triggered by specific peptide epitopes presented on molecules of the major histocompatibility complex class I (MHC I), which are scanned by cytotoxic T cells. Intracellular transport, loading, and cell-surface recognition of antigenic peptides on MHC I are orchestrated by machineries, the peptide-loading complex (PLC) and the T cell receptor (TCR) complex. The PLC is composed of multiple subunits, including the antigen translocation unit TAP, the MHC I heterodimer, and several chaperones ensuring that only stable peptide-MHC I molecules are released to the cell surface for decoding by TCR complexes. Ligand binding and the supramolecular organization of TCR complexes are translated into phosphorylation of conserved tyrosine-containing cytosolic sequence motifs that initiate downstream signaling cascades. Based on their incredible efficiency and selectivity, we hypothesize that the biogenesis of MHC I is highly processive and coupled via allosteric networking, and that antigen processing and recognition machineries are compartmentalized by a defined supramolecular organization. However, despite their fundamental importance, these architectural details of the PLC and the TCR, as well as the dynamic networking that is included in the quality control of the endoplasmic reticulum (ER) and receptor signaling processes, remain enigmatic due to their inherent dynamics, low abundance, and complexity.
This ambitious proposal will contribute to a long-awaited holistic understanding of the machineries that shape the vertebrate adaptive immunity. The expected findings from this project will be groundbreaking in understanding the hidden processes of epitope selection and reception in human disease.

Link to the ERC project webpage:

Keywords of the ERC project: molecular immunology, antigen recogniation, antigen processing, ER quality control, cryo-EM, membrane biology, synthetic biology, chemical biology

Keywords that characterize the scientific profile of the potential visiting researcher/s: molecular immunology, antigen recogniation, antigen processing, ER quality control, cryo-EM, membrane biology, synthetic biology, chemical biology

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Project ID:	Project Acronym:	Evaluation Panel:
101042634	**i-SignalTrace**	**LS2** Integrative Biology: from Genes and Genomes to Systems

Principal Investigator:	**Dr Anna Alemany**
Host Institution:	ACADEMISCH ZIEKENHUIS LEIDEN - NLD

Deciphering signalling pathway dynamics during cell-fate commitment in stem cells

Understanding the identity and intensity of the specific extracellular signals that a cell experiences at different times during its differentiation is essential to develop advanced cellular therapies. However, uncovering the sequence of these signaling events, their intensities, timing, and relevance in development and disease is proving to be very challenging. Here, I propose to build i-SignalTrace: a CRISPR/Cas9-based molecular recorder with the capacity to store both lineage information and signalling pathway activity for multiple signals over time in single cells. By performing kinetic experiments and mathematical modeling, I will use i-SignalTrace to extract the probability of signalling pathways to be activated in stem cells when subject to different extracellular signals and reconstruct the lineage tree of pathway activities during differentiation with single-cell resolution. In combination with single-cell RNA sequencing, i-SignalTrace will make it possible to characterize transition and intermediate states along differentiation trajectories, and quantify the integration between extracellular signals and autonomous programs of gene expression. These results will allow predicting the differentiation trajectories that stem cells follow when subject to external perturbations, and deciphering the role of heterogeneity in signalling pathway activity during cell-fate commitment. Using i-SignalTrace, I will identify missing or redundant signalling pathways induced during in vitro differentiation protocols. Therefore, I expect that exploitation of i-SignalTrace will allow establishing new criteria to design protocols to differentiate stem cells on demand. As a proof-of-concept, I propose a framework to improve the functionality of monolayer-derived cardiomyocytes. Taken together, i- SignalTrace will find applications in both fundamental developmental biology and translational regenerative medicine, which will benefit a much wider scientific community.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101054957	**DeepCell**	**LS2** Integrative Biology: from Genes and Genomes to Systems

Principal Investigator:	**Dr Fabian Theis**
Host Institution:	HELMHOLTZ ZENTRUM MUENCHEN DEUTSCHES FORSCHUNGSZENTRUM FUER GESUNDHEIT UND UMWELT GMBH - DEU

Learning and modeling the molecular response of single cells to drug perturbations

Advances in single-cell genomics (SCG) allow us to read out a cell's molecular state with unprecedented detail, increasingly so across perturbations. To fully understand a cellular system, one must be able to predict its internal state in response to all perturbations. Yet such modeling in SCG is currently limited to descriptive statistics. Building upon my expertise in machine learning, I propose to systematically model a cell's behavior under perturbation, focusing on the largely untouched area of drug-induced perturbations with multiomics SCG readouts. A sufficiently generic model will predict perturbed cellular states, enabling the design of optimal treatments in new cell-types. In a pilot study, we predicted gene expression changes of a cell ensemble in response to stimuli. DeepCell builds upon this approach: Based on a multi-condition, multi-modal deep-learning approach for both normal and spatially-resolved genomics, we will set up a constrained, interpretable model for the cellular expression response to diverse perturbations. The added flexibility of the DeepCell model versus classical small-scale systems biology models will allow us to interrogate the effects of combined drug stimuli and characterize the gene regulatory landscape by interpretation of the learned deep network. DeepCell provides unique possibilities to capitalize on cell-based drug screens to address fundamental questions in gene regulation and predicting treatment outcomes. As a proof of concept, I will identify targets that regulate enteroendocrine lineage selection in the intestine. I will set up a 500-compound single-cell organoid RNA-seq screen based on compounds from a spatial imaging screen across 200,000 intestinal organoids, both of which we will model with DeepCell. We will leverage those models to predict optimal treatment for obese mice. DeepCell opens up the possibility of in silico drug screens, with the potential to expedite drug discovery and impact clinical settings.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101054957

Keywords of the ERC project: single cell genomics, machine learning, deep learning, drug screening, gene regulatory networks

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101078353	**GutTransForm**	**LS2** Integrative Biology: from Genes and Genomes to Systems

Principal Investigator:	**Dr Michael Zimmermann**
Host Institution:	EUROPEAN MOLECULAR BIOLOGY LABORATORY - DEU

Gut microbiota drug biotransformation as a tool to unravel the mechanisms of metabolic microbiota-host interactions

The variability of the human gut microbiome (entirety of microorganisms inhabiting the intestine) far exceeds human genome variability, and has been connected to various aspects of human health. Although microbiome differences are often linked to altered metabolism, the current view on metabolic interactions between the microbiota and the host remain mostly descriptive due to several limiting factors. First, most sequencing-based human microbiome studies rely on correlative analyses between microbiome composition and human phenotypes, depend on largely incomplete microbial genome annotations, and are not targeted to identify community-mediated functional traits. Second, many metabolites can be both of microbial and human origin, which makes it conceptually and methodologically challenging to disentangle metabolic microbiota-host interactions. To overcome these limitations, I propose a systematic bottom-up strategy to mechanistically study metabolic microbiota-host interactions by harnessing gut microbiota's capacity to biotransform (chemically modify) drug molecules. The large chemical diversity and exogenous origin makes medical drugs ideally suited for experimental in vitro and in vivo approaches to probe microbiota-host interactions in a controlled way. We will combine high-throughput culturing protocols, genetics, metabolomics measurements, genomics analyses, gnotobiotic mouse work, and computational modeling to connect interpersonal differences in microbiome composition to differences in metabolic functions of individuals' gut microbiota, and ultimately link them to molecular host phenotypes. Generating these mechanistic insights and transformational resources is essential to understand the fundamental principles of the microbiota-host relationship. In addition, this project has direct medical relevance, as it provides actionable microbiome-based links to interpersonal differences in medical drug response, which remain a widespread problem in clinical practice.

Link to the ERC project webpage:

Keywords of the ERC project: gut microbiome, metabolomics, biotransformation, microbiota-host interactions, drug discovery, pharmacokinetics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101095860	**ONCOLIPID**	**LS2** Integrative Biology: from Genes and Genomes to Systems

Principal Investigator:	**Dr Michal Holcapek**
Host Institution:	UNIVERZITA PARDUBICE - CZE

Oncolipidomics: Why is lipidomic dysregulation pattern in blood similar for various cancers?

Lipids are involved in numerous pathways of human metabolism that are related to pathological states. Alterations of lipid concentrations in the blood of cancer patients have been reported but the biological origin is still unknown. Deciphering the mechanisms of the lipid dysregulation mechanism could dramatically change oncology because it can open new avenues for cancer detection with subsequent effective treatment and drug development targeting dysregulated pathways. Early cancer diagnosis is one of the main unmet needs in medicine, which can improve the unfavorable prognosis of patients. The potential of lipidomics has not been fully explored yet, because analytical workflows have limitations in terms of accurate molar quantitation and insufficient coverage of the lipidome. Biologists predict up to 100,000 lipid species in nature, but current methods typically report less than 1% of this number. Here, we will develop novel approaches for quantitation of more than 2,000 lipids from >80 classes using 13C stable isotope labeled internal standards and ultrahigh-resolution methods in liquid or supercritical fluid chromatography, mass spectrometry, and ion mobility. The comprehensive characterization of lipidome will allow us to construct Cancer Lipidome Atlas (WP1). We will develop new Bayesian software for automated data processing and statistical evaluation applicable to the main lipidomic and metabolomic workflows (WP2). We will correlate lipidomics data with metabolomics, proteomics, and transcriptomics data to unravel why lipidomic dysregulation in blood has a similar pattern for various cancers (WP3). This strategy will be applied for the comparison of ten types of cancer with control samples in cell lines, animal models (mice and pigs), human samples (tissues and plasma), and extracellular vesicles. Our initial hypothesis is that the lower activity of CERS2 triggered by cancer cells can downregulate very long fatty acyl ceramides and other sphingolipids.

Link to the ERC project webpage: https://holcapek.upce.cz/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: Analytical chemistry; Mass spectrometry; Liquid chromatography; Supercritical fluid chromatography; Lipidomics; Metabolomics; Glycomics; Cancer Biomarkers

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Project ID:	Project Acronym:	Evaluation Panel:
101097317	**ViveRNA**	**LS2** Integrative Biology: from Genes and Genomes to Systems

Principal Investigator:	**Dr Andrzej Dziembowski**
Host Institution:	MIEDZYNARODOWY INSTYTUT BIOLOGII MOLEKULARNEJ I KOMORKOWEJ W WARSZAWIE - POL

Principles of endogenous and therapeutic mRNA turnover in vivo

During the COVID-19 pandemic, we witnessed the application of mRNA vaccines for SARS-CoV-2, paving the way for the widespread use During the COVID-19 pandemic, we witnessed the application of mRNA vaccines for SARS-CoV-2, paving the way for the widespread use of therapeutic mRNAs in medicine. However, lack of knowledge regarding mRNA metabolism in vivo limits the optimization and refinement of such therapies. Our preliminary data, acquired via Direct RNA Sequencing (DRS), shows that variability of poly(A) tail length and, therefore, stability of endogenous and therapeutic mRNAs in different tissues and cell types is much larger than previously thought.

Here, we propose the ViveRNA project, which will enhance the DRS (eDRS) pipeline and combine it with analyses of mouse models, primary cell cultures, and synthetic biology approaches to examine the nature of mRNA turnover in vivo and characterize the metabolism of endogenous and administered mRNAs. The goal of the ViveRNA project is to elucidate the complexity of mRNA lifetime regulation. Specifically, our aims are:

• Part 1: Construction of an enhanced nanopore Direct RNA Sequencing pipeline (eDRS) for comprehensive analyses of mRNA metabolism. eDRS will assess the composition and lengths of poly(A) tails, modifications, isoforms, and dynamics.

• Part 2: Comprehensive analysis of the lifecycle of endogenous mRNAs, analyzing: dynamics, ribosome association, and poly(A) tail metabolism in organs and primary cells and providing insights into the role of particular enzymes. The reach data resource will help designing better mRNA therapeutics and enable the formulation of testable mechanistic hypotheses.

• Part 3: Description of the metabolism of therapeutic mRNAs in relevant cell types and tissues. Then, together with the knowledge gained in Part 2, the design of more stable mRNAs with therapeutic potential will be initiated.

The ViveRNA project will facilitate the rational design of next-generation mRNA therapeutics.

Link to the ERC project webpage:

Keywords of the ERC project: mRNA turnover, mRNA theraputis, mRNA vaccines

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101115930	**MeioPoly**	**LS2** Integrative Biology: from Genes and Genomes to Systems

Principal Investigator:	**Dr Heïdi Serra**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Meiotic adaptation to allopolyploidy

Hybridization between related species resulting in allopolyploidy is ubiquitous in the evolutionary history of plants. Such nascent allopolyploids face the challenge of ensuring accurate chromosome segregation during meiosis in the presence of related, but non-identical chromosome sets (called homoeologues), inherited from the allopolyploid's progenitors. Essential for fertility, this relies upon the formation of physical connections (crossovers) between homologous chromosomes, while crossovers between homoeologues - that could lead to aneuploidy - must be prevented. Meiotic stability in the allopolyploid context thus requires a tight control of recombination partner choice. The existence of highly fertile natural allopolyploids shows that solutions exist and have arisen many times during evolution, but the mechanisms involved remain poorly understood. My goal is to elucidate the evolutionary processes of meiotic stabilization of nascent allopolyploids, with a special emphasis on the molecular mechanisms that prevent recombination between homoeologous chromosomes. I propose to recreate in the lab the natural hybridization that happened ~16 Kya between A. thaliana and A. arenosa leading to Arabidopsis suecica in order to characterize the mechanisms underlying the evolution of the young allopolyploids over the first generations as they acquire meiotic stability and full fertility. The proposed project has three main objectives: (1) map and characterize genome-wide recombination between homoeologues; (2) identify the factors that control homoeologous pairing and recombination and (3) elucidate how this control is progressively set up in newly formed allopolyploids. Our studies have the potential to bring new and fundamental insights on the evolutionary processes enabling meiotic stabilization of nascent allopolyploids and to contribute to polyploid crop improvement through knowledge transfer to plant breeding programs.

Link to the ERC project webpage:

Keywords of the ERC project: Meiosis, Recombination, Polyploids, Plants

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101117905	**SpaceClones**	**LS2** Integrative Biology: from Genes and Genomes to Systems

Principal Investigator:	**Dr Xavier Rovira Clavé**
Host Institution:	FUNDACIO INSTITUT DE BIOENGINYERIA DE CATALUNYA - ESP

Integrative profiling and engineering of clonal cancer cell behaviours: from the tissue level down to the molecular scale

Clonal evolution in tumours, the process by which cancer cells expand, diversify and are selected, is a major determinant of tumour growth and response to therapy. How the co-existence of diverse cancer cell clones shape tumour development is a fundamental question that remains open, in part because of limitations on existing experimental platforms and analytical frameworks. Our expertise inferring multicellular behaviours within tissue microenvironments, together with recent advances in imaging, assay automation, and cell engineering, timely place us in an excellent position to profile and engineer clonal interactions within tumours from the tissue level down to the molecular scale, which enables targeting this important question with unprecedented throughput and spatial resolution. In SpaceClones, we aim to: (1) characterize clonal interactions in genetically engineered tumours at sub-100 nm resolution, (2) characterize clonal signatures under metabolically defined environmental conditions, and (3) examine the cell state of engineered clonal spatial patterns. To overcome a variety of challenges to understanding molecular and cellular mechanisms of clonal behaviours in tumours, I have designed a ground-breaking approach that combines highly-multiplexed imaging, in vitro and in vivo tumour models, cell engineering, super-resolution microscopy, combinatorial low-volume liquid handling, and algorithms for deconstruction of spatial patterns. Altogether, SpaceClones will exemplify how to imply causality on the emergence of clonal spatial patterns in tumours, having far-reaching implications for the study of any other multicellular system. Ultimately, a deeper understanding of clonal evolution will contribute in the design of more effective cancer therapies and tools to predict clinical outcomes.

Link to the ERC project webpage:

Keywords of the ERC project: spatial proteomics, cancer, perturbation

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101164799	**scEpiTarget**	**LS2** Integrative Biology: from Genes and Genomes to Systems

Principal Investigator:	**Dr Peter Zeller**
Host Institution:	AARHUS UNIVERSITET - DNK

Development of novel single cell multi-omics methods to uncover regulators of cell type specific epigenetic states.

Although all cells of an organism share the same genetic information, they selectively access this information in a cell type- and context-dependent manner. Epigenetic mechanisms, such as post-translational histone modifications (PTHMs) have been identified as central regulators of Transcription Factor-DNA interactions. During cell differentiation, the distribution of PTHMs is modulated to enable the new cell state. Most of the protein complexes that position (writer) and remove (eraser) PTHMs have been identified, but we still do not understand how these proteins are recruited to the genome and thereby dictate the specific genomic distribution of PTHMs. Previous studies were unable to identify these targeting factors as they only interact with a fraction of writer complexes at a time and likely form transient interactions. Thus, new experimental approaches are needed to identify these proteins that are directing localised epigenetic changes.
In scEpiTarget I will develop novel single-cell methods to identify the key factors that determine cell-type specific PTHM deposition. I will use the identified regulators to re-target PTHMs and evaluate their impact on cell fate decisions in state-of-the-art cell differentiation systems.
Recently, I made a technological breakthrough by developing a method that allows the simultaneous measurement of histone modifications and total RNA in single cells. Together with my background in genetic screening and chromatin biology, this will enable me to reach scEpiTarget's objectives. The proposed techniques are transferable to study any protein:DNA interaction, making them highly valuable for the research community.
Epigenetic pathways are essential for multi-cellular life from the beginning of embryonic development, until their mis-regulation during ageing. The identification of factors regulating PTHM distribution will lead to a better understanding of their function and how they can be therapeutically influenced during pathogenes

Link to the ERC project webpage:

Keywords of the ERC project: epigenetic, single cell sequencing, method development, embryology, in-vitro differentiation

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101165361	**REGULADOSIX**	**LS2** Integrative Biology: from Genes and Genomes to Systems

Principal Investigator:	**Dr Rafael Galupa**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Regulation of gene dosage on the mouse X chromosome

Differences in gene dosage can be as powerful as to drive species evolution (e.g., whole-genome duplications) and as harmful as to lead to human diseases (e.g., aneuploidies or haploinsufficiencies). Regulating the effects of gene-dosage differences is thus extremely critical, and this is paradigmatically illustrated by what happens to the X chromosome in mammals. In XX individuals, one of the X chromosomes is transcriptionally silenced as a result of a developmental and epigenetic process called X-chromosome inactivation (XCI), which is presumed to have evolved to compensate X-linked gene dosage between XX and XY individuals. Since its 'discovery' in 1961 by Mary Lyon, we have learnt much about XCI developmental dynamics and molecular underpinnings, however very little is understood about the developmental and molecular reasons at the basis of its evolution. REGULADOSIX aims to gain a functional and mechanistic understanding of the need of X-linked dosage compensation in mammals – we will (i) determine the developmental and molecular consequences in the absence of XCI in mouse embryogenesis, and (ii) functionally identify genes on the X chromosome that are dosage-sensitive, as well as their functions, which would have dictated the emergence of XCI in mammalian evolution. Building on my previous expertise, I propose a multidisciplinary approach at the intersection between development and genetic engineering, which includes cutting-edge genomic technologies (epigenetic screens, functional transcriptomics and proteomics) and novel approaches that we will develop to tune levels of expression in mouse embryonic stem cells and in mouse models. Besides bringing new insights into the need for dosage compensation between the mammalian sexes, REGULADOSIX will contribute to a quantitative understanding of gene expression, and pave the way to establishing fundamental principles of gene dosage regulation in development and disease.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101169963	**Hetrepair**	**LS2** Integrative Biology: from Genes and Genomes to Systems

Principal Investigator:	**Dr Aniek Janssen**
Host Institution:	UNIVERSITAIR MEDISCH CENTRUM UTRECHT - NLD

Heterochromatin repair: mechanisms and roles across scales

Cells face continuous challenges from insults that damage their DNA. To safeguard DNA integrity, a range of repair mechanisms have evolved, which are crucial for organismal survival. However, the eukaryotic nucleus contains different chromatin domains, each requiring specific repair mechanisms to ensure genome stability. In particular, the compact and transcriptionally silenced heterochromatin domains, which are riddled with repetitive DNA and developmental genes, are a challenging environment to repair DNA damage. Despite covering a substantial amount of our genome and being essential for organismal viability and development, heterochromatin remains poorly understood in its response to DNA damage. Heterochromatin domains possess specific molecular and biophysical properties, which I hypothesize necessitate unique chromatin responses at the damaged site to ensure effective repair and maintain genome stability. The aim of this proposal is to identify the dynamic responses to DNA damage in heterochromatin domains and determine their role in maintaining genome stability and tissue health. I will study this across scales, utilizing our recently developed in vitro reconstitution systems that mimic DNA damage in heterochromatin, as well as our unique in vivo systems to study and manipulate heterochromatin repair in fruit fly tissue. These approaches will be integrated with state-of-the-art proteomics, single-cell chromatin analyses and live imaging to identify the mechanisms of DNA repair in heterochromatin, and ultimately determine their impact on genome maintenance and tissue homeostasis. Unravelling chromatin dynamics during DNA repair in heterochromatin has the potential to yield broader insights into their role in other essential nuclear processes such as DNA -replication and -transcription. Importantly, HETREPAIR could in the long-term shed light on how heterochromatin repair processes are disrupted in disease and how these can be exploited during treatment.

Link to the ERC project webpage: Https://www.aniek.janssen.org

Keywords of the ERC project: Heterochromatin, fruit flies, DNA repair

Keywords that characterize the scientific profile of the potential visiting researcher/s: Molecular cell biology, epigenetics

Project ID:	Project Acronym:	Evaluation Panel:
101171662	**SPECOLA**	**LS2** Integrative Biology: from Genes and Genomes to Systems

Principal Investigator:	**Dr Davide Risso**
Host Institution:	UNIVERSITA DEGLI STUDI DI PADOVA - ITA

Spatial Transcriptomics through the lenses of statistical modeling and AI

In recent years technological advances have made it possible to quantify the mRNA expression of large numbers of genes while preserving the spatial context of tissues and cells. These techniques, collectively known as spatial transcriptomics, are important because key biological processes depend on the physical proximity of cells and the spatial organization of tissues. Furthermore, several diseases are characterized by abnormal spatial organization within tissues. Despite its early age, spatial transcriptomics is rapidly becoming a widely used tool, complementing single-cell RNA-seq as the tool of choice to study gene expression in complex tissues, e.g., in cancer research and neurobiology. In addition to the gene expression measurements and the spatial localization of transcripts, available data include images collected from the samples that can be used to learn cell-level and tissue-level morphological features. The main objective of this proposal is to combine transcriptomics, spatial structure, and morphology data to better inform key spatial transcriptomics analytical steps. Specifically, we will: - Enhance the comprehension of imaging-based spatial transcriptomics data by a characterization of the statistical properties of the data and a mechanistic modeling of the in situ transcriptional measurements. - Combine imaging and tabular data to better define cell types and states through the use of statistical models and artificial intelligence. - Develop an inferential framework to model the localization of transcripts within and across cells and of cells within and across samples. Overall, this proposal will combine machine learning and artificial intelligence approaches with rigorous statistical modeling of transcriptomics data in a spatial, sub-cellular context. This will ultimately serve the biomedical community and provide a suite of tools that will help pave the way towards personalized medicine and computer-assisted pathology.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101043370	**RiboRescuePhagy**	**LS3** Cell biology, development, stem cells and regeneration

Principal Investigator:	**Dr Yasin Dagdas**
Host Institution:	RUPRECHT-KARLS-UNIVERSITAET HEIDELBERG - DEU

How does autophagy rescue stalled ribosomes?

Multiple ribosomes simultaneously move along the mRNAs to translate the genes into proteins. Cellular stress triggers collisions of ribosomes and disrupts protein synthesis. Eukaryotes have evolved multi-tiered quality control mechanisms that monitor ribosomes and rescue them on collision. While much is known about the rescue of cytosolic ribosomes, how the cell rescues stalled endoplasmic reticulum bound (ER-bound) ribosomes remains unknown. We recently discovered that the stalling of ER-bound ribosomes induces autophagy, a major cellular degradation pathway. We discovered two autophagy receptors that are induced upon stalling of ER-bound ribosomes and these proteins are conserved between plants and humans. We also showed that ufmylation, an elusive posttranslational modification system regulates ER-bound ribosome stalling-induced autophagy. These two discoveries indicate that autophagy plays a major role in the maintenance of a functional ER-bound ribosome population. Based on these discoveries, I hypothesize that autophagy rescues stalled ER-bound ribosomes by selectively degrading harmful polypeptides and RNAs that clog the ribosomes during collisions. Here, I propose to define and characterize this conserved quality control mechanism. I will establish a suite of complementary methods in the model plants Arabidopsis thaliana and Marchantia polymorpha to explore the physiological significance of autophagy-mediated ribosomal rescue (RiboRescuePhagy) in complex multicellular organisms. In parallel, I will carry out unbiased genetic screens in human cell lines to discover the molecular components that mediate RiboRescuePhagy. Finally, I will perform structure-function analysis of a key ufmylation enzyme to untangle the connection between ufmylation and autophagy. At the completion of this project, we will have defined a new quality control mechanism that rescues stalled ER-bound ribosomes to maintain cellular homeostasis in eukaryotes.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101044951	**MitoSignal**	**LS3** Cell biology, development, stem cells and regeneration

Principal Investigator:	**Dr Alena Zíková**
Host Institution:	BIOLOGICKE CENTRUM AKADEMIE VID CESKE REPUBLIKY VEREJNA VYZKUMNA INSTITUCE - CZE

Mitochondrial signaling drives parasite differentiation

Mitochondria perform three essential functions: ATP production, metabolite synthesis and cellular signaling. These signals, communicating the bioenergetic and biosynthetic fitness of the organelle to the nucleus, play a powerful role in determining cellular fate. The incorporation of mitochondrial reactive oxygen species (mROS) in cellular signaling is an interesting evolutionary outcome, as excess levels of these potent oxidizers have been implicated in many pathologies. While most research focuses on these outcomes of oxidative stress, much less is known about how mROS drive a range of physiological responses. Furthermore, the available studies are limited to a few traditional model organisms, featuring complex cellular systems with numerous mitochondria at different energetic states. Here, we propose to utilize the unicellular parasites, Trypanosoma brucei and T. congolense, as simplified but elegant models to define mROS-driven cellular differentiation. As these protists undergo programmed development between several distinct life cycle forms, there are striking changes to the structure and physiology of their single mitochondrion that manifest in elevated ROS levels. Importantly, we demonstrated that these ROS molecules are essential for the developmental progression of the parasite. Employing these well-chosen models and combining next-generation biosensors, advanced bioenergetic methods, redox proteomics and a CRISPR/Cas9 genetic screen, we will answer the following fundamental questions: Does mROS drive Trypanosoma cellular differentiation? What molecular processes are responsible for the elevated mROS levels during differentiation? How is the redox signal propagated to the rest of the cell? The proposed research aspires to unravel the fundamental mechanisms underlying the intricate communication between mitochondria and the rest of the cell, featuring cellular hallmarks of cell fate decisions.

Link to the ERC project webpage:

Keywords of the ERC project: Trypanosoma, mitochonria, ROS, signaling, cell differentiation

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101078070	**gutTEimpact**	**LS3** Cell biology, development, stem cells and regeneration

Principal Investigator:	**Dr Katarzyna (Kasia) Siudeja**
Host Institution:	INSTITUT NATIONAL DE LA SANTE ET DE LA RECHERCHE MEDICALE - FRA

Illuminating the role of selfish genetic elements in somatic tissue homeostasis and aging

Life-long tissue homeostasis requires sustained function of differentiated cell types as well as progenitor cells, which ensure tissue self-renewal. Little is known about the role that non-genic repetitive DNA sequences play in the maintenance of cellular homeostasis in divers somatic tissues in vivo. Transposable elements (TEs) are omnipresent, highly repetitive DNA sequences that mobilize and propagate within host genomes. Though previously thought to be fully repressed in the soma, TEs can be actively transcribed and, at least to some extent, mobile in certain somatic tissues. Indeed, somatic TE activity was proposed to contribute to normal development, aging, and pathologic conditions, such as cancer or neurodegeneration, underscoring the potential bearing that these selfish genetic elements could have in the soma. Nevertheless, the dynamics of activity and tissue-specific regulation of TE sequences are poorly understood, as is the impact of TE activity on different somatic cell-types and tissues. We have recently uncovered that prevalent, tissue-specific TE mobility occurs in the Drosophila intestine and can lead to gene inactivation and tumor formation. Here, using this powerful and genetically amenable in vivo model system, I aim to combine genomic techniques with developmental and cell biology approaches to address the intriguing interplay between TEs and somatic tissue function in vivo. I will ask: 1- How TE activity differs between diverse cell types and how it changes in a tissue under normal or pathological conditions, as well as during aging? 2- What processes control TE activity in somatic cells in vivo?; and 3- What are the direct consequences of TE transcriptional activity and mobility on somatic cell function, and the long-term impacts at a tissue and organism level? Ultimately the proposed research program will shed new lights on the importance of mobile DNA sequences in the maintenance of lifelong tissue homeostasis in vivo.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101078070/results

Keywords of the ERC project: transposable elements, tissue homeostasis, stem cells, Drosophila, aging

Keywords that characterize the scientific profile of the potential visiting researcher/s: molecular biology, development, repetitive DNA, bioinformatics, population genomics, cancer research, non-model organisms

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Project ID:	Project Acronym:	Evaluation Panel:
101087656	**EpiPhys**	**LS3** Cell biology, development, stem cells and regeneration

Principal Investigator:	**Dr Jean-Léon Maître**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Physics of the first mammalian epithelium

Epithelia operate major biological functions throughout the human body. Forming de novo during preimplantation development, the trophectoderm (TE) is our first epithelium. The TE mediates the formation of the first mammalian lumen, which involves considerable physical challenges. Indeed, pressurized fluid, pumped through the TE, fractures intercellular contacts before cells squeeze this fluid into a single lumen. We recently found that cell adhesion and cell contractility determine the position of this lumen, which then controls further differentiation of the TE. This suggests that physical cues can determine the first mammalian axis of symmetry and TE patterning. However, most physical properties of epithelia controlling this process remain unknown, as their study in vivo has been so far very limited. In this project, we will investigate how the physics of the TE shapes and patterns the mouse preimplantation embryo, by using novel approaches, such as microfluidics and optical tweezers, that allow direct measurement of physical properties in vivo. First, we will determine epithelial transport properties of the TE and their regulation during lumen opening. We will next map plasma membrane reservoirs and membrane mechanics during preimplantation development. We will then characterize how the nuclear envelope and chromatin regulate nuclear mechanics during epithelial thinning. With this broad and unprecedented in vivo physical characterization, we will determine how epithelial transport, plasma membrane and nuclear mechanics influence epithelial stretching and patterning during lumen growth and positioning. Finally, we will determine the relative contributions of these physical properties in this process, and investigate their relationship. Together, we will build an integrated view of how uncharted physical properties of epithelia control stretching and patterning, in the context of a process that is key to the fertility of the ageing European population.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101115795	**CROSSTALK**	**LS3** Cell biology, development, stem cells and regeneration

Principal Investigator:	**Dr Laura Aradilla Zapata**
Host Institution:	UNIVERSITAT DES SAARLANDES - DEU

Opposites attract: Crosstalk between vimentin and microtubules - mechanical stability vs. dynamic adaptability

The cytoskeleton is mainly composed of actin, microtubules, and intermediate filaments. It is fundamentally important for many cellular processes, which is reflected in its morphological and functional diversity. In the past, in-depth analysis of actin and microtubule networks made it possible to reconstitute their diversity in vitro with astonishing precision. This enabled a detailed understanding of the mechanisms underlying actin and microtubule network formation, which are the basis for many cellular processes.

In contrast, our knowledge of intermediate filaments is still in its infancy, and we are far from rebuilding complex intermediate filament networks and their interactions with other cytoskeletal elements in vitro. As intermediate filaments are a major determinant of cellular resilience against mechanical stress and their mutations associate with diseases, detailed insight into intermediate filament network formation and properties will represent a milestone in cytoskeletal research.

The proposed project will be a major step in this direction. We focus on vimentin, the most ubiquitous member of the intermediate filament family. We will investigate the role of vimentin-microtubule crosstalk as well as the relation between network morphology and mechanical stress. How do these networks provide cells with mechanical stability, while being able to rapidly change their morphology? Through a combination of biochemical, structuring, and mechanical methods we will address this question, which is relevant in many biological systems – from subcellular structures to tissues and organisms.

In this way, CROSSTALK will pave the way towards a clearer picture of this heavily understudied cytoskeletal filament. It aims at integrated, mechanistic insight into the organization and (mechanical) functions of vimentin and its interactions with microtubules, which form the basis for understanding its role in many higher-order physiological and pathological processes.

Link to the ERC project webpage: www.biocytolab.com

Keywords of the ERC project: Cytoskeleton, microtubules, vimentin intermediate filaments, in vitro reconstitution, protein biochemistry, biophysics, mechanobiology

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101117186	**MitErra**	**LS3** Cell biology, development, stem cells and regeneration

Principal Investigator:	**Dr Stamatis Papathanasiou**
Host Institution:	INSTITUT FUR MOLEKULARE BIOLOGIE GGMBH - DEU

Mechanisms of cellular response to errors in mitosis: a new, non-genetic approach to an old question

One of the holy grails in cancer biology is to understand how genomic instability, a hallmark source of mutagenesis, arises. However, surprisingly little is known about non-genetic drivers of tumorigenesis. My proposal will delve into the old question of how Mitotic Errors and nuclear Abnormalities (MitErrA) affect cellular homeostasis, from a fresh perspective: the elucidation of non-genetic effects on genome function and cellular adaptation. I recently discovered that micronuclei, a prominent type of errors in mitosis, are a previously unappreciated source of epigenetic instability. This discovery, together with the novel technologies that I developed, will serve as the springboard to address four fundamental questions: 1) How is chromatin state affected in abnormally segregated chromosomes? 2) What are the mechanisms of transcriptional (dys)regulation following errors in mitosis? 3) How is genome organization perturbed in imbalanced genomes? 4) What is the physiological significance of abnormal chromosomes generated by mitotic errors? I will combine cutting edge techniques, such as targeted chromosome manipulation and single-cell genomics, with advanced systems to track mis-segregated chromosomes by live-cell imaging over multiple generations. I will identify additional sources of inherited abnormal nuclear structures (termed “Mit-bodies”) and characterize their DNA damage/repair dynamics and epigenetic alterations. I will study how transcription dynamics are perturbed in daughter cells upon abnormal mitosis and define higher-order genome organization, nuclear positioning and lamina association of mis-segregated chromosomes. Finally, I will investigate long-term cellular adaptations and assess the tumorigenic potential of these abnormal chromosomes. Altogether, these studies will offer the first comprehensive assessment of the non-genetic mechanisms by which errors in mitosis may drive cellular adaptation and tumorigenesis.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101165259	**Tightly Controlled**	**LS3** Cell biology, development, stem cells and regeneration

Principal Investigator:	**Dr Elif Eroglu**
Host Institution:	KAROLINSKA INSTITUTET - SWE

Tight junctions and tissue mechanics as sensors and executers of heart regeneration

One of the most fascinating aspects of salamander regeneration is the level of precision at which restoration of complex structures occurs. How the recovery of form and function is sensed at a cellular level leading to appropriate termination of regenerative programs remains largely unknown. This is partly due to technical challenges of studying cellular events at a high-resolution during regeneration and establishing a constitutive link between cell behavior, tissue architecture and function. Here, I propose taking an interdisciplinary approach that combines gene editing, deep-tissue imaging, force measurements and spatial -omics to overcome these barriers. My goal is to gain holistic understanding of regeneration by integrating molecular, cellular, mechanical and functional parameters. Specifically, I aim to explore the role of tight junctions and mechanical cues in sensing and relaying macroscale information to adapt cellular events as the regeneration unfolds. We will utilize the newt Pleurodeles waltl and heart regeneration as an ideally suited regeneration context where I recently showed that the injury response by the epithelial-like covering called epicardium and the dedifferentiating cardiomyocytes are closely coordinated to replenish the lost muscle. By combining long term intravital cell tracking, mechanical characterization and ultrasound imaging with tight junction manipulations and mechanical perturbations we will 1) define cell dynamics and regenerative state transitions 2) test whether unique expansion in the tight junction protein Claudin-6 sequence that extends its N-terminus is protective against overproliferation and 3) map the physical properties controlling the termination of regenerative programs. Our results will identify mechanisms underlying the tight control of regeneration and bring new insights into the function of Claudins that are frequently dysregulated in cancer, opening new venues in regenerative medicine and cancer research.

Link to the ERC project webpage:

Keywords of the ERC project: Heart Regeneration, Intravital imaging, Mechanobiology, Tight junctions

Keywords that characterize the scientific profile of the potential visiting researcher/s: Mathematical modelling, cardiovascular system, biophysics, engineering

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Project ID:	Project Acronym:	Evaluation Panel:
101169998	**MITOSIZE**	**LS3** Cell biology, development, stem cells and regeneration

Principal Investigator:	**Dr Kurt Schmoller**
Host Institution:	HELMHOLTZ ZENTRUM MUENCHEN DEUTSCHES FORSCHUNGSZENTRUM FUER GESUNDHEIT UND UMWELT GMBH - DEU

Mitochondrial DNA homeostasis in growing cells

Mitochondrial DNA (mtDNA) constitutes a substantial proportion of DNA in eukaryotes, and its regulation is critical not only for mitochondrial function but also for cell survival. However, it is still unclear how mtDNA copy number is maintained during cell proliferation and how mtDNA copy number impacts on cell function. Recently, my group showed that in budding yeast, mtDNA copy number is tightly linked to cell volume to maintain constant concentrations, providing an elegant and potentially conserved strategy for mtDNA homeostasis. But how is mtDNA coupled to cell volume? Based on my group's work, we proposed that nuclear-encoded mtDNA maintenance factors produced in proportion to cell volume limit mtDNA replication and stability. This provides a conceptual mechanism for how cells link mtDNA copy number to total cellular protein content, and opens the door to a quantitative and molecular understanding of mtDNA homeostasis.
With MITOSIZE, I will reveal the molecular basis of this 'limiting machinery' mechanism. To test whether the mechanism is conserved across species and to chloroplast DNA, I will use two evolutionary distant eukaryotes: S. cerevisiae, whose size I can control genetically, and C. reinhardtii, whose size I can control with light. I will use an interdisciplinary approach combining molecular biology, quantitative live-cell imaging, and modelling to develop a quantitative understanding based on measurements of mtDNA replication and degradation. I will then unravel the contribution of the 'limiting machinery' regulation to the dynamic adaptation of mtDNA to changing environments. Moreover, by breaking the coupling of mtDNA copy number to cell volume, I will dissect how cell volume and mtDNA copy number determine cell function and aging. By identifying the molecular regulation underlying organellar DNA homeostasis, I will address a fundamental question in cell biology and open the door to new intervention strategies for mtDNA misregulation in diseases.

Link to the ERC project webpage:

Keywords of the ERC project: mitochondria, mtDNA, cell size, imaging, yeast

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101170642	**XDose**	**LS3** Cell biology, development, stem cells and regeneration

Principal Investigator:	**Dr Bruno Hudry**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Discover the physiological and developmental functions of X chromosome dosage using new genetic and system models

Sex chromosomes are critical for controlling the phenotypic differences between males and females. However, they also create an imbalance in the gene products of sex-linked genes, with males having only one copy and females having two copies. To counteract this imbalance, many species evolved a chromosome-wide mechanism known as dosage compensation, which helps equalise gene expression between the sexes. This process is vital, as failed dosage compensation can lead to sex-specific disorders and lethality in several species including humans. Although researchers have made significant progress in understanding the mechanistic basis of dosage compensation, the core questions remain unanswered: why is the lack of X-chromosome compensation lethal and what are the physiological consequences of its absence? The proposed research aims to identify the mechanisms underlying X monosomy-associated lethality by studying the genes, cells, and developmental processes sensitive to X chromosome doses. This question has been poorly investigated partly due to the difficulties of studying sex chromosome effects. To overcome this barrier, we will investigate flies as these permit the remarkable possibility of generating mosaic animals where sex chromosomes can be genetically manipulated in defined organs, and consequently, functional and molecular analysis. Here, I will combine classical fly genetics, two novel model systems and cutting-edge genomic techniques to: 1. Identify the functions of X chromosome dosage in fly development. 2. Characterise the ancestral X chromosome compensatory system of all insects. 3. Discover the general shared functions of sex chromosome dosage in development using new insect model species. Thus, results from this research should have a major impact on our understanding of the importance of sex chromosome dosage in physiology and disease.

Link to the ERC project webpage: http://ibv.unice.fr/research-team/hudry/

Keywords of the ERC project: Sex chromosomes, sexual differentiation, dosage compensation, Y chromosome, X chromosome, Sex differences in development, metabolism and behaviour, Anatomy and physiology of the reproductive systems

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101075624	**SEMICYCLE**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr Serena Sanna**
Host Institution:	CONSIGLIO NAZIONALE DELLE RICERCHE - ITA

Deciphering female's SEx hormones - MIcrobiota interactions during a menstrual CYCLE for an efficient personalized medicine in cardiometabolic disorders

Cardiometabolic disorders (CMD), a group of conditions that include cardiovascular diseases, type 2 diabetes and metabolic syndrome, are characterised by dysfunction of glycaemic and/or lipid metabolism. Clinical manifestations, severity and progression are different between sexes, the underlying mechanisms of which are largely unknown. The poorer prognosis in women globally calls for an urgent need for better women's tailored prevention and treatment strategies. Still, for an efficient personalised strategy, female-specific mechanisms have to be identified. The SEMICYCLE project will systematically investigate female's sex hormones-microbiota interactions to unravel female-specific microbiota features regulating glycaemic and lipid metabolism in women during homeostasis and diseases. Findings of this research project will pinpoint key mechanisms useful to improve current prevention and diagnostic tools as well as therapeutic options of CMD. SEMICYCLE will follow up 300 healthy women during one menstrual cycle and longitudinal cross-omics data (five layers of information from host genome, gut microbiome, gut metabolome, vaginal microbiome, plasma proteome) will be generated, analysed and integrated with female sex hormones variations, lifestyle and diet, glycaemic and lipid phenotypes using state-of-the-art methodologies and computational approaches. Subsequently, mechanisms identified during homeostasis will be investigated for association with CMD onset and progression, using already existing cohorts totalling more than 10,000 samples. This research is based on my expertise and that of my research group in generating and analysing omics data in large data sets. Findings will reveal previously unknown microbiota regulators of CMD in women thus offering alternative routes for prevention, diagnosis and treatments in women, a necessary step for an efficient personalised medicine.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101075624/results

Keywords of the ERC project: women's health, cardiovascular health, microbiome, longitudinal data,

Keywords that characterize the scientific profile of the potential visiting researcher/s: bioinformatics, metagenomics, proteomics, metabolomics, microbiology

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Project ID:	Project Acronym:	Evaluation Panel:
101077922	**IMMAGE**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr Noga Ron-Harel**
Host Institution:	TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY - ISR

In vivo metabolic determinants of T cell aging trajectories

T lymphocytes play a central role in the immune defense against intruders, and support tissue homeostasis and function. Strikingly, an aged or dysfunctional T cell immunity is sufficient to promote organ aging and multiple age-related morbidities. In this proposal we hypothesize that there is a bidirectional relationship between T cells and their in vivo microenvironment that could develop into a vicious cycle under conditions of aging and disease. While a lot is known about the cellular mechanisms underlying T cell dysfunction with age, A profound understanding of how aging of the microenvironment impacts T cell immunity is missing. This work directly targets this gap to determine how the in vivo microenvironment in an aged mouse dictates T cells aging trajectories. Following on our preliminary findings, we will study two major mechanisms: (1) deficient metabolic support: we propose novel mechanisms by which stromal cells in the T cell zone of secondary lymphoid organs provide T cells metabolic needs for activation, and its failure in aged lymph nodes; and (2) toxic signals specific to the aged spleen that inhibit T cell metabolism and activation. Finally, we will investigate whether targeting these pathways would rejuvenate T cell immunity in vivo. The proposed study will discover unknown mechanisms supporting T cells metabolism in situ and will provide a causative link between T cell aging phenotypes and aging of their microenvironment. Finding new ways to rejuvenate immunity holds the promise for comprehensive and simultaneous targeting of multiple age-related pathologies.

Link to the ERC project webpage:

Keywords of the ERC project: Immune aging, Immunometabolism, hemolytic stress

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council Executive Agency Established by the European Commission	Project ID:	Project Acronym:	Evaluation Panel:
	101078188	**AquaAgeRate**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr Itamar Harel**
Host Institution:	THE HEBREW UNIVERSITY OF JERUSALEM - ISR

Genetic Design of Biological Time in Fish

Every species experiences a unique pace-of-life, which determines the duration of its embryonic development, onset of puberty, and rate of aging. However, how these traits are scaled so differently between species is largely unknown. Here, I propose to develop the tools to systematically study how the pace of life is regulated in vertebrates. To date, progress in our understanding has been experimentally hindered by the relatively long lifespans of classical vertebrate models. To address this challenge, I recently pioneered a genetic platform for rapid exploration of aging in the naturally short-lived turquoise killifish.

Killifish species display up to 10-fold differences in their lifespan, thus providing a “microcosm” of extreme life-history adaptations. Here, we will significantly advance the state of the art by transforming selected species into genetic models. Specifically, we will use unbiased chemical screens to explore the molecular switch that allows killifish development to be suspended for years, in a process called diapause. We will then use our findings to establish genetic control of diapause and the aging processes that co-evolved in this clade. Interrogation of the transcriptional networks in play will be made possible by developing a CRISPR screen platform for fish cells. Finally, we will explore the co-regulation of rapid puberty and compressed lifespan in killifish, by developing multiplexed and reversible genetic approaches.

Aging is the primary risk factor for many human pathologies. Thus, developing a quantitative and mechanistic understanding of the pace of life could revolutionize the way we manipulate aging, treat related diseases, and even control complex traits. Identifying such new principles will also have a broader impact, such as affecting developmental rates in in-vitro fertilization. Furthermore, providing precision genome editing tools for fish, and accelerating the generation time will greatly impact commercial aquaculture.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101163219	**IDENTIKIT**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr Irene Franco**
Host Institution:	UNIVERSITA VITA-SALUTE SAN RAFFAELE - ITA

IDENTIfication and tracking of cancer-prone cells in KIdney Tubules

Understanding what makes our cells prone to develop cancer is key for identifying effective strategies of tumor prevention. By analyzing the genome of normal human cells, I obtained compelling evidence that the pattern of somatic mutations can be used to identify the cell-of-origin of kidney cancer. Although every cell accumulates somatic mutations during a lifetime, some are exposed to a specific mutational process that leave a detectable mark in their genome. Kidney cancers and their cell-of-origin show the same genetic mark, consisting of excess somatic point mutations with unique characteristics and unknown origin. We plan to use this mutational signature to track cancer-prone cells in human kidneys and a) follow their population dynamics; b) study their genome and transcriptome at a single cell level; c) understand the underlying causes of excessive mutation. Having already established a non-invasive assay to detect cancer-prone cells in urine samples, we can now analyse numerous donors, longitudinally and without biopsies. Our preliminary analyses point to adaptation to low-oxygen conditions (hypoxia) as the likely cause of excessive mutation in kidney cells and suggest defects in specific DNA repair pathways as a mechanism. We will test whether overactivation of hypoxia signalling, caused by either a genetic syndrome or exposure to renal ischemia, induces the kidney-specific mutational signature in humans. We will then dissect the molecular mechanism by functional experiments in vitro and in mouse models. Finally, we will test whether and how the diet contributes to the expansion of the mutation-prone cell subset in mouse kidneys. Overall, this study will provide unprecedented resolution of early events leading to kidney cancer initiation and will determine whether hypoxic stress is mutagenic and cancer-promoting. Further, this project will pursue the novel idea that cells can be tracked and possibly arrested before cancer initiation.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101163219

Keywords of the ERC project: somatic mutation, kidney physiology, kidney cancer, mutational signature

Keywords that characterize the scientific profile of the potential visiting researcher/s: kidney physiology, tissue evolution, environmental exposure, diet

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Project ID:	Project Acronym:	Evaluation Panel:
101164006	**GLP1RES**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr Elisa Araldi**
Host Institution:	UNIVERSITA DEGLI STUDI DI PARMA - ITA

Hormone-Induced Resistance to GLP-1 Receptor Agonists in Diabetes: Unraveling the Molecular Complexities

Glucagon-like peptide-1 receptor agonists (GLP-1RAs) have revolutionized the treatment of type 2 diabetes mellitus (T2DM). However, a subset of patients does not respond to these agents or develop treatment resistance, which poses a significant clinical challenge.

Emerging evidence from our work in humans and mice shows that endogenous amidated hormones synergize with GLP-1RAs to reduce glycated hemoglobin, and their absence promotes GLP-1RA resistance. This proposal explores the intricate mechanisms by which endogenous amidated hormones affect endogenous GLP-1 secretion, modulate its function, and influence the effectiveness of GLP-1RAs. Furthermore, it will investigate which characteristics predict the GLP-1RA effectiveness in patients, and test potential therapeutic approaches to prevent detrimental GLP-1 resistance mechanisms with the goal of ameliorating T2DM treatment and outcomes.

A plethora of approaches will be used to elucidate amidated hormone-induced GLP-1 resistance. We will study L-cell functions and GLP-1 endogenous secretion in vitro and in vivo in the absence of amidated hormones. With tissue-specific genetically engineered mice, we will selectively deplete key amidated hormones that counteract the effects of GLP-1RAs and dissect their contribution in physiological readouts of GLP-1RA resistance. Lastly, we will leverage machine learning approaches to clinical data analysis on large deeply phenotyped biomedical cohorts to select for patient characteristics that determine the likelihood of developing GLP-1RA resistance, and to assess the combinatorial contribution of amidated hormones on T2DM susceptibility.

By combining experimental and computational approaches, this project aims to gain a deeper understanding of the complex interplay between endogenous hormones (and their combinatorial effects) and GLP-1 signaling, to develop more effective and personalized therapies, and ultimately to improve clinical outcomes in individuals with T2DM.

Link to the ERC project webpage: https://www.systemsmedicine.unipr.it/projects/15/

Keywords of the ERC project: diabetes, GLP-1, hormone, amidation

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101171508	**MUCPLUG**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr George Birchenough**
Host Institution:	GOETEBORGS UNIVERSITET - SWE

The molecular foundation of cervical mucus plug protection from intrauterine infection during pregnancy

During pregnancy, the cervix undergoes dramatic remodelling characterised by the emergence of mucus secreting goblet cells (GCs) that generate a cervical mucus plug (CMP) in the cervical canal. The CMP is thought to act as a barrier that is crucial for maintaining uterine sterility, thereby protecting the foetus from ascending bacterial infections. However, this view is based on relatively little experimental evidence and our knowledge of specific endogenous or exogenous factors that may regulate cervical GC functions and CMP properties is virtually non-existent. This knowledge gap has significant clinical implications, as preterm birth is a common consequence of intrauterine bacterial infections and is associated with up to 0.6 million annual infant deaths. Over the previous decade, significant research efforts have been made to dissect GC and mucus protective functions in the gut and lungs, while the female reproductive tract has been largely neglected. Fortuitously, much of the knowledge and tools developed by this research can be repurposed to study cervical GCs and the CMP. These include transgenic mice with tagged cervical GCs, null mutant mouse models, targeted mucus biochemical and barrier property analytics, ex vivo mucosal methodologies and large-scale mutagenesis libraries of bacteria that can cause intrauterine infection. In this proposal we will repurpose these tools to: 1) Define GC and CMP gestational dynamics in pre-clinal mouse models; 2) Identify causal links between endogenous and exogenous factors that regulate GC and CMP functions; 3) Screen for bacterial virulence factors associated with breach of the CMP during pregnancy; 4) Isolate CMP alterations associated with human preterm birth. Addressing these aims will provide new insights into GC and mucus biology, host-pathogen interactions and develop a deeper understanding of female reproductive biology that can applied to the development of precision interventions to reduce infant mortality

Link to the ERC project webpage:

Keywords of the ERC project: Preterm birth; mucus; goblet cell; cervix; microbiome

Keywords that characterize the scientific profile of the potential visiting researcher/s: Microbiology; bioinformatics; imaging

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101220029	**NeoGutChip**	**LS4** Physiology in Health, Disease and Ageing

Principal Investigator:	**Dr Jianbo Zhang**
Host Institution:	UNIVERSITEIT VAN AMSTERDAM - NLD

A Neonatal anaerobic Gut-microbiome-on-a-Chip to decode bacterial colonization and infant gut T cell maturation

Developing a healthy host-microbiome symbiosis during the first 1000 days of human life is critical for lifelong health. Despite its importance, our understanding is limited and derives from animal studies or associative human trials. Therefore, there is a pressing need for an infant gut model to capture dynamic microbiome-epithelium-immune interactions in early life. In NeoGutChip I will develop and validate a first-of-its-kind in vitro human Infant Gut-Microbiome-Immune-on-a-chip model (iGuMI) that will faithfully simulate the complex anaerobic environment of the infant gut, which current models cannot achieve. I will capitalize on my cutting-edge GuMI and microbiome engineering experience, to ensure that iGuMI is microbiota- and immune-competent. I will use iGuMI to determine the impact of dietary and microbial factors (especially early bacterial colonizers) on the development and maturation of infant gut microbiota, the mucosal barrier, and immune cells, and unravel the keystone bacterial species and key genes driving these effects. I will realize these objectives through autologous coculture of infant colonic organoids derived epithelium and naïve immune cells in iGuMI. Using bacterial colonization and long-term coculture in iGuMI, I will identify a set of infant gut species driving the immune maturation, and key bacterial genes through RNA sequencing, metabolomics, and loss-of-function assays. Finally, I will investigate mechanism-guided intervention of the microbiota-immune axis in iGuMI to promote anti-inflammatory T cells and mucosal barrier function in infant gut. The successful completion of NeoGutChip will decode the strain-by-strain view of immune modulation by infant gut microbiota in early life and offer a molecular basis to rationally "design" new interventions that directionally promote immune health in babies. Finally, iGuMI can be further developed into a preclinical tool, representing a breakthrough for pediatric biology and medicine.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101087731	**ASTROCYTES-REWARD**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Inbal Goshen**
Host Institution:	THE HEBREW UNIVERSITY OF JERUSALEM - ISR

Astrocytes in Reward and their Bidirectional Relationship with the Dopaminergic System

Astrocytes are currently investigated in a range of questions extending far beyond their traditional 'housekeeping' functions. We have contributed to expanding the horizon of functions attributable to astrocytes, and have recently identified a novel and unexpected role for hippocampal astrocytes in signaling the location of reward. This pioneering ERC project, will drive considerable progress in an important and completely unknown facet of reward-related information processing: the roles of hippocampal astrocytes in signaling reward, and their interaction with dopamine, the main player in the reward system. In Aim 1 we will define the role of hippocampal astrocytes in the perception of reward. We will test whether astrocytes can encode the presences of reward irrespective of its location, based on non-spatial (auditory) cues. By simultaneously imaging both astrocytes and neurons, we will delineate the spatio-temporal interplay between them in reward representation, and examine the projection-specific effect of astrocytes in rewarded behavior. Work on Aim 2 will delineate the effects of the dopaminergic system on astrocytes. We will comprehensively analyse the distribution of dopamine receptors on astrocytes and the astrocytic response to tonic vs. phasic dopaminergic signals. We will also perform simultaneous imaging of dopamine levels and astrocyte Ca2+ dynamics in different behavioral states. Aim 3 will determine how astrocytes mediate the effects of the dopaminergic system. We will do that by manipulating astrocytic activity measure pre-synaptic dopamine axonal release in the hippocampus and its influence on the poorly understood phenomenon of over-representation of reward locations by neuronal place cells. Our published work and our new (unpublished) results generate the conceptual basis for this proposal and demonstrate its technical feasibility. Achieving our goals will provide fundamental insights into the roles of astrocytes in information processing.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101114633	**olfACTION**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Sebastian Bitzenhofer**
Host Institution:	UNIVERSITAETSKLINIKUM HAMBURG-EPPENDORF - DEU

A circuit perspective on olfaction – how learning and context shape the propagation of information between brain areas

Sensory information is initially processed in specialized brain areas but only integration with previously acquired knowledge provides meaningful information for flexible action selection. This requires the propagation of information from sensory to association areas, where sensory information is put into context and memories are acquired. The entorhinal-hippocampal network is of particular importance for information integration and memory formation. Recent findings about learning-induced changes in sensory areas raise the question whether they occur independently or reflect altered top-down influence of the abundant feedback projections from associative areas. While learning- and context-related changes of activity have been described for individual brain areas, it is largely unknown how learning affects propagation of information between areas. The proposed project aims to dissect the mechanisms by which learning and context shape propagation of sensory information from the olfactory system to the entorhinal-hippocampal network in mice. Olfaction provides unique features to address this aim: a short pathway from sensory to association areas, a discrete time frame for information sampling by respiration, and the capability of mice to quickly learn odor-guided tasks. The main hypothesis of this project is that timing and synchrony of neuronal activity are key parameters in determining the propagation of information between brain areas and that they are affected by learning and context through feedback projections from association areas. This hypothesis will be tested by simultaneous electrophysiological recordings in olfactory bulb, piriform cortex, lateral entorhinal cortex, and hippocampus during learning of odor-reward associations, combined with optogenetic manipulations and anatomical assessment of connectivity between these areas. This project will reveal the mechanisms by which learning- and context change the propagation of information between brain areas.

Link to the ERC project webpage:

Keywords of the ERC project: electrophysiology, mouse, circuits

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101116500	**ZoomINs**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Gali Umschweif**
Host Institution:	THE HEBREW UNIVERSITY OF JERUSALEM - ISR

The missing link: inhibitory interneurons as the core of anxiety and depression comorbidity

Rates of depression and anxiety are constantly surging, resulting in a growing global mental health crisis. These two disorders have a remarkably high prevalence of comorbidity, with anxiety generally preceding depression. However, the biological basis of these disorders and their comorbidity is poorly understood, leaving millions of patients with inadequate treatments and thus an urgent need for improved medications. Accumulating evidence suggests that both disorders involve GABAergic deficits, but the nature of these deficits is undefined and may be the holy grail for cracking the mysteries of depression and anxiety comorbidity. Here, I will apply cutting-edge technologies to focus on hippocampal GABAergic interneurons (INs) and propose a data-driven hypothesis for the cellular and molecular basis of anxiety and depression comorbidity. I suggest that INs selectively recruit microglia to reshape inhibition in the depressed brain. This hypothesis may provide the missing link between major hallmarks of depression: GABAergic deficits, synaptic loss, and neuroinflammation. I seek to unravel the molecular adaptations of INs to stress that lead to microglia recruitment and connect them with anxiety preceding depression. Finally, I will elucidate a novel model for innate anxiolysis mediated by local dendritic translation in INs. I will combine, for the first time, the robustness of two analytical methods: translating ribosome sequencing and spatial transcriptomics to identify the involved genes, the INs subtypes expressing them, and their hippocampal location. These data will be complemented by calcium imaging, behavioral tests, imaging, connectomics, and electrophysiology. ZoomINs targets an urgent public health concern by providing a novel hypothesis for a long-standing question: what causes anxiety and depression comorbidity? The results of this ambitious project will set the ground for the development of INs-targeting medications, giving hope to millions worldwide.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101117989	**SpaRC**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Michael Ratz**
Host Institution:	KAROLINSKA INSTITUTET - SWE

Revealing the wiring rules of neural circuit assembly with spatiotemporally resolved molecular connectomics

The human genome contains several thousand genes that play a key role in the development of the brain's connectome, a precise assembly of neural connections with billions of neurons and trillions of synapses. How is genomic information translated into synapse-specific connectivity underlying behavior and cognition? Answering this fundamental question will provide important insights about the principles underlying nervous system development and is relevant for neurodevelopmental disorders such as autism. However, current approaches to measure neuronal connectivity have intrinsic limitations that prevent combined analysis of connected neurons, and their gene expression profiles at a scale that matches the complexity of the mammalian nervous system. Here I propose to develop a novel approach for massively parallel neural circuit tracing with barcoded rabies virus and 3D intact-tissue RNA-sequencing. This will permit a comprehensive understanding about neural network architecture via the large-scale measurement of molecular, cellular, and circuit-level mechanisms in the mouse brain. Compared to current efforts that require vast scientific resources to map synaptic connectivity among a few cells or small tissue volumes, my approach will enable routine measurements of connections among thousands of single neurons with molecular detail. Based on my expertise in in vivo barcoding I will conduct a longitudinal study to reveal the wiring rules underlying the spatiotemporal development of neural circuits from diverse neuron types in the mouse prefrontal cortex, a brain region that plays a key role in cognition. I will follow a cross-sectional approach to unravel the effects of distinct mutations on neuronal wiring in the prefrontal cortex in two mouse models of autism (Cntnap2-/-, Syngap1+/-). My work will provide an innovative experimental platform and provide mechanistic insights into the developmental algorithms that the genome uses to encode the connectome.

Link to the ERC project webpage:

Keywords of the ERC project: neurodevelopment, neural circuits, spatial RNAseq, autism, mouse models

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101125054	**BRAINAMICS**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Alessandro Gozzi**
Host Institution:	FONDAZIONE ISTITUTO ITALIANO DI TECNOLOGIA - ITA

Neuromodulatory control of brain network dynamics

Spontaneous brain activity, the most expensive metabolic process of the human brain, is highly dynamic and continually evolves over timescales of seconds. Human neuroimaging has made it possible to map dynamic patterns of spontaneous network activity with increasing precision. However, our understanding of the origin, function and organization of this phenomenon remains alarmingly limited. This project aims to elucidate the physiological mechanisms and operational principles that govern spontaneous network dynamics (termed here "brain network dynamics" - BND). To achieve these goals, I will establish an integrated research platform that combines advanced manipulations and recordings of BND in the awake mouse brain. To comprehensively probe the mechanisms that operate BND, I will carry out two complementary sets of causal manipulations that are conceptualized as exogenous or endogenous neuromodulation, depending on whether they encompass synthetic (optogenetically generated, Aim 1) or intrinsic (neurotransmitter related, Aim 2) modulatory mechanisms, respectively. Using this approach, I will (a) uncover the rhythms that causally sustain BND, and establish how BND causally responds to (and can be controlled by) mechanistically-precise exogenous neuromodulation; (b) empirically test the hypothesis that cholinergic and noradrenergic transmission cooperatively control the intrinsic organization of BND, as well the selective engagement of higher-order cortical systems relevant for attention and cognition. Crucially, multiscale network activity will be theoretically linked to dynamical regimes (brain states) of translational relevance via quantitative analyses. This research will address fundamental questions regarding the neural mechanisms governing BND and the possibility of controlling its organization via targeted exogenous modulation, with important implications for basic, theoretical and translational neuroscience.

Link to the ERC project webpage: gozzilab.it

Keywords of the ERC project: fMRI, mouse, chemogenetics, optogenetics, fUS, computational neuroscience, arousal, neuromodulation

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101125118	**EPIAROUSAL**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Sylvain Rheims**
Host Institution:	UNIVERSITE LYON 1 CLAUDE BERNARD - FRA

Arousal and respiratory co-dysfunction in drug-resistant epilepsy: from mechanisms to therapy

Both seizures and their complications are modulated by patients' vigilance states. Several epilepsy complications are associated with sleep, including Sudden and Unexpected Death in Epilepsy (SUDEP). SUDEP primarily results from a fatal postictal central apnea after a nocturnal generalized convulsive seizures. While transient seizure-related respiratory dysfunction is frequent in patients, current hypotheses suggest that in some of them, repetition of seizures may induce a chronic alteration of respiratory regulation, increasing the risk of fatal apnea. Reducing the severity of postictal respiratory dysfunction has thus appeared as one of the most promising way to prevent SUDEP. However, no encouraging result has been reported yet, suggesting that epilepsy-related respiratory dysfunction may only be the tip of the iceberg. Given the numerous interconnections between the network that regulates arousal and sleep and the respiratory network, I make the hypothesis that some patients with drug-resistant epilepsy might combine this well-known seizure-related respiratory dysfunction with a chronic alteration of arousal regulation, resulting in abnormal asphyxia-induced arousal. Adenosine system is deeply implicated in the regulation of sleep and central respiratory control and is modulated by seizures. Epilepsy-related alteration of the brainstem adenosine pathway may play a key role in the development of arousal and respiratory co-dysfunction. Using both experimental and clinical studies, EPIAROUSAL will investigate the exact interplay between epilepsy-related respiratory dysfunction and arousal regulation on the one hand, and the relation between long-term repetition of seizures, brainstem adenosine pathway and the respiratory and arousal co-dysfunction on the other hand. The final objective is to validate that adenosine-targeted therapy can restore normal asphyxia-induced arousal in drug-resistant epilepsy, paving the way for a first a clinical trial of SUDEP prevention

Link to the ERC project webpage:

Keywords of the ERC project: Epilepsy

Keywords that characterize the scientific profile of the potential visiting researcher/s: Post-doc - PI

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Project ID:	Project Acronym:	Evaluation Panel:
101141522	**GrowthSINE**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Mike Fainzilber**
Host Institution:	WEIZMANN INSTITUTE OF SCIENCE - ISR

Growing Long Distance - RNA Control of Neuronal Extension

Neurons are the longest cells, extending axons over distances that can reach four orders of magnitude larger than their cell body diameters. How can they achieve such long distance growth? After initial engagement with target cells, neurons undergo stretch-induced elongation as the nervous system matures with the growth of the organism. The molecular mechanisms enabling such prodigious growth are unknown. Based on strong preliminary evidence, we tested the hypothesis that both the initial elongating and later stretch-induced axon growth act via a shared RNA localization mechanism. Very strikingly, we identified a specific subset of polyadenylated repeat element RNAs, hereby termed growth-inducing SINEs (GI-SINEs), as key growth regulators. GI-SINEs are induced from AP-1 promoter-associated extragenic loci, and interact with ribosomal proteins and the axon growth regulating RNA binding protein nucleolin, in neuronal cytoplasm. We will elucidate how this intrinsic mechanism controls neuron growth, determining (1) how known elongating growth regulators affect stretch-induced growth; (2) how local and global protein synthesis regulate neuron growth control; and (3) how growth regulates the GI-SINEs and how they regulate different growth modalities. We will apply a multidisciplinary suite of techniques and approaches to these challenges, including a new technology for characterization of nascent proteomes developed in-house. The proposed project will provide ground-breaking and fundamental mechanistic insights on neuronal growth, and will establish novel methods that will be widely applicable. Moreover, establishing that a repeat element RNA is an intrinsic effector linking AP-1 transcription to translation regulation is a breakthrough finding that opens new horizons for cell biology and neuroscience.

Link to the ERC project webpage:

Keywords of the ERC project: neuron growth, regeneration, non-coding RNA, RNA binding protein, local translation, axonal cell biology

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101142488	**Pain channels**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Gary Lewin**
Host Institution:	MAX DELBRUECK CENTRUM FUER MOLEKULARE MEDIZIN IN DER HELMHOLTZ-GEMEINSCHAFT (MDC) - DEU

Molecules for Nociceptor Force Transduction

Pain results from activation of the nociceptive sensory system, which is built upon the primary afferent nociceptor a type of sensory neuron specialized to detect, code and relay information about potentially or actually damaging stimuli. Humans lacking properly functioning nociceptors never experience pain and have reduced life expectancy and suffer severe disability. Nociceptors detect sustained force into ranges that are potentially damaging and sustained nociceptor activation will always lead to pain. It has been assumed that mechanical force transduced by nociceptors requires mechanically activated ion channels in the nociceptor membrane. However, recent data suggests that sensory Schwann cells that wrap the nociceptor ending also participate in force transduction. The aim of this proposal is to identify molecules specifically involved in nociceptor force transduction at this neuroglial site. We have already identified an ion channel (Tmem87a/ELKIN1) and an extracellular tether protein (TENM4) as being involved in nociceptor force transduction. In addition, STOML3 modulates ELKIN1 function and can sensitize almost all nociceptors to mechanical force. The identification of a set of molecules involved in force transduction (ELKIN1/TENM4/STOML3) will allow us to design “guilt by association” approaches to identify new players. We will use ultra-low input spatial proteomics, BioID and high throughput electrophysiological screening to achieve this aim. We have designed novel genetic strategies to interrogate the function of candidate proteins in nociceptor force transduction with timescales ranging from weeks to minutes. This ambitious and challenging project promises to deliver novel molecular targets that can be used to specifically target nociceptor force transduction. Specific targeting of nociceptor force transduction could be a powerful new way to treat multiple pain types poorly served by existing therapies.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101161748	**LEXSYN**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Katarzyna Grochowska**
Host Institution:	UNIVERSITAETSKLINIKUM HAMBURG-EPPENDORF - DEU

Lysosomal exocytosis of metastable proteins to control synaptic function

The extreme length and small caliber of neuronal processes entail complex local regulation of protein turnover. In light of the high metabolic demand and dynamic protein exchange imposed by synaptic neurotransmission, several surveillance mechanisms should be in place to sense protein damage that will otherwise cause synaptic dysfunction. However, it is still essentially unclear how local control of the metastable proteome, whose proteins have a high copy number and are crucial for synaptic function, is accomplished in dendrites to prevent formation of toxic aggregates. My previous work suggests that neuronal activity drives lysosomal fusion with the plasma membrane and exocytotic release of supersaturated, aggregation-prone proteins. The deposition of these proteins in the interstitial space likely feeds into the glymphatic system and cleaning routines associated with the enhanced circulation of cerebrospinal fluid during sleep. Intriguingly, I could show that, the concomitant release of lysosomal proteases enables growth of spine synapses suggesting that lysosomal exocytosis might serve both, protein removal and synaptic plasticity, whereas the latter might be an inevitable consequence of the necessity for local disposal of aggregation-prone proteins.
Building on my expertise in synapse biology and advanced imaging, the LEXSYN project aims to characterize the secretome of exocytotic lysosomes and to understand the consequences of dendritic lysosomal fusion for synaptic plasticity. I will decipher physiological signals regulating lysosomal exocytosis and investigate the pathological consequences of lysosomal fusion impairment, thereby assessing its relevance in neurodegenerative diseases. To achieve these ambitious goals, I will develop new tools for monitoring and manipulation of dendritic lysosomal exocytosis in vivo. I expect to reveal mechanisms of fundamental relevance for the control of the metastable proteome and its contribution to neurodegeneration.

Link to the ERC project webpage:

Keywords of the ERC project: Synapse, protein homeostasis, neuronal cell biology, plasticity

Keywords that characterize the scientific profile of the potential visiting researcher/s: molecular/cell biology, neuroscience, fluorescence microscopy

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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101163046	**NEURO-FUSE**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Adam Gosztolai**
Host Institution:	MEDIZINISCHE UNIVERSITAET WIEN - AUT

A unifying dynamical theory of distributed computation and generalisation in biological and artificial neural systems

Understanding how the coordinated activity of neurons in multiple brain regions achieves robust behaviour is one of the most fundamental questions in neuroscience. Although recent single-cell technologies enable addressing this question by recording from large neural populations, they are limited to surveying focal brain regions and superficial cortical layers. Without an analytical framework to jointly model isolated measurements, we cannot hope to understand and quantitatively model how single-neuron dynamics give rise to distributed computations. I hypothesise that global brain dynamics fall on distinct attractor states during a given stimulus or task. Attractors naturally give rise to invariant representations, dynamical motifs independent of the sampled neurons' identity. Inferring these invariances would allow reconstructing activity in extended regions from incomplete local recordings to reveal brain-wide cognitive processes. Further, composing invariances would provide insights into the neural correlates of generalisation, with a broad impact on neuroscience and machine learning. I propose a novel mathematical theory combining abstract combinatorial dynamical systems theory and modern machine learning to infer and compose invariant latent dynamics across measurements. We will use this theory to unify large-scale cell-resolution recordings of the mouse and macaque cortex into a common model to make cell-specific predictions across several brain regions. Our results could fundamentally challenge our view on distributed cognitive computations by revealing moment-by-moment single-neuron dynamics in spatially distributed neurons. Further, my theory will help understand how the brain generalises knowledge across tasks by composing and repurposing invariances. More broadly, my theory will open new avenues for machine learning and neuroscience to interact through sharing and shaping the dynamical processes that underpin neural computations in vivo and in silico.

Link to the ERC project webpage:

Keywords of the ERC project: neuroscience, machine learning

Keywords that characterize the scientific profile of the potential visiting researcher/s: mathematics, neuroscience, deep learning

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101163926	**StateNeuromod**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Nikolaos Karalis**
Host Institution:	INSTITUT NATIONAL DE LA SANTE ET DE LA RECHERCHE MEDICALE - FRA

Combinatorial neuromodulation of internal states

Being sleepy, hungry, afraid, or happy impacts our daily experience and defines our behavior and actions. Such internal states are characterized by unique signatures of activity across neural circuits and are actively shaped by neuromodulators, such as dopamine, serotonin, acetylcholine, and norepinephrine, that are released widely throughout the brain to alter the function of target neural circuits.

At any moment, distinct combinations of neuromodulators are being released in each brain region. Changes in the neuromodulator balance have a powerful impact on the brain-wide configurations that underlie internal and behavioral states, while most mood disorders are associated with neuromodulator imbalance, and most therapeutic strategies attempt to restore this balance. However, how combinations of neuromodulators define distinct brain configurations and shape internal states remains unknown.

The prefrontal cortex and the hippocampus are two interconnected regions, which are essential for cognitive processing and memory. They receive converging neuromodulatory inputs, and synaptic alterations in these regions are critical for learning, while dysfunction of this pathway is involved in most mood disorders. Despite the vital role of these circuits for brain function, little is known about how combinatorial neuromodulation regulates circuit configuration and coordinates information flow between these regions.

In this project, we will combine neuromodulator monitoring with large-scale in vivo electrophysiology, optogenetics, and in vivo genome editing to answer the following questions and resolve the contribution of neuromodulators to the organization of neuronal ensembles and information gating in the hippocampus-prefrontal circuit in behaving mice.

1. What is the neuromodulatory landscape across behavioral states?
2. How does state-specific neuromodulation sculpt neuronal dynamics?
3. What are the circuit elements underlying combinatorial neuromodulatory action?

Link to the ERC project webpage: www.neuronaldynamics.eu

Keywords of the ERC project: neuromodulators, brain states, electrophysiology, fiber photometry, optogenetics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101170455	**GLYCOCIRC**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Urte Neniskyte**
Host Institution:	VILNIAUS UNIVERSITETAS - LTU

Sugars maketh the brain: investigating the role of neuronal glycocalyx in shaping the architecture of emerging circuits

Neuronal glycocalyx has been recently recognized as an active agent that contributes to neuronal synapse formation, neuron excitability as well as neuron-autonomous and microglia-dependent brain network remodelling. In particular, the glycan-terminating sialic acids, which often dominate the ends of the chains of glycoproteins and glycolipids on neuronal surface, are required for appropriate brain development and function. Interestingly, almost a fifth of sialic acid biology genes have human-specific changes and aberrant neuronal sialylation and desialylation are implicated in different neurodevelopmental and neuropsychiatric conditions. Thus, I hypothesize than neuronal glycocalyx and specifically its component sialic acid in particular have a critical role in the formation of unique human brain. Despite its recognized importance, there is still a lack of mechanistic understanding filling the knowledge gap how synapses are shaped by the dynamics of the glycocalyx. Therefore, here I propose to merge my expertise in biochemistry and neuroscience to tackle this challenging area of research to further our knowledge of brain sialome through evolutionary approach. We will use in vitro, ex vivo and in vivo models from humans, non-human primates and mouse that can be modified at genetic level for selective labelling and modification of neuronal cells and will combine it with advanced microscopy techniques as well as synaptic-level molecular analysis. We will demonstrate how the glycocalyx and sialic acid act as a defining factor for neural circuitry formation and refinement in developing brain, in particular through the interaction of neurons and their synapses with brain immune cells – microglia. Our results will advance our understanding of fundamental contribution of the glycocalyx to brain physiology and pathology with the translatability to human conditions, thus paving potential ways to develop treatment for brain network disorders.

Link to the ERC project webpage: https://www.gmc.vu.lt/en/cellular-and-molecular-mechanisms-of-brain-development/projects-and-collaboration#sugars-maketh-the-brain-investigating-the-role-of-neuronal-glycocalyx-in-shaping-the-architecture-of-emerging-circuits

Keywords of the ERC project: neurodevelopment, glycocalyx, glycobiology, circuit development, neuron-glia interaction

Keywords that characterize the scientific profile of the potential visiting researcher/s: multi-electrode array, spatial omics, glycome

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Project ID:	Project Acronym:	Evaluation Panel:
101200284	**MEMORAT**	**LS5** Neuroscience and Disorders of the Nervous System

Principal Investigator:	**Dr Israel Nelken**
Host Institution:	THE HEBREW UNIVERSITY OF JERUSALEM - ISR

Continual learning and memory for sounds in rat

How much can we remember and for how long? Decades of key advances in our understanding of synaptic plasticity resulted in a puzzle. On the one hand, memories can be highly stable and organisms are capable of adding new memories without destroying old ones. On the other hand, data and models support neither stability nor lifelong ('continual') learning. Many experiments suggest that responses of neuronal populations slowly but inexorably drift ("representational drift"), while synapses spontaneously turnover. At the same time, models predict that memory traces of new experiences tend to interfere destructively with old traces. Here, I will study auditory continual learning in the behaving rat. I will develop a novel behavioral paradigm that will train rats to recognize two new sounds every few days, memorizing up to 100 sounds over 3-4 months of continuous training, and check the stability of memory during that time. My lab will apply state-of-the-art recording techniques in order to document the neural activity during memory acquisition and between training sessions while the rats sleep and consolidate newly acquired memories. I will repeat these studies in a rat model for Alzheimer's disease, which expresses early memory deficits. These results will be compared with predictions of models for memory in the auditory cortex. At one end, I will test the predictions of a model, based on recently published results, that posits the existence of a few neurons that carry the memory of each learned sound by intrinsic bursting. At the opposite end, I will test predictions of models in which memory resides in the coordinated activity of large, distributed ensembles of neurons. Overall, this project will address the deep puzzles of memory when memory load is high, a regime that has not been studied in animal models.

Link to the ERC project webpage:

Keywords of the ERC project: auditory, memory, rat, electrophysiology, imaging, continual learning

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101041177	**DecipherHSV**	**LS6** Immunity, Infection and Immunotherapy

Principal Investigator:	**Dr Lars Doelken**
Host Institution:	MEDIZINISCHE HOCHSCHULE HANNOVER - DEU

Deciphering cellular and viral determinants of lytic HSV-1 infection, latency and reactivation

Herpes simplex virus 1 (HSV-1) is an important human pathogen which infects the majority of the world`s population and inflicts a substantial burden of disease. Over the past 10 years, systems biology approaches, to which my lab has provided seminal contributions, have substantially broadened our understanding of the complex interaction of this common pathogen with its human host. However, the underlying molecular mechanisms remain poorly understood and their importance for virus latency and reactivation remain elusive. Furthermore, currently available technology lacks the temporospatial resolution to decipher the cellular and viral determinants that govern the virus life cycle. The main goal of DecipherHSV is to close these knowledge and technology gaps and decipher novel mechanisms and their functional interplay by which HSV-1 manipulates its host cells throughout the virus life cycle. Accordingly, the three primary objectives of DecipherHSV are to: (i) decipher the full complement of viral elements that govern productive infection; (ii) decipher how and why HSV-1 manipulates pervasive transcription within the host and viral genome; and (iii) decipher the cellular and viral determinants of HSV-1 latency and reactivation. Alongside, I will develop new computational approaches and integrative analysis tools, and employ artificial intelligence to exploit the wealth of information that is provided by the novel single cell RNA sequencing approaches, which I will pioneer (Heterogeneity-seq and Perturb-scSLAM-seq). Thereby, I will deliver new leads for novel therapeutic approaches targeting HSV-1 latency and reactivation. This will provide a paradigm for the study of other herpesviruses and their complex host-pathogen interactions.

Link to the ERC project webpage:

Keywords of the ERC project: Herpes; virus-host interactions; systems biology; single-cell analysis, CRISPR/Cas9

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council Executive Agency Established by the European Commission	Project ID:	Project Acronym:	Evaluation Panel:
	101076170	**CYTOMAC**	**LS6** Immunity, Infection and Immunotherapy

Principal Investigator:	**Dr Marten Hoeksema**
Host Institution:	ACADEMISCH MEDISCH CENTRUM BIJ DE UNIVERSITEIT VAN AMSTERDAM - NLD

Cytokine signaling in macrophages: beyond JAK-STAT

Dysregulated macrophage function underlies many inflammatory diseases. Cytokines, small secreted signaling molecules with immune-modulatory functions, shape the macrophage's phenotype, thereby affecting disease states. Puzzlingly, many cytokines with opposing functions, utilize highly similar JAK-STAT signaling cascades, leaving it unclear how cytokine-specific responses can occur.

In my previous work, I studied enhancer activation in mouse macrophages from genetically different strains. By studying genetic variation, I found that transcription factor (TF) motifs crucial for enhancer activation can be identified. I further developed the bio-informatic tool MAGGIE to study TF motif mutations in different strains of mice, which subsequently enabled me to discover a novel TF important for enhancer activation by the cytokine interleukin-4.

Based on my findings, I hypothesize that cytokines require specific, yet unidentified TFs that cooperate with JAK-STAT signaling to mount cytokine-specific effects.

CYTOMAC aims to identify these cytokine-specific TFs downstream of JAK-STAT that direct appropriate cell responses. I will exploit the genetic variation across mouse strains and study enhancer activation in macrophages from these strains in response to different disease-related cytokines. Specifically, I will: (1) use genetic diversity between mouse strains to identify specific TFs regulating cytokine-specific responses; to then target these novel TFs in (2) mouse and (3) human macrophages and (4) translate my findings to human disease and inflammatory disease models.

Inhibitors targeting JAK-STAT show high potential in clinically treating inflammatory diseases, including rheumatoid arthritis. However, as they affect generic pathways of many cytokines they come with considerable side-effects, limiting applicability. CYTOMAC will reveal novel, cytokine-specific TFs, which will aid in developing better tailored intervention strategies.

Link to the ERC project webpage:

Keywords of the ERC project: macrophages, cytokines, enhancers, JAK-STAT, transcription factors

Keywords that characterize the scientific profile of the potential visiting researcher/s: post-doc

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101077734	**MycoViralPath**	**LS6** Immunity, Infection and Immunotherapy

Principal Investigator:	**Dr Neta Shlezinger**
Host Institution:	THE HEBREW UNIVERSITY OF JERUSALEM - ISR

The role of fungal viruses in shaping fungal pathogenesis and mammalian host responses

Fungal pathogens present a significant threat to global health. As eukaryotes, they share considerable homology with their hosts, necessitating the development of innovative, non-cross-reactive therapies. Mycoviruses, viruses of fungi, can transform fungal virulence. Yet, despite their ubiquity and importance, the underlying mechanisms driving mycoviral infection and their consequences on fungal pathogenesis remain understudied. Using a naturally mycovirus-infected Aspergillus fumigatus strain, a model human fungal pathogen, we found that the mycovirus bestows a survival benefit to the fungus under oxidative stress and in the murine lung. We posit that mycoviral pressure modulates fungal fitness and virulence, thereby shaping the fungal host repertoire and facilitating the emergence of new fungal diseases. The proposed research aims to elucidate the mycoviral, fungal and mammalian determinants governing fungal cell fate during infection. We will:1) determine the molecular details governing mycoviral impact on fungal fitness, virulence, and host adaptation, 2) identify fungal antiviral mechanisms, and 3) determine how mycoviral infection affects the mammalian antifungal response. This complex multipartite pathosystem (mycovirus-fungal host-mammalian host) is highly heterogenous and dynamic, and this diversity can trigger different infection outcomes. To this end, we have developed a suite of fluorescent probes of fungal and mycoviral infection and of fungal physiology that enable tracking of virus-fungus-host interactions at single-cell resolution, and assessment of the physiological state of phagocytosed fungi in the host tissue. We propose the first in vivo interaction map of a virus within a fungus within an animal in the context of in vivo infection. We anticipate that this work will fundamentally shift our paradigms of fungal pathogenesis, and lay the groundwork for the development of novel therapeutics that operate in an entirely unexploited target space.

Link to the ERC project webpage:

Keywords of the ERC project: Fungal pathogens, infectious diseases, virulence, mycoviruses

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101125593	**DEFLAMMATION**	**LS6** Immunity, Infection and Immunotherapy

Principal Investigator:	**Dr Florian Ingo Schmidt**
Host Institution:	UNIVERSITATSKLINIKUM BONN - DEU

Negative Regulation of Inflammatory Responses Revealed with Camelid Nanobodies

The innate immune system evokes inflammation to control pathogens or damage. Sophisticated mechanisms interpret molecular triggers to activate inflammasomes or transcription of pro-inflammatory genes. While numerous autoinflammatory conditions underline the need to control inflammation, we still rely on simplistic models to understand its negative regulation. I hypothesize that an intricate signaling network interprets information to prevent or downregulate inflammation. Understanding these so far elusive processes demands radically new cell biology tools, which I will develop and apply in 'DEFLAMMATION'. I propose to define signaling hubs that integrate cellular input and coordinate effectors to actively downregulate inflammation where beneficial to the organism. To yield unprecedented molecular insights, we will apply nanobodies to inhibit protein function, manipulate post-translation modifications, and visualize endogenous proteins and their binary interactions. I hypothesize that two poorly understood members of the NLR family, NLRC3 and NLRX1, act as signaling hubs that coordinate negative regulation of pro-inflammatory gene expression. No such coordinator is known for inflammasomes. In objective 1, we will pinpoint how NLRC3 controls inflammation and T cell activity. I hypothesize that NLRC3 forms anti-inflammatory signalosomes to control the ubiquitination status of pro-inflammatory signaling components. In objective 2, we will reveal how NLRX1 counteracts interferon responses, inflammation, and proliferation. We will explore whether NLRX1 activation coordinates organelle-specific autophagy to remove pro-inflammatory signaling complexes. In objective 3, we will identify novel regulatory circuits that control inflammasome activation using CRISPR/Cas9 and cDNA screens, taking advantage of a novel reporter we have developed. The anticipated results will reveal entirely new layers of regulation of inflammation with implications for therapeutic interventio

Link to the ERC project webpage:

Keywords of the ERC project: Inflammation, inflammasome, negative regulation

Keywords that characterize the scientific profile of the potential visiting researcher/s: Virology, innate immunity, cell biology, advanced microscopy techniques

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Project ID:	Project Acronym:	Evaluation Panel:
101141569	**Allosteris**	**LS6** Immunity, Infection and Immunotherapy

Principal Investigator:	**Dr Jan Steayert**
Host Institution:	VIB VZW - BEL

Allosteric modulation of immune checkpoint complexes as a new mode of therapeutic intervention in immunotherapy

The fastidious balance of our immune system to fight infections or cancer while avoiding autoimmune reactions is regulated by coinhibitory and co-stimulatory immune checkpoint complexes (ICCs), which have become major drug targets. We witness the skyrocketing progression in cancer immunotherapy with antibodies that block inhibitory ICCs whereas Abs that block stimulatory ICCs are in clinical trials for treating autoimmune diseases.

Surprisingly, but likely fuelled by the most obvious focus on IC inhibitors, the field largely ignored that ICCs are genuine transmembrane receptors that transmit signals upon binding of an extracellular protein ligand. This leaves unexplored modes of therapeutic intervention that I will uncover by validating Nanobodies (Nbs) as first-in-class modulators of signaling pathways associated with immune receptors in a unique, previously unexplored fashion.

By applying innovative immunization and bio-selection techniques and building on POC data, I will deliver Nbs for representative ICCs to demonstrate the efficacy and selectivity of these Nbs in preclinical models of various inflammatory conditions, focusing on cancer and autoimmune diseases. We will deliver novel therapeutics agents which may outperform current inhibitor-based immunotherapies that trigger a magnitude of side effects. In this regard, the Nbs will exert their therapeutic effect through a distinctive mode of action that will ensure patient safety, even in the event of an overdose.

Link to the ERC project webpage:

Keywords of the ERC project: Immune checkpoints, positive allosteric modulation, Nanobodies

Keywords that characterize the scientific profile of the potential visiting researcher/s: Molecular pharmacology, protein protein interactions, immune checkpoints

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101141804	**PIWIdefense**	**LS6** Immunity, Infection and Immunotherapy

Principal Investigator:	**Dr Ronald Van Rij**
Host Institution:	STICHTING RADBOUD UNIVERSITAIR MEDISCH CENTRUM - NLD

PIWI-interacting RNAs at the interface of virus-host conflicts in Aedes aegypti mosquitoes

Background: The mosquito Aedes aegypti transmits viruses with pandemic potential but is also host to a large repertoire of mosquito-specific viruses and endogenous retroviruses. These viruses may invade the ovaries and eventually the oocyte to be transmitted from mother to offspring and to expand in the population. This transmission route exposes them to the specific host defense mechanisms of the ovary, which they must overcome to ensure onward transmission. This intriguing virus–host conflict is crucial for virus evolution and ecology and for host reproduction and survival, but has thus far not been studied. Hypothesis: I hypothesize that a specific class of small RNAs, called PIWI-interacting RNAs (piRNAs), are essential for protection of the mosquito germline from virus infection. Aim: My goal is to define the role of the piRNA pathway as a host defense system against RNA viruses, endogenous retroviruses, and other genomic parasites, and to identify viral counter-defense mechanisms. Additional to these fundamental aims, we will reprogram the piRNA pathway to induce resistance against pathogenic viruses in mosquitoes. Approach: This interdisciplinary project c¬ombines powerful genetic, genomic, and proteomic approaches at the intersection of virology, RNA biology, and entomology. Of particular importance, we will establish urgently needed tools for tissue-specific gene inactivation in vivo to define the functions of the expanded PIWI gene family of mosquitoes. Importance and Innovation: ERC project PIWIdefense will be the first to define host defense functions of the piRNA pathway in the germline of a major vector mosquito. The project generates unprecedented insights into the fundamental processes that shape the fascinating virus–host conflicts in mosquitoes. In addition, the project establishes a novel approach that can be translated into mosquito-centered intervention strategies against arthropod-borne viruses.

Link to the ERC project webpage:

Keywords of the ERC project: piRNA, RNA silencing, mosquito, virus, transposable element

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101162759	**PlasmoArp**	**LS6** Immunity, Infection and Immunotherapy

Principal Investigator:	**Dr Franziska Hentzschel**
Host Institution:	UNIVERSITATSKLINIKUM HEIDELBERG - DEU

The unusual role of a highly divergent Arp2/3 complex in the mosquito stages of malaria parasites.

The malaria-causing Plasmodium parasites often use highly divergent proteins to regulate fundamental biological processes, such as sexual replication in the mosquito. Therefore, the molecular and cellular biology underlying parasite development is often little understood, especially during the mosquito stages, a major bottleneck in the Plasmodium life cycle. Recently, I identified an unconventional, Plasmodium-specific actin-related protein 2/3 (Arp2/3) complex that mediates DNA segregation during male gamete formation and is essential for development of the main replicative mosquito stage, the oocyst. Understanding the regulation and function of this structurally and functionally divergent actin nucleator could provide targets for new antimalarial strategies. Here, I propose to elucidate the molecular mechanism of the Plasmodium Arp2/3 complex on three levels: (1) I will uncover how Arp2/3 is activated during gamete formation, revealing the likely unusual mode of regulation of this complex. (2) I will explore the hypothesis that Arp2/3 is linked to a cryptic spindle assembly checkpoint, a mitosis regulator so far thought to be absent in Plasmodium. (3) I will reveal why Arp2/3-deficient parasites arrest in oocysts, which will shed light on the unusual cell division mode of this elusive stage. To address these ambitious aims, I will combine molecular biology methods, single cell transcriptomics and imaging, and I will engineer a new genetic tool to dissect gene function specifically in the oocyst, a stage that is notoriously difficult to study. PlasmoArp will thus not only give insight into the molecular biology of Plasmodium development in the mosquito and advance our understanding of Arp2/3 and actin biology across the eukaryotic kingdom, but it will also expand the toolbox to study the neglected oocyst. As Plasmodium Arp2/3 is essential for malaria transmission, this research will pave the way for new intervention strategies to mitigate malaria infections.

Link to the ERC project webpage:

Keywords of the ERC project: Plasmodium, Arp2/3, actin, mitosis

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101165699	**VaxVision**	**LS6** Immunity, Infection and Immunotherapy

Principal Investigator:	**Dr Leo Hanke**
Host Institution:	KAROLINSKA INSTITUTET - SWE

Structure and Function-based Design of Vaccine Antigens and Antiviral Immunotherapies

Vaccines are critical in preventing viral diseases, and recent advances in vaccine development and delivery platforms have enhanced their reach and efficacy. Viral glycoproteins that mediate host cell entry are the primary target of the humoral immune response and thus the main antigenic component of vaccines. However, for many viruses, we lack fundamental biological insights that would easily allow transforming their glycoproteins into highly effective vaccine antigens.

In this proposal, I introduce a completely novel approach to thoroughly extract structural and functional insights of viral glycoproteins for rational design of superior antigens. By conducting nanobody repertoire screens, I will bypass common constraints encountered in antibody screening, such as immunodominance bias and redundancy. Contrasting with conventional techniques that narrowly target a limited selection of epitopes, my approach promises an exhaustive mapping of glycoprotein surfaces and epitopes. This paradigm shift enables antigen rather than antibody or nanobody characterization. By determining high-resolution cryoEM structures of nanobodies bound to glycoproteins in transitional states, we will understand their structural dynamics.

Equipped with these unparalleled insights, we will harness pioneering deep learning methods to computationally design glycoproteins with enhanced antigenic form and exposed neutralizing surfaces. I will showcase this method for viruses with high case fatality rates, including Hendra, Nipah, Lassa, Tick-borne encephalitis, and Borna disease viruses.

VaxVision is set to offer a comprehensive framework for the antigen design of these and genetically or structurally related viruses.

My work aims to capitalize on the unused potential for vaccine antigen improvement and will provide an innovative workflow for extracting mechanistic insights and leveraging them for vaccine antigen design, with the potential to drive vaccine innovations beyond just viral pathogens.

Link to the ERC project webpage:

Keywords of the ERC project: Virus, entry, structure, nanobody, vaccine

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
949667	**CARsen**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Judith Feucht**
Host Institution:	EBERHARD KARLS UNIVERSITAET TUEBINGEN - DEU

Senolytic CAR T cells as novel therapeutic concept for solid tumors and senescence-associated diseases.

The adoptive transfer of T cells expressing CD19-directed chimeric antigen receptors (CARs) has yielded remarkable efficacy in patients with hematological B-cell malignancies. CARs are a class of synthetic receptors that reprogram T cell specificity, function and metabolism. Engineered T cells are applicable in principle to other cancers and diseases, but clinical success will critically depend on further progress to overcome current limitations such as antigenic heterogeneity or impaired T cell trafficking and function. We propose to develop CAR T cells targeting senescent cells as a novel therapeutic concept for cancer and senescence-associated diseases. Cellular senescence is a stress-response program characterized by stable cell cycle arrest that serves as a potent tumor-suppressive mechanism. Conversely, accumulation of senescent cells generates a chronic inflammatory milieu, which contributes to a plethora of pathologies, such as liver or lung fibrosis and can even promote tumor progression. Our preliminary data demonstrate that CAR T cells can efficiently clear senescent cells, providing therapeutic benefit in a murine model of liver fibrosis. We thus firmly believe that senolytic CAR T cells have broad therapeutic potential. To this end, we will apply innovative engineering strategies to develop modular CAR designs tailored to senescence-specific requirements. We will determine safety and efficacy of senolytic CAR T cells in murine models of cellular senescence and solid tumors. Importantly, we will evaluate combined treatment approaches of senescence-inducing therapies with CAR T cells targeting senescent and proliferating tumor cells. Finally, we will investigate engineering tools to optimally direct senolytic CAR activity to mediate durable tumor regression. This project combines two emerging concepts of anticancer therapies and goes beyond current applications of CAR therapies. The efforts may lead to promising new therapeutic avenues.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
949906	**ALLERGENE**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Marie Standl**
Host Institution:	HELMHOLTZ ZENTRUM MUENCHEN DEUTSCHES FORSCHUNGSZENTRUM FUER GESUNDHEIT UND UMWELT GMBH - DEU

Allergic multimorbidity from birth to young adulthood: determinants, epigenetic regulation and inflammatory processes

The prevalence of allergic diseases, such as atopic eczema, asthma and rhinitis, has increased over the past decades and is currently estimated to be up to 40%. Prevention strategies play a pivotal role, as there are no curative treatments available. Therefore, the aim of ALLERGENE is to understand the complex interplay of genetic, environmental and lifestyle factors and to identify involved mechanisms that distinguish between young adults free of allergic diseases and those suffering from allergic multimorbidity. Therefore, the aims of the present project are to: 1. Define allergic disease trajectories from birth to young adulthood, describe their determinants and identify risk and protective early-life environmental and lifestyle factors contributing to progression towards allergic multimorbidity or remission of allergic diseases. 2. Investigate molecular mechanisms of epigenetic regulation of allergic disease trajectories and test effect modification by inclusion of selected environmental and lifestyle factors. 3. Characterise the underlying inflammation profile of allergic disease trajectories and determine interactions with environmental and lifestyle factors The project makes use of two long-standing, prospective German birth cohort studies, GINIplus and LISA, with available data from birth to young adulthood, and an extensive examination planned at age 25. Within this project, a comprehensive characterisation of allergic disease trajectories, their determinants, comorbidities, risk and protective factors across the life-course will be obtained. ALLERGENE will enhance the understanding of how modifiable factors contribute to allergic disease aetiology. This will be an essential prerequisite to develop effective early intervention strategies for susceptible populations and to identify disease-specific biomarkers for the development and progression of allergic diseases in the future.

Link to the ERC project webpage:

Keywords of the ERC project: genetic, environmental and lifestyle factors, allergic diseases, early intervention strategies

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
950010	**FamilySleeps**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Lorna Lopez**
Host Institution:	NATIONAL UNIVERSITY OF IRELAND MAYNOOTH - IRL

Disrupted Circadian Rhythms in Families - an Endophenotype of Autism Spectrum Disorder?

Sleep disturbances are highly prevalent in children with neurodevelopmental disorders, and this adversely impacts the whole family's wellbeing. While the origins of neurodevelopmental disorders are considered largely genetic, the mechanisms that underlie sleep disruption, and their relationship to neurodevelopment, is relatively unexplored. Chronotype is our daily preference for morning or evening time, and a recent large-scale genome-wide association study highlighted its significant relationship with the most common neurodevelopmental disorder, autism spectrum disorder (ASD). Chronotype is an indication of our circadian rhythms, which alongside environmental factors, influences sleep disturbance. However, challenges in obtaining objective circadian rhythm and sleep timing measurements in ASD mean we are uncertain about their role. The FamilySleeps research programme will challenge the view that sleep disruption in children with ASD is driven only by environmental and behavioural factors. I will address two hypotheses; 1) that a disruption to circadian rhythms is an endophenotype of ASD 2) that a disruption to circadian rhythms has an independent common genetic component. To test these hypotheses, FamilySleeps will ask if children with ASD show sleep and circadian rhythm disturbances compared to typically developing children; if unaffected siblings have disturbed sleep and circadian rhythm patterns; and if sleep and circadian rhythm disruption correlates with a genetic risk for ASD. I will apply technologically-advanced and non-invasive sensors to obtain a one-year longitudinal objective measure of sleep disturbances and circadian rhythms in 60 families. I will generate genomic risk scores to establish the genetic risk of ASD. FamilySleeps will lead a breakthrough in understanding the role of circadian rhythms in ASD, which has implications for breakthroughs in other neurodevelopmental disorders, and understanding a process fundamental to life – sleep.

Link to the ERC project webpage:
https://www.familygenomics.maynoothuniversity.ie/chronobiologyofmentalhealth/familysleeps

Keywords of the ERC project: Genetics, Sleep, Neurodevelopment

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101044665	**PROTECT**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Daniel Aili**
Host Institution:	LINKOPINGS UNIVERSITET - SWE

Protease Profiling and Triggered Drug Delivery for Personalized Cancer Therapy

Proteases are involved in all hallmarks of cancer and are key regulators of tumor progression. The difficulties to monitor protease activity in vivo with sufficient sensitivity and selectivity make development of protease targeting cancer drugs and implementation of protease activity as a diagnostic and prognostic biomarker very challenging. The aim of PROTECT is to develop a novel comprehensive protease activity profiling platform for cancer-associated extracellular proteases that can address the main limitations of current strategies for in vivo protease activity monitoring with the ambition to enable a dramatic increase in sensitivity and multiplexing capabilities. We will design Liposomal Activity-Based Sensors (LABS) that can amplify proteolytic cleavage by triggering release of liposome encapsulated synthetic biomarkers. We will further leverage the possibilities to extract tumor specific protease profiles for development of personalized protease-triggered liposomal drug delivery vehicles (PROVES) for precision medicine. Sophisticated protease-responsive membrane active peptides (proMAPs) will be developed to couple protease activity to biomarker and drug release. Methods to correlate biomarker release patterns to protease activity profiles in 3D breast cancer models will be explored. The PROTECT platform can then rapidly be repurposed for precision drug delivery. The PROVES concept will combine the excellent properties of liposomes for drug delivery and the optimal combination of proMAPs, based on the protease activity profile retrieved from the LABS, for optimized protease-triggered liposomal drug release. Combined, the LABS and PROVES concepts represent a unique and comprehensive platform for diagnostics and personalized cancer therapy. The proposed work goes far beyond stat-of-the-art and will address a significant and real bottleneck that hampers drug development and exploitation of proteases as diagnostics and prognostic cancer biomarkers.

Link to the ERC project webpage: https://liu.se/en/employee/danai11

Keywords of the ERC project: peptide design, membrane active peptides, drug delivery, liposomes

Keywords that characterize the scientific profile of the potential visiting researcher/s: peptide synthesis, molecular dynamics, peptide chemistry, membrane active peptides

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101055152	**MEDICATE**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Mette Rosenkilde**
Host Institution:	KOBENHAVNS UNIVERSITET - DNK

Molecular dissection of viral genomes for future antiviral treatments

Viruses are obligate pathogens with massive impact on global health. Nearly all currently marketed antiviral drugs target viral enzymes. We hypothesize that hitherto unrecognized virus-encoded transmembrane proteins may prove valuable as pharmaceutical targets. Through a systematic dissection of viral genomes (WP1) we will identify potential transmembrane segments in a defined workflow. We will predict their function in silico (WP2) as being either (A) internalizing transmembrane proteins or (B) ion channels. Segments showing promising transmembrane and/or internalization motifs will be expressed, functionally characterized and evaluated in proof-of-modality assays (WP3). The newly identified internalizing proteins may transfer a molecular Trojan horse, a toxin payload, into infected cells, which will be tested with a generic fusion-toxin protein (Mode A), while the potential viral ion channels (viroporins) will be tested for their ability to mediate a current via formation of ion pores (Mode B). In WP4, the internalizing transmembrane proteins passing the WP1-3 attrition will be utilized for initial drug discovery and fusion-toxin protein design. Through co-internalization with the viral transmembrane protein, the toxins may prevent long-term pathologies by eradicating the virus. The novel viroporins will be screened for inhibition using ion channel drugs regulatory approved for other purposes. This ensures fast access to the market through drug repurposing, allowing for prevention and treatment of acute virus pathology. This project on new ground entails high risk, yet also creates opportunities of enormous gain, considering the huge unmet medical needs for effective and specific antiviral therapeutics. However, the biggest gain is the potential for ground-breaking discoveries regarding virally encoded transmembrane proteins, thereby bridging basic virology and molecular pharmacology with structural biology and early drug discovery in a highly innovative manner.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: Molecular pharmacology, bioinformatics, molecular virology, cell biology, membrane proteins structure-function

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101075421	**ExMilk**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Trine Moholdt**
Host Institution:	NORGES TEKNISK-NATURVITENSKAPELIGE UNIVERSITET NTNU - NOR

Exercised breastmilk: a kick-start for childhood obesity prevention

Innovative preventive strategies are urgently required to halt the rising prevalence of childhood obesity given the inefficacy of current interventions. Mother-to-child transmission of obesity accounts for a large proportion of childhood obesity, more than what can be explained by genes. Nutrition during the first 3 months of life is crucial, with rapid weight gain in this period associated with subsequent obesity. Breastmilk is considered optimal for infant nutrition, but its composition depends on the mother's metabolic health: the concentrations of some breastmilk compounds linked to infant obesity are associated with maternal body mass index. Maternal lifestyle factors, such as diet, can alter breastmilk composition. Little is, however, known about the effect of exercise during lactation. Exercise is a major regulator of systemic metabolism affecting multiple tissues and organs. In this ambitious, inter-disciplinary project, I will determine how exercise during lactation influences breastmilk composition in women with overweight/obesity and whether exercise-induced changes in breastmilk will influence infant obesity risk. My preliminary data show acute effects of exercise on breastmilk concentrations of adiponectin and lipid metabolites relevant for energy metabolism. In ExMilk, I will determine both acute effects and adaptations after regular exercise on a complex matrix of breastmilk compounds. By linking breastmilk data to comprehensive data for the infants, I will investigate the potential mechanisms underlying the effects of maternal exercise on infant obesity risk, mediated by changes in breastmilk composition. To reach my goals, I will perform gold-standard randomised trials and analyse biological samples from mothers and infants on multi-omics platforms. My experience in metabolomics and exercise intervention trials in reproductive-aged women will enable me to break new ground in understanding how exercise during lactation modifies infant obesity risk.

Link to the ERC project webpage:

Keywords of the ERC project: Metabolomics, bioinformatics, human milk, microRNA, growth trajectory

Keywords that characterize the scientific profile of the potential visiting researcher/s: multiomics integration, metabolomics, bioinformatics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101078646	**REACT-DC**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Marco Gargaro**
Host Institution:	UNIVERSITA DEGLI STUDI DI PERUGIA - ITA

Breaking oncometabolites dynamics for next-generation dendritic cells tumor immunotherapy

Owing to an increased appreciation of the potential for immunotherapy in neoplasia, much attention has been focuing on a greater understanding of the immune, bidirectional intricacies involving the Tumor MicroEnvironment (TME). Recent work has demonstrated that TME elicits environmental changes, metabolic in nature, in the host's immune cells, that dampen their ability to REACT against tumors. Manipulating the biology of oncometabolites can strengthen an antitumor immune response as well as circumvent therapy resistance. Here I propose innovative modalities to tackle this problem. The Aryl hydrocarbon Receptor (AhR), best known as the receptor for dioxins, has recently been shown to be one "central node" for communication between host's cells and its ligands, disparate as the nature and source. I have recently found that selective AhR deletion in a subset of antigen presenting cells triggers the rejection of an otherwise progressive fibrosarcoma tumor in vivo. I thus hypothesize that, AhR, expressed in orchestrators of immune responsiveness, represents a key sensor of TME composition, influencing the outcome of an immune reaction against tumors. The main objective of this project is to identify AhR-activating metabolites in TME and disclose their impact on tumor rejection or progression. In parallel, I aim at developing novel advanced strategies, with a high degree of translatability to human cells, to specifically inhibit AhR or AhR-dependent programs in selected APCs. I will combine state-of-the-art technology with new and powerful technologies, including advanced single-cell analysis, promoter gene-editing approaches and computational chemistry. The potential of such a project is very high, because such metabolites may be predictors of immune activation or suppression in TME, and the downstream targets of those immunesuppressive oncometabiltes may represent druggable targets to inhibit tumor escape mechanisms.

Link to the ERC project webpage:

Keywords of the ERC project: Dendritic Cells, TME, Oncometabolites, AhR, Soft Tissue Sarcomas

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101078824	**FEMALE-PH**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Konda Babu Kurakula**
Host Institution:	STICHTING AMSTERDAM UMC - NLD

Mending sex differences: Unravelling the female predominance in pulmonary hypertension

Pulmonary hypertension (PH) is a rare but progressive fatal disease characterized by accumulation of persistently activated cell types in the pulmonary vascular wall exhibiting abnormal expression of genes driving proliferation, inflammation, and metabolism. The currently used vasodilatory therapies have little or no impact on this activated phenotype and therefore offer no cure or even substantial survival benefit. PH has a high female predominance (3:1 to 9:1). This proposal aims to understand the mechanism behind the high female predominance to identify novel therapeutic targets to attenuate disease progression in male and female PH patients. Female predominance can be linked to sex hormones and/or incomplete X chromosome inactivation (XCI) leading to biallelic expression of immunoinflammatory and metabolic genes. To understand the impact of oestrogen and androgen signalling on abnormal vascular remodelling in PH, I will develop a unique opposite-sex lung transplantation rat model, identify oestrogen metabolites in a large set of patient serum samples and explore their biological relevance using pulmonary vascular cells from male and female PH patients in cell-based assays. Preliminary experiments suggest there is incomplete XCI in PH. I propose to combine sequencing and molecular studies to extensively characterize the impact of incomplete XCI on the physiology of male and female PAH cells and identify genes and druggable targets regulating incomplete XCI in PH. Finally, I will explore a novel pulmonary endothelium-specific drug delivery method to deliver identified promising genes/compounds to selectively inhibit the activated pulmonary vasculature thereby minimalizing side effects compared to current delivery methods. Together, this high risk-high gain study will dissect the molecular mechanisms underlying the unresolved female predominance in PH and offer novel pulmonary endothelium-specific therapies for both male and female PH patients.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101096706	**NO PRESSURE**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Rainer Böger**
Host Institution:	UNIVERSITAETSKLINIKUM HAMBURG-EPPENDORF - DEU

Regulation of the L-arginine – ADMA – Nitric Oxide (NO) Pathway in the Pulmonary Vascular Response to Hypoxia and its Role for Survival of High-Risk COPD Patients

NO PRESSURE will address the hypothesis that intermittent hypoxaemia is a major driver of the pulmonary pathophysiology and the systemic co-morbidity that is present at a sub-clinical level already in early disease stages of a significant sub-group of COPD patients with a high risk of rapidly declining lung function and poor prognosis. The project has been conceptualized to achieve ground-breaking scientific insight into the role of intermittent hypoxaemia as a driver of COPD progression and outcome via dysfunction of the L-arginine-ADMA-NO pathway. Its five work packages will span from molecular regulation of the pulmonary L-arginine-ADMA-NO pathway in hypoxia to cellular oxygen sensing and signal transduction mechanisms, via translational studies in genetically modified mouse models and genotyped healthy humans, to clinical proof-of-concept studies of exercise-induced, intermittent hypoxaemia as a diagnostic indicator to identify a subgroup of high-risk COPD patients and the ability to therapeutically intervene by pharmacological modification of the L arginine-ADMA-NO pathway. Combining state-of-the-art molecular biology techniques, specifically designed genetically engineered animal models, and translation of the obtained results into genomically characterized humans who will be exposed to hypoxia, NO PRESSURE will achieve a unique level of depth in our understanding of the molecular pathophysiology of the lung's response to hypoxia with proven relevance to human biology. Beyond this, NO PRESSURE will take the step towards validation of pathophysiologically proven biomarkers and, thus, molecular mechanisms in the world's unique long-term prospective cohort for lung disease. In addition, it will deliver unequivocal evidence for clinical utility in two small, but well defined COPD patient cohorts, with one having a focus on prognostic relevance and the other one opening the avenue towards future pharmacotherapeutic intervention to improve prognosis.

Link to the ERC project webpage:

Keywords of the ERC project: cardiovascular disease; lung disease; nitric oxide; COPD; hypoxia; pulmonary hypertension; mass spectrometry; molecular biology

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101125482	**RESTOREGUT**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Jakob Stokholm**
Host Institution:	REGION HOVEDSTADEN - DNK

Restoration of the gut microbiome after delivery by caesarean section to prevent asthma

Associations between caesarean section (CS) and childhood asthma may be mediated through microbial changes. In 700 children followed prospectively from birth, I recently showed that microbial perturbations after delivery by CS explain the delivery mode-associated risk of developing asthma in the first 6 years of life. CS was associated with more than a doubled risk of later asthma and allergic sensitization as well as immense compositional changes in the gut microbiota. An increased asthma risk was only found in children born by caesarean section, if their microbiome did not normalize by age 1 year, suggesting that a healthy microbial maturation can alleviate the child's increased asthma risk. Under the hypothesis that asthma risk from CS can be avoided by restoring the early gut microbiome, the proposed project will identify key environmental, dietary and host factors that help restoring a CS perturbed microbiome, map the compositional and functional potential of the CS microbial profiles, evaluate the role of the virome in the CS associations and perform co-cultures of key microbial consortia that may restore a healthy trajectory. Finally, I will perform murine experimental models to validate the findings and perform pilot studies on CS microbiota restoration by fecal microbiota transplantation (FMT) and fecal virome transplantation (FVT) in newborns. This will be a truly translational research project, with the potential to go from clinical observations to mechanisms based on bioinformatics and microbiological laboratory work and experimental models and a pilot human trial to infer causal relationships with the perspective of developing a potential future intervention strategy. If successful, this strategy will be groundbreaking for understanding the microbiome's role in asthma development after CS and in the future potentially lead to novel prevention strategies and targeted, efficient microbiota manipulation in children with early microbial perturbations.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101126235	**ADAMI**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Ben Jeurissen**
Host Institution:	UNIVERSITEIT ANTWERPEN - BEL

A Data-driven Approach to Microstructural Imaging

The ability to study tissue microstructure in vivo and completely noninvasively using magnetic resonance imaging (MRI) has the potential to radically change how we detect, monitor, and treat diseases, in particular the many neurodegenerative diseases that affect our world's aging population. Unfortunately, the MRI signal is a very indirect measure of microstructure, and the variety of contributing factors complicates a one-to-one association between the MRI measurements and the biological substrate. As a result, microstructural mapping is still a poorly understood and challenging inverse problem that often yields inconsistent and contradictory outcomes. In ADAMI, I will take the next leap in microstructure imaging by approaching the problem in a completely data-driven fashion as opposed to the state-of-the-art that is model-driven. This paradigm shift will enable me to turn the MRI scanner into a powerful in vivo microscope that can provide reliable information about tissue microstructure that closely matches the underlying cellular composition. Rather than relying only on a single source of contrast, I will exploit the versatility of MRI and use multiple, independent contrast mechanisms that will provide the necessary information to distinguish reliably between microscopic substrates. Rather than relying on preconceived models, I will use machine learning to learn the appropriate models directly from the data. Rather than performing a posteriori histological validation of these new microstructural models, I will acquire a priori histological data to directly inform this learning process, guaranteeing, for the first time, a close match between microstructural readouts obtained from MRI and invasive histology. Through these innovations, ADAMI will advance the field of medical imaging by introducing a groundbreaking data-driven approach to microstructure imaging which will significantly impact the understanding, diagnosis, and monitoring of brain diseases and beyond.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101162733	**VISIONSAFE**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Alejandra Consejo**
Host Institution:	UNIVERSIDAD DE ZARAGOZA - ESP

Visual Impairment Screening using Images from Ophthalmology and Novel pathways for Structural Analysis and Fast Evaluation

Clinical eye images could be explored in an entirely new way to provide early detection of serious eye diseases that currently affect thousands worldwide yet could be preventable. The objective of VISIONSAFE is to extract macro- and microstructure biomarkers from real-world clinical images depicting the retina, lens, and cornea, thereby facilitating early disease detection and personalised management. While macrostructural biomarkers related to ocular shape are well-established, microstructural biomarkers related to tissue remain largely unexplored. The project's foundation rests on the preliminary work of the PI, which demonstrated the feasibility of deriving disease-related microstructure biomarkers from low-resolution clinical eye images. The approach combines data science, advanced image processing, and rigorous experimental validation to better understand the interplay between macro- and microstructural biomarkers in prevalent sight-threatening eye diseases, including age-related macular degeneration (AMD), glaucoma, cataracts, and corneal ectasia, using efficient, cost-effective, and accessible tools. VISIONSAFE covers several ground-breaking aspects: clinical eye data is already available but underused (can we use data science for vision preservation?); the acquisition and combination of macro- and microstructural biomarkers from clinical images have not yet been considered (is this combination a key for the early diagnosis of eye diseases? Are we missing out essential information from already available data?). The project's potential gains are significant. It enhances knowledge on eye disease biomarkers accessible through routine eye exams, shifts the paradigm toward macro- and microstructural biomarker synergy, and represents an important step towards a future where eye diseases are identified and managed earlier, offering hope and improved quality of life to countless individuals.

Link to the ERC project webpage: https://visionsafe.unizar.es/

Keywords of the ERC project: opthalmology, cornea, retina, image processing, animal models

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101163931	**GLIOMERS**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Alessio Malfanti**
Host Institution:	UNIVERSITA DEGLI STUDI DI PADOVA - ITA

Leveraging Polymer Therapeutics as Nanomedicine for Local Glioblastoma Immunotherapy

Research focusing on cancer immunotherapy has provided little progress toward improved survival rates for patients with glioblastoma (GBM), a poorly immunogenic tumor. Clinical trials for GBM immunotherapy primarily focus on the systemic administration of therapeutics; however, they have shown limited therapeutic success. The blood-brain barrier, the tumor immune microenvironment (TIME), the extracellular matrix, the highly invasive/proliferative nature of GBM, and intra- and inter-patient heterogeneity represent challenges to immunotherapy success. Administering polymer therapeutics as a class of biodegradable nanomedicines for localized treatment − a concept I pioneered − represents a less explored area that may fulfill the potential of GBM immunotherapy while reducing doses and adverse systemic effects. GLIOMERS aims to design an immunomodulatory brain-penetrating polymeric drug delivery system that will exploit its intrinsic therapeutic effect by synergizing with conjugated chemotherapeutic agent(s) to directly stimulate antitumor immunity. By encompassing different biomaterials properties, hybrid nanocarriers will be developed using a synthetic microfluidic-assisted approach based on chemically stabilized self-assembled hyaluronic acid – as immunomodulator – with complementary poly-L-lysine to support brain penetration. I will capitalize on the properties of this new class of nanocarriers by conjugating chemotherapeutics re-purposed for immunotherapy. This approach will allow not only the local spread of the drug within the GBM, but also an additional rewiring of immunosuppressive TIME with an enhanced T cell-mediated immune response. GLIOMERS will provide an innovative advance in the design of translational nanomedicines for local brain delivery, contributing to enhanced immunotherapeutic efficacy for GBM treatment.

Link to the ERC project webpage:

Keywords of the ERC project: Glioblastoma, Nanomedicine, Polymer conjugates, linking chemistry, repurposing drugs, Immunotherapy

Keywords that characterize the scientific profile of the potential visiting researcher/s: Nanomedicine, Immunotherapy, Immunology, Glioblastoma,

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Project ID:	Project Acronym:	Evaluation Panel:
101164864	**OMEGA**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Isis Fernandez**
Host Institution:	HELMHOLTZ ZENTRUM MUENCHEN DEUTSCHES FORSCHUNGSZENTRUM FUER GESUNDHEIT UND UMWELT GMBH - DEU

Overcoming Monocyte Complexity in Pulmonary Fibrosis Progression from Onset to End-Stage

Progressive pulmonary fibrosis (PF) is a debilitating and incurable disease. Scaring of the lung leads to respiratory failure and 50% of patients die 3-5 years after diagnosis. Our understanding of the pathophysiology of PF is unfortunately limited to established and advanced stages when the extensive lung scaring is irreversible. OMEGA is designed to explore new mechanisms underlying PF progression, from early to advanced disease and propose therapies that timely target the disease, prior to becoming permanent. Two lines of evidence are at the core of OMEGA. First, I was among the first to show that circulating monocytes are strongly linked to PF pathology. Which subtypes are important and what roles they play in PF etiology, however, is still unknown. Second, interstitial lung abnormalities or ILA are the only detectable features characterizing earlier stages of PF and can be identified in people without clinical suspicion of disease. Studying ILA provides the unique opportunity to identify early targets that would prevent progression to PF. OMEGA will first provide a detailed phenotype definition of human monocyte subtypes from early to advanced PF. Second, it will probe mechanistically how and where the monocytes acquire a pathogenic phenotype as they journey from the bone marrow to the blood and differentiate in the fibrotic lung. I will use human and mouse material and state-of-the-art methodology to answer these questions. My current standing ensures direct and ample access to patient samples, clinical data, multi-disciplinary interactions, and a team of consultants/collaborators that will make possible identifying how monocytes and their progenitors are involved in the progression of PF, and what pathways we can target, as early as disease starts, and as early as monocytes egress the bone marrow, to end the progression of this deadly disease.

Link to the ERC project webpage: https://www.linkedin.com/posts/helmholtzmunich_erc-omega-helmholtzmunich-activity-7238856405040922624-3L2g/

Keywords of the ERC project: Pulmonary Fibrosis Progression, Immunology, Myeloid cells, Aging, IPF

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101165242	**EARTHWORM**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Jana Hutter**
Host Institution:	UNIVERSITATSKLINIKUM ERLANGEN - DEU

EARTHWORM: pEristAlsis in Real-Time Human mri to study the interWOven fRequency & Microstructural properties

EARTHWORM will develop a new paradigm of adaptive and focused comprehensive Magnetic Resonance Imaging (MRI) techniques to study peristaltic motion and the underlying microstructure throughout the human body.

Peristaltic motion is responsible for multiple key functions in the human body such as food transport through the gastro-intestinal system, the rapid and directed sperm transport and embryo implantation and retrograde menstruation for the preservation of body iron. Alterations are linked to the pathophysiology of diseases such as adenomyosis, Crohn's disease, endometriosis and Parkinson's disease among many others, which together affect >10% of EU citizens.

The underlying process requires a complex cascade of events, which can be disrupted by a range of factors from interrupted neuronal activity to altered biochemistry to changes in the interwoven layers of muscle fibres and connective tissue, resulting in hyper- and hypomotility of the involved organs. Similarly, changes in motility are associated with resulting microstructural damage.

Despite the undisputed importance, current imaging techniques focus on suppressing or altering peristalsis through unphysiological preparations to make ongoing human life comply with the needs of the assessment techniques.

The confluence of novel lower field MRI scanners, real-time end-to-end AI methods, external MR-compatible sensors and efficient multi-contrast techniques allows me to develop a new paradigm to study the link between the microstructure and motility patterns in the abdomen and pelvis. Replacing rigid, pre-defined examinations by a continuous running MR acquisition, adapting to the ongoing life provides novel eloquent information, paving the way for enhanced diagnosis and bespoke, data-driven nonlinear continuum dynamic modelling approaches to reveal signatures of disease and to interconnect previously disjoint observations. Two embedded clinical pilot studies will facilitate immediate translation.

Link to the ERC project webpage:

Keywords of the ERC project: AI, imaging, women's health, MRI, signal processing, MEG, anomaly detection

Keywords that characterize the scientific profile of the potential visiting researcher/s: AI, imaging, women's health, MRI, signal processing, MEG, anomaly detection

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Project ID:	Project Acronym:	Evaluation Panel:
101165552	**MoodMAP**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Donghao Lu**
Host Institution:	KAROLINSKA INSTITUTET - SWE

Unveiling the Molecular Secrets of Reproductive Mood Disorders: a Multi-Omics Approach Project

Reproductive mood disorders (RMDs), including premenstrual disorder and postpartum depression, have a significant impact on women and their families, contributing to the well-known gender gap in mental health. However, effectively diagnosing and treating RMDs remains an ongoing challenge. These conditions are closely tied to hormonal changes during menstruation and childbirth, indicating a shared vulnerability. While the precise mechanisms are not yet fully understood, emerging data, including my work, supports the hypothesis that genetic predisposition, chronic inflammation, and metabolic dysfunction play pivotal roles in the development of RMDs. The MoodMAP project aims to discover novel molecular markers for RMDs, provide insights into the biological factors influencing varying vulnerabilities to mood disorders in women, and enhance diagnostic, preventative, and treatment strategies for RMDs. The endeavor leverages three Nordic population-based cohorts a) to DEPICT a comprehensive architecture of RMDs by integrating genomic, inflammatory proteomic, and metabolomic data; b) to TRIANGULATE evidence for identifying biologically functional and causal biomarkers using cell data manipulated with hormones and advanced epidemiologic methods; c) and to PREDICT treatment outcomes, including treatment resistance and subsequent suicidal behavior, through multi-omics data and machine-learning methods. MoodMAP adopts an innovative approach by studying both RMDs together, aiming to uncover the biological basis of female vulnerability to mood disorders through multi-omics data. By integrating advanced omics techniques, hormone-manipulated cell data, and cutting-edge epidemiologic and statistical methods, MoodMAP holds the potential to understand the psychiatric sensitivity associated with sex hormones, drive transformative changes of diagnosis, prevention, and treatment strategies for RMDs, and ultimately contribute to the reduction of the gender gap in mental health.

Link to the ERC project webpage:

Keywords of the ERC project: women's health, mental health, premenstrual dysphoric disorder, postpartum depression, mood disorder

Keywords that characterize the scientific profile of the potential visiting researcher/s: epidemiology, data science, mental health, psychiatry, omics

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Project ID:	Project Acronym:	Evaluation Panel:
101169897	**WhatsMRI**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Christian Langkammer**
Host Institution:	MEDIZINISCHE UNIVERSITAT GRAZ - AUT

Elemental and Structural Composition underlying Brain MRI

Magnetic Resonance Imaging (MRI) is widely established, with 50,000 scanners worldwide and more than 100 million diagnostic scans conducted yearly. Myelin acts as the electrical insulation of neuronal fibers and is essential for motor, sensory, and cognitive functions and is composed of several lipids and proteins arranged in a specific geometry. However, myelin loss occurs regionally in inflammatory diseases like multiple sclerosis, myelitis, and optic neuritis, and it also serves as a biomarker of aging. Despite the availability of various MRI-based approaches for detecting myelin, there remains a significant gap in systematically validated knowledge regarding how myelin's lipids, proteins, and structural variations influence MRI signal generation. Furthermore, there is no gold standard for assessing the constituents of myelin, and conclusions are primarily based on MRI of formalin-fixed tissue. Quantitative post-mortem MRI of unfixed human brains in situ, combined with subsequent mass spectrometry imaging (LA-ICP-TOF-MS, MALDI-MSI), small-angle X-ray scattering (SAXS), and microscopy (CARS, TEM, IHC), will enable histologically enriched modelling of tissue and the simulation of fundamental MRI parameters (relaxometry, susceptibility, and diffusion) to reveal causal relationships with chemical elements, matrix composition, structure, and common molecules of myelin, neural fiber orientation, and biometals. In addition to 20 control brains, 10 brains from deceased individuals with multiple sclerosis will be recruited to broaden the spectrum of myelination under investigation. This research addresses the fundamental biophysical mechanisms underlying MRI of myelin and chemical elements, which currently lack validation. We will establish a publicly available elemental and histochemical atlas of the human brain and identify how histological features causally contribute to quantitative MRI parameters.

Link to the ERC project webpage: http://www.whatsmri.eu/

Keywords of the ERC project: mri, myelin, iron, metals, qmri

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101171183	**HealthAEye**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Hrvoje Bogunovic**
Host Institution:	MEDIZINISCHE UNIVERSITAET WIEN - AUT

Health-monitoring with AI-enabled smartphone-based imaging of the eye

The gift of longevity carries with it a host of complexities in ensuring that lifespans are not only prolonged but also healthy and functional. Effective health strategies must be deeply embedded in a framework that provides continuous access to healthcare services. This involves persistent monitoring of both health and illness.

The human retina stands out as an invaluable window into one's health, shown to reflect not only ocular diseases but also aging, neurodegeneration, and heart function. High-end optical imaging devices such as optical coherence tomography (OCT) provide clinicians with remarkably clear pictures of the living retina. However, they are not widely accessible and portable for personal use. With the drastic improvements in smartphone optical and sensory capabilities, taking diagnostic-quality snapshots of the eye fundus is becoming a viable option. This poses a paramount opportunity to turn the smartphone imaging with the support of artificial intelligence (AI) into a powerful health monitoring tool.

The proposed research will advance the AI methodology and provide a proof-of-concept in retinal disease monitoring. It is based on the hypothesis that the disease-specific biomarkers visible on gold-standard 3D OCT imaging are recoverable with AI from 2D portable fundus imaging provided by smartphones. In a unique interdisciplinary setting, it aims to (i) build multimodal foundation AI models based on a large amount of available retrospective imaging data, (ii) advance the AI methodology to distill across the imaging modalities the knowledge accrued by the models, and (iii) in a clinical study demonstrate that AI models operating on smartphone-based fundus images are comparable to their high-end optical imaging counterparts across diagnostic tasks. The work will lead to a potentially disruptive, accessible and scalable technology for monitoring of retinal changes and disease activity having a lasting impact on patients and public health.

Link to the ERC project webpage:

Keywords of the ERC project: Artificial Intelligence, Machine Learning, Medical Imaging, Retina

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101171420	**AuditeMatrem**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Marc Vaudel**
Host Institution:	UNIVERSITETET I BERGEN - NOR

Temporary inconvenience or early warning signs? A new take on maternal symptoms in early pregnancy and their consequences.

Pregnancy is a unique time of life where mother and child live in symbiosis. This relationship however induces multiple symptoms for mothers including nausea, vomiting, bleeding, pain, fatigue and many more. In their majority, symptoms pass without adverse consequences and are thus understudied. Instead of a temporary inconvenience, what if maternal symptoms were the key to understanding and preventing harmful consequences for both mother and child? So far, research on pregnancy has primarily focused on complications, maternal survival, and fetal health. Very little is known on the biological underpinnings of the wide range of symptoms mothers experience in the first half of pregnancy, leaving families and healthcare professionals inadequately informed about potential health consequences. Nausea and vomiting is a notable exception, where fetally-expressed proteins have recently been demonstrated to cause maternal symptoms. My recent research has further disentangled the respective contributions of the fetal and maternal genomes and characterized the trajectory of genetic signals over time. In addition, my team has established innovative approaches to study proteins accounting for haplotypic variation, paving the way for new research on how symptoms are mediated between mother and child. These findings open the opportunity to turn the tables, give overlooked maternal symptoms long overdue scientific attention, and unlock their potential in antenatal care. I hereby propose the creation of a new research framework that will 1) establish pregnancy profiles based on maternal symptoms, 2) reveal their genetic and proteomic underpinnings through the establishment of novel proteogenomic methods, and 3) resolve how maternal symptoms link to pregnancy complications and later health of mother and child. This transformative project will close a long-standing knowledge gap, opening novel research avenues for the study of pregnancy and its consequences for mothers and children.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101171420

Keywords of the ERC project: Pregnancy sickness, woman's health, genetic epidemiology, proteomics

Keywords that characterize the scientific profile of the potential visiting researcher/s: genetic epidemiology in pregnancy

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Project ID:	Project Acronym:	Evaluation Panel:
101171648	**ASTUTE**	**LS7** Prevention, Diagnosis and Treatment of Human Diseases

Principal Investigator:	**Dr Gustaf Edgren**
Host Institution:	KAROLINSKA INSTITUTET - SWE

Advanced Studies in Transfusion Epidemiology: Using 'Big Data' to safeguard the blood supply of the future

The lifetime risk of receiving a transfusion is almost 20%, meaning that close to 100 million EU citizens will receive a transfusion at some point in their lives. Consequently, the issue of blood transfusion safety—in a wide sense—are highly relevant for population health. It is therefore disconcerting that blood safety is often narrowly defined, focusing almost exclusively on the elimination of known transfusion-transmitted disease, ignoring donor health and failing to consider unconventional pathogens. In this comprehensive research program, proposing a series of Advanced Studies in Transfusion Epidemiology, I will lead research within four distinct work packages, first creating a nationwide vein-to-vein database, with detailed data on blood donors and transfused patients in Sweden between 1968 and 2023, linked to detailed outcomes registers, and then making a version of this database publicly available through anonymization. We will then exploit this database in a series of applied studies divided into three work packages. In the first of these, we will conduct a careful, hypothesis-based investigation where we follow-up a previous publication from my research group, showing possible transfusion transmission of an agent causing intracerebral hemorrhage, seeking to establish the etiology of these hemorrhages, and testing whether it might have been driven by transmission of amyloid β. In the second work package we will perform a series of studies of blood donor health, investigating aspects on donor health behavior, short term risks of donating blood, and the risks of negative intergenerational effects from the iron-depletion suffered by many female blood donors. Lastly, we will perform a comprehensive, phenome-wide study where we search for unknown transfusion-transmitted disease using both traditional epidemiological and state-of-the-art machine learning methods. Together, these tasks have the potential of making important gains for transfusion safety in Europe.

Link to the ERC project webpage:

Keywords of the ERC project: transfusion, blood safety, epidemiology, data science

Keywords that characterize the scientific profile of the potential visiting researcher/s: epidemiology, data science, machine learning, artificial intelligence

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Project ID:	Project Acronym:	Evaluation Panel:
101002644	**BEE-MOVE**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Mathieu Lihoreau**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - GBR

Pollination ecology: how do bees move across the landscape and fashion plant reproduction?

How pollinators, such as bees, exploit plaHow pollinators, such as bees, exploit plant resources is a fundamental question in biology, with deep ecological, economical and societal consequences. When foraging on flowers, pollinators transfer pollen and mediate the reproduction of plants on which most animals (including us humans) rely on. Understanding the spatial foraging strategies and interactions of pollinators across the landscape is thus a critical scientific challenge to discover their influence on plant mating patterns and pollination efficiency. BEE-MOVE will use an interdisciplinary approach to mechanistically link pollinator movements to pollination efficiency at field scales, thereby crossing boundaries between research on pollinator behaviour and plant ecology. I will focus on two key pollinators worldwide: the buff-tailed bumblebee and the Western honey bee. 1) I will develop a new radar system to record and analyse the individual 3D movements of hundreds of bees foraging simultaneously. 2) I will use arrays of communicating radars and robotic plants to study how bees search and exploit food resources in field setups of several square kilometres, by manipulating key environmental factors such as the density of bees, the 3D distribution of plants, and the nutritional content of nectars and pollens. 3) From these observations, I will build computational agent-based models to investigate the influence of bee spatial strategies on pollination efficiency. Critical experiments will test model predictions in populations of natural plants. The dialogue between observations and simulations will create a positive feedback towards a robust, multi-level understanding of plant-pollinator interactions at the scale of landscapes. In addition to exploring entirely new grounds in pollination ecology, my results could be used to design practical interventions for conservation, sustainable agriculture and green development in the worrying context of pollinator declines.

Link to the ERC project webpage: http://www.mathieu-lihoreau.com/bee-move/

Keywords of the ERC project: bees, pollinators, behaviour, cognition, navigation, movement ecology, pollination, radar tracking, artificial flowers, computational modeling

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101039843	**CHIMERA**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Anouk Willemsen**
Host Institution:	UNIVERSITAT WIEN - AUT

The sympatric lifestyle of giant viruses: contact tracing and fitness through mobile genetic elements

Giant viruses appear to be ubiquitous in soil and aquatic environments, infecting a wide range of protist hosts. As lytic viruses, they are important regulators in nutrient and energy cycles and key influencers of microbial community composition. The recent discovery of giant viruses challenged previous assumptions and blurred the sharp division between viruses and cellular life. Besides large particle sizes, giant viruses possess complex "chimeric" genomes, including genes that were likely acquired from their hosts and bacteria that parasitise the same hosts. Unique is the presence of prokaryotic-like mobile genetic elements (MGEs) that are speculated to aid giant viruses in defence against the host immune system or in direct competition for resources with other viruses or bacteria. Contrarily, bacteria may use MGEs to help the hosts counteract viral infections. Our current knowledge on the factors promoting giant virus diversity and maintenance of the virus-host balance in nature, are largely unknown. In the proposed project, I will investigate the role of MGEs in the evolution and ecology of giant viruses. I postulate that the presence of MGEs plays a crucial role in the competition between giant viruses and other parasites infecting the same hosts. Using co-infection experiments, as well as cutting-edge molecular, microscopy, and sequencing techniques, I will investigate viral competitive fitness as well as physical and molecular interactions between selected partners. By developing a highly specific giant virus genome editing tool, I will rigorously test whether MGEs can provide giant viruses with higher fitness. Moreover, I will combine cell sorting with metagenome analysis of two selected habitats, to unravel how MGEs are distributed in a natural ecosystem. My overarching goal is to elucidate the molecular dialogue between viruses, bacteria, and their hosts, and to use MGEs as a tool to trace the evolutionary history of this unique group of viruses.

Link to the ERC project webpage: https://dome.univie.ac.at/research/dome-research-projects-detail/virus-host-interactions

Keywords of the ERC project: giant viruses, mobile genetic elements, virus-host interactions, virus-microbe interactions

Keywords that characterize the scientific profile of the potential visiting researcher/s: experimental evolution, bioinformatics, computational molecular evolution, biotechnology, molecular biology, microbiology

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Project ID:	Project Acronym:	Evaluation Panel:
101041354	**HOW2DOUBLE**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Polina Novikova**
Host Institution:	MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV - DEU

The basic principles of polyploidy in plants and animals

Many eukaryotes have more than two sets of chromosomes due to whole-genome duplication (WGD) and are called polyploids. WGDs explain many cases of speciation bursts and evolutionary inventions. Some evidence suggests an adaptive advantage of polyploids: the origins of many ancient WGDs correspond to the times of extreme climate change, and contemporary polyploids often occupy harsher environments compared to their ancestors. However, most new polyploids are not as lucky and rarely survive. To explain the cause, predict and manipulate this process, we need to understand the basic principles of polyploidy: (1) how it is triggered, (2) what enables the initial survival of newly formed polyploids, and (3) how they stabilize a population and become successful. My program will comprehensively cover all these aspects, from the functional and genetic levels to the evolutionary forces driving the entire process. I propose a cross-disciplinary approach to identify common polyploidy principles in plant and animal diploid-tetraploid species complexes: Arabidopsis lyrata, widespread plant in Northern Hemisphere, and Neobatrachus, burrowing frogs living in the Australian desert. The approach combines classic genetics with the latest genomics technologies and population genetics analysis of natural herbarium and museum collections across broad geographies. I will (1) expose genetic and environmental predispositions to polyploidy formation by mapping natural variation of the unreduced gametes rates; (2) reveal mechanics and genetics stabilizing meiosis in polyploids, comparing recombination and selection across ploidies; (3) uncover polyploid populations recovery processes after bottlenecks accompanying their origin by reconstructing introgression patterns. Deciphering the mechanisms leading to successful polyploidization across the plant and animal kingdoms will deliver groundbreaking advances relevant across biology, agriculture, and medicine.

Link to the ERC project webpage:

Keywords of the ERC project: polyploidy, adaptation, population genetics, genomics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101043835	**pMolEvol**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Tal Dagan**
Host Institution:	CHRISTIAN-ALBRECHTS-UNIVERSITAET ZU KIEL - DEU

Molecular and Genome Evolution of Prokaryotic Plasmids

Plasmids are autonomously replicating extra-chromosomal elements that play a major role in prokaryote ecology and evolution. The study of plasmid evolution has so far focused mostly on their biodiversity and effect on their host ecology and evolution. Nonetheless, the fundamentals of plasmid genome evolution remain to a large extent uncharted territory. Plasmids reside within a host cell that supplies their environmental, energetic and metabolic requirements. Consequently, natural selection operates on plasmids in two hierarchical levels: one component is the plasmid replication and inheritance within the host cell, and the other is the host fitness within the population. Studying the determinants of plasmid evolutionary success thus requires the expansion of classic population genetics theory to populations of plasmids within bacterial cells. The overarching aim of pMolEvol is to create a novel unified framework for plasmid molecular and genome evolution. This includes: 1) to quantify the effect of multilevel drift and selection on plasmid genetic diversity, 2) supply a framework for quantification of plasmid fitness and its effect on plasmid evolution, 3) characterize patterns and rate of plasmid genome evolution. Our conceptual framework will be based on empirical data from plasmid evolution experiments and reconstruction of past events from genomic information. The conceptually novel measures and approaches developed in pMolEvol open up avenues for the extension of classic population genetic theory to prokaryotic organisms. Across all domains of life, genetic information is stored, replicated and translated by similar mechanisms. Focusing on plasmids, we aim to uncover the general principles that govern the evolution of autonomously replicating genetic elements. Our ultimate goal is to describe plasmid evolution from emergence to extinction.

Link to the ERC project webpage:

Keywords of the ERC project: Plasmid; Bacteria; Molecular Evolution

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101045057	**MIXOTROPH**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Vincent Merckx**
Host Institution:	STICHTING NATURALIS BIODIVERSITY CENTER - NLD

Mixotrophy: an uncharted carbon flux in the plant world

Plants need light to grow. They use energy from sunlight to produce organic carbon. However, new findings – including my own work – now hint that up to 35% of all plant species can also obtain carbon from root-associated fungi when light availability is insufficient for growth. This calls into question much of what we thought we knew about how plants survive in the understory. The goal of this project is to determine the frequency and magnitude of this newly discovered form of 'mixotrophy' in our terrestrial ecosystems. I will achieve this exciting goal by working at the intersection of physiology, ecology, evolutionary and molecular biology. The vast majority of land plants transfer part of the organic carbon they produce by photosynthesis to root-associated 'arbuscular mycorrhizal' (AM) fungi, which help plants to take up nutrients and water from the soil. My previous findings demonstrate that this carbon can be subsequently taken up by rare non-green plants that tap into the same fungal network. This paved the way for the discovery of AM mixotrophy, in which common green plants take up carbon from AM fungi. However, the plant and fungal diversity involved in AM mixotrophy are unknown. Likewise, the environmental drivers that influence carbon uptake have never been measured, nor do we know about its evolution and geographic distribution. This is problematic because we are unable to quantify or understand the role of AM mixotrophy in our natural world. With field studies, laboratory experiments, and genetic screening of natural history collections, I will (1) identify AM mixotrophic plants and their habitats; (2) reveal environmental drivers that regulate carbon uptake; (3) expose fungal networks that sustain AM mixotrophs; and (4) measure the magnitude of AM mixotrophy across evolutionary and geographic scales. This will lead to a fundamental shift in our understanding of carbon uptake by plants, with profound effects for carbon cycling models and conservation.

Link to the ERC project webpage:

Keywords of the ERC project: mycorrhiza, mycoheterotrophy, plant biology, forests

Keywords that characterize the scientific profile of the potential visiting researcher/s: forest ecology, carbon transfer

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Project ID:	Project Acronym:	Evaluation Panel:
101054307	**FishLEGs**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Craig Primmer**
Host Institution:	HELSINGIN YLIOPISTO - FIN

Life-history genes in fishes: bridging functional and evolutionary genetics for understanding life-history trait evolution

Life history is one of the most central concepts in biology. Numerous biological questions ultimately revolve around the causes and consequences of variation in reproduction and survival i.e. fitness. Tremendous effort has been put in establishing the causes and mechanisms for life history trait variation and trade-offs. But even in well studied model organisms, evolutionary genetic and functional genomic approaches are rarely combined, and thus the path from genotype to phenotype often remains a black box. A strategy to overcome this major hurdle has recently emerged, with the discovery of loci that explain exceptionally large proportions of the variation in various life history traits. These "life-history genes" offer new opportunities to study not just the why (evolution) but also the how (functional genetics) of life history trait variation. I will address critical outstanding questions by bridging functional and evolutionary genetics approaches to study multiple loci linked with life-history traits including age at maturity, migration timing and migration strategy in 3 fish species: Atlantic salmon, Rainbow trout/steelhead and Atlantic cod. The relatively simple genetic architecture of the traits, combined with the features of these species as model systems, offer a unique opportunity to finally reveal the genetic architectures, molecular mechanisms and ecological drivers that translate large-effect genotypes into adapted life history phenotypes, and examine how evolution shapes these processes. In FishLEGs I will: i) characterize the molecular functions behind genotype-life history associations; ii) elucidate life history trait reaction norms and evolution in variable environments and iii) determine the strength of natural and sexual selection on life history traits, their sex specific effects, and model the evolutionary consequences. Life history research also has societal relevance for health, sustainable fisheries, conservation and climate resilience.

Link to the ERC project webpage: http://www.helsinki.fi/evolution-conservation-and-genomics

Keywords of the ERC project: ecology, evolution, genomics, salmon, trout

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101054718	**Xspect**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Mikkel Heide Schierup**
Host Institution:	AARHUS UNIVERSITET - DNK

X-chromosome driven speciation through testes-expressed genes: comparative population genomics meets scRNA analysis in primates

Primate X chromosomes evolve extraordinary fast and are also tightly associated with the establishment of reproductive barriers between emerging species. The hypothesis of this proposal is that genetic conflicts between the X chromosome and the rest of the genome during spermatogenesis cause rapid X chromosome evolution and build reproductive barriers. Genetic conflicts for transmission to haploid gametes, called meiotic drive, will cause non-adaptive evolution, which is expected to be countered by other genomic elements that will then be under selection. Such an arms race is expected to lead to a very rapid evolution of the X chromosome and a fast accumulation of incompatibilities between isolated populations, leading to speciation. The goal of the project is to identify the underlying mechanisms and the genes responsible for meiotic drive using primates as the study system. A priori candidate processes include X-linked genes under repeated fast evolution with a focus on genes targeted by pachytene piRNAs and on ampliconic genes. Population genomics analysis will generate specific hypotheses that will then be tested by following expression of candidate genes during spermatogenesis through scRNAseq, and validate findings by ultrasensitive, in situ, staining of single transcripts and immunohistochemistry. Finally, the behaviour of key genes and processes will then be investigated in incipient speciation events. Specifically, 850 individuals of 250 species of primates with full genome data will be analysed for candidate genes on the X chromosome. These genes will be investigated in large scale comparative scRNA sequencing analyses of >10,000 individual testicular cells from 14 primate species, including all great ape species, thus allowing expression trajectories through spermatogenesis to be inferred and followed up in functional experiments. The success criterion is to report on primate speciation genes together with their biological mode of action.

Link to the ERC project webpage:

Keywords of the ERC project: Speciation, sex chromosomes, spermatogenesis, mutations, primates, population genetics, single cell

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council Executive Agency Established by the European Commission	Project ID:	Project Acronym:	Evaluation Panel:
	101076740	**STOIKOS**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Marcos Fernández Martínez**
Host Institution:	CENTRO DE INVESTIGACION ECOLOGICA Y APLICACIONES FORESTALES - ESP

Elemental Ecology: towards an element-based functional ecology

Life on Earth, as we have known it for millennia, is at stake. Human activities are putting all kinds of ecosystems under increased stress because of land-use change and the alteration of the biogeochemical cycles of nitrogen (N), phosphorus (P) and carbon (C), thus inducing climate warming. Functionally diverse ecosystems are more productive and stable than less diverse ones, and biogeochemical changes affect both biodiversity and the elemental composition of organisms (their elementome), changing how they and their ecosystems function. It is, therefore, imperative to provide evidence about how the interactions between elementomes, biodiversity, and climate drive ecosystem functioning if we are to avoid the serious threat of reducing essential resources for life within the context of global change. STOIKOS will achieve an in-depth understanding of the interaction between elementomes and biodiversity in determining ecosystem functioning by introducing the concept of elemental diversity, and moving functional ecology from using functional traits to elementomes, an easy and universal way to compare all sort of organisms. STOIKOS will particularly test the hypothesis that community-weighted elementomes and elemental diversity explain ecosystem functioning better than functional traits and their diversity. STOIKOS will integrate data from observations (field campaigns), long-term monitoring sites, microcosm experiments and theoretical modelling to provide synergies amongst their outputs to build the foundations of an elemental-based ecology. This will allow STOIKOS' hypotheses to be tested at the individual, species and community/ecosystem scales using new and game-changing methodologies and study systems. The cutting-edge science of STOIKOS will not only provide the foundations of an elemental-based ecology, but will also deliver new ecological theory and methodological tools that will help us predict the future of ecosystems and assess the fragility of our biosphere.

Link to the ERC project webpage: https://stoikos.creaf.cat/

Keywords of the ERC project: nutrients, elements, organism and ecosystem functioning, global change

Keywords that characterize the scientific profile of the potential visiting researcher/s: nutrients, elements, organism and ecosystem functioning, global change

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Project ID:	Project Acronym:	Evaluation Panel:
101076837	**FutureNature**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Koenraad Van Meerbeek**
Host Institution:	KATHOLIEKE UNIVERSITEIT LEUVEN - BEL

Shaping functional ecosystems of the future

Accelerating climate change is moving ecosystems rapidly beyond the bounds of historical variability. Many of the traditional conservation approaches trying to maintain a status quo are no longer effective. Rather than resisting change, we need to guide transforming ecosystems towards preferred ecological outcomes. Assisted migration, the active translocation of species to mimic range expansion under climate change, is a widely proposed adaptive management strategy. But it is also controversial, as it disrupts long-held views on biological conservation. Focusing on risks and ignoring benefits has hampered scientific research on assisted migration and halted necessary conservation innovation. Yet, the costs of inaction are too high and time is running out. In FUTURENATURE, I will approach the assisted migration of plant species from an innovative functional perspective, shifting the focus from minimising the impact of translocated species to maximising their contribution to the functioning of novel communities. I will advance our understanding of how assisted migration can safeguard functioning ecosystems by combining the wealth of large observational databases, state-of-the-art joint species distribution models and a cutting-edge climate change experiment. Specifically, I will (1) study the contribution of non-invasive alien species to ecosystem functioning; (2) incorporate species interactions and traits into species distribution modelling to simulate novel grassland communities; and (3) experimentally test the functionality of the best performing communities under future climate scenarios. With the knowledge gained, we will be able to shape ecosystems that will not only survive, but thrive under climate change. FUTURENATURE will provide a "greenprint" to study assisted migration across species groups and ecosystems, and, ideally, enable a paradigm shift in conservation thinking by lifting the psychological barriers preventing changes in natural ecosystems.

Link to the ERC project webpage: www.futurenature.be

Keywords of the ERC project: Biodiversity Conservation; Climate Change; Plant species; Assisted migration; Ecosystem Functioning

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101078303	**ERODE**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Hernan Morales**
Host Institution:	KOBENHAVNS UNIVERSITET - DNK

Evolutionary dynamics of genomic erosion and its application in biodiversity conservation

Reducing biodiversity loss is one of the most pressing societal challenges of our time. Population decline has put many species on the path of collapse and extinction. Reducing or reversing this decline is not enough to tackle the associated hidden evolutionary costs, most notably genomic erosion which compromises the long-term viability and resilience of species. ERODE will employ state-of-the-art approaches – (paleo)genomics, quantitative genomics, and evolutionary modelling – to assess the dynamics of genomic erosion on neutral, beneficial, and deleterious variation and understand its effects on organismal fitness, population viability, and extinction risk. I will perform one of the most comprehensive genome-fitness studies to date by examining the fitness effects of genomic erosion over time in 6,530 individuals of three iconic endangered bird species for which I have access to over 30 years of genetic samples and fitness data. Together with zooarchaeological and museum-preserved samples, I will draw a dynamic timeline of genomic erosion in response to population decline. Next, I will develop a modelling framework parametrized and validated with empirical data to predict the consequences of genomic erosion. I will use this framework to understand the efficacy of in-situ and ex-situ conservation strategies in collaboration with The European Association of Zoos and Aquaria (EAZA). The computer model will incorporate genomics into the Green Status of Species to evaluate species recovery and conservation impact, in collaboration with members of the International Union for Conservation of Nature (IUCN). ERODE will produce one of the largest genomic datasets for endangered species in the world and a robust modelling framework for conservation scientists and practitioners. The outputs will be disseminated in academic journals but also over a series of workshops, instruction videos and other outreach activities, which will support their practical application.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101078303

Keywords of the ERC project: conservation genomic evolutionary genomics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101087134	**ETHYLUTION**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Bram Van De Poel**
Host Institution:	KATHOLIEKE UNIVERSITEIT LEUVEN - BEL

Revealing the ancient plant ethylene biosynthesis and ACC signaling pathway

When ancestral plants colonized the land 450 million years ago, they needed to adapt to harsh environmental conditions when giving up their aquatic lifestyle. I hypothesize that during this water-to-land transition, the volatile plant hormone ethylene became an important growth regulator to face terrestrial stressors. In fact, modern-day crops use ethylene to regulate stress responses, and perhaps ethylene served this role in pioneering land plants to cope with the harsh conditions coinciding with this habitat transition. During my postdoc, I showed that ethylene signaling was functionally assembled in ancestral Charophyte green algae, prior to land colonization. Now I question why and how early land plants produced ethylene. While seed plants make ethylene using ACC as precursor, non-seed plants follow a different, yet unknown ethylene biosynthesis pathway, which I want to reveal using the liverwort Marchantia polymorpha, a model species representing early life on earth. I also question why non-seed plants make ACC, but not use it for ethylene synthesis. Recent studies revealed that ACC itself can act as a signaling molecule, independent from ethylene, by an unknown signaling pathway to regulate plant development. I also postulate that both the alternative ethylene biosynthesis and ACC signaling pathway might have an origin in ancient algae, prior to land colonization, and might be conserved in seed plants, possibly exerting important functions yet to be uncovered. Using functional genetics in representative species of algae and crops, ETHYLUTION will unravel the importance and role of ACC and ethylene that allowed plants to thrive on earth, perhaps one of the most impactful events in the evolutionary history of plants.

Link to the ERC project webpage:

Keywords of the ERC project: Ethylene, ACC, evolution, plants, Marchantia polymorpha

Keywords that characterize the scientific profile of the potential visiting researcher/s: Molecular plant hormone evolution

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Project ID:	Project Acronym:	Evaluation Panel:
101088709	**EcoEvoDiv**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Jan Hrcek**
Host Institution:	BIOLOGICKE CENTRUM AKADEMIE VID CESKE REPUBLIKY VEREJNA VYZKUMNA INSTITUCE - CZE

Eco-evolutionary dynamics and the maintenance of organismal diversity

There is growing evidence of rapid evolution leading to entangled eco-evolutionary dynamics. However, we are only beginning to address what this implies for maintenance of biodiversity in nature. Community ecology studies how species diversity is maintained in communities despite negative interactions. Separately, population biology studies how phenotypic and genetic variation is maintained in populations despite selection and drift. These two questions are interlinked, but usually addressed independently, not considering the other level. Intriguingly, genetic variation could help maintain species diversity, and reciprocally, diversity could help maintain variation, forming a positive feedback loop. However, this hypothesis has not been empirically tested in complex ecological networks, because maintaining such networks in the laboratory is a major challenge. I propose to experimentally test this hypothesis using a uniquely tractable network of tropical rainforest Drosophila and their parasitoids (6 fly and 5 wasp species), that I developed to allow multigenerational microcosm experiments. We will manipulate species diversity and genetic variation of all species in a factorial design to test the hypothesis. We will then explore the mechanisms of interactions between diversity and variation, focusing on rapid evolution. To link the findings to natural eco-evolutionary dynamics, we will investigate mechanisms maintaining diversity and variation in the wild. Based on the empirical work we will advance eco-evolutionary concepts of organismal diversity and stability. This project will provide a causal test of the interaction between maintenance of diversity and variation, thus linking two key questions in ecology and evolutionary biology. Uncovering the specific coexistence mechanisms will allow us to predict the importance of diversity – variation feedbacks in other systems with important implications for conservation of biodiversity.

Link to the ERC project webpage: http://lab.hrcek.net/

Keywords of the ERC project: rapid evolution, community ecology

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101097167	**RegEvol**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Thomas Lenormand**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

The evolution of cis and trans-regulators in eukaryotes

Gene regulation plays an essential role in shaping species differences and modulating phenotypes across development and environmental conditions. It essentially works through the recruitment of trans-acting intermediates to cis-acting DNA sequences affecting the expression of the nearby gene. While gene expression regulation is central in molecular, cellular, developmental, and system biology, its detailed mechanisms have relatively little been incorporated into modern evolutionary theory. I previously discovered two processes specific to gene expression evolution in diploids, cis-regulator runaway and divergence. They arise because of (i) transient dominance modifications that automatically occur following the evolution of cis-acting regulatory elements and (ii) coevolution of these cis-acting elements with trans-acting regulators. I have shown that accounting for these processes calls into question a half-century of theory on sex chromosome evolution and may rejuvenate empirical and theoretical work in this field. Here, I will develop the evolutionary theory of cis- and trans-regulators at full scale and empirically test its core features and predictions. Specifically, there are sound reasons to believe that this new theory also has the potential to strongly advance our understanding of other fundamental and enigmatic features of eukaryotic life. It may be a crucial missing element to explain the origin of eukaryotic regulatory complexity and how and why sex – asex transitions fail or succeed and, therefore, why eukaryotic sex is maintained. RegEvol offers a new and original approach to important problems in evolutionary biology. If successful, it will significantly advance our understanding of eukaryotic life-forms and provide a general framework for gene expression evolution in eukaryotes.

Link to the ERC project webpage:

Keywords of the ERC project: Evolution, genomics, regulation, theory, asexuals, sex chromosomes, regulatory networks

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101115960	**EcoMEMO**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Alberto Canarini**
Host Institution:	ALMA MATER STUDIORUM - UNIVERSITA DI BOLOGNA - ITA

Ecological memory of extreme drought events in soil microbial communities

Current global changes are increasing frequency and intensity of extreme drought events, with severe consequences for ecosystems. Recent evidence of ecological memory formation upon recurrent disturbances — defined as the capacity of past events to influence current ecosystem responses —, challenges our ability to simulate future ecosystem response to drought. Yet an important question remains: is ecological memory a fundamental feature regulating how ecosystem functioning responds to extreme climatic events? EcoMEMO aims at filling this large knowledge gap, with a focus on soil microbial communities, for which I previously showed ecological memory of drought. Soil microbes regulate important biogeochemical processes for carbon and nutrient cycling. They also possess an enormous taxonomic and functional diversity which allows for potential short-term adaptation. By embracing new approaches to study microbial ecology under drought conditions and new experimental facilities targeted to test ecological memory under realistic climate scenarios, I aim to quantify the importance of ecological memory of drought and identify its mechanisms. All this makes EcoMEMO potentially ground-breaking towards our understanding of soil microbial community response to climate change. My overarching hypothesis is that ecological memory is a common phenomenon in soil microbial communities, attenuating negative effects of extreme drought on the processes they mediate. I also hypothesize that microbial community transition to alternative stable states during exposure to extreme drought underpins the positive effect on biogeochemical cycling. Combining soil biogeochemistry, molecular ecology and mathematics I will: - quantify ecological memory across ecosystems and its consequence for soil processes; - assess legacies of previous drought events within soil biotic and abiotic properties; - identify features of soil microbial community dynamics underpinning ecological memory formation.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101124629	**SeaSym**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Jillian Petersen**
Host Institution:	UNIVERSITAT WIEN - AUT

Symbioses between plants and sulfur-oxidizing bacteria sustain coastal 'blue carbon' ecosystems

Sea- and saltmarsh grasses thrive along most of Earth's coastlines. They form the basis for some of the most ecologically and economically valuable ecosystems on the planet that are also major 'blue carbon' sinks. One of the main challenges these marine flowering plants faced during their evolution back into the sea millions of years ago, and one that global change is currently intensifying, is toxic sulfide accumulation around their roots, produced by microorganisms. Like on land, marine plants associate with specific communities of microorganisms, but much less is known about their roles in the health and evolution of their hosts. Intriguingly, one group of microorganisms, Sedimenticolaceae, is virtually ubiquitous in molecular surveys of sea- and saltmarsh grass roots, and is often enriched in root vs rhizosphere or sediment. Their known relatives are beneficial sulfide-oxidizing, nitrogen-fixing symbionts of marine animals, however, their function in sea- and saltmarsh grasses is unknown. SeaSym's central goal is to reveal the biodiversity and functional roles of widespread symbioses with Sedimenticolaceae, to understand the ecological networks in which they function and evolve, and to understand how global change could shift their future functioning. SeaSym will use established and novel tools to understand symbiont diversity, function and dispersal, in the context of natural yet complex plant-associated microbial communities. My overarching hypothesis is that Sedimenticolaceae is a widespread symbiont of sea- and saltmarsh grasses, directly influencing host health and shaping element cycling in coastal ecosystems. Just as diverse land plants rely on symbioses with Rhizobia for nitrogen, I propose that diverse marine plants rely on Sedimenticolaceae that provide nitrogen whilst removing toxic sulfide. If so, this so far largely overlooked symbiosis could be one of the most important in terms of current ecological and past evolutionary significance.

Link to the ERC project webpage:

Keywords of the ERC project: Marine symbiosis seagrass microbial ecology

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101124827	**MiMeRe**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Suvi Ruuskanen**
Host Institution:	JYVASKYLAN YLIOPISTO - FIN

The role of the gut microbiome in host responses to environmental variation: within and across generations and species

The gut microbiome is strongly linked to health and sickness. A current key challenge is to understand how the microbiome helps the host adapt to environmental variation. Yet, most research originates from few laboratory animal models and thus misses large parts of environmental, physiological and life-history variation, while data from wild populations and species is needed. Thus, our overarching aim is to unravel how the microbiome mediates host's responses to environmental variation, covering molecular to evolutionary scale, using wild birds as a study system. We focus on how gut microbiome helps hosts to cope with temperature variation, given the pervasiveness of temperature as a challenge across taxa, and climate-crisis driven thermal challenges. The objectives:
(O1) To study the role of the microbiome in mediating host (adaptive) reversible thermal plasticity in adulthood
(O2) To assess the role of the microbiome in mediating host (adaptive) developmental and transgenerational thermal plasticity, and explore the underlying epigenetic changes
(O3) To quantify the contribution of host genetic variation and the microbiome on host thermal physiology
(O4) To explore the macroevolutionary patterns of microbiome and host thermal physiology
(O5) To examine the underlying molecular mediators of host-microbiome interactions
To understand the causal role of microbiome, we apply state-of-the-art methods (incl. microbiome transplants) within and across populations (O1) and generations (O2), and identify the molecular mediators (incl. bacterial vesicles; O5), many tools adapted from the biomedical field to eco-evo research. We further use quantitative genetics, reaction norms, selection lines (O3) and multivariate phylogenetic models (O4), rarely used in host-microbiome field, opening new lines of research. We produce ground-breaking findings on the microbiome-mediated mechanisms of phenotypic variation, which helps to predict how organisms respond to anthropog

Link to the ERC project webpage: https://www.jyu.fi/en/research-groups/environmental-physiology-lab

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101125029	**EvolCommunity**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Shuqing Xu**
Host Institution:	JOHANNES GUTENBERG-UNIVERSITAT MAINZ - DEU

Real-time (co)evolution in a multitrophic community under current and future climates

In nature, organisms live in communities and form complex trophic interactions. Understanding how multitrophic communities evolve and respond to environmental changes is a fundamental and pressing challenge in face of global change. While research in evolutionary biology revealed that a warming climate can drive adaptive evolution of individual organisms in the community, studies from community ecology showed that a warming climate can alter trophic interactions and community structure, which in turn changes the (co)evolutionary trajectory of interacting species. Thus, integrating evolutionary and ecological responses is crucial to understand the climate responses of individual species and communities. However, methodological challenges have hampered empirical studies until now. EvolCommunity will address these challenges by experimentally evolving populations of three interacting species (aphid, duckweed, and daphnia) in their native communities using outdoor mesocosms with different climate conditions. We will quantify how warming shapes the function and evolution of the multitrophic community in real-time. By manipulating climate-driven plant evolution, we will determine whether plant evolution alters the community's response to climate change. We will also assess whether the interacting species coevolve in the community by quantifying the reciprocal selection imposed from their evolutionary changes. We will investigate the molecular mechanisms underlying (co)evolution using state-of-the-art genetic tools. Using a combination of experimental evolution, community manipulation, and cutting-edge genetic and analytic tools, EvolCommunity will push the research boundaries of evolutionary ecology by revealing the mechanisms and processes of community evolution at work. The outcomes will open new research avenues in evolutionary ecology by establishing a new methodological framework that integrates evolutionary biology and community ecology in natural communities.

Link to the ERC project webpage:

Keywords of the ERC project: Evolutionary ecology; genomics; plant-insect interactions; genetics

Keywords that characterize the scientific profile of the potential visiting researcher/s: evolutionary genetics; genomics;

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Project ID:	Project Acronym:	Evaluation Panel:
101126121	**Starship**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Aaron Vogan**
Host Institution:	UPPSALA UNIVERSITET - SWE

Revealing an active mechanism of horizontal gene transfer in fungi

Current theory asserts that eukaryotic evolution is almost exclusively mediated through vertical transmission, from parent to offspring, and relegates horizontal gene transfer (HGT), the movement of genes between individuals, to an extraordinarily rare event. In recent years, mounting evidence from high-quality genome sequencing has forced the field to consider that HGT is likely a persistent occurrence in eukaryotic evolution. However, as no active mechanism for HGT is known in eukaryotes, the evolutionary origin of these genes remains almost entirely a mystery. A potential vector of HGT in eukaryotes are transposable elements (TEs), parasitic genetic sequences that can replicate independently of their host genome. Recently, I discovered a novel group of TEs that are common in filamentous fungi, which I named Starships. These elements are massive, reaching sizes over 500 kb, and carry an extreme diversity of genetic "cargo", some with adaptive functions such as plant pathogenicity. Furthermore, evidence suggests that many Starships have undergone HGT among a diverse set of lineages. Thus, I propose that the Starships represent the first known mechanism of active HGT among eukaryotes. I will examine this role by developing a tractable model system in which to observe HGT under laboratory conditions. This will be done by investigating the basic biology of Starship transposition in a model fungus with the use of transposon assays that we have recently developed and used to prove that the Staships are mobile. We will use this knowledge to design and create "donor" strains which we can pair with any recipient strain of fungus to monitor for HGT. Lastly, we will determine if fungi utilize the movement of the Starships to adapt to their environment by assaying the impact of a Starship on the fitness of a plant pathogenic fungus. This work will demonstrate that HGT is an active and ongoing process in eukaryotic evolution, dramatically reshaping our current views.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101162895	**MeMori**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Ella Tali Sieradzki**
Host Institution:	AARHUS UNIVERSITET - DNK

Quantifying temporal patterns of viral mortality in soil

Atmospheric CO2 levels are affected by sources (industrial processes, respiration) and sinks (carbon fixation, storage of organic carbon). Viruses that infect microorganisms may play an important role in soil carbon sink properties. In soil, carbon is stored, or sequestered, by binding to minerals. Recent studies show that long-term mineral-associated matter is mostly microbial debris, and its fraction out of soil organic carbon varies by soil type. Hence, viruses that break microbial host cells create microbial debris and contribute to carbon sequestration in soil, yet are missing from carbon flux models. We lack fundamental information about the physiology of soil viruses to link viral lysis of microbes and soil carbon sequestration. Recently, we provided the first estimate of microbial mortality by viruses during soil re-wetting after the dry season, a peak time of carbon flux. Our study estimated mortality of up to 46% of cells within a week. The main knowledge gaps preventing better accuracy of mortality estimates are the average number of viruses produced per host cell and infection rates year-round. I propose to address these gaps using a combination of classic microbiology and cutting-edge bioinformatics. This project will: (1) generate physiological constraints for soil viral mortality across soil types with different amounts of microbial debris, and (2) establish a multi-year monthly time-series of viral infection dynamics of soil microorganisms. I will focus on soil viruses infecting Actinobacteriota, an abundant phylum of drought-resilient soil bacteria that experiences consistently high viral infection rates. A time-series of viral activity will place the culture-based physiological parameters within the context of spatiotemporal dynamics of the entire viral community. This project will create an unprecedented ability to estimate the potential contribution of viruses to soil carbon sequestration and incorporate it into global carbon flux models.

Link to the ERC project webpage:

Keywords of the ERC project: soil, virus, virome, carbon sequestration, actinobacteria, phage, metatranscriptomics

Keywords that characterize the scientific profile of the potential visiting researcher/s: metagenomics, microbial ecology, environmental microbiology

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Project ID:	Project Acronym:	Evaluation Panel:
101163496	**FEEDRES**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Camilla Sguotti**
Host Institution:	UNIVERSITA DEGLI STUDI DI PADOVA - ITA

Feedback mechanisms approach to resolve regime shifts in ecological systems.

Our planet is changing at a pace never experienced before. Ecosystems worldwide are impacted by multiple anthropogenic pressures and are experiencing abrupt changes, sometimes leading to regime shifts. Marine ecosystems are prone to these dynamics and regime shifts are at the spotlight of research which seeks to reduce the uncertainties related to our incomplete understanding of these processes. Three main questions need to be answered to understand regime shifts: when they happen; i.e. detection, why; i.e. drivers and characteristics, and how; i.e. mechanisms. Present literature has focused mainly on detecting regime shifts, neglecting feedbacks and how ecosystems function. This ignorance has limited the causal understanding of these phenomena and has hindered the capacity to predict them, a fundamental step under global changes. FEEDRES brings feedbacks mechanisms at the fore and aims at responding to all the three challenges to understand and project regime shifts. To fulfil this, FEEDRES will develop a cutting-edge methodological framework combining methods from system dynamics theory and ecology. FEEDRES will follow three steps. 1) Map worldwide marine regime shifts – Through a systematic mapping FEEDRES will assess the extent of regime shifts, highlighting knowledge gaps (when). 2) Empirically study the important structural elements and connections that characterize marine systems under regime shifts (from populations to socio-ecological systems) – FEEDRES will apply a two-step modelling approach to understand how the system change during regime shifts (why). 3) Develop mechanistic models to understand how changes in feedback mechanisms mediate marine regime shifts (how). Based on the knowledge developed FEEDRES will identify common feedback types in marine systems and will project the likelihood of regime shifts. FEEDRES will revolutionise ecosystem science and will increase the understanding on how complex systems behave under cumulative stressors.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101163496

Keywords of the ERC project: marine ecology, feedback mechanisms, regime shifts, statistical modelling, networks, empirical networks

Keywords that characterize the scientific profile of the potential visiting researcher/s: statistical modeller, ecologist, network

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Project ID:	Project Acronym:	Evaluation Panel:
101164033	**RETRO-PUMP**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Judith Klatt**
Host Institution:	PHILIPPS UNIVERSITAET MARBURG - DEU

Reconstruction of global redox transitions based on an evolving Precambrian biological carbon pump

The history of life on Earth is intricately tied to the story of molecular oxygen (O2). Given that we breath O2 every day, the quest to understand its rise over billions of years is inherently tied to the fundamental question of our existence. However, critical turning points in our planet's oxygenation, including the Great Oxidation Event, continue to escape our full comprehension. O2's narrative involves a complex interplay of microbial life, biogeochemical processes, and geological factors, all intricately woven into the carbon cycle. Within the web of transformations, a black hole persists: the Biological Carbon Pump (BCP). The BCP is a crucial component of the Earth's carbon cycle, sequestering carbon from the atmosphere and transferring it to the ocean depths for burial over geological timescales. This burial process directly impacts global O2 levels, making the understanding of the ancient BCP crucial for unlocking Earth's oxygenation mysteries. However, deciphering how the ancient BCP functioned is challenging, as insights from the modern BCP, which is predominantly shaped by complex life forms, offer limited guidance when it comes to understanding its ancient counterpart, which operated in a world ruled by microorganisms. RETRO-PUMP sets out to unveil the secrets of the Precambrian BCP by reconstructing an ancient and evolving BCP with the goal of unravelling its regulation of O2 levels. It challenges the conventional view of a less efficient Precambrian BCP and explores uncharted relationships between microbial carbon cycling and major O2 transitions. This journey follows a simulated ocean pipeline, from the sunlit photic zone to the deep ocean, culminating in an integration of insights into a numerical framework. By tackling the drivers behind Earth's oxygenation, RETRO-PUMP has substantial implications for understanding how the interplay of biological and geological factors ultimately paved the way for the rise of complex life as we know it today.

Link to the ERC project webpage:

Keywords of the ERC project: Archean, Proterozoic, photosynthesis, biological carbon pump, redox cycling, carbon cycle, iron cycle, sulfur cycle, silica cycle, banded iron formations, cyanobacteria, photoferrotrophy, Great Oxidation Event

Keywords that characterize the scientific profile of the potential visiting researcher/s: Geomicrobiology, geochemistry, biogeochemistry, microbial ecology, modeling

European Research Council Executive Agency Established by the European Commission	Project ID:	Project Acronym:	Evaluation Panel:
	101164921	**PhagoPhoRe**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Nils Rädecker**
Host Institution:	ALFRED-WEGENER-INSTITUT HELMHOLTZ-ZENTRUM FUR POLAR- UND MEERESFORSCHUNG - DEU

The interplay of symbiont nutrient release and host phagosome maturation in photosymbiosis regulation

Photosymbioses between heterotrophic hosts and phototrophic algal endosymbionts have repeatedly and independently evolved across the tree of life. The immense productivity of photosymbioses affects global nutrient cycles, yet global warming is disrupting these nutrient-exchange symbioses, destabilizing the ecosystems they support. Heat stress erodes the metabolic controls underlying the establishment and maintenance of mutualistic carbon recycling in these symbioses. A link between endosymbiont nutrient release and their intracellular maintenance could thus explain the evolutionary establishment as well as the ecological collapse of photosymbioses in the Anthropocene.

Harnessing recent advances in cell isolation and culture techniques, PhagoPhoRe seeks to understand the processes underlying the establishment, maintenance, and breakdown of the cnidarian-algal symbiosis. Specifically, I will investigate the idea that the release of photosynthates enables algal endosymbionts to evade phagosomal digestion and autophagic immune responses of the host by mimicking ongoing digestion processes. In three complementary work packages that combine state-of-the-art single-cell transcriptomics, proteomics, and isotopic imaging techniques, I will: 1) Characterize the role of host phagosome maturation processes in the intracellular establishment and maintenance of algal endosymbionts. 2) Investigate the postulated link between algal nutrient release and host phagosome arrest and immune suppression. 3) Examine the drivers of co-evolution towards obligate metabolic interactions in photosymbioses.

Deciphering the interplay between symbiotic nutrient cycling and host phagosome maturation will be key to understanding the establishment and subsequent breakdown of photosymbioses. These processes are unlikely restricted to photosymbioses and could reveal fundamental mechanisms enabling the establishment of endosymbioses and, as such, eukaryotic life itself.

Link to the ERC project webpage: https://hifmb.de/research/working-groups/photosymbiosis/

Keywords of the ERC project: photosymbiosis, coral bleaching, endosymbiosis, nutrient cycling

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101165485	**MarCyano**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Cyprien Verseux**
Host Institution:	UNIVERSITAET BREMEN - DEU

Physiological and evolutionary responses of cyanobacteria in a sustainable Mars exploration program

The world's major space agencies share a goal of sending humans to Mars within the next few decades. A sustainable human presence there, akin to today's presence in Antarctica, could generate paradigm-shifting knowledge at an unprecedented pace. One major challenge lies in providing the food, oxygen and other necessary consumables: these cannot be shipped from the Earth over the long term. They should instead be produced on site and for this, Nostocaceae cyanobacteria can be instrumental: fed with materials available in the Martian ground and atmosphere, they could provide feedstock for a range of bioprocesses which, in turn, could produce a wide range of consumables. However, fundamental knowledge is lacking to turn this concept into practical solutions: the physiology of cyanobacteria in the foreseen cultivation conditions is poorly understood. These conditions combine low total pressures, low partial pressures of dinitrogen, interactions with a basaltic substrate from which nutrients are leached, and high concentrations of chaotropic salts.
In the proposed project, I will enable a deep understanding of cyanobacterial physiology in these conditions. For this I will employ a unique approach combining cultivation assays in unique hardware previously developed by my team, adaptive laboratory evolution, cutting-edge omics technologies, the development of a mathematical model which can predict the productivity and efficiency of cyanobacterium cultivation from Martian resources, and the construction of a testbed for the experimental validation of this model. I will use the generated knowledge and tools to design, characterize and demonstrate the viability of bioprocesses which dramatically improve the odds that Mars exploration is done in a sustainable way. Finally, I will adapt the concepts developed for bioproduction on Mars to open new avenues for sustainability on Earth, which I plan to follow up by applying for an ERC Proof of Concept Grant.

Link to the ERC project webpage:

Keywords of the ERC project: space microbiology; astrobiology; omics; geomicrobiology; cyanobacteria

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101169909	**ClimateCountDown**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Arnaud Sentis**
Host Institution:	INSTITUT NATIONAL DE RECHERCHE POUR L'AGRICULTURE, L'ALIMENTATION ET L'ENVIRONNEMENT - FRA

Using thermal limits to understand community response to climate warming

When will communities reach their upper thermal limits (i.e., their climate countdown)? A key challenge for ecology and conservation only to be addressed by understanding the biological processes driving community thermal limits and assessing how fast warming actually pushes communities to these limits and thus increases their vulnerability.

The difference between upper thermal limit and habitat temperature is widely used to predict thermal vulnerability. Yet, existing models are mostly limited to single species and neglect key processes such as species interactions. To predict the thermal vulnerability of multi-trophic communities, we need to scale up thermal limits from species to community. This can only be done by answering four key questions: i) How do species interactions impact individual thermal limits? ii) How do acclimation and evolution influence community thermal limits? iii) How do temperature impacts on food web structure and community composition influence community thermal limits? iv) How does spatial heterogeneity in warming rates affect community's vulnerability? To address these four key research questions I propose a novel integrative approach combining semi-natural aquatic experiments, temperature-dependent community models, analyses of 200 lake food webs and climatic projections. This ambitious research programme will evaluate how the evolutionary dynamics of each species, their interactions and food web structure collectively contribute to defining community thermal limits. It will predict the climate countdown of lake communities and test if the latter informs of biodiversity losses induced by climate warming.

This project will provide unprecedented insights on community thermal vulnerability by linking ecophysiology with community ecology. By uncovering the mechanisms of community thermal limits it will contribute to understanding how communities respond to climate change and provide a new means of predicting the future of biodiversity.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101169909

Keywords of the ERC project: climate change, thermal limit, aquatic, CTmax, community

Keywords that characterize the scientific profile of the potential visiting researcher/s: Food web, temperature, community dynamics, trophic interactions, freshwater, extremes

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Project ID:	Project Acronym:	Evaluation Panel:
101170898	**CARBONWEB**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Anton Potapov**
Host Institution:	SENCKENBERG GESELLSCHAFT FUR NATURFORSCHUNG - DEU

Food web control of the global topsoil carbon cycling

Soil food webs process 90% of the terrestrial primary production and regulate the second largest carbon pool on Earth – soil organic matter. Soil food webs themselves are regulated by soil animals through changes in microbial functioning, detritus quality, and physical soil structure. However, neither drivers of soil food web structure and functions nor their effects on global biogeochemistry and carbon stabilisation are quantified across large environmental gradients. CARBONWEB addresses this challenge at the global scale and tests the following Key Hypotheses: (A) biotic controls of soil food web structure and functions increase under conditions promoting biological activity and nutrient limitation; (B) consumption of detritus by consumers in soil food webs increases the stable fraction of soil carbon across ecosystem types; (C) the effect of soil animals on multiple ecosystem functions increases with temperature, precipitation, and nutrient limitation, proportionally to the total energy flux in soil food webs; (D) the global net effect of soil animals on topsoil carbon is positive (>10% increase) and will increase with climate warming. To test my hypotheses, I will use (1) the first comprehensive global monitoring of soil animal communities in the framework of Soil BON, (2) an EU-wide survey and isotopic experiments on carbon stabilisation, (3) steady-state and dynamic food web modelling and AI-based animal image analysis approaches, and (4) geospatial extrapolations. My experience in soil macroecology, functional ecology, large-scale project coordination, and the established collaborative network will help to ensure this project is successful. I will describe and mechanistically model the status and trends of energy fluxes, animal biodiversity, and carbon pools in global topsoils. Results of the project will provide the first-ever global estimation of soil food web effects on soil functioning and facilitate long-term monitoring of soil biodiversity.

Link to the ERC project webpage:

Keywords of the ERC project: soil biodiversity, soil organic matter, food web modeling, stable isotopes

Keywords that characterize the scientific profile of the potential visiting researcher/s: soil biodiversity, experimental ecology, biogeochemistry, spatial biodiversity modelling

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Project ID:	Project Acronym:	Evaluation Panel:
101171969	**HotLife**	**LS8** Environmental Biology, Ecology and Evolution

Principal Investigator:	**Dr Andreas Nord**
Host Institution:	LUNDS UNIVERSITET - SWE

Pathways to survival in a hotter world

Global warming and heatwaves – hallmarks of climate change that are expected to worsen in the 21st century – diminish reproductive success and cause excess mortality in wild and domesticated animal populations. Yet, we still have sub-standard knowledge of almost all fundamental traits that medi-ate success or failure under climate change, and, for most animals, there are no data on the extent to which plasticity, local adaptation, or evolutionary change can alleviate the stress imposed by a hotter world. Collectively, therefore, the research field is at status quo. To mitigate this situation, HotLife will leverage my previous phenomenological studies on ontogenetic priming and plasticity of thermoregulatory capacity to generate novel knowledge on when and why animals fail in the heat, and whether plastic or evolutionary responses may render failure a less likely outcome in the future. The main outcomes of HotLife will reveal: 1) How heat tolerance manifests, how much it can evolve, and whether plasticity halts evolutionary rescue; 2) Whether climate warming and climatic extremes directly or indirectly cuts life expectancy short; and 3) If the physiological basis for heat tolerance is inherited in the wild and if it is already being selected upon I will achieve these ambitious goals by combining state-of-the-art thermal and sub-cellular physiology with intricate genomic techniques and powerful heritability analyses in captive and wild bird models – the endotherm group for which heat-induced mass mortality is most frequently reported. HotLife goes beyond the state-of-the-art, by i) bridging crucial knowledge gaps between heat failure in birds, its physiological basis, and its links to fitness and survival; ii) addressing the potential for rescue by plasticity or evolution from these effects; and iii) uncovering evidence for local adaptation and heritability of heat tolerance in the wild.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101002646	**Switch2See**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Andre Christian Stiel**
Host Institution:	HELMHOLTZ ZENTRUM MUENCHEN DEUTSCHES FORSCHUNGSZENTRUM FUER GESUNDHEIT UND UMWELT GMBH - DEU

Genetically encoded reporters and sensors for whole animal imaging using photo-modulated Optoacoustics

In vivo imaging of cellular localization and function and visualization of the chemicals that drive life are key challenges for biological research. Current methods limit our insight into this "bigger picture" to either a glimpse (low penetration and small field of view) or a coarse overview (low resolution). Optoacoustic (OA) imaging has the physical means to overcome these limitations, but it lacks the necessary toolbox of genetically encoded reporters and sensors that allow specific probing of localizations and distributions. So far, all efforts to create such a toolbox were impeded by the strong tissue background inherent to OA. Recently, exploiting my longstanding expertise in reversibly switchable reporters I overcame this hurdle by introducing the concept of photo-modulation to OA. Switchable reporters allow modulation of the reporter signal to separate it from the background – making the latter virtually invisible ("Switch2See"). In parallel, the concept was used by a U.S. consortium in vivo, underpinning its validity. Hence, now is the time to combine my expertise in switching, protein-engineering, sensors, and OA imaging to create a toolbox that will allow to follow cells over time, visualize their interactions, and image the distributions of chemicals – all on the scale of the whole live organism with resolutions of 20 - 150 µm. With Switch2See, I will lay the foundations by building dedicated screening infrastructure, use it to develop a range of reporters (multiplexing) and sensors, and develop algorithms to convert the photo-modulation patterns into images. I will demonstrate the revolutionary impact on whole-animal imaging by visualizing localization, dynamics and interaction of immune cells in the tumor micro-environment (TME) and visualize aspects of its chemical heterogeneity. Beyond cancer research, this will impact all questions requiring a "bigger picture" – from developmental processes over neurobiology to the functioning of the immune system.

Link to the ERC project webpage:

Keywords of the ERC project: Photo-/Optoacoustic, AI image data analysis, deep tissue imaging, Protein engineering, labels and reporters, transgene

Keywords that characterize the scientific profile of the potential visiting researcher/s: 2 options: 1) Whole animal imaging / image data analysis (preferably ultrasound or photoacoustic); 2) Protein engineering of labels / sensors for optical imaging approaches

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Project ID:	Project Acronym:	Evaluation Panel:
101076355	**AsexualEmbryo**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Charles Underwood**
Host Institution:	STICHTING RADBOUD UNIVERSITEIT - NLD

Asexual reproduction through clonal seeds: mechanisms to application

Some plant species have abandoned sex and produce clonal seeds by apomixis; here, we will explore how this occurs, and exploit these insights to develop novel breeding technologies. In contrast to most eukaryotic species in which reproduction is sexual, a minority of plants and animals have evolved alternative – asexual – reproductive strategies. In plants, apomixis allows clonal transmission of favorable, hybrid genotypes through seeds over unlimited generations. Hybrid crop varieties are stress-resistant and high-yielding due to hybrid vigor, yet they reproduce sexually. The introduction of apomixis in hybrid crops would allow stable inheritance of hybrid vigor through seeds, in perpetuity, and eradicate the need to continuously re-make hybrids by crossing. However, our knowledge of the genetic and molecular basis of apomixis remains incomplete, and blueprints for synthetic apomixis in crops must be established. This project will decipher the function and evolution of a novel PARTHENOGENESIS gene that I recently demonstrated causes asexual embryo formation in naturally apomictic dandelions. Harnessing and extending fundamental findings, synthetic apomixis systems will be developed in two important vegetable crops – hybrid lettuce and tomato – allowing the full complement of hybrid traits to be faithfully inherited through seeds. Ultimately, apomixis in crops could revolutionize the €22 billion hybrid seed industry, make hybrid seeds readily available for all, and facilitate sustainable, high-performance agriculture around the world. Specifically, this project will involve: 1) Deciphering how a PARTHENOGENESIS gene homologue functions during sexual reproduction 2) Optimizing the expression of PARTHENOGENESIS factors through evolutionary insights and mutagenesis 3) Engineering synthetic apomixis – a holy grail of plant breeding – in two important dicot crop species by skipping meiosis and triggering PARTHENOGENESIS

Link to the ERC project webpage: https://www.ru.nl/en/research/research-projects/asexual-embryo-asexual-reproduction-through-clonal-seeds

Keywords of the ERC project: Plant reproduction, Meiosis, Apomixis, Seed biology, Clonal reproduction

Keywords that characterize the scientific profile of the potential visiting researcher/s: Genetics, Cell biology, Genomics, Bioinformatics

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Project ID:	Project Acronym:	Evaluation Panel:
101077812	**LOKI**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Daan Weits**
Host Institution:	UNIVERSITEIT UTRECHT - NLD

Low oxygen, key ingredient of the plant stem cell niche?

Oxygen (O2) is essential for efficient energy conversion by multicellular organisms, including plants. Therefore, environmental conditions where O2 is limited (hypoxia) such as during flooding stress, pose a severe threat to plant survival and can lead to death when prolonged. I recently discovered that plant stem cells of the shoot apical meristem (SAM) are embedded in a local hypoxic niche and that this condition is even important for meristem activity. This suggests that local hypoxia may play a positive role in regulating meristems, despite being harmful to other plant tissue. Safeguarding the stem cell pool of the SAM is especially important for plant fitness, since it not only produces all above ground tissue, but also specifies the germline. In this project, I will therefore challenge the paradigm of hypoxia as a solely stressful conditions and propose that local hypoxia might create a protective environment for stem cells, whereas oxygenation outside the meristem might allow growth of differentiating organs. I will address this hypothesis via three interlinked strategies. (1) Complete the development of prototype O2 biosensors, which will unlock the ability to visualize and understand the role of O2 gradients in plant tissue. (2) Employ genetic manipulation of the O2 sensing machinery to test if and how O2 gradients provide a positional cue that spatially organizes the SAM and its derived organs. (3) Investigate the role of meristem hypoxia in formation of DNA-damaging radicals from O2 metabolism and study the evolution of the hypoxic niche and its perception. Protection of meristems and differentiating organs is essential for plants to survive flooding events which are increasing in frequency due to global warming. The novel insights on how O2 levels regulate development and the tools developed in this project will therefore be fundamental to make the strides forward that are needed to face global climate change and secure crop productivity under stress

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101077853	**PANDEMIC**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Thorsten Langner**
Host Institution:	MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV - DEU

Defusing mini-chromosomes—the Achilles' heel of the wheat blast pandemic

PANDEMIC is an ambitious high-risk/high-gain program to deliver an innovative pathogen-guided strategy for crop disease resistance. The wheat blast pandemic is a clear and present danger to global food security. It is caused by the blast fungus, Magnaporthe oryzae, which, after emerging in Brazil only ~35 years ago, has spread over the last 5 years to Southeast Asia and Africa. We discovered that all isolates of the pandemic wheat blast fungus belong to a single, asexual clonal lineage. These pandemic isolates carry a supernumerary mini-chromosome (mChr) of ~2 Mb, which encodes 19 secreted effector (virulence) proteins and renders the pandemic lineage highly virulent. We propose that this mChr is the Achilles' heel of the pandemic fungus. In PANDEMIC, my team and I will target the mChr virulence properties by gene editing and engineering of disease resistance genes that target mChr-encoded effectors. The central hypothesis of this project is, that detailed knowledge about the biophysical properties of pathogen effector-host target interactions can guide bioengineering of non-transgenic disease resistance in wheat. To achieve our goal, we will employ a multi-disciplinary approach combining genetics, structural biology, and gene editing. Specifically, we will pursue the following objectives: 1. GENETICS. Determine the mChr-encoded effectors conferring high virulence on the pandemic wheat blast fungus. 2. BIOPHYSICS. Define the biophysical properties of effector-host target interactions. 3. IMMUNITY. Apply CRISPR/Cas gene editing to deliver innovative, non-transgenic solutions for blast disease management. At the completion of this project, my team and I will generate a detailed understanding of the biophysical properties of mChr-encoded effector-target protein complexes and deliver novel traits and non-transgenic solutions for developing resistance against the pandemic wheat blast fungus.

Link to the ERC project webpage:

Keywords of the ERC project: plant-pathogen interaction, genome evolution, resistance gene bioengineering

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101086622	**FLEXINEL**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Jochem Verrelst**
Host Institution:	UNIVERSITAT DE VALENCIA - ESP

FLEX-based inferring of terrestrial photosynthesis dynamics for quantifying European vegetation productivity

Photosynthesis, the biochemical process by which vegetation harvests sunlight to convert carbon dioxide and water into carbohydrates and O2, fuels all life on Earth and drives the global carbon cycle. Although the majority of absorbed light is used for carbon assimilation, a remaining part is lost as heat and dissipated as emissions of solar-induced chlorophyll fluorescence (SIF). SIF, the radiant flux emitted between 650 and 800 nm, is therefore the most direct measurable reporter of photosynthetic machinery in plants. Dedicated to retrieve the full SIF signal emitted across the globe, ESA has selected the FLuorescence EXplorer (FLEX) mission concept as Earth Explorer 8. To be launched in 2024, FLEX will fly in tandem with Copernicus' Sentinel-3 (S3) and will operate at ideal spectral, spatial and temporal resolutions. We are only at the dawn of uncovering the full SIF potential from space, as so far only a few single SIF bands have been exploited. The key challenge in the upcoming FLEX era will be to explore this unique new source of information and link it to photosynthetic activity. This proposal - named FLEXINEL - is determined to take leadership in exploiting and interpreting the forthcoming FLEX data stream targeting European vegetation productivity and carbon fluxes monitoring, given state of the art in plant physiology, leaf-canopy-atmosphere radiative transfer mechanisms, machine learning and image processing. FLEXINEL seeks to advance the science in consolidating relationships between SIF products and complementary S3 vegetation traits, thereby uncovering the role of dynamic vegetative and atmospheric variables given a changing Earth. Together with physically-based modelling, latest image processing concepts will be applied, such as emulation and cloud computing. FLEX and S3 products will be fed into assimilation systems for quantifying photosynthesis dynamics, and into an operational biosphere model for improving Europe-to-global carbon flux estimation.

Link to the ERC project webpage: https://leoipl.uv.es/flexinel/

Keywords of the ERC project: FLEX; Sentinel; hyperspectral; Earth observation; vegetation

Keywords that characterize the scientific profile of the potential visiting researcher/s: hyperspectral; Earth observation; vegetation

European Research Council Executive Agency Established by the European Commission	Project ID:	Project Acronym:	Evaluation Panel:
	101089250	**SymbioticExchange**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Caroline Gutjahr**
Host Institution:	MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV - DEU

Molecular exchange at the plant-fungal interface in arbuscular mycorrhiza symbiosis

Nutrient acquisition is the basis of life. Arbuscular mycorrhiza (AM) symbiosis of plants with nutrient-delivering fungi is detected in the oldest land plant fossils and considered a prerequisite for plant life on land. It is wide-spread in the plant kingdom and its secondary loss is the exception. AM improves plant nutrition, stress resistance and general plant performance. Breeding AM-optimized crops has significant potential for improving food security and sustainable agriculture. Understanding the molecular underpinnings of AM function is thus imperative. The hallmark of the symbiosis are the arbuscules, highly branched hyphal structures, which develop in root cortex cells. They build a large membrane interface with the plant derived peri-arbuscular membrane (PAM) that surrounds them. Most mineral nutrients are delivered from the arbuscules and taken up via the PAM into plant cells through transporter proteins. In return, the fungi receive up to 20% of the photosynthetically-fixed carbon. The balance in mineral-nutrient-gain-for-carbon-loss influences the effect of the symbiosis in plant growth and yield. However, the full range of transported nutrients, any mechanisms regulating transport and the balance in molecular exchange are unknown. 'SymbioticExchange' strategically integrates transcriptomics, phosphoproteomics, metabolomics and protein-protein interaction analysis, with reverse genetics, cell biology and transport physiology to identify novel plant and fungal transporters involved in symbiotic nutrient and metabolite exchange, and to understand the molecular mechanisms of their regulation. 'SymbioticExchange' will thus deliver major advances on the range of transporters at the plant-fungal interface, the exchanged goods and the regulation of exchange. This important knowledge-base will provide crucial clues on how nutrient exchange can be tuned for profitable agricultural application of one of the most important symbioses on earth.

Link to the ERC project webpage:

Keywords of the ERC project: arbuscular mycorrhiza symbiosis, nutrient exchange, molecular mechanisms

Keywords that characterize the scientific profile of the potential visiting researcher/s: root symbiosis, molecular biology, biochemistry, cell biology

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Project ID:	Project Acronym:	Evaluation Panel:
101096163	**Glossi**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr An Martel**
Host Institution:	UNIVERSITEIT GENT - BEL

Targeting skin glycosylation patterns to protect threatened salamanders from disease driven extinction

Disease driven amphibian declines are frequently compared to the extinction of dinosaurs and have become an icon of the global biodiversity crisis. The deadly skin disease chytridiomycosis is causing the greatest recorded loss of biodiversity attributable to a disease. The recently introduced chytrid fungus Batrachochytrium salamandrivorans (Bsal) is expanding its range in Europe, remains unmitigated and thus poses an imminent threat to western Palearctic urodele (= salamanders and newts) diversity. While hypersusceptible species invariably die after exposure, other species show a much more variable, individual and dose dependent response, ranging from self-limiting infections with self-cure to lethal disease. My group recently discovered that host susceptibility correlates with the skin glycosylation pattern of salamanders, with cutaneous galactose content predicting variation in intensity of Bsal colonization. The variability of the skin glycosylation pattern offers a unique opportunity for marker directed selection of disease resistant salamanders. The overarching hypothesis of GLOSSI (Glycosylation in Salamander Skin Infection) is that variability of hereditary glycosylation patterns in the salamander skin underpins differential Bsal colonization and allows the selection of colonization resistant host lineages. To study the contribution of skin glycosylation patterns towards the development of salamander resistance against the Bsal epidemic, GLOSSI will combine laboratory and field trials to study 1) the temporal dynamics and heritability of glycosylation patterns and associated susceptibility to Bsal infection in urodeles, 2) the potential of natural selection towards increased resistance in infected, natural urodele populations and its impact on population dynamics, 3) the host genetics that underpin the epidermal glycosylation pattern and implications for disease resistance. GLOSSI will lead to novel strategies for curbing disease driven loss of biodiversity.

Link to the ERC project webpage:

Keywords of the ERC project: amphibian - chytrid - fungus - glycoprotein - skin

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101123888	**SCRIBE**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Marc Guell**
Host Institution:	UNIVERSIDAD POMPEU FABRA - ESP

RNA-based gene writing in human cells

CRISPR development has enormously accelerated genetic engineering principles, and precise methods to modify small alleles (such as base or prime editing) are now available. However, generating large genomic changes still presents enormous challenges. Large modifications, such as gene transfers, are performed generally with viral vectors, which have been associated with toxicities in the clinic, and often lack versatility needed for basic science experimentation. Newer CRISPR-based techniques for gene transfer suffer from significant efficacy and safety problems when used for large message writing. The overall goal of SCRIBE is to create new strategies for gene writing and define their molecular principles. These new writers will use RNA to both encode and transfer the message. The SCRIBE strategies will take advantage of the retrotransposon capacity for writing genes from RNA, and the precision of CRISPR in addressing specific sites of the genome. Thus, the “find” function will be dominated by CRISPR components, and “copy-paste” activity will be executed by retroelement components. To develop and optimize such a technology, we will use evolutionary analysis to select those retroelements with the highest activity and orthogonality, and modulate their message writing capacity by engineering their components. We will test various CRISPR and retrotransposon combinations, and adapt both of them to converge into a unified molecular machine. We will use artificial intelligence applied to protein design and a novel concept of synthetically oriented evolution to accelerate emergence of the new function. Finally, we will deploy new gene writing principles for RNA-based in vivo gene delivery. In sum, we will develop a new family of tools for engineering life. The real breakthrough will be the establishment of gene writing as a simple and general method for both research advancement and applied purposes.

Link to the ERC project webpage: synbio.upf.edu

Keywords of the ERC project: synthetic biology, CRISPR, RNA, gene writing

Keywords that characterize the scientific profile of the potential visiting researcher/s: protein design, AI, genetic engineering

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Project ID:	Project Acronym:	Evaluation Panel:
101125746	**GENESYS**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Kaspar Valgepea**
Host Institution:	TARTU ULIKOOL - EST

Next-generation engineering of gas-fermenting cell factories through large-scale systems-level maps

Gas fermentation provides a unique opportunity for the circular bioeconomy by enabling carbon recycling from gaseous waste feedstocks into value-added bioproducts using microbes. Acetogens are ideal biocatalysts for gas fermentation as they use gas (CO and/or CO2+H2) as their sole carbon and energy source, evidenced by the commercialisation of the waste gas-to-ethanol conversion process. Despite recent efforts, our understanding of genotype-phenotype relationships in acetogens is still minimal. This, however, is required for rational metabolic engineering and expanding the product spectrum of acetogens to unlock their full potential. GENESYS aims to engineer superior gas-fermenting cell factories through revolutionising systems-level understanding of acetogens and pioneering a new workflow for making large-scale arrayed CRISPR-engineered microbial strain libraries. First, essential genes for autotrophy of the model acetogen Clostridium autoethanogenum will be determined using a genome-wide CRISPRi screen. We then create ~750 single-gene knock-down strains of essential genes, transcription factors, and proteome "dark matter" using a novel "pooled-to-arrayed" workflow combining synthetic biology, automation, and DNA sequencing. Next, we will generate systems-level phenotype maps for up to ~750 strains through high-throughput gas fermentation and –omics analyses. Big data will be translated into a systems-level acetogen knowledgebase–A-BASE–through integrated bioinformatics and machine learning, metabolic modelling, and data engineering. Finally, we apply A-BASE to engineer acetogen cell factories from the "unexplored territories" of essential genes, transcription factors, and proteome "dark matter" for improving production of ethanol and acetone. This project will create superior gas-fermenting cell factories, advance fundamental understanding of acetogen metabolism, and pioneer a new workflow for creating large-scale arrayed engineered microbial strain libraries.

Link to the ERC project webpage: https://valgepealab.com/

Keywords of the ERC project: gas fermentation, microbial engineering, systems biology, synthetic biology,

Keywords that characterize the scientific profile of the potential visiting researcher/s: Computational biologist, machine learning, data mining, database engineering

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Project ID:	Project Acronym:	Evaluation Panel:
101126019	**PLANTEX**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Panagiotis Moschou**
Host Institution:	IDRYMA TECHNOLOGIAS KAI EREVNAS - GRC

Limited proteolysis mechanisms in plants for selective protein translation to improve heat tolerance

Heat waves threaten agriculture in the EU and worldwide. Exactly how we can protect our crops precisely and rapidly from heat is a lingering question with important implications for future food security. My aim with PLANTEX is to explore the potential of a rapid stress response that my lab has discovered and incorporate this knowledge into the design of new breeding strategies to improve crops. To bolster heat tolerance, I propose an innovative approach for the control of protein production networks by repurposing proteolytic pathways that control the dynamics of organelle-like assemblies known as condensates. My lab pioneers the study of proteolysis on the formation of condensates with unique properties that allow them to store functionally related proteins and RNAs. I dubbed the networks in these condensates that we discovered “coregulons”. These coregulons are responsible for undocumented rapid and synchronized stress responses, for example during heat, that depend on proteolysis. I hypothesize that the discovered condensates ensure an unappreciated rapid response to stress that is important for plant acclimation and that this knowledge can be exploited to engineer desirable traits in crops. In this project, I propose 1) to use our approaches to collect an extensive dataset of coregulons important for growth and environmental adaptation in the model organism Arabidopsis and the agricultural-relevant crop tomato, 2) to characterize novel mechanisms involving proteolysis of coregulons by refining and developing new approaches of protease-substrate capture, and 3) design and implement innovative strategies based on cutting-edge genetic approaches to improve the tolerance of tomato to heat waves. My objectives are ambitious but potentially game-changing by providing approaches that can help combat the escalating problem of food security and for our comprehension of how plants adapt to dynamic environments.

Link to the ERC project webpage:

Keywords of the ERC project: condenses; plant biology; climate change

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101162607	**REVEAL**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Anja Lena Thiebes**
Host Institution:	UNIVERSITAETSKLINIKUM AACHEN - DEU

Development of an Advanced Airway-On-A-Chip Model to Investigate Neuronal Hypersensitivity in Chronic Cough

Coughing is one of the most frequent reasons for physician appointments, and chronic coughing affects one in every 10 people in Europe. It has severe consequences on the patients' quality of life. Treatment options are limited. Because animal models do not accurately replicate the human disease, the underlying mechanisms that trigger the onset of chronic coughing remain unclear and several promising drug candidates have failed in clinical testing. Human in vitro models could overcome these hurdles if all relevant cell types are integrated. In the REVEAL project, we will develop a comprehensive airway in vitro model to gain insight into the mechanisms underlying the onset and manifestation of neuronal hypersensitivity in chronic cough. We will develop a novel airway-on-a-chip that replicates the complex architecture of human airway tissue with innervation, immunocompetence, differentiated epithelium, and perfusable vascularization using primary cells and iPSC-derived neurons. The novel chip will facilitate high-throughput experiments. Disease models will be created using cells from chronic cough patients followed by the induction of inflammation. We will investigate neuroimmune interactions that trigger neuronal hypersensitivity and use the chip for drug screening. The REVEAL model will help to reduce the burden of chronic cough by offering a better understanding of neuronal hypersensitivity in the airways. It will facilitate the development and testing of new drugs, offer a tool for personalized medicine, and provide a new approach methodology for risk assessment and toxicity testing. This will support the 3R principles, replacing and reducing animal testing in basic and applied research. The anticipated outcome of this project will also have an impact on other highly prevalent chronic airway diseases by providing a platform technology to study conditions such as asthma and chronic obstructive pulmonary disease (COPD), achieving a positive impact for many patients.

Link to the ERC project webpage:

Keywords of the ERC project: organ-on-chip, tissue engineering, IPSC, neurons

Keywords that characterize the scientific profile of the potential visiting researcher/s: microfluidics, control engineering, cell biology, molecular biology

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Project ID:	Project Acronym:	Evaluation Panel:
101170268	**TerpenCode**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Tomáš Pluskal**
Host Institution:	USTAV ORGANICKE CHEMIE A BIOCHEMIE, AV CR, V.V.I. - CZE

Decoding the Biochemistry of Terpene Synthases

Enzymes are biological catalysts indispensable for biotechnology. Conventional approaches to enzyme design and optimization, relying on biochemical intuition and combinatorial mutagenesis, have yielded significant success over decades. Building on these foundations, the TerpenCode project aims to instantly elucidate and engineer enzymatic reactions by designing a new generation of deep learning models that (1) incorporate biochemical principles as inductive biases and (2) model all intermediate biochemical transformations that occur sequentially in the active site of each enzyme. We will focus on terpene synthases, which produce the core hydrocarbon scaffolds of terpenoids, the largest and most diverse class of natural products. My group has already curated a comprehensive training dataset comprising thousands of terpene synthase reaction mechanisms. In Objective O1, we will develop deep learning models for predicting the substrates, products, and reaction mechanisms of terpene synthases directly from their amino acid sequences. In Objective O2, we propose to engineer a generative machine learning algorithm for designing new variants of terpene synthases with altered quantitative product distribution, adjusted product stereochemistry, or new reaction cascades that lead to novel terpene products. We will experimentally validate these models by yeast expression experiments, including complete chemical structure elucidation of the detected reaction products. Breakthrough progress on these objectives would be a key important step towards the holy grail of biotechnology: providing a computational prediction of the exact enzyme function from its amino acid sequence and instant de novo generation of new enzymes for catalyzing desired biochemical reactions for an important class of enzymes. Generalizing our solutions further to other classes of enzymes would enable sustainable biotechnological production of a broad spectrum of new-to-nature chemicals and bioactives.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101171156	**LIMITLESS**	**LS9** Biotechnology and Biosystems Engineering

Principal Investigator:	**Dr Emma Andersson**
Host Institution:	KAROLINSKA INSTITUTET - SWE

Direct in utero engineering of mouse models

Mouse models are a gold standard for life sciences research, spanning developmental biology, cancer studies, and pre-clinical testing, but they also have important limitations. Mouse colony maintenance is expensive, and the large colonies needed are ethically problematic. Approaches aiming for cell-type specific manipulations can be confounded by leaky promoters, off-target/unknown promoter expression, endogenous Cre sites, and Cre toxicity. Finally, mouse strains generated in different inbred genetic backgrounds yield confounding results when interbred, or necessitate extensive back-crossing, and again - large usage of mice. An alternative strategy to generate mouse models, circumventing these issues, is direly needed.

To solve this problem for the mouse nervous system, we previously developed neural plate targeting with in utero nano-injection (NEPTUNE). NEPTUNE targets 95% of cells in the brain, can recapitulate established mouse models, and can be used flexibly for cell-type specific manipulations.

In LIMITLESS, my lab will leverage our expertise in ultra-high titer viral production, developmental biology, and technology development to go beyond the state of the art and develop a technology for whole-embryo editing in utero. We will combine this technology with next generation single cell lineage tracing, to resolve the “family tree” of all cell types in developing embryos, providing both fundamental new knowledge and information that is leverageable for further development of the technique.

In sum, my lab will go develop a much-needed technology for whole embryo genetic manipulation, opening the door to limitless new types of experiments. Direct in utero whole-embryo gene editing would accelerate life sciences research, reduce the financial and ethical costs of animal work, and enable experiments currently beyond reach with existing technology.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101171156

Keywords of the ERC project: mouse embryonic lineage tracing

Keywords that characterize the scientific profile of the potential visiting researcher/s: bioinformatics, lineage tracing, mouse models, virus development

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Project ID:	Project Acronym:	Evaluation Panel:
101018153	**NEUROMORPH**	**PE1** Mathematics

Principal Investigator:	**Dr Ansgar Jüngel**
Host Institution:	TECHNISCHE UNIVERSITAET WIEN - AUT

Emerging Network Structures and Neuromorphic Applications

Network structures arise in many applications like for biological tissues, neuron systems, and nanoelectronic devices. Neuronal network structures are inspiring novel neuromorphic computer architectures, overcoming physical scaling limits in traditional hardware. The project NEUROMORPH focuses on the interplay of emerging structures in biological neuron systems and electronic circuit models. The problems we address are formulated in terms of nonlinear partial differential systems, including stochastic and nonlocal terms. Examples include transport through ion channels, chemotaxis-fluid systems, mean-field network models, and memristor networks. The aims of this mathematics-oriented project are to explore the structure of the multiscale systems, prove their well-posedness, and devise structure-preserving numerical methods. Mathematical challenges are coming from the cross-diffusion character, the coupling of different types of equations (partially diffusive, stochastic, algebraic), the nonstandard degeneracies of the equations, and the hierarchy of scales, ranging from the molecular to the cellular to the network level. To achieve these goals, we develop new tools by combining variants of the boundedness-by-entropy method, compensated compactness, stability theory, and stochastic analysis. We build on the expertise of the PI on semiconductor device modeling, theory of cross-diffusion systems, numerical analysis, and recent work on stochastic differential equations. Concepts from thermodynamics, cell biology, and electrical engineering will be condensed into innovative mathematical theories for cross-diffusion systems and multiscale models. The project culminates in the simulation of small bio-inspired neuromorphic circuits, where memristor devices model the behavior of synapses or ion channels and mimic neuronal connectivity. The combination of bio-physical and device-circuit models is expected to make a vital progress for the design of neuromorphic structures.

Link to the ERC project webpage: https://www.tuwien.at/mg/asc/juengel

Keywords of the ERC project: Memristors, semiconductor devices, diffusion systems, cell biology models, numerical structure preservation

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101086697	**LoCal**	**PE1** Mathematics

Principal Investigator:	**Dr Lauri Oksanen**
Host Institution:	HELSINGIN YLIOPISTO - FIN

Lorentzian Calderon problem: visibility and invisibility

This project addresses questions in the mathematical theory of inverse problems, a research field at the interface between pure and applied mathematics. The techniques that will be developed lie at the intersection of partial differential equations and geometry, with affinity to control theory and general relativity. The Lorentzian Calderon problem is central to the proposal. A physical interpretation of the problem asks us to recover a moving medium given data generated by acoustic waves probing the medium, and seen from the mathematical point of view, it is the simplest formulation of an inverse boundary value problem for a linear wave equation that is expressed in a generally covariant fashion. The project explores the geometric conditions under which the problem can be solved, that is, media that are visible to probing waves, as well as counterexamples violating such conditions, leading to invisibility. The Lorentzian Calderon problem is poorly understood in comparison to similar inverse problems for nonlinear wave equations. One of the guiding ideas in the project is to adapt techniques from the theory of these problems, developed recently by PI and others, to the Lorentzian Calderon problem. Another source of inspiration is the recent solution of the Lorentzian Calderon problem under curvature bounds by PI and his coauthors. The project develops a new approach to solve the Lorentzian Calderon problem, and this may also lead to a breakthrough in the resolution of the Riemannian version of the problem, often called the anisotropic Calderon problem. The latter problem has remained open for more than 30 years. In addition to being the hyperbolic analogue of this well-known problem, the Lorentzian Calderon problem can be viewed as a generalization of the even more classical inverse problem studied by Gelfand and Levitan in the 1950s.

Link to the ERC project webpage:

Keywords of the ERC project: inverse problems

Keywords that characterize the scientific profile of the potential visiting researcher/s: inverse problems

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Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101096251	**CoDeFeL**	**PE1** Mathematics

Principal Investigator:	**Dr Enrique Zuazua**
Host Institution:	FRIEDRICH-ALEXANDER-UNIVERSITAET ERLANGEN-NUERNBERG - DEU

Control for Deep and Federated Learning

Machine Learning (ML) is forging a new era in Applied Mathematics (AM), leading to innovative and powerful methods. But the need for theoretical guarantees generates challenging, fundamental, deep mathematical questions. This great challenge can be addressed from the perspective of other, more mature areas of AM. CoDeFeL seeks to do so from the rich interface between Control Theory (CT) and ML, contributing to the analytical foundations of ML methods, significantly enlarging, and updating the range of applications of CT. As our recent results show, classification, regression, and prediction problems in Supervised Learning (SL) and the Universal Approximation Theorem can be successfully recast as the simultaneous or ensemble controllability property of Residual Neural Networks (ResNets). Following this path, we will develop ResNets of minimal complexity and cost, addressing the deep, intricate issue of linking the structure of the data set to be classified with the dynamics of the networks trained. Taking the turnpike principle as our inspiration, we will build new simplified ResNet architectures. This, however, raises major challenges for the genuinely nonlinear dynamics that ResNets represent.Adjoint methods will also be developed and applied, to understand the sensitivity of ResNets, and proposing techniques for Adversarial Training and computing Saliency Maps, applicable in Unsupervised Learning. The project is strongly inspired on the challenges arising in relevant applications in digital medicine and internet recommendation systems, among other areas. Accordingly, we will also develop a body of rich, hybrid, cutting-edge methods for data-aware modelling, combining ResNet surrogate models and those inspired on Mechanics, with the aid of Model Predictive Control strategies. New Federated Learning methodologies with privacy preservation guarantees will also be developed. The computational counterparts will be brought together in a new CoDeFeL GitHub repository.

Link to the ERC project webpage: https://dcn.nat.fau.eu/codefel/

Keywords of the ERC project: control theory, PDEs, Deep Learning, Federal Learning

Keywords that characterize the scientific profile of the potential visiting researcher/s: Advanced Mathematical expertise, mathematically driven modelling, solid quantitative and analytical skills

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101116001	**COMSCAL**	**PE1** Mathematics

Principal Investigator:	**Dr Rudolf Zeidler**
Host Institution:	UNIVERSITAET POTSDAM - DEU

Comparison and rigidity for scalar curvature

Questions involving the scalar curvature bridge many areas inside mathematics including geometric analysis, differential geometry and algebraic topology, and they are naturally related to the mathematical description of general relativity. There are two main flavours of methods to probe the geometry of scalar curvature: One goes back to Lichnerowicz and uses various versions of index theory for the Dirac equation on spinors. The other is broadly based on minimal hypersurfaces and was initiated by Schoen and Yau. On both types of methods there has been tremendous progress over recent years sparked by novel quantitative comparison and rigidity questions due to Gromov and by on-going attempts to arrive at a deeper geometric understanding of lower scalar curvature bounds. In this proposal we view established landmark results, such as the non-existence of positive scalar curvature on the torus, together with the more recent quantitative problems from a conceptually unified standpoint, where a comparison principle for scalar and mean curvature along maps between Riemannian manifolds plays the central role. Guided by this point of view, we aim to develop fundamentally new tools to study scalar curvature that bridge long-standing gaps in between the existing techniques. This includes a far-reaching generalization of the Dirac operator approach expanding upon techniques pioneered by the PI, and novel applications of Bochner-type methods. We will also study analogous comparison problems on domains with singular boundary motivated by a first synthetic characterization of lower scalar curvature bounds in terms of polyhedral domains, and by the general quest for extending the study of scalar curvature beyond smooth manifolds. At the same time, we will treat subtle almost rigidity questions corresponding to the rigidity aspect of our comparison principle.

Link to the ERC project webpage: https://www.rzeidler.eu/comscal/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101116964	**SQGT**	**PE1** Mathematics

Principal Investigator:	**Dr Ilya Chevyrev**
Host Institution:	SCUOLA INTERNAZIONALE SUPERIORE DI STUDI AVANZATI DI TRIESTE - ITA

Stochastic quantum gauge theories

This proposal aims to solve central open problems in the mathematical foundation of quantum gauge theories (QGTs), an important challenge comprising the Yang-Mills (YM) Millennium Prize Problem. A key outcome of the proposal will be the first constructions in finite volume of 2- and 3-dimensional non-exactly solvable QGTs, with a view towards the physical case of 4 dimensions. The principal tools that will be developed and used to address these problems are in the field of rough analysis, in particular singular stochastic partial differential equations (SPDEs). Singular SPDEs appear widely in the study of dynamics with randomness and have seen revolutionary progress in the past decade. By developing new rough analytic methods applicable to QGTs, the proposal will push the frontiers of rough analysis, in particular studying discrete approximations of SPDEs, introducing novel geometric solution theories, and linking SPDEs with random matrix theory. My research has shown that the stochastic quantisation equations of YM (SYM) can be renormalised in a geometrically faithful way, which has already revealed new properties of the exactly solvable 2D YM measure. This is strong evidence that rough analytic techniques can bring new light to the study of QGTs and render their construction in 2D and 3D finally within reach. The proposal is split into the following three long-term projects. 1. Two-dimensional theories: solve and identify the invariant measure of SYM for non-trivial principal bundles; prove large N convergence of SYM; construct the non-Abelian YM-Higgs measure in finite volume. 2. Three-dimensional theories: give the first construction of the 3-dimensional YM measure in finite volume; prove a discrete version of the BPHZ renormalisation theorem in regularity structures. 3. Axiomatic quantum gauge theory: formulate and prove the Osterwalder-Schrader reconstruction theorem applicable to QGTs; prove Uhlenbeck's regularity theorem for distributions.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101116964

Keywords of the ERC project: Stochastic analysis, quantum field theory

Keywords that characterize the scientific profile of the potential visiting researcher/s: Stochastic analysis, rough path theory, quantum field theory, dynamical systems

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101141305	**ACME**	**PE1** Mathematics

Principal Investigator:	**Dr Stijn Vansteelandt**
Host Institution:	UNIVERSITEIT GENT - BEL

Assumption-Lean (Causal) Modelling and Estimation: A Paradigm Shift from Traditional Statistical Modelling

I propose a cutting-edge and transformative paradigm for statistical modelling that is crucial to enhance the quality of data analyses. Leveraging my expertise in causal inference and semiparametric statistics, I will establish the fundamental principles of a comprehensive estimation theory, which maps model parameters onto generic, interpretable, model-free estimands (e.g., association or effect measures) with favourable efficiency bound, and harnesses the power of debiased (statistical/machine) learning techniques to estimate these. My core objective is to develop a flexible and accessible data modelling framework, called 'assumption-lean modelling'. This framework will deliver minimal bias and maximal interpretability, even in the presence of model misspecification, along with honest confidence bounds that account for model uncertainty. Debiased learning is at the core of this research. While gaining popularity, a rigorous scientific optimality theory is lacking. I shall draw on my expertise in (bias-reduced) double robust estimation to develop optimal debiased learning estimators. These utilize learners that optimize strategically chosen loss functions to achieve low variance and high stability, along with confidence intervals that are valid under weak conditions on the learners. I will connect to timely, exciting developments in statistics, such as debiased learning of function-valued parameters and the construction of confidence bounds for such parameters. I will offer novel avenues into these problems by incorporating the assumption-lean modelling principles and connecting to real-world needs. I will develop assumption-lean modelling strategies to tackle significant challenges in causal modelling, including target trial emulation, causal mediation analysis, and statistical modelling of dependent outcomes. I will deliver methods with potential impact on all empirical sciences, as well as on the foundations of the discipline of statistical modelling.

Link to the ERC project webpage:

Keywords of the ERC project: causal inference, debiased machine learning, semiparametric statistics

Keywords that characterize the scientific profile of the potential visiting researcher/s: statistics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101141807	**acleanbrain**	**PE1** Mathematics

Principal Investigator:	**Dr Kent-Andre Mardal**
Host Institution:	SIMULA RESEARCH LABORATORY AS - NOR

Brain fluids - Transport and clearance

Scientific breakthroughs in neuroscience explain the need for sleep and the development of neurodegenerative diseases such as Alzheimer's and Parkinson's diseases in terms of fluid dynamics: the waste created during the day is cleared away as we sleep or it accumulates. However, a decade of research after the original theory was posed has revealed that the underlying physical mechanisms are still not understood and that the advanced mathematical tools are needed. In this project we propose a research program addressing 1) new fluid dynamics mechanisms, 2) novel numerical analysis for advanced multi-physics brain simulations, and 3) a framework for patient-specific simulations. We will exploit reduced order and machine learning methods in addition to finite element solutions. With successful delivery, the "aCleanBrain" will establish the main drivers of brain fluid dynamics, provide a foundation for accurate, efficient and robust algorithms for multi-physics problems and develop a software framework for advanced biomechanical brain simulations.

Link to the ERC project webpage:

Keywords of the ERC project: https://cordis.europa.eu/project/id/101141807

Keywords that characterize the scientific profile of the potential visiting researcher/s: applied mathematician, neuroscience computational modeller

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101142781	**Correspondence**	**PE1** Mathematics

Principal Investigator:	**Dr David Kazhdan**
Host Institution:	THE HEBREW UNIVERSITY OF JERUSALEM - ISR

The Langlands Correspondence

R. Langlands conjectured the existence of a correspondence between automorphic spectrums of Hecke algebras and representations of Galois groups of global fields. The existence of such correspondence is one of the main conjectures in mathematics. Even if not known in full generality it leads to proofs of Ferma and Sato-Tate conjectures. This project is on three aspects of the Langlands correspondence. The first part of this project is a description of the spectrum of Hecke algebras on the space generated by pseudo Eisenstein series of cuspidal automorphic forms of Levi subgroups. In the simplest non-trivial case, the precise description is a conjecture of Langlands. This conjecture is proven in my work with A. Okounkov, by an unexpected topological interpretation. I expect this approach to work in a number of other cases. The second part of this project is an extension of the Langlands correspondence to a completely new area of fields of rational functions on curves over local fields. This extension of the Langlands correspondence to a new area could lead to new interplays between Representation Theory and Number Theory. The third part of the project is on a categorification of the Langlands correspondence necessary for establishing the strong form of this correspondence.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
884715	**NECTAR**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Beatriz Jurado**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Nuclear rEaCTions At storage Rings

Obtaining reliable cross sections for neutron-induced reactions on unstable nuclei is a highly important task and a major challenge. These data are essential for nuclear astrophysics -since most of the heavy elements in the Universe are produced by neutron-induced reactions in stars- and for applications in nuclear technology. However, their measurement is very complicated as both projectile and target are radioactive. The most promising way to infer these cross sections is to use surrogate reactions in inverse kinematics, where the nucleus formed in the neutron-induced reaction of interest is produced by a reaction involving a radioactive heavy-ion beam and a stable, light target nucleus. The decay probabilities (for fission, neutron and gamma-ray emission) of the nucleus produced by the surrogate reaction provide precious information to constrain models and enable much more accurate predictions of the desired neutron cross sections. Yet, the use of surrogate reactions is hampered by the numerous long-standing target issues. I propose to solve them by combining surrogate reactions with the unique possibilities at ion storage rings. In a storage ring heavy radioactive ions revolve at high frequency passing repeatedly through an electron cooler, which will greatly improve the beam quality and restore it after each passage of the beam through the internal gas-jet serving as ultra-thin, windowless target. This way, decay probabilities can be measured with unrivaled accuracy. NECTAR aims to develop a detection system based on cutting-edge technology and a new method to measure accurate decay probabilities of radioactive nuclei at the CRYRING storage ring of the GSI/FAIR facility. The extreme vacuum conditions of the ring put severe constraints on the detection setup. I propose original, even revolutionary options to overcome these issues like the use of solar cells. Thus, NECTAR will be the seed of a new generation of nuclear-reaction experiments with unstable beams.

Link to the ERC project webpage: https://www.lp2ib.in2p3.fr/nucleaire/nex/erc-nectar/

Keywords of the ERC project: Experimental nuclear physics, nuclear reactions, heavy ion storage rings, particle detectors.

Keywords that characterize the scientific profile of the potential visiting researcher/s: Experimental nuclear physicist

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101041074	**SPINFIELD**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Romain Geneaux**
Host Institution:	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES - FRA

Controlling spin angular momentum with the field of light

Short pulses of light allow controlling electrons in solids with superb precision and outstanding speed, now reaching the sub-femtosecond timescale. Yet, our ability to act on the angular momentum of materials at these ultrafast time scales is surprisingly close to inexistent. This is because very little is known about direct, first-order coherent interactions between the electromagnetic field of light and angular momentum. Predictions show that these interactions are extraordinarily complex and comprise components of fundamentally different nature – originating from quantum many-body effects, relativistic quantum electrodynamics, or symmetry breaking. These coherent phenomena, however, have yet to be directly captured. The proposed research aims at unveiling this class of direct light-spin interactions for the first time. My strategy relies on the use of the shortest pulses of light available today – attosecond pulses – employed to probe systems which selectively enhance different components of the coherent response. We will establish spectroscopic schemes building upon mature state-of-the-art attosecond technology, providing clear-cut evidence of phenomena which are in the blind spot of current approaches. Two control scenarios will be explored – in the first one, ultrashort pulses will redistribute angular momentum among the system constituents, on sub-femtosecond timescales. In the second, the spin angular momentum of light pulses itself will be imparted to matter, thereby coherently controlling the magnetic and topological properties of materials. We aim to answer key fundamental questions reaching across several disciplines of physics. Because spin angular momentum in solids is intimately related to magnetism and topology, SPINFIELD will also provide a decisive blueprint guiding the design of a new generation of devices that can be optically controlled and switched at unrivaled speeds.

Link to the ERC project webpage:

Keywords of the ERC project: Attosecond, Magnetism, Ultrafast spectroscopy

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101042399	**QuESADILLA**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Tim Bartley**
Host Institution:	UNIVERSITAET PADERBORN - DEU

Quantum Engineering of Superconducting Array Detectors In Low-Light Applications

Optical measurements are fundamental to experimental science and observations of nature. At the single photon level, superconducting nanowire single-photon detectors (SNSPDs) are well-established as the gold standard in measurement, due to their near-unit efficiency, negligible noise and ultrafast response. Building SNSPD arrays and simultaneously extracting intensity, spectral and spatial resolution from a device at the single photon level will revolutionise astronomical measurements, spectrometry in chemistry and life sciences, and quantum imaging. Key to unlocking this potential is to marry concepts from detector tomography with robust high-yield detector fabrication, the integration of complementary optical technologies and low heat-load scalable readout schemes. QuESADILLA tackles these challenges head-on, with a series of experiments demonstrating the groundbreaking potential of quantum detector engineering. In contrast to engineering quantum states of light for metrology, QuESADILLA will shift that paradigm by engineering the quantum mechanical response of the detector itself. QuESADILLA introduces the concepts of a modal decomposition of the positive operator valued measure (POVM), and quantum-enhanced POVM engineering in low-light applications. To do so, arrays of SNSPDs in combination with lithographically-written etalons and dielectric coatings will be developed, in concert with state-of-the-art scalable approaches to large scale quantum tomography. QuESADILLA will exceed the state of the art in many areas: performing the first modal decomposition of detector tomography and the largest tomographic reconstruction of a quantum detector; the first demonstration of quantum detector engineering using nonclassical ancilla states; the first demonstration of etalon array reconstructive spectrometry with single photons; and exploit the fastest electronic shutter speed of any optical sensor to enable the highest dynamic range detection of continuous illumination.

Link to the ERC project webpage: https://physik.uni-paderborn.de/en/mesoscopic-quantum-optics/research

Keywords of the ERC project: Superconducting detectors; quantum photonics; cryogenic optoelectronics; detector characterisation

Keywords that characterize the scientific profile of the potential visiting researcher/s: Scientists at any career stage curious about developing and interfacing superconducting electronics, integrated photonics, and quantum optics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101055319	**SUPERSOLIDS**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Giovanni Modugno**
Host Institution:	UNIVERSITA DEGLI STUDI DI FIRENZE - ITA

Supersolids: unveiling an extraordinary quantum phase of matter

Supersolids are a paradoxical quantum phase of matter that combines the properties of superfluids and crystals, searched for long time in quantum solids and many other systems. Recently, we discovered a novel cluster phase in a quantum gas of magnetic atoms which realizes a supersolid. However, the limited size, the inhomogeneity, and the lack of appropriate detection methods have allowed so far to assess only very basic properties of supersolids. Here I propose an innovative density-phase microscope and original ideas that combine the best of matter-wave and condensed-matter methods to unveil the extraordinary properties of supersolids. With a two-layer superfluid-supersolid configuration we will measure both density and phase of the supersolid. With controllable optical potentials we will realize large, homogeneous crystal geometries in 1D and 2D. With high-resolution optical addressing we will manipulate locally the wavefunction, e. g. creating phase patterns or force fields, and we will follow the local dynamics. Our main goal is to explore fundamental properties that are largely unknown even theoretically: variable superfluid density under rotation; variable angular momentum of quantized vortices; dissipation-less deformation of the crystal; Josephson effect without barriers; quantum entanglement properties. We will also attempt the realization of new types of supersolid, to prove the generality of the phenomena: with coupled supersolid layers, we will move towards supersolidity in 3D; using a quasi-2D environment, we will attempt to realize two proposed types of strongly interacting and strongly correlated supersolids. Our work will establish connections between supersolids and other patterned quantum phases, such as pair-density waves in superconductors and in helium superfluids, intertwined phases in low-dimensional superfluids, and pasta phases in neutron stars. Our work might open directions for the realization of materials with novel functionalities.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101088193	**FAIM**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Marius De Leeuw**
Host Institution:	THE PROVOST, FELLOWS, FOUNDATION SCHOLARS & THE OTHER MEMBERS OF BOARD, OF THE COLLEGE OF THE HOLY & UNDIVIDED TRINITY OF QUEEN ELIZABETH NEAR DUBLIN - IRL

Finding All Integrable Models

Symmetry plays an important role in our current understanding of nature. For instance, in the development of the Standard Model of particle physics the understanding of the gauge group of symmetries was crucial. There is a class of models, called integrable systems, which have so many symmetries that they are exactly solvable. Such models have the exciting possibility to be understood in all aspects and thus give valuable insights into physical phenomena. In this way integrable models offer a unique approach to tackling open problems in physics, such as, for instance, describing strongly coupled systems. The aim of this proposal is to develop a new method to find and classify new integrable systems. Our approach is based on a new framework which was very recently put forward by the PI and his group. This new approach was applied to models that are closely related to regular integrable systems from string theory, quantum field theory and condensed matter physics. Several new models were discovered in this way but their physical and mathematical properties still remain to be understood. FAIM will be particularly focussed on models that have long-range interactions. These models are crucial in understanding strong coupling behaviour in for instance integrable models that appear in the AdS/CFT correspondence. Understanding long-range interactions is paramount to the computation of correlation functions in these models. Long-range interactions are also important for quantum systems in condensed matter such as cellular automatons. More generally, integrable structures appear in basically all areas of physics. For this reason, finding new integrable models and classifying them will have a large multidisciplinary impact, with exciting applications ranging from condensed matter to string theory. This will potentially help us understand physical phenomena in various different fields.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: Integrability

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101095857	**Conformal-EIC**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Sven-Olaf Moch**
Host Institution:	UNIVERSITY OF HAMBURG - DEU

From conformal symmetries and integrability to the Electron-Ion Collider

The primary goal of this research proposal is to lay the foundations for precision predictions for the physics program in deep-inelastic scattering (DIS) at the Electron-Ion-Collider (EIC). The commissioning of the EIC will open a new era in the exploration of the strong interaction physics and the hadron structure at an unprecedented level of detail. This is expected to lead, among other results, to the clarification of the proton spin puzzle. The crucial ingredient for the success of this undertaking is the ability to confront experimental data to precise predictions for a those benchmark processes, which will form a core part of the EIC physics program: inclusive lepton-hadron DIS, including polarized beams; DIS charm- or bottom-quark production; deeply-virtual Compton scattering in off-forward kinematics. Capitalizing on recent theoretical advances, driven to a significant extent by the work of the PI, this proposal outlines a challenging and ambitious program to advance quantum chromodynamics (QCD) perturbation theory in order to achieve a theoretical description of the key observables at the EIC at percent level precision. The proposal puts forward a novel research methodology based on the systematic use of conformal symmetry and integrability, as realized in gauge theories with extended supersymmetry, such as the N=4 supersymmetric Yang-Mills (SYM) theory to reveal structural information on QCD results. Observables in lepton-hadron DIS are particularly well suited to turn the connections between N=4 SYM theory and QCD into a powerful computational tool, which leads to significant simplifications due to the hidden symmetries underlying integrable systems. Progress in this direction will open new avenues for research and will establish new bridges between the scientific communities in phenomenology and mathematical physics. The new QCD results will be used in the course of the project to explore precision phenomenology at the EIC.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101115353	**INTREPID**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Santiago Folgueras**
Host Institution:	UNIVERSIDAD DE OVIEDO - ESP

INnovative TRiggEr techniques for beyond the standard model PhysIcs Discovery at the LHC

The discovery of the Higgs boson at the Large Hadron Collider (LHC) closes a central chapter of the standard model (SM) of particle physics while raising several questions, such as the nature of dark matter, an explanation to neutrino masses, or the origin of baryon asymmetry in the Universe. The answer to those questions could be linked to the production of beyond the SM (BSM) particles which may have long lifetimes, compared to SM particles at the weak scale. If these long-lived particles (LLPs) were to be produced at the LHC, they would yield non-standard signatures which require dedicated identification algorithms. A complex filtering (trigger) system running sophisticated algorithms allows to decide, in real time, whether a given event of interest should be saved for data analysis or discarded. The general goal of this proposal is to enhance the trigger capabilities to enable the discovery of LLPs and thus find evidence of BSM physics exploring innovative technologies that may be of use in future facilities. With several years before the start of the High-Luminosity LHC (HL-LHC), it is now the perfect time to explore alternative trigger architectures and technologies not considered in the plans of the collaboration and that could not be explored otherwise. To this end, I will use a multidisciplinary approach involving advanced Machine Learning techniques and top-of-the-line ultra-fast processing platforms to propose an innovative solution that will improve the capabilities of future trigger systems. The foreseen studies might be the only way in which LLPs can be discovered at the HL-LHC. Any manifestation of such particles will revolutionise the field of High Energy Physics and help to answer several fundamental questions regarding the energy scale and nature of the BSM physics. Beside progressing in the frontiers of science, the designed techniques can be of great use for industries requiring real-time processing of large data-volumes to extract features.

Link to the ERC project webpage: intrepid.uniovi.es

Keywords of the ERC project: LHC, FPGA, Trigger, LLPs

Keywords that characterize the scientific profile of the potential visiting researcher/s: Electronics, LLPs, FPGAs, LHC

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101124288	**CompleX**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Valentina Sola**
Host Institution:	UNIVERSITA DEGLI STUDI DI TORINO - ITA

Doping Compensation in Thin Silicon Sensors: the pathway to Extreme Radiation Environments

Silicon sensors have been extensively exploited in high-energy physics experiments in the past 40 years, from their first use in NA11 at the SPS (CERN) to their application in the present-day design of very large particle trackers. The capability of silicon sensors to work in environments with high radiation levels has been of utmost importance for experiments at accelerating machines with very energetic and intense particle beams. Presently available silicon sensors can operate efficiently up to particle fluences of 2E16/cm2, while future frontier accelerators envisage the use of silicon sensors in environments with fluences exceeding 5E17/cm2. If not overcome, this gap will prevent the use of silicon sensors in future hadron-collider experiments. CompleX aims at extending the range of operation of silicon detectors by more than one order of magnitude, up to a fluence of 5E17/cm2. The idea behind this unprecedented target in radiation tolerance relies on a novel understanding of the saturation of the radiation damage and on the advantages that compensated implants bring to radiation hardness. The application of these two breakthroughs to thin silicon sensors (20–40 microns) with an internal gain of 10–20 will allow the design of sensors able to operate up to the target fluence. I am the PI of three projects to develop silicon sensors for extreme fluences (eXFlu – INFN, eXFlu-innova – AIDAinnova, FLEX – UNITO), which represent preparatory developments for the CompleX proposal. In this context, I introduced the principle of doping compensation in silicon sensors to the detector community. My expertise in the design and testing of silicon sensors, my involvement in radiation hardness studies, and my experience in project coordination qualify me as a recognised expert in the development of sensors for extreme fluences and enable me, as PI, to target the CompleX goals.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101125670	**Beyond the visible**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Hanieh Fattahi**
Host Institution:	MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV - GRC

Super-resolution Field-Resolved Stimulated Raman Microscopy

The next generation of biological imaging will be a movement towards super-resolution, label-free approaches to visualize subcellular structures in a nonperturbative, non-invasive manner. In this proposal, a super-resolution, label-free, Raman microscope based on a novel, ambient-air, field-detector is envisioned to fulfil the requirements of these exciting prospects, essential for biomedical advancements. By employing bright, ultra-broadband, femtosecond electromagnetic forces at petahertz frequencies, Raman molecular vibrations are driven coherently and efficiently. Temporal confinement of the excitation pulses to a few femtoseconds allows for temporal filtering of the molecular response and therefore, a high signal-to-noise ratio, and high detection sensitivity is achieved. The same laser provides optical pulses with ultrashort duration to directly access and detects the field oscillations of the emitted Raman molecular response. This novel detection metrology allows for simultaneous and broadband detection of the entire molecular fingerprint and beyond with high dynamic range and sensitivity down to quantum shot noise. Most importantly, due to the near-field imaging in this scheme super-resolution, chemically sensitive images can be constructed without the need for labeling molecules or using structured light. The advanced near-infrared femtosecond source in combination with the novel field detection technology will enable acquiring the complete fingerprint of complex biological molecules non-invasively with a spatial resolution and sensitivity exceeding that of any previously demonstrated method, for the first time. The next generation of laser-driven biological microscopy requires a dramatic leap in sensitivity, dynamic range, spatial resolution, and non-invasiveness; this proposal represents a coherent, achievable approach to fulfilling this need opening up new horizons for fundamental studies in science to see beyond the visible.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101140677	**IC4Stars**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Robin Kaiser**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Intensity Correlations for Stars

The pioneering experiments of intensity correlations by Hanbury-Brown and Twiss more than 50 years ago not only allowed to measure the angular diameter of many bright stars, but it also motivated Roy Glauber to develop his quantum formalism of photon statistics. The advent of direct optical interferences of light collected by different telescopes developed in the beginning of the 70s, with superior performances in terms of signal to noise ratio and correspondingly reduced required observation time put an end to these first attempts of intensity correlation imaging for astrophysics. State of the art optical interference imaging is however limited by accessible baselines and the required mechanical precision for optical delay lines are limited in particular due to atmospheric fluctuations and at short wavelengths. In IC4Stars we will use modern photon counting techniques to perform quantum optics measurements and probe quantum systems in astrophysics. A first target will be a quantum degenerate Fermi gaz of electrons (a white dwarf) whose angular diameter is out of reach for direct optical imaging techniques. A second goal will be the search for quantum sources of radiation by looking for random lasing in astrophysics, to be detected by second order photon correlation.

Link to the ERC project webpage:

Keywords of the ERC project: Intensity correlations, Quantum Astrophysics, intensity interferometry, random lasin

Keywords that characterize the scientific profile of the potential visiting researcher/s: quantum optics experiments, intensity correlations, random lasing

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Project ID:	Project Acronym:	Evaluation Panel:
101163591	**SymQuaG**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Markus Dierigl**
Host Institution:	ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE - CHE

Symmetries in Quantum Gravity

Throughout the history of physics symmetries have played a pivotal role. In recent years our understanding of them has been revolutionized to include their action on extended, rather than point-like, operators, called generalized symmetries. So far, however, they have mainly been discussed in theories without gravity. In this project I will take on this important challenge and derive universal constraints on theories of quantum gravity with generalized symmetries. This combination of generalized symmetries and universal properties of gravitational systems allows to utilize the remarkable recent progress in both fields to provide insights into the hitherto unknown laws of quantum gravity, their manifestation in our Universe, and their implications at low energies. Applying these new laws to supersymmetric theories, I will show that all consistent low-energy supergravity theories necessarily have a string theory origin. I will further apply the constraints to restrict phenomenological models describing the dynamics of Nature. The key strategy of my proposal is to investigate the gauging and explicit breaking of generalized symmetries, required by the absence of global symmetries in quantum gravity. Gauging demands the absence of anomalies, which would break the symmetries via quantum effects. I will classify these for generalized symmetries including the presence of quantum gravity fluctuations of the underlying spacetime manifold. The breaking of symmetries requires the inclusion of new objects, whose structure, properties, and applications I will explore systematically. Both, the classification of these general anomalies as well as the classification of symmetry-breaking objects uses the mathematical formalism of bordism groups. Generalizing these to include localized degrees of freedom, SymQuaG uncovers a full web of novel anomalies in order to derive universal consistency constraints, which are then tested in the laboratory of string theory and beyond.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101164400	**MaglevHunt**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Gerard Higgins**
Host Institution:	OESTERREICHISCHE AKADEMIE DER WISSENSCHAFTEN - AUT

Hunting for Dark Matter using Magnetically-Levitated Superconductors

Magnetically-levitated superconductors have strong potential to revolutionise inertial sensing and magnetic field sensing. In this project I will develop levitated superconductor sensors with unprecedented sensitivities, and use an array of these sensors to search for well-motivated dark matter candidates in unexplored parameter regimes. The sensors will consist of gram-scale superconducting particles stably confined within anti-Helmholtz-like magnetic traps. I will precisely measure the motion of the levitated particles using superconducting quantum circuits. The particle motion will be highly isolated from unwanted effects of the surroundings, since the particles will levitate far from surfaces, in ultrahigh vacuum, at millikelvin temperatures, within nearly dissipationless traps. Passive and active vibration isolation will be used to mitigate vibrational noise, and magnetic shielding will diminish magnetic field noise. Furthermore, the sensor array will be configured to reject common noise. The mechanical sensors will be sensitive to oscillatory forces caused by axion-like particles, dark photons and vector B-L dark matter. Additionally, they will be sensitive to impulses caused by ultraheavy dark matter near the Planck mass. The primary focus of this project is to hunt these diverse dark matter candidates. This project will also establish the groundwork for future searches with this innovative platform. In the long term, levitated superconductor sensors hold the potential to search for dark matter through its gravitational interaction with ordinary matter. Such a search would be able to conclusively probe the existence of dark matter near the Planck mass.

Link to the ERC project webpage: https://www.darkmatterlab.eu/

Keywords of the ERC project: Mechanical sensors, Dark matter search, Levitated superconductors, Quantum sensing, Cryogenics

Keywords that characterize the scientific profile of the potential visiting researcher/s: Experimentalist

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101165230	**ETQO**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Ludovico Lami**
Host Institution:	SCUOLA NORMALE SUPERIORE - ITA

Entanglement Theory: a Quantum Odyssey, from the Generalised Quantum Stein's Lemma to Quantum Gravity

Quantum entanglement fuels the most important quantum information processing protocols and is central to modern physics. However, the most profound questions concerning its operational meaning remain unanswered. Most importantly, we do not know how efficiently mixed-state entanglement can be (i) manipulated or (ii) detected, (iii) whether it is possible to formulate a thermodynamical theory of entanglement revolving around a unique entropic measure, and finally (iv) how entanglement can be exploited to reveal quantum features of gravity in experiments with gravitationally interacting quantum systems. A single key statement connects all these questions, the Generalised Quantum Stein's Lemma (GQSL) from quantum hypothesis testing. I have however uncovered [Lami and Regula, Nature Physics 19, 184 (2023); BBGLPRT, Nature Physics, in press (2023)] a fatal flaw in the original proof of the GQSL, which is now regarded as one of the most important open problems in entanglement theory. This project addresses questions (i)-(iv) in a unified way through the GQSL. The road map includes five key objectives. (O1) Solve the GQSL with techniques from quantum Shannon theory. (O2) Expand its scope from entanglement to other quantum resources and from states to processes. (O3) Design new entanglement measures and use them to obtain tight constraints on entanglement manipulation. (O4) Determine the ultimate performances of quantum communication networks, and characterise entanglement in many-body systems. Finally, (O5) investigate quantum gravitational experiments systematically with the formalism of quantum hypothesis testing, formulating a complete proposal of a new type of `dynamical' quantum gravitational experiment. Thanks to my strong track record in quantum information theory, entanglement theory, and their applications to fundamental physics problems, I am in an ideal position to complete this project, whose goal is to build new bridges connecting these three key areas.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101165230

Keywords of the ERC project: quantum entanglement, quantum resource theories, information theory, quantum Shannon theory, quantum hypothesis testing, generalised quantum Stein's lemma, quantum magic, quantum gravity

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101165667	**QuSiGauge**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Jad Halimeh**
Host Institution:	LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN - DEU

Quantum simulation of far-from-equilibrium gauge theories

Gauge theories (GT) are the staple of the Standard Model, and their far-from-equilibrium dynamics opens a window into the most fundamental questions of high-energy physics (HEP) and the nature of equilibration in isolated quantum many-body systems. However, this dynamics is often highly nonperturbative and difficult to probe using classical methods due to entanglement buildup. Through quantum advantage and tunability, quantum simulators (QS) emerge as a particularly suitable venue to solve this problem.

QuSiGauge hinges on developing an overarching framework composed of two main interconnected pillars: a technological one focused on designing robust tunable experimentally feasible QS of GT, and a phenomenological one concerned with a rigorous formulation of far-from-equilibrium quantum criticality and equilibration in isolated many-body models. The project will focus on the quantum simulation of (non-)Abelian GT, qudit quantum computing for HEP, non-ergodic dynamics of GT, and extracting far-from-equilibrium quantum critical exponents from dynamical phase transitions in GT. The approach is organized such that it provides both basic intuition and formal understanding, while emphasizing quantitative predictions accessible to state-of-the-art and near-term QS.

QuSiGauge will pave at least two solid paths to uncover new physics: (1) It will provide a toolbox for probing engineered exotic GT and gauge-noninvariant dynamics not easily accessible to particle colliders, yielding tunable platforms for investigating the equilibration of controlled isolated many-body models. (2) It will advance QS towards the holy grail of making them a reliable complementary venue for exploring collider-relevant physics. QuSiGauge will be of immediate impact to current cold-atom and ion-trap experiments, which are approaching quantum advantage, and will reach far beyond its immediate field, eliciting strong connections between condensed matter, HEP, and quantum simulation/computing.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101170019	**HyperSense**	**PE2** Fundamental Constituents of Matter

Principal Investigator:	**Dr Mikkel Brydegaard**
Host Institution:	LUNDS UNIVERSITET - SWE

REMOTE MICROSCOPY, NANOSCOPY AND PICOSCOPY BY HYPERSPECTRAL LIDAR

HyperSense will spearhead hyperspectral lidars expanded to exotic spectral regions outside the imaginable by lidar community, and demonstrate stand-off biosensing beyond what can be resolved by existing methods by employing plasma and supercontinuum light sources. Leveraging my patented hyperspectral Scheimpflug lidar concept, adding an uncontested number of spectral bands, spatio-temporal resolution and sensitivity, We will reveal aspects of our biosphere inaccessible by existing lidars. Active remote sensing of our biosphere uncovers details that cannot be resolved in space and time by sunlight, e.g. protein absorbance shielded by the ozone layer, life in dark ocean depths, narrow oxygen lines in a breath or nocturnal movements of disease vectors. Lidar constitute an efficient measurement technique where the same light transilluminates a volume until it interacts with the sample and simultaneously reports range and backscatter quantitatively, whereas hyperspectral lidar also provide microscopic absorption pathlengths, nano-features on biological surfaces, and deformations of electron shells on the picometer scale. HyperSense will explode multiple boundaries of current lidar, demonstrate and revolutionize biomonitoring, by my inexpensive, robust, compact and portable Scheimpflug method. HyperSense comprise 4 novel hyperspectral lidars with short, long, narrow and broad spectral coverage, applied to 8 biological challenges, showcasing light-biology interactions on the micro, nano and picoscopic level: A) DUV lidar (220-440 nm) Biomolecules specificity for classification of pollen and lichen B) Aquatic lidar (400-800 nm) Profile plankton biodiversity using both oscillatory and spectral properties C) Hires NIR lidar (760-762 nm) Resolving O2 and temperature in breath to understand host seeking and hill-topping in insects D) SWIR lidar (900-2500 nm) Quantify the surface nanostructures, internal tissue microstructure and molecular composition of vegetation and aerofauna

Link to the ERC project webpage: www.mbrydegaard.com

Keywords of the ERC project: lidar, spectroscopy, biophotonics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
866236	**SEE_QPT**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Beena Kalisky**
Host Institution:	BAR ILAN UNIVERSITY - ISR

Imaging phase transitions in quantum materials

Strongly interacting electron systems lead to a wealth of competing phases, phase transitions, and quantum critical points. When probed globally, the inherent inhomogeneities, disorder, localization, and mixture with other phases can be a stumbling block in detecting and controlling the various electronic states. Armed with a suitable local probe, however, spatial inhomogeneities turn from a concealing factor into the key to unveil new exotic electronic phases. Our unique tool, the scanning SQUID, is the most suitable probe, as it provides both extremely high magnetic sensitivity - capable of detecting trace amounts of conductivity, superconductivity and magnetism - with a high spatial resolution. We will integrate our state-of-the-art sensor with a set of tuning knobs, to enable simultaneous manipulation and imaging of quantum phase transitions. Our key goal is to provide clear-cut evidence for elusive many-body states that are in the blind spot of global measurements. We will detect hidden phases, such as traces of superconducting islands in an insulator, puddles of strongly correlated electrons at the onset of metallicity, and protected states in topological phases. The spatial distribution of states and disorder-related inhomogeneities will serve as the main tool in our quest. We will elucidate the correlations between emergent states that show non-trivial coexistence, such as magnetism and superconductivity, conductivity in a ferroelectric medium and itinerant ferromagnetism. We will provide clues about the mechanisms that drive fundamental transitions, such as the metal-insulator and the superconductor-insulator transitions. We will track phases and fluctuations near quantum criticality, and use the local information to bridge the gap between the microscopic behavior and the thermodynamic limit, where critical phenomena emerge. We aim to explore fundamental questions like the universality of transitions and assist the development of quantum materials.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101039098	**QUANTWIST**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Thore Posske**
Host Institution:	UNIVERSITY OF HAMBURG - DEU

Enhanced quantum resilience through twists

Quantum technology will revolutionize information transmission, processing, and sensing with unprecedented potential for science, economy, and the society as a whole. Yet, the strong sensitivity of quantum systems to unavoidable environmental noise impedes quantum technological breakthroughs. Here, we propose to twist coupled elemental quantum systems such that they form a global, robust quantum state that is resilient against environmental perturbations. For instance, in magnetic spin chains, fixing the magnetization at one end while rotating the magnetization at the other end can result in stable quantum helices. Such quantum twists cannot easily be unwound: They exhibit topological protection. We want to explore the full potential of this concept and extend it to higher-dimensional twists including vortices and skyrmions, see Fig. (1). The main objectives of this project are to (1) theoretically describe quantum twists in chains and arrays of atoms; (2) identify concrete realizations in cold atoms and solid state systems; (3) supply a general theory for quantum twists and connect it to topological models in high-energy physics; (4) designing and implementing an on-top error-reduction scheme for quantum information processing. The presented approach is unrelated to known quantum-mechanical topological approaches in electronic and magnetic systems that rely on momentum space, adiabatic manipulations, or globally indistinguishable quantum states. Quantum twists can serve as a topological source of entanglement, quantum energy storage, and establish an independent and versatile noise-protection mechanism for future quantum devices.

Link to the ERC project webpage: www.posske.de

Keywords of the ERC project: topological quantum spin systems, quantum spins, quantum spin graphs, quantum spin graphs, large degeneracy, winding numbers

Keywords that characterize the scientific profile of the potential visiting researcher/s: topological quantum spin systems, quantum spins, quantum spin graphs, quantum spin graphs, large degeneracy, winding numbers, topological superconductors, Yu-Shiba-Rusonov states, YSR states, Majorana zero modes

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Project ID:	Project Acronym:	Evaluation Panel:
101042349	**NANOWHYR**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Marta De Luca**
Host Institution:	UNIVERSITA DEGLI STUDI DI ROMA LA SAPIENZA - ITA

Dots-in-NANOWires by near-field illumination: novel single-photon sources for HYbRid quantum photonic circuits

Quantum photonic integrated circuits are ideal platforms for quantum computation and communication. A long-standing issue in their realization is the lack of a deterministic quantum light source compatible with silicon. Indeed, planar self-assembled III-V quantum dots (QDs) –which provide high-performance quantum light sources (i. e. single photons)– can hardly be grown on Si, and also lack the positioning control necessary for efficient post-growth III-V-on-Si hybrid integration.

Nanowires (NWs), in contrast, are rod-shaped nanoscale semiconductors that can host intrinsically site-controlled III-V QDs and can even be grown on Si. However, QDs in NWs have yet to reach the performances of planar QDs, an issue that could be overcome by integrating QDs in NWs in photonic cavities. Such a solution is, at present, out of reach, because conventional creation of QDs during NW growth hinders their successful integration with cavities.

The NANOWHYR project will allow the integration of QDs in NWs with cavities by realizing an unprecedented post-growth creation of QDs inside NWs. The new method consists of the incorporation of hydrogen in III-V nitride NWs whose bandgap can be controllably modified by hydrogen. Subsequent hydrogen removal by scanning near-field illumination will permit tuning the bandgap of the NW in a nanoscale region. This will allow us to form a QD in that region with a widely tunable energy. The deterministic control of the QD position and energy is the key that will enable us to efficiently integrate the QD with: A) planar photonic cavities fabricated on Si and B) vertical NW cavities grown on Si. This will lead to the breakthrough of a site-controlled, electrically-driven, telecom-friendly single photon source in Si photonic circuits.

Moreover, this new strategy permits the modulation of semiconductor properties at the nanoscale, and it is thus expected to open new grounds in other research areas, such as photovoltaics and thermal energy converters.

Link to the ERC project webpage: www.nanospectroscopylab.com

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101077402	**DYNAMHEAT**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Guillaume Nataf**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Ferroic Materials for Dynamic Heat Flow Control

Tackling climate change is one of the most pressing challenges of our modern society and requires researching new refrigeration and renewable energy systems. Performances of all these systems could be significantly improved if they were combined with solid-state thermal switches and diodes. Current strategies that require to nanostructure materials or to operate in the vicinity of a phase transition, lead to thermal switches or thermal diodes with low efficiencies or not suitable for applications where space is limited. Furthermore, once designed, thermal properties of these elements are set and cannot be modified.

My objective is to investigate a fundamentally new mechanism to design compact and efficient thermal switches and diodes. My strategy exploits, in ferroelectric and ferroelastic oxides, the interactions between phonons and spontaneously occurring planar defects known as domain walls. Domain walls can be easily generated, moved, and oriented by application of a small voltage or a small uniaxial pressure, and interact with phonons as defects do. They are thus perfect interfaces to achieve large and reconfigurable anisotropies in thermal conductivities in controlled directions in a fast and reversible way.

In this ambitious project, I develop a novel approach to demonstrate a dynamic heat flow control through (i) the reversible engineering of the density of domain walls in desired directions, and (ii) the development of advanced experimental techniques for in-operando thermal characterizations. My multidisciplinary strategy will unravel the interactions between phonons and domain walls to reach higher thermal conductivity variations, and lead to ground-breaking thermal switches and diodes. These thermal switches and diodes will be compatible with a large range of devices and have an impact in many fields critical for our transition toward a sustainable future (e.g. solid-state refrigeration, solar panels, thermoelectric devices).

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101087096	**SUPERLAND**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Annica Black-Schaffer**
Host Institution:	UPPSALA UNIVERSITET - SWE

A new SUPERconducting LANDscape: using nanoscale inhomogeneity for enhanced superconductivity

Superconductivity is a truly quantum mechanical phenomenon, strongly dependent on the zero-energy density of states (DOS). This project aims to create and enhance superconductivity using nanoscale inhomogeneity to produce large DOS peaks at zero energy, thereby creating an entirely new, spatial and figurative, landscape for superconductivity. One recent example is twisted bilayer graphene, an all-carbon material that becomes superconducting due to a moiré structure producing large zero-energy DOS peaks. In this project we will establish superconductivity driven entirely by nanoscale inhomogeneity generating zero-energy DOS peaks, including in moiré structures. We will also use zero-energy DOS peaks to create a superconducting phase crystal in many different superconductors, generalizing findings from high-temperature cuprate superconductor surfaces. In the project we will continue to develop our state-of-the-art computational tools to self-consistently study superconductivity in large inhomogeneous systems at the atomistic level.

Link to the ERC project webpage: https://materials-theory.physics.uu.se/black-schaffer/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101087829	**Twistrain**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Peter Makk**
Host Institution:	BUDAPESTI MUSZAKI ES GAZDASAGTUDOMANYI EGYETEM - HUN

Straintronic control of correlations in twisted van der Waals heterostructures

Correlations and topology are the cornerstones of modern condensed matter physics, and their coexistence is believed to lead to novel quantum electronic devices with built-in information protection. In the landmark discoveries of previous years it has been found that in 2D materials placed on top of each other at a magic rotation angle, correlated phases appear. In contrast to high-Tc materials, in twisted van der Waals materials correlation effects are coupled with topology and thanks to their gate tuneability the exploration of their phase diagram takes only days instead of years. This has led to the discovery of a multitude of correlated phases including correlated insulators, orbital magnetic, non-conventional superconducting and ferroelectric phases, etc. Despite the immense interest, the understanding of their behaviour at the microscopic level is limited, which calls for further experiments and novel experimental tools. In this project we will implement techniques that are radically new in this field: hydrostatic pressure and mechanical strain to uncover the ground state properties of twisted graphene and transition metal dichalcogenide heterostructures. Since the interlayer coupling plays the dominant role, changing the distance of the layers with hydrostatic pressure has a dramatic effect on the band structure and the correlated phases that emerge. The symmetries of the system can be deterministically broken by strain patterns applied in-situ. This very timely project will lead to several breakthroughs including a) revealing the ground state of twisted bilayer graphene at different filling factors from the large set of competing phases, b) in-situ engineering of the topology of these systems, or c) tuning quantum phase transition between non-Fermi liquid phases. The highly challenging research concept relies on my unique background in sample fabrication, quantum transport under strain and pressure, and studies on correlated and topological systems.

Link to the ERC project webpage: https://nanoelectronics.physics.bme.hu/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101088169	**NanoRecycle**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Janine Splettstoesser**
Host Institution:	CHALMERS TEKNISKA HOGSKOLA AB - SWE

On-chip waste recovery in quantum and nanoscale devices guided by novel performance quantifiers

Quantum and nanoscale technologies promise to revolutionise computing, sensing, information and communication applications. However, they are missing a dedicated effort towards energy sustainability exploiting their characteristic properties.

The theoretical project NanoRecycle addresses this important outstanding problem, by developing schemes for on-chip recovery of waste that typical device operations leave behind: in classical devices, this waste is often dissipated heat, but waste in nanoscale and quantum devices has characteristic nonthermal, fluctuating, and quantum properties. The scope of NanoRecycle is to develop processes converting this waste to electrical power or other resources that are useful for further on-chip tasks. The analysis will be based on sufficiently generic setups to capture the characteristic waste properties, that are at the same time typical elements of current quantum and nanotechnologies and are concretely connected to feasible, state-of-the-art experiments. This involves multi-terminal electronic conductors, but also hybrid devices coupling to microwave resonators.

To guide the design, analysis, and optimisation of on-chip waste-recovery, my team and I will first capture and quantify the characteristic properties of the various types of waste and then put in place comprehensive performance quantifiers for the efficiency of dedicated conversion processes. An important performance goal of such a conversion in small-scale devices, which we will also account for in our performance analysis, is the output power precision (namely the suppression of power fluctuations), crucial for further on-chip use.

While the power obtained from this waste recovery is expected to be small, its potential for contributing to energy-sustainable processes lies in the availability on-chip for further use, thereby circumventing high-loss attenuation procedures, which occur when bringing large classical fields down to the chip.

Link to the ERC project webpage: https://sites.google.com/site/splettchalmers/research-group

Keywords of the ERC project: quantum thermodynamics, quantum transport, noise

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101088426	**FemtoPix**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Filipe Maia**
Host Institution:	UPPSALA UNIVERSITET - SWE

Imaging Ultrafast Single Particle Macromolecular Dynamics with X-ray Lasers

Conformational dynamics are crucial for the functioning of most macromolecules and a deeper understanding of these motions holds great promise for future discoveries in biology. But it is difficult to probe the structure of macromolecules away from their most stable conformations, and time-resolved studies remain limited by the available techniques. Today a new generation of XFELs is growing. The extremely short pulse duration, high pulse intensity and repetition rate of these lasers offer new research opportunities in physics, chemistry, and biology. Since the first XFELs were proposed, the idea of obtaining images of individual proteins frozen in time has fascinated and inspired many, and we have been at the forefront of this quest. The combination of advances in XFEL technology with ESI has brought the dream of imaging hydrated single proteins by X-ray diffraction within reach. Currently time-resolved studies in solution in the sub-ms range are done through solution X-ray scattering or spectroscopic methods, but they can only provide limited structural information. XFELs provide a way to dramatically improve our understanding of these time-scales. This proposal aims to develop the science and technology to make ultrafast single-protein imaging a reality, through a three-step approach: (I) develop diagnostics suitable for nanosized samples, (II) enable single protein X-ray diffraction imaging through new sample delivery instrumentation, (III) perform time-resolved single protein imaging experiments using the unexplored tender X-ray energy range. Ultrafast imaging of macromolecules will reveal new horizons. As a single-molecule method with high time-resolution, it enables imaging the structural changes associated with fundamental processes such as enzyme catalysis, allosteric signal transduction or even protein folding. It also opens a way to record molecular movies and mapping the conformational landscape of isolated macromolecules for the first time.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101117424	**ChiralTopMat**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Niels Schröter**
Host Institution:	MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV - DEU

Spin-momentum locking and correlated phenomena in chiral topological materials

Chiral topological semimetals are a new class of quantum materials at the intersection of structural and electronic chirality. We discovered the first example of this material class three years ago and have since demonstrated that they host new fermionic quasiparticles without analogue in high-energy physics, which carry large and controllable topological charges. ChiralTopMat will go beyond these initial works and aims to discover new extraordinary properties that have only been predicted for these materials but for which experimental evidence remains elusive: 1) A new form of isotropic parallel spin-momentum locking that can be considered the natural counterpart of Rashba spin-orbit coupling, 2) new electronic phases that are both correlated and topological, and 3) interface effects with magnetic materials that could be exploited for new energy-efficient information technology applications. We will achieve these research goals by employing spin- and angle-resolved photoelectron spectroscopy on various energy scales, probing these materials' surface, bulk, and interface electronic structures. Whilst the proposed experiments are challenging, our prior work and recent preliminary results have demonstrated their feasibility. If successful, ChiralTopMat will build on these discoveries to search for structure-property relationships that can be used to control these new phenomena by chemical and structural modification. We envision that this new understanding will be the basis for future devices that exploit chiral topological semimetals for energy-efficient magnetic memory devices, which use multifold fermions for field-free switching of magnets with perpendicular magnetic anisotropy.

Link to the ERC project webpage: www.schroeterlab.org

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101124492	**CAVMAT**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Michael Sentef**
Host Institution:	UNIVERSITAET BREMEN - DEU

Cavity quantum materials

Light-matter coupling has the potential to modify functional properties of quantum materials to yield the tunability required for quantum-technological applications. However, light-matter control concepts, such as Floquet engineering and light-induced phase transitions, suffer from the requirement of strong laser driving and the lack of coherence on long time scales. Overcoming these key limitations through advancing the infant field of cavity quantum materials is the central objective of CAVMAT. The main hypothesis behind CAVMAT is that cavity materials engineering combines the efficiency of strong-light matter coupling in cavities with the flexibility of Floquet engineering of macroscopic quantum many-body phenomena. CAVMAT aims to explore and expand this new frontier with a combined theoretical-computational effort. The three key objectives of CAVMAT are: (i) To establish cavity-driving schemes that successfully bridge the gap between quantum cavity and semiclassical many-photon Floquet limits. (ii) To propose realistic cavity quantum materials platforms providing guidance for next-generation experiments. (iii) To develop and combine numerical methods that can treat the relevant nonequilibrium electron-polariton problems at short and long time scales. These objectives will be tackled in three work packages, namely WP 1: quantum Floquet engineering, WP 2: plasmonic superconductivity, and WP 3: excited states by design. The proposed work goes well beyond state-of-the-art in both nonequilibrium quantum many-body systems and quantum optics, and its success will be groundbreaking through providing microscopic underpinnings for pathways towards versatile solid-state platforms for cavity and Floquet physics.

Link to the ERC project webpage: https://www.uni-bremen.de/en/lmcqm/cavmat

Keywords of the ERC project: Cavity quantum materials, ultrafast science, theory of nonequilibrium dynamics, polaritonic quantum matter

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101142136	**Quantum Algorithms**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Emanuel Gull**
Host Institution:	UNIWERSYTET WARSZAWSKI - POL

Predictive algorithms for simulating quantum materials

This project seeks to advance the field of predictive algorithms for quantum many-body systems by developing a next-generation numerical toolset. The project will focus on combining field-theory based methods for both perturbative and non-perturbative ab-initio and model systems with innovations in tensor techniques, quantum Monte Carlo, machine learning, and numerical analysis. By utilizing these innovative methods, we aim to deepen our understanding of quantum phases and exotic properties of materials, focusing in particular on experimentally measurable quantities. Currently, accurate methods for studying correlated quantum materials and their excitations are lacking. Established technology either employs the so-called density functional theory, which relies on uncontrolled approximations to electron correlations and may be imprecise for systems with partially filled d- or f-shells, or proceeds by downfolding to an effective low-energy model which may capture correlations but neglects import aspects of electronic structure. Recent years have seen substantial progress in methodologies for simulating finite-temperature field theories ab-initio, using diagrammatic perturbation theory and non-perturbative embedding methods. These methodologies also take advantage of advances in numerical mathematics, computer science, and machine learning, where fast tensor algorithms such as tensor cross-interpolation techniques have been developed. We believe that by combining progress in these areas it will be possible to generate a new generation of predictive and systematically improvable algorithms for obtaining experimentally measurable properties of strongly correlated quantum materials, including angle-resolved spectroscopy, neutron spectroscopy, and resonant inelastic x-rays. Ultimately, we aim to unlock new insights into the behavior of quantum materials, which will have profound implications for future scientific and technological advancements.

Link to the ERC project webpage: gull-group.org

Keywords of the ERC project: Quantum Physics, computational physics, quantum theory, electronic structure, quantum computing

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101164202	**SuperSOC**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Morten Holm Christensen**
Host Institution:	KOBENHAVNS UNIVERSITET - DNK

Effects of Spin-orbit Coupling on Superconducting Pairing Interactions

Superconductors with spin-orbit coupling exhibit many fascinating properties, including abnormally high upper critical fields and possible topological excitations. These effects are recognized as originating from the impact of spin-orbit coupling on the Cooper pair wave function. In contrast, how spin-orbit coupling affects the superconducting pairing interactions – the glue that binds electrons together in Cooper pairs – remains an open question. This is particularly relevant in unconventional superconductors as the interplay between spin-orbit coupling and electronically mediated superconducting pairing interactions may give rise to novel feedback effects that boost the efficacy of the pairing interactions. In this project, I will adopt a dual-pronged approach to study the interplay between spin-orbit coupling and interactions: (1) Develop a generalized Eliashberg theory to account for feedback effects in spin-orbit coupled systems and (2) implement fermionic renormalization group methods and determinant Quantum Monte Carlo simulations to map out the interplay between electronic correlations and spin-orbit coupling. The main results of SuperSOC will be: - Establishing how spin-orbit coupling may fundamentally reshape the pairing interactions and modify the associated superconducting instabilities of unconventional superconductors. - Developing a framework for studying these feedback effects in material-specific models and employing this to understand the phase diagrams of unconventional spin-orbit coupled superconductors. - Demonstrating how the interplay between electronic correlations and spin-orbit coupling leads to anisotropic interactions that alter the shape of the electronic phase diagram and may enhance pairing. These achievements pave the way for identifying the nature and origin of unconventional superconductivity in spin-orbit coupled systems and enable a determination of the electronic phase diagrams in such systems.

Link to the ERC project webpage:

Keywords of the ERC project: unconventional superconductivity, spin-orbit coupling, pairing glue, superconducting pairing

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101164581	**HyperScaleEM**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Philipp Pelz**
Host Institution:	FRIEDRICH-ALEXANDER-UNIVERSITAET ERLANGEN-NUERNBERG - DEU

Revealing 3D Atomic Structure and Chemistry in Scale-Bridging Volumes via 5D Hyperspectral Electron Tomography

Electron microscopy is essential to understanding structure-property-function relationships in modern materials engineering, condensed matter physics, chemistry, and structural biology. Yet, due to complicated scattering physics, today's electron microscopes can only image tiny volumes with 3D atomic resolution. Within this project, I will turn the tables by utilizing and inverting the scattering physics to image scale-bridging volumes with atomic detail and chemical superresolution. Combining compressive data-acquisition protocols, state-of-the-art electron optics and detectors, and co-designed computational imaging algorithms will make this possible. I will use tomographic experiments and computationally invert the multiple scattering from multidimensional measurements in scanning transmission electron microscopy to determine 3D atomic structure and chemistry in technologically valuable volumes. This has not been realized yet due to significant bottlenecks in the computational complexity of the underlying algorithms and a lack of experimental automation, which I plan to overcome in this project. The project is divided into three main objectives: 1) Imaging 3D atomic structure in large volumes 2) Visualizing atomic chemistry in scale-bridging volumes 3) Profiling 3D atomic structure, chemistry, and dynamics in controlled in-situ experiments across scales These methods will be applied to essential materials, including examining single hydrogen atoms at grain boundaries in structural metals and studying concealed, extensive interfaces in modern semiconductor materials. In the final phase, I will record atomistic movies of material fracture in tungsten and alloys. Fracture is one of the most critical failure modes of structural materials with catastrophic consequences. The details of crack nucleation and propagation through the breaking of bonds are still largely unexplored and will be measured directly and compared with large-scale atomistic simulations.

Link to the ERC project webpage: https://pelzlab.science/hyperscale.html

Keywords of the ERC project: electron microscopy, atomic resolution, hyperspectral imaging, computational imaging, computational microscopy

Keywords that characterize the scientific profile of the potential visiting researcher/s: computational imaging, materials science, electron microscopy, quantum physics, signal processing, physics, chemistry

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Project ID:	Project Acronym:	Evaluation Panel:
101171325	**POSA**	**PE3** Condensed Matter Physics

Principal Investigator:	**Dr Matthias Althammer**
Host Institution:	BAYERISCHE AKADEMIE DER WISSENSCHAFTEN - DEU

Pseudospin-based Antiferromagnetic Magnonics

Spin-based information processing is a viable alternative to charge-based approaches, enabling low-power devices. In magnetically ordered systems, spin information can be transported via the quantized excitations of the magnetic lattice, called magnons. In an antiferromagnetic system, we generally find two degenerate magnon modes with opposite Néel precession chirality, i.e., opposite spin. These two modes can couple and give rise to complex dynamics and superposition states. I could show that these dynamics can be well described via the pseudospin and its dynamics. My group showed experimentally that electrical pure spin current injection and detection in hematite thin films gives access to the coherent pseudospin dynamics and leads to the manifestation of the magnon Hanle effect. I propose to investigate the coherent spin dynamics induced by pure spin currents in antiferromagnetic insulators, which open up new avenues for energy-efficient information processing beyond von Neumann architectures. The project aims to achieve three main objectives: 1) Establish an experimental platform for pseudospin-based antiferromagnetic magnonics with efficient generation, manipulation, and detection of pseudospin states utilizing antiferromagnetic insulators. This provides the potential for a paradigm shift in magnonics away from wave-based towards spin-based information processing and encoding. 2) Realize pure spin current-driven spin-torque oscillators in antiferromagnetic insulators. This enables the on-chip generation of frequency combs in the microwave and terahertz regime and coherent magnon generation. 3) Explore spiking artificial neurons based on antiferromagnetic spin-torque oscillators. This provides a pathway towards energy-efficient magnonic neural networks and reservoir computing. The successful project will have a transformative effect for energy-efficient information processing, on-chip generation of frequency combs, and hardware for artificial neural networks.

Link to the ERC project webpage:

Keywords of the ERC project: magnonics, antiferromagnetic insulators, spintronic autooscillators, magnetic thin films,

Keywords that characterize the scientific profile of the potential visiting researcher/s: nanofabrication, magnon dynamics, thin film materials, spin current physics

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Project ID:	Project Acronym:	Evaluation Panel:
948525	**HILTRAC**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Julia Lehman**
Host Institution:	THE UNIVERSITY OF BIRMINGHAM - GBR

Highly Instrumented Low Temperature Reaction Chamber

In this project, I will build, optimize, and apply a Highly Instrumented Low Temperature Reaction Chamber (HILTRAC) to study organosulfur chemical reactions. This chamber is the first of its kind to couple a uniform supersonic flow (USF) capable of achieving a wide range of cold temperatures (30 – 250 K) with the unique detection capabilities of an infrared direct frequency comb spectrometer (DFCS). The combination of DFCS with two additional detection methods (laser-induced fluorescence and time-of-flight mass spectrometry) will make HILTRAC a highly versatile instrument, with sufficient sensitivity and selectivity to measure very low concentrations of molecules in a gas phase chemical reaction. The spectrally broadband and high resolution frequency comb laser enables both reactants and products to be identified and monitored simultaneously as a function of reaction time. For the first time, a single instrument will have the ability to collect multiplexed information on temperature-dependent reaction kinetics, product identification, and product branching ratios. This will set a new benchmark for what should be considered a more complete understanding of the way a reaction progresses. As a first target for the newly commissioned HILTRAC, I will study three different organosulfur reactions relevant to chemical environments ranging from the interstellar medium to biological systems. There is very little information about organosulfur reactions in general and especially at low temperatures due to experimental challenges which the USF is able overcome. By using the combined power of the HILTRAC detection methods and the temperature controlled environment, with supporting quantum chemical calculations and reaction kinetics simulations, I will be able to draw conclusions about the reaction potential energy surfaces which govern the branching to reaction products. This in turn will allow predictive abilities beyond achievable experimental conditions.

Link to the ERC project webpage:

Keywords of the ERC project: astrochemistry, laboratory, spectroscopy, kinetics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101001784	**CoMMBi**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Vittorio Limongelli**
Host Institution:	UNIVERSITA DELLA SVIZZERA ITALIANA - CHE

Computational Microscope on Molecular Binding: from atom to cell membrane scale

Molecular binding is a major research topic that has undoubtedly benefited of recent technological innovation, especially in the area of the so-called computational sciences. However, the predictive power of computations remains low mainly due to the poor correlation of the in-silico models with the real world. A clear example is drug discovery where the drug in vivo efficacy is seen correlated to the ligand residence time, which is hardly predictable by current computational methods. The present proposal tackles the challenge aiming at reshaping the border of the state-of-the-art simulations in molecular binding. I outline a research program that realises a vision where drug design is entrusted to ligand binding affinity and kinetics prediction, and molecular binding interactions are simulated in a realistic plasma membrane model. To achieve the ambitious goals of the research, my team will develop and apply cutting-edge computational techniques based on free-energy calculations, machine learning and multiscale molecular dynamics simulations. Evidence of the innovative nature of the developed approaches will be given by elucidating fundamental aspects of the functional mechanism of the G-protein coupled receptors (GPCRs), a pharmacologically prominent membrane protein family targeted by ~ 40% of marketed drugs. We will achieve a thorough characterization of the binding thermodynamics and kinetics of signal molecules (antagonists and agonists) that will be used by an original machine learning model to identify novel receptor antagonists with prescribed binding affinity and residence time. We will then investigate the receptor conformational transition from the inactive to the active state and develop an ad hoc multiscale approach to characterize the formation of GPCRs dimers, oligomers and clusters in cell membrane and their interaction with the G-protein that activates the signal transduction. Experiments will be performed to validate all the in-silico results.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101042989	**QuantMol**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Michal Tomza**
Host Institution:	UNIWERSYTET WARSZAWSKI - POL

Ultracold polyatomic molecules for controlled chemistry and precision physics

Ultracold atoms have been successfully used in quantum simulations and precision measurements. Molecules possess a richer internal structure promising new applications. However, only relatively simple molecules have been produced and employed at ultralow temperatures. This project aims to understand and harness the increasing complexity of ultracold polyatomic molecules to probe the fundamentals of chemistry and physics. We will extend the range of ultracold polyatomic molecules and their applications in controlled chemistry and precision spectroscopy. We will propose and theoretically investigate two paths: 1) association of ultracold deeply-bound diatomic molecules into ultracold weakly-bound polyatomic molecules and 2) direct cooling deeply-bound polyatomic molecules carefully selected and manipulated with electromagnetic fields. The first approach will build on established atomic techniques, which we will extend to molecular systems. The second one will employ strong fields, short pulses, and structural modifications to engineer closed transitions suitable for laser cooling. We will combine and develop novel electronic structure and quantum scattering methods enhanced by machine learning and high-performance computing. Next, we will study new applications exploiting features emerging from single-molecule and coherent control, conical intersections, and non-trivial electronic states and geometries absent in simpler systems. Applications will range from quantum-controlled chemical reactions and molecular dynamics to precision measurements of fundamental constants and their spatio-temporal variation. The realization of the project will push cold chemistry into the quantum realm and bring unprecedented complexity to ultracold physics, thus, give new insights into the physical basis of chemistry and the fundamental laws of nature. A unique experience of the PI in both quantum chemistry and ultracold atomic physics will be instrumental in achieving these goals.

Link to the ERC project webpage: http://quantmol.uw.edu.pl

Keywords of the ERC project: ultracold molecules, ultracold atoms, ultracold collisions, quantum control, molecular electronic structure

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101043272	**HyBOP**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Ali Hassanali**
Host Institution:	UNITED NATIONS EDUCATIONAL SCIENTIFIC AND CULTURAL ORGANIZATION - FRA

Hydrogen Bond Networks as Optical Probes

Fluorescence takes place throughout the natural world. Most conventional chemical wisdom proposes that in organic entities, fluorescence occurs in conjugated systems, such as in the aromatics. However, in biological settings, the interaction of light with matter occurs in media built up of dense networks of hydrogen bonds. Recent experiments suggest that it is possible to observe fluorescence from these networks too. This could open the possibility of designing hydrogen-bond networks with enhanced fluorescence, offering enormous fundamental and practical potential.

The overarching goal of HyBOP is to decipher, using advanced computer simulations, the exotic optical properties of hydrogen-bond networks and to harness them as probes of water-mediated forces. To achieve this, HyBOP will tackle the following challenges:1) Establish the ground rules for creating fluorescent hydrogen-bond networks in biological materials. 2) Understand how to drive the electrons and nuclei of water networks into regimes where they can fluoresce. 3) Use the optical behaviour of these networks to probe hydrophobic forces in nature.

To uncover the complex chemistry of hydrogen-bond network fluorescence, and guide the discovery of new fluorophores, we will deploy state of the art electronic excited-state molecular dynamics in combination with machine-learning techniques. This will provide HyBOP with ground-breaking knowledge which will lay a theoretical framework to motivate development of new experimental probes of hydrophobicity.

HyBOP seeks to bring hydrogen-bond networks to the forefront of chemistry in their use as optical probes; by laying the theoretical ground-work for designing non-invasive fluorophores in biophysics, opening up a new window into the origins of autofluorescence in medical diagnostics and finally, provoking frontier electron and nuclear spectroscopy, HyBOP will have a spill-over effect and build new synergies across several branches of the physical sciences.

Link to the ERC project webpage:

Keywords of the ERC project: Computer Simulations; Molecular Dynamics; Machine Learning; Hydrogen-Bond Networks;

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101044726	**HypFlow**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Sami Jannin**
Host Institution:	UNIVERSITE LYON 1 CLAUDE BERNARD - FRA

Inexhaustible Spring of Hyperpolarization For Magnetic Resonance

Nuclear magnetic resonance (NMR) has become a well-established and versatile tool in numerous fields of research and in industry, but features a relatively low sensitivity which prevents solving today's most pressing challenges in modern science.

Hyperpolarization by dissolution dynamic nuclear polarization (dDNP) provides a partial solution by enhancing sensitivity 10'000-fold. However, hyperpolarized solutions are available only once (single-shot), and are contaminated and diluted. This is incompatible with most NMR experiments, except for some niche applications.

HypFlow will reach the ground-breaking overall aim of providing inexhaustible (multi-shot) and pure (unpolluted and undiluted) hyperpolarization, thus truly compatible with NMR by:

1) designing and building a pulsed-DNP freeze&flow polarizer,
2) integrating the use of hyperpolarizing matrices with polarized electrons, and
3) validating multi-scan applications in metabolomics, drug discovery, and chemistry.

Liquid NMR samples will freeze in the HypFlow system where high levels of polarization will be generated, will then melt and flow toward the spectrometer, and will recirculate repeatedly. This will offer, for the first-time, inexhaustible and pure hyperpolarization with a 10'000-fold boost in sensitivity.

The PI has a unique combined leading expertise in most recent instrumental, methodological and chemical developments in dDNP that will empower him to tackle the scientific challenges of HypFlow.

HypFlow will deepen the fundamental scientific knowledge of nuclear and electron spin polarization generation, transfer, and relaxation phenomena. It will enable detection of hyperpolarized samples in a fully compatible way with a broad range of NMR applications, radically transforming and democratizing the practice of hyperpolarized NMR in research laboratories and industries.

Link to the ERC project webpage: hmrlab.eu

Keywords of the ERC project: NMR, EPR, ESR, DNP, Hyperpolarization

Keywords that characterize the scientific profile of the potential visiting researcher/s: Physicist, Chemist, Biochemist

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Project ID:	Project Acronym:	Evaluation Panel:
101075996	**GlycoX**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Kelvin Anggara**
Host Institution:	MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV - DEU

Imaging Single Glycoconjugates

GlycoX aims to develop single molecule analytical methods to address the challenge of elucidating glycoconjugate structures. Glycoconjugates are glycans (a.k.a carbohydrates) that are attached to another biomolecules such as proteins or lipids. Glycoconjugates are essential to all living organisms, carrying out key cell-cell communication roles in immune system or in microbial infection. Glycoconjugates are found in all biological systems and yet, when compared to proteins or nucleotides, very little is known about their structures and how they lead to their biochemical properties or how they can be exploited in therapeutics. Efforts to reveal their structures by ensemble averaged approaches, whether primary structures (sequences) or secondary structures (conformations), have been severely hampered by the high complexity and flexibility of glycans. GlycoX addresses this challenge by direct imaging of single glycoconjugate molecules, devoid of any ensemble averaging. To this end, glycoconjugate ions generated from electrospray ionization are soft landed on surface and imaged one-at-a-time by scanning probe microscopy in vacuo. The Project proposes the use of direct imaging (1) to identify the glycoforms of any glycoconjugates (i.e. variants of a specific glyconjugate that possess different glycan primary structures), (2) to sequence any glycan residues in any glycoconjugates, and (3) to determine the conformations of any glycoconjugates. The Project plans to focus on glycoconjugates that are intractable by present analytical methods, many of which are central in immune system, in microbial infection, and in emerging diagnostics, drugs, and vaccines. These works have far reaching impacts: shedding light into the language used by cells to communicate and by pathogens to infect; creating new opportunities in glycan-based therapeutics; as well as opening new frontiers in single molecule analytical chemistry of biomolecules.

Link to the ERC project webpage: https://anggara.science

Keywords of the ERC project: Single molecule microscopy, Structural chemistry/biology, Computational chemistry, Scanning probe microscopy, Soft landing, Electrospray ion beam deposition

Keywords that characterize the scientific profile of the potential visiting researcher/s: Model building, Software development, Density functional theory, Machine learning

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Project ID:	Project Acronym:	Evaluation Panel:
101076972	**aCCuracy**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Péter Nagy**
Host Institution:	BUDAPESTI MUSZAKI ES GAZDASAGTUDOMANYI EGYETEM - HUN

Turning gold standard quantum chemistry into a routine simulation tool: predictive properties for large molecular systems

We propose comprehensive theoretical method development targeting a long-standing dilemma in molecular quantum simulations between controllable predictive power and affordable computational time. While the outstanding reliability of quantum chemistry's gold standard model is repeatedly corroborated against experiments, its traditional form is limited to the size of an amino acid molecule. By exploiting the short-range nature of leading interaction contributions, a handful of groups, including ours, have recently extended the reach of such quantitative energy computations up to a few hundred atoms. However, these state-of-the-art models are still too demanding and are not at all equipped to compute experimentally relevant dynamic, spectroscopic, and thermodynamic molecular properties. Thus, to break down these barriers, we will further accelerate our cutting-edge gold standard methods up to few 1000 atoms via concerted theoretical and algorithmic developments, and high-performance software design. Additionally, we will take into account biochemical, crystal, and solvent environment effects via cost-efficient embedding models. For the first time, we will also derive and implement practical approaches to compute static and dynamic observable properties for large molecules at the gold standard level. The exceptional capabilities of the new methods will enable us to study challenging chemical processes of practical importance which are not accessible with chemical accuracy for any current lower-cost alternative. We aim at modeling and understanding intricate covalent- and non-covalent interactions governing supramolecular and protein-ligand binding as well as the mechanism of organo-, organometallic, surface, and enzyme catalytic reactions. Once successful, this project we will deliver groundbreaking and open access tools for the systematically improvable and predictive quantum simulation of large molecules in realistic conditions and environments.

Link to the ERC project webpage: http://www.fkt.bme.hu/~theoreticalchem/

Keywords of the ERC project: development and application of efficient and predictive quantum chemistry methods, computational chemistry, coupled cluster, perturbation and density functional theory methods, computation of reaction mechanisms and molecular interactions, computation of

Keywords that characterize the scientific profile of the potential visiting researcher/s: development and/or scientific programming of electronic structure methods OR ab initio molecular/materials modeling numerical simulations/computational modeling in chemistry/physics/biochemistry/materials science OR applied computational modeling for rea

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Project ID:	Project Acronym:	Evaluation Panel:
101077502	**ReMembrane**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Raya Sorkin**
Host Institution:	TEL AVIV UNIVERSITY - ISR

How do tetraspanin proteins organize, shape, and remodel biological membranes?

Our bodies rely on protein driven shaping and remodelling of our cells' membranes to function. Uncovering the mechanisms of remodelling of the cell membrane is, therefore, essential for understanding biological processes such as fertilization, but also to allow for precise intervention in them when needed. The interplay between protein position, membrane tension, and local curvature is believed to dictate these processes. However, experimental verifications of this hypothesis in specific biological systems are scarce. Here, I propose to apply my expertise in the characterization of mechanical properties and remodelling of membranes to obtain ground-breaking quantitative details of the shaping and remodelling mechanisms in which the Tetraspanin (TSPN) family of proteins are involved. TSPNs provide an ideal case study for several reasons, they are of extreme importance to biological processes such as viral infection, they are well characterized by biochemical, genetic and proteomics approaches, and their mode of action is suspected to depend on membrane tension and curvature. Of specific interest is the role of TSPN in the formation of the newly discovered cellular organelles, called migrasomes, which are a new cell-cell communication paradigm. This proposed project addresses TSPN functions by a bottom-up approach, reconstituting the processes of interest from simple building blocks and characterizing the distinguished roles of membrane tension and curvature. To this end we will use several new assays based on combined optical tweezers, micropipette aspiration and confocal microscopy as well as AFM that will operate on crafted membrane model systems. Our unique experimental approach will allow us to recreate the conditions leading to migrasome formation, egg-sperm, and viral membrane fusion. Revealing the mechanisms underlying these processes will have direct impact on the development of infertility treatments, non-hormonal contraceptives, and novel anti-viral drugs.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101078595	**SATTOC**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Hugo Marroux**
Host Institution:	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES - FRA

Solution attosecond chemistry

X-ray photons carry sufficient energy to interact with molecular core-shell's electrons. Accessible for decades in the energy domain, the resulting core-excited states (CES) can now be observed in the time domain using attosecond (10-18 s) spectroscopy. These states are important as they govern the lineshapes in all x-ray spectroscopies. Here, we propose to first investigate and then manipulate the CES time evolution in solvated biomolecules in order to reveal key chemical information – i.e. solute-solvent interactions, local symmetries and chiral fields. CES lifetimes dictate the emission of secondary electrons active in radiotherapy. By observing the effect of solute-solvent interactions on CES we will be able to achieve a better understanding of the first molecular mechanisms of radiotherapy. CES are also a subtle probe of the absorbing atom's bonding environment. CES line splittings are lost in conventional x-ray spectroscopy due to homogenous broadening. We developed a technique based on the laser manipulation of CES capable of producing lineshapes up to an order of magnitude below the spectroscopy's lifetime broadening and revealing core-level splitting. We will employ this approach to observe core-level splitting in solvated amino acids and metalloproteins and will use this new information to reveal the binding geometry of ligands with unprecedented accuracy. Finally, we will show how one can use nonlinear optics with attosecond pulses to reveal the chirality of the field surrounding sulphur and phosphorus atoms in biological samples. X-ray excitation localizes the point of view on the chiral field to a single atom. This perspective will allow us to examine the chiral landscape near the target atom. Here, chirality due to a single chiral centre will be probed in L-cysteine while the chirality due to the macromolecular arrangement will be measured in DNA helixes. Our proposal brings attoscience techniques in the investigation field of large solvated systems.

Link to the ERC project webpage:

Keywords of the ERC project: Attosecond, liquid pahse ultrafast

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101088303	**LIVE**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Ioachim Pupeza**
Host Institution:	RHEINLAND-PFALZISCHE TECHNISCHE UNIVERSITAT - DEU

Laser-Based Infrared Vibrational Electric-Field Fingerprinting

A biological system's phenotype and the evolution thereof are mirrored in molecular composition. The complexity of biological samples, however, renders quantitative, multivariate molecular probing challenging, in particular for non-destructive, label-free approaches. Vibrational spectroscopies capture signals from all molecular bonds exchanging energy with an optical excitation, delivering highly-specific optical fingerprints of samples in their native state, to which virtually all molecules contribute. Yet, while infrared (IR) spectroscopies profit from large vibrational cross-sections, technical limitations of IR radiation sources and detection have so far limited their applicability to real-world biomedical settings, in particular in the context of highly absorbing water (ubiquitous in biological samples). The project LIVE aims at harnessing the unparalleled control over light, on the level of individual optical-field oscillations, afforded by femtosecond lasers and nonlinear optics, to overcome current technological limitations and advance IR spectroscopy toward the fundamental limits set by the nature of light and, thus, toward the ultimate sensitivity, specificity and throughput achievable in optical vibrational fingerprinting. To this end, we envisage the development of powerful sources of fewcycle pulses covering the entire IR molecular fingerprint region (500–4000 cm-1) with utmost electric-field waveform stability, and of innovative electric-field sampling techniques capturing nearly all photons emitted by linearly and nonlinearly excited molecular vibrations. The host institution permits immediate validation of these developments for real-world biomedical samples, including, high-throughput vibrational fingerprinting of individual cells in flow cytometry, spectral tissue histopathology and high-resolution, high-sensitivity breath gas monitoring. Thus, LIVE promises direct impact on patients' health, deeply rooted in basic photonics research.

Link to the ERC project webpage: lightwavelab.de

Keywords of the ERC project: infrared spectroscopy, laser spectroscopy, microscopy

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101088734	**SupraSense**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Frank Biedermann**
Host Institution:	KARLSRUHER INSTITUT FUER TECHNOLOGIE - DEU

Development of Suprasensors and Assays for Molecular Diagnostics

SupraSense combines completely new strategies to design and realize biomimetic artificial receptors for bioactive small molecules, i.e. metabolites, with the aim of overcoming long-standing selectivity and sensitivity limitations that hindered other synthetic sensory systems from reaching diagnostic applications. Sophisticated yet easy to fabricate "SupraSensors" will be developed based on unprecedented hybrid zeolitic materials whose binding cavities are modulated by peptide-based cofactors, thereby mimicking enzyme pockets. SupraSensors will be functional and directly applicable for molecular diagnostics in urine, saliva, and blood and will be of utility in point-of-care units and personal homes. Emphasis is given to the detection of metabolites that are important disease indicators.

I am an expert on "conventional" synthetic chemosensors and have studied both their merits and fundamental shortcomings. Out of this deep routed analysis, I developed the proposed ambitious strategy that marries principles of molecular recognition with materials science and chemistry-informed deep learning. These SupraSensors will advance the field through the following elements: i) high-energy water release from microporous materials ensures high binding affinity; ii) strategically placed peptide-based recognition elements provide selectivity while offering synthetic tunability; iii) information-rich signal output from SupraSensor libraries enables metabolite distinction in biofluids; iv) novel signal amplification concepts increase sensitivity. SupraSensor discovery will be fast and generalizable to many metabolite classes.

SupraSense has the potential to unleash supreme opportunities for multiparameter diagnostics, which will be essential for patient subgrouping based on metabolic phenotypes. The new concepts developed herein have the prospect to revolutionize early detection of emerging cardiovascular events, inflammations, sepsis, and other metabolic or aging-associated diseases.

Link to the ERC project webpage: Biedermann-labs.com

Keywords of the ERC project: supramolecular chemistry, molecular diagnostics, molecular recognition

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101097351	**MaMa**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Carlo Adamo**
Host Institution:	ECOLE NATIONALE SUPERIEURE DE CHIMIE DE PARIS - FRA

In-silico Models for the Design of Mechanochromic Functionalized Polymers

The MaMa project aims at developing integrated computational approaches enabling to describe and design new mechanochromic materials. In particular, we aim at rationally design technologically consistent commodity polymers with smart and intelligent features such as mechano-responsive elastomeric, thermoplastic and thermoset polymers by the introduction of chromogenic species in the polymeric matrix in the form of mechanophore chromophores. The inter- or intra-molecular interactions ruling the opto-mechanical behaviour of the chromophores within the polymer matrix, and thereby the macroscopically perceived colour, can be tuned by application of an external force and they will be the key issue to control - by suitable design of the chromophores and polymers- and to predict by theoretical tools. In this respect the present project concerns, beside primary fundamental issues, such as the development of theoretical approaches for the description of photophysical processes in complex matrix, the handling, description and prediction of phenomena occurring from molecular to nano-scale in presence of an external stimulus such as pression/shearing or drawing. We will focus on mechanochromic luminogenic materials based on strain-induced modulation of molecular covalent or non-covalent interactions, affecting phenomena like excimer modulation or aggregation-induced emission at the molecular chromogenic scale. The functionalized smart materials designed can find real-life applications ranging from anti-counterfeiting systems for intelligent packaging, smart coatings and textiles, and optical indicators for the detections of cracks and fatigue issues in thermoset polymers. The solid and active collaboration with leading experimental and theoretical chemists will allow for the efficient synthesis and characterization of the most promising demonstrators, to exhaustively validate the computational tools and to further illustrate the technological relevance of these materials.

Link to the ERC project webpage: www.quanthic.org

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101115787	**STRAINSWITCH**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Sven Rogge**
Host Institution:	UNIVERSITEIT GENT - BEL

Strain engineering to design functional 4D polymorphism in nanostructured materials

It is often easy to observe the ability of polymorphic materials to undergo a phase transition through changes in colour, conductivity, photovoltaic efficiency, or other functional properties. In contrast, it is challenging to control under which external stimuli–stress, temperature, adsorption–these materials switch. Yet, enabling such polymorphic material design would be a game changer for pressing societal challenges, from access to drinkable water to producing green energy. This requires a firm understanding of how changing a material's structure impacts its polymorphism and macroscopic function. In STRAINSWITCH, I aim to transform polymorphic material design by establishing the strain engineering concept. The central characteristic in my in silico approach is strain: the extent to which a material deforms due to external or internal triggers. On the one hand, external stimuli generate strain, even before they activate a phase transition. On the other, spatial disorder in a structure, tuneable from the atom to the device scale, also induces strain that interferes with external strain fields. My key hypothesis is that it is possible to systematically predict which disorder is needed to ensure polymorphism only occurs under well-defined external triggers by balancing these internal and external strain fields. To confirm this hypothesis, I will develop new in silico methods with the goal to: i. understand how disorder induces strain fields in a material that propagate through both space (3D) and time (+1D) to enable 4D design; ii. predict which internal strain fields activate a material's polymorphism under specific external stimuli. In STRAINSWITCH, I will combine both goals to establish fundamental disorder-strain-function relationships that can be validated experimentally for metal-organic frameworks and metal halide perovskites. They will pave the way for 4D polymorphic material design with application in water harvesting, photovoltaic devices, and more.

Link to the ERC project webpage:

Keywords of the ERC project: strain fields, molecular dynamics, phase transformations, metal-organic frameworks, metal halide perovskites, stability, functional material design, nanostructured materials, electronic structure methods, force field methods

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101116089	**RadicalProtON**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Daniel Reta**
Host Institution:	UNIVERSIDAD DEL PAIS VASCO/ EUSKAL HERRIKO UNIBERTSITATEA - ESP

Designing organic molecules as platforms for reversible charge-to-spin conversion with applications in chromophore optimisation and drug discovery

Chemistry and Biology are governed by molecules and how they interact. Crucially, what glues a molecule together are chemical bonds, made from atoms pairing all their electrons. Although preferred, this is not the only option: in the comparatively rare cases where a molecule presents unpaired electrons, it acquires a fascinating new status that transforms its chemical and biological properties, best described by the acutely apt name of radical. Despite the extraordinary toolset found in radical-bearing molecules, the rather demanding methods to radical formation currently available mean that only very specific molecular architectures can withstand them, inadvertently limiting the scope of their applicability. The aim of this ERC project is to show that reversible diradical formation upon deprotonation is prevalent, and yet unexplored, in general donor-acceptor organic molecules and use this new knowledge to develop novel design criteria in light-emitting molecules and drug discovery. To achieve this unique aim, I will exploit a widespread structural pattern in a novel way, enabling a molecule to reversibly convert its charge and spin and become a diradical. I will first characterise how different molecular constituents (un)favour diradical formation on isolated molecules. I will then establish, for the first time, the role that diradicals play in defining the function of the numerous bioactive molecules sharing the proposed structural pattern. By exposing the overlooked diradical character in general families of deprotonated organic molecules, I will deliver transformative mechanistic understanding on i) the photo physical properties of fluorescent proteins and ii) the reactivity of small molecule drugs, particularly a new class of covalent inhibitors. The field of organic radicals sits at a critical crossroads between Chemistry and Biology, and as such, taking it a step forward has the potential to cross-pollinate research fields and reshape research frontiers.

Link to the ERC project webpage: https://www.danielreta.com/

Keywords of the ERC project: Organic magnetism, EPR, Computational chemistry

Keywords that characterize the scientific profile of the potential visiting researcher/s: Physical Chemist, Spectroscopy, Organic Synthesis

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101117858	**HOLOFAST**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Franco Camargo**
Host Institution:	CONSIGLIO NAZIONALE DELLE RICERCHE - ITA

Holographic nanoscale imaging via femtosecond structured illumination

Solution-processed organic and hybrid materials have immense promise for low-cost photovoltaic devices. Their intrinsically heterogeneous morphology directly impacts the photophysical processes that happen over multiple timescales down to femtoseconds and which ultimately define functionality, such as carrier diffusion, charge separation and recombination. Currently, experimental techniques that can simultaneously study the nanoscale morphology and the ultrafast photophysics are limited. Ultrafast microscopes are restricted to single point or very small fields of view, lacking the large sample area coverage needed to place observations in their proper statistical context. Moreover, they are generally incompatible with super-resolution imaging, preventing the required nanoscale spatial resolution from being achieved. Recently, I introduced a widefield transient holographic microscope using off-axis holography that has shot-noise limited performance and can image large sample areas. Importantly, this approach is compatible with nonlinear structured illumination, a widefield super-resolution technique based on combining a spatially structured illumination pattern and a nonlinear sample response, with the spatial resolution being only limited by how many nonlinear terms can be acquired.
In HOLOFAST, my team and I will combine the new ultrafast holographic microscope with nonlinear structured illumination to bring unprecedented photophysical knowledge of organic photovoltaic materials, with temporal resolution down to 10 femtoseconds, spatial resolution down to 50 nm while simultaneously imaging ~100 micron areas, correlating morphology with excited state dynamics. This will enable us to finally reveal the heterogeneity of charge separation and extraction processes over large sample areas. HOLOFAST will create a photophysical and morphological database that will be valuable to understand and solve the problems that currently limit device efficiencies and lifetimes.

Link to the ERC project webpage:

Keywords of the ERC project: ultrafast spectroscopy, ultrafast microscopy

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101124199	**SEISPY**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Michal Leskes**
Host Institution:	WEIZMANN INSTITUTE OF SCIENCE - ISR

Deconstructing the Electrode-Electrolyte Interface by Novel NMR Methodology

More efficient rechargeable batteries must be developed for utilizing sustainable energy sources and stopping the rapidly advancing climate change. The current technology cannot be merely extended for the next-generation storage systems. New approaches are required, especially for understanding and controlling the complex chemistry at the electrode-electrolyte interface. It has already been established that such control can, in principle, be realized by the solid electrolyte interphase (SEI), a stable passivating layer formed on the electrode. Such a layer should enable continuous transport of ions across it, but the fundamental understanding of what SEI components and architectures may give rise to such transport is not yet available. The ultimate goal of this ERC project is to establish structure-function correlation for the SEI by implementing methodologies for directly probing interfaces at the atomic-molecular level and for guiding the design of novel interphases.

We will achieve this goal by introducing to materials science a set of NMR 'tools' based on chemical exchange saturation transfer (CEST), commonly used to study dynamics in biomolecular-NMR. Here we propose to develop variants of CEST to probe ion dynamics across the SEI. Implementing these new approaches in situ, we will disentangle the multistep transport process at the electrolyte-SEI-electrode interfaces. Coupled with sensitivity enhancement by Dynamic Nuclear Polarization from inherent polarization sources, we will identify the SEI components participating in the ion exchange processes. Integrating our results with the battery performance, we will determine the pathways and bottlenecks for transport across the SEI.

Applying advanced NMR methods combined with controlled surface chemistry to state-of-the-art battery materials, such as lithium and beyond metal anodes, high-energy cathodes and composite electrolytes, we will establish design rules for next-generation energy storage systems.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101125295	**HAND**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Noelia Barrabes**
Host Institution:	TECHNISCHE UNIVERSITAET WIEN - AUT

Heterogeneous Asymmetric Nanocluster-catalysis Design

Chirality plays a major role in several areas due to the different behavior of each enantiomeric form of a compound, critical in the pharmaceutical industry. Obtaining pure enantiomers is one of the most difficult challenges, in which homogeneous asymmetric catalysis has achieved significant steps. Now it is time to undertake the challenge by heterogeneous enantioselective catalysis, implying great advantages in terms of sustainability, and offers further opportunities for in-depth understanding of mechanisms at the molecular level, relevant in multidisciplinary fields. However, successful design of such processes requires understanding and control of all relevant steps, which requires well-defined catalysts designed at atomic level. A new class of atomically precise nanomaterials that offers ample opportunities to explore chirality at the fundamental level, are the monolayer protected metal nanoclusters, which exhibit unexpected catalytic and intrinsically chiral properties. The HAND project aims to tackle actual challenges in heterogeneous asymmetric catalysis and achieve enantioselectivity with chiral nanoclusters on surfaces designed at atomic level. After creating chiral clusters active in homogeneous asymmetric reactions, we will control their immobilization on the support surface and their chiral properties. Such atomically precise chiral surfaces will allow us to overcome sensitivity barriers of available chiral spectroscopic techniques, improving studies of chirality at surfaces. Finally, having a well-defined chiral surface, asymmetric/enantioselective model reactions will be explored, aiming to obtain pure enantiomers. Each process step by itself represents a novel pioneering work in the field of nanoclusters and asymmetric catalysis, so far mostly unexplored. The fabrication and understanding of such a new class of chiral surfaces at the atomic level represent a breakthrough in knowledge relevant for materials science, nanotechnology and medicine.

Link to the ERC project webpage: https://cluscat.com/

Keywords of the ERC project: nanoclusters, catalysis, chirality, spectroscopy

Keywords that characterize the scientific profile of the potential visiting researcher/s: catalysis

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101160499	**In-Phase**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Jorge Rene Espinosa**
Host Institution:	UNIVERSIDAD COMPLUTENSE DE MADRID - ESP

Multiscale modelling of aberrant phase transitions in biocondensates

The spatiotemporal organization of the cell material represents one of the great wonders in physics, chemistry and biology. Compartmentalization plays a key role in such precise molecular coordination and enables cellular function. Over the past decade, transformative experiments have revealed that most intracellular compartments are not enclosed by membranes, but instead they are dynamical assemblies, termed condensates, and thought to occur via liquid-liquid phase separation of biomolecules. Nevertheless, the misregulation of these condensates—mostly formed by proteins and nucleic acids—can give rise to deleterious solid-like aggregates, which are associated with the proliferation of age-related and neurodegenerative disorders.

In-phase aims to develop an innovative computational approach to resolve the dynamical behaviour of molecules inside functional condensates that drift their complex physicochemical behaviour into pathological solid aggregates. To this end, we plan to develop a multiscale modelling platform—combining coarse-grained force fields and atomistic simulations—which will address the following critical questions: What are the encoded molecular features in RNA and protein sequences regulating phase behaviour? What pushes biomolecular condensates to shift their material properties over time? Can we prevent the proliferation of pathological aggregates induced by condensate misregulation? The overarching goals of this project are: (1) to understand the thermodynamic and intermolecular forces driving condensates out-of-function; and (2) devise potential strategies for preventing RNA/protein aberrant phase transitions in biomolecular condensates. This alone is ground-breaking because it will reveal the underlying mechanisms and interactions by which the structure and sequence of RNA and proteins dictate the material properties of intracellular condensates, and their implication in cellular dysfunction.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101161771	**MultiBonds**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Janine George**
Host Institution:	BUNDESANSTALT FUER MATERIALFORSCHUNG UND -PRUEFUNG - DEU

Understanding and designing inorganic materials properties based on two- and multicenter bonds

A major challenge for the green transition is our inability to rationally design inorganic materials with tailor-made properties. This project will tackle this inability by transforming our understanding of chemical bonding in inorganic materials.
Understandable rules based on chemical bonds have greatly advanced chemistry but are missing for most material properties, severely limiting the rational design of materials. Until recently, quantum chemical bonding analysis of inorganic materials has only been carried out on a small scale, making it impossible to derive such rules using machine learning. In addition, quantum chemical bonding analysis primarily focuses on two-center bonds. However, multicenter bonds play a critical role in material properties: For example, multicenter bonds have been held responsible for the superhardness of boron-containing compounds and the unusual properties of phase-change materials. By significantly going beyond my recent results on two-center bonds predicting materials properties with simple machine-learning models, I propose to overcome these challenges. The overarching objective of MultiBonds is to derive understandable and universal rules based on chemical bonds for inorganic materials properties through large-scale quantum-chemical bonding analysis considering multicenter bonds. We will 1) develop and apply innovative automated quantum-chemical methods to compute, for the first time, multicenter bonding indicators on a large scale. The generated database will then be used for 2) developing novel predictive deep-learning models and 3) intuitive human-understandable rules for materials properties. As initial applications, we will focus on phase-change materials with low thermal conductivities, magnetic and hard materials, since their properties are known to be governed by multicenter bonds, and they have critical applications (e.g., as thermoelectrics and in the green transition of vehicles).

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101164162	**MIETEN**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Narain Karedla**
Host Institution:	THE CHANCELLOR, MASTERS AND SCHOLARS OF THE UNIVERSITY OF OXFORD - GBR

Metal-Induced Energy Transfer based Electrometry and Nanometry: Dissecting Electrostatic Phenomena in Biological Processes

Almost all biological processes, involving molecular trafficking, signal-transduction, cell-to-cell interactions, hinge on precisely orchestrated electrostatic interactions, arising from electrical charges on biomolecules and membranes. Yet, our understanding of the role of electrostatics in these fundamental processes remains elusive due to the absence of quantitative methods to measure the electrical charges of biomolecules and to map the surface charge distribution of membranes. This challenge is further compounded by the requirement of capturing molecular and membrane dynamics that take place at the nanometre length scales and nano- to sub-millisecond time scales. The overall objective of this project is to bridge this technological gap by introducing Metal-Induced Energy Transfer based Electrometry and Nanometry (MIETEN), a groundbreaking technology that will quantify the electrical charge of biomolecules or membranes while capturing their dynamics with nanometre spatial and microsecond temporal resolutions. We will demonstrate MIETEN for measuring: (i) the charges and sizes of individual membrane proteins, (ii) membrane protein structural changes, conformational dynamics, and spatial organization in response to changes in membrane potential, (iii) reaction-diffusion kinetics at a charged membrane, (iv) mechanical properties and dynamics of membranes containing charged inclusions and (v) interactions between two charged membranes. The ability to measure biomolecular and membrane electrical charges and to elucidate the role of electrostatics in structure, organization, and interactions of proteins, as well as in membrane dynamics and intermembrane interactions, will be crucial for our understanding of fundamental biology and for advancing biomedical research. MIETEN will open new frontiers in studying protein and membrane dynamics and impact drug development, early diagnostics, and therapeutic interventions.

Link to the ERC project webpage:

Keywords of the ERC project: Biophysics, Optical microscopy

Keywords that characterize the scientific profile of the potential visiting researcher/s: biophysics, membrane mechanics, membrane electrostatics

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Project ID:	Project Acronym:	Evaluation Panel:
101165245	**TERES**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Kasra Amini**
Host Institution:	FORSCHUNGSVERBUND BERLIN EV - DEU

Complete Characterization of Photochemical Reactions by Time- and Energy-Resolved Electron Scattering

Many processes in nature and industry are intricately linked to the structure-function relationship of molecules, which optical stimuli can profoundly alter. Chemists and physicists have long sought to unravel the ultrafast structural changes of photochemical reactions. Using two short pulses with precisely synchronized time delays, a series of snapshots of the evolving electronic and molecular structures at various reaction times can be collected, analogous to assembling frames in a video. Measuring coupled electronic-nuclear dynamics remains a formidable challenge due to the small time, energy and spatial scales involved. State-of-the-art ultrafast electron diffraction (UED) techniques excel in molecular structure retrieval, but the critical signatures stemming from simultaneous transformations in electronic structure remain elusive, as several molecular reaction channels overlap and cannot be separated with current imaging technologies.
My goal is to pioneer a novel time- and energy-resolved electron scattering (TERES) method for real-time monitoring of coupled electronic-nuclear dynamics in photochemical reactions by energy-resolving UED. TERES will experimentally separate and identify electron scattering signals arising from different electronic structures of excited molecules (e.g., in different excited states) while preserving molecular structure information, comprehensively mapping the potential energy surfaces involved at different reaction times – capabilities significantly exceeding current UED technology. Successful realization of TERES promises to usher in a new era in photochemistry, unveiling hidden aspects of chemical reactivity.

Link to the ERC project webpage: https://aminigroup.eu

Keywords of the ERC project: ultrafast electron diffraction, ultrafast molecular dynamics, ultrafast structural dynamics, ultrafast photochemistry, ultrafast spectroscopy, ultrafast laser physics, non-linear optics, attosecond physics, attosecond chemistry, femtosecond physics, femto

Keywords that characterize the scientific profile of the potential visiting researcher/s: ultrafast electron diffraction, ultrafast structural dynamics, ultrafast spectroscopy, femtosecond chemistry

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101166044	**NEXUS**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Gianluca Levi**
Host Institution:	UNIVERSITA DEGLI STUDI DI TRIESTE - ITA

New excited state methods for overcoming challenges in sunlight conversion

The dynamics of charges and atoms when electrons are excited to energy levels above the ground state underpins energy conversion in photosynthesis, photocatalysis and solar cell technologies. Modelling excited electronic states remains however a major challenge. While density functional theory (DFT) has been hugely successful in predicting ground state properties of systems with several atoms and electrons, excited state extensions based on time-dependent formulations often lack the required accuracy. I have pioneered alternative approaches where the excited state orbitals are variationally optimized by converging on saddle points on the electronic energy surface. Preliminary studies show that such time-INdependent methods have similar efficiency and predictive power as ground state DFT. The central idea of NEXUS is to develop an innovative computational framework leveraging saddle point search strategies to significantly expand excited state simulations beyond their current scope.
Meanwhile, modern ultrafast X-ray techniques can achieve structural sensitivity for organic chromophores, offering a means to validate and complement the theoretical models for this important class of photoactive systems. By simulating the excited states in condensed phase rather than gas phase and directly visualizing atomic motion via ultrafast X-rays, NEXUS will provide unprecedented insights into the electronic and structural dynamics of organic molecules with application in photoswitching, singlet fission, and artificial photosynthesis. The goal is to unravel the elusive interplay between structure and function and pave the way to the rational design of photofunctional systems, enhancing the efficiency of solar energy conversion. An effective, low cost approach for modelling excited states of large systems is ground breaking and will have impact well beyond organic molecules, enabling the study of charge and atom dynamics in photochemical reactions for a wide range of applications.

Link to the ERC project webpage:

Keywords of the ERC project: Excited state method development, time-resolved X-ray scattering, photoinduced molecular dynamics

Keywords that characterize the scientific profile of the potential visiting researcher/s: Method development, molecular dynamics simulations, time-resolved experiments

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101169761	**QUADYMM**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Mariana Rossi**
Host Institution:	MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV - DEU

Steering the Quantum Dynamics of Confined Molecular Materials

Molecular materials are often present in forefront technologies targeting new sustainable energy alternatives. However, most of these alternatives currently fall short of the needs of industry and society. QUADYMM will investigate new fundamental mechanisms that could lead to paradigmatic changes in the design of such technologies.

We will explore two main thematic avenues, from a theoretical perspective: 1) tuning the atomic and electronic properties of molecular materials in confined structured environments, and 2) realizing nonequilibrium molecular material states for dynamic control of stable and reactive phases of matter. From a large pool of areas where these concepts can be applied, QUADYMM will focus on water interfaces with inorganic materials and on aromatic hydrocarbon interfaces with 2D materials, because of their fundamental impact on electrochemistry and optoelectronics. The state of the art of computer simulation in this area is still based on classical mechanics of nuclei or simplified models, especially for nonequilibrium and nonadiabatic processes. Once successful, QUADYMM will provide new first-principles methodology to treat electronic and nuclear nonequilibrium dynamics, changing the predictive capacity of computational simulations of important processes, such as water-splitting and vibronic energy transport.

Crucially, we will develop novel protocols for the inclusion of external stimuli in quantum dynamics simulations, bridging electronic and vibrational time scales and reaching the thermodynamic limit. This will be achieved by new techniques joining machine-learning methods with first-principles electronic structure and trajectory-based path-integral approaches. The resulting framework will elucidate the nonequilibrium quantum dynamics of complex weakly-bound systems containing thousands of atoms, and provide new structural and electronic phase diagrams to aid vibrational design.

Link to the ERC project webpage:

Keywords of the ERC project: Vibrational design, molecular materials, density-functional theory, molecular dynamics, quantum mechanics, machine-learning

Keywords that characterize the scientific profile of the potential visiting researcher/s: theoretical physical chemistry, theoretical chemical physics, computational research, atomistic simulations, quantum mechanics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101170309	**FORECAT**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Nikolay Kosinov**
Host Institution:	TECHNISCHE UNIVERSITEIT EINDHOVEN - NLD

Force-Responsive Heterogeneous Catalysts

Efficient catalytic materials are essential for the sustainable energy transition. To design such materials, we have a lot to learn from Nature, where bio-catalysts enzymes can perform many reactions that are virtually impossible for chemists to replicate. Enzymes operate by dynamically confining reactants and transition states, during the catalytic reaction, with high geometric and chemical precision. While we can mimic static confinement with existing nanoporous catalysts, we do not have in-situ control over the confinement geometry inside these generally rigid materials.

I aim to bridge this material gap by developing the first catalytic system with externally tunable confinement. My original approach is based on soft graphene-based materials – zeolite-templated carbons (ZTC). The unique property of these materials is that their pore size can be finely tuned within the sub-nanometer range by external mechanical force. This feature enables the precise modulation of the confinement geometry by simply varying the compression degree.

In FORECAT, my team and I will:

- Synthesize a library of catalytic transition metal nanoparticles inside the pores of ZTCs
- Explore the force-responsive performance of these catalysts in selective CO2 hydrogenation and N2 fixation
- Link the geometry of confinement with i) diffusivity of reactants, intermediates, and products; ii) their adsorption strength and coverage on active sites; and iii) reactivity and selectivity of the catalysts
- Utilize oscillatory compression–release of ZTC-based catalysts to drastically enhance their performance through catalytic resonance

The new field of force-responsive catalysis will provide unique fundamental insights and deep understanding of the chemistry of confinement. This understanding will enable designing better functional porous materials for catalysis and other applications. Eventually, the results of this project will contribute to bridging the gap between artificial and natural catalysts.

Link to the ERC project webpage:

Keywords of the ERC project: Heterogeneous catalysis; isotopes; operando spectroscopy; zeolites

Keywords that characterize the scientific profile of the potential visiting researcher/s: Heterogeneous catalysis; isotopes; operando spectroscopy; zeolites

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101170460	**ZoomNMR**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Anne Schuetz**
Host Institution:	LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN - DEU

Zooming in on small-molecule ligands by magnetic resonance

Small molecules are critical players in the chemistry of life. In the role of substrates, cofactors, solvent, inhibitors or activators, they steer the activities of proteins and nucleic acids. For mechanistic studies, it would be desirable to single out a small ligand from a large macromolecular complex, even if their sizes lie several orders of magnitude apart, and follow its fate during chemical and structural transformations. Few experimental techniques would achieve this under native conditions. NMR spectroscopy grants insights into molecular motions, interactions and chemical transitions at atomic-level resolution. However, it faces challenges when observing small-molecule ligands within large complexes: The first prerequisite are NMR active nuclei. Unlike biomolecular NMR, where isotope labelling is routine, the site-directed introduction of desired nuclei into small molecules still requires lengthy, individual synthesis. Second, transverse-relaxation optimised experiments have been instrumental in pushing the size limits of protein-observed NMR into the biologically relevant range of tens to hundreds of kilodaltons. Such experiments are not directly transferable to the small molecule space due to its different chemical build-up. ZoomNMR proposes to cover this blind spot with a spectroscopic toolbox for ligand-detected NMR of large macromolecular complexes. Our approach capitalizes on late-stage isotope labelling strategies, inspired by organic chemistry, in conjunction with relaxation interference phenomena to maximize sensitivity and resolution. The tools will be implemented on a prototypical human enzyme and three exemplary ligand classes. We will deliver a proof-of-concept that our novel methodology can tackle diverse research problems, from fundamental mechanistic enzymology to the design of drug molecules. Our future vision is that ligand-observed NMR of large complexes will become as straightforward and efficient as protein-observed NMR is today.

Link to the ERC project webpage: https://schuetz.cup.uni-muenchen.de/research/nmr-methods-for-ligand-molecules/

Keywords of the ERC project: NMR spectroscopy, proteins, enzymes, ligands, allostery

Keywords that characterize the scientific profile of the potential visiting researcher/s: isotope labelling, synthesis, biocatalysis

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Project ID:	Project Acronym:	Evaluation Panel:
101171583	**Interfacial Ionics**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Peter Ngene**
Host Institution:	UNIVERSITEIT UTRECHT - NLD

Interface-mediated fast ionic conductivity in nanocomposite solid-state electrolytes

Ion conduction in solid-state electrolytes (SSEs) is the bedrock of several electrochemical devices like batteries and fuel cells which are vital to our modern society. High conductivity is crucial for such applications, and increasing the intrinsically low conductivity of SSEs has been of enormous technological interest. The discovery that the conductivity of SSEs can increase or decrease by orders of magnitude at their interface with a non-conductor (e.g., oxides) has led to much interest in the use of interface engineering to rationally design SSEs with improved conductivity and overall performance in electrochemical devices. This has so far not been successful because the underlying mechanisms that lead to the profound changes in conductivity at interfaces are not yet well understood due to the complex composition of such interfaces, and the fact that several properties of the two components concomitantly influence this effect.

Building on my preliminary results, I aim to unravel the fundamental mechanisms of interface ion conductivity by preparing model nanocomposite SSEs (SSE + oxides) that will allow me to disentangle the different parameters that contribute to this effect. The interface physics/chemistry responsible for interface ion transport will be precisely tuned via surface and compositional modification of the oxides. I will combine advanced surface-sensitive probe techniques, including XPS, X-ray Raman Scattering, HR-TEM/EDX, and NMR to study the interface compositions. This will enable me to establish for the first time how the properties of SSE-oxide mixtures influence their interface reactions, conductivity, and performance in applications. Such fundamental insights will enable the design of novel SSEs with tailor-made properties for a variety of electrochemical applications. My extensive expertise and track record in nanocomposite materials, SSEs, and advanced materials characterization, place me in the perfect position to lead this project.

Link to the ERC project webpage:

Keywords of the ERC project: Solid state electrolytes, Solid state Ionics, Batteries, Ionic conductors, Interface effects, Nanocomposites, All-solid-sate batteries, electrochemistry, Energy storage

Keywords that characterize the scientific profile of the potential visiting researcher/s: Solid state electrolytes, Solid state Ionics, Batteries, Ionic conductors, Interface effects, Nanocomposites, All-solid-sate batteries, electrochemistry, Energy storage

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Project ID:	Project Acronym:	Evaluation Panel:
101200719	**SteadyNMR**	**PE4** Physical and Analytical Chemical Sciences

Principal Investigator:	**Dr Lucio Frydman**
Host Institution:	WEIZMANN INSTITUTE OF SCIENCE - ISR

Unleashing the power of steady-state high-resolution NMR: Methods, Molecules, Metabolism

Pulsed Fourier-transform (FT) has reigned supreme in nuclear magnetic resonance (NMR) for over 50 years, standing at the core of numerous analytical, pharmaceutical, materials, biophysical and medical applications. However, if spectral information is not a must, FT NMR is not necessarily the optimal way for maximizing sensitivity: when, as often happens, spin relaxation times are long and T1≈T2, steady-state free-precession (SSFP) experiments can provide a higher sensitivity per unit time. SSFP NMR applies a train of closely spaced pulses and works only at suitable offsets, and has therefore been assumed impractical when seeking high resolution among multiple chemical sites. We have recently found a way to break this limitation, enabling SSFP-based schemes to resolve multiple sharp peaks spread over arbitrarily large bandwidths. We have also devised routes that can incorporate J-driven polarization transfers onto these sequences. On the basis of such findings, we propose here a series of SSFP-based developments, that in numerous heteronuclear NMR applications should provide sensitivities exceeding by sizable margins those afforded by FT NMR. SteadyNMR presents preliminary experiments and calculations substantiating such claim (see below an example on a mix of aromatic hydrocarbons in chloroform), and builds on them to: devise optimal spectral reconstruction algorithms translating SSFP's enhancements into high-resolution methods opening new frontiers in chemical and biomolecular research; exploit these methods potential to monitor dynamics on thermal and on hyperpolarized samples; develop new families of metabolic 13C spectroscopic imaging experiments that are both 1H- and SSFP-enhanced, serving as basis for potentially superior ways of detecting cancer and metabolic abnormalities on widely available MRI platforms; combine these and other principles into new approaches complementing – and eventually improving– existing FT-based 2D NMR schemes.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101039578	**PROTOMAT**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Pierangelo Gobbo**
Host Institution:	UNIVERSITA DEGLI STUDI DI TRIESTE - ITA

Integrating non-living and living matter via protocellular materials (PCMs) design and synthetic construction

The bottom-up construction of synthetic cells or protocells from inanimate molecules and materials is one of the grand challenges of our time. While research thus far has been focused on increasing the biochemical complexity individual protocells, this research proposal intends to pioneer the first scientific advancements towards the controlled assembly of protocell building blocks into forms of adaptive and self-regulating protocellular materials (PCMs) that can integrate with living cells and target their mechanochemical sensory pathways.

To achieve this, I am proposing to work at the interface of synthetic chemistry, materials science, microfluidics, and tissue engineering to address the following unprecedented aspects of PCM design and synthetic construction: (1) the engineering of PCMs with mechanical properties that mimic those of soft living tissues; (2) the engineering of PCMs with rudimentary adaptive and self-regulating higher-order behaviours; and (3) the development PCMs capable of interacting and integrating with living cells. I will start by developing the first experimental methodologies to assemble PCMs with a range of elastic moduli that mimic those of soft living tissues from protocells endowed with synthetic polymeric cytoskeletons of different composition. I will then engineer the first adaptive PCMs capable of autonomously converting environmental luminous stimuli into mechanical motions and reconfigurations that will self-regulate their endogenous enzymatic reactivity. Finally, I will develop the first forms of PCMs capable of delivering both mechanical and biochemical cues for living cell spreading, proliferation and differentiation in vitro.

Overall, the proposed work will pioneer new internationally leading science at the life/non-life interface that will generate transformative ideas in the field of bottom-up synthetic biology with profound fundamental and applied consequences, especially in tissue engineering and regenerative medicine.

Link to the ERC project webpage:

Keywords of the ERC project: protocell, prototissue, biomimetic materials chemistry, soft matter

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101040025	**SYNPHOCAT**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Luca Dell'Amico**
Host Institution:	UNIVERSITA DEGLI STUDI DI PADOVA - ITA

Synthetic Bimodal Photoredox Catalysis: Unlocking New Sustainable Light-Driven Reactivity

Solar light is an inexhaustible, abundant, and free reactant that can promote the construction and transformation of molecules. The chemistry community is particularly interested in photocatalysis, which uses light energy to promote a chemical transformation. Photocatalysts (PCs) play a key role in transformative light-driven processes by donating or receiving electrons to or from the target substrate. The selection and structural refinement of PCs can channel reactivity to diverse mechanistic pathways, but often proceeds via trial and error. Here, I will use structure-property relationships to: 1) define novel bimodal organic PCs able to catalyse thermodynamically demanding and opposite photoredox events exploiting their electronically excited state; 2) explore the PCs reactivity by means of their radical ions, going beyond conventional photoredox approaches; 3) capitalise on the new reactivity and bimodal way of action of the PCs to implement novel selective transformations of biological targets under physiological conditions. These project core concepts will be accomplished by the rational evaluation and optimisation of the PCs physicochemical and structural properties as well as the careful analysis of the mechanistic features subtending the light-driven chemical events. Overall, SYNPHOCAT will deliver new conceptual and experimental tools for the sustainable light-driven construction and functionalisation of biorelevant molecules, opening the way to a new dimension of sustainable light-driven chemistry.

Link to the ERC project webpage: https://dellamicogroup.com/

Keywords of the ERC project: organic chemistry - synthesis - photochemistry - photocatalysis

Keywords that characterize the scientific profile of the potential visiting researcher/s: organic chemistry

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101041759	**ReHuse**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr José Augusto Berrocal**
Host Institution:	FUNDACIO INSTITUT CATALA D'INVESTIGACIO QUIMICA - ESP

Reversible Heterolytic Mechanophores for Dynamic Bulk Materials

Stimuli-responsive polymers adapt their properties in response to external cues. Engineering such “smart” behaviour in artificial systems by molecular design is an exciting fundamental challenge that can lead to technological breakthroughs. Most stimuli-responsive polymers rely on heat and light to trigger changes in materials properties in a predictable fashion. However, limitations intrinsic to these stimuli highlight the necessity of alternative strategies. Naturally evolved systems widely exploit mechanical stimulation to regulate their functions, but recreating such concept in artificial materials has proven extremely challenging thus far. ReHuse proposes a radically new approach that focuses on the application of mechanical force to induce changes in bulk materials properties isothermally and reversibly. The research project aims at pushing the frontiers of covalent mechanochemistry through the development of reversible heterolytic mechanophores – molecular platforms that dynamically generate and recombine two oppositely charged (macro)molecular fragments upon mechanical stimulation. These new motifs will enable dynamic chemistries involving organic ionic species in solid-state systems in two different types of advanced bulk materials. Combining reversible mechanochemistry and dynamic covalent chemistry will lead to dynamic covalent polymers displaying selective mechanoresponsiveness. This concept will be leveraged to create recyclable materials. The reversible generation of charges from the heterolytic scission will enable to modulate hydrophilicity/hydrophobicity dynamically. Such principles will be explored to set the groundwork for mechano-responsive atmospheric water harvesters. This interdisciplinary research project will advance our understanding of mechanochemistry and, more importantly, will usher new avenues for its productive and repeatable use in adaptive materials.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: Polymer chemist, supramolecular chemist, organic chemist, material scientist, polymer or mechanical engineer

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101042881	**bioTARGET**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Hannes Mikula**
Host Institution:	TECHNISCHE UNIVERSITAET WIEN - AUT

Bioorthogonal Cascade-Targeting: Directing Drugs into Cells with Molecular Precision

Bioorthogonal chemistries cross the boundaries between static chemical connectivity and the dynamic physiologic regulation of molecular state, enabling powerful tools for molecular control in complex biological environments. In combination with ligand-directed drug delivery, safe and selective chemical reactions that perform efficiently in vivo can fuel the design of new therapeutic strategies. Despite significant progress in the field of drug targeting, it remains challenging to shuttle therapeutic agents to the desired tissue, reaching the necessary cellular and even sub-cellular level, all while avoiding collateral damage. To engage this challenge, I aim to develop the concept of bioorthogonal cascade-targeting to direct the recognition, activation, and intracellular delivery of therapeutic constructs with molecular precision. We will develop next-level chemical tools for bioorthogonal bond-cleavage with exceptional reaction performance and the unique capability of tunable sequential release events ('tandem release'). These innovations will enable us to design bioorthogonally activatable ligands for multiple therapeutic approaches that open new ground, most notably in escalating the complexity of (bio)chemical choreography. In particular, I propose cascade-processes, triggered by a single biocompatible click event, that can achieve: (i) the 'bridging' of non-internalizing cell-surface receptors to forward therapeutics into cells; (ii) the 'hopping' of drug conjugates from one target to another, or from one cell to another; and (iii) kinetically preprogrammed 'escape' of drugs from the endosomal compartment of cells entered via cascade-targeting. This will allow us to spatially and temporally control the movement and release of therapeutics in a (sub)cellular environment, and ultimately to establish bioorthogonal cascades as unique strategies that shift the paradigm of biologically controlled drug delivery.

Link to the ERC project webpage:

Keywords of the ERC project: bioorthogonal chemistry, click chemistry, drug targeting

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council Executive Agency Established by the European Commission	Project ID:	Project Acronym:	Evaluation Panel:
	101043428	**LIVINGPORE**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Carlos Marti-Gastaldo**
Host Institution:	UNIVERSITAT DE VALENCIA - ESP

Bringing Nanospace to Life by Adapting Pore Environments to Chemical Complexity

The conformational flexibility and biological function of proteins is dictated by the positioning of a few amino acids into specific arrangements linked by peptide bonds. We intend to implement this same principle of sequencing, essential to biology, to synthetic porous materials by encoding pore environments with atomic precision to control structural response and function. The road to this vision remains blocked by the lack of methodologies and understanding which is required to untap the value of pore chemistry in controlling the conformational response of frameworks and encapsulated guests. LIVINGPORE is structured around the complementary concepts of 'transformable' and 'transformative' porosity, that share the use of amino acid side chain chemistry and peptide bond rotations for selecting the conformational response and function of flexible frameworks (oligopeptide linkers) or flexible guests (small enzymes) by using programmed pore settings and mutants. We will develop both concepts in parallel by implementing a central high-throughput workflow that integrates computational and experimental routines for rational design and accelerated discovery. These synergic, multidisciplinary tools will be used to i) guide chemical synthesis, ii) evaluate structural response and iii) rationalize function, all required for going beyond what can be currently achieved with conventional methods. The central objective of this materials chemistry project is to lay definitive understanding on how reticular frameworks can be used to respond to (transformable) or select (transformative) specific molecular recognition patterns for cooperative selection in a crystalline solid. The long-term vision is a shift in the present perception of Metal-Organic Frameworks into unique porous materials capable of structural/functional responses closer to biological systems that enable distinctive applications currently unthinkable of, here initially demonstrated in separation and biocatalysis.

Link to the ERC project webpage: www.funimat.es

Keywords of the ERC project: metal-organic frameworks; reticular chemistry; porous materials; functional inorganic materials

Keywords that characterize the scientific profile of the potential visiting researcher/s: metal-organic frameworks; reticular chemistry; porous materials; functional inorganic materials

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101045466	**BIOMATFAB**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Filipe Natalio**
Host Institution:	UNIVERSIDADE NOVA DE LISBOA - PRT

Biological fabrication of cotton fibers with tailored properties

Naturally produced fibers have always played central roles in shaping human civilizations. Current hazardous chemical-based manufacturing processes and consumers' preferences for cotton products are putting much strain on the future of cotton's global economy. Thus, it is urgent to seek future sustainable alternatives. What alternatives and tools are available? Which new avenues are waiting to be explored toward this end? Harnessing biological systems is one of humanity's ultimate frontiers. Yet, the intrinsic complexity of higher organisms and the lack of in-depth, comprehensive understanding of the underlying mechanisms and their interactions across a multitude of scales has primarily hindered their use to manufacture bio-based materials with desired properties. This project addresses this lack of knowledge by answering key questions concerning the sugar uptake and upwards transport from the roots and biosynthesis of naturally produced fibers at the level of cotton plants while using this body of information to create a roadmap to produce cotton fibers with tailored properties. Our approach will dive into the exploration of a recent and largely unexplored discovery that cotton plants uptake sugar by the roots, transporting them upwards, reaching as far as the fibers (root-to-fiber). In particular, we will dwell on the dynamics of this process using sugar derivatives. This body of information will set the stage for feeding the roots of whole cotton plants with sugar derivatives carrying specific functionalities to become, ultimately, biologically incorporated into the fibers modifying their end properties, particularly fluoro-sugars to yield fibers with increased hydrophobicity. We will demonstrate the feasibility of biological fabrication and material farming in whole cotton plants as a revolutionizing and sustainable alternative to manufacturing current chemical-based strategies and toward a bio-based global economy.

Link to the ERC project webpage:

Keywords of the ERC project: cotton, plants, biomaterials, cellulose, textiles, dyeing, colors, sustainability, plant biochemistry, genetics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101052997	**EDISON**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Ramón Martínez Máñez**
Host Institution:	UNIVERSITAT POLITECNICA DE VALENCIA - ESP

Engineered Particles for Chemical Communication

This project aims to the development of communication at the nanoscale and to advance in the understanding of how abiotic micro/nanoparticles can communicate between them and how micro/nanoparticles can communicate with living systems. In this context, an approach for establishing communication at the nanometric level is to mimic how nature communicates. Chemical or molecular communication, based on transmitting and receiving information by means of molecules (chemical messengers) is one of the communication forms used by living organisms. Moreover, many swarm systems found in nature communicate by modifying the environment using a concept called stigmergy. The advantages of nanoparticles that communicate each to another are immediately obvious; they constitute the basis of a dynamically interacting network eventually resulting in certain autonomy of the system. If we would be able to raise the bases for communication between micro/nanoparticles and between micro/nanoparticles and cells, the potential future applications in the biomedical field, environmental research and industry technology are almost unlimited. The project will establish firm handholds for the use of nanoparticles able to communicate from one to another and with cells in different applications. The project will trace, optimise and adapt all single steps from the idea to its implementation into applicable final systems with the aim of targeting issues that are difficult to address with conventional single particles. The project is divided into three WPs. The first work package (WP1) will create the basic elements for chemical communication. In a more complex situation, WP2 will use the tools of WP1 to develop systems able to establish communication between nanoparticles and living systems. Finally, WP3 will generate nano-systems integrating gated nanoparticles and up-to-date electronics to develop new communication structures.

Link to the ERC project webpage:

Keywords of the ERC project: communication, nanoparticles

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101054751	**COLDOC**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Peter Richard Schreiner**
Host Institution:	JUSTUS-LIEBIG-UNIVERSITAET GIESSEN - DEU

Cold Organic Chemistry

This proposal ventures into organic chemical reactions under not-so-common conditions, namely in the cold, at insufficient energies, and under the action of hard radiation. As many organic molecules have been discovered in space or brought to earth in meteorites, they must have formed under such conditions through hitherto largely undisclosed mechanisms. One key hypothesis is that quantum-mechanical tunneling (QMT) and novel reactions with exceptionally low barriers are at work. Hence, one of the key objectives is to uncover how QMT, where reactions occur through and not over barriers, controls chemical reactivity and selectivity. A second goal is the examination of cryogenic reactions of hydroxycarbenes or enols with carbonyl compounds. Our methods include organic synthesis of starting materials (also isotopically labelled) and products, infrared as well as ultaviolet/visible matrix-isolation spectroscopy, ab initio computations of structures, spectra, and potential energy surfaces as well as QMT rate calculations. We will examine isotope-selective reactions of competing QMT reactions that can be made selective through strategic isotope incorporation. QMT also offers new ways to activate carbon dioxide and even to catalyze reactions. We propose a unifying synthesis of carbohydrates and alpha-amino acids through a common mechanistic scenario, namely a newly discovered hetero-carbonyl-ene reaction of carbenes or enols in the gas phase. Finally, chemistry far from thermodynamic equilibrium is explored with probing the activation and reaction of highly stable molecules under irradiation with energetic electrons, thereby mimicking conditions of the interstellar medium exposed to galactic cosmic rays. This should shed light on the formation of larger “complex organic molecules” found in this medium and often considered as building blocks for life.

Link to the ERC project webpage:

Keywords of the ERC project: molecules of life, quantum tunneling, matrix isolation

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101075357	**GLYCOFOLD**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Martina Delbianco**
Host Institution:	MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV - DEU

Glycan foldamers: designing oligosaccharides to build three-dimensional architectures

Natural biopolymers have inspired the development of synthetic analogues – i.e. foldamers – capable of adopting defined conformations and forming programmable three-dimensional architectures. These compounds are mainly based on peptides and nucleic acids, that are well understood at the molecular level. The diversity, intrinsic chirality, and ability to generate hierarchical assemblies suggest that carbohydrates hold an even larger potential for the generation of three-dimensional structures. However, the complexity of carbohydrate synthesis and structural analysis have prevented access to synthetic carbohydrates capable of adopting defined geometries. I propose the creation of carbohydrate foldamers capable of 1) adopting rigid secondary structures and 2) assembling into supramolecular architectures. To achieve these goals, we will address fundamental questions related to carbohydrate structure, design new methods to stabilize particular conformations, and we will implement protocols for systematic structural analysis. State-of-the-art synthetic platforms (i.e. automated glycan assembly) and analytical techniques (i.e. NMR spectroscopy, microED, and single molecule imaging) will be the tools to complete this ambitious project. My group has proved to be very successful at gaining a basic understanding of carbohydrate structure and aggregation. Building upon these preliminary results, I aim to develop programmable carbohydrate architectures, which have the potential to open a new field of carbohydrate and supramolecular chemistry. Analogous to the birth of a new field after the discovery of peptide-based foldamers, carbohydrate foldamers could find applications in several areas, including material science, biology, and catalysis. Moreover, carbohydrate foldamers will expand our understanding of carbohydrate structures and interactions, and new analytical protocols will standardize the characterization of carbohydrate materials.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101087685	**PhosphatNGs**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Carlos Romero Nieto**
Host Institution:	UNIVERSIDAD DE CASTILLA - LA MANCHA - ESP

Design, Synthesis and Applications of Phospha(twisted)NanoGraphenes

Nano-Graphitic molecules (NGs) are pivotal for existing microelectronics and the development of emerging technologies: wearable electronics, artificial skins and nerves, etc. Their outstanding semiconducting properties rely on the efficient overlap of their carbon-scaffold and the spatial disposition of molecules. If we could twist the planar framework of NGs, diversify their pi-scaffold with heteroatoms, while keeping control over the molecular organization, we could modify their properties and access innovative materials with uncharted research opportunities for organic electronics. Through an innovative approach, I target to insert phosphorus heterocycles into (twisted)NGs as tools to tailor their properties and meticulously control their molecular arrangement. With Phospha(t)NGs, I will provide a highly versatile protocol for the preparation of novel, twisted phospha-NGs. Thanks to the unique chemistry of phosphorus, I aim at establishing an unconventional methodology to sequentially organize NGs into hierarchical architectures. My groundbreaking approach will lead to materials that were inaccessible to date as organophosphorus chemistry was too immature so far. Through an arsenal of spectroscopic techniques, I will achieve the first comprehensive investigation on the impact of heteroatoms into the twisting-induced properties of NGs. The outcomes of Phospha(t)NGs will have a wide range of applications. Here, I will test selected individual and assembled phospha-NGs as chiroptical materials and as prototypes of field-effect transistor sensors, laying the foundation for new research opportunities in material science. Thus, Phospha(t)NGs will consolidate the bedrocks for new, cutting-edge fields of research, whose development will clearly extend beyond the time-scale of this proposal.

Link to the ERC project webpage:

Keywords of the ERC project: molecular materials, synthesis, organophosphorus materials, phosphorus heterocycles, chiroptical properties

Keywords that characterize the scientific profile of the potential visiting researcher/s: synthetic chemist with speciality in organic molecular materials or organometallic chemistry from main group elements

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101095974	**NEHA**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Liberato Manna**
Host Institution:	FONDAZIONE ISTITUTO ITALIANO DI TECNOLOGIA - ITA

Nanoscale Epitaxial Heterostructures Involving Metal Halides

Building epitaxial interfaces between two materials that match each other with atomic precision is key to control the flow of electrons in many technological devices spanning electronics, optics and catalysis. Today, these interfaces are realized also with colloidal nanocrystals, for example in the strongly light emitting core/shell quantum dots used in TV displays. For nanocrystals, the synthesis of epitaxial interfaces based on traditional semiconductors (metal chalcogenides/pnictides, etc.) is well consolidated, while it has been much more challenging with metal halides (including the popular halide perovskites), for two reasons: (i) the attempt of coupling materials that are structurally very different from each other; (ii) the high reactivity of metal halide nanocrystals that defies conventional approaches to make heterostructures. This is regretful, considering that many applications (in lighting, energy conversion, catalysis, etc.) would greatly benefit from the ability to grow heterostructures, also considering the variety of materials belonging to the metal halide family. In NEHA, I will turn the intrinsic reactivity of metal halide nanocrystals into an opportunity to re-design synthetic strategies of nanoscale epitaxial nano-heterostructures in which at least one component is a metal halide. I will leverage on our recent discovery that these heterostructures can form when there is a continuity of ionic sublattices, ensuring that the local coordination of ions at the interface is similar in both components. My aims are to: i) identify materials that can be coupled to form epitaxial heterostructures; ii) uncover the synthesis conditions to make these nano-heterostructures; iii) study their properties, also with advanced techniques and modelling, and transformative behaviour; iv) exploit them in proof-of-concept applications that will benefit from the presence of metal halide interfaces. These will include photocatalysis, photoharvesting and photonic devices.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101115164	**NANOGROWDIRECT**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Leonardo Scarabelli**
Host Institution:	UNIVERSIDAD DE CANTABRIA - ESP

Nanoparticles in Situ Surface Growth for Direct Fabrication of Functional Patterned Nanomaterials

Due to their unique physicochemical properties, nanopatterned surfaces can contribute to important technological innovations for efficient optical and communication devices, long-lasting batteries, and ultrasensitive diagnostic devices. Bottom-up synthesis enable to construct nanomaterials atom-by-atom from precursors using synthetic chemistry, usually producing colloidal nanoparticle suspensions that are later assembled on a surface. Alternatively, the fabrication process can be greatly simplified by instead applying bottom-up growth directly on a substrate. However, these “in situ” growth routes remain largely unexplored and poorly understood. To address this knowledge gap and improve versatility and quality of this class of approaches, I propose to use an unconventional methodology called “chemical contrast in situ growth” or CC-iSG, where precise nanometric chemical contrast drives nanostructure formation at pre-determined sites. With NANOGROWDIRECT, I will develop a foundational understanding of CC-iSG through the interrogation of fundamental synthetic aspects, and maximize its potential for achieving exemplary control over nanoscale properties of nanosurfaces and metamaterials. I will interrogate the effect of the identity, concentration, and delivery of various reactants to the pre-determined reaction sites, with focus on chemical control (Objective 1) and fluid dynamic control (Objective 2). I will also test the use non-chemical external factors, such as electromagnetic fields (Objective 3), and electrochemical potentials (Objective 4). In the short term, CC-iSG will open up unexplored directions for engineering physicochemical properties of patterned nanosurfaces, combining wet-chemistry and external stimuli. Consequently in the long term, the far-reaching impacts of NANOGROWDIRECT will go beyond the field of nanochemistry, and yield breakthroughs in (photo/electro)catalysis, energy production and storage, medicine, and communications.

Link to the ERC project webpage: https://nanooddlab.unican.es/project-1/

Keywords of the ERC project: Plasmonics, metasurfaces, in situ growth, soft lithography, electrochemistry, microlfuidics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101115752	**BioLure**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Shiqi Wang**
Host Institution:	HELSINGIN YLIOPISTO - FIN

Quantitative analysis of endosomal escape and intracellular delivery via bioorthogonal luminescent reaction

Intracellular delivery of membrane-impermeable biomacromolecules is essential for a broad spectrum of life sciences, ranging from fundamental biological studies to applied biomedical and pharmaceutical sciences. Despite the great efforts in developing new intracellular delivery nanocarriers in the recent 20 years, simple, high-throughput, and accurate intracellular delivery quantification in live cells is still technically challenging. In BioLure, I propose an unconventional approach to quantify intracellular delivery and endosomal escape by a bioorthogonal luminescent reaction in live cells. Instead of a bulky fluorophore, I will label the molecule of interest (MOI) to be delivered with a single amino acid tag, which causes minimal changes in MOI's physicochemical properties and functions. The tag will generate luciferase substrate inside live cells upon successful translocation into the cytoplasm by bioorthogonal reactions with chemoselectivity, rapid kinetics, biocompatibility, and high efficiency. The quantification strategy will initially be applied to the intracellular delivery of proteins via physical membrane disruption and validated by complementary methods. It will then be expanded to nanocarrier-mediated endosomal escape with different MOIs, including therapeutic siRNAs. The successful endosomal escape quantification will allow further nanoparticle screening for siRNA delivery. I envision that BioLure will lead to a paradigm shift in the intracellular delivery field, facilitating the transformation from qualitative routine fluorescence imaging to high-throughput real-time quantification. The high sensitivity and low background make it an appealing tool for biologists to study endosomal escape and for material scientists to develop potent next-generation non-viral intracellular nanocarriers. Eventually, it will facilitate the design and screening of endosomal escape carriers and future nanomedicine formulations.

Link to the ERC project webpage:

Keywords of the ERC project: gene delivery, bioorthogonal reaction, intracellular reporter, endosomal escape, lipid nanoparticles

Keywords that characterize the scientific profile of the potential visiting researcher/s: endocytic trafficking, endosomes, lysosomes, chemical biology, reporter proteins, PROTAC, RNA aptamer, bioconjugation, fluorogenic proteins, fluorogenic RNA

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Project ID:	Project Acronym:	Evaluation Panel:
101117070	**ConCASM**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Prince Amaniampong**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Controlling Cavitation for the Activation of Small Molecules

Sonochemistry is the use of ultrasound to facilitate chemical reactions. Chemical reactions requiring stringent conditions can be effectively carried out using sonochemistry at ambient conditions. The current state of sonochemistry is limited by the low efficiencies in converting electrical energy to cavitation energy for free radical generation. This makes the application of ultrasound for chemical synthesis an expensive technique in terms of energy per productivity. Controlling cavitation with novel catalytic cavitation agents (CCA) to reduce energy requirement for inertial cavitation will open a new paradigm for sonochemistry, potentially impacting the catalytic chemistry, acoustic and sonochemistry communities and opening opportunities to address challenges faced by chemists in sustainable chemicals synthesis. The objective of my project is to systematically progress towards deep understanding of cavitation bubbles generation through in-situ observation approaches, engineering of multifunctional catalytic cavitation agents and machine learning. This will exert better control on the formation, uniformity and collapse location of cavitation bubbles thereby significantly reducing acoustic energy requirement for inertial cavitation. I will synthesize multifunctional transition metal oxides catalytic cavitation agents, investigate and optimize their structure/properties relationships in response to acoustic cavitation. This project offers a unique integration of approaches, competences and resources in material science (synthesis of CCAs), physics (modelling) and chemistry (activation of small molecules). The iterative project focus on the most fundamental understanding of the physical mechanisms, will allow for substantial progresses into the complex phenomenon of sonochemistry and sonocatalysis.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101117639	**Glyco13Cell**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Luca Unione**
Host Institution:	ASOCIACION CENTRO DE INVESTIGACION COOPERATIVA EN BIOCIENCIAS - ESP

Isotopically labelling of cell surface glycans to illuminate infectious processes at atomic resolution

Every human cell is covered by a dense coat of glycans (sugars, carbohydrates). Sugars are the first molecules that viruses encounter when they approach host cells. Many viruses encode lectins to adhere to the outer glycan layer and start infection. In this scenario, Glycoscience holds a tremendous potential for combating infections. Elucidating the molecular basis of infection is essential, but far from trivial. The complexity of the chemistry of glycans, including synthesis, structure, conformation, and dynamics hampers the full knowledge of sugar-mediated recognition events and the development of glycan-based drugs.

Surfing the current information on glycan/lectin interactions, we stumble in contradictory outcomes, pointing out the tremendous difficulty of translating in vitro results to the in vivo environment, which limits the translation from the bench to clinics.

I propose an unprecedented strategy to untangle the key glycan's molecular interaction features breaking the limits in answering fundamental questions related to sugar structure, presentation, dynamics, and eventually function. I will chemically remodel the glycans, directly on the cell surface, using NMR active probes to decode their roles at atomic resolution, while preserving their presentation in a near-to-in-vivo environment.

I am in a favoured position to accomplish this project due to my experience in NMR, synthesis, and mammalian cells manipulation. I will combine chemical biology tools, novel chemical and enzymatic synthesis, and NMR-based methods: From chemistry to biology and beyond.

Glyco13Cell will gap down the observed differences between in vitro and in vivo results paving the way for develop novel glycan-based tools for predicting, diagnosing and treating infectious diseases.

Now it's time. The increasing understanding of infection biology with the atomic precision of modern chemical tools will make glycomics run in parallel with genomics & proteoms towards personalized medicine.

Link to the ERC project webpage:

Keywords of the ERC project: Viral Infection, chemo-enzymatic synthesis, cell engineering, NMR probes, Molecular Interactions

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101124411	**EVA**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Milena Patricia Arciniegas**
Host Institution:	FONDAZIONE ISTITUTO ITALIANO DI TECNOLOGIA - ITA

Tailoring Organic-Inorganic Layered Structures to Build Functional Graded 2D Nanomaterials for Advanced Nanointerfaces

Advanced functional devices require integration of distinct materials (polymers, ceramics, metals) with different properties to achieve high performance in aerospace, biomedicine, electronic, and automotive. A major structural challenge is associated with localized (mechanical, thermal, electrical) stresses due to property mismatch at different scales, thus causing premature malfunction and failure. Research has focussed on compositional or structural material gradients (in at least one spatial direction) to enable fabrication of "in-one" body parts (mostly inorganics) with exceptional properties. Examples at rather macroscale include AlGaAs with graded bandgap for solar cells, or Al2O3/Ti with graded mechanical stiffness for bioimplants. However, in light of miniaturization technology, there is a need to translate this concept to nanomaterials. The EVA project aims to establish scientific principles to design and fabricate pioneering organic-inorganic 2D layered nanomaterials with functional gradients and continuous interfaces. My approach to designing such innovative nanomaterials is based on their compositional engineering by using correlations to perform an extended mapping of combinations and properties. I will explore self-assembly techniques in solution and translate them into automated processes to hierarchically build robust components with nm-layered thicknesses and mechanical and optoelectronic gradients. EVA will also demonstrate their use as advanced interfaces for soft bio-tissue coupling and flexible lighting nanosystems, providing answers from the nanoscale to key drivers in these fields: reliability, robustness, and durability. Through this interdisciplinary approach (physics, chemistry, mechanics, biology, and materials science), the envisioned atomically designed hybrids will be a hallmark for frontiers in fields such as energy, health, robotics, and digital technologies.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: robotic material chemistry, 2D graded structures, nanomaterials, solution processes, mechanical and optical properties

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101162465	**SeleCStem**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Laia Josa-Culleré**
Host Institution:	AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS - ESP

Exploiting the activity of the ALDH enzyme to develop highly selective drugs for cancer stem cells

Despite huge advances in cancer treatment, resistance to chemotherapy is still common. It is now well established that a small population of cells named cancer stem cells (CSCs) have high tumorigenicity and are able to initiate and maintain a tumour. CSCs usually remain in a quiescent state that is not affected by standard chemotherapy; thus, they are often responsible for treatment resistance and relapse. There is a clear need to find effective treatments against CSCs to fully eradicate the tumour. However, the close similarities of CSCs to healthy stem cells hinders the identification of selective drugs.

In the last years, new drug modalities are emerging to provide therapeutic options for challenging targets and diseases, expanding the drug discovery landscape. In line with these trends, SeleCStem aims to develop innovative chemical biology strategies to target CSCs in a safe and effective manner. It will exploit the activity of the enzyme ALDH, which is overexpressed in CSCs of many cancer types, to obtain selective drugs using three orthogonal strategies: we will use the oxidoreductase activity of ALDH to trigger the selective (1) accumulation or (2) release of drugs inside CSCs and (3) use external light to inhibit ALDH only in the tumour area. Successful strategies will be combined at the end of the project to overcome potential limitations of the individual approaches, hence massively increasing the drugs' selectivity and efficacy. We will design these molecules with the aid of docking studies, synthesise them, and assess their ALDH- or light-triggered activation in purified enzyme assays and in CSC spheres.

Overall, we will develop the proof of concept of unprecedented approaches to eliminate CSCs with outstanding precision, thus overcoming some of the limitations of conventional small molecules going beyond state-of-the-art chemical biology. Our ultimate goal is to contribute to improve cancer treatment and increase complete remission rates.

Link to the ERC project webpage:

Keywords of the ERC project: medicinal chemistry; cancer stem cells; oncology; photopharmacology; ALDH; organic chemistry

Keywords that characterize the scientific profile of the potential visiting researcher/s: medicinal chemist; organic chemist; pharmacist

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101162721	**INTERCHAIN**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Florian Glöcklhofer**
Host Institution:	TECHNISCHE UNIVERSITAET WIEN - AUT

Conjugated polymers with interchain aromaticity

INTERCHAIN aims to develop and investigate a ground-breaking new molecular design concept for conjugated polymers. The concept is expected to enable the occurrence of stacked-ring aromaticity between polymer chains, drastically advancing our fundamental understanding of stacked-ring aromaticity and introducing a route to exploit this effect for the development of conjugated polymers with excellent charge transport properties. For conjugated polymers with excellent charge transport properties, strong intermolecular interactions are needed, which is difficult to achieve without compromising processability. However, as an emerging class of organic molecules, conjugated macrocycles provide an exciting playing field for the discovery of effects and properties that cannot usually be achieved. In contrast to other molecules, conjugated macrocycles can sustain global aromatic or antiaromatic ring currents, offering exciting prospects to enhance the properties of conjugated materials by enabling exceptionally strong intermolecular interactions. If the macrocycles used are antiaromatic, the interactions between two macrocycles can even result in stacked-ring aromaticity. Integrated into the backbone of conjugated polymers, such macrocycles may enable interchain stacked-ring aromaticity and interchain π-electron delocalisation, in addition to intrachain π-electron delocalisation. However, the inherent instability of the required antiaromatic molecules poses a tremendous challenge for the investigation of stacked-ring aromaticity and prevents the development of polymers that exploit this effect. INTERCHAIN proposes a ground-breaking new molecular design concept that overcomes this challenge by eliminating the need for antiaromatic molecules to achieve stacked-ring aromaticity. The project will drastically advance our fundamental understanding of stacked-ring aromaticity, but it will also yield highly stable conjugated polymers with excellent properties for applications.

Link to the ERC project webpage: https://research.gloecklhofer.eu/

Keywords of the ERC project: conjugated macrocycles, conjugated polymers, organic semiconductors, stacked-ring aromaticity

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101164285	**IMPACT**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Ina Vollmer**
Host Institution:	UNIVERSITEIT UTRECHT - NLD

In-situ Mechano-catalysis for Polymer Activation and ConTrolled Conversion

Less than 9% of plastic is recycled. Currently applied recycling technology yields degraded materials because undesired mechano-chemical bond cleavage shortens the polymer upon repeated processing. Here, I introduce a new type of catalyst to exploit this undesired effect to recover the polymer building blocks, the monomers, which enables the production of new high-quality polymer. I will focus on polyolefins (PP, PE) that make up 50% of polymer production and for which the state-of-the-art pyrolysis process has high energy costs and does not yield pure monomer. That is because at the 600 °C needed to break the strong carbon-carbon (C-C) bonds of PP and PE unwanted reactions occur. Adding a catalyst powder, a known strategy to exert reaction control, is inefficient for polymers because they cannot reach the active sites in the catalyst pores.

I will break the C-C bonds with force instead of heat. The force is provided by collision of balls in a ball mill, a mature grinding technology that I repurpose as reactor to introduce my tunable direct mechano-catalyst: I will chemically treat the surface of the balls to create catalytic, e.g., acid, sites that are in efficient contact with polymer through vigorous ball movement. In our ground-breaking proof-of-concept experiment, we were surprised to see monomer form below 60 °C from PP, and a remarkable 4x increased activity over a traditional catalyst.

To realize the full potential of this new catalytic concept, I will establish the underlying fundamental framework by A) understanding the mechanism of reactions following C-C cleavage, B) developing a predictive model of cleavage rate as a function of temperature and force and C) understanding the synergistic interplay of catalytic spheres and mechano-chemical activation. To achieve this, I will develop a new methodology for in-situ spectroscopy during ball milling in combination with radical trapping and apply the tunable direct mechano-catalysts to a variety of polymers.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101165395	**eBioNetAniMat**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Oliver Maguire**
Host Institution:	THE UNIVERSITY OF BIRMINGHAM - GBR

Electrochemically Programmable Biochemical Networks for Animate Materials

Life's biological materials are animate materials, capable of adapting to their surroundings via actively changing in response to the environment. A key distinguishing feature of animate materials is their ability to autonomously make decisions over how to respond. An example of an animate material is your skin: on cold days the hairs on your skin rise to trap warm air without your conscious thought. The ability of living materials to make decisions arises from biochemical reaction networks (e.g. protein signalling) in the material. The networks process environmental information and decide how to adapt the material in response. Artificial animate materials promise to be superior for many applications (e.g. soft robots, MedTech) compared to their inert counterparts as their decision-making abilities will enable them to leverage advantageous events into better outcomes and limit the damage from disadvantageous ones. However, currently, there is not a well-established route to fabricate artificial animate materials. eBioNetAniMat charts a pathway to a new generation of electrochemically programmable artificial animate materials that act as soft actuators capable of autonomously making decisions about their movement. Novel, protein-based chemical reaction networks integrated into the actuators will process electrochemical stimuli and make decisions over how to generate chemo-mechanical motion, e.g. peristalsis, rotation. I will develop a method for electrochemically controlling protein-activity and use this to construct a series of novel, electrochemically programmable protein networks of increasing complexity. I will develop a new method for electrochemical fabrication of patterned hydrogels with new protein redox-binding tools. Finally, I will unite the new protein networks and gels together to make novel artificial animate actuators, that will be biocompatible, integrable with electronic devices and have potentially transformative impacts in MedTech + soft robots.

Link to the ERC project webpage: https://www.maguire-research-group.com/

Keywords of the ERC project: Systems Chemistry, Chemical Reaction Networks, Enzymes, Physical Organic Chemistry, Hydrogels, Electrochemistry,

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101166026	**MAX-FOX**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Conrad Goodwin**
Host Institution:	THE UNIVERSITY OF MANCHESTER - GBR

Maximising f-element oxidation states

The applicant is a rising early-career scientist with an international reputation in frontier rare earth and actinide science. This StG project melds synthesis and electrochemistry with computational and spectroscopic methods to afford a transformative advancement in electronic structure and oxidation state control in f-elements. By advancing our understanding of the design principles which influence the properties of these complexes, we propose to maximise their stability and expand beyond the current approaches to isolate molecular lanthanide species in unprecedented high oxidation states.

We target high oxidation state lanthanide (Ln), actinide (An), and transuranium f-element complexes beyond the current state-of-the-art by expanding to novel ligand platforms which address all key aspects to maximize the thermodynamic, and hence electrochemical, stability of these powerful oxidisers. We will show that the range limit of tetravalent Ln ions available to solution chemistry has not been reached.

By accessing high oxidation states we will isolate multiply bonded motifs to Ln(IV) beyond Ce for the first time, including iconic organometallic linkages which offer unique spectroscopic (EPR and NMR) handles with which to probe the bonding in these systems. This will be extended to actinide and transuranium elements, affording unprecedented opportunities to gain insight into orbital energy vs spatial overlap components in bonding, and probe the relative magnitudes of inter-electronic repulsion, spin-orbit coupling, and crystal field effects in f-elements.

An StG will provide resources required to bring this ambitious project to fruition. We will address the rarity of high oxidation state 4f-elements and define the chemical properties that can be leveraged to control their electronic structures. This addresses the Quantum Flagship, a key Horizon 2020 priority area, and will train a cohort of interdisciplinary scientists essential for the scientific goals of the EU.

Link to the ERC project webpage: https://www.capgoodwin.com

Keywords of the ERC project: Lanthanides actinides organometallic coordination chemistry

Keywords that characterize the scientific profile of the potential visiting researcher/s: Early career synthetic chemist

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101169746	**BiMetalGAS**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Jesus Campos**
Host Institution:	AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS - ESP

Low-Coordinate Bimetallics for the Catalytic Activation of Carbon Dioxide, Nitrous Oxide and Ammonia

The catalytic conversion of carbon dioxide, nitrous oxide and ammonia poses a major challenge in modern chemistry due to the high inertness of their strong chemical bonds. These gaseous molecules are abundant and cheap. Therefore, their use as C1, O1 and N1 building blocks in synthetic chemistry entails remarkable environmental and economic advantages. Nonetheless, there are yet many limitations to meet their true synthetic potential and industrial applicability, which clearly demands innovative catalytic solutions.
In BiMetalGAS, I will develop two unique families of tailor-made heterobimetallic complexes specifically designed for the catalytic activation of carbon dioxide, nitrous oxide and ammonia.
The two types of cooperative bimetallic catalysts are: (i) highly polarized bimetallic complexes and (ii) transition metal/heavier tetrylene (Ge, Sn) compounds. The high polarization of the former and the distinct and flexible bonding of the latter, will enable the activation and cleavage of the strong bonds within CO2, N2O and NH3. Importantly, these systems will share for the first time the key feature of exceptionally low-coordination environments, a design principle mostly underdeveloped in bimetallic chemistry. This will unlock the main mechanistic bottlenecks associated to highly challenging catalytic transformations of these gaseous molecules by reducing the existing energetic barriers through metal-metal cooperation or by introducing alternative pathways based on bimetallic synergisms. Of high synthetic feasibility, the targeted catalysts will offer a range of tunable features and a landscape of multi-site molecular reactivity unattainable for mononuclear complexes.
This project will offer cutting-edge science to transform cheap and abundant, yet largely inert gaseous molecules. Through groundbreaking bimetallic synergies, BiMetalGAS will set new grounds towards a more sustainable production of large-scale commodity chemicals with broad ranging applications.

Link to the ERC project webpage:

Keywords of the ERC project: Catalysis; Organometallic; Bimetallic

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101169813	**Lighthouse**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Seraphine Wegner**
Host Institution:	UNIVERSITAET MUENSTER - DEU

Light as a signal for nonchemical cell-to-cell communication in synthetic and biological cell communities

Engineering cell-to-cell communication is fundamental –yet highly challenging– for programming multicellular systems and interfacing living and biomimetic synthetic cells. The problem lies in developing specific communication that is independent of existing chemical signaling and in connecting it to cell behavior. Both the high complexity of intercellular signaling in living cells and the fairly limited capabilities of synthetic cells severely restrict possibilities to engineer communication in and between these two realms. Here, I propose a new nonchemical mode of cell-to-cell communication that operates with light as a signal. I aim to develop sender cells that produce visible light as a signal that corresponding receiver cells respond to. In this light-based communication, the signal will propagate at the speed of light independent of diffusion, will cross optically transparent barriers without the need for membrane transporters, and will allow communication even between physically separated cells. Also, the light signal will be orthogonal of native chemical signals, resulting in high specificity and no cross talk. First, I will establish light-based communication in molecularly defined synthetic cells to decipher the central rules of this new mode of communication. Detailed characterization (light generation, response, distance, dynamics, orthogonality) of light-based communication will provide the framework for later programming of multicellular behavior. Second, I will transplant light-based communication into bacterial and mammalian cells, showing for the first time that communication with light is possible at the cellular level. Last, I will engineer diverse communities of living and synthetic cells with light-based communication showing various behavior, including collaboration, predation, and defense. Ultimately, this will pave the way for an independent, highly modular, nonchemical mode of communication for cellular bionics and cellular bioengineering.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101170207	**PhagoSynCell**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Cesar Rodriguez-Emmenegger**
Host Institution:	FUNDACIO INSTITUT DE BIOENGINYERIA DE CATALUNYA - ESP

Design and Chemical Construction of Quasi-living Phagocytic Synthetic Cells for Artificial Phagocytosis of Bacteria

The growing occurrence of antimicrobial-resistant infections, compounded with the stalling development and approval of new antibiotic drugs, has created a therapeutic gap, threatening a global health crisis. Resistance emerges when bacteria mutate their molecular targets for antibiotics, evading their action. Is it conceivable to design synthetic cells assembled from abiotic synthetic macromolecules, capable of mimicking the most salient features of phagocytosis —Nature's most selective, effective, and advanced strategy to eradicate pathogens? The aim of PhagoSynCell is to create Phagocytic Synthetic Cells (PSCs) that selectively recognize, capture, engulf and kill antibiotic-resistant bacteria without generating selection pressure for resistance. Firstly, we will develop the membrane of the PSCs by the simulation-aided synthesis of novel macromolecular amphiphiles (Janus dendrimers and amphiphilic comb polymers) self-assembled into vesicle libraries with functional diversity and phenotype programmability. We will then study novel methods to facilitate engulfment of micro-objects by leveraging principles of mechanical actuation programmed at the molecular level. We will introduce superselectivity to artificial membranes to selectively capture bacteria. Furthermore, we will develop an antimicrobial strategy triggered and activated by engulfment that disrupts the bacterial membrane —an element highly unsusceptible to evolution. Finally, we will demonstrate the efficacy of PSCs against pathogenic antibiotic-resistant strains and show their biosafety in cells, organoids, and advanced tissue models as proof-of-concept for future applications. PhagoSynCell will unveil the underlying principles of Artificial Phagocytosis, delivering synthetic cells able to selectively recognize and kill bacteria. Ultimately, this will provide the steppingstone towards the use of synthetic cells as a quasi-living therapeutic —a field I envision will revolutionize medicine.

Link to the ERC project webpage:

Keywords of the ERC project: synthetic cells, antimicrobials, polymer chemistry

Keywords that characterize the scientific profile of the potential visiting researcher/s: synthetic cells, antimicrobials, polymer chemistry, hemocompatibility, polymer brushes

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101170534	**CUBIC**	**PE5** Synthetic Chemistry and Materials

Principal Investigator:	**Dr Aurelien De La Torre**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Chiral bUilding Blocks with bRidged or Caged polyclic structures

"Drug candidates should have a higher proportion of Csp3 over Csp2 and Csp and a greater number of stereogenic centers". That is essentially the message of F. Lovering et al. in their seminal article "Escape from Flatland" published in 2009 which induced a paradigm change in drug design. The first recommendation (higher proportion of Csp3) has opened a new field of research over the last 15 years, in a quest aiming at the synthesis and functionalization of small rigid polycyclic (bridged or caged) molecular scaffolds, used as building blocks in medicinal chemistry and particularly as bioisosteres of aromatics. This quest has strongly influenced academic and industrial research in organic and medicinal chemistry. However, the second recommendation (more stereogenic centers) was largely unmet due to the lack of efficient methods for the enantioselective synthesis of such chiral rigid polyclic structures. In this project, we will develop an array of synthetic methods involving diverse enantioselective cycloadditions reactions and cascade transformations to fill this essential gap in knowledge. Ultimately, we will apply these methods to the enantioselective synthesis of various bridged and caged polycyclic scaffolds, which could become the building blocks of the future in drug design. In particular, we propose to achieve the first enantioselective synthesis of a polysubstituted cubane scaffold, a long-standing challenge in asymmetric synthesis. We will also apply these synthetic approaches to the unprecedented enantioselective total synthesis of various polycyclic natural products. Knocking down the scientific barrier of enantioselective synthesis of bridged and caged rigid molecular scaffolds will have huge repercussions for the fields of organic chemistry and asymmetric synthesis, through the development of new synthetic methods and total syntheses, but also for medicinal chemistry and drug discovery, via the design of the next generation of building blocks.

Link to the ERC project webpage:

Keywords of the ERC project: Organic synthesis, enantioselective catalysis, total synthesis

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101001995	**FRESCO**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Assia Mahboubi**
Host Institution:	INSTITUT NATIONAL DE RECHERCHE EN INFORMATIQUE ET AUTOMATIQUE - FRA

Fast and Reliable Symbolic Computation

The use of computers for formulating conjectures, but also for substantiating proof steps, pervades mathematics, even in its most abstract fields. Most computer proofs are produced by symbolic computations, using computer algebra systems. Sadly, these systems suffer from severe, intrinsic flaws, key to their amazing efficiency, but preventing any flavor of post-hoc verification. But can computer algebra become reliable while remaining fast? Bringing a positive answer to this question represents an outstanding scientific challenge per se, which this project aims at solving. Our starting point is that interactive theorem provers are the best tools for representing mathematics in silico. But we intend to disrupt their architecture, shaped by decades of applications in computer science, so as to dramatically enrich their programming features, while remaining compatible with their logical foundations. We will then design a novel generation of mathematical software, based on the firm grounds of modern programming language theory. This environment will feature a new, high-level, performance-oriented programming language, devised for writing efficient and correct code easily, and for serving the frontline of research in computational mathematics. Users will have access to fast implementations, and to powerful proving technologies for verifying any component à la carte, with high productivity. Logic- and computer-based formal proofs will prevent run-time errors, and incorrect mathematical semantics. We will maintain a close, continuous collaboration with interested high-profile mathematicians, on the verification of cutting-edge research results, today beyond the reach of formal proofs. We ambition to empower mathematical journals to install high-quality artifact evaluation, when peer-reviewing falls short of assessing computer proofs. This project will eventually impact the use of formal methods in engineering, in areas like cryptography or signal-processing.

Link to the ERC project webpage:

Keywords of the ERC project: Formal proofs, Rocq, computer algebra

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101040177	**SAML**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Isabel Valera**
Host Institution:	UNIVERSITAT DES SAARLANDES - DEU

Society-Aware Machine Learning: The paradigm shift demanded by society to trust machine learning.

To date, the design of ethical machine learning (ML) algorithms has been dominated by technology owners and remains broadly criticized for strategically seeking to avoid legally enforceable restrictions. In order to foster trust in ML technologies, society demands technology designers to deeply engage all relevant stakeholders in the ML development.

This ERC project aims at responding to this call with a society-aware approach to ML (SAML). My goal is to enable the collaborative design of ML algorithms, so that they are not only driven by economic interests of the technology owners but are agreed upon by all stakeholders, and ultimately, trusted by society. To this end, I aim to develop multi-party ML algorithms that explicitly account for the goals of different stakeholders---i.e., owners, those experts that design the algorithm (e.g., technology companies); consumers, those that are affected by the algorithm (e.g., users); and regulators, those experts that set the regulatory framework for their use (e.g., policy makers). The proposed methodology will enable quantifying and jointly optimizing the business goals of the owners (e.g., profit); the benefits of the consumers (e.g., information access); and the risks defined by the regulators (e.g., societal polarization).

The SAML project involves a high-risk/high-gain paradigm shift from an owner-centered to a society-centered (multi-party) ML design. On the one hand, it will require significant and challenging methodological innovations at every stage of the ML development: from the data collection all the way to the algorithm learning. On the other hand, it will impact how ML technologies are deployed in society by enabling an informed discussion among different stakeholders and, in general, by society about these new technologies. The results of this project will provide the urgently needed methodological foundations to ensure that these new technologies are at the service of society.

Link to the ERC project webpage:

Keywords of the ERC project: Society-Centric Machine Learning; Multi-objective ML

Keywords that characterize the scientific profile of the potential visiting researcher/s: Fairnes and explainability; Probabilistic ML

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Project ID:	Project Acronym:	Evaluation Panel:
101042702	**InteVol**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Asier Marzo**
Host Institution:	UNIVERSIDAD PUBLICA DE NAVARRA - ESP

Interactions with Future Reach-Through Volumetric Displays

Displays in the shape of televisions, computer screens or phones are ever present in our education, work and entertainment. However, they do not take full advantage of our inner spatial abilities that we have to interact with the real world. True 3D displays can provide the same visual clues as the real world without forcing the users to wear devices. However, with State of the art (SoA) displays, the users cannot reach inside the display volume to directly interact with the virtual objects as they would do in real life. We envision a volumetric display capable of projecting true 3D virtual objects in mid-air that can be reached by the users to enable direct interaction, i.e. a reach-through volumetric display (RVD). This vision has been presented in multiple movies and books but there is no realization. Three novel technologies will be developed and combined to create an RVD. 1) fast time-multiplexed acoustic fields will create virtual force fields that give shape to microfabricated light-scaterring particles. 2) Tomographic illumination will shine on the particles as a more scalable alternative to phase-based holographic. 3) Volumetric tracking of the particle distribution will control the previous technologies in a closed-loop manner. Applications will serve as benchmarks to test novel interaction techniques and develop a framework that fills in the knowledge gap for interactions with as yet nonexistent RVDs. The objectives of the project are: O1) find a set of technologies that enables the realization of RVDs, O2) create interaction techniques for RVDs and categorize them using a framework that will be applicable to future displays, our current frameworks for 3d-interactions may not be applicable to RVDs. O3) enhance an RVD with tactile sensations, spatial audio and study its effects on humans. The PI is uniquely qualified with experience in designing mid-air interactions and using levitated particles for displays.

Link to the ERC project webpage: https://upnalab.com/

Keywords of the ERC project: Volumetric Displays, Direct Interaction, HCI, Ultrasound

Keywords that characterize the scientific profile of the potential visiting researcher/s: computer graphics, acoustic levitation, 3d displays, aerosols, optics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101043467	**HomE**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Antonio Peña**
Host Institution:	BARCELONA SUPERCOMPUTING CENTER CENTRO NACIONAL DE SUPERCOMPUTACION - ESP

Enabling Homomorphic Encryption of Deep Neural Network Models and Datasets in Production Environments

Deep learning (DL) is widely used to solve classification problems previously unchallenged, such as face recognition, and presents clear use cases for privacy requirements. Homomorphic encryption (HE) enables operations upon encrypted data, at the expense of vast data size increase. RAM sizes currently limit the use of HE on DL to severely reduced use cases. Recently emerged persistent memory technology (PMEM) offers larger-than-ever RAM spaces, but its performance is far from that of customary DRAM technologies. This project aims at sparking a new class of system architectures for encrypted DL workloads, by eliminating or dramatically reducing data movements across memory/storage hierarchies and network, supported by PMEM technology, overcoming its current severe performance limitations. HomE intends to be a first-time enabler for the encrypted execution of large models that do not fit in DRAM footprints to execute local to accelerators, hundreds of DL models to run simultaneously, and large datasets to be run at high resolution and accuracy. Targeting these ground-breaking goals, HomE enters into unexplored field resulting from the innovative convergence of several disciplines, where wide-ranging research is required in order to assess current and future feasibility. Its main challenge is to develop methodology capable of breaking through the existing software and hardware limitations. HomE proposes a holistic approach yielding highly impactful outcomes that include novel comprehensive performance characterisation, innovative optimisations upon current technology, and pioneering hardware proposals. HomE can spawn a paradigm shift that will revolutionise the convergence of the machine learning and cryptography disciplines, filling a gap of knowledge and opening new horizons such as DL training on HE, currently too demanding even for DRAM. HomE, based on solid evidence, will unveil the great unknown of whether PMEM is a practical enabler for encrypted DL workloads.

Link to the ERC project webpage:

Keywords of the ERC project: Homomorphic Encryption; privacy-preserving deep learning

Keywords that characterize the scientific profile of the potential visiting researcher/s: FHE for HPC

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101054961	**InterText**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Iryna Gurevych**
Host Institution:	TECHNISCHE UNIVERSITAT DARMSTADT - DEU

Modelling Text as a Living Object in Cross-Document Context

Interpreting text in the context of other texts is very hard: it requires understanding the fine-grained semantic relationships between documents called intertextual relationships. This is critical in many areas of human activity, including research, business, journalism, and others. However, finding and interpreting intertextual relationships and tracing information throughout heterogeneous sources remains a tedious manual task. Natural language processing (NLP) fails to adequately support it: mainstream NLP considers texts as static, isolated entities, and existing approaches to cross-document understanding focus on narrow use cases and lack a common, theoretical foundation. Data is scarce and difficult to create, and the field lacks a principled framework for modelling intertextuality.

InterText breaks new ground by proposing the first general framework for studying intertextuality in NLP. We instantiate our framework in three intertextuality types: inline commentary, implicit linking, and semantic versioning. We produce new datasets and generalizable models for each of them. Rather than treating text as a sequence of words, we introduce a new data model that naturally reflects document structure and cross-document relationships. We use this data model to create novel, intertextuality-aware neural representations of text. While prior work ignores similarities between different types of intertextuality, we target their synergies. Thus, we offer solutions that scale to a wide range of tasks and across domains. To enable modular and efficient transfer learning, we propose new document-level adapter-based architectures. We investigate integrative properties of our framework in two case studies: academic peer review and conspiracy theory debunking. InterText creates a solid research platform for intertextuality-aware NLP crucial for managing the dynamic, interconnected digital discourse of today.

Link to the ERC project webpage: https://intertext.ukp-lab.de

Keywords of the ERC project: Natural Language Processing, Large Language Models, multi-document reasoning, AI for Science, Misinformation Detection

Keywords that characterize the scientific profile of the potential visiting researcher/s: Natural Language Processing, Large Language Models, multi-document reasoning, AI for Science, Misinformation Detection

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101076663	**ECCC**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Noga Ron-Zewi**
Host Institution:	UNIVERSITY OF HAIFA - ISR

Error-correcting Codes and Computation

Error-correcting codes are a method for a redundant representation of data, that enables one to can recover the original data even in the presence of some noise or corruption. In addition to their wide practical applicability, error-correcting codes are also supported by a rich theory, with connections to diverse disciplines in mathematics, science, and engineering. A particularly fruitful such connection has been the interplay with the theory of computation, where on the one hand, computational methods were used for the design of error-correcting codes admitting efficient error-correction algorithms, and in the reverse direction, such codes were useful for a variety of applications within the theory of computation. The current project aims to significantly enhance the aforementioned connections. Our first main objective is to design error-correcting codes that on the one hand, achieve the best possible information-theoretic trade-off between their redundancy and error-resilience, and on the other hand, admit super-fast error-correction algorithms. We further believe that such codes are a powerful tool that can be used for boosting the efficiency of various fundamental computational tasks, and our second main objective is to explore such potential applications. We outline a couple of such potential applications within the theory of computation, to obtaining highly-efficient proof systems, fine-grained inapproximability results, fast derandomization, and code-based cryptography with low overhead. The goals we plan to pursue are fundamental and long-standing, and even a partial progress on them would be groundbreaking, with theoretical, and potentially also practical, impact. Despite the significant challenge, there has recently been an exciting progress towards these goals (including by the PI), and we consequently believe that we are now in a unique position for pursuing these goals.

Link to the ERC project webpage:

Keywords of the ERC project: Coding Theory, Error-correcting Codes, Algorithms, Complexity

Keywords that characterize the scientific profile of the potential visiting researcher/s: Computer science, Mathematics, Electrical Engineering

Project ID:	Project Acronym:	Evaluation Panel:
101077481	**ExplainYourself**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Isabelle Augenstein**
Host Institution:	KOBENHAVNS UNIVERSITET - DNK

Explainable and Robust Automatic Fact Checking

ExplainYourself proposes to study explainable automatic fact checking, the task of automatically predicting the veracity of textual claims using machine learning (ML) methods, while also producing explanations about how the model arrived at the prediction. Automatic fact checking methods often use opaque deep neural network models, whose inner workings cannot easily be explained. Especially for complex tasks such as automatic fact checking, this hinders greater adoption, as it is unclear to users when the models' predictions can be trusted. Existing explainable ML methods partly overcome this by reducing the task of explanation generation to highlighting the right rationale. While a good first step, this does not fully explain how a ML model arrived at a prediction. For knowledge intensive natural language understanding (NLU) tasks such as fact checking, a ML model needs to learn complex relationships between the claim, multiple evidence documents, and common sense knowledge in addition to retrieving the right evidence. There is currently no explainability method that aims to illuminate this highly complex process. In addition, existing approaches are unable to produce diverse explanations, geared towards users with different information needs. ExplainYourself radically departs from existing work in proposing methods for explainable fact checking that more accurately reflect how fact checking models make decisions, and are useful to diverse groups of end users. It is expected that these innovations will apply to explanation generation for other knowledge-intensive NLU tasks, such as question answering or entity linking. To achieve this, ExplainYourself builds on my pioneering work on explainable fact checking as well as my interdisciplinary expertise.

Link to the ERC project webpage: https://www.copenlu.com/

Keywords of the ERC project: Explainable AI, Natural Language Understanding, Fact Checking

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101089163	**NEON**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Hayley Hung**
Host Institution:	TECHNISCHE UNIVERSITEIT DELFT - NLD

Nonverbal Multimodal Social Intention Modelling

An under-explored problem in Social Signal Processing (SSP) is human social intent detection. SSP develops automated systems to interpret human social behaviour from sensors such as cameras, microphones, and wearables. Prior work estimating intent uses scenarios that are constrained enough so that the intent is determined by a congruent outcome. In reality, this is not true, otherwise emergent leaders are never female because they do not speak up and black minorities are criminals because they are often seen interacting with police. NEON addresses intention detection in more open-ended contexts involving large unstructured social gatherings such as networking or mingling events. During these events, there are no prearranged conversations, multiple conversations can occur at the same time, and all conversation come about via coordination with multiple independent actors with their own possibly conflicting goals. How do we train machines to perceive plausible intentions? Asking the individual to continuously report on their immediate intentions would contaminate their spontaneous social behaviour. NEON hypothesises that plausible social intentions are perceivable by external observers though the explanations of why (based on the behaviours of the individual and the surround social context) may vary depending on the perceivers own life experiences. To this end, NEON will develop a novel framework to harvest and learn from social intentions and their relation to future outcomes using a novel multi-task learning set up that clusters both on the traits of the perceivers as well as the observed individuals, a unified theory that situates conversations in free standing groups in both space and time and a novel Graphical Neural Network architecture to model it through multi-sensor cross modal learned neural representations. Aside from being a significant advance for SSP, NEON also benefits a range of other fields from human-robot interaction to organisational psychology

Link to the ERC project webpage:

Keywords of the ERC project: Multimodal Machine Learning, Social and Affective computing, intention modeling,

Keywords that characterize the scientific profile of the potential visiting researcher/s: Annotation systems, pervasive and ubiquitous computing, Situation Awareness, intention modeling, cognitive modeling, organizational psychology, learning science, social connection, nature language processing, speech enhancement, beam forming , soc

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101097959	**NFITSC**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Benny Applebaum**
Host Institution:	TEL AVIV UNIVERSITY - ISR

New Frontiers in Information-Theoretic Secure Computation

Information-theoretic secure computation is a general-purpose technique for processing sensitive data without compromising its confidentiality or integrity even in the presence of a computationally-unbounded all-powerful adversary. This notion plays an important role in cryptography, both as a stand-alone object and as a tool for computational constructs. Despite its increasing importance, we have a very limited understanding of the *intrinsic complexity* of information-theoretic security, and some of the most central feasibility questions in this area have remained open for more than three decades. In this proposal, we aim to decipher the power and limitations of this notion. We will focus on three main objectives. First, we aim to improve the complexity of general *secret sharing schemes* and exploit such improvements towards realizing highly-efficient general-purpose zero-knowledge proofs. The second objective is to explore the complexity of Secure Non-Interactive Reductions and Multiparty Randomized Encoding -- a powerful generalization of information-theoretic garbled circuits that was recently presented by the PI. The third objective is to expand our theoretical understanding of constant-round information-theoretic protocols, optimize their round complexity, and study their concrete and asymptotic computational complexity. Being part of several recent exciting developments in these areas, we believe that it is now possible to make progress in some of these basic open problems. The suggested research will bridge across different regions of computer science such as coding theory, cryptography, and computational complexity. It is expected to impact central problems in cryptography, while enriching the general landscape of theoretical computer science.

Link to the ERC project webpage:

Keywords of the ERC project: foundations of cryptography, information-theoretic cryptography, theoretical computer science

Keywords that characterize the scientific profile of the potential visiting researcher/s: strong background in foundations of cryptography/information-theoretic cryptography/theoretical computer science/TCS-oriented coding theory

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101116095	**PERSONAE**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Debora Nozza**
Host Institution:	UNIVERSITA COMMERCIALE LUIGI BOCCONI - ITA

Personalized and Subjective approaches to Natural Language Processing

My project, PERSONAE, will make language technology (LT) accessible and valuable to everyone. I will revolutionize research in subjective tasks in NLP such as abusive language detection and sentiment and emotion analysis by developing a new field called personal NLP, yielding new datasets, tasks, and algorithms. This new research area will explore subjective tasks from the perspective of the individual as information receiver, making users active actors in the creation of LTs instead of mere recipients. This will allow for a more tailored, effective approach to NLP model design, resulting in better models overall. Each person has their own interests and preferences based on their background and experience. These factors impact their views of what makes them happy, angry, or depressed over time. Language technologies (LTs) can consider individual preferences. However, current research presumes a static view of subjectivity: that a single ground truth underlies subjective tasks such as abusive language detection, an assumption that lacks human variability and prevents universal access to LTs. Language-based AI such as virtual assistants is widely available. But despite significant scientific advances, most LT applications are inaccessible to individuals and their public's opinion has become increasingly negative. GPT-3's 2020 release boosted business-oriented applications such as copywriting and chatbots, yet few that let people improve their lives—for example, by controlling what they see on social media. This gap becomes more pronounced for subjective tasks. I will design subjective LTs that can be adapted by individuals at will over time. Based on an ambitious meta approach able to generalize from existing, disconnected work, PERSONAE will rely on fully personalizable privacy-aware algorithms that can be used by anyone. It will reveal benefits of LT far beyond those of existing systems, paving the way for future applications.

Link to the ERC project webpage:

Keywords of the ERC project: Natural Language Processing; Computational Social Science; Human-centered AI

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101116395	**SPARSE-ML**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Rebekka Burkholz**
Host Institution:	CISPA - HELMHOLTZ-ZENTRUM FUR INFORMATIONSSICHERHEIT GGMBH - DEU

Cascade Processes for Sparse Machine Learning

Deep learning continues to achieve impressive breakthroughs across disciplines and is a major driving force behind a multitude of industry innovations. Most of its successes are achieved by increasingly large neural networks that are trained on massive data sets. Their development inflicts costs that are only affordable by a few labs and prevent global participation in the creation of related technologies. The huge model sizes also pose computational challenges for algorithms that aim to address issues with features that are critical in real-world applications like fairness, adversarial robustness, and interpretability. The high demand of neural networks for vast amounts of data further limits their utility for solving highly relevant tasks in biomedicine, economics, or natural sciences. To democratize deep learning and to broaden its applicability, we have to find ways to learn small-scale models. With this end in view, we will promote sparsity at multiple stages of the machine learning pipeline and identify models that are scaleable, resource- and data-efficient, robust to noise, and provide insights into problems. To achieve this, we need to overcome two challenges: the identification of trainable sparse network structures and the de novo optimization of small-scale models. The solutions that we propose combine ideas from statistical physics, complex network science, and machine learning. Our fundamental innovations rely on the insight that neural networks are a member of a cascade model class that we made analytically tractable on random graphs. Advancing our derivations will enable us to develop novel parameter initialization, regularization, and reparameterization methods that will compensate for the missing implicit benefits of overparameterization for learning. The significant reduction in model size achieved by our methods will help unlock the full potential of deep learning to serve society as a whole.

Link to the ERC project webpage: https://cispa.de/en/research/grants/sparse-ml

Keywords of the ERC project: deep learning, efficiency, graph neural networks, agentic networks, biomedical applications

Keywords that characterize the scientific profile of the potential visiting researcher/s: deep learning efficiency

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Project ID:	Project Acronym:	Evaluation Panel:
101125586	**dynaBBO**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Carola Doerr**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Dynamic Selection and Configuration of Black-box Optimization Algorithms

Black-box optimization algorithms are among the most widely applied optimization techniques in practice, used to solve numerous problems across a broad range of industrial branches and academic disciplines every day. Given this importance, it is not surprising that a plethora of different black-box optimization algorithms exist, complementing each other in strengths and weaknesses. In the dynaBBO project, we set out to obtain more efficient black-box optimization techniques by leveraging this complementarity, both with respect to different problem instances and with respect to different stages of the optimization process. To this end, we will develop approaches that select and dynamically switch between different black-box optimization algorithms "on the fly". The two key research questions that guide our project are (1) when to switch from one algorithm to another, and (2) how to warm-start the selected solver so that it can continue the search as effectively as possible. Both questions are largely under-explored and are handled rather naively in practice. To obtain our dynamic approaches, we intertwine insights about black-box optimization algorithms, obtained through rigorous theoretical analyses, with automated machine learning techniques. In particular, we will design trajectory-based algorithm selection and configuration techniques that combine exploratory landscape analysis with newly designed algorithm features that capture information about the solver-instance interaction. We compare the efficiency of these feature-based approaches with deep learning techniques, reinforcement learning, and approaches based on hyperparameter optimization. We will further increase our project's impact by validating its results on applications in bio-medicine and in computational mechanics.

Link to the ERC project webpage:

Keywords of the ERC project: optimization, black-box optimization, evolutionary computation, reinforcement learning, AutoML

Keywords that characterize the scientific profile of the potential visiting researcher/s: optimization, black-box optimization, evolutionary computation, reinforcement learning, AutoML

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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101125993	**NoKnow**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Søren Hauberg**
Host Institution:	DANMARKS TEKNISKE UNIVERSITET - DNK

Not Knowing in Deep Representation Learning

Machine learning and artificial intelligence techniques are progressing at a tremendous pace and impressive results appear across scientific fields. However, as machine learning models grow in capacity, they become increasingly 'black box', and it becomes harder for humans to reason about the patterns discovered by the machine. A root cause of this difficulty is that most machine learning models can express the same pattern in infinitely many, equally good, ways within their internal representations of the world. This is known as an identifiability problem. Today we lack a general solution to identifiability problems, and either give up on understanding the patterns discovered by the machine or reduce model complexity to lessen the problem. The latter also reduces the fidelity and applicability of the model. NoKnow rephrase the question of identifiability to be concerned with tasks solved by the representation rather than the representation itself. Using tools from differential geometry and Bayesian inference, we develop the theoretical tools to ensure that tasks solved in the representation have an identifiable outcome even if the representations themselves are not identifiable. To turn theory into practice, we develop state-of-the-art algorithms for assessing the uncertainty of learned representations in order to indirectly estimate the topology of the representation manifold. We further develop novel, high-fidelity predictive models that have identifiable outcomes when trained on learned representations. NoKnow provides the fundamental tools needed to engage with learned representations to guarantee identifiable outcomes. This, in turn, increase trust in findings as they are not dependent on arbitrariness in learned representations. As society increasingly automates decisions, this trust in machine learning becomes ever more important.

Link to the ERC project webpage:

Keywords of the ERC project: Bayesian deep learning, generative models, identifiability, differential geometry, numerical linear algebra

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101141916	**Artificial User**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Antti Oulasvirta**
Host Institution:	AALTO KORKEAKOULUSAATIO SR - FIN

Artificial User

PROBLEM: Despite decades of research on human-computer interaction (HCI), the problem of how to predict human performance with a given user interface (UI) is unsolved. Existing computational models are limited in scope or require large datasets or expert input. Instead, empirical methods are used that are costly and error-prone. OBJECTIVE: This project establishes the foundations of simulation intelligence in HCI through computational rationality. Given a design and a task environment, a simulator generates human-like moment-to-moment behavior autonomously, from which key metrics can be computed, i.e. for learning, performance, and ergonomics. ”Artificial users” can be commanded using natural language without modeling expertise. APPROACH: We seek a breakthrough through the theory of computational rationality that would dramatically expand the models’ scope and actionability. The theory posits that interactive behavior is an emergent consequence of a control policy adapted to internal bounds (cognition) and rewards. While previous work has demonstrated progress, scope has been limited to simple sensorimotor tasks and required reward engineering. This project will study the principles of computationally rational agents that learn skills like humans, can operate autonomously and yet be commanded via natural language. We design a workflow for building dramatically larger models via self-supervised pretraining. IMPACT: We develop a strong complement to existing evaluation methods in HCI. The pushes forward generative modeling in HCI by combining theory-driven causal assumptions about people and modern ML, while being deployed directly in high-fidelity simulators. This allows dealing with novel task environments with higher accuracy. This will be a leap forward in applications of design and engineering (rapid evaluation) and ML (realistic synthetic data) in HCI.

Link to the ERC project webpage:

Keywords of the ERC project: User modeling, intelligent systems, human-AI interaction, decision theory, reinforcement learning

Keywords that characterize the scientific profile of the potential visiting researcher/s: Cognitive science, human factors, user modeling, reinforcement learning

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Project ID:	Project Acronym:	Evaluation Panel:
101142702	**DeepLog**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Luc De Raedt**
Host Institution:	KATHOLIEKE UNIVERSITEIT LEUVEN - BEL

Deep Probabilistic Logics

Neurosymbolic AI (NeSy) is the 3rd wave in AI. It wants to answer the key open question in AI as how to combine learning (2nd wave) and reasoning (1st wave) by integrating logic based AI with deep learning. However, there is only little understanding of the underlying principles and there exist no widely used machine learning tools that support NeSy. This makes the development of learning and reasoning systems extremely hard. What is urgently needed is a paradigm shift in NeSy that focuses on foundations rather than on which system from the 'alphabet-soup' scores best on the latest benchmarks. I propose to develop these foundations by identifying key building blocks and demonstrate that they support the integration of knowledge and reasoning into any neural network learning task. My methodology is based on the slogan that I have coined: NeuroSymbolic AI = Neural + Probabilistic + Logical AI This advocates that we need to integrate the two main paradigms for reasoning (logic and probability), with that for learning (neural networks). I will exploit many similarities I have identified between statistical relational AI, which focuses on probabilistic logics, and NeSy. More specifically, I shall develop the foundations of NeSy. At the conceptual level, I shall identify the building blocks of NeSy by designing primitives that integrate logical, probabilistic and neural networks representations; at the semantic level, I shall introduce the notion of NeSy networks (that encompass logic circuits, algebraic operators and neural networks) as a semantic framework for NeSy; at the computational level, I will show how to exploit NeSy networks for inference and learning. DEEPLOG is not 'yet another NeSy system', but rather a fundamental and operational framework in which a wide variety of NeSy systems and applications can be cast and implemented. We will develop an open-source software environment, and evaluate DEEPLOG 's generality and applicability.

Link to the ERC project webpage: https://wms.cs.kuleuven.be/cs/onderzoek/deeplog

Keywords of the ERC project: neurosymbollc AI

Keywords that characterize the scientific profile of the potential visiting researcher/s: neurosymbollc AI

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Project ID:	Project Acronym:	Evaluation Panel:
101160648	**Harmony**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Florian Bernard**
Host Institution:	RHEINISCHE FRIEDRICH-WILHELMS-UNIVERSITAT BONN - DEU

Harmonising Observations and Underlying Principles for Visual Data Association

Visual data association aims to find task-specific mappings involving visual data. Two significant examples are the mapping of physics models to complex scenes for planning overtaking manoeuvrers in autonomous driving, or matching collections of 3D shapes for medical analysis. Despite the high relevance of visual data association, its progress has not kept pace with the revolutionary developments fuelled by recent deep learning advances: existing data association machinery lacks theoretical guarantees (e.g. global optimality, or structure such as geometric consistency in 3D shape matching) that are critical for high-stakes settings, or suffers from poor scalability. Moreover, current procedures fall short of understanding complex interconnections across different observable entities (collections of e.g. objects or scenes). The vision of Harmony is to tackle these shortcomings by harmonising the complex interconnections between observable entities and underlying fundamental principles (e.g. geometry, or physics). This research direction is challenging, largely unexplored and will require to break substantially new ground at conceptual, algorithmic and practical levels simultaneously. Harmony is organised into four complementary challenges:
Challenge A addresses global optimality and scalability for 3D shape matching;
Challenge B addresses structure and dynamics inference from static images;
Challenge C addresses non-linear synchronisation in data collections defined over graphs;
Challenge D will exploit synergies and cross-fertilise insights across Harmony.
Overall, Harmony will benefit both researchers and practitioners by providing solutions to more complex tasks in practically relevant settings (e.g. geometrically consistent medical shape analysis, or physics-based scene understanding).

Link to the ERC project webpage:

Keywords of the ERC project: visual computing, machine learning, shape analysis, image understanding, physics inference

Keywords that characterize the scientific profile of the potential visiting researcher/s: shape analysis, graph-based optimisation, matrix factorisation, physics inference

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101161364	**INF_2**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Marco Mondelli**
Host Institution:	INSTITUTE OF SCIENCE AND TECHNOLOGY AUSTRIA - AUT

Inference in High Dimensions: Light-speed Algorithms and Information Limits

Extracting information from data is the key challenge of our time, and in many applications (e.g., genome-wide association studies, data compression, and virtual assistants such as ChatGPT) both the data and the machine learning model used to extract information are increasingly high-dimensional. As traditional statistical theory is ill-equipped to face this explosion in the dimensionality of the problem, machine learning is now predominantly experimental. However, empirical approaches come with huge costs affordable only to large companies, and they lack interpretability, which is especially troublesome in medical applications. To address these issues, the INF^2 project develops information-theoretically principled methods for high-dimensional inference in machine learning and data science. The key insight is that, via a "mean-field" approach, high-dimensional quantities are well approximated by low-dimensional ones and then characterized exactly. Leveraging this characterization, we will (i) establish the fundamental limits of inference, i.e., the minimal amount of data necessary to solve the problem, and (ii) design efficient algorithms requiring only the minimal amount of data. The challenge we tackle is to apply this paradigm to practical settings, in which data are structured and heterogeneous (as in genome-wide association studies), and models consist of complex architectures tailored to applications (auto-encoders for data compression, and transformers for ChatGPT). Through a novel analysis of spectral methods, approximate message passing and gradient descent, INF^2 builds a theoretical framework having conceptual impact, as well as vast applicability, in machine learning and information theory. This framework is then brought to the real world via applications in genome-wide association studies. Broadly, our results enable the principled design of machine learning algorithms and models, drastically reducing costs and providing interpretable solutions.

Link to the ERC project webpage: marcomondelli.com

Keywords of the ERC project: Theory of Machine Learning, Information Theory, High-dimensional Statistics, Genome-Wide Association Studies (GWAS), Approximate Message Passing (AMP), Spectral Estimators, Neural Networks, Mean-field Analysis

Keywords that characterize the scientific profile of the potential visiting researcher/s: Theory of Machine Learning, Information Theory, High-dimensional Statistics, Genome-Wide Association Studies (GWAS), Approximate Message Passing (AMP), Spectral Estimators, Neural Networks, Mean-field Analysis

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Project ID:	Project Acronym:	Evaluation Panel:
101165402	**Control-LM**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Yonatan Belinkov**
Host Institution:	TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY - ISR

Controlling Large Language Models

Large language models (LMs) are quickly becoming the backbone of many artificial intelligence (AI) systems, achieving state-of-the-art results in many tasks and application domains. Despite the rapid progress in the field, AI systems suffer from multiple flaws inherited from the underlying LMs: biased behavior, out-of-date information, confabulations, flawed reasoning, and more. If we wish to control these systems, we must first understand how they work, and develop mechanisms to intervene, update, and repair them. However, the black-box nature of LMs makes them largely inaccessible to such interventions. In this proposal, our overarching goal is to: *Develop a framework for elucidating the internal mechanisms in LMs and for controlling their behavior in an efficient, interpretable, and safe manner.* To achieve this goal, we will work through four objectives. First, we will dissect the internal mechanisms of information storage and recall in LMs, and develop ways to update and repair such information. Second, we will illuminate the mechanisms of higher-level capabilities of LMS to perform reasoning and simulations. We will also repair problems stemming from alignment steps. Third, we will investigate how training processes of LMs affect their emergent mechanisms and develop methods for fine-grained control over the training process. Finally, we will establish a standard benchmark for mechanistic interpretability of LMs to consolidate disparate efforts in the community. Taken as a whole, we expect the proposed research to empower different stakeholders and ensure a safe, beneficial, and responsible adoption of LMs in AI technologies by our society.

Link to the ERC project webpage:

Keywords of the ERC project: Large language models, controllability, Interpretability

Keywords that characterize the scientific profile of the potential visiting researcher/s: Large language models, interventions, controllability, Interpretability, robustness, vision-language models

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Project ID:	Project Acronym:	Evaluation Panel:
101166056	**beyond2**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Sebastian Goldt**
Host Institution:	SCUOLA INTERNAZIONALE SUPERIORE DI STUDI AVANZATI DI TRIESTE - ITA

Beyond two-point correlations: from higher-order data statistics to neural representations

Deep neural networks (DNNs) have revolutionised how we learn from data. Rather than requiring careful engineering and domain knowledge to extract features from raw data, DNNs learn the relevant features for a task automatically from data. In particular, high-order correlations (HOCs) of the data are crucial for both the performance of DNNs and the type of features they learn. However, existing theoretical frameworks cannot capture the impact of HOCs – they either study "lazy" regimes where DNNs do not learn data-specific features, or they rely on the unrealistic assumption of Gaussian inputs devoid of non-trivial HOCs.
beyond2 will develop a theory for how and what neural networks learn from the high-order correlations of their data. We break the problem into two parts:
(i) *How?* We analyse the learning dynamics of neural networks trained by stochastic gradient descent to unveil the mechanism by which they learn from HOCs efficiently (in terms of the minimum amount of training data / learning time required to attain satisfactory predictive performance).
(ii) *What?* Our preliminary research suggests that neural filters are primarily determined by the "principal components" of HOCs. We investigate how these principal components relate to fundamental data properties, such as symmetries of the inputs.
We attack these problems by extending methods from statistical physics and high-dimensional statistics to handle non-Gaussian input distributions. Studying the interplay between data structure and learning dynamics will allow understanding how specific learning mechanisms, like attention or recursion, are able to unwrap HOCs.
By shifting the focus from unstructured to non-Gaussian data models, beyond2 will yield new insights into the inner workings of neural networks. These insights will bring theory closer to practice and might facilitate the safe deployment of neural networks in high-stakes applications.

Link to the ERC project webpage:

Keywords of the ERC project: Theory of neural networks, statistical physics, high-dimensional probability, theoretical neuroscience, language models

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101171131	**Gen3D**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Matthias Niessner**
Host Institution:	TECHNISCHE UNIVERSITAET MUENCHEN - DEU

Learning to Create Virtual Worlds

In recent years, we have seen a revolution of learning methods that generate highly-realistic images, such as generative adversarial neural networks, autoregressive methods, or diffusion models (e.g., DALL-E, Stable Diffusion, Runway, etc). Unfortunately, the vast majority of these methods are tailored towards the 2D image domain, while their respective 3D counterparts – 3D models that fuel computer graphics applications, and enable visually immersive experiences – remain in their infancy. In this proposal, we tackle the challenge of automatic generation of 3D content for virtual worlds. Such 3D generated content enables versatility, with flexible rendering from arbitrary viewpoints that match the visual fidelity of the real world. We focus on 3D content creation for visually immersive experiences for a much wider audience in myriad applications, such as video games, movies, AR/VR scenarios, CAD modeling, architectural & industrial design, and medical applications. We believe that the key towards automated, high-fidelity content creation lies in developing new machine learning techniques to transform 3D content generation. (A) We will develop 3D Generative Models that output 3D polygon meshes, along with their surface textures and material properties, highlighting generation of 3D content that can be directly consumed by modern graphics pipelines. (B) To train our 3D generative models to reflect the complexity and diversity of real data, we will devise methods for Supervision from Images and Videos. The key challenge here is that such collections of images and videos are by nature incomplete projections of the underlying 3D world, thus requiring learning paradigms that generalize across partial instances. (C) We will research techniques that provide Control and Editability through Conditional Generation. In particular, we will focus on conditional input from both novice (e.g., text-based editing) and expert (e.g., based on existing authoring tools) users alike.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101171393	**SMARTI3**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Gerhard Neumann**
Host Institution:	KARLSRUHER INSTITUT FUER TECHNOLOGIE - DEU

Scalable Manipulation Learning through AR-enhanced Teleoperation enabling Intuitive Interactive Instructions

SMARTI3 addresses three pivotal visions in robotics: enabling robots to handle diverse objects in complex scenes, manipulate objects with varying geometries and physical properties, and interpret and follow intricate instruction manuals. While AI is predestined to realize these visions, its promises to fulfill these visions have not been fully realized yet. Despite significant breakthroughs of AI in many domains, robotics has not seen a parallel surge, primarily due to challenges in task-specific data collection, the high demand for training data, and the extensive expertise required for applying AI in robotics. Our innovative approach integrates intuitive data generation, fine-tuning of foundational knowledge, leveraging human feedback for continual self-improvement, and incorporating offline instructions with semantic and geometric information into skill, perception, and prediction models. Our objectives are to streamline the generation of human and synthetic data for robot learning, develop few-shot adaptable foundational representations, scale-up robot skill-learning capabilities, and enhance learning from interactive human feedback and offline instructions. The project showcases its advancements through three use cases that mirror future industrial applications: sorting and disassembling a variety of Lego pieces, origami folding from visual instructions, and assembling complex Lego structures from unsorted pieces using instruction manuals. These cases highlight our approach's adaptability and potential for industrial application. SMARTI3 aims to revolutionize robotic skill, perception, and prediction models, significantly broadening the scope of robotic technology in various industries. This groundbreaking project lays the foundation for a new era of intelligent, adaptable, and user-friendly robotic solutions, set to rival human manipulation capabilities.

Link to the ERC project webpage:

Keywords of the ERC project: robot foundation models, reinforcement learning, robot learning

Keywords that characterize the scientific profile of the potential visiting researcher/s: reinforcement learning, robot learning, interactive learning

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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101222956	**AToM-FM**	**PE6** Computer Science and Informatics

Principal Investigator:	**Dr Edoardo Ponti**
Host Institution:	THE UNIVERSITY OF EDINBURGH - GBR

Adaptive Tokenization and Memory in Foundation Models for Efficient and Long-Horizon AI

The recent revolution in generative AI is powered by the ever-growing scale of Foundation Models (FMs). This, however, causes a series of harmful ramifications, such as their unsustainable energy demand and environmental pollution, which accelerate climate change. Moreover, the scale of FMs jeopardises data privacy, as it compels users to deploy them on third-party servers rather than edge devices. AToM-FM sets out to reverse this trend by remedying a fundamental source of inefficiency in FMs: the granularity of the "atomic" units for representing information in current FMs is fixed, as it entirely depends on how they update their memory and segment input data (a process known as tokenization). Instead, AToM-FMs will couple their granularity with the complexity of each task, allocating only as much computing effort as needed. As its key technical breakthrough, AToM-FM will make memory and tokenization adaptive, elevating FMs to unprecedented levels of efficiency. To facilitate the swift adoption of this new technology, I will repurpose state-of-the-art FMs into adaptive architectures and release them to the public. This will not only drastically cut the carbon footprint of FM deployment and uphold data privacy, but also foster the emergence of new FM capabilities. In fact, compressing the FM representations will effectively broaden their horizon, i.e., the amount of input and output they can perceive and generate, respectively, without exhausting their memory. This will unlock 1) permanent memories, which are a prerequisite for lifelong learning; 2) longer reasoning chains, perfecting the mathematical and planning skills of FMs; 3) modality-agnostic and fine-grained inputs, facilitating the integration of low-resource modalities and grounding agentive FMs onto physical spaces. Overall, AToM-FM's ambitious agenda will usher in the next generation of FMs, paving the way for efficient and long-horizon AI.

Link to the ERC project webpage:

Keywords of the ERC project: LLM, foundation models, efficiency, ltokenization, memory, long context, test time scaling, multimodal

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101039827	**HIGH-HOPeS**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Michael Schaub**
Host Institution:	RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN - DEU

Higher-Order Hodge Laplacians for Processing of multi-way Signals

Network analysis has revolutionized our understanding of complex systems, and graph-based methods have emerged as powerful tools to process signals on non-Euclidean domains via graph signal processing and graph neural networks. The graph Laplacian and related matrices are pivotal to such analyses: i) the Laplacian serves as algebraic descriptor of the relationships between nodes; moreover, it is key for the analysis of network structure, for local operations such as averaging over connected nodes, and for network dynamics like diffusion and consensus; ii) Laplacian eigenvectors are natural basis-functions for data on graphs and endowed with meaningful variability notions for graph signals, akin to Fourier analysis in Euclidean domains. However, graphs are ill-equipped to encode multi-way and higher-order relations that are becoming increasingly important to comprehend complex datasets and systems in many applications, e.g., to understand group-dynamics in social systems, multi-gene interactions in genetic data, or multi-way drug interactions. The goal of this project is to develop methods that can utilize such higher-order relations, going from mathematical models to efficient algorithms and software. Specifically, we will focus on ideas from algebraic topology and discrete calculus, according to which the graph Laplacian can be seen as part of a hierarchy of Hodge-Laplacians that emerge from treating graphs as instances of more general cell complexes that systematically encode couplings between node-tuples of any size. Our ambition is to i) provide more informative ways to represent and analyze the structure of complex systems, paying special attention to computational efficiency; ii) translate the success of graph-based signal processing to data on general topological spaces defined by cell complexes; and iii) by generalizing from graphs to neural networks on complexes, gain deeper theoretical insights on the principles of graph neural networks as special case.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101054904	**TRANCIDS**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Tolga Duman**
Host Institution:	BILKENT UNIVERSITESI VAKIF - TUR

Transmission over Channels with Insertions and Deletions

Insertions and deletions represent perhaps the most challenging impairments exhibited by communication channels in a wide range of applications from recording systems and covert communications to DNA storage. While tremendous progress has been made in determining the ultimate limits of communication using information-theoretic tools as well as in designing and implementing signaling solutions for various channel models with practical significance; for the case of insertion/deletion channels, even the simple scenarios are not fully understood. For instance, we do even not know the capacity of the basic independent and identically distributed binary deletion channel. TRANCIDS will take on the monumental challenge of conquering the insertions and deletions by developing precise theoretical limits of communication and by designing explicit and implementable coding solutions approaching these limits. Specifically, TRANCIDS will 1) establish with precision the capacity of basic deletion/insertion channels, and obtain tight upper and lower bounds on the capacities of more sophisticated channel models encountered in practice (including the effects of noise and interference); 2) formulate and explore wireless communication problems with insertions and deletions (including multi-input and multi-output systems as well as different multi-user communications settings); 3) develop explicit and implementable channel coding solutions for a variety of channel models with insertions and deletions of practical importance; 4) address the channel capacity and code design problems for channels with additional impairments such as permutations as motivated by in-vivo DNA storage applications. TRANCIDS will highly impact different emerging applications such as DNA storage and beyond 5G wireless communications. Furthermore, the findings will help facilitate the development of DNA computing technologies of the future.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101055250	**CITRON**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Daniel Comparat**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Correlated Ion elecTRon fOr Nanoscience

Electron and Ion beams have become indispensable tools in surface and materials science. Many applications rely on extreme miniaturization, like in nanostructuring and doping, which imposes to control the energy, the number and the locations of electrons or ions at the nanometric level. The CITRON project aims at achieving breakthroughs in focused ion and electron beams, exploiting monochromaticity in the low-energy domain (eV-keV) to reach such a fine level of control of the sources of charged particles. In contrast with standard tools, the proposed developments rely on the ionization of a neutral atomic species and on the simultaneous production, detection and control of both the ion and the electron. Such a detection in coincidence yields correlated information on both particles that can be used to improve the beam properties, like the deterministic knowledge of the creation of the charged particles, and the correction of their trajectories in real time. Using this novel technique, which I have recently demonstrated the feasibility with my group, I propose to develop three innovative prototypes: • 1) A focused ion beam using feedback control with unprecedented focused properties. I will used it to realize semiconductor circuit-editing at the (sub-)nm scale. • 2) A deterministic source of (potentially) any type of ion for controlled implantation at the nm level. I will use it for on-demand doping of quantum devices. • 3) A high-resolution electron-energy-loss microscope with precise knowledge of the electron energy and the position on the sample. I will use it to realize both imaging and vibrational spectroscopy for surface analysis. The synergy between the three prototypes is based on atomic beam laser excitation to create a monoenergetic beam of charged particles, with energy and position controlled by correlation between oppositely charged particles. All will require dedicated optical columns designs and fast time and position sensitive detectors.

Link to the ERC project webpage: http://www.lac.universite-paris-saclay.fr/?page_id=1952&lang=en

Keywords of the ERC project: Rydberg atoms, electrons sourecs, ion sources, correlation, microscopy, spectroscopy

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101077361	**SENSIBILITÉ**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Derya Malak**
Host Institution:	EURECOM GIE - FRA

Computing Nonlinear Functions over Communication Networks

SENSIBILITÉ describes a novel theory for distributed computing of nonlinear functions over communication networks. Motivated by the long-lasting open challenge to invent technologies that scale with the network size, this intriguing and far-reaching theory elevates distributed encoding and joint decoding of information sources, to the critical network computing problem for a class of network topologies and a class of nonlinear functions of dependent sources. Our theory will elevate distributed communication to the realm of distributed computation of any function over any network.

Overall, this problem requires communicating correlated messages over a network, coding distributed sources for computation of functions, and meeting the desired fidelity given a distortion criterion for the given function. In such a scenario, the classical separation theorem of Claude Shannon, which modularizes the design of source and channel codes to achieve the capacity of communication channels, is in general inapplicable.

SENSIBILITÉ envisions a networked computation framework for nonlinear functions. It will use the structural information of the sources and the decomposition of nonlinear functions for efficient distributed compression algorithms. For scalability, it will design message sets that are oblivious to the protocol information. For parsimonious representations across networks, it will grip the curious trade-off between quantization and compression of functions. SENSIBILITÉ has a contemporary vision of network-driven functional compression via accounting for the description length and time complexities towards alleviating large-scale, real-world networks of the future. The advanced theory will be tested in a real-life setting on applications of grand societal impact, such as over-the-air computing for the internet-of-things, massive data compression for computational imaging, and zero-error computation for real-time holographic communications.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101077917	**QOMUNE**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Davide Bacco**
Host Institution:	UNIVERSITA DEGLI STUDI DI FIRENZE - ITA

Quantum Optical MUltidimensional NEtworks

Quantum Internet will allow unprecedented applications that will dramatically change our lives, spanning from quantum secured communications to distributed quantum simulations, i.e., ultra-precise clock synchronisation, quantum secured identification, efficient distribution of data and energy, quantum sensors and secure access to quantum devices in the cloud. The main technical limitations currently restricting the range of applicability of the quantum internet are the intrinsic rate-distance limit and the extremely difficult coexistence with the present classical telecommunication infrastructure. Present quantum communication systems mainly use a two-dimensional encoding scheme (qubit) as information unit, which is very fragile and susceptible to external noise. In fact, due to decoherence processes, caused by the interaction with the external environment, the ability of the adopted qubits to remain in superposition and/or in an entangled state is severely jeopardised. On the contrary, by adopting multidimensional quantum states (qudit), which are by nature more robust to noise owing to their higher information efficiency, the potential to realise the quantum internet is within our grasp. QOMUNE intends to build and test the constituents for a Quantum Internet based on multidimensional quantum states, by combining new technological advances with unconventional quantum interference. QOMUNE envisages a novel scheme for the generation, transmission and interference of qudits, which are fundamental actions of a quantum network. Photonic integrated quantum sources combined with multicore deployed fibres and pioneering design of efficient and scalable multidimensional quantum interference will be adopted for the realisation of QOMUNE building blocks. QOMUNE's objectives and results will redefine the state-of-the-art of Quantum Internet in terms of tolerance to noise in a realistic scenario and coexistence with the worldwide telecommunication infrastructure.

Link to the ERC project webpage:

Keywords of the ERC project: quantum communications; quantum network

Keywords that characterize the scientific profile of the potential visiting researcher/s: quantum physics; quantum communications

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101087709	**FemtoMagnet**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Mathieu Mivelle**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Manipulating magnetic domains through femtosecond pulses of magnetic field

While the electronic industry has successfully entered the nanoworld following Moore's law, the speed of manipulating and storing data lags behind, creating the so-called ultrafast technology gap. Processors already have a clock speed of a few gigahertz, while the storage on a magnetic hard disk requires a few nanoseconds. This bottleneck can also be found in magnetic random access memory devices. The use of ultrafast pulses of light has demonstrated effectiveness in manipulating magnetic orders on very short time scales. However, the physical processes involved are still poorly understood, and such a control reaches the micrometer scale at best, effectively preventing their use for high-density data storage. FemtoMagnet aims to develop an entirely new approach to manipulating magnetic domains based on the engineering of plasmonic nanodevices. For that, these devices will optically generate ultra-short, intense, and reversible pulses of magnetic field at the nanoscale, a challenge that no other technique can achieve so far. To meet its ambitious goals, my research program engineers innovative plasmonic nanostructures inversely-designed to tailor light-matter interactions at the nanoscale. Under the right illumination conditions, the electromagnetic fields generated by the nanostructure set the electrons in a metal (such as in a coil) in pseudo-continuous drift motion, in turn yielding the creation of a strong stationary magnetic field. By specifically creating and manipulating ultrafast, strong, confined and reversible pulses of magnetic field in an all-optical fashion, my research program will enable the manipulation of magnetic domains at the nanoscale and over very short timescales (a few tens of femtoseconds), opening the way to applications in ultrafast data storage and data processing.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101088147	**C-NORA**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Nikolaos Bekiaris-Liberis**
Host Institution:	POLYTECHNEIO KRITIS - GRC

Micro-Macro Secure Control of Infinite-Dimensional Transport Systems

Although "transport" may imply different notions for different scientific fields, the feature of incorporation of interacting system components through which "information'' is propagated remains invariant. Biological transport systems is an example whose significance has become evident with the recent outbreak of COVID-19 spreading. Blood transport in cardiovascular systems falls also under this category. The urgent need of design of efficient/safe, epidemics spreading suppression and congested blood transport monitoring, strategies is apparent, considering the potential, significant socioeconomic impact. However, the continuum, spatiotemporally-varying nature of such interconnected systems, in addition to dynamic complexity and limited available control authority, hamper development of systematic feedback control design and analysis methodologies. C-NORA aims at introduction of a pioneering holistic framework for systematic, computationally tractable control design and analysis of large-scale, interacting, distributed parameter transport systems, which i) harmonizes control at micro-macro levels, ii) accounts in design for all essential dynamic phenomena, iii) compensates adverse effects of limited control authority in design, and iv) develops ad hoc tools for system-specific analysis. C-NORA new control design and analysis tools will be demonstrated in distributed parameter, epidemiological/cardiovascular transport systems and will be validated in numerical simulation. C-NORA high risk lies in unification and complexity of heterogenous, unexplored infinite-dimensional systems, whose treatment requires rethinking of fundamental control-theoretic tools. C-NORA high scientific gain lies in that, on the way of executing its key ideas, novel, interdisciplinary concepts and groundbreaking control/analysis methodologies will be introduced, while unprecedented research arenas will open for systems and control, transport, mathematicians, and systems biologists.

Link to the ERC project webpage: https://c-nora.tuc.gr/

Keywords of the ERC project: Control of Partial Differential Equations (PDEs); Control of epidemics transport; Estimation of blood flows

Keywords that characterize the scientific profile of the potential visiting researcher/s: Macro modeling/control of epidemics transport; Blood flow estimation; Hyperbolic PDEs

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101089040	**TUSCany**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Romain Peretti**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Terahertz Ultra Strong Coupling for mAcromolecules structure aNalYse & control

MacroMolecules (e.g Proteins, DNA) carry out most of the functions of the living and these functions come from their 3D-structure. For instance, foldopathy like Alzheimer's and Parkinson's disease are caused by misfolding of proteins. Modifying this structure non-invasively is consequently a tremendous challenge for both microbiology research and applications. Besides, light-Matter strong coupling (SC) occurs when a material is located at a high density of state of a photonic mode resonant with one of its transitions. Extensively studied in optics and quantum physics, SC recently gave exciting results in chemistry with the demonstration of its ability to change the product ratio of several chemical reactions. Experimental and theoretical results unveil that macromolecules have delocalized vibrations over their whole 3D-structure in the Terahertz (THz) range. Therefore, one can ask if the functions of macromolecules can be modified by implementing strong coupling on the vibration of macromolecules in the THz. In Tuscany, I will develop µ/nano THz photonics devices and experiments to establish reliable methods for macromolecules THz spectroscopy from cryogenic to body temperatures on samples from the single macromolecules to the cell culture. Then, I will demonstrate vibrational SC in the THz on these samples. Finally, I will demonstrate that the function of macromolecules, including catalysis and macromolecules assembly can be modified by selectively coupling individual vibrational modes from the single macromolecules up to in vivo experiments with prion propagation and viral capsid assembly. My overall aim is to understand in detail the vibrational strong coupling in the THz range for macromolecules and make it a useful tool for biochemists and biophysicists. In the longer term, I hope this knowledge will seed the design of new approaches in µbiology leading to medical treatments impeding the proteins aggregation and ultimately the evolution of the foldopathies.

Link to the ERC project webpage: https://www.tuscany-erc.fr/

Keywords of the ERC project: photonics, THz, strong coupling, spectroscopy

Keywords that characterize the scientific profile of the potential visiting researcher/s: material science or photonics or electromagnetism

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101116523	**CHIPzophrenia**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Thomas E Winkler**
Host Institution:	KUNGLIGA TEKNISKA HOEGSKOLAN - SWE

Feedback-control of the Microenvironment: Modular Organ-on-Chip Technology to elucidate the role of Neurovascular Stress in Schizophrenia

A well-controlled microenvironment is paramount for reproducible biomolecular studies. Organs-on-chips are in-vitro cell culture systems that employ microfluidic and biomaterial engineering towards that goal. They combine the advantages of animal models (physiological environment) with those of plastic-dish culture (human cells), and thereby hold exceptional promise in unraveling the biological processes that underlie health and disease. Yet control over the biochemical environment remains poor. With CHIPzophrenia, I propose to develop a new generation of organ-chip, one that features feedback-enabled control of the biochemical environment. I aim to realize dynamic and well-controlled application of stable therapeutics (via feedback sensors and flow control), and crucially also of highly volatile oxygen/nitrogen stressors by relying on electrochemistry to generate them in situ. My goal is to moreover implement a highly functional modular architecture so that the system can easily be repurposed and sensor/control modules reused – all with negligible dead volumes and displacement (key challenges in current organ-chips towards novel functionalities). I intend to leverage this organ-chip to elucidate how nitrosative stressors disrupt the complex multicellular interactions of the blood-brain barrier, where existing in-vitro models fail to provide the requisite cellular and chemical microenvironment. Yet such disruption is implicated in a wide array of disorders – including schizophrenia, where our biological understanding remains poor and in-vivo models are uniquely challenging. I will specifically test the hypothesis that nitrosative dysregulation of perivascular cells plays a causative role in neuronal dysfunction associated with the disorder. Not only will CHIPzophrenia thus reveal new potential treatment targets, but it will also establish the platform as a transformative tool for dynamic and well-controlled in-vitro research into stress-related disorders and beyond.

Link to the ERC project webpage: https://lab.winkler.site

Keywords of the ERC project: organ-on-chip, microphysiological systems, blood-brain barrier, iPSC-based disease models, schizophrenia, biosensors, electrochemistry, microfluidics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101116856	**ROBOFLUID**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Vito Cacucciolo**
Host Institution:	POLITECNICO DI BARI - ITA

Robotic Fluids for artificial muscles, wearable cooling, and active textiles

Fluid circulation is ubiquitous in both living creatures and machines, and it serves multiple functions: temperature regulation, transport of nutrients, mechanical actuation. A beating heart is a soft pump that keeps animal alive through blood circulation.

ROBOFLUID will merge fluids capabilities with electrical control to equip robots and wearables with the superpowers of fluids. By untangling the interaction between intense electric fields and fluid mechanics, ROBOFLUID will develop a new class of solid-state fluidic devices where flow is directly driven in situ by electrical signals, and where fluid velocity, pressure and temperature are used to sense the device status and the environment.

The large number of components required to operate conventional fluidics (pumps, valves, tubing, plugs), have prevented its use in untethered systems. ROBOFLUID will overcome this limitation by means of solid-state pumps where fluids are directly accelerated by electric fields. Similarly, to robotic hearts, robotic fluids will drive (1) new strong and robust artificial muscles, (2) wearable coolers and (3) active textiles for movement support and haptics.

ROBOFLUID will leverage our experience with soft robotics, electroactive materials and solid-state pumping based on Electrohydrodynamics (EHD). By bringing these fields together and bridging them with emerging active fibers technologies for wearables, we aim to create new scientific understanding of fluid mechanics and field emission in liquids under high electric fields and to create new ground-breaking functionalities for robots and wearables.

We will create (1) robust, high-power-density fluidic muscles that will make low-cost dexterous robotic hands possible, (2) wearable coolers to reduce energy consumption from air conditioning and to protect fragile people during extreme heat waves, (3) textile artificial muscles to facilitate daily actions in the elderly and to enable remote physical interactions.

Link to the ERC project webpage: https://robophysics.poliba.it/erc-robofluid/

Keywords of the ERC project: Soft Robotics, Artificial Muscles, Wearable Robots, ElectroHydroDynamics, Electrofluidic muscles

Keywords that characterize the scientific profile of the potential visiting researcher/s: Exosuits, Wearable Robotics, Artificial Muscles, Soft Actuators, Soft Robotics, Electrochemistry, Robotics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101117133	**MALIN**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Luca Calatroni**
Host Institution:	UNIVERSITA DEGLI STUDI DI GENOVA - ITA

Model-aware learning for imaging inverse problems in fluorescence microscopy

This project will develop model-aware, i.e. physics-informed, learning methods for solving imaging inverse problems (IIPs) in fluorescence microscopy imaging (FMI). IIPs are frequently encountered in FMI whenever a visual representation of a biological sample needs to be reconstructed from incomplete and noisy input measurements. Such IIPs are typically ill-posed: their solution (if it exists) is unstable to perturbations. Classical model-based approaches reformulate the IIP at hand as an energy minimisation task. Such approaches rely both on the (approximate) knowledge of the complex physical processes involved and on the mathematical design of hand-crafted optimisation methods whose tuning is often very time-consuming. Concurrently, the impressive development of machine and deep learning methods has enabled the applied imaging community with new data-driven methodologies providing unprecedented results in tasks such as image classification. The performance of data-driven methods for solving IIPs in FMI, however, is halted by their intrinsic unstable behaviour. In MALIN, I propose an integrative paradigm where the stable performance of model-based approaches is combined with the effectiveness of data-driven techniques by means of shallow model-constrained learning and deep physics-informed generative approaches. The reliability of the model-aware methods proposed will be justified by theoretical results providing reconstruction and convergence guarantees. The study will further account for possible geometric invariances and imperfect physical modelling, showing robustness to modelling errors which are frequent when standard (low-cost) equipment is used. Algorithmic acceleration strategies and inexact/stochastic algorithms will be devised to guarantee efficient performance also under limited computational resources and training data. The methodologies will be deployed on several IIPs in FMI and democratised through the release of open software and plug-ins.

Link to the ERC project webpage:

Keywords of the ERC project: Non-smooth optimisation, Image reconstruction, Data-driven regularisation, Fluorescence microscopy

Keywords that characterize the scientific profile of the potential visiting researcher/s: Generative models for image reconstruction, Optimisation-driven deep learning methods for imaging, Non-convex optimisation

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101117392	**NaNoLens**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Maciej Trusiak**
Host Institution:	POLITECHNIKA WARSZAWSKA - POL

Lensless label-free nanoscopy

Optical nanoscopy has changed the “seeing is believing” paradigm. This was achieved within a limited field of view (FOV~100µm2) and required fluorescent markers. Large-FOV high-throughput live unimpaired cell imaging is crucial for biology and biomedicine. Hence, improving the space bandwidth product (SBP) using time-consuming scanning stitching is not a good solution. Lensless holographic microscopy (LHM) inherently bypasses FOV limitations by using full sensor-size hologram reconstruction for label-free object information retrieval. Its major limitation, not yet addressed, is its low lateral (~1µm) and axial (~3µm) resolution. I will overcome this fundamental problem by pioneering deep UV (DUV) lensless holotomographic nanoscopy (LHN) as a simple and compact device easily operated inside the cell chamber or outside the laboratory (in contrast to lens-based systems). Owing to DNA damage, DUV is used to sterilize and never image bio-samples. This paradigm will be shifted to provide a breakthrough 10 giga pixel SBP via a low-dose DUV optical-elements-free (no cost, no radiation loss) lensless setup with a worlds-first full-angle tomographic scenario, numerical aperture > 1, and a new class of reconstruction algorithms to decrease the effective pixel (to 100 nm) and remove background noise. I will use LHN to enable the discovery of a new mechanistic understanding of extracellular vesicles expression and intake within large live cell cultures with single-vesicle resolution. EVs, nanosized lipid spheres released by virtually every cell type, are currently emerging as novel disease biomarkers and drug nanovehicles. LHN is a new research field that inherently makes this a high-risk project, but the potential gains are also high as a new era of simple ultrahigh SBP nanoimaging might be opened. The proposed multidisciplinary project calls for near-unique expertise in computational microscopy and digital holography, which I acquired in cooperation with international leaders.

Link to the ERC project webpage: https://qcilab.mchtr.pw.edu.pl/

Keywords of the ERC project: computational imaging, optical microscopy, label-free bioimaging, numerical methods in optics and photonics, biophotonics, optical metrology, quantitative phase imaging, lensless holographic microscopy, holotomography

Keywords that characterize the scientific profile of the potential visiting researcher/s: computational imaging, optical microscopy, label-free bioimaging, numerical methods in optics and photonics, biophotonics, optical metrology, quantitative phase imaging, lensless holographic microscopy, holotomography

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101117433	**TeraERC**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Lukasz Sterczewski**
Host Institution:	POLITECHNIKA WROCLAWSKA - POL

Chip-based room-temperature terahertz frequency comb spectrometers

Although visual perception of humans is limited to a fraction of wavelengths spanning the electromagnetic spectrum, technological advances enable us to see in other spectral regions by providing suitable sources and detectors. Of particular interest for many applications is the ability to probe objects in the terahertz (THz) range, which bridges the microwave and infrared domains. THz radiation offers unique opportunities for imaging or sensing due to its high transmission by optically-opaque materials like paper, textiles, ceramics or plastics, while for gas sensing it enables identification of structurally-complex molecules. Unfortunately, access to this region is difficult due to limitations of conventional electronics and photonics, and often involves cryogenic operation. Even the most mature systems operating at room temperature, despite years of advances, still struggle to provide chip-scale miniaturization of the source and detector, and moving-parts-free acquisition of a broadband THz spectrum. Here, to fill this niche and address the critical demand for broadband, chip-based THz spectroscopy without any moving parts, we propose to leverage mid-infrared (3-5 um) semiconductor laser frequency combs based on interband cascade lasers (ICL). We postulate that nonlinear frequency conversion due to the recently discovered second order susceptibility of the ICL medium can be used to obtain microwatt to sub-milliwatt level of THz power at a battery-compatible bias. A complementary mid-infrared photomixer technology envisioned in this proposal will additionally enable coherent detection of broadband THz comb radiation at room temperature. Although the project is inherently risky due to uncertainties in the ultrafast dynamics of semiconductor structures, losses in the terahertz range, and fabrication complexity, it is timely and strongly demanded by the community. It will unlock new opportunities across many disciplines ranging from chemistry to 6G telecommunications.

Link to the ERC project webpage: https://thz.pwr.edu.pl/teraerc/

Keywords of the ERC project: THz radiation, ultrafast optics, organic nonlinear crystal, semiconductor laser

Keywords that characterize the scientific profile of the potential visiting researcher/s: ultrafast optics, nonlinear optics, semiconductor laser, optoelectronics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101125498	**MINING**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Ferruccio Pisanello**
Host Institution:	FONDAZIONE ISTITUTO ITALIANO DI TECNOLOGIA - ITA

Multifunctional nano-bio INterfaces wIth deep braiN reGions

Capturing the dynamics of brain activity in its multifaceted components is a key challenge for neural interfaces. Deciphering the complex electrical and chemical signaling exchanged by the different constituents of the brain tissue will result in a better understanding of neural circuits and functions, informing and enabling novel diagnostic and therapeutic approaches. Next generation of research tools should therefore aim at a multifunctional and fully integrated approach, probing and triggering multiple signals simultaneously with high spatio-temporal resolution and low invasiveness. MINING aspires at generating a novel class of multifunctional neural endoscopes, able to trigger and detect electrical and molecular signaling with cellular resolution in vivo. The result will be the unprecedented ability to correlate multiple types of signals in the same volume, with spatial and temporal resolution at depth. The limitation of current state of the art will be surmounted by exploiting light-matter interactions in hybrid metal-dielectric metasurfaces and their synergistic integration with organic electrochemical transistors. The main objectives of MINING are: 1) Devise hybrid metal-dielectric metasurface (HMS) neural endoscopes, enabling simultaneous (i) high-resolution functional imaging of neural signals, (ii) label-free optical monitoring of chemical compounds from both wide and localized brain volumes and (iii) optogenetic and thermoplasmonic modulation of neural functions with cellular resolution, 2) Integration of organic electrochemical transistors on HMSs endoscopes, generating a novel optoelectrical neural interface with cellular resolution based on active electronics, 3) Development of methods for spatial-resolved multifunctional studies, to demonstrate the power of MINING endoscopes to reveal so far hidden patterns of electrochemical functional dynamics in the living mouse brain.

Link to the ERC project webpage: https://ercmining.eu

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101126012	**H3PMAG**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Ziwei Ouyang**
Host Institution:	DANMARKS TEKNISKE UNIVERSITET - DNK

Advanced Magnetic Components for High-Efficiency and High-Power-Density Converters

Today's magnetic components, such as inductors and transformers, in power converters operating at a low frequency of around 100-500 kHz are large compared to other electronic components. These components are a major constraint, limiting the miniaturization and integration of power electronic systems. Increasing the switching frequency can reduce the size of the magnetic components, but this is generally accompanied by significant power losses. I aim to address the fundamental challenges of magnetic components in the frequency range of 1 MHz to 10 MHz, and the main approach will be to reduce the power loss and the component size by creating unique and innovative solutions. My overall objective is to create novel magnetics technologies within conductor materials, nanogranular magnetic materials and component integration that, together with a new winding pattern technique, will enable creation of power converters with unprecedented power-efficiency and power-density. The specific target is to develop efficient, integrated magnetic components suitable for the voltage regulator modules (VRM) in high performance computing systems. I will demonstrate a new VRM converter that is 50 times smaller in size and 5% more efficient than current VRM products. Achieving successful outcomes will have a major impact on the power electronics infrastructure, with the potential to reduce energy waste significantly. To do this, the project's research questions and hypotheses will be addressed through 5 objectives in 5 corresponding work packages: 1: Mitigation of high-frequency eddy-current winding loss by creating a novel hybrid material structure; 2: Design of new magnetic materials with nanoparticles for a low magnetic core loss; 3: Creation of new core geometries and winding schemes in magnetics integration to handle large current efficiently; 4: "All-in-one" passive components integration mixing the functions of magnetics and capacitors; 5:Experimental verification and demonstration

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101126146	**INTEGRATE**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Jan Hasenauer**
Host Institution:	RHEINISCHE FRIEDRICH-WILHELMS-UNIVERSITAT BONN - DEU

Integrated Mechanistic Modelling and Analysis of Large-scale Biomedical Data

Modern cancer therapeutics target signalling processes within the cancer cells and the interaction of cancer and immune cells. A comprehensive understanding of these signalling processes is therefore essential to identify drug targets, plan clinical trials, and to select suitable drugs, drug combinations and drug dosages for a specific patient. Yet, most of the available mathematical models capture only a small number of molecular species and pathways, thereby ignoring important crosstalk and feedback loops. Furthermore, these models are usually based on experimental data for cell lines, which behave differently from complex cancer tissues. In INTEGRATE, I will develop computational methods for the full process of data-driven modelling of signalling processes in cancer, ranging from model development to parameterisation all the way to uncertainty analysis. To this end, I will combine methods from the fields of mathematical modelling, machine learning, and signal processing with established approaches in systems biology. The model development will employ natural language processing and an automatic testing framework. For federated model inference, I will develop scalable mini-batch optimisation and marginalisation based uncertainty quantification. To refine models, I will exploit tools from signal processing, such as blind identification of latent variables. I will apply the developed scalable mechanistic modelling approach to integrate large-scale biomedical data for molecular phenotyping studies and clinical trials across sites. This will provide mechanistic models reconciling the available data. The study will, for the first time, combine mechanistic modelling and machine learning for the integrated analysis of patient-derived omics and phenotypic data. By linking these data sources, INTEGRATE will deepen our understanding of biological signal processing and provide the basis for the development of digital twins.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101139828	**HYPERSPIM**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Claudio Conti**
Host Institution:	UNIVERSITA DEGLI STUDI DI ROMA LA SAPIENZA - ITA

Optoelectronic and all-optical hyperspin machines for large-scale computing

Efficient hardware for combinatorial optimization and machine learning impacts science, engineering, and society. With new computational models, photonics tackle problems intractable with conventional computing systems. However, existing devices only scale up to thousands of spins and operate at the second timescale. I demonstrate photonic machines for ultrafast parallel processing of millions of spins with microsecond timescale. The strategy is minimizing a class of functions, the Ising Hamiltonian, by a new computational system that uses a high-dimensional feature space and speeds up optimization by orders of magnitude by ultrafast nonlinear optical processes. I build digital, optoelectronics, and all-optical classical and quantum devices and benchmark with real-world, large-scale problems. By spatial modulation technology and a cheap, simple, and scalable design, light propagation is recurrently trained towards the ground state of a programmable Ising Hamiltonian. Starting from my proof-of-concept, first, I aim at the energetically efficient computing of large-scale Hamiltonians. Second, I include self-optimizing all-optical nonlinear ultrafast phase-locking processes. Third, I demonstrate record combinatorial optimization by letting the spins evolve in a high dimensional space to guarantee high success probability. HYPERSPIM leverages the interplay of classical and quantum dynamics through the onset of entanglement and squeezing. The unprecedented scale and versatility allow the first quantum optimization tests for real-world complex computational tasks. HYPERSPIM achieves the fastest and biggest optical computing device operating in classical and quantum regimes in an interdisciplinary route towards new photonic artificial intelligence, large-scale all-optical computing, and fundamental science.

Link to the ERC project webpage: www.hyperspim.og

Keywords of the ERC project: photonics, nonlinear optics, quantum computing, Ising machine

Keywords that characterize the scientific profile of the potential visiting researcher/s: photonics, nonlinear optics, quantum computing, Ising machine

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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101164780	**NOBIAS**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Sanathana Konugolu Venkata Sekar**
Host Institution:	UNIVERSITY COLLEGE CORK - NATIONAL UNIVERSITY OF IRELAND, CORK - IRL

Novel diffuse Optical method to combat skin color bias in non-invasive optical biomarker sensing devices such as pulse oximeters

During COVID-19, skin color bias in Optical Biomarkers Sensing (OBS) devices (e.g., pulse oximeter) was suspected to have contributed to the loss of lives in darkly pigmented people. The Continuous Wave (CW) technology used in these devices is limited in accuracy and results are biased by skin color and light scattering in tissue.

NOBIAS aims to break through frontiers to create foundational multilayer fast Time Domain Diffuse Optical Spectroscopy (TDDOS) to eliminate color bias and inaccuracy shortcomings of current CW technology and revolutionize the future of bias-free, accurate optical biomarker sensing. To achieve this ambition, NOBIAS will create a multilayer TDDOS dynamic skin tissue model based on Monte Carlo to investigate the effect of skin type and anatomy on color bias, to optimize the concept, device and probe design to compensate and eliminate color bias and inaccuracies (WP1, Obj.1). 2 groundbreaking approaches (i) intermediate hybrid CW-TDDOS fusion approach (phase 1) is envisioned to compensate for skin color bias, followed by (ii) an ambitious new frontier fast TDDOS approach (phase 2) to eliminate color bias (WP2, Obj.2) and provide faster (100-250X), real time measurements at wearable footprint (100X). A first-of-a-kind compensation algorithm based on real-time instrument response function (IRF), and phantom arm aims to deliver groundbreaking accuracy (14X) (WP3, Obj.3). Early benchtop testing and feedback across work packages will mitigate risks of ambitious objectives. NOBIAS paradigm device/algorithm will be validated on tissue-mimicking phantoms and bias-free sensing will be demonstrated on blood biomarkers (haemoglobin (Hb, HbO), oxygen saturation (StO2, SpO2)) sensing at wrist location on healthy i) adults ii) infants (WP4, Obj.4).

NOBIAS breakthrough lays the foundation for the world's first bias-free and accurate OBS devices and sets its legacy to be the gold standard for bias-free clinical and personal biomarkers sensing applications

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101164780

Keywords of the ERC project: biophotonics, photonics integrated circuits, biomedical optics, skin color bias

Keywords that characterize the scientific profile of the potential visiting researcher/s: ML/AL expert, algorithm developer, automation

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101165786	**BESSEL**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Denys Nikolayev**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Deep-Body Wireless Bioelectronics Enabled by Physics-Based Bioadaptive Wave Control

Wireless medical devices can be implanted in the body to monitor health and to deliver therapies. Recent advances in biosensors, neural interfaces, biotechnology, microelectronics, and improved surgical techniques enable a vision of minimally invasive battery-free bioelectronic implants that can perform a wide range of medical and research tasks. Examples include biosensing for an early detection of health anomalies, recording and precision stimulation of central and peripheral nervous systems, implantable labs-on-a-chip, surgical microbots, and so on. A key scientific challenge lies in how these devices can be powered and controlled from outside of the body. Existing wireless solutions remain limited in their ability to transfer energy and data. These limitations result from the difficulty in controlling electro-magnetic waves in the human body – a dynamic, heterogeneous, and lossy medium. The objective of this proposal is to develop bio-adaptive wave control technologies that overcome these challenges to enable efficient powering and precise control of mm/µm-scale deep-body bioelectronics. To accomplish this, we will (1) focus on the fundamental studies of waves and their control in complex and dynamic anatomical media; (2) develop new reconfigurable architectures of conformal radiating surfaces for the practical implementation of the developed wave control methodologies, and (3) demonstrate clinical utility by fully wireless recording and modulation of the pancreatic nerve activity in an anesthetized porcine model through dynamic wave control. The proposal relies on interdisciplinary track-record of the PI in bioelectronics and neural interfaces, wave physics and computational electromagnetics, conformal radiating structures and wireless power transfer. BESSEL consolidates these skills and enables conducting research on highly capable deep-body wireless bioelectronics with high translational potential.

Link to the ERC project webpage: Deniq.com

Keywords of the ERC project: Wireless bioelectronics, biosensors, implantable devices, neural interfaces, battery-free

Keywords that characterize the scientific profile of the potential visiting researcher/s: Wave physics, antenna engineering, metasurface engineering, bioelectronics, biosensors, translational studies

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101169720	**SMARTMAG**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Paavo Rasilo**
Host Institution:	TAMPEREEN KORKEAKOULUSAATIO SR - FIN

Controllable Magnetic Cores for Transformers and Electrical Machines

Ferromagnetic cores are used in transformers and electrical machines to allow producing a large magnetic flux with a small electric current. These cores have been traditionally designed for guiding a predefined magnetic flux to a predefined location, leaving them uninvolved with the actual control of the energy conversion process. As the consequence, there are millions of power and distribution transformers and variable-speed electrical motors in the EU alone whose performance, compactness and robustness are limited due to need of complex mechanical arrangements or excessive current and voltage requirements. SMARTMAG will advance the transition towards active and smart magnetics, where the magnetic cores themselves take a key role in controlling the magnitude and distribution of magnetic fields in transformers and electrical machines. Starting from the fundamental principles of varying the reluctance of ferromagnetic flux paths by direct current biasing and voltage-controlled magnetoelectric composites, we will demonstrate unprecedented methods for tuning three-phase transformers and synchronous motors during the operation, significantly improving their performance and simplifying their construction compared to existing solutions. We have identified four scientifically novel and industrially relevant target applications – two transformers and two electrical machines – whose conceptualization, design, manufacturing and validation form the overarching goal of the project. Our three objectives aim to push the relevant nonlinear and multiphysics material models beyond the state-of-the-art, implement them in customized numerical design tools for transformers and electrical machines and to validate the feasibility of the four concepts by working prototypes in laboratory conditions. As the result, new methods will arise for reducing outdated auxiliary devices and enabling new functionalities in power delivery as well as designing improved motors for electric drives.

Link to the ERC project webpage: https://doi.org/10.3030/101169720

Keywords of the ERC project: electrical machines, electrical steel sheets, finite element analysis, high-temperature superconductors, magnetic materials, magnetoelectric materials, transformers

Keywords that characterize the scientific profile of the potential visiting researcher/s: electrical steel sheets, finite element analysis, high-temperature superconductors, magnetic materials, magnetoelectric materials

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Project ID:	Project Acronym:	Evaluation Panel:
101170783	**CellWise**	**PE7** Systems and Communication Engineering

Principal Investigator:	**Dr Irene Otero-Muras**
Host Institution:	AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS - ESP

Engineering, Analysis and Control of Biomolecular Circuits Under Uncertainty

Synthetic Biology is one of the pillars of the bioeconomy. However, a number of fundamental issues need to be resolved before its full potential can be realized. First, the design of dynamic biomolecular circuits faces high levels of uncertainty from different sources leading to poor predictability of Synthetic Biology designs. Furthermore, there is an urgent need for more sophisticated biomolecular circuit functionalities to meet the demands arising from cutting-edge applications and scientific challenges such as the synthetic cell, including those related with cell cognition. CellWise aims to make a major contribution to the field by developing theoretical tools, and mathematical and computational methods to achieve enhanced predictability in Synthetic Biology. The objectives are: i) harnessing noise of different sources, uncertainty and context dependency for the precise engineering of complex biological functions, ii) fundamentally advancing the bifurcation analysis of biomolecular circuits under noise and uncertainty, and iii) achieving precise control of cell function, both at the single cell and population levels. The project has a special focus on the engineering and control of cell cognition capabilities such as memory and cell decision-making. To accomplish this, we propose an innovative mathematical modelling framework for dynamic biomolecular circuits under noise and uncertainty, combined with state-ofthe-art optimization methods, our recent insights on the automated design and bifurcation behaviour of stochastic systems, and experimental work. Through the realization of these objectives, CellWise will unlock innovative synthetic biology applications and improve our understanding of fundamental questions in biology, illuminating mechanisms by which cells achieve robust function in presence of noise, and elucidating how cellular decisions can be precisely controlled.

Link to the ERC project webpage: www.celwwise.

Keywords of the ERC project: Synthetic Biology

Keywords that characterize the scientific profile of the potential visiting researcher/s: Synthetic Biology

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101002561	**BIOMITRAL**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Antonio D'Amore**
Host Institution:	FONDAZIONE RI.MED - DEU

Engineering the mitral valve: bioinspired control of structure and function for enhanced in vivo performance

Tissue Engineered Heart Valves (TEHVs) can restore function in the pulmonary and aortic positions and have shown capacity for tissue regeneration and growth in pre-clinical models. Yet, this concept has not been extended to the Mitral Valve (MV), whose pathologies affect >25% of the valve disease patients in Europe. In this proposal, we introduce a bio-inspired design methodology and bioprocessing technology to engineer BIOMITRAL: a polymeric, stent-less, tissue engineered MV that recapitulates native structure-function. Key to our approach is the engineering of MV leaflets and chordal apparatus. In the native MV, this set of tendon-like appendages mechanically connects the leaflets to the left ventricle (LV) and allows for harmonization of the valve kinematics, coaptation and ventricle contractile dynamics. Commercial MV prostheses used for MV replacement, as well as most existing TEHVs are mounted on synthetic stents that lack of this important structure and consequently neglect this physiological mechanism. In addition, non-degradable stents cannot adapt to patient's growth, de-facto negating a key advantage in TEHVs. Our specific hypothesis is that recapitulating native leaflet structure-function and incorporating engineered chordal apparatus will lead to an engineered MV with enhanced functional and remodeling performances. To verify our hypothesis, we will: Aim 1. Characterize the structure-function of freshly isolated human valve tissue and use the derived properties to fabricate stented (control) and stentless BIOMITRAL prototypes; Aim 2. Assess prototypes mechanics and kinematics in silico via finite element modeling and in vitro in a pulse duplicator; Aim 3. Evaluate BIOMITRAL in vivo functional performance and assess remodeling in a chronic ovine model. Engineering a “living” MV with bioinspired leaflets and chordae that connect engineered leaflets with the LV is a revolutionary concept that can fundamentally transform the design of MV prostheses.

Link to the ERC project webpage:

Keywords of the ERC project: Cardiovascular tissue engineering; bioprocessing; biomimicry;heart valve engineering.

Keywords that characterize the scientific profile of the potential visiting researcher/s: Cardiovascular tissue engineering; bioprocessing; biomimicry; heart valve engineering.

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Project ID:	Project Acronym:	Evaluation Panel:
101039198	**SURFACE**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Antonio Papangelo**
Host Institution:	POLITECNICO DI BARI - ITA

Towards Future Interfaces With Tuneable Adhesion By Dynamic Excitation

Macroscopic adhesion is of utmost importance in key technologies such as soft and climbing robots, aerospace grasping technologies, human-robot interactions, pick-and-place manipulators. Commonly, bioinspired adhesives interfaces have been characterized from a quasi-static perspective, neglecting the effect of dynamic excitations. Nevertheless, recent observations suggest that added micro-vibrations may be exploited to strongly enhance and rapidly tune macroscopic adhesion. By exploiting the multiplicative coupling between geometric- and viscoelastic vibration-induced enhancements of macroscopic adhesion, SURFACE aims at designing future soft interfaces with unprecedented and tuneable adhesion strength. To this end, I aim to: (i) develop highly efficient numerical tools for studying adhesion of patterned soft surfaces under micro-vibration excitation, (ii) unveil the coupling effect between topography and viscoelasticity that determine the interfacial strength and toughness (iii) design optimal surface topography and excitation for macroscopic adhesion tuning, by exploiting artificial intelligence models to unveil new mechanisms for adhesion enhancement, (iv) prove the adhesive performance reached, by experimentally testing high-resolution 3D printed interfaces with the desired topography and superposed micro-vibrations. So far, the adhesive performance of bioinspired patterned interfaces has been limited by manufacturing capabilities at the micro/nanoscale. SURFACE ground-breaking approach aims at exploiting dynamics excitation to outperform state-of-the-art adhesive interfaces. By exploiting artificial intelligence models, SURFACE aims at revealing new mechanisms for adhesion enhancement, which lay beyond our intuition. Rapidly tuneable strong adhesive interfaces have the potential to revolutionize cutting-edge technologies based on soft adhesive interfaces that require to move and place objects quickly and with accuracy.

Link to the ERC project webpage: https://tribodynamicslab.poliba.it/

Keywords of the ERC project: adhesion, viscoelasticity, soft materials, polymers, contact mechanics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101042402	**Texwearots**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Özgür Atalay**
Host Institution:	ISTANBUL TEKNIK UNIVERSITESI - TUR

Textile-Based Wearable Soft Robotics with Integrated Sensing, Actuating and Self Powering Properties

Wearable soft robotic devices for rehabilitation and motion assistance have emerged in the past decade as promising robotic systems owing to their adaptable morphologies. Soft robotics allow safer human-robot interactions, as opposed to rigid exoskeletons made of metals. Elastomers and textiles have become attractive low-cost and flexible material solutions to build wearable soft robots. Despite their high potential, the demonstrated solutions of previous studies are bulky, unreliable, non-scalable, and have limited portability and mobility. All those drawbacks do not allow practical applications of soft robotic devices for at home assistance and rehabilitation during activities of daily living, where they are intended and most needed. The core objective of TEXWEAROTS is to develop untethered knitted soft robotic assistive devices to overcome current drawbacks related to the wearable soft-robotic system reliability, mobility, sustainability, and integration. TEXWEAROTS focuses on the development of a knitted robotic glove free from bulky components with seamlessly integrated actuation, sensing, and self-powering functionalities. With my solid experience in textile manufacturing, soft sensors, and soft robotics, I will leverage the latest advances in digital machine knitting to manufacture 3D actuator shells with the integrated functionalities in a monolithic manner. This will lead to garment-like customizable textile-based robotic devices which are highly scalable and reliable. Furthermore, I will enable thermally powered fluidic actuation mechanism through integration of soft Peltier cooling functionality which enhances the actuator response time needed for motion assistance applications. TEXWEAROTS combines textile and material science, physiotherapy, robotics, electronics, and biomedical engineering. The proposed novel technologies and manufacturing techniques of the glove will lead to a breakthrough in wearable soft robotics and wearable electronics at wide

Link to the ERC project webpage: https://softsensorslab.itu.edu.tr/

Keywords of the ERC project: Soft robotics, control, sensors, actuators, exeskeletons, smart textiles, e- textiles

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101044228	**ArcHIDep**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Sara Bagherifard**
Host Institution:	POLITECNICO DI MILANO - ITA

revolutionary tailored ARChitected Heterostructures obtained by solId state DEPosition

Imagine having unlimited freedom in design and scalable fabrication of engineering components with an almost arbitrary selection of mixed composition, inner spatial arrangement and outer shape; this implies the ability to integrate multiple heterogeneity indexes to selectively adjust a variety of site-specific properties over several length-scales in one single component. To offer this treat, ArcHIDep challenges the traditional (composition-structure-process)-function correlations that currently neglect or are incapable to include the intriguing concept of heterogeneity. ArcHIDep paves the way to understand and exploit the synergistic strengthening mechanisms induced by compositional and architectural heterogeneity to offer unprecedented functionalities. My recent studies confirm the significant potential of solid state powder deposition for obtaining 3D metallic objects with notable structural integrity; I also achieved tunable mechanical properties by tailoring heterogeneity features in micro-nanophase deposits thru this method. Thus, I believe solid state deposition holds the key to add extra degrees of freedom (multi-indexed heterogeneity) to customization of metal-based products, beyond what is currently thought as the limits of engineering. I will outline novel mechanism-based strategies to establish a revolutionary tailored 3D manufacturing scheme that will offer countless uncharted functional opportunities. This is achieved by pairing a versatile and scalable solid state fabrication technique with advanced in-situ micro-mechanical tests and multiscale computational models. Successful implementation of ArcHIDep will give rise to in-depth conceptual developments towards a non-existing framework that enables design and real-time tailoring of compositional and structural complexity. This will be reinforced by inexhaustible recipes of bulk heterogeneity regarding chemical composition, microstructure, fraction and hierarchical arrangement of dissimilar phases.

Link to the ERC project webpage: https://www.archeslab.polimi.it/

Keywords of the ERC project: Heterogeneity, Solid-state deposition, Additive Manufacturing, multi-material

Keywords that characterize the scientific profile of the potential visiting researcher/s: Material Scientist, Mechanical Engineer

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101044828	**O-Health**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Jérôme Noailly**
Host Institution:	UNIVERSIDAD POMPEU FABRA - ESP

Scalable systems modelling to simulate body-level interplays among non-communicable diseases

Non-communicable diseases (NCD) that involve load-bearing organs emerge silently according to complex mechanisms that are likely to involve inter-disease systemic communications. Clinical explorations cannot apprehend such intricate emergence, but I postulate that multiscale in silico models can. The digital twin for health has progressed a lot in the last decades, but multi-disease transversal modelling has not happened. It requires unique developments to couple small to large-scale model components with appropriate balance of phenomenological and mechanistic approaches, to cope with overwhelming biological complexity, preserve interpretability and incorporate real-world data. This is the niche of O-Health that proposes a scalable ecosystem of multiscale NCD models interrelated through a systemic model of low-grade inflammation. The project tackles such vertical and transversal physiology-based computational modelling through four major NCD, lung emphysema, atherosclerosis, intervertebral disc degeneration and knee osteoarthritis that affect load-bearing organs at different anatomical locations. The cellular /molecular scale components of each NCD model will vertically share predicted variables with an interface model of endothelial cell dysfunction that communicates with a transversal model of body-wide systemic communications. The O-health ecosystem will be modular and interoperable. Mechanistic modelling will be covered by finite element models at the organ /tissue scales and by agent-based (AB) models at the cell /molecular scales. AB models will incorporate high-level interaction graphs for interpretable phenomenological modelling where necessary. Graphs will merge knowledge projection and correlation models extracted from longitudinal population cohort data, also used to evaluate O-Health. Interoperability will be ensured through standard languages such as Field and Systems Biology Mark-up Languages, enabling the scalability of the O-Health ecosystem.

Link to the ERC project webpage: https://www.upf.edu/web/o-health

Keywords of the ERC project: Digital twins in health; Multiscale Modelling; Systems Biology; Personalized Modelling; Biomechanics

Keywords that characterize the scientific profile of the potential visiting researcher/s: Data Science; Bioinformatics; Computational Biology; Finite element modelling; Medical image analysis; Software Development

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Project ID:	Project Acronym:	Evaluation Panel:
101053309	**NABUCCO**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Chiara Bisagni**
Host Institution:	POLITECNICO DI MILANO - ITA

New Adaptive and BUCkling-driven COmposite aerospace structures

The NABUCCO project aims to develop radically new concepts of adaptive and buckling-driven composite structures for next generation aircraft. In aeronautics, buckling is generally avoided because it causes stiffness reduction, large deformations, and can result in a catastrophic collapse. Instead, NABUCCO considers buckling no longer as a phenomenon to be avoided, but as a design opportunity to be explored for its ground-breaking potentialities. The idea is to use buckling drawbacks in a positive way, to conceive, design and realize adaptive structures and aircraft morphing wings. These new, lighter, flexible structures will be designed considering all the potentialities offered by composite materials, thanks also to novel manufacturing processes, and modifying the boundary conditions to govern when buckling occurs and to tune multiple non-traditional post-buckling stable configurations. These structures will be able to adapt their shape during different flight conditions, acting on two of the biggest levers for the future of clean aviation: reduced weight and increased efficiency. The concepts proposed in NABUCCO will require a step change for what concerns the design, analysis and optimization methodologies, since the design space will be significantly enlarged and the designer will need the ability to identify, manage and control the buckling phenomena. These solutions can be obtained by adopting an integrated design approach established on a multi-disciplinary thinking. A strongly coupled computational-experimental framework will be developed based on novel analytical formulations, artificial intelligence techniques for large multi-objective optimizations, high-fidelity simulation methodologies and advanced test techniques.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101055186	**qMOTION**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Oliver Roehrle**
Host Institution:	UNIVERSITY OF STUTTGART - DEU

Simulation-enhanced High-density Magnetomyographic Quantum Sensor Systems for Decoding Neuromuscular Control During Motion

Being able to decode neural signals that control skeletal muscles with high accuracy will enable scientific breakthroughs in diagnostics and treatment, including early detection of neurodegenerative diseases, optimising personalised treatment or gene therapy, and assistive technologies like neuroprostheses. This breakthrough will require technology that is able to record signals from skeletal muscles in sufficient detail to allow the morpho-functional state of the neuromuscular system to be extracted. No existing technology can do this. Measuring the magnetic field induced by the flow of electrical charges in skeletal muscles, known as Magnetomyography (MMG), is expected to be the game-changing technology because magnetic fields are not attenuated by biological tissue. However, the extremely small magnetic fields involved require extremely sensitive magnetometers. The only promising option is novel quantum sensors, such as optically pumped magnetometers (OPMs), because they are small, modular, and can operate outside of specialised rooms. Our vision is to use this technology and our expertise in computational neuromechanics to decode, for the first time, neuromuscular control of skeletal muscles based on in vivo, high-density MMG data. For this purpose, we will design the first high-density MMG prototypes with up to 96 OPMs and develop custom calibration techniques. We will record magnetic fields induced by contracting skeletal muscles at the highest resolution ever measured. Such data, combined with the advanced computational musculoskeletal system models, will allow us to derive robust and reliable source localisation and separation algorithms. This will provide us with unique input for subject-specific neuromuscular models. We will demonstrate the superiority of the data over existing techniques with two applications; signs of ageing and neuromuscular disorders and show that it is possible to transfer these methodologies to clinical applications.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101075832	**SAC_2.0**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Gianvito Vile**
Host Institution:	POLITECNICO DI MILANO - ITA

Single-Atom Catalysts for a New Generation of Chemical Processes: from Fundamental Understanding to Interface Engineering

The grand challenge for the chemical industries of the 21st century is the transition to more sustainable manufacturing processes that efficiently use raw materials and eliminate waste. Catalysis engineering is the key enabling technology to drive this transition, and single-atom catalysis is an emerging new approach to catalyst design. However, major questions concerning the local structure of these systems, their reactivity, and their evolution when prepared and structurally integrated into chemical devices are elusive. This project will address these important scientific gaps, laying the foundation for a new generation of catalysts for CO2 conversion. To unveil their microscale functioning, I will study for the first time the charge transfer taking place before, during, and after reactant adsorption and surface reactivity. This will be done combining synthesis, operando characterizations, microkinetics, and theoretical methods. Then, merging microreactor technology and process intensification, I will manufacture single-atom catalysts in powder and as miniaturized thin films or foams, using new, scalable and greener methods. This will bypass current limitations in terms of efficiency and metal dispersion, and close the gap on challenges related to catalyst-reactor integration, bridging chemical and device engineering. The materials will be validated in the valorization of CO2 to derive structure-function relationships and prove major catalytic improvements under realistic conditions. Overall, this is a fundamental and interdisciplinary project with ambitious objectives and high-risk/high-gain potential, that will go beyond the traditional pillars of catalysis. The scientific outcomes will provide new perspectives in catalysis and open paths in other fields, such as materials chemistry, green synthesis, and purification science. My pioneering contributions in this field and new proof-of-concept data place me in a unique position to undertake this fundamental study.

Link to the ERC project webpage: https://www.vile-researchgroup.com/

Keywords of the ERC project: catalysis

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101086075	**Off-coustics**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Esteban Ferrer**
Host Institution:	UNIVERSIDAD POLITECNICA DE MADRID - ESP

Minimisation of the offshore wind and tidal turbine acoustic footprint on marine life

For renewable energies to be sustainable in the future, their impact and harmful effects on the environment should be minimum. Recent evidences suggest that offshore wind and tidal turbines can have an acoustic damaging impact on marine life, due to the sustained generation of noise, which propagates very efficiently underwater. Off-coustics combines numerical simulations and experiments to provide insights into the physics governing the aero/hydro-acoustic generation and propagation for offshore wind and tidal farms. Control of these physics will enable the design of silent offshore farms enabling renewable energy with zero acoustic impact. First, I propose to develop a novel aero/hydro-acoustic solver, blending advanced high order numerical techniques through machine learning and trained with experiments, to simulate flow-acoustic signatures for wind and tidal turbines, in realistic offshore environments (including bathymetry, air-water surface, etc.). Second, an experimental campaign will generate aero/hydro-acoustic data for scaled turbines and farms to help elucidate the physics governing offshore acoustics and to guide/validate the flow-acoustic simulator. Third, simulations and experiments will be combined to characterise turbines in complex offshore environments and to develop physic-informed surrogate models. Fourth, using the developed surrogate models and optimisation, Off-coustics will propose new designs of silent farms that minimise the acoustic impact while ensuring energy production. Major advances in multidisciplinary aspects are expected, including fluid mechanics, numerical simulations, optimisation, experimental acoustics, aero/hydro-acoustics and offshore wind and tidal turbine physics.

Link to the ERC project webpage: https://blogs.upm.es/offcoustics/

Keywords of the ERC project: wind turbine, tidal turbine, noise, aeroacoustic, hydroacoustic, marine life

Keywords that characterize the scientific profile of the potential visiting researcher/s: noise, aeroacoustic,hydroacoustic, marine life

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101086573	**BioValCat**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Jakob Albert**
Host Institution:	UNIVERSITY OF HAMBURG - DEU

Enhanced Biomass Valorisation by Engineering of Polyoxometalate Catalysts

This project builds on a recent and ground-breaking discovery of the PI in the field of homogeneously catalysed, selective biomass valorisation. Materials technologies that promise improved catalytic performance are of utmost interest for a more sustainable chemical industry. Manipulating molecular catalysts like polyoxometalates (POM) in solution by tuning the solvent properties and gas atmospheres introduces a new paradigm in homogeneous-catalysed biomass valorisation technologies.

It has been found that by using methanol as a (co)solvent, POM catalysts can completely suppress undesired total oxidation to CO2 under oxidative conditions. This drastically enhances the carbon efficiency from biomass to close to 100% yield. Remarkably, this manipulating effect could be explained with the formation of a new vanadyl-methanolate-complex in methanol-aqueous solutions having a methanol content of at least 10%.

The proposed BioValCat project aims for developing this potentially disruptive technology towards an industrial viable biomass valorisation process by laying the foundations for a scalable, safe and economic process for the oxidation of biomass to valuable carboxylic acid esters. The project is structured according to the key challenges that have to be mastered in order to achieve this ambitious goal: a) Investigations to identify the nature of the POM-solvent interactions; b) Understanding and revealing the key organic mechanisms in solution; c) Development of novel POM catalysts specifically optimised to perform in aqueous-alcoholic solvent mixtures; d) Extension of the substrate and product scope to industrially viable biomass feedstock; e) Process development, with special emphasis on safety aspects, process intensification as well as product isolation and catalyst recovery.

With the proposed project the PI aims for paving the scientific route to novel, low-cost biomass utilisation technologies with great promise for decentralised valorisation of biogenic waste.

Link to the ERC project webpage: https://www.chemie.uni-hamburg.de/en/forschung/erc-biovalcat.html

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101088694	**BREATHE**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Tommaso Andreussi**
Host Institution:	SCUOLA SUPERIORE DI STUDI UNIVERSITARI E DI PERFEZIONAMENTO S ANNA - ITA

Building a space Revolution: Electric Air-breathing Technology for High-atmosphere Exploration

Airflight and spaceflight gave mankind different perspectives and opened new paths for communication. A gap remains, between 50 km and 250 km of altitude, where the rarefied atmosphere makes it hardly viable to operate with either spacecraft or planes. Air-breathing Electric Rockets (AERs) will allow to close this gap, lowering the altitude of spacecraft operations below 250 km, in the so-called Very Low Earth Orbits (VLEOs). Operations in VLEOs will give radical advantages in terms of orbit accessibility, payload performance, protection from radiations, and end-of-life disposal. AERs combine an intake to collect the residual atmosphere in front of the spacecraft and an electric thruster to ionize and accelerate the atmospheric particles. Such residual gas can be exploited as renewable resource not only to keep the spacecraft on a VLEO, but also to remove the main limiting factor of spacecraft lifetime, i.e., the amount of stored propellant. Several realizations of the AER concept have been proposed, but limited evidence of the concept feasibility is available. The few end-to-end experimental campaigns highlighted the need to improve the AER functional design and the representativeness of simulated atmospheric flows. The difficulty in recreating the VLEO environment in a laboratory limits the data available to validate scaling laws and modelling efforts. The objective of BREATHE is to increase the understanding of air-breathing electric propulsion and to pave the way toward the in-orbit demonstration of the AER concept. With this aim, project activities will focus on: 1) Developing theoretical models and simulation tools, to characterize atmospheric flows and low-temperature plasmas; 2) Merging on-ground testing and virtual simulations, to provide a controlled environment for the characterization of prototypes and the extrapolation to flight conditions; 3) Identifying the main scaling laws governing AERs and, thus, the optimal operating principle and design.

Link to the ERC project webpage: https://www.santannapisa.it/en/institute/mechanical-intelligence/breathe

Keywords of the ERC project: electric propulsion, space propulsion, very-low Earth orbit, nanosatellite, CubeSat, air-breathing electric propulsion, rarefied gas dynamics, plasma physics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101088740	**XenoSim**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Philip Cardiff**
Host Institution:	UNIVERSITY COLLEGE DUBLIN, NATIONAL UNIVERSITY OF IRELAND, DUBLIN - IRL

Providing Computational Insights into Cardiac Xenotransplantation

We are at the dawn of a new age in medicine, marked by the first pig-to-human heart transplant. Xenotransplantation has long been a dream for clinicians and now, due to rapid progress in gene editing, is becoming a reality. To overcome immediate rejection, barriers of immunity and infection have to be overcome, however, achieving long-term success requires a deep understanding of the physiological and mechanical challenges introduced by the anatomically dissimilar xenotransplants. XENOSIM aims to address these challenges by providing fundamental clinical insights into the nascent field of cardiac xenotransplantation through the development and application of novel high-resolution, higher-order, multiphysics simulation methods. Tremendous progress has been made in biomedical imaging, nonetheless, a multitude of physical phenomena relevant to xenotransplantation are not available for experimental observation. In silico studies are uniquely placed to provide insights into the haemodynamic disruption caused by replacing a human heart with an anatomically dissimilar one. XENOSIM is targeting the establishment of the first family of porcine cardiac xenotransplant models that can provide clinically significant insights into the haemodynamic compatibility of porcine donor hearts, the impact of surgical approach, and the consequence of pathologies. To provide these novel insights requires new coupled simulation approaches. Accordingly, the second goal of XENOSIM is to create a new class of monolithic finite volume fluid-electro-solid interaction methods, which can provide predictions in clinically relevant timescales through the exploitation of hybrid CPU-GPU systems. XENOSIM will establish the new field of computational cardiac xenotransplantation. Furthermore, the novel numerical methods established by XENOSIM are expected to impact a broad range of fields well beyond the project end.

Link to the ERC project webpage:

Keywords of the ERC project: finite volume method; fluid-solid interaction; cardiovascular; OpenFOAM

Keywords that characterize the scientific profile of the potential visiting researcher/s: finite volume method; fluid-solid interaction; cardiovascular; OpenFOAM

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101097433	**HAPI**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Thomas Pardoen**
Host Institution:	UNIVERSITE CATHOLIQUE DE LOUVAIN - BEL

Ultimate fracture toughness through thickness engineering

The design of critical structural metallic components in the aeronautic, biomedical, nuclear or pipeline fields is often dictated by a fail-safe criterion established in the context of fracture mechanics. The design must prevent any pre-existing crack to propagate under nominal but also sometimes accidental loads. In this context, the primary material property is the fracture toughness quantifying the resistance to crack initiation. In ductile metals, the fracture toughness depends on plate thickness with a peak value attained at an intermediate thickness in the range of a fraction of a millimetre up to ten millimetres or more. Although this thickness dependence is known since the 60's, the literature is very silent regarding the peak fracture toughness value, about what sets its magnitude and about the corresponding optimum thickness. Hence, there is no definitive rational about how to use or account for such an optimum fracture toughness in structural design. The vision of HAPI is that the fracture resistance of critical metallic structural components can be significantly enhanced by selecting and/or controlling the plate thickness for thin-walled applications and the constituent plate thickness for thick laminates. In particular, metal laminates with optimum thickness of the constituents, selected for their high strain hardening capacity will lead to unattained levels of cracking resistance. This will require generating a range of new experimental fracture data, performing complex 3D finite element simulations relying on a rich micromechanical model with new enhancements, extending the materials selection approach, exploring the processing/assembling of novel ultra-tough metal laminates up to a radically new concept of laminate pressure vessel. Major gains are expected on the weight of structures, potentially up to a factor five if fracture toughness is the dominating design factor, and this, without changing the chemistry or inventing new microstructures.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101114664	**CIRCULARIZE**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Alessandro Pellis**
Host Institution:	UNIVERSITA DEGLI STUDI DI GENOVA - ITA

Chemo-enzymatic processing of bio-based building blocks to circular functional materials

Recent advances driven by the society's need of implementing a more sustainable polymer chemistry, led to the development of several bio-based materials and the booming of the interest of using biocatalysts for polymer processing and recycling.

The aim of CIRCULARIZE is to develop appropriate chemo-enzymatic methods to process bio-based resources to obtain advanced functional materials via the exploitation of highly selective reactions following the green chemistry principles. Further, the aim is, based on that knowledge, to improve the reaction efficiency of the biocatalysts and understand and control the surface and bulk properties of the produced materials in pursuit of novel smart materials and reactive surfaces.

Current processes for the utilization of bio-based monomers and resources are unspecific and lead to products in poor quality due to side reactions. Specific biocatalysts could achieve optimal selectivity together with minimal damage to the monomers and polymers and provide high-quality advanced materials.

When considering the multifunctional monomers deriving from biomass, the chemo catalytic techniques used by industry have some major shortcomings such as limited selectivity (leading to side reactions) and use of toxic catalysts and solvents. Using this knowledge, the CIRCULARIZE project will develop and apply techniques based on sustainable chemo-enzymatic processes, developing a series of fully bio-based hybrid polymers having smart characteristics (temperature-switchable, vitrimeric properties) while being able to finely tune their degradation via the insertion of enzyme-susceptible motifs. Methodologically, CIRCULARIZE strives to establish new approaches at the cross-sectorial biotechnology/polymer chemistry interface to extend the current knowledge on enzymes for polymer synthesis and processing and, in the long term, the development of a sustainable biopolymer chemistry able to build an endless selective carbon recovery loop.

Link to the ERC project webpage: https://sites.google.com/view/pellislab/home-page

Keywords of the ERC project: chemo-enzymatic synthesis, enzymatic polymerization, green solvents, biobased materials, polymer recycling and upcycling, sustainable synthesis, esterases, lipases, cutinases, laccases, biomass valorization, polyesters

Keywords that characterize the scientific profile of the potential visiting researcher/s: chemo-enzymatic synthesis, enzymatic polymerization, green solvents, biobased materials, polymer recycling and upcycling, sustainable synthesis,esterases, lipases, cutinases, laccases, biomass valorization, polyesters

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101115741	**DANTE**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Giovanni Stabile**
Host Institution:	SCUOLA SUPERIORE DI STUDI UNIVERSITARI E DI PERFEZIONAMENTO S ANNA - ITA

Data Aware efficient models of the urbaN microclimaTE

The share of the world's population living in cities is rapidly increasing, and it is expected to rise to 80% by 2050. It is therefore crucial to develop new efficient and reliable methods to model the urban microclimate; in fact, these models can support urban planners and policymakers to create more comfortable and sustainable cities. High computational requirements limit existing numerical methodologies, and DANTE fits in this context and aims to create a new paradigm for fast and reliable numerical simulations bridging the fields of model order reduction, machine learning, and data assimilation. The idea is to create a research team to answer many unresolved questions in model order reduction for complex and real-life urban microclimate simulations. Particular emphasis will be given to advanced machine learning tools, which incorporate physics knowledge, aiming to improve the accuracy, interpretability, and reliability of predictive models. The identified tasks cover a wide range of different topics: dimensionality reduction of the solution manifold in problems governed by complex physical principles, uncertainty quantification, data assimilation, and inverse modeling. The new tools will have the agility of data-driven methods in complex nonlinear settings and the physical rigor of projection-based methods with quantified errors. The developed methods will significantly impact digital transformation, enabling digital twins of urban environments. Possible applications include, but are not limited to, urban air pollution, heat island modeling, wind loads on buildings, and inverse modeling approaches.

Link to the ERC project webpage: https://www.giovannistabile.com/projects/dante-erc-stg

Keywords of the ERC project: scientific machine learning, reduced order models

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101116461	**DESignSX**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Nicolas Schaeffer**
Host Institution:	UNIVERSIDADE DE AVEIRO - PRT

Hydrophobic Eutectic Solvents for Tailored Metal Separation and Recycling

DESignSX proposes the application of bio-inspired non-ionic hydrophobic eutectic solvents (DES) to the solvent extraction (SX) separation of lanthanides (Ln) based on the understanding of these complex mixtures that are defined by hydrogen-bonded supramolecular self-assembly. Sustainable metallurgy stands uniquely poised to reduce the environmental impact of existing processes whilst recovering the metal value in end-of-life devices, thereby closing the resource loop. Despite their growing demand and geopolitical criticality, Ln separation remains technologically challenging due to the small monotonic variation in their properties, negatively affecting the economics of their recycling. DESignX seeks to exacerbate the steric factors defining the interactions between Ln and ligands, dictating the ensuing complex geometries and mutual separation selectivity, through the inclusion of complexing agents as components of molecularly crowded DES. By carefully selecting the DES phase binary components, the energy penalty associated with the structuration of the apolar phase may be rationally adjusted to increase the selectivity between adjacent Ln versus the same extractant in conventional SX. Given that the separation of adjacent Ln occurs over dozens of counter-current extraction stages, even seemingly small increases in the separation factors yield measurable environmental and economic gains. DESignSX rely on a tandem experimental-computational approach spanning multiple time and size scales, from a molecular description of pair-wise interactions to laboratory-scale process optimisation. DESignSX will overcome the traditional SX issues of complex flowsheets, third-phase formation, toxicity of the organic diluent through the inclusion of bio-derived components, and entrainment losses, whilst improving the selectivity of the separation. DESignSX outcomes are expected to be transferable to other critical SX separations.

Link to the ERC project webpage: https://www.design-sx.com/

Keywords of the ERC project: Hydrometallurgy, Solvent extraction, Thermodynamics, Alternative solvents, Circular economy

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101116991	**CHIPFRICTION**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Bart Weber**
Host Institution:	STICHTING NEDERLANDSE WETENSCHAPPELIJK ONDERZOEK INSTITUTEN - NLD

Chip production without friction

Friction contributes to the global computer chip shortage: friction and wear limit the positioning accuracy and throughput in chip production. As future positioning requirements approach the atomic scale, contact, friction and wear need to be understood at this scale to inspire new positioning solutions which are more urgently needed than ever before. CHIPFRICTION will focus on a key interface in chip production: carbon based material-on-silicon subjected to nanoslip in a hydrogen-rich environment. How nanoscale elasticity, plasticity and adhesion control rough contact formation will be revealed by matching contact models to ground-breaking fluorescence microscopy contact observations. How a local frictional stability criterion translates into the nanometre partial slip that characterizes the onset of multi-contact sliding will be modelled and observed through unique pre-sliding experiments. The oxidation, interfacial bonding and mechanical mechanisms that lead to wear of the carbon based material will be exposed through a combination of environmental control, new nanowear visualization methods and ex-situ XPS characterization. I am uniquely suited to conduct this work because I have fuelled the development of these experimental techniques, and I have experience in conducting the associated physical modelling. Macroscopic friction emerges from generic physical ingredients such as elastic deformation of surface topography and shearing of interfacial covalent bonds. How friction emerges, creates a scientific challenge with major impact: Friction is responsible for 25% of the world's energy consumption. I will address this long-standing challenge by experimenting and modelling the complex interplay between contact mechanics, frictional slip and wear of the specific interface. The transfer of new friction manipulation strategies for chip production without friction is facilitated by having an institutional link to the lithography industry.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101117080	**Self-Flow**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Martin Brandenbourger**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Self-contracting vascular networks: From fluid transport to autonomous locomotion of soft materials

Liquid flows in vascular networks are among the most effective ways to transport matter and information for life. Artificial vascular networks have mimicked this strategy without reproducing the same level of autonomy and adaptability. From animals to fungi, the most adaptable organisms control fluid transport with vessels that actively contract upon local sensing of stimuli. This adaptative fluid transport enables functionalities in organisms such as autonomous locomotion toward objectives. How are the orientation and rate of fluid flows controlled by self-contractions? How do these self-contracting networks tailor autonomous functionalities? So far, we do not know. Studies on organisms are limited to observations and lack the systematical characterizations required to apply these observations to artificial materials. Self-Flow hypothesizes that artificial vascular networks containing distributed sensors and actuators can decipher how self-contractions enable adaptable fluid transport. From there, materials containing self-contracting artificial vascular networks will enable systematical studies on the emergence of autonomous functionalities. With this experimental asset reinforced by theoretical and numerical models, my group and I will address the following questions: • Q1 DELIVER: How do self-contractions transport fluids across networks? • Q2 ADAPT: How do self-contractions autonomously adapt to the need of the network? • Q3 BEHAVE: How do self-contractions enable living matter functionalities? Self-Flow will combine active matter and mechanistic approaches to model fluid transport in self-contracting vascular networks. I will use these results to design active vascularized materials that use fluid transfer to autonomously locomote towards objectives and exchange information with their pairs. This will open the way to autonomous robots that can change shape, split or recombine like soft materials and develop functionalities beyond locomotion.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101123381	**THERMO2DEAL**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Miguel Muñoz Rojo**
Host Institution:	AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS - ESP

THERmal MOdulators based on novel 2D mxEne materials for nearly isothermAL battery operation

Batteries represent the present and future of our electrified society. One of the challenges within this field is ineffective battery thermal management (BTM), leading to device failure, limited performance, and lifetime reduction. BTM require a) effective dissipation of heat in warm environments to avoid thermal runaways, while b) the retention of heat in cold environments to avoid energy drops. This relates to the inevitable compromise of cooling (dissipate heat) and insulating (retain internal heat) in batteries depending on the needs. Current BTM are too bulky and provide mostly cooling capabilities, hampering batteries to perform optimally. Solid-state thermal modulators represent the ultimate solution for regulating batteries' temperature. However, their performances and sizes are far from sufficient to deploy them for BTM.
THERMO2DEAL aims to develop a novel interfacial thermal modulator that enables dynamic heat management in batteries to achieve nearly isothermal performance. We will develop specific types of large area 2D transitional metal carbides materials, i.e. MXenes, that will be tuned electrochemically to modulate their thermal properties. These MXenes will be the essence of a new thermal modulator design for facile integration in batteries. The scalability, its quickly and repeatedly toggle on and off, and its large hot to cold switching contrast makes it pioneer in the field. I will address scientific challenges in the synthesis of scalable and unique MXenes, demonstration of thermal tuning on them and their integration in pouch cells,e.g. basic battery stack units in cars or house appliances,for temperature modulation. Experiments and theory using a nano- to macro-scale approach will be used to overcome these challenges.
This proposal will be a key stepping stone in developing advanced BTM for improved battery performance and lifetime. In the long term, this project will be at the frontier of new thermal technology for energy recovery or storage

Link to the ERC project webpage:

Keywords of the ERC project: MXenes; 2D materials; nanoscale heat transport; electronic 2D devices; Chemical Vapor Deposition; Thermal management;

Keywords that characterize the scientific profile of the potential visiting researcher/s: thermal and electrical engineering; Chemical Vapor Deposition; 2D electronic devices; MXenes; thermal and electronic transport;

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Project ID:	Project Acronym:	Evaluation Panel:
101125009	**ICEVOLT**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Senbo Xiao**
Host Institution:	NORGES TEKNISK-NATURVITENSKAPELIGE UNIVERSITET NTNU - NOR

Icevoltaics: from the Workman-Reynolds Freezing Potentials to Electrical Energy

Water and aqueous solutions release a huge amount of thermal energy during freezing. Accessing energy utilizing the freezing process has never been attempted until today. It is known that orderly freezing of dilute aqueous solutions can result in electrical potentials as great as 230 volts at the ice-solution interface, namely the Workman-Reynolds freezing potential (WRFP), and a maximal electrical current of 1 μA. Based on our newly published results of counter ion separation during icing growth in ionic liquids, this project aims to combine high-throughput computing and nanotechnology for probing the approach of controlling and utilizing stable WRFPs and for the first time to enable energy exploration in the freezing process of aqueous solutions. Specifically, ionic liquids will be screened for maximizing WRFP and electrical energy output via atomistic modeling and multiscale experiments. Critical parameters for WRFP, including ion concentration, temperature and freezing rate, will be investigated for their effects in electrical energy generation. Novel electrical energy output based on WRFP will be constructed and tested, which will seed an entirely new green energy acquisition research and application field. The project, termed Icevoltaics, explores an un-touched energy source and provides highly innovative solutions of the future and clean energy.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101125172	**HOT-BIOPRINTING**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Daniel Nieto**
Host Institution:	UNIVERSIDADE DA CORUNA - ESP

Holographic Optical Tweezing Bioprinting (HOTB): Towards precise manipulation of cells for artificial multi-scaled vascularized tissues/organ printing.

Because current limitations in 3D bioprinting for tissue engineering stem from the fact that the multi-scaled vasculature associated to the human microtissues and organs cannot be replicated. The overarching aim of the HOT-BIOPRINTING project is to deliver a methodology enabling the manufacturing of a new generation of tissue-like structures with properties mimicking more closely the complexity of biological tissues and organs. The innovation of HOT-BIOPRINTING lies on the development of a disruptive technology named Holographic optical tweezing bioprinting (HOTB) for single and automatized multiple cell 3D bioprinting. The non-contact nature of light will eliminate the fails on bioprinting associated to instrumentation, which along with the HOTB capabilities for manipulating single cells for printing will drive a new paradigm shift: “resolution will be dictated by the cell size instead of by the mechanical component of the instrumentation”. This new technological advancement for resolution enhancement while maintaining bioprinting speed using holographic automatization can open new opportunities to the tissue engineering and regenerative medicine community.
I propose the following general objectives that go beyond the state of the art in bioprinting human mimetic tissue:
1) Generate the knowledge and develop a Holographic Optical tweezer bioprinter (HOTB) for high-definition single/multiple cell bioprinting.
2) Demonstration and automatization for 3D multicellular printing for large area tissue generation.
3) Overcome the challenges associated with existing biofabrication techniques (limited multi-scaled vascularization and oversimplified structures).
4) Demonstrating lymph-node bioprinting with integrated vasculature.
This represents a big challenge, if achieved, will revolutionize the bioprint technology by increasing the tissue complexity and by responding to the demand of biofabricating multi-scale vascularized complex tissues and organs.

Link to the ERC project webpage: www.dnietolab.com

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101126209	**3D.Fetoprint**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Alessandro Filippo Maria Pellegata**
Host Institution:	POLITECNICO DI MILANO - ITA

In-situ fetoscopic 3D bioprinting for spina bifida treatment

Currently available pre-birth surgical treatments for Spina Bifida Aperta (SBA) still do not provide a complete recovery in babies and would potentially benefit from a tissue engineering approach, indeed the first clinical trial using stem cells for SBA has recently started, however this is performed via an open-uterus approach. This made me wonder, what if we can develop an innovative system to deliver via fetoscopy a bioprinted tissue engineering costructfor SBA repair? Such an approach would promote tissue regeneration and ease the surgery. In 3D.FETOPRINT I will develop a system for the in-situ fetoscopic bioprinting of a gel composed of extracellular matrix (ECM) proteins and amniotic fluid stem cells (AFSCs) to close the defect of spina bifida aperta (SBA) in a large animal model. The project will be divided into three work packages. First work package will address the development and testing of the gel, by studying the interaction between fetal ECM proteins and AFSCs, to define a gel formulation that could be bioprinted in-utero. Second work package will focus on the design and development of an innovative fetoscopic bioprinting device capable of bioprinting a gel patch on the fetus. Last work package will finally validate the innovative approach. We will first validate through in-vitro testing using a laparoscopic simulator, then we will perform a sheep spina bifida aperta model where the innovative fetoscopic 3D bioprinting system will be vaildated. We will leverage my expertise in biomaterials, cells and tissue engineering device design to carry out this project that will deliver a revolutionary system that will open up the possibility to bioprint tissue engineered constructs on the fetus.

Link to the ERC project webpage: https://pellegatalab.chem.polimi.it/3d-fetoprint/

Keywords of the ERC project: bioprinting, tissue engineering, regenerative medicine, spina bifida, fetal surgery

Keywords that characterize the scientific profile of the potential visiting researcher/s: biomaterials, pediatric surgery, stem cells

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Project ID:	Project Acronym:	Evaluation Panel:
101142065	**e-cracker**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Kevin Van Geem**
Host Institution:	UNIVERSITEIT GENT - BEL

Revolutionizing Olefin Production with the electric High Mach Steam Cracking Reactor

Power to heat (P2H) is expected to be the first type of electrification that will drastically transform the chemical industry. This holds in particular for producing its major building blocks: the 300 Mt/yr light olefins via steam cracking at more than 800°C. e-CRACKER will implement P2H by so-called shockwave heating, enabling an increase in temperature to >1000°C in 10 ms, an order of magnitude faster than the current furnace-based technology in a revolutionary High-Mach reactor. When combined with insight in the pressure-dependence of the cracking chemistry this will allow to avoid undesired side reactions and to increase olefin yields of ethane and plastic waste derived naphtha cracking by 10 wt.% compared to yield gains of 0.1 wt.%, at best, when applying alternative P2H such as resistive heating.
e-CRACKER will:

1. generate new fundamental understanding of shock wave heating and kinetics under sub- and supersonic conditions;
2. demonstrate the practical applicability of an open-source, high fidelity Multiscale Modeling platform in combination with finite rate chemistry for turbulent reacting and rotating flows;
3. develop a compact, energy-efficient, electrified High-Mach reactor generating shockwaves and minimizing side products by avoiding back-mixing;
4. pave the way to avoid more than 200 Mt CO2/yr emissions with a scalable, flexible, step-by-step implementable technology driven by renewable electricity.

Starting from fundamental local and global (non-)reactive data collection (WP1), and a high-fidelity open source Multiscale Modeling framework (WP2) novel 3D reactors will be designed in silico using advanced optimization (WP3). The power of the approach will be demonstrated in a 3D-printed High-Mach reactor, which, by operating under unconventional cracking conditions (lower pressures and faster heating) achieves yield increases of more than 10 wt% (WP4), contributing in a decisive way to the transition of the chemical industry.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101142539	**NanoLPC**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Dongsheng Wen**
Host Institution:	TECHNISCHE UNIVERSITAET MUENCHEN - DEU

Engineering light induced phase change for emerging nanoscale processes

Light-induced phase change (LPC) is the unifying theme underpinning many apparently non-related processes in i) additive manufacturing (AM) for metals where laser induced vaporisation and the formation of keyhole porosity is a major limiting factor for 3D printing, ii) nanomedicine (NM) where laser induced nanobubble dynamics and associated shockwave effect is powerful for malicious cell destruction, and iii) solar energy (EN) where direct steam /vapor production from bulk and surface fluid is a promising technology for power and clean water solutions. In addition to the challenging multiscale nature of phase change, LPC add further complexities by introducing the multiphysics nature due to strong light-absorber interactions. We will tackle the fundamental challenge of the formation and control of LPC and develop a physics-based platform, supported by multiscale experimentation and multiscale simulation, as the tool to design and engineer LPC as innovative mechanism for in situ process steering and control. Five work programs are designed focusing on two complementary paradigms: i) fundamental studies for enhancing LPC mechanism understanding via developing physics-informed multiscale modelling validated by dedicated nanoscale experiments, and ii) application studies for engineering LPC for designed functions towards EN, NM and AM respectively. Many breakthroughs beyond state-of-art work are expected, such as i) the establishment of a unique multi-physics and multiscale LPC simulation platform; ii) the revelation of LPC mechanisms by sub 100 nm experiments with localized temperature and nanobubble dynamics measurement; and iii) the reverse engineering of LPC to maximize solar vapor production, inhibit keyhole pore formation and control nanobubble shockwave effects. The project will not only advance LPC understanding in the domain of Thermodynamics and Heat Transfer, but also transfer the developed expertise into emerging applications.

Link to the ERC project webpage:

Keywords of the ERC project: phase change, heat transfer, multiscale modelling, solar energy. bubble

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101160908	**FragTuRe**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Mahdi Saeedipour**
Host Institution:	UNIVERSITAT LINZ - AUT

Fragmentation in Turbulence Revisited - Toward a universal theory for turbulent emulsification

Droplets and bubbles are omnipresent in many environmental and industrial applications that involve atomization and emulsification processes, and the ability to control the size of these dispersed elements in turbulent multiphase flows is essential for design and optimization purposes. Despite the importance of the fragmentation of one fluid in another one by turbulent eddies, a universal theory applicable to a majority of the scenarios is still missing. Following the seminal work of Hinze on characterizing the size of the largest stable droplets in turbulence known as Kolmogorov-Hinze theory, I aim to revisit this concept with a novel deterministic approach through theoretical investigation, experimental characterization, and numerical simulation. In my recent contribution, I have presented a novel description for the Hinze scale based on the concept of enstrophy transport across the scales in turbulence, which could serve as the basis for my deterministic approach to studying turbulent emulsification. By providing the theoretical basis for sustained homogenous isotropic turbulent flows, I will measure the spectral rate of enstrophy transport rates by the vortex stretching, surface tension, and other relevant mechanisms in a drop-laden turbulent flow in the lab using tomographic PIV and shape reconstruction. Furthermore, by performing direct numerical simulation (DNS), I will explore the situations where experimentation may be limited such as highly-dense emulsifications and surfactant-laden environments. The simulations will provide a large dataset based on which we could generate a universal theory for emulsification in turbulent drop-laden and bubbly flows. The FragTuRe project revisits the fundamental understanding of turbulent fragmentation by a concept that has not been employed before and aims at generating a novel case-independent universal correlation for the Hinze scale that is essential in many engineering applications.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101160908

Keywords of the ERC project: Multiphase Flows, Turbulence, drops and bubbles, breakup

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101162658	**AUTOMATHIC**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Aurelie Carlier**
Host Institution:	UNIVERSITEIT MAASTRICHT - HRV

New methodologies for automated modeling of the dynamic behavior of large biological networks

In silico models aim to capture and elucidate the complex and emergent interactions of biological systems, with the goal of expediting research and potential clinical translation. For example, ordinary differential equation (ODE) models of toxin and drug transport are being developed to bring safer therapies to chronic kidney disease patients. Despite recent progress, these cutting-edge ODEs only model transport in steady state and remain limited regarding the amount and complexity of dynamic transport mechanisms as it is often not clear which kinetic relation is most suitable. This limitation is due to the manual and labor-intensive approaches to construct the ODEs, which critically hinder their application in quantitative toxicity assessment in key industrial settings like drug development. In AUTOMATHIC, I will leverage and combine my expertise in mathematical modeling and machine learning to develop an integrated framework for automated ODE structure identification, parameter estimation and model evaluation, focusing on cell transport and signaling, which is the timely leap forward needed to create large dynamic models and transform the field. I will test and illustrate the capabilities of the developed framework by exploring the dynamics and regulation of proximal tubule (PT) toxin and drug transport. I will use the dynamic PT model to define novel therapeutic regimens that minimize toxin accumulation in combination with a state-of-the-art in vitro set-up to measure the essential time series data required for model calibration and validation. The anticipated outcomes of AUTOMATHIC are: 1) a next-generation, integrated framework for automated model structure identification and parameter estimation that will become the new standard for the creation and interrogation of large dynamic models of cell transport and signaling; 2) crucial knowledge about PT transport and metabolism; 3) a dynamic PT model to optimize nephrotoxicity protocols, drug dosing and screening.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: automated ODE model inference, automated data curation, multi-agent systems

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Project ID:	Project Acronym:	Evaluation Panel:
101162848	**BREAKDOWN**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Enrico Salvati**
Host Institution:	UNIVERSITA DEGLI STUDI DI UDINE - ITA

Wide-ranging Probabilistic Physics-guided Machine Learning Approach to Break Down the Limits of Current Fatigue Predictive Tools for Metals

It appears paradoxical how today's frontier & high-impact research seeks for designing new materials to delay structural failures – especially fatigue – while the same effort is not seen concerning the way materials can be efficiently and safely used in real structural applications. BREAKDOWN aims to transform engineering products' design methods by identifying and including a set of (sub)micro-scale material inhomogeneities characteristics in a novel probabilistic framework. The time has come to exploit modern experimental techniques to probe material properties at a small scale, which are scarcely involved in current fatigue characterisation schemes. To attain this very ambitious goal, the project will rely on a breakdown of different classes of inhomogeneities to advance the fundamental mechanical understanding of their contribution to fatigue, and then reunite them within an advanced Bayesian Physics-Guided Neural Network (B-PGNN) frame. Over the past three years, I assiduously worked to prove the feasibility of BREAKDOWN and demonstrate its superior capabilities. However, I have merely scratched the surface of what is potentially achievable with this approach, both in terms of knowledge advancement and real engineering applications. An extensive multimodal experimental characterisation campaign will be conducted on different material inhomogeneity states to separate and identify their individual influence on fatigue in a systematic and detailed way. Cutting-edge numerical & analytical models will be developed and exploited as the physics knowledge in the B-PGNN scheme to effectively tackle the small datasets issue when dealing with fatigue and to ensure soundness of results. The outstanding capabilities of the framework developed in BREAKDOWN will be confirmed through specific demonstrators. BREAKDOWN will excellently contribute towards the development of a much more sustainable design procedure with unprecedented social, economic and environmental benefits.

Link to the ERC project webpage:

Keywords of the ERC project: Fatigue; probabilistic; Physics-informed Machine Learning; defects; residual stress; micromechanics; additive manufacturing; material processing; structural reliability; computational mechanics

Keywords that characterize the scientific profile of the potential visiting researcher/s: fatigue; structural integrity; fracture mechanics; multiscale

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Project ID:	Project Acronym:	Evaluation Panel:
101163330	**E-Nucl**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Mirko Gallo**
Host Institution:	UNIVERSITA DEGLI STUDI DI ROMA LA SAPIENZA - ITA

PrEdicting Nucleation to support next-generation microtechnology: Diffuse Interface, fluctuating hydrodynamics and rare events.

There is a noticeable trend in simulations of fluid processes to try to be as much as possible multiscale, i.e. to carry out simulations from molecular scale to hydrodynamics. This is made possible by the unprecedented capabilities of parallelization, GPUs, and supercomputing in general, which allow in-silico representation of fluids with billions of degrees of freedom. Despite this formidable scientific progress, one crucial aspect still hinders a quantitative description of phase transitions: the way a phase change originates, namely the nucleation process. The elusiveness of this process stems from its strong multiscale nature, involving both atomistic and hydrodynamic scales. More importantly, as nucleation is a rare event, it inherently involves a broad spectrum of time scales, the most ambitious feature to be characterized. It is also clear that the next technological breakthroughs in phase-change-based microtechnology are limited by the inadequate comprehension of phase transitions. As a matter of fact, the fluid dynamic design of frontier microtechnologies is mainly based on empirical ground. Promising two-phase cooling strategies for microelectronics, phase-change-driven micro-robots, synthetic micro-trees, and bio-inspired microstructures for condensation control are typical examples. Meeting these fundamental and technological needs, the objective of E-Nucl is to provide a holistic understanding of phase change processes in fluids which shall describe both the nucleation inception and its coupling with multiphase hydrodynamics. Pursuing this goal, E-Nucl advocates a paradigm shift in fluid modelling by combining innovative rare-event techniques based on Large Deviation Theory with the Diffuse Interface and Fluctuating Hydrodynamics modelling of multiphase flows. This framework could be a game changer in multiphase fluid dynamics and it will allow the first in-silico high-fidelity trials of archetypal microtechnologies.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101164365	**IntensifiedCO2**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Jingxiu Xie**
Host Institution:	RIJKSUNIVERSITEIT GRONINGEN - NLD

Intensified processes for CO2 conversion to sustainable synthetic fuels

Developing intensified catalytic processes for CO2 conversion may drive their implementation at CO2-producing sites, counteracting current practices of emitting CO2 and waste gases. Converting CO2 to synthetic fuels is a win-win scenario as they are used as sustainable aviation fuel. A leading technology to convert CO2 to synthetic fuels proceeds indirectly via Reverse Water Gas Shift (RWGS) and Fischer-Tropsch Synthesis (FTS). CO2 is first reduced to CO via RWGS and then converted to hydrocarbons via FTS. Based on current chemical engineering practices, four unit operations (two reactors and two intermediate separations) are required. The ambition of the IntensifiedCO2 technology is to intensify the current practice through the reduction of unit operations, without compromising on selectivity towards synthetic fuels. The objectives are to eliminate two separation units for CO2 and H2O and to consolidate two reactors into a single bifunctional (RWGS and FTS) reactor. As such, the IntensifiedCO2 technology will be the first demonstration of metallic cobalt catalysts 'converting' CO2 to synthetic fuels in a single reactor. Metallic cobalt catalysts are industrial FTS catalysts, but produce mainly methane from CO2. Attempts thus far on tuning cobalt phases to attain synthetic fuels are unsuccessful, signalling the need for a radical strategy as proposed in IntensifiedCO2. My innovative approach involves coaxing a metallic cobalt FTS catalyst to disregard the presence of CO2 and H2O within the reactor, ensuring its catalytic performance mirrors that of synthesis gas (a mixture of CO and H2) conditions. Ideally, undesired species stay in the reactor's mass transfer zone, while desired species interact in the catalyst's adsorption/reaction/desorption zone. This concept of customising the catalyst's environment in the reactor stands in stark contrast to the common approaches of tailoring catalyst material and active sites, signifying a paradigm shift in catalysis research.

Link to the ERC project webpage:

Keywords of the ERC project: chemical engineering, catalysis, process intensification, CCU

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101170592	**MiGEM**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Alessio Gizzi**
Host Institution:	UNIVERSITA CAMPUS BIO MEDICO DI ROMA - ITA

Modelling Inter-Scale Energetics in GastroIntestinal ElectroMechanics

The MiGEM proposal targets one of the remaining grand challenges in biomechanics: the development of a comprehensive, inter-scale, thermodynamically and energetically coherent multiphysics model of gastrointestinal (GI) motility. Despite the importance of gastrointestinal disorders as a primary global health problem, electromechanical modelling of gastrointestinal motility still presents significant theoretical and experimental limitations compared to more advanced fields such as cardiovascular bioengineering. Technical difficulties exist due to the intrinsic multiscale nature of gastrointestinal tissues, the coupling of multiple cell types and roles, and the combination of electrical and mechanical phenomena involving different energetic mechanisms. MiGEM has the potential to unlock new frontiers in GI research, addressing several state-of-the-art problems in gastrointestinal motility and opening unprecedented opportunities in novel subject-specific therapies. By adopting a rigorous theoretical-experimental scientific approach, MiGEM will advance state-of-the-art gastrointestinal theoretical modelling and experimental measurements, unveiling fundamental energetic mechanisms that govern stomach and intestine motility in health and disease. MiGEM will enable the first calorimetric measurement of tissue sample from the GI tract and create a new path in biomechanical modelling by assimilating innovative data into multiscale thermodynamic models. The project will create a new network of scientists with complementary experimental and modelling skills, fostering cross-fertilization, providing senior-to-junior methodological transfer, and supporting gender balance. The scientific experience of the PI, the formal membership to the project of the ABI, University of Auckland, and the multiple scientific collaborations that the PI has engaged for many years will be the key elements to successfully carry out an ambitious and high-risk project.

Link to the ERC project webpage: https://tcbiomech.unicampus.it/

Keywords of the ERC project: biomechanics, computational modeling, gastrointestine, motility, digital twin, simulation, experiments

Keywords that characterize the scientific profile of the potential visiting researcher/s: mathematical and computational modeling, CAD design and imaging analysis, computational biomechanics

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101171135	**REMOTE**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Xiaodong Liang**
Host Institution:	DANMARKS TEKNISKE UNIVERSITET - DNK

Revolutionizing Molecular Thermodynamics by Water and Electrolytes

Molecular thermodynamics plays a crucial role in the modeling, design, and optimization of various systems in product and process engineering. Despite significant progress made over the decades, existing thermodynamic models and theories still face significant challenges, particularly when dealing with water and electrolytes. This project seeks to harness these challenges as opportunities to revolutionize molecular thermodynamics by developing novel and physically sound models and theories that surpass current limitations. I aim to deepen our fundamental understanding of the underlying physics and pave the way for a paradigm shift in molecular thermodynamics. By employing a synergistic combination of infrared spectroscopic measurements, quantum chemical calculations, and molecular dynamics simulations, I will go beyond current boundaries and innovate advanced analytical methods to quantify critical structural information that will be used in the development and evaluation of molecular thermodynamic models and theories. I will pioneer the development of a 'two-state' theory for association interactions, explicitly accounting for diverse hydrogen-bonding structures characterized by the Gibbs energy of reactions obtained from quantum chemical calculations. We will lead the way in developing a physically consistent theory for ion-ion Coulombic interactions, unlocking the full potential of the molecular thermodynamic models and theories for electrolyte solutions. Extending beyond the established theories, we will develop novel 'two-state' theories for generally overlooked properties, such as dielectric constant, surface tension, and electrical conductivity. We will further demonstrate how structural information and these less commonly investigated properties can be systematically employed to evaluate and select the most powerful and physically correct models and theories, moving beyond mere parameterization towards a deeper understanding of molecular thermodynamics.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101200111	**MECCANO**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Lorenzo Moroni**
Host Institution:	UNIVERSITEIT MAASTRICHT - NLD

Directing Stem Cell Activity through Mechanical Stimulation of Metamaterial 3D Scaffolds

Regenerative medicine aims at repairing damaged tissues in our body. To do so, stem cells are often used. My research has been focused on biofabrication innovations for tissue engineering, which aims to direct stem cell fate to steer tissue regeneration. While mechanical loading play a determinant role in the organization of adult cells and tissue development, and my past work with 3D scaffolds demonstrated the importance of mechanical cues to direct stem cell fate, very little is known about its influence on pluripotent stem cells (PSCs). PSCs are a powerful resource for tissue engineering whose application currently suffers from many limitations. One such limitation is the reliance on added biological factors to induce iPSC differentiation, which do not reflect accurately what occurs in vivo. MECCANO aims to establish a new research program that focuses on the systematic understanding of the influence of mechanical loading on tissue development from PSCs in 3D cultures. I will design mechanically active metamaterial scaffolds, which are porous 3D materials that can morph their shape in response to mechanical loading, thus providing defined dynamic stresses and deformations to cells hosted on them. I will then develop a library of mechanical metamaterial scaffolds able to maintain PSCs undifferentiated or to direct their differentiation into the three germ layers of embryological development (ecto-, meso-, endoderm lineages) through mechanical loading. This knowledge will be fed back into a mathematical model to enable the rational design and fabrication of scaffolds for the regeneration of a targeted tissue, here vascularized and conductive cardiac tissue, which has not yet been accomplished and provides a proof of concept. MECCANO will deliver a new paradigm for PSC differentiation, based on the optimization of 3D scaffolds' mechanical and structural properties. This solution holds the potential to generate more targeted, complex products for tissue replacement.

Link to the ERC project webpage:

Keywords of the ERC project: biofabrication; pluripotent stem cells; cardiac regeneration; additive manufacturing; boimaterialis

Keywords that characterize the scientific profile of the potential visiting researcher/s: Artificial Intelligence; Machine Learning; pluripotent stem cells; cardiac developmental biology; cardiac stem cells

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Project ID:	Project Acronym:	Evaluation Panel:
101200554	**REALTOWIND**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Johan Meyers**
Host Institution:	KATHOLIEKE UNIVERSITEIT LEUVEN - BEL

Real-time optimal control of wind-farm atmosphere interaction

Current Wind-Farm flow Control (WFC) focuses on the interaction of wind turbines through their wakes, and relies on fast heuristic wake models that are mostly considered in an open-loop control framework. However, modern wind farms interact with the atmosphere at much larger scales, such, e.g., as their excitation of atmospheric gravity waves. WFC response is thereby not only governed by intra-farm turbine wakes, but possibly even more by the interaction between the larger atmospheric mesoscales and the farm operation. The only models that realistically capture these aspects down to the wake scale are large-eddy simulations (LES), which are generally run on high-performance computers, yet considered orders of magnitude too slow for use in real-time model predictive control. Recently however, we have shown that coarse-grid LES integrated in a time-decoupled model predictive control (TDMPC) framework, is about a factor three too slow only for real-time use, while potentially still being effective at realizing the WFC objective. With wind turbines being the largest manmade “flow actuators” existing today, and smaller-sized systems exhibiting faster time scales, the wind farm will be the first turbulent flow system in which LES can be used as a real-time control model. We aim at inducing a paradigm shift in the use of LES, by developing a first fully integrated LES-based TDMPC and demonstrate it in a high-fidelity emulator environment, as well as, in part, using field data. This raises following fundamental research challenges: diverging sensitivities of perturbations in turbulent flows (chaotic systems) over long time horizons, the sparse nature of measurements in the atmosphere required for state estimation in the control loop, the limited understanding of wind-farm atmosphere interaction in non-neutral stratification, and the efficient emulation of WFC using high-performance computing. My pioneering work in these fields will enable us to tackle these challenges.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101201568	**Frameglow**	**PE8** Products and Processes Engineering

Principal Investigator:	**Dr Nicola Pugno**
Host Institution:	UNIVERSITA DEGLI STUDI DI TRENTO - ITA

Advanced Quantized FRActure MEchanics models of ice and snow for GLObal Warming risk mitigation

Fracture mechanics theories remain incomplete, limiting the capacity to accurately predict material/structural strength, which is critical in civil and mechanical engineering as well as in material science. The ERC-funded FRAMEGLOW project aims to tackle this challenge from a fundamental engineering science perspective. As such, it will formulate a more thorough fracture mechanics theory, which is quantised/finite. Following its formulation, the theory and related models will be refined drawing from other disciplines, such as tribology and thermodynamics, to model the impacts of climate change on snow/ice avalanche fragilisation. Ultimately FRAMEGLOW aims to advance the fundamental understanding of fracture mechanics, predict avalanches under global warming and potentially avert related tragedies.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101201568

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
945155	**GWmining**	**PE9** Universe Sciences

Principal Investigator:	**Dr Davide Gerosa**
Host Institution:	UNIVERSITA' DEGLI STUDI DI MILANO-BICOCCA - ITA

Gravitational-wave data mining

Gravitational-wave astronomy is entering its large-statistics regime. Catalogs with thousands of gravitational-wave events will soon be available, providing a wealth of information on the most compact objects in the Universe --black holes and neutron stars. These new datasets need new tools to be exploited effectively in order to maximize their scientific impact. GWmining is an ambitious program to explore upcoming gravitational-wave catalogs with data-mining techniques. We will develop a complete framework to analyze gravitational-wave data in light of astrophysical predictions. Going beyond phenomenological models, we will train machine-learning algorithms directly on large banks of population-synthesis simulations and post-Newtonian integrations. The development of these astrophysical predictions requires new modeling strategies to accurately capture all the gravitational-wave observables, notably spins and eccentricities. Combined with a hierarchical Bayesian analysis, our neural network will deliver the most stringent measurements to date on elusive phenomena influencing the lives of massive stars. We will constrain phenomena such as binary common envelope, supernova kicks, stellar winds, tidal interactions, etc. Besides harnessing the catalog in its entirety, our complete framework will put us at the forefront to analyze outliers --golden events with favorable properties of one or more parameters. We will design a complete strategy to exploit the strongest signals to infer exquisite details of the relativistic dynamics of their sources. GWmining is a unique project strategically placed at the intersection of astronomy, data analysis, and relativity. As the large-statistics revolution of gravitational-wave astronomy unfolds, GWmining will pioneer the application of data-mining techniques in gravitational-wave population studies, setting the foundations of this booming field for decades.

Link to the ERC project webpage: www.davidegerosa.com

Keywords of the ERC project: black holes, gravitational waves, machine learning

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101052347	**FIERCE**	**PE9** Universe Sciences

Principal Investigator:	**Dr Nuno Santos**
Host Institution:	UNIVERSIDADE DO PORTO - PRT

FInding ExoeaRths: tackling the ChallengEs of stellar activity

FIERCE aims at providing the long-needed step forward to tackle the challenges of stellar activity on the search for Exoearths. The detection and characterisation of other Earths, planets with the physical conditions to hold liquid water and thus potential life-sustaining environments, is a bold objective of present day astrophysics. This goal continuously pushes the development of new ground- and space-based instrumentation. However, the quest for other Earths is severely limited by astrophysical ``noise'' from the host stars, whose signatures distort the spectra that are used to detect and characterise them. Existing methods usually circumvent the problem without a detailed understanding of the individual sources of variability. This is insufficient to reach the required precision levels. To enable the full scientific success of major exoplanet research facilities a new approach is clearly needed. With FIERCE, the PI will employ his competitive team, together with the strong participation in cutting-edge ESO and ESA projects and missions, to break through in this obstacle. The ultimate goal is to i) develop novel approaches to identify, model, and correct stellar spurious signals in radial velocity measurements down to 10 cm/s, and ii) obtain a comprehensive understanding of the impact of stellar granulation and activity on the detection of exoplanet atmospheres. To this end, FIERCE will approach the problem of stellar ``noise'' from a whole new angle, building a dedicated facility, the Paranal solar Espresso Telescope (PoET). PoET will connect to the recently commissioned ESPRESSO spectrograph and, using the Sun as a proxy, allow to unambiguously identify and understand the sources of relevant variability in solar-type stars. Ambitious, timely, and feasible, this project will provide crucial information for the success of present and future major efforts aiming at detecting and characterising other Earths.

Link to the ERC project webpage: http://poet.iastro.pt

Keywords of the ERC project: Exoplanets, Sun, spectroscopy

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101075919	**LSS_BeyondAverage**	**PE9** Universe Sciences

Principal Investigator:	**Dr Cora Uhlemann**
Host Institution:	UNIVERSITAET BIELEFELD - DEU

Probing cosmic large-scale structure beyond the average

The cosmic large-scale structure is entering a new 'full space' era with the launch of the Euclid galaxy survey satellite in 2023 coinciding with the first light for the Rubin Observatory. My proposal is centred on using galaxy surveys across a third of the sky as a laboratory for fundamental physics beyond the standard model by combining powerful theoretical models with exquisite data for galaxy clustering and weak gravitational lensing. To fully realise the potential of Euclid's 'full space' galaxy survey, I will use my unique expertise in developing analytical, computational and statistical methods to predict and analyse the cosmic large-scale structure beyond the average. I will hunt for fundamental physics by going beyond the average probed by standard two-point analyses and unlocking additional information from novel clustering statistics sensitive to different density environments. I will provide new insights into dark matter dynamics and enable a field-based analysis by pioneering a particle-wave duality inspired phase-space technique that goes beyond the average effective fluid modelling. This will push forward modelling to a new level, overcome limitations of standard fluid and N-body methods, and enable the joint modelling of dark matter, baryons and massive neutrinos. My research program will unlock key insights into particle physics (by pinning down the total neutrino mass and potential wavelike properties of dark matter), the early universe (by constraining primordial non-Gaussianity providing hints for inflationary physics), gravity (by measuring the nature of dark energy and potential modifications of general relativity) and astrophysics (by determining the relationship between galaxies and dark matter). My expertise in developing analytical, computational and statistical methods for clustering dynamics and statistics and my leadership within the Euclid collaboration places me in a strategic position to lead such an ambitious research program.

Link to the ERC project webpage:

Keywords of the ERC project: cosmic large-scale structure, galaxy clustering, weak lensing, dark matter, dark energy

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101076533	**MicroStars**	**PE9** Universe Sciences

Principal Investigator:	**Dr Tarek Hassan**
Host Institution:	CENTRO DE INVESTIGACIONES ENERGETICAS MEDIOAMBIENTALES Y TECNOLOGICAS - ESP

Extreme time and angular resolution in the optical with Cherenkov telescopes

The universe in the visible wavelength remains largely unexplored in the sub-second time regime and sub-milliarcsecond scale, primarily due to instrumental limitations. Overcoming these impediments would bring a breakthrough in our knowledge of stellar physics, evolution and modelling by imaging the stars and their surroundings as well as unravel the history of the Solar System. MicroStars will demonstrate the viability of a cost-effective and novel solution to enhance the capabilities of Imaging Atmospheric Cherenkov Telescopes (IACTs) to perform ultra-fast optical measurements. Such an upgrade allows two novel applications of these telescopes in the visible range: their use as Stellar Intensity Interferometers and as high-time-resolution, fast, high-precision photometers. MicroStars will allow to expand the limiting time and angular resolution of current optical observatories by at least an order of magnitude. By upgrading the capabilities of next-generation IACTs, MicroStars has the potential of creating a host of scientific breakthroughs, answering fundamental questions regarding stellar physics, magnetic activity and modelling, exoplanet properties and the Solar System planetary formation. The interdisciplinary and field-transforming nature of MicroStars, merging astroparticle physics instrumentation with optical astronomy, will extend the scientific life of current IACT experiments, and greatly expand the scientific impact of the next generation: the Cherenkov Telescope Array. Bringing this proposal to life is only possible with an ambitious funding scheme, willing to finance the major equipment needed, and support a research team with the required multidisciplinary skills to expand the state of the art with novel instrumentation and methodologies.

Link to the ERC project webpage:

Keywords of the ERC project: fast optical astronomy, optical interferometry, cherenkov telescopes, kuiper belt objects

Keywords that characterize the scientific profile of the potential visiting researcher/s: stellar astrophysicist, solar system astrophysicist, CUDA programmer

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Project ID:	Project Acronym:	Evaluation Panel:
101093572	**StarDance**	**PE9** Universe Sciences

Principal Investigator:	**Dr Elena Pancino**
Host Institution:	ISTITUTO NAZIONALE DI ASTROFISICA - ITA

StarDance: the non-canonical evolution of stars in clusters

Thanks to their ubiquity, brightness, and the fact that they are made of stars with similar properties, star clusters have been used as astrophysical laboratories or test particles in an impressive range of research domains. However, we still do not understand fundamental details of their formation and evolution. In spite of recent technological progress, a list of unsolved problems and apparently isolated mysteries has been accumulating over time, some standing since decades. Among them, the existence of multiple stellar populations in globular clusters, with different chemistry, has challenged generations of researchers. They are not the result of classical galactic chemical evolution, mostly mediated by supernovae, and they jeopardize the use of clusters as simple stellar population templates for extragalactic studies. Given the mounting problems faced by the most favored scenarios to explain multiple populations, I think it is now time to revisit the foundations of our current thinking. New results by my team and by others show that: (i) the peculiarities in the chemistry of multiple populations are not limited to the oldest globular clusters; (ii) they can be transient in the evolution of individual cluster stars; and most importantly (iii) binary interactions and fast stellar rotation cannot be neglected in the study of star clusters and do have the capability to produce the observed chemistry. With StarDance I will test a very different scenario, based on a new hypothesis: that multiple stellar populations and five other non-canonical stellar populations (extreme horizontal branch stars and hot sub-dwarfs; extended main sequence turn-offs; red stragglers and sub-subgiants; lithium rich- stars; and blue stragglers) are caused by the interplay between stellar rotation and binary interactions, that are greatly enhanced in the special environment of star cluster, with spectacular results.

Link to the ERC project webpage: https://stardance.inaf.it/

Keywords of the ERC project: Stars - star clusters - spectroscopy - binary stars - stellar dynamics - stellar chemistry - stellar evolution

Keywords that characterize the scientific profile of the potential visiting researcher/s: Stars - star clusters - spectroscopy - binary stars - stellar dynamics - stellar chemistry - stellar evolution

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Project ID:	Project Acronym:	Evaluation Panel:
101097905	**ENIMUS**	**PE9** Universe Sciences

Principal Investigator:	**Dr Ana Inés Gómez De Castro**
Host Institution:	UNIVERSIDAD COMPLUTENSE DE MADRID - ESP

INVESTIGATION OF THE ENANTIOMERIC IMBALANCE IN THE SOLAR SYSTEM THROUGH ULTRAVIOLET SPECTROPOLARIMETRY

Amino acids and the reference nucleobases for RNA and DNA can be formed in space ice under high energy, vacuum ultraviolet (VUV) irradiation. This statement is based on twenty years of laboratory research and has profound implications in the understanding of the emergence of life in the Cosmos, the universality of the processes involved and the compatibility of life forms across the Universe. However, this laboratory work still needs to be confronted with actual, on-field measurements. Promising data have been obtained through in-situ techniques: the analysis of carbonaceous chondrites such as the Murchinson meteorite or the detection of Glycine in the coma of comet 67P/Churyumov-Gerasimenko. Unfortunately, neither of these techniques suits well a systematic investigation. Meteorites reaching the Earth surface represent a reduced and biased subset and contamination by Earth-based amino acids needs to be carefully controlled. Space probes such as Rosetta are very costly and limited in scope given the constraints in space navigation. Thus, it is crucial to develop remote detection techniques to carry out a comprehensive study of the distribution of amino acids within the Solar System, their relative abundances and their enantiomeric imbalance. According to recent estimates, this is possible at VUV wavelengths for optically active amino acids such as the very abundant alanine. The interaction between VUV radiation and optically active amino acids in space bodies is yet poorly studied. The formation of crystallites and complex structures, the interaction between the various molecules, the dependence on the VUV photon energy, polarization and flux needs to be quantified, prior to any attempt of remote detection in the Solar System. This project aims to carry such in-depth study and develop a laboratory prototype of the instrument to make, at the least, alanine remote detection feasible by a small probe navigating the asteroids belt.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101117541	**DistantDust**	**PE9** Universe Sciences

Principal Investigator:	**Dr Irene Shivaei**
Host Institution:	AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS - ESP

Dissecting Dust in the Distant Universe: A Panchromatic Study with JWST and ALMA

At the core of galaxy evolution is the evolution of the baryonic components that modify the observable properties of galaxies. A crucial component of the baryonic matter is the interstellar medium (ISM) that consists of gas and solid-phase metals called dust. Interstellar dust determines how galaxies look like from UV to IR, how the ISM behaves, and the very process of star formation that creates the stellar component that defines a galaxy. Despite our wealth of knowledge about dust in local galaxies, very little is known about the properties of dust grains, where it resides inside galaxies, and how it is formed, beyond the nearby Universe (i.e., at high redshifts). The fundamental importance of advancing our knowledge about dust at high redshifts is further underlined by the vital need to correct for its attenuation effects in the observed rest-frame UV/optical emission of high-redshift galaxies. This situation will fundamentally change in the next few years owing to the unprecedented capabilities of the James Webb Space Telescope (JWST). This ERC program capitalizes on the massive technological advance of JWST to take a holistic approach, physically and observationally, and conduct a panchromatic study of dust emission and absorption properties at two key cosmic epochs:1) z~1-3, dubbed as Cosmic Noon, the peak epoch of cosmic star formation activity, and 2) z~5-10, the early Universe and the epoch of reionization. Owing to my leading role in multiple deep extragalactic JWST surveys, my ERC group will take full advantage of the very first data from this revolutionary observatory. This will be done in synergy with ALMA and other powerful ground-based observatories such as VLT and Keck to observe the attenuation and emission properties of dust from rest-frame UV to submm wavelengths at Cosmic Noon and beyond. This ambitious research program will bring novel key insight into the physical processes that enable star formation and galaxy evolution throughout cosmic time.

Link to the ERC project webpage: https://sites.google.com/view/ercdistantdust/home

Keywords of the ERC project: galaxies, astrophysics, observational astronomy, galaxy evolution

Keywords that characterize the scientific profile of the potential visiting researcher/s: galaxy evolution, ISM, high redshift

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101124679	**WIRE**	**PE9** Universe Sciences

Principal Investigator:	**Dr Dedong Wang**
Host Institution:	GFZ HELMHOLTZ-ZENTRUM FUR GEOFORSCHUNG - DEU

Waves in the Inner Magnetosphere and their Effects on Radiation Belt Electrons

The magnetosphere is a natural plasma laboratory. Radiation belts in the magnetosphere are full of high energy particles. The energetic electrons in the Earth's radiation belts can be hazardous to Earth-orbiting satellites and astronauts in space. Many of the space systems on which modern human society depends operate in this region. The fluxes of radiation belt electrons are very dynamic, which is not fully understood due to the delicate balance between various acceleration and loss processes. Wave-particle interactions are believed to play a crucial role in the acceleration and loss of these particles. To quantify the effect of different waves on the dynamics of radiation belt electrons, comprehensive wave models are needed. Currently, there are some wave models based on satellite measurements. However, the space coverage of these wave models is not sufficient due to the orbit limit of satellites. In this project, combining state-of-the-art measurements from multiple satellites, comprehensive wave models will be developed. We will improve our sophisticated physics-based radiation belt dynamic model by using the wave models developed in this project and calculate diffusion coefficients using more realistic background magnetic field and plasma density models for the first time. Furthermore, fundamental acceleration and loss of energetic electrons caused by different waves in the Earth's radiation belts will be quantified. We will systematically validate simulation results against satellite measurements to understand the competition between acceleration and loss caused by various mechanisms. All these improvements will be critically important for answering the overarching scientific question: Why do the Earth's radiation belts respond differently to geomagnetic storms which have approximately the same intensity? The knowledge gained in this project can be useful for basics plasma physics and astronomy physics because the similar fundamental processes exist.

Link to the ERC project webpage:

Keywords of the ERC project: wave-particle interactions; radiation belts

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101124914	**Dark100**	**PE9** Universe Sciences

Principal Investigator:	**Dr Elisa Pueschel**
Host Institution:	RUHR-UNIVERSITAET BOCHUM - DEU

Probing the Finely-resolved 100 TeV Gamma-ray Sky for Ultra-heavy Dark Matter

Dark100 will shine a light into an underexplored dark matter particle mass range. Driven by recent theoretical developments, both in tools and motivation, Dark100 will search for dark matter particles between 100 TeV and several tens of PeV. Leveraging novel, cost-effective telescope technology, Dark100 will deploy an array of telescopes capable of probing dark matter annihilation, improving on the sensitivity of currently operating and planned gamma-ray instruments by an order of magnitude with unprecedented energy and angular resolution. Dark100 will build a unique dataset of deep gamma-ray observations of dark-matter-rich astrophysical systems. Dark matter will potentially be detected, or in the event of non-detection, limits on its velocity-weighted annihilation cross section will be set. For a non-detection, dark matter will be ruled out for part of the probed mass range and theoretical models constrained for the full probed mass range. The impact of Dark100 will be felt beyond the dark matter community. By demonstrating a new gamma-ray telescope paradigm, Dark100 will enable a range of possible astrophysical studies with gamma rays above 100 TeV, including searches for Galactic Pevatrons and transient events. Its public data archive will encourage synergy with other gamma-ray instruments. Dark100 takes advantage of a unique moment in theoretical and technological development that enables its pioneering science goals. While the theoretical motivation is fully developed and the technology is well-tested, the deployment of the Dark100 array and collection and interpretation of its observations is an ambitious project that demands the resources of an ERC consolidator grant. The PI's leadership in dark matter searches and gamma-ray analysis and simulation make her ideally suited to direct this program.

Link to the ERC project webpage: https://epuesche.github.io/

Keywords of the ERC project: dark matter, gamma-ray astronomy

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101141362	**Open SESAME**	**PE9** Universe Sciences

Principal Investigator:	**Dr Stefaan Poedts**
Host Institution:	KATHOLIEKE UNIVERSITEIT LEUVEN - BEL

Open Superior Efficient Solar Atmosphere Model Extension

The goal is to develop a time evolving model for the entire solar atmosphere, including the chromosphere and transition region, based on a multi-fluid description. At present, models are steady, rely on a single-fluid description and include only the corona due to computational challenges. We plan to use time-evolving ion-neutral and ion-neutral-electron models. The multi-fluid approach will enable us to describe the intricate physics in the partially ionized chromosphere and quantize the transfer of momentum and energy between the atmospheric layers. The questions where the solar wind originates and solar flares and coronal mass ejections are driven have both fundamental scientific importance and substantial socio-economic impact. Indeed, the solar atmospheric model is the crucial missing link in the Sun-to-Earth model chain to predict the arrival and impact of CMEs at Earth. What makes this goal now possible is the combination of our implicit solver with a high-order flux-reconstruction (FR) method. The implicit solver avoids the numerical instabilities that lead to strict time step limitations on explicit schemes. The high-order FR method enables high-fidelity simulations on very coarse grids even in zones of high gradients. We will start from this new development and introduce three critical innovations. First, we will combine high-order FR with physics-based r-adaptive (moving) unstructured grids redistributing grid points to regions with high gradients. Second, we will implement CPU-GPU algorithms for the new heterogeneous supercomputers advanced by HPC-Europa. Third, we will implement AI generated magnetograms to make the model respond to the time-varying photospheric magnetic field which is crucial for understanding important properties. We will thus develop a first-in-its-kind high-order GPU-enabled 3D time-accurate solver for multi-fluid plasmas. If successful, we will have the most advanced solar atmosphere model implemented in an operational environment.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: expert in Flux-reconstruction methods or r-AMR or solar chromosphere modelling

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101170338	**ROGALLO**	**PE9** Universe Sciences

Principal Investigator:	**Dr Ondrej Pejcha**
Host Institution:	UNIVERZITA KARLOVA - CZE

Fluid dynamics of binary systems composed of stars and black holes

This project aims to conduct previously unachievable (magneto)hydrodynamical simulations of binary systems involving stars, planets, neutron stars, and black holes. The phenomena occurring in these systems lie at the heart of some of the most important unsolved astrophysical problems, such as the evolutionary origin of gravitational wave sources, the acceleration sites of high-energy particles, and the coevolution of galaxies with their supermassive black holes. Advancements in the theoretical understanding of these phenomena are urgently needed to interpret observations from a wide range of current and future ground- and space-based facilities. Traditionally, numerical simulations of fluid dynamics in binary systems have relied on general-purpose codes that either discretize matter into particles or divide space into finite volume elements organized in an unstructured or logically-Cartesian mesh, such as spherical or cylindrical coordinates. However, these approaches lose accuracy or yield unphysical results when applied to the complicated, yet largely predictable, structure of binary systems. To achieve a dramatically higher level of realism in fluid dynamics simulations of binary systems, I will develop a new 3D parallel multiphysics code, ROGALLO. This code will be based on the discontinuous Galerkin method coupled with complex meshes specifically adapted to structures arising in binary systems. Leveraging the most recent developments in numerical mathematics, I will use ROGALLO to substantially advance the theory of fundamental processes such as pulsations, turbulence, mixing, mass transfer and mass loss, accretion, and explosions for a wide variety of binary systems. These systems include tidally-deformed or mass-transferring stars, chemically-homogeneous gravitational wave progenitors, classical novae, Type Ia supernovae, circumbinary disks around supermassive black holes, or gaseous bodies moving through fluid.

Link to the ERC project webpage: https://utf.mff.cuni.cz/~pejcha/

Keywords of the ERC project: Astrophysics, computational hydrodynamics, binary stars

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101199769	**GT4Pebbles**	**PE9** Universe Sciences

Principal Investigator:	**Dr Carsten Dominik**
Host Institution:	UNIVERSITEIT VAN AMSTERDAM - NLD

Ground Truth for Pebbles in Planet Formation

The discovery of exoplanetary systems has triggered a boost in the development of planet formation models. Most of these models rely on the presence of so-called pebbles – dust aggregates that have grown and been compacted in just the right way to be dynamically loosely coupled to the gas in the planet-forming disk. Only then do they enable key processes that produce planetary seeds and grow them efficiently into planets, overcoming growth barriers and enormous time scale problems. The models require that conversion of micron-sized dust particles into pebbles is global, efficient and fast. However, this is currently an unproven assumption that renders base assumptions of these models as shaky. GT4Pebbles will answer the following questions: - Do pebbles with useful properties for planet formation actually form, and with sufficient abundance? - What are the quantitative properties of these pebbles, and the consequences for planet formation models, disk observations and disk mass measurements? Building upon my recent advances in modeling and disk observations, and on advances in experimental technology in our partner laboratory, we will develop the first full-size range fractal dust-agglomeration experiment. We will gain comprehensive insights into the formation and properties of dust aggregates without relying on extreme extrapolations. By integrating experimental results with advanced numerical models, we will derive the structural, mechanical and optical properties of these aggregates as they evolve into pebbles. We will create a robust global dust growth model that for the first time meticulously accounts for porosity and compaction phenomena. This research will enable us to identify and characterize the initial seeds crucial for planet formation models in disks, providing valuable contributions to our understanding of planetary-system formation. With GT4Pebbles, planet formation models will no longer be “built on sand”, but on a solid foundation.

Link to the ERC project webpage: https://gt4pebbles.github.io/Website/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101000987	**FireIce**	**PE10** Earth System Science

Principal Investigator:	**Dr Sander Veraverbeke**
Host Institution:	STICHTING VU - NLD

Fire in the land of ice: Climatic drivers and feedbacks

2019 was the largest fire year since at least 1997 within the Arctic Circle, largely driven by Siberian fires. The arctic-boreal region stores about two atmospheres worth of soil carbon with 90 % currently locked in permafrost soils, or perennially frozen ground. Fire releases parts of this carbon stock, which may induce a vigorous climate warming feedback. FireIce will investigate feedbacks between climate warming and arctic-boreal fires by studying direct and longer-term carbon emissions from fires. FireIce will acquire highly needed observations of carbon emissions from Siberian forest and tundra fires. On top of the direct fire emissions, fires accelerate permafrost degradation, which leads to greenhouse gas emissions for several decades. Their sum may be substantially larger than the direct emissions, yet is largely unknown. In addition, FireIce will investigate the relative contribution of CH4 from smoldering fires to fire emissions. CH4 emissions represent a small, yet not well known, fraction of carbon emissions from fires, but CH4 is a more potent greenhouse gas than CO2. FireIce will investigate feedbacks between climate warming and arctic-boreal fires by studying controls on fire size and ignition. Fire growth can be limited because of fuel or fire weather limitations. The fire weather control is sensitive to warming, which may lead to larger future fires. Lightning ignition is the main source of burned area in arctic-boreal regions, and more lightning is expected in the future. By combining contemporary controls on fire size and ignition, and future predictions of climate and lightning, FireIce will assess the vulnerability of arctic-boreal permafrost and soil carbon to increases in fire. FireIce's results will be relevant to evidence-based policy. FireIce's innovations are conceptual, i.e. unstudied aspects of an emerging warming feedback loop, methodological, e.g. inclusion of novel spaceborne data, and geographical, i.e. a focus on Siberia.

Link to the ERC project webpage: https://sites.google.com/view/climateco/projects?authuser=0

Keywords of the ERC project: fire, lightning, permafrost, carbon, remote sensing

Keywords that characterize the scientific profile of the potential visiting researcher/s: fire, lightning, permafrost, carbon, remote sensing

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Project ID:	Project Acronym:	Evaluation Panel:
101001282	**METAL**	**PE10** Earth System Science

Principal Investigator:	**Dr Frederic Moynier**
Host Institution:	INSTITUT DE PHYSIQUE DU GLOBE DE PARIS - FRA

Making Terrestrial Planets

Understanding the formation and early evolution of terrestrial planets is one of the most important goals in sciences. The objectives of this proposal, METAL (Making tErresTriA pLanets), are to study the accretion and differentiation processes that have shaped the present composition of the Earth, Moon, Mars and differentiated asteroids including understanding the origin, and timing of delivery of their volatile and siderophile elements. To reach this goal we have identified the best-suited isotopic tools, which are sensitive to the different physico-chemical processes acting at different stages of planetary formation. This work will involve: 1) Development and use of new cutting-edge stable isotope systems for moderately volatile elements (e.g. In, Sb, Sn) in terrestrial, lunar and meteoritic materials, in order to constrain the origin of solar system's volatile element depletion. 2) Quantifying experimentally the isotopic effects during metal/silicate partitioning and evaporation in all conditions relevant to planetary accretion and differentiation. 3) Building a physical model of volatile loss. 4) Studying the timing, proportions, fate and nature of the material that accreted to Earth and Mars after core formation (i.e. the late-veneer) by using a new method based on the stable isotopes of a highly siderophile element, Pt. This high-risk high-rewards approach seeks to link innovative novel isotopic systems, experiments under extreme conditions, and dynamical modelling, to solve long-standing major scientific questions related to the formation and evolution of the terrestrial planets.

Link to the ERC project webpage: https://cosmochemistry-metal.com/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101039588	**PRIMETIME**	**PE10** Earth System Science

Principal Investigator:	**Dr Birgit Wild**
Host Institution:	STOCKHOLMS UNIVERSITET - SWE

Rhizosphere priming: Quantifying plant impacts on carbon dioxide emissions from a warming Arctic

Rapid warming is accelerating Arctic carbon cycling, including CO2 release by degradation of thawing soil organic matter and CO2 uptake by better-growing plants. Projections of future Arctic greenhouse gas fluxes retain large uncertainties and do not consider plant-soil interactions that can substantially affect CO2 release - the RHIZOSPHERE PRIMING EFFECT. Theoretical considerations, comparison of ecosystem carbon stocks and model extrapolation of temperate studies suggest a high potential for globally-relevant, priming-induced CO2 emissions from a warming Arctic following shifts in vegetation and rooting patterns. PRIMETIME aims to provide the first observation-based estimate of total plant effects on circum-Arctic soil and ecosystem carbon stocks in a changing climate. Central questions include: (1) How do different vegetation types affect soil and ecosystem carbon stocks and CO2 balance? (2) How do changes in rooting depth interact with depth gradients of soil properties to affect carbon stocks and CO2 fluxes? (3) What is the net effect of expected changes in plant productivity, vegetation distribution and rooting on ecosystem carbon storage across the circum-Arctic? The EXPERIMENTAL MODULE will quantify plant-soil carbon fluxes and plant impacts on soil CO2 release for different vegetation types and soil depths, combining a novel living-plant macrocosm experiment with field observations, cutting-edge 14C-dating (high risk) and 13C-labelling. The MODELLING MODULE will take our recent model to the next level and integrate experimental data to calculate the combined plant effect on ecosystem CO2 sink/source strength in a changing Arctic. The model will be validated against Eddy Covariance-observed CO2 fluxes (high risk). The integrated PRIMETIME approach will break new ground by shedding light on plant impacts on belowground carbon cycling, and provide a tool box to quantify and integrate these fine-scale processes in large-scale emission estimates.

Link to the ERC project webpage: https://www.su.se/english/research/research-projects/primetime-rhizosphere-priming-quantifying-plant-impacts-on-co2-emissions-from-a-warming-arctic

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101040823	**ESTABLIS-UAS**	**PE10** Earth System Science

Principal Investigator:	**Dr Norman Wildmann**
Host Institution:	DEUTSCHES ZENTRUM FUR LUFT - UND RAUMFAHRT EV - DEU

Exposing Spatio-Temporal structures of turbulence in the Atmospheric Boundary Layer with In-Situ measurements by a fleet of Unmanned Aerial Systems

Exchange and transport processes in the atmospheric boundary layer (ABL) are driven by turbulence on a wide range of scales. Their adequate parameterization in numerical weather prediction (NWP) models is essential for a high predictive skill of forecasts. In heterogenous and complex terrain, the common simplification of turbulence to statistical models does not necessarily hold. Coherent structures such as convective cells, secondary circulations, gusts, slope and valley flows can be summarized to sub-mesoscale structures which are not well represented in models. A reason for the lack of understanding of these flow features is the challenge to adequately sample their spatio-temporal structure and their contribution to the energy budget of the ABL. The project ESTABLIS-UAS will provide methods to expose spatio-temporal structures in the ABL with in-situ measurements by a fleet of unmanned aerial systems (UAS). For this purpose, small, rotary-wing UAS will be enabled to measure three-dimensional wind, temperature and humidity in organized, spatially distributed networks. The project will include a three-fold approach to validate single UAS measurements, fleet observations and methods to derive spatial averages and fluxes. Wind tunnel tests, field experiments and virtual measurements in numerical simulations will be performed. The validated UAS fleet will be deployed in two campaigns in the framework of the TEAMx research programme, focusing on the mountain boundary layer (MoBL). The ESTABLIS-UAS measurements will fill observational gaps in the sub-mesoscale. The analysis of the UAS fleet data in synthesis with ground observations and remote sensing will provide unprecedented new insights into the complex MoBL flow and the components of its energy budget. The results will foster the development of new and better parameterization of the ABL in complex terrain.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101043356	**PROGRESS**	**PE10** Earth System Science

Principal Investigator:	**Dr Alida Timar-Gabor**
Host Institution:	UNIVERSITATEA BABES BOLYAI - ROU

Reading provenance from ubiquitous quartz: understanding the changes occurring in its lattice defects in its journey in time and space by physical methods

Quantitative provenance analysis studies are instrumental in understanding the tectonic and climatic processes that are shaping Earth`s landscape. Although the most abundant mineral in the sedimentary system is quartz, almost all studies in provenance analysis investigate accessory minerals. Quartz crystals contain a vast number of point defects, intrinsic or due to impurities. Although our understanding on the formation and dynamics of these defects is far from complete, a few of these defects in quartz are used for dating Quaternary sediments by luminescence (thermoluminescence (TL) or optically stimulated luminescence (OSL)) or by electron spin resonance (ESR). PROGRESS aims at proving that point defects in quartz have also the capacity to carry genetic information and their modifications can provide evidence for antiquity, metamorphism (or lack thereof) as well as knowledge on weathering, transport, or recycling. This information can be unravelled by ESR and luminescence methods in combination with microscopic techniques such as scanning electron microscopy coupled with cathodoluminescence (CL) wavelength resolved spectroscopy. To understand changes that are occurring at atomic level in quartz in nature in geological time, PROGRESS will investigate quartz grains extracted from independently dated old to young quartz-bearing continental crustal sources, metamorphosed rocks versus their unmetamorphosed equivalents, fresh versus highly weathered samples, as well as intrusive versus volcanic rocks, besides conducting experiments in laboratory environments. To tackle nature`s complexity during sediment movement in space and time the effect of physical and chemical changes that occur during transport of quartz grains will be investigated by the study of river sediments that drain different lithologies. These investigations will allow a simple quartz based fingerprinting method to be developed, that will have a significant impact on quantitative provenance studies.

Link to the ERC project webpage: https://icibns.institute.ubbcluj.ro/erc-cog-progress/

Keywords of the ERC project: spectroscopic techniques, quartz, provenance, geochronology

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101043381	**DeepTrace**	**PE10** Earth System Science

Principal Investigator:	**Dr Mustafa Yücel**
Host Institution:	MIDDLE EAST TECHNICAL UNIVERSITY - TUR

Tracing nanoparticle-fuelled co-mobilization of catalyst metals across Earth's deep-sea redox interfaces to pave the way for habitability detection in Ocean Worlds

Redox metals such as Fe, Mo, V, Ni, Cu and Mn, supplied from deep-sea interfaces, played a pivotal role in the coupled evolution of Earth's biogeochemical cycles and life. Accordingly, future search for life in Ocean Worlds of the Solar System will greatly benefit from going beyond parameters such as water and organics, and being able to detect signs of subsurface metal catalysis. As fundamental metabolism requires metal clusters and nanoparticles; their formation, detection and link to Earth's ocean biogeochemical structure can pave the way for inference of metal catalysis from plume ejecta compositions of Ocean Worlds such as Europa and Enceladus. DeepTrace will advance a ground-breaking mechanistic, analytical and predictive framework on the nanoparticle-fuelled co-mobilization of catalyst metals across Earth's marine redox interfaces. The key idea is to establish the concept of sub-ocean metal redox catalysis underpinning the ecosystem evolution of Earth's oceans and use it to explore habitability of Ocean Worlds. In DeepTrace we will conduct multidisciplinary sea expeditions to unravel how the six redox metals co-mobilize by studying Earth analogues such as deep-sea hydrothermal vents and suboxic/anoxic seas. Integrating state-of-the-art methods with emerging innovative approaches such as time-of-flight single-particle-inductively coupled plasma mass spectrometry, we will advance the multi-element detection of nanoparticles. Finally, to build a predictive framework that will enable the estimation of nanoparticle fluxes from deep-sea boundaries and inferring the metabolic potential of Ocean Worlds, we will develop novel biogeochemical models. DeepTrace will tap the potential of tracing redox metals as one of best opportunities in the next decade for detecting life in Ocean Worlds, and accelerate improved parametrizations of metal cycles for better prediction of Earth's marine ecosystems under multi-stressors such as deoxygenation, warming and biodiversity loss.

Link to the ERC project webpage: https://www.deepsearedox.com/

Keywords of the ERC project: Deep-sea, hydrothermal vents, astrobiology, Black Sea, iron, sulfur, metals, nanoparticles, sensors

Keywords that characterize the scientific profile of the potential visiting researcher/s: Deep-sea, hydrothermal vents, astrobiology, Black Sea, iron, sulfur, metals, nanoparticles, sensors

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Project ID:	Project Acronym:	Evaluation Panel:
101044276	**LITHO3**	**PE10** Earth System Science

Principal Investigator:	**Dr Emma Tomlinson**
Host Institution:	THE PROVOST, FELLOWS, FOUNDATION SCHOLARS & THE OTHER MEMBERS OF BOARD, OF THE COLLEGE OF THE HOLY & UNDIVIDED TRINITY OF QUEEN ELIZABETH NEAR DUBLIN - IRL

Quantifying the formation and evolution of the Archaean lithospheric mantle

The formation of the Archean lithosphere was a key event in Earth history, resulting in the construction of the first continents, or cratons. The lithosphere formed by extensive mantle melting, however, there are conflicting models for the environment in which melting took place. Efforts to understand the formation of the cratonic lithosphere are hampered by a lack of quantitative information on the depth of mantle melting and the original thickness of the Archean lithosphere. Exsolved orthopyroxenes within peridotite xenoliths and silicate inclusions in diamond hold the key to constraining these critical parameters. We will reconstruct the original compositions of an extensive collection of exsolved orthopyroxenes and use our recently published thermodynamic model to calculate their formation pressures and temperatures. This innovative approach will reveal the depth extent of Archean melting. We will provide the first constraints on the vertical extent of the lithosphere in the Archean using geothermal gradients calculated from dated diamond inclusions. To achieve this, we will perform cutting edge laser ablation U-Pb dating of garnet inclusions, this challenging application has yielded promising results for xenolithic garnet. Observations will be complemented by new experiments using fertile, depleted and silica-enriched compositions, coupled with with thermodynamic modelling, which will lead to a better understanding of phase relations during peridotite melting. The origin and significance of silica enrichment is poorly understood. We will conduct melt-rock reaction experiments to test the hypothesis that silica addition occurred via interaction with ascending komatiite melt. We will thus address several fundamental issues: the depth of Archean mantle melting; the origin of silica enrichment; and the link between cratonic peridotite and komatiite magma. LITHO3 will provide unprecedented insight into the formation and evolution of the cratonic lithosphere.

Link to the ERC project webpage:

Keywords of the ERC project: mantle lithosphere craton diamond

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101045217	**PALEONILE**	**PE10** Earth System Science

Principal Investigator:	**Dr Faysal Bibi**
Host Institution:	MUSEUM FUR NATURKUNDE - LEIBNIZ-INSTITUT FUR EVOLUTIONS- UND BIODIVERSITATSFORSCHUNG AN DER HUMBOLDT-UNIVERSITAT ZU BERLIN - DEU

Evolution on the Nile: Faunal Regionalization and Continuity in the Pleistocene of Sudan

Over a century of paleontological investigation in Africa has revealed a rich Pleistocene fossil record that includes the evolution of hominins and their material cultures. However, the vast majority of fossil sites are located in the East African Rift Valley (EARV), and our knowledge is heavily skewed by this geographic bias. Poor continental geographic sampling means we lack an understanding of faunal regional variations, and the role of dispersal and geographic variation in the emergence of modern ecosystems. Furthermore, many have questioned the role of the Nile, the longest river in the world, in promoting faunal and cultural dispersal between Subsaharan and North Africa, and beyond to Eurasia. For decades such questions have been answered speculatively, with little data to stand on. PALEONILE is an ambitious project that will address these major gaps in our knowledge through large-scale surveys to reveal a new fossil record from the Middle Nile River Basin in Sudan. This project will test an overarching hypothesis of Pleistocene zoogeographic regionalization in the Nile Basin with respect to the EARV and surrounding areas, and will use an interdisciplinary array of paleontological, geological, geochronological, and archaeological approaches to reach its objectives. The geographic scale of the project is large and the techniques are cutting edge, including high-risk experimental methodologies such as paleobiomolecular recovery and new developments in sedimentary dating. PALEONILE forms the first ever large-scale systematic paleontological project to be conducted in Sudan, where the Cenozoic fossil record remains largely undiscovered, and its potential overlooked. PALEONILE will generate a new paradigm of zoogeographic dynamics and evolution in the African Pleistocene that represents a new synthesis of hydrographic, phylogenomic, archaeological, and paleontological evidence.

Link to the ERC project webpage: https://amniota.org/paleonile/

Keywords of the ERC project: Pleistocene; Africa; Fossils; Paleoenvironments; Paleolithic; Human Evolution; Vertebrate Evolution

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101052601	**SOFA**	**PE10** Earth System Science

Principal Investigator:	**Dr Christian George**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Spontaneous interfacial oxidant formation as a key driver for aerosol oxidation

Aerosols and clouds are key players in tropospheric chemistry. These tiny particles suspended in the air, with a radius ranging from a few nanometres to tens of micrometres, impact atmospheric composition, represent one of the largest uncertainties in climatic projections and cause millions of deaths worldwide every year. Hence, they have enormous societal and economic consequences. Nonetheless, there is still a knowledge gap preventing us from describing the chemical evolution of aerosols and clouds during their atmospheric lifetime. Supported by preliminary experiments, I therefore propose to unravel the impact of the spontaneous oxidant formation at the air/liquid interface as a key driver for multiphase oxidation processes. Water molecules in bulk liquid are stable and inert under ambient conditions. In sharp contrast, it was very recently shown that the local orientation of water molecules at an air/water interface induces an electric field that generates spontaneous radicals in micron-sized droplets. This production does not involve any catalysts such as light or heat. It is an intrinsic property of the air/water interface, and therefore potentially ubiquitous in the troposphere. This spontaneous interfacial oxidant formation has never been explored for its atmospheric significance. Therefore, the SOFA project aims to unravel the atmospheric importance of this interfacial (dark) chemistry. If oxidants (including OH radicals) are in fact spontaneously produced at the air-water interface, under atmospherically relevant concentrations, this would profoundly challenge our understanding and description of atmospheric multiphase chemistry. SOFA will develop a novel strategy, scaling up from laboratory-based measurements to fieldwork and modelling to assess the importance of this interfacial chemistry. SOFA will advance an entirely new perspective on how to address the multiphase oxidation capacity of the troposphere, and will therefore have a wide impact.

Link to the ERC project webpage:

Keywords of the ERC project: aerosol; microdroplets; interfacial chemistry

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101054994	**HotCores**	**PE10** Earth System Science

Principal Investigator:	**Dr Sébastien Merkel**
Host Institution:	UNIVERSITE DE LILLE - FRA

High Temperature Dynamics of Metals and the Earth's Solid Inner Core

The Earth's inner-core (IC) is 1220 km radius planet within the Earth, made of solid iron (Fe) crystallizing from the outer core (OC) as the Earth cools down. The IC affects our life at the surface; its growth provides a major source of energy for maintaining the Earth's magnetic field. One may view the IC as a freezing ball of Fe floating at the center of the OC, but seismic exploration reveal structures of increasing complexity, raising fundamental questions on the history and internal dynamics of the IC. Geophysical observations unearth the IC as it is today. Understanding the history of the IC and the effect of the IC on the global Earth dynamics, however, requires a reconstruction based on today's observations and knowledge of the physical properties of the IC Fe alloy, how they could affect IC dynamics, and their relation with present-day geophysical observables. There are significant knowledge gaps and outdated principles regarding the underlying physical properties of the IC Fe alloy. The IC temperature is close to melting, and the IC might even be partially molten. How does temperature affect of the mechanical properties of the IC Fe alloy? What is the effect of temperature and partial melting on seismic observables such as wave travel time and attenuation? This is poorly known and it hinders our interpretation capability of the ever-growing body of geophysical observations. In HotCores, advanced high pressure and/or high temperature experiments will be performed on Fe alloys and analogues. I propose to reenact key events of the history of the IC in the laboratory, as Fe crystallizes at the inner-outer-core boundary, as the IC grows and dynamically evolves to its present state, and as we see it today through the lenses of geophysical exploration. What is the structure and dynamics of the IC? How will the IC evolve in the future? HotCores aims at providing the mineralogical foundation that will help solving these mysteries.

Link to the ERC project webpage: https://erc-hotcores.univ-lille.fr/the-hotcorers-project/about-the-hotcores-project

Keywords of the ERC project: High pressure, Earth inner core, X-ray diffraction, European XFEL, Internal friction, Attenuation, Synchrotron

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101075826	**ExTrA**	**PE10** Earth System Science

Principal Investigator:	**Dr Shira Raveh-Rubin**
Host Institution:	WEIZMANN INSTITUTE OF SCIENCE - ISR

Extratropical-Tropical interAction: A unified view on the extratropical impact on the subtropics and tropics at weather timescales

An immediate, critical challenge facing humanity is the impact of weather extremes under a changing climate across the globe. Accurate weather forecasts and reliable climate projections rely on understanding the complex interactions between the atmospheric circulation and the water cycle. Largely governed by deep clouds, tropical weather cannot be forecasted more than a day in advance, leaving almost half of humanity living in these regions even more vulnerable. Although extratropical (outside the tropics) flows can drastically affect tropical clouds and precipitation, this effect has not been systematically quantified or understood. The novelty of this proposal is in asking a new question: How do extratropical dynamics influence the (sub)tropics? We will build on our recent work and paradigm-challenging preliminary results to study how extratropical dry, cold air intrusions into the tropics dramatically modify its atmosphere and air-sea interaction. We will use a new global Lagrangian identification approach to study this extratropical-tropical interaction for the first time, and uniquely combine state-of-the-art data from multiple sources, diagnostic tools, and multi-scale modelling. We will quantify the global spatiotemporal occurrence, variability and trends of these events (WP1); understand their underlying dynamics and precursors in midlatitudes and their impact on the water cycle (WP2); and assess their suitability as predictors of high-impact tropical weather (WP3). A dedicated international observational flight campaign will allow us to synergistically study the extratropics' impact on the tropics (WP4). Our findings will advance not only the meteorological community but also the oceanographic, cloud physics and climate dynamics scientific communities, by providing a unified, global view of the interacting large-scale atmospheric dynamics, clouds and precipitation through their common weather timescales, paving the way for timely, accurate weather warnings.

Link to the ERC project webpage: https://www.weizmann.ac.il/EPS/raveh-rubin/

Keywords of the ERC project: tropical-extratropical interaction, weather system, weather extremes, predictability

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101076205	**A3m-transform**	**PE10** Earth System Science

Principal Investigator:	**Dr Felix Pithan**
Host Institution:	ALFRED-WEGENER-INSTITUT HELMHOLTZ-ZENTRUM FUR POLAR- UND MEERESFORSCHUNG - DEU

Understanding Arctic amplification of climate change through air-mass transformations

We expect that temperatures over the wintertime central Arctic will increase by 20 degrees - and precipitation will double - by the end of this century if greenhouse gas emissions continue to rise. Arctic sea-ice is projected to completely melt in summer within the next decades, and may cease to form in winter in the coming century. The traditional framework to understand this Arctic amplification of climate change focuses on the steady-state mean Arctic climate. However, the Arctic wintertime atmosphere has two preferred states that are largely controlled by initially warm and moist air masses that cool and dry after being advected from lower latitudes. We understand little about how these air masses cool and dry, and what controls the sudden transition from a cloudy state to a clear state along their trajectory. This lack of understanding is a major obstacle to scientific progress and improved climate models. To achieve groundbreaking progress, I will analyze the warm, moist poleward flows, cold, dry equatorward flows and the air-mass transformations that lead from one to the other. I will observe and model such air masses along their trajectories using recently developed air-mass following balloons and customized model setups. Cooling of air in the Arctic mirrors heating in the Tropics. Together, these drive the global atmospheric circulation, but the Arctic's role in this picture has largely been overlooked. My team will investigate how the Arctic couples to the global climate system using a novel concept of averaging the atmospheric circulation. We will focus on how and why both the heat and moisture content and the amount of air transported into and out of the Arctic change in a warming world and contribute and respond to Arctic amplification. A3M-transform will deliver a step change in understanding the air-mass transformation processes that shape Arctic amplification and transform our view of how the Arctic couples to the global climate system.

Link to the ERC project webpage: https://www.awi.de/en/science/junior-groups/a3m-transform.html

Keywords of the ERC project: Arctic amplification, climate change, cloud feedbacks

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101087884	**MadSilica**	**PE10** Earth System Science

Principal Investigator:	**Dr Wei-Li Hong**
Host Institution:	STOCKHOLMS UNIVERSITET - SWE

Silicate alteration in marine sediments: kinetics, pathway, and dependency

Over its long geological history, the overall habitability of Earth has been governed by the chemical alteration of silicate minerals, a reaction that buffers pCO2 and climate. While terrestrial silicate weathering is widely appreciated, marine silicate weathering and reverse weathering (or marine silicate alteration, MSiA, altogether), has long been considered insignificant in the big picture. This paradigm is challenged by recent work that suggests reverse weathering, as an oceanic Si sink, could be three times higher than previously thought. The latest estimates of marine silicate weathering showing its CO2-fixing capacity could be 82% of that of its terrestrial counterpart. Though potentially significant, these estimates are associated with large uncertainties and untested assumptions. In particular, information about the exact chemical pathway of MSiA, kinetics, and the environmental dependency is missing. To fill these gaps, I will provide the first comprehensive assessment of MSiA by quantifying its rates through both laboratory experiments and field observations. While the former constrains how MSiA initiates, the latter represents the million-year quasi-steady state condition in nature. Reproducing the conditions for MSiA in the laboratory is undeniably challenging due to the required multi-year incubation under up to 340 times atmospheric pressure and near-frozen conditions, which I can reproduce with a novel apparatus. Circulation of modified seawater with realistically slow flow will be maintained to derive MSiA rates through continuous fluid composition monitoring. Together with the rates estimated from field observations, I will evaluate the dependency of MSiA on environmental factors, such as the type/quality of silicates and organic matter. The project will be transformative in our understanding of the coupling between Si and C cycles, and thus provide fundamental knowledge for predicting Earth responses to a likely hotter and wetter future.

Link to the ERC project webpage:

Keywords of the ERC project: marine sediments, Silicate, laboratory incubation, weathering

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101088452	**ROVER**	**PE10** Earth System Science

Principal Investigator:	**Dr Kjetil Våge**
Host Institution:	UNIVERSITETET I BERGEN - NOR

Resilient northern overturning in a warming climate

A vigorous Atlantic Meridional Overturning Circulation (AMOC) is crucial for the mild northern European climate; it brings warm water northward near the surface and returns cold, dense water at depth. In a warming climate the AMOC is projected to weaken – or even approach a tipping point. Contrary to this established view, I hypothesize that an overlooked, climate-change induced mechanism may impart resilience to the overturning: As the sea ice recedes, increasing stretches of the boundary current system around the Nordic Seas and Arctic Ocean become exposed to the atmosphere. The resulting increased ocean heat loss in winter further densifies the water in the boundary current, which is a direct pathway supplying the lower limb of the AMOC. Enhanced dense-water formation is counter-intuitive in a warming climate and not represented by current climate models, but has the potential to safeguard the northern overturning and maintain a steady supply of dense water to the AMOC. Sparse observations and preliminary results from a 1D model indicate that water mass transformation occurs in the increasingly ice-free boundary current, but its extent, importance, and future development are unknown. In ROVER, I will explore this concept through an extensive field campaign, which includes a mooring array across the boundary current and an unprecedented wintertime survey of this severely under-sampled area. Combined with targeted high-resolution modeling, I will use the comprehensive data set to document the occurrence of this process, understand its dynamics, quantify its extent, and assess its climatic importance. Dense-water formation in the boundary current system that may safeguard the northern overturning would represent a paradigm shift for water mass transformation at high latitudes and the stability of the overturning circulation. As such, ROVER is timely and will have a substantial and significant impact on the science of climate change and climate impact assessment.

Link to the ERC project webpage: https://www.uib.no/fg/fysos/164420/rover

Keywords of the ERC project: Physical oceanography; high northern latitudes; overturning

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101114969	**ProtoSigns**	**PE10** Earth System Science

Principal Investigator:	**Dr Sean Jordan**
Host Institution:	DUBLIN CITY UNIVERSITY - IRL

Protocells in the Archaean Rock Record: Implications for the Origin of Life and Detection of Biosignatures

Fossilised remains of protocells transitioning towards the first living organisms may be observable in the early rock record distorting our interpretation of biosignatures. Protocells – cellular structures existing prior to the emergence of life – would have comprised simple membranes and molecular machinery. The formation of complex protocells is poorly understood. The interpretation of fossilised microorganisms in the early rock record is steeped in controversy. The potential for abiotic microstructures to further complicate this interpretation has long been recognised but has not been systematically tested. Evidence suggests that prebiotic structures are very difficult to distinguish from microfossils. However, little is known about the chemical and physical characteristics of these 'biomorphs' that may enable us to tell the difference. This project will use a novel microfluidic approach to expand the experimental scope for formation of protocells of increasing complexity. Resulting microstructures will undergo silicification and diagenesis, the principal preservation pathway for early Archean microfossils. State-of-the-art analytical techniques will be used to characterise biomorphs, providing the first rigorous investigation of the feasibility of protocell preservation and how this might express in the geological record. These data combined with a predictive model and biological controls will allow for identification of key observables that will act as biogenicity indicators. Purported microfossils will then be examined and reinterpreted using the novel biosignatures. This project has the capacity to represent a paradigm shift in our fundamental understanding of the origin and evolution of life on Earth and possibly elsewhere in the Solar System. Collectively this will represent a major advance in our understanding of the geological record, providing the first comprehensive methodology to distinguish between abiotic, prebiotic, and biological microstructures.

Link to the ERC project webpage:

Keywords of the ERC project: origin of life; protocells; biosignatures; geobiology; astrobiology; archaean; micropaleontology; organic geochemistry

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101117373	**ChroMCrust**	**PE10** Earth System Science

Principal Investigator:	**Dr Pedro Waterton**
Host Institution:	KOBENHAVNS UNIVERSITET - DNK

The Chromite Record of Mafic Crustal Growth

Understanding Earth's crustal growth is crucial to understanding the evolution of its tectonics, the birth of the first continents, and the fundamental changes that transformed Earth into a habitable planet. However, much of our understanding of Earth's crustal growth is predicated on a single mineral - zircon - that is strongly biased towards detecting felsic crustal growth. This is particularly problematic for the early Earth, where average crustal compositions were far more mafic than today, and the very first protocrust may be entirely undetectable using conventional methods. I propose to access the mafic to ultramafic crustal growth record using detrital chromite preserved in sedimentary rocks from Archaean Cratons. Like zircon, chromite chemical compositions reflect the magmas that they crystallised from, and can be used to identify the provenance of the mafic portions of a sedimentary rock. Furthermore, they can be dated using Re-Os isotopes, to identify the age of eroded mafic terranes.

This project has three main objectives:

1. Develop techniques to identify the age and composition of chromite sources in ancient sedimentary rocks.
2. Use a range of detrital chromite samples from sedimentary sequences in the Superior Craton, to reconstruct a mafic-ultramafic crustal growth curve for the craton.
3. Search for evidence of Earth's mafic protocrust in some of the oldest known chromite-bearing sedimentary rocks.

These achievements will open a new avenue for studying sedimentary provenance, unlock the archive of mafic crustal growth throughout Earth history, and provide insights on the nature and survival of Earth's earliest crust. The techniques developed will be broadly applicable, paving the way for a better understanding of Earth's crustal evolution.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101117373

Keywords of the ERC project: chromite; crustal growth; mafic protocrust; mafic and ultramafic magmatism; Re-Os isotopes; platinum-group elements

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101125296	**SEA-THROUGH**	**PE10** Earth System Science

Principal Investigator:	**Dr Jan Taucher**
Host Institution:	HELMHOLTZ-ZENTRUM FUR OZEANFORSCHUNG KIEL (GEOMAR) - DEU

Novel in situ imaging technology to explore the "ladder of vertical migrations" to the deep-sea

The pelagic deep ocean is the largest but least-understood habitat on Earth, harboring enormous fish stocks, a rich (and largely undiscovered) biodiversity, as well as a large carbon sink in the climate system. As almost all life at depth is ultimately nourished by primary production in the surface ocean, pathways of "vertical connectivity" are critical in linking ecological and biogeochemical processes across several thousands of meters. One of the most enigmatic phenomena is the so far virtually unexplored "ladder of vertical migrations": this mechanism is hypothesized to link food-webs across the entire oceanic water column through a complex interplay of feeding-interactions and synchronized migrations of a multitude of species, thereby supporting pelagic life at depths of up to several kilometers. So far, very little is known about this phenomenon, mainly due to the methodological challenges of studying organisms and their behavior at ecologically relevant spatial and temporal scales, particularly under the extreme pressure in the deep sea. SEA-THROUGH aims for a breakthrough by providing "a new set of glasses" to study the so far unexplored "ladder of migrations". To achieve this, we will: (a) Develop novel in situ imaging technology for unparalleled and highly detailed observations of organisms in the deep sea (to 6000m depth): "who is where at which time and what are they doing" (b) Use this new deep-sea imaging system on ship expeditions for targeted studies of the enigmatic "ladder of migrations" Pushing the limits of in situ observation technology will reveal a holistic picture of biodiversity and food-web structure, providing novel insights into the functioning of deep-sea ecosystems and their ecological and biogeochemical connectivity across the water column – knowledge that is urgently needed for evaluating the ecosystem services of the deep ocean (e.g. fisheries, CO2 sequestration), as well as the sustainable management of this vast habitat.

Link to the ERC project webpage: https://www.geomar.de/en/fb2-bi/imaging-technology-and-deep-sea-plankton/translate-to-english-sea-through

Keywords of the ERC project: Deep-sea ecology, Zooplankton, Micronekton, Vertical Migration, Marine Imaging, Ocean acoustics

Keywords that characterize the scientific profile of the potential visiting researcher/s: Plankton Ecology, Micronekton, Food-Web Ecology, Biogeochemistry, Marine Imaging, Marine Acoustics, Data Science

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101126078	**Glass2Melt**	**PE10** Earth System Science

Principal Investigator:	**Dr Sergey Lobanov**
Host Institution:	GFZ HELMHOLTZ-ZENTRUM FUR GEOFORSCHUNG - DEU

Universal Model of the Density of Deep Silicate Melts

The starting conditions for the Earth's evolution were set by gravitational differentiation in the solidifying magma ocean. Yet, a thorough understanding of the magma ocean dynamics and thus of the primordial Earth is lacking. One key unknown is the density of silicate melts at high pressure, which determines whether the crystallizing phases rise or sink. Magma density also governs the storage, spatial distribution, and migration of melts in the present-day Earth. Densities of silicate liquids at mantle pressures and temperatures are extremely difficult to measure because of the tiny sample size, melt chemical reactivity, and its lack of crystalline structure. The use of glasses as proxies of melts lifts some but not all of these challenges. Albeit needed for a holistic picture of planet Earth, no density systematics exists for glasses or melts across the pressure range of the entire mantle. Glass2Melt will employ and further a novel class of fast white laser spectroscopy methods to measure the density of multicomponent synthetic silicate glasses and melts at mantle pressure-temperature conditions. Our approach is ground-breaking because it allows to thoroughly explore a large compositional space and determine the density of any deep silicate melt. Our results will (i) parametrize a universal silicate melt density model applicable to the entire mantle, and (ii) quantify solid-liquid buoyancy throughout the whole crystallizing magma ocean. Glass2Melt will have a broad, lasting impact on our understanding of the Earth's interior and its evolution over geologic time. The new density model will provide critical input for future numerical simulations assessing fundamental questions about the solidification of the primordial magma ocean, as well as the initiation and development of physical and chemical heterogeneity in the mantle. It will also be crucial for deciphering deep low seismic velocity structures, and to modeling magma dynamics in the present-day Earth.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101141836	**Tree2Globe**	**PE10** Earth System Science

Principal Investigator:	**Dr Thomas Pugh**
Host Institution:	LUNDS UNIVERSITET - SWE

Global reanalysis for a forest carbon sink in flux

Three trillion trees lie behind a carbon sink that has taken up about 30% of humanity's carbon emissions over recent decades. Yet whether we can continue to rely on this huge natural subsidy is highly uncertain. The sink emerges from systematic perturbations in the dynamics of growth, death and establishment of individual trees. Taken together across the forest, these lead to the net uptake or release of carbon. Both theory and recent observations point towards profound changes in these dynamics of the world's forests being underway, potentially causing the sink to saturate and decline. But our ability to accurately assess and quantify such on-going changes worldwide is severely limited. The reasons for this are twofold: a lack of standardised measurements of the sink and the dynamics that cause it across the world, and the difficulty of modelling the dynamics of trillions of trees. Tree2Globe solves both of these limitations, using a novel model-data assimilation approach to consistently integrate the dynamics of millions of observations of individual trees collected under disparate protocols worldwide and link together this information in space and time based on physically-consistent principles. The resulting global forest reanalysis system will (a) provide a step-change in capability to make accurate and timely assessment of the rates of tree growth, death and establishment globally and (b) quantify how these combine with the legacies of past land-use and disturbance to explain the size, location and trajectory of the global carbon sink in trees over the period 1990-2027. This will enable us to make a definitive assessment of whether hypothesised changes in forest dynamics and the resulting carbon sink are coming to pass. This unique insight into how the world's forests and their contribution to climate change mitigation are changing will provide key information to help guide the world to meet its net zero emissions policy commitments.

Link to the ERC project webpage:

Keywords of the ERC project: Forest dynamics, carbon cycle, modelling

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101161989	**AtmosCOC**	**PE10** Earth System Science

Principal Investigator: **Dr Nanna Myllys**

Host Institution: HELSINGIN YLIOPISTO - FIN

Formation, Clustering, and Atmospheric Impact of Clusterable Organic Compounds

Atmospheric aerosol particles have a critical impact on Earth's radiative balance and human health. Oxygenated organic molecules play an important role in the formation and growth of aerosol particles. To contribute to initial steps of particle formation, a compound must either condense from the gas to the particle phase or undergo cluster-phase proton-transfer or other chemical reaction. I define a clusterable organic compound (COC) to be an oxygenated organic molecule which can participate stable cluster formation under atmospheric conditions. Due to the limited knowledge of the formation, structures, and properties of COCs, the exact mechanisms for the formation of aerosol particles remain puzzling. My vision to bridge this long-lasting knowledge gap is to implement a unique computational approach to tackle bottlenecks in studies of complex reaction mechanisms, to combine a versatile suite of quantum chemical methods to accurately investigate cluster formation and properties, and to combine the best qualities of mass spectrometry and matrix isolated vibrational spectroscopy to solve structures directly from the reaction chamber. The scientific objectives are to 1) solve the role of dimerization-initiated autoxidation mechanism in COC formation, 2) develop an instrumentation capable to reveal molecular structures and properties of COCs, 3) determine the formation mechanisms and rates of COC containing particles, and 4) estimate the atmospheric impact of newly formed COC containing particles. This project will establish the molecular-level foundation for future atmospheric research by solving how COCs form, what is their contribution to particle formation and properties, and what is their impact for our climate. This research results highly accurate reaction kinetics and cluster thermodynamics parameters for atmospheric models, which are crucial to constrain the large uncertainty in climate predictions caused by small aerosol particles.

Link to the ERC project webpage: https://www.helsinki.fi/en/researchgroups/molecular-level-atmospheric-science

Keywords of the ERC project: atmospheric chemistry, reaction mechanisms, cluster formation, gas-phase radical reactions

Keywords that characterize the scientific profile of the potential visiting researcher/s: atmospheric science, computational chemistry, physical chemistry

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101162777	**Deep-C**	**PE10** Earth System Science

Principal Investigator:	**Dr Olivier Sulpis**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Deep-sea carbonates under pressure: mechanisms of dissolution and climate feedbacks

As humanity grapples with the escalating crisis of climate change, understanding and mitigating the sources of carbon dioxide (CO_2) emissions is imperative. A lesser-known yet significant aspect of this crisis lies in the vast expanses of marine sediments which encompass two-thirds of the Earth's surface. A key component of these sediments is calcium carbonate ($CaCO_3$), a family of minerals that makes up the shells and skeletons of marine organisms. CO_2 emissions lead to ocean acidification, triggering $CaCO_3$ dissolution, which in turn neutralizes CO_2, acting as a crucial CO_2 sink over millennial timescales. However, the mechanisms and rate of this dissolution remain unknown due to the challenges posed by the deep ocean's high pressures and the elusive bacterial communities mediating the dissolution process. Proposed here is an ambitious five-year research initiative aimed at understanding deep-sea $CaCO_3$ dissolution, thereby paving the way towards a more thorough understanding and potential mitigation of climate change impacts. By focusing on the abyssal and hadal realms, this groundbreaking research seeks to unveil the nature and rate of $CaCO_3$ dissolution through high pressure reactors. These reactors, which mimic the pressure and temperature of deep-sea environments, present a robust alternative to in-field studies. With the integration of cutting-edge sensors and the use of advanced $CaCO_3$ imaging techniques, we anticipate generating precise and continuous data on the unfolding biogeochemical processes. By housing bacterial cultures within the reactors, alongside natural $CaCO_3$ grains, this project will delve into the mechanisms driving dissolution. The insights will be instrumental in refining a global biogeochemical model, thereby promoting a deeper comprehension of the ocean's role in carbon sequestration and propelling forward the global efforts towards effective climate change mitigation.

Link to the ERC project webpage: https://exocean.academicwebsite.com/projects/4096-deep-c

Keywords of the ERC project: Ocean Carbonates Dissolution CO_2 Pressure

Keywords that characterize the scientific profile of the potential visiting researcher/s: Microbiology Genetics Ecology Modeling Diagenesis Earth System

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101164120	**FloW**	**PE10** Earth System Science

Principal Investigator:	**Dr Aaron Bufe**
Host Institution:	LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN - DEU

Floodplain Weathering

Chemical weathering of rocks is central to Earth's biogeochemical cycles. It exchanges CO2 with the atmosphere, balances CO2 emission from the mantle, and stabilizes Earth's climate. Years of research have established data and models of weathering in eroding landscapes, because erosion supplies unweathered rocks to the surface of the Earth. However, the sediment eroded from mountains can continue to weather during temporary storage in wide floodplains. Recent estimates indicate that floodplain sediments may contribute over 50% of the global weathering flux; yet, we do not have a framework to quantify floodplain weathering or predict its sensitivity to climate and tectonics. A quantitative understanding of floodplain weathering will allow building new models of the global carbon cycle, and it will increase the accuracy of tools to predict Earth's response to natural and anthropogenic perturbations in CO2. I propose an ambitious, innovative, and multidisciplinary research program to develop, quantify, and test a model for weathering fluxes as a function of sediment transport and storage on floodplains. The predictive power of the model will be tested against new data from floodplains influenced by different tectonic and climatic boundary conditions. Thus, FloW will yield a novel framework to link physical and chemical mass fluxes across Earth's surface, potentially transforming the power of simulations of Earth's carbon cycle and climate evolution.

Link to the ERC project webpage:

Keywords of the ERC project: Carbon cycle, chemical weathering, sediment transport, sediment residence time

Keywords that characterize the scientific profile of the potential visiting researcher/s: fluvial geomorphology, chemical weathering, earth surface dynamics, carbon cycle

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101170410	**BOREAUSTRALIS**	**PE10** Earth System Science

Principal Investigator:	**Dr Jesper Björklund**
Host Institution:	GOETEBORGS UNIVERSITET - SWE

Resolving troubling discord in Boreal versus Austral late Holocene temperature history

According to temperature reconstructions based on natural climate proxy archives (ice cores, lake sediments, tree rings etc.), Northern and Southern Hemisphere (NH, SH) temperature histories differ in important features over the past millennia. This stands in contrast to the broad hemispheric agreement found in corresponding climate model simulations. I hypothesize that a new tree-ring proxy, based on quantitative wood anatomy, can be used to improve temperature reconstructions in both hemispheres, and by this reduce differences between reconstructions and simulations. Preliminary studies show such results at regional scales in Eurasia, and Hemispheric scale networks based on quantitative wood anatomy are thus expected to confirm my hypothesis. These advances will be novel and highly relevant to communities engaged in climate modelling, climate reconstructions, and human history research. To test my hypothesis, the project is divided into the following aims: 1. Create Boreal and Austral networks of quantitative wood anatomy data from tree rings from already sampled, as well as newly sampled trees growing in extra-tropical regions. 2. Use the new proxy data to examine volcanic-related responses specifically in the SH, where model simulations and existing proxy reconstructions clearly disagree. 3. Investigate if intra- and inter-hemispheric patterns of long-term temperature changes are more coherent among the new proxy records, and less different from corresponding model simulations. I am convinced that the results of this project will substantially improve upon the quality of both NH and SH temperature reconstructions, but if improved NH and SH reconstructions remain distinct from corresponding simulations, this may constitute an important basis for revisiting system physics implemented in current climate models. The outcome of these investigations will thus likely challenge conventional wisdom in at least one, and possibly several research communities.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101170410

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: dendroclimatologist, image analysis developer, owner of millennium-long temperature sensitive tree-ring samples/data

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101170872	**DEGAS**	**PE10** Earth System Science

Principal Investigator:	**Dr Sara Callegaro**
Host Institution:	ALMA MATER STUDIORUM - UNIVERSITA DI BOLOGNA - ITA

Deconvolving sources and sinks of carbon and sulfur in magmas to reconstruct DEGASsing from Large Igneous Provinces

The magnitude and consequences of future climate change depend on how Earth's climate will respond to atmospheric chemistry alterations – vastly related to human activities. However, the complexity of the climate system makes future scenarios hard to predict. The geological record is our best source of information to constrain these scenarios by studying periods of Earth's history during which volcanic degassing from outstanding magmatic episodes (Large Igneous Provinces, LIPs) acted as major forcing agents of climate and environmental change. Earth-system models that aim to reconstruct the global consequences of LIPs degassing proliferated in recent years, but they urgently need ground-truth gas emission data. The goal of DEGAS is to offer a new framework for obtaining these data by deconvolving sources and sinks of LIP magmatic volatiles, from the mantle source, across the crustal filter. DEGAS aims to: 1) quantify sulfur and carbon concentrations in LIPs parental magmas, hinging on the S-in-clinopyroxene method, pioneered by the PI; 2) investigate emblematic natural examples of magma-host rock interaction in volcanic basins from a within-sill perspective and with special focus on sulfur; 3) evaluate the role of the "crustal filter" as carbon and sulfur sink, with an unprecedented basin-scale approach. DEGAS investigates carbon and sulfur in LIPs magmas through multiple lenses, from the mineral to the basin-scale, in two natural laboratories, the Skagerrak-centered LIP (Oslo Rift), and the Karoo LIP. Knowing the initial volatile load and the modalities of magma-host-rock interaction is fundamental if we want to gauge the effect of the crustal filter and reconstruct source-sensitive parameters of degassing, such as isotopic signatures. DEGAS will constrain the magmatic side of the intricate volatile exchange between LIP magmas and crust, marking a fundamental step forward towards a full portrait of LIPs degassing, the only past analogue to anthropogenic emissions.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101170872

Keywords of the ERC project: Large Igneous Provinces; magmas; sulfur; carbon; crustal assimilation

Keywords that characterize the scientific profile of the potential visiting researcher/s: geochemistry; geology

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101198636	**DAWN**	**PE10** Earth System Science

Principal Investigator:	**Dr Razvan Caracas**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

The dawn of the Hadean atmosphere

During the Hadean eon, the first 500 million years of Earth's geological history, the atmosphere underwent its most dramatic transformations. An abundance of greenhouse gases prevented runaway cooling in the face of a fainter Sun, but the concentration, chemistry, and decline rates of these gases are unknown. Retracing this intriguing metamorphosis is impeded by the scarcity of Hadean samples, a vast parameter space, and volatile flux estimates that largely rely on empirical extrapolations. Here, I aim to decipher the formation and chemical evolution of the Hadean atmosphere using a pioneering multi-scale approach, bridging atomic to planetary scales. At the foundation of my project lies a unique combination of state-of-the-art atomistic simulations that cover different length and time scales. With ab initio calculations, I compute equilibrium thermodynamics and thermochemistry at the nanoscale. Subsequently, I employ these ab initio results to train new advanced machine-learning interatomic potentials tailored for liquid-vapor and vapor-solid interactions. These simulations quantify the devolatilization rates from the cooling magma ocean and reconstruct the volatile cycle during its crystallization, including the effects of redox changes and fugacity variations. I incorporate the results of the atomistic simulations into thermochemical calculations and global circulation modeling. In this way, I simulate the behavior and evolution of the atmosphere in Hadean, retrace the major volatile fluxes between geological reservoirs and their contributions to the atmosphere, and dynamically integrate gas losses to space, incoming meteoritic contributions, and fast-changing surface conditions, including the appearance of the hydrosphere. This modeling also gives feedback on the surface state that constrains the atomistic simulations. Thus, I can chart a comprehensive evolutionary path of the Hadean atmosphere and bridge the gap to the better-constrained state of the Archaean.

Link to the ERC project webpage:

Keywords of the ERC project: atmosphere, Hadean, molecular dynamics, ab initio, machine learning, data science, volatiles, magma, lava

Keywords that characterize the scientific profile of the potential visiting researcher/s: atmosphere, Hadean, molecular dynamics, ab initio, machine learning, data science, volatiles, magma, lava

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101199624	**LISTEN FLASH**	**PE10** Earth System Science

Principal Investigator:	**Dr Philippe Lognonne**
Host Institution:	INSTITUT DE PHYSIQUE DU GLOBE DE PARIS - FRA

Lunar Impact's Seismic and Telescopes European Network for Flash

Terrestrial Planetary Seismology aims to revolutionize our understanding of planetary interiors and seismic activity. After the Mars interior exploration by InSight seismometer, the next steps will be on the Moon, with three seismometer deployments planned for 2026/2027 : NASA's Far Side Seismic Suite (FSS) with a French spare InSight sensor, NASA's Artemis-3 Lunar Environment Monitoring Station, and the Chinese Chang'E-7 Lunar Seismometer. This ERC project hinges on detecting and locating lunar impacts, essential for constraining interior models, akin to seismic studies on Mars. It does this by deploying a network of three Earth-based telescopes to monitor Lunar Impact Flashes, complementing data from FSS and other lunar seismometers. This synergy enables precise impact location and timing, crucial for mapping lunar crustal and mantle structures of the lunar south hemisphere, including Schrödinger impact basin and South Pole shallow layers. Moreover, the project pioneers a multi-messenger approach in planetary science by combining seismic waveforms from impacts, high-resolution imaging of impact craters and impact digital twins to understand impact dynamics, lunar scattering and attenuation and lunar subsurface properties comprehensively. It aims to establish empirical relations between impact characteristics, seismic source parameters and seismic signals, enhancing our understanding of impact processes and enabling "natural" controlled seismology using impacts for future planetary exploration. With a robust implementation plan aligned with lunar mission timelines, this ERC project is based on partnership between IPGP and CNRS and promises to deliver groundbreaking insights into planetary seismology. It leverages expertise from planetary seismology, impact observations, and instrumentation, supported by international collaborations, to address fundamental questions about planetary interiors and enhance our understanding of planetary formation and impacts processes.

Link to the ERC project webpage:

Keywords of the ERC project: Lunar Impact Flash, LIF, Telescop, seismology, moon

Keywords that characterize the scientific profile of the potential visiting researcher/s: Lunar Impact Flash, LIF, Telescop

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Project ID:	Project Acronym:	Evaluation Panel:
101040057	**2d-sandwich**	**PE11** Materials Engineering

Principal Investigator:	**Dr Tim Verhagen**
Host Institution:	FYZIKALNI USTAV AV CR V.V.I - CZE

2D sandwiches, artificial layered building blocks for multifunctional materials

The possibility to create new materials bottom-up was enhanced via the stacking of atomically thin layers of two-dimensional (2D) materials with van der Waals interactions (vdWIs). Unfortunately, the downside of vdWIs is the, in general, weak electronical and mechanical interaction between the individual layers. This hinders the creation of multiferroic materials working at ambient conditions, which are despite extensive research still very scarce, from stacked layers with vdWIs. This research aims to create a new 2D building block: the 2D sandwich. This is a layered heterostructure with a strong interaction between the sandwich's individual layers mediated via an ionic or multivalent bond, whereas the interaction with other layers is still solely due to the vdWIs. As the prototype functional material, a 2D magnetoelectric multiferroic sandwich composed of layered transition metal chalcogenides, oxides or iodides will be grown using the modulated elemental reactants method. To tackle the possible sample degradation in the sandwiches, ultra-high vacuum optical surface science spectro-microscopy techniques will be developed to optically probe the 2D multiferroic sandwiches for both magnetism, ferroelectricity and the coupling between them. The concept of open samples will be introduced, facilitating the scientific community with the straightforward verification of the data and accelerate the development of this new class of 2D sandwiches. This project will provide material design strategies that can remove the stringent lattice matching criteria to stack different classes of layered materials and provide these class of layered materials with similar stacking freedom as layered materials with vdWIs. These insights will allow the interbreeding of different classes of layered quantum materials, such as complex oxides, 2D layered crystals with vdWIs, cuprate superconductors or topological insulators or semimetals.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101042781	**DREAM**	**PE11** Materials Engineering

Principal Investigator:	**Dr Daniel Grave**
Host Institution:	BEN-GURION UNIVERSITY OF THE NEGEV - ISR

Design Rules for Efficient Photogeneration in Metal Oxides

Photoelectrochemical (PEC) water splitting is an attractive route for green hydrogen production. Despite nearly half a century of research efforts, no material has successfully met the stringent requirements for a photoelectrode material, the light harvesting semiconductor within the PEC cell. Metal-oxides are widely viewed as the most promising photoelectrode materials for their exceptional stability in aqueous electrolytes, but those with suitable band gaps for visible light absorption typically have open d shell configurations, and suffer from low photoconversion efficiencies. I hypothesize that the underperformance of such materials is related to their electronic configuration which reduces the photogeneration yield of mobile charge carriers, an overlooked yet critical loss mechanism in metal-oxides. Thus, unlike conventional semiconductors where all absorbed photons generate electrons and holes, in metal-oxides with open d shell configuration, many of the photons give rise to localized electronic transitions that do not contribute to the photocurrent. In addition, polaronic transport and charge carrier recombination reduce the charge carrier collection efficiency. DREAM will address these challenges and provide a leap forward in understanding the photogeneration processes in metal-oxide photoelectrodes and their effect on photoconversion efficiency. To achieve these goals, we will couple systematic control of crystallographic structure, d orbital occupancy, and local cation environment using heteroepitaxial thin film growth together with wavelength and temperature-resolved characterization of the photogeneration yield spectrum. The knowledge gained by these fundamental investigations will lead to new design rules, which we will employ to engineer new metal-oxides with near unity photogeneration yield, and integrate them into novel device architectures, enabling highly efficient PEC-PV tandem cells for unassisted solar water splitting.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101043417	**Elmo**	**PE11** Materials Engineering

Principal Investigator:	**Dr Christian Müller**
Host Institution:	CHALMERS TEKNISKA HOGSKOLA AB - SWE

Electrical Modulation of Elastic Moduli

How could a textile change its feel upon the push of a button? While we are accustomed to visual displays and loudspeakers, interactive tactile perception largely eludes our experience. Textiles that change their pliability and texture would allow for communication using our sense of touch. Potential applications abound, from human-machine interfaces for robotics to new forms of virtual reality. To facilitate such a tuneable mechanical response, materials are needed whose stiffness can be altered. This project will use conjugated polymers to realise stimuli-responsive materials. The developed materials will be spun into fibres and yarns, which will be integrated into prototype textile devices that can undergo a reversible change in pliability and texture. The explored materials science concepts will open up a new line of research in the blossoming field of organic electronics, while the application-oriented part of the project opens new horizons for the interdisciplinary field of wearable electronics.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: Organic electronics, electrochemistry, electrochemical transistor, conjugated polymer, organic semiconductor

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Project ID:	Project Acronym:	Evaluation Panel:
101043969	**TRITIME**	**PE11** Materials Engineering

Principal Investigator:	**Dr Christoph Kirchlechner**
Host Institution:	KARLSRUHER INSTITUT FUER TECHNOLOGIE - DEU

Isolation, observation and quantification of mechanisms responsible for hydrogen embrittlement by TRITIum based microMEchanics

Hydrogen is an indispensable element in the energy transition and expected to be key for decarburization of the European society. Hydrogen embrittlement – recognized and in focus of materials science since almost 150 years – still causes catastrophic failure until today. It is well-understood that all mechanisms of hydrogen embrittlement materialize at the scale of individual defects, such as dislocations, grain- and phase-boundaries. But we are still missing a correlative measurement of the mechanical behaviour of individual defects and the local hydrogen content, which is urgently needed to assess the occurrence, importance and magnitude of mechanisms playing a role during hydrogen embrittlement. In aid of this, TRITIME for the first time facilitates the isolation, observation and quantification of hydrogen embrittlement mechanisms by TRITIum based microMEchanics. The mechanisms of hydrogen embrittlement will be isolated by small scale mechanical testing on samples containing only a few crystal defects. The defect properties are observed and measured by in situ micromechanical experiments in the scanning electron microscope and at synchrotron beamlines. Simultaneously, TRITIME will monitor the local hydrogen content by observing the decay of tritium with high spatial resolution, for which a unique tool will be developed. In addition, post mortem analysis using atom probe tomography and secondary ion mass spectroscopy take advantage of the reduced mobility of tritium. TRITIME will provide unprecedented insights into the local hydrogen content of newly formed slip bands, mobile and immobile dislocations and fracture surfaces. Consequently, if successful, TRITIME will obtain a mechanism-based, quantitative understanding of HEDE, HELP and their interplay. In doing so, TRITIME sets the base for a mechanism-based optimization of microstructures used in distribution and storage of hydrogen and, therefore, is an indispensable tool towards Europe`s hydrogen society.

Link to the ERC project webpage:

Keywords of the ERC project: Hydrogen embrittlement, in situ techniques, tritium, small scale mechanics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101045098	**LEAP**	**PE11** Materials Engineering

Principal Investigator: **Dr Feng Gao**

Host Institution: LINKOPINGS UNIVERSITET - SWE

Electrically Pumped Perovskite Lasers

Electrically pumped lasers are considered as a holy grail in the field of optoelectronics. Despite the success of lasers based on expensive epitaxially grown semiconductors, low-cost solution-processed semiconductors provide new opportunities to significantly expand the applications of lasers. On one hand, low-cost and scalable deposition can meet increasing demand of using lasers in consumer electronics. On the other hand, solution-processed semiconductors can be easily proceeded into thin films, providing great promise to develop thin-film lasers which are required for highly integrated photonics chips in advanced applications. A superstar in the family of solution-processed semiconductors is metal halide perovskites, which have shown great success in a range of optoelectronic applications. Especially, recent breakthroughs on optically pumped perovskite lasers and high-performance perovskite light-emitting diodes indicate great potential of developing perovskites into a new generation of materials for electrically pumped lasers. This project has the ambitious goal to realise solution-processed electrically pumped perovskite lasers. I will take a holistic approach, where novel concepts are proposed to address critical challenges on the development of perovskite lasers. Both type-I and type-II perovskite quantum well heterostructures, which utilise fundamentally different mechanisms to reach low thresholds, will be developed as the gain media. Edge-emitting devices based on these new perovskite gain media will then be coupled into rationally designed cavities for lasing actions. At the core of the research is the synthesis of new perovskite materials, combined with advanced spectroscopic characterizations and device/cavity development. This project makes use of recent advances in perovskite optoelectronics to create a new paradigm for electrically pumped perovskite lasers, and will open up new possibilities to revolutionize the current laser technology.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101077842	**SupraModel**	**PE11** Materials Engineering

Principal Investigator:	**Dr Julija Zavadlav**
Host Institution:	TECHNISCHE UNIVERSITAET MUENCHEN - DEU

Peptide-based Supramolecular Co-assembly Design: Multiscale Machine Learning Modeling Approach

Supramolecular self-assembly is a fundamental process abundantly utilized by nature and emerging functional materials technologies ranging from drug delivery to soft semiconductor devices. Recently, an increased focus has been placed on the multicomponent peptide co-assembly as they often display unique emergent properties that can dramatically expand the functional utility of peptide-based materials. Still, the full potential is hindered by the combinatorial complexity of peptide-based materials and our inability to predict the co-assembled structures and, therefore, properties and functionality. Machine Learning models built on top of Molecular Dynamics simulations are ideally suited to decipher the co-assembly behavior. However, the existing molecular models either suffer from severe approximations disabling them to give accurate predictions or are computationally too expensive to transverse the material space. Addressing this trade-off, I aim to develop a computational framework for fast and accurate peptide co-assembly prediction using as a key strategy a multiscale construction of Graph Neural Network-based models that can predict the peptide co-assembly. This innovative approach will enable me to reach the following objectives: (1) obtain unprecedented molecular insight into the peptide co-assembly process inaccessible to experiments, (2) uncover novel candidate materials, and (3) provide rational design rules for multicomponent peptide-based supramolecular materials. In a broader context, increased insight into cooperative behavior will bring us closer to understanding and ultimately synthetically replicating the exceptional functionality of living systems, while the methodological advancements of data-driven molecular modeling will be of paramount importance in other areas of biomaterial engineering and beyond.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101087086	**MIRACLE**	**PE11** Materials Engineering

Principal Investigator:	**Dr Sergio Fernandez Garrido**
Host Institution:	UNIVERSIDAD POLITECNICA DE MADRID - ESP

Quantum-engineered lattice-matched III-V-on-Si multijunction solar cells

Photovoltaics is called to be a main player in the global transformation of the energy sector the world is facing to fight climate change. Multijunction solar cells, based on classical III-V compound semiconductors, are the most advanced photovoltaic cells holding a record photoconversion efficiency of 38.8%. However, the high cost associated to their manufacturing process has typically relegated this technology to non-terrestrial applications in favour of Si cells. On the contrary, single-junction Si cells are cost-effective, but there is almost no room left to further improve their efficiency, which already approaches its theoretical limit, 29.4%. MIRACLE is created to make true a dream of decades: combining the unbeatable efficiency of multijunction solar cells with the cost-effectiveness of Si technology. The ultimate objective of MIRACLE is the demonstration of both double- and triple-junction solar cells based on III-V materials pseudomorphically grown on top of a Si cell, configurations that promise photoconversion efficiencies of up to 43 and 47%, respectively. Quaternary dilute-nitride alloys are the only III-V compounds that can be grown lattice-matched to Si with ideal band gaps for the fabrication of multijunction solar cells in combination with a bottom Si cell. Nevertheless, despite of their well-known potential, reports on dilute-nitride solar cells are rather scarce yet due to their challenging fabrication with the high structural perfection demanded in photovoltaics. The revolutionary idea of MIRACLE is to make use of quantum engineering to fabricate dilute-nitride compounds lattice matched to Si not as thick layers, as attempted so far, but as short-period superlattices by periodically alternating simpler compounds on atomic-layer scale. Hence, MIRACLE does not only aim to push the efficiency of cost-effective Si-based tandem solar cells to their theoretical limits, but also to unveil the physical properties of unexplored quantum heterostructures.

Link to the ERC project webpage: www.erc-miracle.eu

Keywords of the ERC project: III-V compound semiconductors, diluted nitrides, epitaxy, phovoltaics, tandem solar cells

Keywords that characterize the scientific profile of the potential visiting researcher/s: Epitaxy, optical spectroscopy, microscopy, x-ray diffraction, solar cell modelling, semiconductor simulations,

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Project ID:	Project Acronym:	Evaluation Panel:
101088359	**C2C-PV**	**PE11** Materials Engineering

Principal Investigator:	**Dr Ian Marius Peters**
Host Institution:	FORSCHUNGSZENTRUM JULICH GMBH - DEU

Cradle-to-Cradle Design of Photovoltaic Modules

The project cradle-to-cradle design of photovoltaic modules (C2C-PV) will design and build the first photovoltaic module with full cradle-to-cradle (C2C) recyclability. Achieving this goal requires a radically new design framework. Today's photovoltaic modules were not designed for recycling, resulting in a recycling process that is slow and delivers materials of inferior quality. In contrast, C2C-PV will apply the principles of green engineering and techno-economics to create a photovoltaic module with minimal environmental impact over multiple generations and economic viability. Unique to this project is the design of a complex opto-electronic device from scratch according to these principles. The scientific challenge of this proposal is to reconcile durability and separability. Current photovoltaic modules follow a "design for immortality" approach, monolithically integrating solar cells in a module to minimize exposure to the environment. This approach pits durability against separability and is the root cause of all challenges in current photovoltaic module recycling. Highly adhesive interfaces make a clean separation of components slow and challenging at best, and often infeasible. Yet, high throughput and retention of material quality are essential for the economic viability of recycling. The key to resolving this challenge lies in the choice of materials and the design of interfaces. Following the design principles of C2C, the project C2C-PV will only use materials that can be produced and processed in a close-loop manner, avoid toxicity and scarcity, and are material- energy- and capital efficient. Interface design will focus on eliminating unnecessary adhesion and equip all necessary sealing with a mechanism for separation. Perovskite solar cells and photovoltaic modules will serve as a vehicle for demonstrating multigenerational close-loop recyclability. Tracking material-, energy- and capital flow over multiple generations will allow quantifying and op

Link to the ERC project webpage:

Keywords of the ERC project: recycling, solar cells, sustainability

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101096650	**InnovaLEC**	**PE11** Materials Engineering

Principal Investigator:	**Dr Ludvig Edman**
Host Institution:	UMEA UNIVERSITET - SWE

Sustainable light-emitting devices through control of dynamic doping

Artificial illumination is fundamental and ubiquitous in modern society, and the cuArtificial illumination is fundamental and ubiquitous in modern society, and the current large-scale commercialization of more efficient and practical technologies, in the form of LEDs and OLEDs, is therefore important. This development is not only resulting in improved luminaires and displays, but also paving the way for a wide range of applications in, e.g., medtech, security, and communication. However, a growing concern is related to that the fabrication of LEDs and OLEDs consumes large amounts of critical raw materials (CRMs) and energy, and that their recycling is poorly developed and difficult. A novel illumination technology, the light-emitting electrochemical cell (LEC), is in this context interesting, and we and others have recently developed concepts for its material- and energy-efficient and CRM-free printing fabrication and its delivery of efficient emission (although not yet on par with LED/OLED). These combined achievements now pave the way for a timely and important challenge: can the LEC become the first emissive technology that is truly sustainable through its entire lifecycle? We boldly argue that this vision can turn true if we can take control of the defining LEC feature, viz. the dynamic formation of a p-n junction by electrochemical doping. It was recently shown that current LECs suffer from severe quenching of the excitons (the photon precursors formed in the p-n junction) by too-nearby dopants, and we here introduce new insights and methodologies that address this setback through rational design and careful development of new materials. A key task is to tune the mobility of the electronic charge carriers and excitons, through guidelines established by modeling, for the attainment of a sharp p-n junction boundary. We emphasize that our proposed path to high-efficiency LECs does not depend on energy-intense processes or the use of toxic or CRM-based materials.

Link to the ERC project webpage: https://opeg-umu.com/

Keywords of the ERC project: Organic electronics, light-emitting devices, printing fabrication

Keywords that characterize the scientific profile of the potential visiting researcher/s: Organic electronics, light-emitting devices, printing fabrication

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Project ID:	Project Acronym:	Evaluation Panel:
101097856	**unseen**	**PE11** Materials Engineering

Principal Investigator:	**Dr Philippe Lalanne**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Nanostructure-Based Design of Visual Perception using High-Index Disordered Metasurface Physics

The optics of disordered media with subwavelength high-contrast resonant inhomogeneities is a fascinating research topic emerging at the interface between the physics of waves in complex media and nanophotonics. UNSEEN explores and exploits unconventional wave-interference phenomena in disordered metasurfaces towards a new application: the creation of brand-new visual appearance.

Our perception of objects is completely determined by how they scatter light. Color is crucial, but other attributes, such as texture, gloss for reflective surfaces, clarity for transmissive ones, illumination directivity also largely influence appearance. Although this perception plays a key role in virtually all fine and applied arts, appearance engineering has been so far applied only to materials structured at length scales significantly larger than the wavelength; this is because the link between nanostructure morphologies and appearance is very complicated for subwavelength scale resonant inhomogeneities.

UNSEEN bridges, for the first time, the fertile environments of optical metasurfaces and visual appearance in an original and cross-disciplinary way. At the forefront of optical modelling and characterization, we will develop new tools in nanophotonics, which will merge nanoscale electromagnetism, mesoscale multiple scattering, and macroscale ray-tracing rendering. The tools will allow us to understand the complicated relation between morphology and appearance, to harness the manifold degrees of freedom offered by disordered metasurfaces and to discover clues to design novel appearance. We will then use available state-of-the-art nanofabrication and develop new characterization setups to produce and observe metasurfaces with novel appearances, and further study their most promising applications: luxury goods, document security, and head-up display.

Link to the ERC project webpage: https://www.lp2n.institutoptique.fr/equipes-de-recherche-du-lp2n/light-complex-nanostructures

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101097966	**H2Bro**	**PE11** Materials Engineering

Principal Investigator:	**Dr Avner Rothschild**
Host Institution:	TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY - ISR

Continuous electrolytic-catalytic decoupled water electrolysis for green hydrogen production

H2Bro will develop a transformative decoupled water electrolysis process for green hydrogen production. It aims for high efficiency in a continuous and isothermal process that supports membraneless electrolysis with high-throughput and minimal energy losses, going far beyond other electrolysis processes. I propose to achieve these goals by dividing the oxygen evolution reaction into two sub-reactions, electrochemical and chemical ones, carried out in different cells. Towards this end, I propose to use a soluble redox couple that will be oxidized electrochemically while hydrogen evolves at the cathode in one cell, and reduced spontaneously in the presence of a catalyst in a chemical reaction that evolves oxygen in another cell. I have identified the bromide/bromate couple as a promising candidate due to its high solubility and suitable redox potential. Fundamental materials challenges will be addressed in developing the electrolytic process with an aim to achieve high efficiency and selectivity to produce bromate without volatile side products such as O2 or other loss reactions, and a suitable catalyst for spontaneous bromate reduction and oxygen evolution. Addressing these challenges requires a multidisciplinary research in materials science, electrochemistry, catalysis and process engineering, where questions of materials selection and catalyst activity and selectivity intertwine with process parameters such as electrolyte composition, temperature and flow, with an ultimate goal of combining the electrolytic and catalytic sub-processes into a seamless process in a flow system that generates hydrogen and oxygen in different cells at high efficiency and rate. Progress towards these aims will lead the way to a competitive solution for green hydrogen production to fight global warming, and advance the science of catalysts and electrodes for advanced water electrolysis and related technologies.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101097966

Keywords of the ERC project: decoupled water electrolysis; bromide-mediated electrolysis; green hydrogen

Keywords that characterize the scientific profile of the potential visiting researcher/s: electrochemistry; electrocatalysis; electrodes

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101098216	**LUCIOLE**	**PE11** Materials Engineering

Principal Investigator:	**Dr Catherine Dubourdieu**
Host Institution:	HELMHOLTZ-ZENTRUM BERLIN FUR MATERIALIEN UND ENERGIE GMBH - DEU

Layering, Understanding, Controlling and Integrating Ferroelectric Polar Textures on Silicon

Ferroelectric materials have been known, and their fascinating properties exploited for more than 100 years. Still, in recent years, exotic polar textures resembling those found in magnetic materials have been unraveled in nanoscale ferroelectric perovskite oxides, such as flux closure domains, curling polarization, vortices, and the groundbreaking discoveries of polar skyrmions and merons in 2019/2020. Polar textures hold huge promise for novel robust topological electronic devices such as ultra-compact (> Tbit/in2) memories. However, so far, nanoscale polar domains have only been studied on special oxide substrates (e.g. SrTiO3), which precludes practical applications. I propose to take a revolutionary approach to the field of topological polar textures by bringing them to the realm of the Si platform. Not only is this necessary to implement energy-efficient nanodevices, but Si material and advanced CMOS semiconductor technologies offer multiple unexplored ways to engineer mechanical and electrical boundary conditions in ultrathin films and nanostructures of transition metal oxides. With LUCIOLE, I will push the limits in the exploration and future harnessing of emergent states in ferroics with the following objectives: - Create monolithically-integrated topological polar textures on silicon by molecular beam epitaxy and atomic layer deposition of epitaxial and glass-composite nanoscale ferroelectrics using strain, confinement and frustration engineering. - Understand the polar textures created on silicon by combining advanced state-of-the-art correlative microscopies and spectroscopies at the nanoscale, including operando time-resolved methods. - Integrate ferroelectrics at the nanoscale at the front-end- and back-end-of-line of Si chips in sub-500 nm two- and three-terminal devices with tunable stress and study their manipulation under electric field by statistically screening their properties at the wafer scale to unveil potentially rich behavioral patterns.

Link to the ERC project webpage:

Keywords of the ERC project: Ferroelectrics, polar textures, silicon, devices, advanced STEM, modelling

Keywords that characterize the scientific profile of the potential visiting researcher/s: Thin films, Ferroelectrics, piezoreponse force microscopy, devices, X-ray diffraction, scanning transmission electron microscopy, sputtering

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Project ID:	Project Acronym:	Evaluation Panel:
101115925	**EOS**	**PE11** Materials Engineering

Principal Investigator:	**Dr Giuseppe Maria Paternò**
Host Institution:	POLITECNICO DI MILANO - ITA

Engineering of bacteria to see light

EOS wants to create a new class of biohybrid living materials capable to perceive light and perform tasks remotely (i.e. drug delivery in hard-to-reach body locations). I propose to achieve this by inducing light sensitivity into non-photosynthetic motile bacteria at minimum invasiveness and complexity. Based on the notion that the active manipulation of the bacteria membrane potential allows controlling bacterial functions, including motion, EOS challenge is how to trigger effectively a membrane potential dynamics. EOS will employ a materials-based approach that I call "optobacterial-stimulation" and is composed by two key ingredients: i. light as a spatiotemporal precise tool that can control bacteria remotely; ii. phototransducing organic materials that associate spontaneously with bacterial cells without the need for neither covalent attachment nor genetic modification. The phototransducing mechanism stems from the "cross-talking" between molecular excitations and the polarization state of cells. The photoinduced membrane potential dynamics is ultimately linked to ion motive force, and thus to the bacterial flagellar motor. All these abovementioned elements have in common the study of light-matter interaction, which represents my main research interest in the last decade. Using optobacterial-stimulation I will answer to three outstanding questions that are related to each other and shape EOS objectives: i. can we engineer bacteria to perceive light through exogenous phototransducers? ii. are bacteria able to perceive different photostimulation approaches, as dictated by molecular excited states, in terms of membrane potential dynamics and motion? iii. can we understand the relationship between the fate of excited states and bacterial function? In the case study, I will demonstrate phototactic guidance of "eyeless" bacteria that are competent to swim in the gastrointestinal tract, with the view to develop intrinsically bio-compatible microswimmers.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101115925

Keywords of the ERC project: Bioelectricity; bacterial swimmers; membrane potential; electrophysiology; photoresponsive materials

Keywords that characterize the scientific profile of the potential visiting researcher/s: Optical spectroscopy and imaging; microbiology; materials science; physics of living matter; engineering living materials

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101117951	**NanoDep**	**PE11** Materials Engineering

Principal Investigator:	**Dr Daniel Sharon**
Host Institution:	THE HEBREW UNIVERSITY OF JERUSALEM - ISR

Controlling Electrodeposition Processes at the Nanoscale with Well-Ordered Nano-Structured Electrolytes

Even though electrodeposition processes have been used since the nineteenth century, it is remarkably challenging to control their behaviour on the nanoscale. To the naked eye, deposited metal surface appears homogeneous, yet their morphology at the nanoscale is anything but smooth, with ramified metal structures (dendrites) forming on their surface. The utility of electrodeposition for advanced technologies such as NextGen high-energy metal batteries is proportional to our ability to control metal growth at the nanoscale. In theory, this requirement may be accomplished through nanoscale control over ionic processes. Due to lack of appropriate material systems, it appears that examining and validating this hypothesis, much less meeting its requirements, is currently beyond reach. NanoDep envisions a future in which these requirements are met by the development of nano-structured electrolyte systems with well-ordered conductive and nonconductive nanodomains. Our early results suggest that we may be able to completely prevent uncontrolled dendritic formation by designing structured electrolytes that allow nanoscale regulation over local ionic transport processes. The goals of NanoDep are to (1) uncover the behaviour of uncontrolled nanoscale electrodeposition processes within nano-structured electrolytes, (2) prevent them, and (3) apply these newly acquired insights to the construction of a "real-world" system. To accomplish these goals, we will develop a novel in-situ electrochemical platform for investigating the spatiotemporal electrodeposition behaviour in well-ordered nano-structured model electrolytes. The model system insights and guidelines will be translated into "real-world" macroscale batteries using advanced molecular engineering and self-assembly methods. The successful development of well-ordered nano-structured electrolytes represents an important step toward NextGen high-energy metal batteries based on fully regulated electrodeposition processes.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101124721	**EpiC**	**PE11** Materials Engineering

Principal Investigator:	**Dr Fabian Meder**
Host Institution:	SCUOLA SUPERIORE DI STUDI UNIVERSITARI E DI PERFEZIONAMENTO S ANNA - ITA

Epicuticular electrification: spontaneous charging of materials at the world's largest bio-air interface

The materials on the outer plant surface create the world's largest bio-air interface. Invisibly, this surface spontaneously charges when hit by raindrops and solid materials. This is due to contact electrification, a phenomenon used in technologies like printing and energy harvesting. Yet, extraordinarily little is known about its role in nature and how biosurfaces charge. EpiC will target two exciting and unresolved questions: a) can one exploit the generated charges to power high-tech devices at the leaf-air interface? and b) how is the organism affected by the electric fields generated on the outer leaf surface? The core of EpiC is thus a detailed surface analysis to gain the highest resolved insights in solid and liquid contact electrification of biosurfaces. To achieve this, I will combine studies of materials surface charging, chemical, and topographical analyses with observations of cellular responses, plant growth, and adaptation. This data set will then indicate how to engineer material systems named 'artificial leaves' that can be installed on the plant leaf or sprayed on it to harvest the contact charges for technical purposes. EpiC will eventually enable energy harvesting, environmental and plant health sensing, communication with robots, and electrocatalytic reactions - autonomously driven by electricity and reactants from the leaf environment. Moreover, I will develop additional features in the materials of the artificial leaf to specifically protect the plant and to boost its growth during energy harvesting. The result of EpiC will be new insights into contact charging of materials in nature, its effect on plant life, and a ground-breaking, energy-autonomous, and sustainable technology platform for the world's most significant bio-air interface with cross-disciplinary impact in materials science, environmental sensing and robotics, smarter agriculture, and plant-based bioelectrochemical systems.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101125962	**EnVision**	**PE11** Materials Engineering

Principal Investigator:	**Dr Ferry Prins**
Host Institution:	UNIVERSIDAD AUTONOMA DE MADRID - DEU

Engineered carrier transport in nanostructured semiconductors using functional disorder.

Disorder is generally considered to have a purely negative impact on carrier transport and most efforts aim to minimize it. However, recent studies suggest that disorder may enhance carrier transport via carrier funneling along energetic gradients or promote carrier interconversion at defect sites. Critically though, before disorder can be exploited for improved optoelectronic performance of nanomaterials, a better understanding of the relationship between disorder and transport is needed. EnVision aims to build a bridge between fundamental observations of the benefits of disorder and materials engineering. To enable this, I have designed a two-fold strategy focussed on 1) defining the detailed design rules for the rational design of disorder driven carrier transport and interconversion, and 2) develop strategies to engineer the local energy landscapes of nanostructured semiconductors that boost carrier transport and interconversion. To enable the definition of the detailed design rules, I will take the crucial step of developing Hyperspectral Transient Microscopy – the first super-resolution technique capable of simultaneously visualizing the transport of carriers in space, time, and energy. Using metal-halide perovskites as a versatile testbed, EnVision will make critical advances beyond the current state-of-the-art in promoting carrier transport along compositional gradients, boost carrier interconversion at local dopants site, and the creation of on-demand energy landscapes using nanoindentation. Through its unique approach, EnVision will introduce the concept of functional disorder, paving the way for new formalisms nanomaterial engineering and guiding the realization of fully optimized energy landscapes for optoelectronic and photonic technologies.

Link to the ERC project webpage: www.ferryprinslab.com

Keywords of the ERC project: energy transport, perovskites, disorder

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101141472	**STOREHEAT**	**PE11** Materials Engineering

Principal Investigator: **Dr Ange Nzihou**

Host Institution: INSTITUT MINES-TELECOM - FRA

Innovative and sustainable carbon-based composites for high temperature sensible thermal energy storage

Although affordable solutions exist to store and recover heat from low temperature sources, the high temperature ones (> 550 °C) such as the concentrated solar and waste heat from high temperature energy intensive industries remain challenging since efficient and affordable storage materials are scarce. The waste heat from these industries is huge and corresponds to 16% (122 Terawatt hours) of the total heat consumption/year in Europe.

STOREHEAT targets the investigation of an outstanding and novel family of High Storage Capacity materials, namely Calcium Carbide-based Composites (3C), for High Temperature Heat Storage. 3C is produced at much lower temperature (1000 – 1200 °C) than the current solutions (1800-2500 °C) based on silicon carbide (SiC) ceramics from fossil source (coke) mainly. 3C is synthesized by carbonization of calcium rich biochar and have not yet been mentioned in the literature neither for high temperature storage nor the mechanism of their formation explored. Preliminary synthesis attempts showed a high temperature storage capacity for 3C of 20% higher than that of SiC while consuming much less energy and using sustainable resources for its production. The scientific breakthrough lies on the counter-intuitive and pioneering approach proposed to combine and stabilize the hierarchical carbon and metal species both from biochar to take advantage of their respective high thermal conductivity and heat capacity at high temperature. This seemingly winning combination, key for effective heat storage has never been done before. To achieve this objective, I propose an ambitious research approach combining in-situ and dynamic experimental methods and modelling to unlock the mechanisms governing the chemical phases assemblage and stabilization of 3C. The storage performance will be evaluated and optimized.

The findings will push a way beyond the frontier of knowledge and broaden research opportunities in scientific communities interested in energy storage.

Link to the ERC project webpage:

Keywords of the ERC project: Decarbonization, Heat storage, Biomass, graphitic biocarbon, synchrotron and light source, thermomechanical properties

Keywords that characterize the scientific profile of the potential visiting researcher/s: modeling, thermal treatments, advanced chemical characterization of solids, carbon materials

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101160604	**MEMBRAIN**	**PE11** Materials Engineering

Principal Investigator:	**Dr Gianluca Milano**
Host Institution:	ISTITUTO NAZIONALE DI RICERCA METROLOGICA - ITA

Memristive self-organizing dendrite networks for brain-inspired computing

Artificial Intelligence needs a hardware revolution to sustain the ever-growing demand of computing power in our society, where the huge energy consumption and environmental impact of computation with current technologies is unsustainable. In the race toward future computing, bioinspired technologies have been shown as promising hardware solutions for computing beyond the Turing model and the classical von Neumann architectures. Going beyond transistor-centred hardware solutions, the research community is exploring new device concepts and architectures that leverage physical phenomena for computing "in materia" with physical laws to emulate the effectiveness of information processing capabilities of our brain. While arrays of memristive devices realised with a top-down approach represent emerging solutions for the hardware realisation of artificial neural networks, these systems do not emulate the topology and emergent behaviour of biological neuronal circuits where the principle of self-assembly and self-organisation regulates both structure and functions, providing adaptability, efficiency, and robustness. Tackling main challenges of neuromorphic computing, the MEMBRAIN project aim to develop a radically new concept of physically grounded computing nanoarchitecture based on self-organising memristive nanonetworks of dendrites, able to efficiently process information and to store knowledge on the same physical substrate at the matter level through physical laws. Overcoming the concept of nanotechnology as a simple advancement of microtechnology, the ambition is to compute like nature – thermodynamically – to push computation near fundamental limits of efficiency. By establishing a hardware-software codesign framework at the crossroads of material science, machine learning and neuroscience, the aim is to retarget the original goal of neuromorphic computing of creating general-purpose truly intelligent systems that endow dynamic learning and multitasking capability.

Link to the ERC project webpage: https://membrain-eu.com/en/

Keywords of the ERC project: Neuromorphic computing, physical computing, memristive devices, memristor, dendrites, electronics

Keywords that characterize the scientific profile of the potential visiting researcher/s: physical computing, memristive devices, memristor

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Project ID:	Project Acronym:	Evaluation Panel:
101161287	**DISCO-DATA**	**PE11** Materials Engineering

Principal Investigator:	**Dr Markus Stricker**
Host Institution:	RUHR-UNIVERSITAET BOCHUM - DEU

Hard work, plastic flow: a data-centric approach to dislocation-based plasticity

Metals as structural materials are at the core of our society. Almost everything we physically interact with includes some form of metal manufactured to specific properties and formed into a desired shape. Consequently, the understanding and design of the balance between ductility and strength of metals are one of the primary disciplines of materials science. On a fundamental level, this is the description of crystalline line defects called dislocations. At the atomic scale, the current understanding of dislocations is often on the level of individual dislocation properties. At the component scale, collective behavior is commonly formulated in continuum variables with the drawback of limited applicability over a wide range of possible scenarios. Our current understanding still shows a gap in how individual dislocation properties translate into their collective behavior. To address this long-standing question, I propose a data-centric approach. First, a comprehensive dataset of dislocation ensemble trajectories for various loading and initial conditions is created using discrete dislocation dynamics as well as molecular dynamics simulations and iteratively extended. The trajectories are subsequently analyzed with tools borrowed from graph theory and time-series analysis to capture the network character of dislocation structures. Subsequently, a novel class of plasticity models is developed: instead of human-derived state variables, I will `let the data speak for itself' to bridge the gap between individual and collective dislocation behavior. The project solves two timely challenges in materials science: One is the described gap, and the other is a demonstration of effective research data management of complex materials data providing solutions to data generation, storage, accessibility, data fusion, reuse, and analysis using the example of dislocation trajectories.

Link to the ERC project webpage:

Keywords of the ERC project: dislocations, data science, plasticity

Keywords that characterize the scientific profile of the potential visiting researcher/s: machine learning, plasticity, dislocations

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Project ID:	Project Acronym:	Evaluation Panel:
101161795	**5D-Neuro**	**PE11** Materials Engineering

Principal Investigator:	**Dr Menahem Rotenberg**
Host Institution:	TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY - POL

5D Electro-Mechanical Bio-Interface for Neuronal Tissue Engineering

The cellular microenvironment is tightly regulated by biochemical and physical cues. While state of the art electrical and mechanical devices can perturb the biophysical cell niche in 2D monolayers, 3D tissue cultures are considered a much more comprehensive and representative model of the in vivo microenvironment. However, the available biomodulation "toolkit" does not meet the required level of complexity, specificity, and accuracy. This limitation hinders the ability to address basic questions in brain research and to develop new nonpharmacological interventions such as next generation neuroengineering-technologies and biointerfaces. We propose to develop a novel biomaterial for nongenetic leadless electrical and mechanical biomodulation in 3D engineered tissues. The leadless electrical biomodulation will be induced via optical illumination of semiconducting silicon micro- and nanostructures, which will potentially yield spatial resolution of hundreds of nanometres, two orders of magnitude smaller than the current state-of-the-art 3D biointerfaces. The mechanical perturbation will be achieved by spatially defined iron microstructures that will be manipulated via spatially homogenous magnetic fields, resulting in mechanical perturbation resolution down to few microns, which is unprecedented in 3D tissue constructs. Lastly, we will integrate the two materials into a single 3D platform to construct the 5D-NEURO, allowing leadless electrical and mechanical bi-modal perturbation simultaneously and independently. Herein, we will both establish a new tool for biophysical modulation and generate new fundamental knowledge about the role of bioelectrical, biomechanical, and their synergistic effect on neuronal growth and regeneration in 3D models. Moreover, such a platform lays the ground for next generation engineered tissues for applications spanning from fundamental brain developmental research and future translational clinical interventions.

Link to the ERC project webpage:

Keywords of the ERC project: Optoelectronic, magnetic, modulation, neuroengineering

Keywords that characterize the scientific profile of the potential visiting researcher/s: Neuroscientist, neuroengineer, material scientist

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101162914	**TREAT**	**PE11** Materials Engineering

Principal Investigator:	**Dr Eva Arianna Aurelia Pogna**
Host Institution:	CONSIGLIO NAZIONALE DELLE RICERCHE - ITA

Taming Radiative heat Emission with Anisotropic and Time-varying media

Thermal emission is a fundamental and ubiquitous process of energy and entropy transport, impacting science and engineering in various way. Yet, its stochastic nature, expressed in a broadband spectrum, lack of polarization and directionality, severely limits its control and manipulation.

TREAT aims at introducing a novel method for engineering the radiative heat transport and achieving unprecedented dynamical control over the spectrum and the momentum of thermal radiation.

To achieve this goal, I propose to combine two classes of emergent materials: time-varying epsilon-near zero (ENZ) media and hyperbolic materials (HMs). The time modulation of ENZ media will allow to overcome the fundamental limits to thermal emission set by the Planck's and Stefan-Boltzmann's laws and achieve active control over its properties. While the HMs, will enable to extract and guide the intense thermal radiation confined at the emitter surface, i.e., in its near-field.

TREAT objectives address three intriguing questions: i) Can we create a time-varying media with ad hoc time modulation? ii) Can we manipulate thermal emission beyond the Planck's law using the time-modulation? iii) Can we improve our control of the radiative heat flow in the near-field? Answering these questions requires the combination of expertise in nanophotonics and ultrafast science and perfectly suits my scientific profile.

TREAT specifically targets the thermal emission engineering in the transparency window of Earth atmosphere, relevant for radiative cooling, and the development of novel coherent thermal sources in the THz range. TREAT will provide a fundamental advance to our understanding of thermal fields, beyond fluctuational electrodynamics, and a novel method for engineering the radiative heat flux, anticipating significant impacts in several applications of thermal light that would benefit from the active control of its properties, such as radiative cooling, energy harvesting, and optoelectronics.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101163419	**DynanoNet**	**PE11** Materials Engineering

Principal Investigator:	**Dr Tobias Benselfelt**
Host Institution:	KUNGLIGA TEKNISKA HOEGSKOLAN - SWE

Adaptive Separation using Dynamic Nanofibril Networks

This research program will develop materials, methods, and technologies that enable adaptive separation of molecules and particles using dynamic nanofibril networks. The ground-breaking nature is the development of dynamically tunable membranes/gels for next-generation separation technology.

Current separation technologies are based primarily on polymeric membranes or gels for membrane filtration or chromatography. Membrane filtration is versatile but lacks selectivity, while chromatography is selective but with limited throughput. As pharmaceutical companies move toward protein or nanoparticle-based therapies, the size limitation of chromatography is a concern. The future separation technology should be adaptive and selective, with high resolution and throughput. It is time to develop next-generation separation technology that enables dynamic adaptability and integration with our electronic infrastructure and AI technology.
Hydrated nanofibril networks with unique nanomechanical behavior, a vast dynamic density range, and large pore sizes enable tunability that polymer networks cannot achieve. It is an unexplored class of materials for separation purposes, now available at scale due to recent cellulose and amyloid nanofibrils developments. Nanofibrils assemble in anisotropic hydrogel networks with a uniaxial swelling, ranging from 0 to 1000 g/g water content with pore sizes from a few to 1000 nm. I will study how different pretreatments or stimuli, such as electrochemistry, enable direct control of this 1000-fold change in pore size, which is unachievable for polymers. I will explore different modes of separation: centrifugation, filtration, electro-filtration, and ion-selectivity, using nanofibril networks as an adaptive mesh to sieve/repel molecules and particles of different sizes and charges. The outcome is a scientific foundation exploring how low-density nanofibril networks can lead to disruptive separation technology in a multi-billion-dollar industry.

Link to the ERC project webpage:

Keywords of the ERC project: Nanofibril networks

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101163768	**SYNNEURON**	**PE11** Materials Engineering

Principal Investigator:	**Dr Jan Steinkühler**
Host Institution:	CHRISTIAN-ALBRECHTS-UNIVERSITAET ZU KIEL - DEU

Bottom-up assembly of synthetic neural networks from biological matter

The long-term objective of my lab is the construction of "synthetic" neural networks from biological matter. In this way, we not only will understand how to build sustainable computing architectures but also provide a novel bottom-up approach towards understanding biological neural networks. To make progress in this direction, I ask: What is the minimal assembly of biological components that allows for bio-realistic electrical information processing? Clearly, voltage-sensitive ion channels form the molecular basis for electrical spiking activity in neuronal networks. However, spatial propagation of spikes is not a property inherent to individual ion channels but rather emerges from the arrangement of ion channels along a tubular lipid membrane, the axon. While the reconstitution of functional ion channels outside of living cells has been well established, the propagation of an action potential along a lipid bilayer nanotube has not yet been shown. Similarly, the physical realization of larger, non-living spiking networks using biological matter remains elusive. Here, I propose to move forward from the state-of-the-art by a) Studying action potentials propagating along lipid nanotubes and demonstrating their electrical cable and spiking characteristics b) Understanding the coupling between membrane elasticity and electrical characteristics and how electromechanical coupling remodels and reshapes membranes and nanotube networks. c) Exploiting these remodeling, reshaping, and self-healing abilities for biomimetic molecular mechanisms of information processing. This research is a challenge of enormous complexity. In this proposal, I argue that this challenge can be overcome using recent methodological advances. My preliminary data and my research experience combing electrical engineering, biophysics and synthetic biology will enable this leap in our understanding and design of biological neural networks.

Link to the ERC project webpage: https://www.uni-kiel.de/de/tf/forschen/institut-etit/bio-inspired-computation

Keywords of the ERC project: synthetic biology neuromorphic computing ion channels neurons

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101170477	**ULTRATWISTROICS**	**PE11** Materials Engineering

Principal Investigator:	**Dr Jose Lado**
Host Institution:	AALTO KORKEAKOULUSAATIO SR - FIN

Engineering ultra-quantum materials with multiferroic super-moiré heterostructures

The groundbreaking objective of this proposal is to engineer a quantum material with super-moiré heterostructures, realizing an electronic state never observed in nature and required to build a universal topological quantum computer. Building universal topological computers, whose building blocks rely on a controllable fractional topological state, is beyond any current capability. Engineering the required quantum materials requires complete control over the electronic state and interactions, a task currently impossible with any current compound. Twisted van der Waals materials have become a highly tunable materials platform to explore exotic electronic phenomena. Here, using van der Waals heterostructures, I will design the required material to build a universal topological computer: a material featuring non-abelian Fibonacci anyons. I will achieve this by exploiting two novel strategies: the design of super-moiré hosting coexisting orders and their control via the proximity effect of multiferroic encapsulation. To tackle this challenge, I will combine well-tested and novel methodologies. In particular, I will develop three novel methodologies with wide impact: an ultra-long range formalism to tackle moiré-of-a-moiré, entanglement extraction from local dynamical impurity tomography, and neural-network solvers for fractional matter. The path to achieving these goals will allow me to create and control fractional Chern states, extract electronic entanglement with scanning tunnel microscopy, and establish a novel physically constrained many-body solver, each a milestone of exceptional interest in quantum materials engineering. I will reveal potential routes to realize and identify physics never found in nature, alongside providing methodologies of wide impact. This proposal will lead to a breakthrough in quantum materials engineering, ultimately providing the building blocks required for a van der Waals-based universal topological quantum computer.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101171002	**Polyvir**	**PE11** Materials Engineering

Principal Investigator:	**Dr Samuel Jones**
Host Institution:	THE UNIVERSITY OF BIRMINGHAM - GBR

Biocompatible Polymer Virucides for a One Health World

We are in a constant and ever evolving battle with viruses. Our only defence are vaccines or antivirals. Both are typically developed in response to viral outbreaks meaning that any defence we mount is reactive and not proactive. Despite the clear need for improved interventions against viruses, there is a lack of innovation, novel materials, targeted approaches and systematic studies. Building on my experience in extracellular antivirals, I have recently identified a series of star polymer materials that display low toxicity (both in vitro and in vivo), can be produced cheaply at scale, and are potent broad-spectrum virucides (in vitro and in vivo). This seminal finding represents a significant leap forward in the development of biocompatible virucides, and with investment in their development, they will be ready for future viral outbreaks. POLYVIR will push the boundaries and expand the synthetic space of these biocompatible virucides by implementing high-throughput, oxygen-tolerant polymerisation, combined with liquid-handling robots, to create libraries of polymer virucides. To screen this unprecedented number of antiviral samples, high- throughput, cell-free, virucidal assays and techniques will be developed and then implemented, enabling screening of a range of structure-property relationships and expanding the scope and breadth of these virucides. Expansion to include glycol-polymers will allow for a truly pan-viral biocompatible virucide to be produced. To prevent animal pandemics, we will also focus on improving their activity window by enabling activity in high-protein and/or low-temperature environments. Our potent virucidal polymers will be applied as coatings to engineer surface properties of a range of materials to create long-lasting broad-spectrum antiviral surfaces and textiles. This project will consolidate my research at the forefront of extracellular antivirals globally and produce the next generation of scientists in this globally relevant fie

Link to the ERC project webpage:

Keywords of the ERC project: Antivirals, disinfectants, polymers, high-throughput

Keywords that characterize the scientific profile of the potential visiting researcher/s: Chemists, polymer chemists, virologists

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Project ID:	Project Acronym:	Evaluation Panel:
101171793	**SelfEnergyDriver**	**PE11** Materials Engineering

Principal Investigator:	**Dr Clara Rodrigues Pereira**
Host Institution:	REQUIMTE REDE DE QUIMICA E DE TECNOLOGIA ASSOCIACAO - PRT

3-in-1 Self-Powered Hybrid Energy-Driven Wearable Technologies: Unifying Energy Harvesting and Storage

In the landscape of wearable electronics, there is a demand for self-powered systems to address the challenges posed by discontinuous and limited power supply. Low-grade heat and moisture are two ubiquitous clean energy sources with great potential for electrical energy production. 2-in-1 technologies combining thermal or moisture-induced energy harvesting (EH) with electrochemical energy storage (ES) are attractive self-charging solutions for wearables. However, their performance remains inconsistent and unsteady. The understanding of the underlying EH and ES mechanisms remains fragmented, without considering synergistic opportunities. SelfEnergyDriver proposes a PIONEER HYBRID textile technology UNIFYING moisture-triggered EH, thermal EH and supercapacitive ES. This groundbreaking 3-in-1 concept aims for the self-sustained harvesting of two clean energy sources and simultaneous in situ storage of the captured energy. Non-toxic multifunctional hybrid electrode nanomaterials with 3D porous architecture, redox-active nature and precisely engineered moisture permeability, thermal and electrochemical properties will be developed to comply with all EH/ES requirements. These hybrids will be incorporated in textiles and assembled with advanced redox-active ionic hydrogel polyelectrolytes in innovative device architectures. SelfEnergyDriver will delve into the intricacies of electrodes, electrolytes, and their interfaces, to guide the rational design of these trailblazing technologies and foster cooperative effects for synergistically-enhanced outputs. The supreme goal will be bridging the knowledge gap between electrode/electrolyte properties, interface phenomena, device architecture and performance. As a proof-of-concept, the 3-in-1 technologies will be tested under simulated real-world conditions, to showcase their potential to revolutionize the landscape of wearable energy systems. The acquired knowledge will set new landmarks in clean energy, textronics and sensing.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101171793

Keywords of the ERC project: Functional and hybrid nanomaterials, energy storage, energy harvesting, smart textiles, energy technologies

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101116659	**Greta**	**SH1** Individuals, Markets and Organisations

Principal Investigator:	**Dr Lassi Ahlvik**
Host Institution:	HELSINGIN YLIOPISTO - FIN

Green tax reform for a just climate transition (GRETA)

The European Union's ambitious climate policies will have wide-ranging distributional impacts in societies. Yet, it is poorly understood how to mitigate the adverse impacts and how compensation mechanisms can be designed to allocate funds to those most in need. GRETA introduces an integrated approach for climate policies and inequality, and will increase our understanding on how to reach climate targets equitably. In the theoretical part, we characterize a green tax reform that creates sufficient incentives to cut emissions, generates public revenue for the green transition, and ensures that costs are fairly distributed across the society. Individuals hold private information about their productivity and abatement costs. In this setting, income taxation and carbon pricing are not separable and, strikingly, effective carbon prices should vary by income-level. The theory shows that the optimal tax design depends on a limited set of sufficient statistics, including: (1) carbon price incidence per income group, (2) emission semi-elasticity per income group and (3) individuals' perception of within- and across-income inequality. In the empirical part, we quantify these sufficient statistics (1)-(3) using price variation created by the Energy Crisis of 2022 and a rich administrative data covering all Finnish firms and individuals. First, we estimate the within- and across-income inequalities created by the sudden rise in electricity prices and, using plausibly exogenous ending dates of fixed-term contract, estimate the individual-level emission semi-elasticities. Second, we study how the energy price spikes contribute to inequality though their different impacts on firm owners and workers, where our identification is based on a shift-share instrument approach. Third, we study the fairness perception by a large-scale survey where responses are linked to the administrative data. These empirical findings allow us to quantify the optimal tax design numerically.

Link to the ERC project webpage:

Keywords of the ERC project: Economics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101162903	**ECHO**	**SH1** Individuals, Markets and Organisations

Principal Investigator:	**Dr Roee Levy**
Host Institution:	TEL AVIV UNIVERSITY - ISR

Echo Chambers: Online Segregation, Mechanisms, and Consequences

The internet and social media dramatically transformed the news landscape. The abundance of online news options, recommendations of social media algorithms, and changes in news production may have segregated individuals into echo chambers, environments where people mostly consume like-minded news. Such echo chambers could exacerbate polarization, distort perceptions of reality, and threaten democracy. However, a gap remains between these grave concerns and the limited evidence on echo chambers. A critical challenge is that research is typically conducted at the outlet level. Focusing on outlets rather than individual articles may underestimate segregation as individuals today consume specific articles from many outlets. This project will analyze the demand and supply of news at the article level to provide new insights regarding the origins, extent, and implications of online echo chambers. The project consists of three parts. First, I will create a new dataset of the slant (political leaning) of millions of articles using high-resolution data, expert ratings, and advances in large language models. I will use this dataset to provide the first estimate of online segregation based on the slant of articles. Second, instead of fixing the set of articles and analyzing consumer behavior, I will fix the audience and analyze how outlets tailor articles to their consumers, and whether this increases segregation. I will complement the descriptive estimates of how outlets distribute news with a casual analysis of whether the internet and social media affect the news that outlets produce. Third, I will elicit individuals' willingness to pay for various articles and causally estimate how the articles people typically avoid affect their attitudes when they are consumed. I will use these estimates to decompose the relative importance of two theories for how news polarizes attitudes: differences in preference for like-minded news and heterogeneity in the effects of news.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council Executive Agency Established by the European Commission	Project ID:	Project Acronym:	Evaluation Panel:
	101165373	**DynamicInfoAsym**	**SH1** Individuals, Markets and Organisations

Principal Investigator:	**Dr Esat Doruk Cetemen**
Host Institution:	LUISS LIBERA UNIVERSITA INTERNAZIONALE DEGLI STUDI SOCIALI GUIDO CARLI - ITA

Dynamic Markets with Information Asymmetries: Strategic and Non-Strategic Information Transmission

This proposal aims to advance our understanding of information transmission in dynamic markets by examining two specific scenarios: (i) information transmission by strategic agents and (ii) information transmission by algorithms. Its core focus revolves around the analysis of competition in dynamic markets with asymmetric information. The proposal encompasses both positive and normative analyses, offering insights into the ongoing discourse on predatory and algorithmic pricing.

The project comprises three ambitious tasks:

The first part develops a state-of-the-art theoretical workhorse model. Unlike the previous literature, it does not follow the "reputation" approach, which assumes the existence of a type committed to playing specific behavior. Instead, it adopts a fully strategic model, which, in turn, enables a thorough examination of the impact of policy and regulatory decisions on consumer welfare or market efficiency in a variety of markets since the equilibrium predictions do not depend on the endogenously specified behavioral types.

The second part showcases the applications of the tools developed in Part 1 across different environments and how the resulting insights can inform policy debates on regulation. When applied to dynamic limit pricing, the model reveals a novel tradeoff: strategic delay. Entrants may opt to delay their entry decisions to gather more information about market conditions, which potentially could lead to a decrease in consumer welfare. This suggests that antitrust policies should also consider strategic delay, rather than solely focusing on the occurrence of entry when deciding whether limit pricing negatively affects consumers or not.

The final part of the project examines decisions made by algorithms rather than strategic agents and draws comparisons with Part 2. This part holds the potential to contribute significantly to the regulation of Artificial Intelligence, particularly within the framework of the EU AI Act.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101170766	**LCCED**	**SH1** Individuals, Markets and Organisations

Principal Investigator:	**Dr Sam Asher**
Host Institution:	IMPERIAL COLLEGE OF SCIENCE TECHNOLOGY AND MEDICINE - GBR

Long-run Cultural Change and Economic Development: Evidence from 100 Years of Ethnographic Data in India

Culture—a set of socially transmitted beliefs and values—is increasingly discussed as a major driver of economic development. Cultural factors such as trust of strangers and gender norms shape, and are shaped by, the nature of economic activity. Yet economic research on the relationship between culture and development has been constrained by the lack of long-run data on cultural change. My ERC CoG develops an ambitious research agenda on the two-way relationship between economic development and culture. I will create an unprecedented quantitative panel dataset describing the long-run evolution of cultural norms across India's 4635 endogamous social groups by digitizing thousands of ethnographic reports produced by the Anthropological Survey of India between 1880 and 1990. I will match them to modern survey data to study the relationship between group-level cultural norms and individual behavior. My research group has already assembled the inputs for this project and proven that large language models like GPT4 can be used to extract standardized data from these ethnographies. This proposal builds on a research agenda and data science toolkit that I have been developing over the past fifteen years. I will generate three major sets of outputs: 1) The world's first long-run, large-scale panel dataset on cultural change: standardized data on hundreds of norms across 4635 social groups covering 100 years. To grow the community of scholars working on culture and development, I will make the data open source and I will write a paper describing these data and the text-as-data tools I will develop. 2) Evidence on how culture shapes economic opportunity: two papers will focus on the impacts of cultural capital and cultural diversity shape opportunity, cooperation, and segregation. 3) Evidence on how economic change—in the forms of urbanization and climate change—affects long-run cultural evolution, and how cultural context shapes responses to economic challenges.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: An expert in text-as-data working on economics of culture and/or urbanization

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101044069	**PARTISAN**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Markus Wagner**
Host Institution:	UNIVERSITAT WIEN - AUT

Partisan Prejudice: Origins, Consequences and Remedies in European Multiparty Democracies

Partisan prejudice exists when citizens hold negative attitudes towards party supporters. Such prejudice is widespread: many people have stereotypical views of and dislike the supporters of certain parties, sometimes amounting to outright partisan hostility. Partisan prejudice is a challenge for liberal democracy. It deepens societal rifts, lowers social trust, weakens the acceptance of elite compromise and leads to discrimination and social ostracism. This challenge is urgent at a time of political division and democratic backsliding. Yet, partisan prejudice is barely studied, particularly in Europe. PARTISAN will provide a novel theoretical framework and rigorous empirical evidence for understanding partisan prejudice, with the ambition of fundamentally altering how voters and parties are studied in multiparty systems. The theoretical framework posits that objective characteristics of party supporters form the basis of partisan stereotypes, but that these linkages are filtered through individual perceptions and moderated by party- and country-level characteristics. Based on this framework, this project will provide ground-breaking evidence on the prevalence and origins of partisan prejudice and assess its political and societal consequences, including for political participation, discrimination and social cohesion. PARTISAN will also provide political and societal actors with evidence on three ways to reduce partisan prejudice: interparty contact, recategorization and social norms. PARTISAN will implement new measurement tools in a new twelve-country survey and in experiments conducted in population-based surveys and in the field. Innovative experimental designs will be used to rigorously assess the origins and consequences of partisan prejudice, as well as potential remedies. Studying a little-studied phenomenon using diverse methods, PARTISAN will significantly extend our knowledge of partisan prejudice, what effects it has and how its impact can be minimized.

Link to the ERC project webpage:

Keywords of the ERC project: polarization, political identities, partisanship, affective polarization, stereotypes

Keywords that characterize the scientific profile of the potential visiting researcher/s: experiments, surveys, polarization, identities

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101044852	**IMPACTUM**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Clara Burbano Herrera**
Host Institution:	UNIVERSITEIT GENT - BEL

ASSESSING THE IMPACT OF URGENT MEASURES IN PROTECTING AT-RISK DETAINEES IN LATIN-AMERICA

Urgent Measures (UMs) are granted by international human rights (HRs) bodies to protect persons in a situation of extreme gravity/urgency. In Latin America, UMs are mostly granted to protect detainees, when their right to life, integrity and/or health are in danger of being violated. When a UM is granted, the state is requested to provide detainees with e.g. immediate access to medical care, drinking water, or sanitation. In such cases, UMs may prompt emergency protective actions that can, in the most extreme circumstances, save the life of the beneficiary of these measures. Though UMs have been issued on thousands of occasions, they have attracted little academic attention. The few studies that exist focus on a doctrinal analysis on compliance. Such studies have several shortcomings in that they primarily examine only procedural legal aspects, and often excessively rely on information provided by HRs bodies themselves. As UMs often face practical, financial and political constraints that shape and limit their implementation, it is crucial to establish a better understanding of how these measures are applied in practice. IMPACTUM moves beyond the traditional legal research questions and methods of analysing UMs. It instead proposes an interdisciplinary study of UMs that: 1) considers the context in which UMs are enforced and how they are applied on the ground; 2) assesses the impacts of UMs on detainees, legal/institutional systems and (inter)national actors; 3) discusses their strengths/limitations; 4) analyses their wider learning effects. With reference to UMs granted by 4 HRs bodies to protect at-risk detainees in 6 Latin American countries, IMPACTUM will develop a critical normative impact framework useful to provide a deeper theoretical analysis, as well as insight into how to formulate UMs to maximise their practical protective effects. IMPACTUM will thus uncover and present new knowledge on emerging issues with UMs that are currently unaddressed in academia.

Link to the ERC project webpage: https://www.humanrightsincontext.be/copy-of-research

Keywords of the ERC project: Human Rights, Persons Deprived of Liberty, vulnerable groups

Keywords that characterize the scientific profile of the potential visiting researcher/s: human rights

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101045653	**CRITICALTRUST**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Tom Van Der Meer**
Host Institution:	UNIVERSITEIT VAN AMSTERDAM - NLD

Healthy or harmful distrust? On the democratic relevance of political scepticism over blind (dis)trust

Paradoxically, representative democracy requires not only citizens' trust in the institutions of democracy, but also a healthy dose of political scepticism towards these institutions. Scholars have warned against the detrimental effects of blind trust and blind distrust. The former would make citizens susceptible to manipulation, the latter to alienation. By contrast, (dis)trust that is not blind but evaluative stimulates vigilant civic engagement. While blind (dis)trust would lead to an anomic democracy, evaluative (dis)trust would stimulate democratic reinvigoration and accountability. We should therefore not merely distinguish between political trust and distrust, but also between dispositional/blind and evaluative (dis)trust. However, empirical studies of political trust focus almost exclusively on the level of trust. The standard political trust survey items cannot distinguish blind (dis)trust from evaluative (dis)trust. This vast lacuna at the heart of political trust research left the major questions in the field unanswered: on the trends, causes, and consequences of political trust. CRITICALTRUST addresses this fundamental problem. It first develops a novel, two-dimensional model of political (dis)trust, and creates new measures that distinguish blind from evaluative (dis)trust. This model and these measures will be the foundation for primary data collection (large-N survey + experiments). The survey is designed as a three-wave, cross-national panel survey in 8 European countries: Estonia, France, Germany, Hungary, the Netherlands, Portugal, Sweden, and the United Kingdom. Both the survey's panel element and the experiments allow us to systematically test causal effects that have long been proposed in the literature. CRITICALTRUST thereby answers questions that plagued political trust research for decades. It will offer diagnoses of the risks of low and declining trust, and advice to democratic actors whether and how to stimulate political trust.

Link to the ERC project webpage:

Keywords of the ERC project: political trust, skepticism

Keywords that characterize the scientific profile of the potential visiting researcher/s: quantitative, public opinion, democracy

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101054122	**SYNCPOL**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Klaus Goetz**
Host Institution:	LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN - DEU

Synchronised Politics: Multiple Times and Political Power

Democratic policy-makers in Europe's multi-level system grapple with multiple times, since different levels of government, parliaments and administrative agencies follow distinct time rules and time preferences. Time clashes are an ever-present threat. Synchronisation is, therefore, a critical, but very little understood dimension of public policy-making. It is designed to avoid systematic time clashes by structuring the timing, speed, frequencies, sequences, durations and time horizons in policy-making. Over the past decade, simultaneous demands for "faster action", "more time" and "extended time horizons" have pushed multi-level synchronisation in opposing directions. In light of major contestation around synchronisation, SYNCPOL asks: 1) What happens when political demands for "faster action", "more time" and "extended time horizons" challenge synchronisation arrangements in multi-level policy domains? 2) How does the reshaping of synchronisation arrangements alter the vertical and horizontal distribution of political power amongst governments, parliaments and administrative agencies and the types of power in Europe's multi-level system? Drawing on institutionalist theory, SYNCPOL conceptualises synchronisation arrangements as a critical variable that is fundamental to the distribution of political power amongst policy-makers. It rigorously probes hypotheses on this crucial connection employing a mixed-methods design that combines document analysis, interviews, a major survey, dictionary-based text analysis and process tracing. The project examines synchronisation across EU, national and subnational governments, parliaments and administrative agencies, with a focus on six multi-level democracies: Austria, Belgium, France, Germany, Italy, Spain. The analysis covers two policy domains - migration-asylum and public health policy – since the early 2010s. SYNCPOL will generate fundamentally new insights into how time shapes democratic multi-level politics and policy.

Link to the ERC project webpage: https://politicalsystems.org/erc-advanced-grant-syncpol-synchronized-politics-multiple-times-and-political-powerproject-detail/

Keywords of the ERC project: time and politics, time pressure, synchronization, European Union, migration and asylum policy, health policy

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101088156	**BIGDATPOL**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Wim Hardyns**
Host Institution:	UNIVERSITEIT GENT - BEL

Towards an evidence-based model for big data policing: Evaluating the statistical-methodological, criminological and legal and ethical conditions

Big data policing is an innovative strategy that uses historical data to forecast when and where there is a high risk of new crime events in order to use police resources more efficiently and proactively, and ultimately reduce crime rates. Big data policing models can consist of variables based on crime data available in police databases (e.g. previous crime events), socio-economic data (e.g. poverty index, residential mobility), opportunity characteristics (e.g. the presence of shops, distance to nearest highway), data from new technologies (e.g. intelligent cameras) and other known predictors of crime (e.g. police patrol intensity). However, there are several research gaps that need to be addressed. First, knowledge about and expertise in big data policing in Europe is currently fragmented. Second, there is a lack of interdisciplinarity with regard to big data policing studies, and yet the involvement of several disciplines is required when studying the issue. Third, there is a lack of scientific evaluations of big data policing models. The overarching objective of this ERC project is to unite and integrate the statistical-methodological, criminological, legal and ethical dimensions of big data policing in an evidence-based model that will be tested by different randomized controlled trials and built on the principles of an international (i.e. European) and interdisciplinary approach. The latter aim should be enabled by incorporating and conducting different PhD tracks focusing on these specific dimensions, which should allow better knowledge, insights and understanding of big data policing to be developed. This approach is innovative and radically different from the existing commercial and economic initiatives, which lack transparency on their predictive reliability and validity, effectiveness and legal and ethical safeguards.

Link to the ERC project webpage: www.bigdatpol.com

Keywords of the ERC project: Big data, AI, crime

Keywords that characterize the scientific profile of the potential visiting researcher/s: AI, statistics, methodology

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101088188	**New Labour Law**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Hila Shamir**
Host Institution:	TEL AVIV UNIVERSITY - ISR

A New Labour Law for Supply Chain Capitalism

Labour law gradually protects fewer of the worlds' workers. Changes in work and capital structure, new technologies and evolving modes of supply and production (together: 'supply chain capitalism'), lead to an incongruence between the distribution of market power and the premises and tools of labour law, creating barriers to workers' organization and agency. This incongruence stems from the fact that labour law developed in industrial economies to respond to the power disparities between capital and labour, and is therefore tied to a dyadic employer-employee paradigm in which labour law seeks to empower workers vis-à-vis employers, the presumed owners of capital. Yet this is no longer the case in the era of supply chain capitalism, where the direct employer is often a supplier in a Global Value Chain (GVC), whose economic calculus is dependent on corporations in higher tiers of the chain. Given the crises of both labour law and GVC governance, this project offers a path to restructure labour law to fit new patterns of supply chain capitalism. The project includes three main components: 1) Theoretical: The project intervenes in existing literature and theory on GVC governance and on labour law to propose a new analytical framework for reconceptualizing the role of workers and of labour law in GVC governance. 2) Empirical: Current initiatives to improve workers' rights in GVCs worldwide are based mostly on voluntary schemes, often perceived as 'private' or rooted in 'soft-law'. The project will closely study existing initiatives and holistically analyse the studies development and examine whether and how labour law can be restructured to support existing successful initiatives and produce new sustainable paths to strengthen worker power in GVCs. 3) Normative: Based on the two preceding parts, the project will create a blueprint for a new, and overdue, labour law for supply chain capitalism.

Link to the ERC project webpage: www.chaingelab.org

Keywords of the ERC project: Labor law. global value chains, workers rights, globalization, unions

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101097835	**RegTrust**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr David Levi-Faur**
Host Institution:	THE HEBREW UNIVERSITY OF JERUSALEM - ISR

Intermediation and Trust in the Regulatory State: More Regulation, Less Trust?

Regulation is sometimes a manifestation of distrust, but on other times it is a manifestation of trust. When do trust and regulation compete, substitute for and mutually-support each other? How can we maximize the benefits of both? Is the proliferation of rules around us a manifestation of growing distrust or trust? Is the regulatory state necessarily a low-trust state? To answer these questions, RegTrust introduces intermediation as a governance mechanism and intermediaries as third parties in trust and regulatory interactions. Intermediaries certify products, report compliance, rank organizations, label products, monitor performance, screen behavior, whistle-blow misbehavior, and audit organizations. The regulation literature treats them as regulatory actors; the trust literature, as trustees. Yet intermediaries are both trustees and regulatees, both subjects and objects of trust and regulation. Most importantly, they may determine successes and failures, winners and losers, of trust and regulation. At their best, intermediaries reinforce regulation and trust, and promote polycentric (pluralist) structures of governance. At their worst, they undermine trust in regulation, leading to vicious cycles of failure and re/centralization (monocentric governance). RegTrust examines under which conditions, why, how, and to what effects trust and regulation compete, substitute for, or mutually-support each other. We problematize the role of intermediaries, develop a three-actor (triadic) model of governance, and assess its institutional macro-political consequences. Going beyond the state of the art, this project sheds light on the multiple interactions of trust and regulation in policy and politics. It advances the theory of intermediation; advances the interaction of trust and regulation as a central element of the governance literature; And explores the conditions that may make a regulatory state into a high-trust state.

Link to the ERC project webpage: 101097835

Keywords of the ERC project: public policy; regulation; governance

Keywords that characterize the scientific profile of the potential visiting researcher/s: public policy; regulation; governance

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101116635	**LEGACY**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Visa Kurki**
Host Institution:	HELSINGIN YLIOPISTO - FIN

Agency in Law

The distinction between agents and non-agents is central in law: only agents can decide about their affairs, enter contracts or be held responsible for their actions. Western law has since the 19th century relied on an understanding of agency that has developed in the liberal tradition of thought. According to this "Liberal Agency", agents are highly rational human individuals. Persons with cognitive disabilities, artificial intelligences, and nonhuman animals are therefore not agents because of their lack of rationality or humanity. This view of agency is deeply embedded in Western legal systems. Liberal Agency has recently come under increasing criticism and challenges. Many now argue that persons with disabilities, artificial intelligences and/or nonhuman animals could in fact be treated as agents. However, these criticisms have been narrow in scope, and the debate is overall highly fragmented. LEGACY, situated within legal philosophy and history, will offer a comprehensive reappraisal of legal agency. It will investigate three main questions: First, how did Liberal Agency become the dominant understanding of agency in law? Second, what challenges confront Liberal Agency today? And finally, what kind of a theory can best explain the evolving notion of agency in law? The objectives of the project are to deliver: (1) a systematic understanding of the historical background and context of Liberal Agency, its spread in Western legal thought, and its challengers; (2) an in-depth analysis of contemporary agency accounts that incorporates and conceptualizes the historical insights with a systematic understanding of the contemporary debates; and (3) a theory of agency that provides an overall synthesis of the accounts and can explain, reconcile and/or solve the outlined contemporary challenges. The project will thus develop a historically informed, comprehensive and rigorous understanding of legal agency, based on a broad synthesis of legal and philosophical thought.

Link to the ERC project webpage: https://www.helsinki.fi/en/researchgroups/agency-in-law

Keywords of the ERC project: law, philosophy, agency, personhood, rights

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101125672	**Democracy Challenged**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Aidan Regan**
Host Institution:	UNIVERSITY COLLEGE DUBLIN, NATIONAL UNIVERSITY OF IRELAND, DUBLIN - DEU

How Global Corporate Tax Avoidance Fuels the Wealth Inequalities that Undermine Democracy.

This project develops a new theoretical framework and causal mechanism to explain how corporate tax avoidance fuels the wealth inequalities that undermine democracy. It implements new methodological innovations that explain how global capital evades the fiscal constraints of democracy, using a combination of forensic accounting, in-person interviews, computational text analysis and original survey experiments. The objectives of the project are guided by two overarching research questions: Why is concentrated capital and wealth inequality a problem for democracy? What is the role of corporate tax avoidance and law in enabling this process? The empirical and comparative case study analysis are designed to answer these questions. First, we explain the global wealth chains and tax avoidance structures of big tech and big pharma multinational groups. Second, we explain how legal-technical actors create these structures and strategies. Third, we explain how their wealth protection strategies destabilise the functioning of democracy. Fourth, we explain the role of the media in politicising corporate tax avoidance as a problem for democracy. The project has four work packages. First, we construct a new theoretical framework, typology and causal mechanism to explain how corporate tax avoidance leads to the wealth inequalities that undermines democracy. Second, we explain the tax avoiding wealth chains of big tech and big pharma using a combination of forensic accounting and statistical mapping techniques. Third, we explain how legal-technical actors create these structures using a combination of in-person interviews, list survey experiments and computational text analysis. Fourth, we implement a cross-national survey experiment to explain the role of the media in disrupting the political consensus of legal-technical experts. Finally, we develop a set of new normative principles to guide how governments can respond in a democracy-enhancing way.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101126248	**MERCURY**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Sorcha Macleod**
Host Institution:	KOBENHAVNS UNIVERSITET - DNK

Mercenarism and the Accountability Void: Finding routes to accountability and remedy for the victims of human rights abuses perpetrated by mercenaries

The recent increasing use of mercenaries in armed conflicts such as in Libya, Central African Republic, Nagorno-Karabakh, Mali, and Ukraine has focused attention on some of the problems arising from the deployment of these private actors. Their involvement in proxy wars, predatory recruitment, and asymmetric warfare, which internationalise, exacerbate, and prolong armed conflicts, creates space for grave human rights abuses and war crimes. Millions of people are directly negatively impacted by mercenaries globally, but accountability is rare, and so these actors operate with impunity, their victims denied access to justice and redress. In essence, mercenaries operate in an accountability void. Academic attention until now has focused on the anti-mercenary norm, definitions of mercenary, and treatment of mercenaries, but there is little research on how accountability and remedy is ensured for victims of mercenarism. MERCURY focuses on this accountability void, combining cutting-edge, data-driven mapping and analysis of mercenary operations with thorough legal and qualitative analysis. The mapping will provide a novel understanding of mercenaries to underpin ground-breaking legal analysis of the shortcomings and weaknesses of national and international frameworks when it comes to remedies for victims. Via legal and qualitative analysis, MERCURY will evaluate routes to accountability and remedy via international and national human rights courts, tribunals, mechanisms, and transitional justice processes, and propose potential pathways to justice for victims. PI MacLeod is internationally recognised for her expertise on mercenaries and human rights. Together with the MERCURY team, she will offer pioneering scholarly insights into routes to accountability and remedy. The richer understanding derived from MERCURY will help inform stakeholders on how they can better prevent abuses perpetrated by mercenaries, or failing that, ensure accountability and redress for victims.

Link to the ERC project webpage: https://jura.ku.dk/privategovernance/english/research/mercury

Keywords of the ERC project: Mercenaries, armed conflict, human rights, international humanitarian law, accountability, justice, remedies

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101141671	**GEOCLOUD**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Vili Lehdonvirta**
Host Institution:	AALTO KORKEAKOULUSAATIO SR - FIN

The Geopolitics of Cloud Computing: How State-Firm Interactions Shape the Geography of Computation to Produce Digital Sovereignty and Dependence

Today's digital superpowers, the United States and China, exploit other countries' reliance on their digital infrastructures for foreign policy and national security advantage. Governments in Europe, Asia, and elsewhere try to navigate this great power competition to retain "digital sovereignty". A pivotal moment in these technology geopolitics is the ongoing "shift to cloud". Instead of data being stored and processed on users' own devices and on servers situated at organizations' own premises, storage and processing are increasingly moving into "hyperscale" cloud data centres dotted around the world. This concentration generates significant economies of scale, decreases capital costs for firms and public sector organizations, and improves energy efficiency. However, it also creates new systemic risks, and since most of these data centres belong to U.S. and Chinese technology giants, will dramatically deepen other states' technological dependence on them—unless smaller states succeed in shaping the shift to their advantage. In the GEOCLOUD project we will for the first time map this changing geography of computation and examine how different states are attempting to shape it with policies. Focusing on the digital superpowers' key battlegrounds of Northern Europe and East/Southeast Asia, we will develop ways of measuring on a country level how exposed public sector and financial sector digital services are to cloud providers and how this exposure is evolving over time. We will use statistical analyses and interviews with policy makers and cloud executives to assess how effective government policies have been at shaping this exposure and at influencing the ownership and locations of hyperscale data centres. We will moreover theorize how government policies are interacting with large technology firms' business strategies to generate new geopolitical dynamics that shape this geography of computation—and with it our prospects of digital sovereignty and dependence.

Link to the ERC project webpage: https://diesl.eu

Keywords of the ERC project: geopolitics, geoeconomics, digital infrastructure, cloud, data centers, compute

Keywords that characterize the scientific profile of the potential visiting researcher/s: economics, political science, international relations

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101161856	**PolMig**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Franzisca Zanker**
Host Institution:	ARNOLD-BERGSTRAESSER INSTITUT FUR KULTURWISSENSCHAFTLICHE FORSCHUNG EV - DEU

The Political Lives of Migrants: Perspectives from Africa

Refugees and other migrants continue to arrive in new places all across the world. Their reception, long-term prospects and lives in their new homes remains one of the most pressing socio-political issues of our times. What about the migrant in all of this? How do they see their life, role and political agency? Migration research has thus far under-conceptualised and under-researched political migrant agency, especially from a Global South perspective and in interaction with states and non-state actors. PolMig aims to redress this gap and combine it with a commitment to tackle global inequalities in knowledge production.

Focusing on Africa, PolMig considers how migrants define political agency, enabled or disabled by politicisation processes of belonging in postcolonial state contexts. Drawing on this research, PolMig advances an Afrocentric understanding of political migrant agency with global relevance. The research will consider the effects of different migrant trajectories (refugee or other migrant; transregional or intraregional; in country of destination, transit or return to origin) on the self-defined understanding of political agency, along intersectional principles of gender, class and race. PolMig uses pioneering research methods to do so including migrant agency diaries and theatre workshops.

PolMig bridges the literature on migrant agency and migration states as well as contributing an Afrocentric perspective to the field. The Afrocentric perspective is ensured through a process of collaboration and exchange, centring the continent empirically and epistemologically. The innovative project will have significant scientific impact through addressing an interdisciplinary research gap and the commitment to highlighting and tackling knowledge inequalities. It also offers highly relevant policy contributions to an urgent societal question.

Link to the ERC project webpage: https://www.polmig.eu/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101164310	**ROBOCRIM**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Kamil Mamak**
Host Institution:	UNIWERSYTET JAGIELLONSKI - POL

Philosophical Foundations of Criminal Law in the Age of Robots

Robots are made to serve humans in carrying out tasks that are hard, dangerous, or repetitive, as well as for entertainment. Despite their (generally) benign objectives, robots may promote harmful outcomes that are under the radar of criminal law. One of the main aims of criminal law is to stabilize society. If something wrong is done, the law provides ways of responding to it. The situation could be complicated by the wider application of robots in social life: not only do they disrupt the practice of law, they also have the potential to challenge its very foundations. The main aim of the ROBOCRIM project is to build a philosophical ground for criminal law that accommodates robots. I will ask, "How can the philosophical foundations of criminal law be reconstructed to accommodate robots?" instead of, "How to accommodate robots into criminal law?" which is the usual formulation. This shifts the approach to the discussion on robots and their alignment with law and social life. The project will be conducted within three interrelated work streams. The first stream will be devoted to robots and their status from the perspective of the philosophy of criminal law. The second stream will focus on the foundation of a new account of criminal law, which I call the "phenomenological account". The emphasis in the third stream will be on building models of institutions that accommodate robots within criminal law, to be tested using experimental methods. These new models of criminal response to crimes committed by robots treat robots as initiators of events that require a response from criminal law rather than as individual agents that could be responsible for their actions. This, combined with a novel account of criminal law, makes the project ground-breaking. It is interdisciplinary, employs multiple methods, and will shed new light on how robots might better fit into society in general, and criminal law in particular.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101164328	**p-age**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Xenia Chiaramonte**
Host Institution:	UNIVERSITA CA' FOSCARI VENEZIA - ITA

Social Defence. Uncovering the Transnational Epistemology of the Punitive Age

The commonly accepted reason for the right to punish is the defence of society, or social defence. However, its meaning in Western criminal justice remains unclear. In an increasingly punitive age, punishments have become harsher, irrespective of the seriousness of the crime. It is therefore necessary to scrutinise the episteme behind punishment. In fact, despite its profound impact on individuals' lives, the penal system lacks an adequate normative foundation because social defence functions as an implicit paradigm without a clear elaboration. P-AGE's objective is to analyse the long-term discourse on social defence and its current transnational relevance, with the ultimate goal of understanding how and why punishment came to be perceived as an adequate response to various societal issues. More specifically, P-AGE sheds light on the criminological legal debate on the concept of social defence, a debate that has been largely overlooked in scholarly literature. Social defence was first theorised at the turn of the 20th century within the underexplored field of Positivist Criminology. This concept has persisted until today, due to the post-WWII emergence of the New Social Defence (NSD) movement, an association of criminal law reformers who worked in concert with the United Nations Social Defence Research Institute (UNSDRI), now called the United Nations Interregional Crime and Justice Research Institute (UNICRI), in shaping current crime policy programmes. P-AGE investigates this historical setting and development in order to understand what social defence means and to make the implicit paradigm of the punitive age explicit. P-AGE's methodology employs the epistemic community model to identify and analyse the transnational network of actors and ideas that substantiate social defence. The project blends critical criminology, intellectual legal history, and policy analysis to rewrite the history of punitive reason by foregrounding the key concept of social defence.

Link to the ERC project webpage: https://pric.unive.it/projects/p-age/home

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101169791	**PERIODS**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Inga Winkler**
Host Institution:	WAGENINGEN UNIVERSITY - NLD

Human Rights in the Menstrual Movement

The period emoji, the year of the period, and an Oscar-winning documentary—with menstruation gaining attention at all levels, PERIODS explores the promises, pitfalls, and renewed potential of human rights in the menstrual movement. While research, policy, and practice on menstruation to date largely focus on tangible, material needs and risk leaving menstrual stigma and its role in perpetuating gender injustices intact, PERIODS recognizes that menstrual stigma and unmet menstrual needs have profound effects on the human rights to health, bodily integrity, education, work, and participation in social, cultural, and public life. The project centers the social practice of human rights in the menstrual movement by drawing on the articulations of lived experiences of people who menstruate and perspectives of movement leaders. It will examine if social movements reframe how human rights related to menstruation are understood and if so, how they move beyond the dominant reductionist framings in favor of a holistic, inclusive, and expansive conceptualization of human rights. The project combines empirical research using in-depth interviews, focus groups, qualitative surveys, and document analysis with conceptual work grounded in human rights. Theoretically, the project is rooted in the critical engagement with human rights and a re-envisioning of human rights 'from below'. It considers the practice of human rights in the menstrual movement as constitutive of what matters for the realization and conceptualization of human rights. By connecting global and local struggles and movements in the global South and North, PERIODS will not only develop a thicker, more nuanced understanding of human rights in the menstrual movement, but also has the potential to generate significant empirical insights from a young, translocal, global South-driven movement for the reconceptualization of human rights based on social practice.

Link to the ERC project webpage: www.periods-erc.org

Keywords of the ERC project: gender justice, social movement, social mobilization, human rights from below, menstrual justice

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101171880	**Reflex**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Cathryn Costello**
Host Institution:	UNIVERSITY COLLEGE DUBLIN, NATIONAL UNIVERSITY OF IRELAND, DUBLIN - IRL

Is International Refugee Law Effective?

Is International Refugee Law effective? This is the central question of RefLex, a project that will offer the first comprehensive empirical study of the workings and effectiveness of International Refugee Law (IRL), a body of law partly imbricated with International Human Rights Law (IHRL), domesticated and judicialized to an extraordinary degree across the globe. There are many theoretically and empirically rich studies of effectiveness of International Human Rights Law (IHRL), as well as many other fields of International Law (IL) in constructivist International Relations (IR) in particular. The effectiveness of human rights courts and other bodies is also a well-established academic subfield. However, there are no analogous empirical studies of IRL in practice. RefLex will fill this huge puzzling knowledge gap, thereby making a vital contribution both to refugee studies and to scholarship on the theory and practical workings of IL. It will develop a new dataset, the Refugee Protection Index (RPI), in order to enable our (and other) large-n quantitative studies, identify key cases to trace how IRL comes to be effective, or not. It will also contribute to the burgeoning field of legal mobilization (LM) studies, which again, have failed to examine refugee legal mobilisation in comparative or transnational fashion. It will break new ground here also, by studying LM from above and below by studying both UNHCR's own LM and that of refugees themselves, both acting via transnational organisations and in local settings. The analysis of the RPI will inform the choice of LM casestudies, in order to develop a new account of when LM emerges and when it is effective. The project aims to provide vital insights at a time when the Global Refugee Regime (GRR) is seen to be increasingly adrift from IL, with over challenges to core norms, and practices focusing on informal cooperation, 'deals' and political trading, lacking normative specificity and legal force.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101171893	**COMPLEX**	**SH2** Institutions, Governance and Legal Systems

Principal Investigator:	**Dr Linda Groning**
Host Institution:	UNIVERSITETET I BERGEN - NOR

Understanding the law's complex association between criminal insanity and mental disorders

The fundamental legal doctrine of criminal insanity is found in most legal orders. It concerns a defendant's lack of capacity for responsible action and defines the justifiable use of punishment. It is a key entrance point for comprehending how law conceives of agency and deviancy, but also a highly controversial legal construct. A major concern is that there is a mismatch between how criminal insanity has been paradigmatically understood in law and how it is today inevitably associated with mental disorders. This doctrine has been formulated in terms of folk psychological notions of rational agency but increasingly relies on psychiatric diagnoses and symptoms, with forensic experts as premise providers in criminal proceedings. However, psychiatric constructs were not developed for criminal law and people diagnosed with mental disorders may have vastly varying functional impairments. Legal research has yet to elucidate how this complexity plays out in criminal insanity rules and judgements. There is a pressing need for cross-country empirical and interdisciplinary legal studies that integrate insights from mind sciences to explore this matter. The lack of legal clarity about the relevance of mental disorders raises concerns about the rule of law, unequal treatment, and criminal justice. COMPLEX will advance our understanding of law's associations between criminal insanity and mental disorders, with a research design that transcends conventional legal research by combining cross-country empirical studies of current legal doctrines with interdisciplinary analysis of how the normative and factual legal premises about mental disorders involved in these doctrines relate to philosophy and mind sciences. The ambition is to provide a new theoretical framework for understanding mental disorders in criminal law. COMPLEX has the potential to challenge current paradigms and have major implications for both science and society.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101019329	**HEALTHINEQ**	**SH3** The Social World and Its Interactions

Principal Investigator:	**Dr Pekka Martikainen**
Host Institution:	HELSINGIN YLIOPISTO - FIN

Social inequalities in population health: integrating evidence from longitudinal, family-based and genetically informed data

Social inequalities in health are observed in all societies. These inequalities have grown markedly over the past 30 years, with those in less advantaged social positions currently expected to live 5–10 years less than those in more advantaged positions. The study aims to establish the root causes of these inequalities by (1) assessing the drivers of long-term changes in health inequalities and establishing the contribution of family factors and macro-level social and economic conditions to these changes; (2) examining multigenerational interdependencies of social position and health in up to four generations; (3) estimating the causal effects of social position on health by employing molecular genetic information and assessing whether genetic associations are mediated or modified by social position; (4) evaluating the generalisability of explanations of social inequalities in health through international comparative research. The study will integrate research scattered in multiple disciplines by establishing how family background – both social as experienced through living conditions and social resources in families, and genetic as inherited from biological parents – affects health and social disadvantage within and across generations. The project will go beyond standard observational research through new conceptual insight and by using a unique combination of longitudinal register-based and genetically informed data sources. We will take advantage of natural experiments – educational and alcohol policy reforms and rapid economic changes – to identify pivotal social processes in the production of health inequalities. Our results will be ground-breaking because we will establish how family and genetic factors are intertwined with individual social characteristics and how they manifest in health outcomes in different macro-level social conditions. The power to test causal hypotheses will advance science and help devise policies to reduce health inequalities.

Link to the ERC project webpage: https://www.helsinki.fi/en/helsinki-institute-demography-and-population-health

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: health, inequalities, social determinants, mortality, population ageing, multimorbidity, long-term care

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101040163	**Loops**	**SH3** The Social World and Its Interactions

Principal Investigator:	**Dr Anna Fruhstorfer**
Host Institution:	FREIE UNIVERSITAET BERLIN - DEU

The Logistics of Popular Uprisings

Imagine you protest the slide of your country into an autocratic regime. The weather is freezing and you rally in these conditions for weeks. Not a pleasant idea, yet in 2004 thousands of Ukrainians demonstrated against electoral fraud and established a permanent protest camp in Kyiv. For two months, thousands of protesters were in this urban camp, requiring food, toilet facilities and accommodations to regain warmth. And not only in Ukraine, but all over the world, people protest under difficult conditions and have to overcome logistical and personal challenges to pursue their goals. While the literature on social movements and revolution has engaged extensively with popular uprisings and large-scale protests, the logistics that are required for these protests to succeed under autocracy are hardly ever addressed. Existing research has long neglected the fundamental questions that LOOPS engages with. Such as: what logistical activity can be observed during these protests, their quantity and professionalism? Who organizes the portable toilets, provides soup, and blankets? And what effect has the level of professionalism on the legitimacy of the protest and autocratic stability? We will first develop a concept of professionalism in backstage logistics and a theoretical argument about its effect on the legitimacy and course of protests. With this we will create a unique dataset of the logistics during uprisings based on the analysis of images, a new and exciting way to generate data. With a substantive human coding effort, LOOPS will identify the basic logistics, their type, quantity, and professionalism. In a second step, LOOPS will include case studies to gather more information about financial and organizational sources for protest logistics. Third, we will test the impact of these logistics on autocratic resilience. I propose an ambitious research agenda, address a salient research gap, offer an innovative approach to data collection and a multi-method design.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101041788	**AfDevLives**	**SH3** The Social World and Its Interactions

Principal Investigator:	**Dr Yonatan N. Gez**
Host Institution:	Iscte - Instituto Universitário de Lisboa - PRT

The Afterlives of Development Interventions in Eastern Africa (Kenya, Tanzania, Mozambique)

International development involves ideologies and activities ostensibly directed towards the improvement of well-being of populations in the Global South. Mainstream development interventions emphasize forward-looking ideas of progress and advocate for novelty. In so doing, however, the sector is often myopic, as evidenced by countless unintended consequences that stretch beyond interventions' official life cycle. Whether deemed success or failure, such interventions leave behind a long trail of tangible and intangible traces. Project AfDevLives explores how development interventions' representational and material remains are experienced, employed, and re-appropriated by local actors over time, and how such active immanence of the past affects people's life-worlds. It weaves together three temporal gazes: prospective (development's blueprints); retrospective (sediments of the past, shorthanded as interventions' 'afterlives'); and present-time lived experience. Consciously de-centering formal development discourse and temporalities, the project develops and applies a phenomenological framework oriented around embodiment and intertwinement of people, objects, and space. Using an interdisciplinary approach centered on social anthropology, research will be conducted in Kenya, Tanzania, and Mozambique, neighbouring Eastern African countries that are among the highest recipients of development aid and whose past and present balance continuities and ruptures. The project will unfold via an iterative process involving four complementary work packages: Movement, Image, Storytelling, and Synthesis. Working across work packages, countries, and case studies, the project will pursue three categories of objectives: conceptual (methodological toolkit), empirical (based on extensive ethnographic fieldwork), and practical (aimed at the development sector, local heirs of interventions, and the public at large). The project will result in a robust set of outputs.

Link to the ERC project webpage: https://afdevlives.iscte-iul.pt/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101055089	**ANIMAPOLIS**	**SH3** The Social World and Its Interactions

Principal Investigator:	**Dr Rivke Jaffe**
Host Institution:	UNIVERSITEIT VAN AMSTERDAM - NLD

Political Animals: A More-than-Human Approach to Urban Inequalities

ANIMAPOLIS aims to understand the role of animals in the formation of urban inequalities, asking: How do animals' interactions with humans and infrastructures co-produce the unequal distribution of risks and resources across urban spaces and populations? It focuses on two critical urban domains, security and public health, that are often characterized by stark inequalities, and takes the role of key animals within these domains – dogs and rats, respectively – as a unique analytical entry-point. Urban inequalities are not only produced and transformed by people. Security dogs have been socialized to identify threatening individuals on the basis of classed and raced markers. Rats pose a public health risk, and thrive in low-income areas with decaying sanitation infrastructure. Urban scholars have recently begun to highlight the importance of infrastructures and technologies in configuring access to essential goods and services. While this research has provided key insights into how non-human entities mediate social relations, it has largely overlooked how animals, too, may co-produce inequalities. While dogs and rats clearly play a role within security and public health, we know little about how they mediate urban inequalities related to these societal challenges. This project investigates such mechanisms by focusing first, on dogs' and rats' distinct biological specificities and cultural imaginations, and second, on the spatial, material and affective dimensions of their interactions with humans and infrastructure. The research design develops a two-way qualitative comparison, between different urban contexts and between different animals, through multispecies ethnographies of animal-human-infrastructure dynamics in Amsterdam and Philadelphia. The project's more-than-human approach extends theoretical and methodological innovations within urban anthropology, geography and human-animal studies in order to open new horizons on the study of urban inequalities.

Link to the ERC project webpage: animapolis.nl

Keywords of the ERC project: multispecies ethnography; urban studies; more-than-human geography

Keywords that characterize the scientific profile of the potential visiting researcher/s: multispecies ethnography; urban studies; more-than-human geography

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101075511	**AMBER**	**SH3** The Social World and Its Interactions

Principal Investigator:	**Dr Alessandro Rippa**
Host Institution:	UNIVERSITETET I OSLO - NOR

Amber Worlds: A Geological Anthropology for the Anthropocene

The Anthropocene compels us to question established categories and binaries through which we understand the world and act in it: human and nonhuman, life and nonlife, biological and geological. What we still lack is a theoretical framework, methodological and storytelling tools, to analyse environmental and social concerns alongside geological pasts and futures. AMBER addresses this key challenge by drawing scientific understanding of ecological and geological relations into a global ethnography of the extraction and exchange of a unique, emblematic gemstone. Amber is a fossilised resin secreted by plants between 16 and 300 million years ago; it is found across the planet and is one of the earliest recorded items in long-distance trade. Aside from its ornamental value, amber contains prehistoric organic material – leaves, invertebrates, dinosaur fragments. This has generated intense scientific interest, so amber is now studied in palaeontology and geology laboratories to answer fundamental questions about the planet's biological evolution and previous phases of mass extinction. This project will be the first in-depth, global study of amber across industry, trade, and science. AMBER breaks new ground by bringing together three dimensions in a common analysis: anthropological frameworks of global circulations; the political ecology of resource extraction; and non-humanist approaches to scientific research and ethics of care beyond the human. Rooted in anthropology, the project considers the multiple and entangled worlds of amber: its extractive economies in the war-torn forests of Kachin state; its scientific study in laboratories in China and Europe; and its wholesale trade in Santo Domingo, Kaliningrad and the Baltic states, and China. The project examines their intersections through collaborative and comparative research and will thus lay the conceptual groundwork for a new geological anthropology for the Anthropocene.

Link to the ERC project webpage: https://www.sv.uio.no/sai/english/research/projects/AMBER/

Keywords of the ERC project: Anthropology; Material Culture; Science and Technology Studies

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101077810	**CONSPIRATIONS**	**SH3** The Social World and Its Interactions

Principal Investigator:	**Dr Elzbieta Drazkiewicz**
Host Institution:	LUNDS UNIVERSITET - SWE

Conflicts Over Conspiracy Theories

In recent years, conspiracy theories have become an important issue not only to the people who propagate them, but also to those who fear their consequences and design initiatives to push back against the 'post-truth' era. Perceived as a major threat to liberal democracies, they are increasingly subjected to state-led interventions. Also many NGOs are now dedicated to preventing and combating conspiracy theories. Clearly, conspiracy theories have become a highly polarizing topic. The objective of CONSPIRATIONS is to analyse this growing tension over conspiracy theories in Europe. The project proposes an innovative approach which moves beyond an exclusive focus on 'truthers' to examine the perspective of 'truth defenders' as well. This project will analyse conspiracy theory not as a standalone phenomenon, but instead as an outcome of the complicated relationship linking stakeholders who are both separated and connected by the conspiratorial divide. By expanding the scope of study from conspiracy theories to conflicts over conspiracy theories, CONSPIRATIONS will explore the possibility that the worlds of these actors are mutually constitutive. This approach goes beyond the question of who is wrong and what to do about it. Instead, it offers a deeper understanding of the conflicts themselves, which are clearly of urgent importance for contemporary Europe. That understanding in turn will provide better knowledge for tackling the damaging effects of the conspiratorial divide. An important premise of this proposal is that the answer lies not in addressing the content of the conspiracy theories themselves, but rather the kinds of conditions that give rise to them. The secondary goal is to understand how these conflicts are influenced by social contexts, and how they unfold across diverse European settings. The objectives of this project will be achieved through ethnographic case studies in Belgium, Bulgaria, Estonia, Germany, Poland, Sweden, and EU institutions.

Link to the ERC project webpage: https://projekt.ht.lu.se/conspirations

Keywords of the ERC project: Conspirationism, conflicts over truth, disinformation, FIMI, politics, media, Europe, science denialism, radicalisation

Keywords that characterize the scientific profile of the potential visiting researcher/s: Social scientist, humanities scholar.

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101098100	**LINLOSS**	**SH3** The Social World and Its Interactions

Principal Investigator:	**Dr Jane Gray**
Host Institution:	NATIONAL UNIVERSITY OF IRELAND MAYNOOTH - IRL

Towards a Sociology of Loss: Disposals and dead-ends in Lineages of Social Innovation and Change

This study aims to provide a new understanding of how losses, disposals and dead-ends shape the direction of social change at moments of rupture, and to develop a formal theory of social loss. Sociologists have shown that people respond to crises by reconfiguring cultural understandings, narratives of self and social relationships. However, we have not paid sufficient attention to how what is disposed of shapes future pathways. LINLOSS will address this gap in the sociological imagination. It will develop new explanations of how loss generates change at multiple, intersecting societal scales: in the transformation of cultural and institutional patterns across generations; within changing configurations of relationships across genealogies and social networks; and in the reconstruction of pasts and futures within biographies. The research will be a comparative, cross-national community study of two 'exurban' districts in Ireland and Poland. The main form of data collection will be mixed biographical interviews, combining unstructured and formal elements, connected within genealogical support networks. The analysis will take place across two iterations: a comparative analysis to trace the effects of breaks and losses within and between social lineages at multiple scales; and a thematic analysis to identify how instances of loss are tied together by a common social pattern. We live in 'unsettled times,' when it is essential that sociologists provide insights on how pathways of social loss and renewal lead to variations and resilience to new challenges, for individuals, families and communities. If successful, the study will make a significant contribution towards this goal. It will deliver a methodological breakthrough in pioneering methods for the analysis of dynamic, multi-scalar social processes and will make a major theoretical contribution to scholarship on social change.

Link to the ERC project webpage: https://linloss.maynoothuniversity.ie/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101117531	**CECC**	**SH3** The Social World and Its Interactions

Principal Investigator:	**Dr Jan David Hauck**
Host Institution:	LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN - DEU

Changing Environments, Changing Childhoods: A Cross-Environmental Ethnography of Moral Socialization in Three Small-Scale Societies

This project investigates how children in three small-scale Indigenous societies develop moral understandings and behavior in relation to different environments and environmental transformations. Communities across the world are experiencing rapid changes to the spaces they inhabit, such as deforestation or changing land use, forcing them to radically alter their ways of life and subsistence. But we know very little about how these may impact the moral development of children.

Environments are frequently invoked as playing important roles in the formation of morality, from the immediate home environments that provide the contexts for a child's ontogenetic development, to the evolutionary environments in which the human species evolved particular moral dispositions, such as cooperation or altruism. But on either timescale, environments are mostly taken for granted as providing stable contexts for human action. To date there is no detailed study of the concrete ways in which environmental affordances and moral socialization interact, and of consequences of environmental transformations.

The aim of this project is to develop a new framework for the study of the role of environments in human moral development through longitudinal, family-based ethnography in three Indigenous former hunter-gatherer communities in Paraguay, Malaysia, and Namibia. These communities have experienced dramatic environmental changes and settled in villages or town, but they also still go on extended foraging treks in nearby nature reserves. Comparing these two environments allows us to examine differences between past and present modes of existence and understand how environmental change impacts sociality and morality. Through video-based analysis, ethnography, interviews, and psychological experiments, the international team of researchers will analyze children's everyday interactions with caregivers and peers across environments, as well as reflexive understandings of attendant moral values.

Link to the ERC project webpage: www.carsoncenter.uni-muenchen.de/outreach/third-party-projects/project_hauck/index.html

Keywords of the ERC project: childhood, environment, morality, language socialization, environmental change, hunter-gatherers, Indigenous people

Keywords that characterize the scientific profile of the potential visiting researcher/s: anthropologist, psychologist, or linguist, with an interest in child socialization, environmental change, and ethics/morality

European Research Council Executive Agency Established by the European Commission	Project ID:	Project Acronym:	Evaluation Panel:
	101124718	**IMPROVE_LIFE**	**SH3** The Social World and Its Interactions

Principal Investigator:	**Dr Heidi Stöckl**
Host Institution:	LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN - DEU

Pliocene Hominin Dispersal to southern Africa: Choice or Chance?

Modern humans are unique in their ability to adapt to, and to thrive in, different environments. This trait facilitated their dispersal out-of-Africa to higher latitudes, i.e. to temperate and seasonal habitats, during the Pleistocene. However, there are Plio-Pleistocene hominins at higher latitudes in South Africa (SA) from ~3.7Ma onwards. Did human behavioural/physiological flexibility evolve early in our evolutionary history? Alternatively, did Pliocene hominins occupy such temperate zones due to different palaeoclimatic conditions in deep time and/or due to stochastic events? To untangle these questions this project will: (1) determine the geomorphological and palaeoecological changes in the Kalahari/proto-Limpopo basin, (2) create dynamic palaeo-precipitation/-vegetation models from various archives, (3) carry out detailed anatomical, functional and morphometric analyses of the hominin fossil record and (4) combine the datasets to appraise species diversity (functional adaptations), geneflow (hybridization) and dispersal scenarios (palaeobiogeography). 3 key working hypotheses underlie the proposal: 1. >2.6Ma East African (EA) hominin ranges expanded/contracted in accord with wet and dry phases; periodically, the southernmost populations became reproductively isolated. Early SA hominins represent descendants of Australopithecus anamensis and Australopithecus afarensis, respectively. 2. ~2.6-1.5Ma With the onset of the Northern Hemisphere Glaciation and the re-organisation of the drainage pattern within the Kalahari basin, dispersal corridors repeatedly closed (vicariance) and opened, resulting in intermittent levels of gene flow (i.e. hybridization) between EA and SA hominins. 3. <~1.5Ma Tectonic and hydrographic changes led to the Zambezi River becoming a powerful barrier during the Pleistocene. SA hominins younger than 1.5Ma are likely the result of endemism; competitive exclusion amongst these hominins resulted in exploitation of distinct ecological niche

Link to the ERC project webpage: https://ihrs.ibe.med.uni-muenchen.de/public-health-evaluation/improve_life/index.html

Keywords of the ERC project: violence against women and girls, pregnancy, birth cohort study, Bangladesh, intimate partner violence

Keywords that characterize the scientific profile of the potential visiting researcher/s: participatory methods, in-depth interviews, longgitudinal analysis

European Research Council Executive Agency Established by the European Commission	Project ID:	Project Acronym:	Evaluation Panel:
	101140664	**fAIces**	**SH3** The Social World and Its Interactions

Principal Investigator:	**Dr Helena Machado**
Host Institution:	ASSOCIACAO ISCTE CONHECIMENTO E INOVACAO - CENTRO DE VALORIZACAO E TRANSFERENCIA DE TECNOLOGIAS - PRT

Facial Recognition Technologies. Etho-Assemblages and Alternative Futures

Facial recognition technologies collect billions of faces that are stored for multiple uses spanning individual identification and tracking, to training of deep neural networks, the mainstay of modern artificial intelligence (AI). From tagging a photo on social media or unlocking a computer, to controversial applications of facial recognition in public spaces, schools, workplaces, and law enforcement activities, facial processing technologies have entered almost every aspect of our lives. While expected benefits relate to security and safety, critics highlight that these technologies normalize surveillance and erode privacy, exacerbate discrimination, and contain insurmountable flaws and inaccuracy. The fAIces project asks: What matters in facial recognition technologies, and why? How politics of mattering enact diverse ways of being implicated? Which forms of citizenship and public engagement are affected? How multiple and complex ethical choices emerge?

This study develops a novel methodology by which the perspectives of social groups that have never been studied together, which are jointly but antagonistically implicated in facial recognition technologies, are taken into consideration: scientists who conduct research on facial recognition; professionals working in start-ups and technology companies; members of advocacy groups and activists; black communities; and artists who incorporate facial recognition in their work. The fAIces project will produce an innovative social theory of the face through the combination of a new conceptual approach – "etho-assemblages", which transgresses the idea of pre-given fixed and dichotomic ethical principles – and the generation of original empirical data. Major outcomes are based on expanding ethics and imagining alternative futures, fueling citizenship and public engagement, and fostering opportunities for academic thinking to be inspired by activism, underrepresented groups, and artistic practices.

Link to the ERC project webpage: https://faices.iscte-iul.pt

Keywords of the ERC project: Facial recognition technologies; AÍ; privacy; ethics;

Keywords that characterize the scientific profile of the potential visiting researcher/s: Social studies of Science and technology; cultural AI; Surveillance studies

Project ID:	Project Acronym:	Evaluation Panel:
101163551	**DATA-ADDICT**	**SH3** The Social World and Its Interactions

Principal Investigator:	**Dr Virve Marionneau**
Host Institution:	HELSINGIN YLIOPISTO - FIN

Data-driven market power in the production of addiction

The DATA-ADDICT project studies data-driven market power in the production of addiction. It focuses on online gambling as a key empirical example of a highly addictive, digital, and data-driven industry. Commercial operation in online environments produces unprecedented amounts of data. Data are circulated within networks and used to increase profit via extractive commercial practices and political influence. Data-driven practices can be particularly harmful when employed by industries that produce and sell addictive commodities, such as gambling. Yet, and largely due to existing asymmetries in accessing data generated and held by industry actors, there has been a notable gap in our understanding of how data translate to power for addictive industries in online environments. What kind of data do addictive industries collect and circulate within their networks? How do these industries mobilise data to influence consumers and regulation?

The project builds a theoretical understanding of data-driven market power in the production of addiction via four interrelated research streams. First, it charts how data are collected, used, and circulated by the online gambling industry and related actors; Second, it looks at how data are mobilised by these industries to leverage power over consumers; Third, it analyses how these industries mobilise data to influence regulation; Fourth, running alongside the three empirical streams, it forms a theoretical conceptualisation of data-driven market power by using empirically informed middle range theory building and by drawing on social theories of digital capitalism and power.

The project produces a novel theoretical understanding of power in digital addictive commodity industries and beyond. The project also formulates and systemises new empirical methods to access and analyse industry data. At a societal level, the project generates crucial information on how to prevent harmful practices employed by addictive commodity industries

Link to the ERC project webpage: https://www.helsinki.fi/en/researchgroups/data-driven-market-power-in-the-production-of-addiction

Keywords of the ERC project: addiction, gambling, networks, power, commercial determinants

Keywords that characterize the scientific profile of the potential visiting researcher/s: gambling, commercial determinants, economic sociology

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101166011	**CAGED**	**SH3** The Social World and Its Interactions

Principal Investigator:	**Dr Diete Humblet**
Host Institution:	VRIJE UNIVERSITEIT BRUSSEL - BEL

Ageing in the Carceral Environment: The Existential Dimensions

The worldwide increase in the number of individuals that are ageing behind bars sparks heightened concerns about the extent to which carceral environments can foster the foundational conditions for ageing individuals to lead meaningful lives. However, the underdevelopment of research on carceral ageing is one of the most significant contemporary challenges in the social scientific study of criminal behaviour and society's response to it. Scholarship is particularly lagging behind in Europe. The CAGED project addresses this critical need by understanding how existential psychosocial changes induced by human ageing intersect with effects of incarceration. It is designed to bridge two distinct academic realms: gerontology, which encompasses the multidisciplinary study of ageing, and penology, which is the study of punishment and incarceration. The project will push disciplinary boundaries, both methodologically and theoretically, by applying an interactive mixed-methods and interdisciplinary approach that is guided by three objectives: First, it will delve into the existential dimensions woven into the narratives of incarcerated ageing individuals, by employing multi and novel interviewing methods. Secondly, the project will develop a novel instrument for measuring existential meaning among diverse regimes and groups of ageing individuals. The measurement will encompass all carceral environments in Belgium. Renowned for its diverse approaches to the integration and segregation of older individuals in carceral settings, it makes an excellent case study with broad relevance across European jurisdictions. The measuring study will also extend to an age-segregated facility for older adults in Germany, unique in Europe. In bringing these insights together, the project will finally culminate in a ground-breaking interdisciplinary theoretical framework. In its pursuit, CAGED will propel the field of carceral ageing studies forward and launch a new field of geronto-penology.

Link to the ERC project webpage:

Keywords of the ERC project: Ageing / Gerontology, Prison / Carceral environments, Meaning in life / Existential psychosocial well-being, Penology / Law, Interdisciplinary research, Mixed-methods approach

Keywords that characterize the scientific profile of the potential visiting researcher/s: Gerontology / Ageing research, Penology / Criminal justice studies, Psychology / Existential well-being, Mixed-methods research / Qualitative methods, Survey design / Measurement of meaning in life, Interdisciplinary research

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101166131	**Sentrix**	**SH3** The Social World and Its Interactions

Principal Investigator:	**Dr Mojca Plesnicar**
Host Institution:	INSTITUT ZA KRIMINOLOGIJO PRI PRAVNI FAKULTETI V LJUBLJANI - SVN

Sentencing architecture: Building a decision-making matrix

The act of sentencing represents a critical juncture at which the power of the state to punish intersects with the personal freedoms of the individual. It is governed by an intricate set of decision-making dynamics, for which we lack a cohesive understanding. This ground-breaking project seeks to fill this gap by introducing a fresh perspective rooted in choice architecture, aiming to devise a comprehensive theoretical matrix that systematically captures the multi-dimensional nature of sentencing decisions.

Employing the notion of the decision-making environment, the project seeks to map out the "sentencing environment" – a concept that includes both well-researched elements like judicial discretion and less examined factors such as procedural nuances and habitual decisions. The objective is to move beyond the dichotomy of legal vs. non-legal factors, using choice architecture in a non-traditional way: not to guide decisions but to understand the sentencing landscape and its mechanics.

The methodology encompasses a metanalysis of existing literature supplemented by workshops, and testing the initial findings through courtroom observation, interviews, and experiments with practitioners to develop a typology of sentencing frameworks. These will be tested against real-world practices and subjected to computer simulations using agent-based modeling, providing a visual representation of the sentencing environment.

The project is pioneering for several reasons. Firstly, it unites fragmented research into a holistic picture, employing an interdisciplinary approach that promises greater transparency in sentencing. Secondly, it uses visualization and simulation as tools for communication and strategic reform, potentially influencing legal and policy directions. Lastly, it offers insights into how various sentencing dimensions interact with human decision-making, contributing to a fairer justice system and a deeper understanding of legal behaviour.

Link to the ERC project webpage: https://inst-krim.si/sentrix/

Keywords of the ERC project: sentencing, decision-making, punishment, law, judges

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101170227	**Touchnet**	**SH3** The Social World and Its Interactions

Principal Investigator:	**Dr Ilona Croy**
Host Institution:	FRIEDRICH-SCHILLER-UNIVERSITÄT JENA - DEU

Touch-induced brain network signatures for social processing and stress reduction

As the digital nature of society increases, the frequency of human contact decreases. This seemingly inevitable relationship has potentially devastating consequences for the mental and emotional health of billions of people. Clear understanding and appropriate action are the only path to mitigating this looming crisis. Currently, the field of interpersonal touch research is a patchwork of theoretical frameworks and, worse still, lacks robust, ecologically valid experimental data. Objective One of TOUCHNET is to build a large database centered around interpersonal touch behavior: its frequency, triggers, and effects. A multi-center, ecological momentary assessment approach, will provide over 100000 individual touch events, connected to, in sub-sets, autonomous nervous system activity, questionnaires, social factors, and health (i.e. stress reduction). The TOUCHNET database itself will be a significant contribution to the field. Objective Two will leverage this database to probe the mechanisms by which touch has its effects. Merging concepts and assumptions across affective touch and social brain theories, I will examine touch-generated networks (neural signatures) associated with social processing and stress reduction. Ultra-high field, touch-no-touch, imaging experiments will compare connectivity and the functional input-output relation within social and allostatic-interoceptive brain networks. Further the direct effect of touch on communication, namely synchronicity, will be examined through fNIRS hyper-scanning. TOUCHNET will help clarify the role touch plays in society. A much-needed database of touch events will allow ecologically valid assessment across the field while detailed lab-based studies will advance our understanding of the interaction between touch, sociality, and stress. Finally, in an increasingly digital world, where touch substitutes may unfortunately be necessary, this work will take initial steps toward positive distance communication.

Link to the ERC project webpage:

Keywords of the ERC project: touch, ecological assesment, psychology, brain imaging

Keywords that characterize the scientific profile of the potential visiting researcher/s: neuroscientist, psychologist, data analysis, epidemiology

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
865077	**MitO2Health**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Iris Kolassa**
Host Institution:	UNIVERSITAET ULM - DEU

Major depression as a metabolic disorder: The role of oxygen homeostasis and mitochondrial bioenergetics in depression etiology and therapy

MitO2Health aims to develop and empirically prove a radically new pathophysiological model of Major Depressive Disorder (MDD) as a systemic energy deficiency disease. Traditionally, MDD is conceptualized as a neurotransmitter deficiency in the brain. However, with pioneering methods my group has provided evi-dence for reduced mitochondrial energy production in MDD, characterizing it as a cellular-metabolic disorder with a lowered production of adenosine triphosphate (ATP). Reduced mitochondrial bioenergy production and impairments in oxygen (O2) homeostasis (reduced levels of erythrocytes, less hemoglobin and its lower O2-binding affinity due to oxidative stress), as well as oxidative stress and inflammation (the "MitO2Health parameters") were consistently associated with an increased risk for MDD, but have been neglected so far in MDD research and therapy. In MitO2Health we will more comprehensively than ever before investigate the physiological mechanisms underlying MDD and will provide first longitudinal evidence on the mutual in-terplay between the MitO2Health parameters and MDD. Moreover, we will apply cognitive-behavioral therapy (CBT) as randomized treatment condition to test whether CBT-related MDD symptom reduction is coupled to a normalization of the MitO2Health parameters. We will treat 100 MDD patients with 6 months of CBT and compare them to 100 MDD patients of a waiting-list group and 100 healthy controls. Clinical and biological status will be assessed at four points over 18 months. We will thus characterize the biomarker pro-files of MDD treatment response and resistance as well as MDD symptom recurrence during a follow-up pe-riod. MitO2Health will not only establish a modern etiological model of MDD, but also identify biomarkers of individual therapy response and relapse. This will lead to new diagnostic standards and inspire personalized MDD treatment concepts that will fundamentally improve clinical outcomes in psychotherapy and psychiatry.

Link to the ERC project webpage: https://www.uni-ulm.de/en/in/psy-kbio/research-network/current-projects/mito2health/

Keywords of the ERC project: depression, mitochondria, energy metabolism, immunometabolism, stress, trauma

Keywords that characterize the scientific profile of the potential visiting researcher/s: psychology, biology, molecular medicine, biochemistry, immunology

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101039378	**NONMANUAL**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Vadim Kimmelman**
Host Institution:	UNIVERSITETET I BERGEN - NOR

Fundamentals of formal properties of nonmanuals: A quantitative approach

Sign languages, in addition to using the hands, also use positions and movements of other articulators: the body, the head, the mouth, the eyebrows, the eyes and the eyelids, to convey lexical, grammatical, and prosodic information. This linguistic use of the nonmanual articulators is known as nonmanuals. Contrary to current assumptions in the field of sign linguistics, this project proposes the hypothesis that all sign languages use the same basic universal building blocks (nonmanual movements) but that each language is different in how it combines these building blocks both sequentially and simultaneously. Languages also differ in the regularity, frequency, and the alignment properties of the nonmanuals. In order to test this hypothesis, the project will investigate formal properties of nonmanuals in five geographically, historically, and socially diverse sign languages using data from published naturalistic corpora of the sign languages, Computer Vision for extracting measurements of the movement of nonmanual articulators, and a statistical technique of Functional Data Analysis for a quantitative comparison of dynamic nonmanual contours. This will result in the first quantitative formal typology of nonmanuals grounded in naturalistic corpus data. The novel methodology proposed in this project requires testing, adjustment, and development, which constitutes an important component of the project. The developed methodological pipeline will be a secondary output enabling large-scale reliable quantitative research on nonmanuals in future. Finally, the established typology of formal properties of nonmanuals in the five sign languages will serve as basis for a cross-modal comparison between nonmanuals and prosody/intonation in spoken languages in order to separate truly universal features of the human linguistic capacity from the effects of the visual vs. auditory modalities.

Link to the ERC project webpage: https://vadimkimmelman.com/nonmanual/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101041885	**TOHR**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Andrea Ravignani**
Host Institution:	UNIVERSITA DEGLI STUDI DI ROMA LA SAPIENZA - ITA

The Origins of Human Rhythm

Humans are particularly rhythmic animals. Why did the human sense of rhythm develop? Many hypotheses try to explain the origins of our acoustic rhythm capacities, but few are empirically tested, compared, and comparatively investigated. This project searches for the evolutionary roots of human rhythmicity, breaking new ground through three concerted approaches. First, I zoom in on key rhythmic properties: isochrony, an even occurrence of events in time, and meter, a relative accentuation of events. Second, I compare hypotheses on rhythm origins, selecting the most relevant ones to music and speech and testing them against each other. Third, I target rhythm precursors in other species as predicted by these alternative hypotheses. I test four hypotheses, which propose that 1) gait or 2) breathing control, and the ability to 3) learn new sounds or 4) sing in a chorus are evolutionary precursors to human rhythm. I will use different measures including behavior, electrophysiology, gait tracking, breathing, and computational modeling to test whether the four features above predict rhythmic capacities. Comparative animal work is needed to test whether similar evolutionary pressures lead to similar rhythmic traits. I will collect data from humans and four more species. I will test seals, displaying vocal learning, and porpoises; both mammals have developed breathing control. I will also test siamangs, displaying rhythmic locomotion, and indris; both primates naturally sing in choruses, a rare trait in non-human mammals. Finding rhythm in other species will provide a test bench to reconstruct the origins of human rhythm. Resting on my background in bioacoustics and mathematics, the project expands in new challenging directions, such as neurophysiology of marine mammals, automated gait analyses, and biomusicology. In brief, I will show which species have rhythm, and why humans evolved to be such chatty, rhythmic creatures.

Link to the ERC project webpage:

Keywords of the ERC project: rhythm, music, speech, neuroscience, psychology, animal behaviour, bioacoustics

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101042139	**e-Perinatal**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Emma Motrico**
Host Institution:	UNIVERSIDAD DE SEVILLA - ESP

Universal prevention of maternal perinatal mental disorders and its implementation as normalized routine practice

Maternal mental disorders are the most common complications during pregnancy and within the first year after childbirth (defined as the perinatal period) and are the leading cause of maternal suicide. Affected mothers cannot function properly, causing a devastating impact on the entire family. Effective primary prevention interventions are urgently needed. However, the current scientific evidence is insufficient to implementing primary preventive programs at the population level. I aim to establish the effectiveness of universal preventive interventions for maternal perinatal mental disorders and to support their implementation as normalized routine practice in global healthcare services. Integrating classical and emerging methodological frameworks (family systems, self-determination theory, and normalization process theory), as well as the perspective of patient and public involvement in research, I will: (a) Develop a personalized mobile-Health preventive intervention for mothers and their partners, which integrates evidence-based psychological components and personalized health recommendations; (b) Test preventive intervention effectiveness for reducing the incidence of maternal depression and anxiety disorder, reducing father/partner symptoms of depression and anxiety, and promoting child health and development; (c) Apply a causal methodology, to pinpoint the underlying mechanisms for the effectiveness of the preventive intervention; and (d) Understand the implementation process and identify the factors that can promote or inhibit implementation. With the multidisciplinary team that I lead – and a large-scale hybrid effectiveness-implementation trail in real-world maternal health services – this research programme promises to be the first in its field. The resulting robust scientific evidence and novel explanatory model will create a new research paradigm. A toolkit for implementation research will enhance translation as normalized routine practice.

Link to the ERC project webpage:

Keywords of the ERC project: Prevention; perinatal mental disorders; postpartum depression; women; primary health care; mHealth, perinatal loss, maternal care

Keywords that characterize the scientific profile of the potential visiting researcher/s: Prevention; perinatal mental disorders; postpartum depression; women; primary health care; mHealth, perinatal loss, maternal care

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Project ID:	Project Acronym:	Evaluation Panel:
101043216	**IN-MIND**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Silvia Benavides Varela**
Host Institution:	UNIVERSITA DEGLI STUDI DI PADOVA - ITA

Infant verbal Memory in Development: a window for understanding language constraints and brain plasticity from birth

Although infants perform more poorly than adults on many cognitive tasks, they are more competent language learners. Newborns must have access to an exceptional processing system where bits of the -inherently transient- speech signal remain encoded to build knowledge of the language around them. Memory, the ability to hold information in mind that is no longer present in the environment, is one of the most important components of this machinery. As yet, however, what characterizes the first cognitive and neural architectures of memory and if (and to what extent) these mechanisms constraint human language remain largely unexplained. IN-MIND proposes a fresh perspective that particularly emphasizes the study of verbal long-term and working memories as a journey in its development during infancy. The project aims to provide new insights into: i) how memories are formed at birth and sometimes stored for longer periods through the reorganization of neuronal circuits, ii) how infants' verbal memory capacities and limits vary as their brain evolves in the first months of life, iii) when verbal working memory capacities emerge and whether they account for concurrent and later language outcomes, and iv) to what extent memory measured in the laboratory relates to how language is implemented in the real world. I will address these issues using an innovative and multimodal approach that combines experiments with behavioral techniques, wearable neuroimaging, polysomnography, and naturalistic recording in newborns, typically developing infants and infants at-risk for language impairments. The outcomes of this research may lay the foundation for identifying vulnerabilities in verbal memory capacities as well as the temporal windows in which eventual interventions might be more effective. From a theoretical perspective, IN-MIND will inform debates regarding the origins of human language, by contributing to a more complete description of what makes an infant brain language-ready.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101055060	**EXPERIENCE**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Axel Cleeremans**
Host Institution:	UNIVERSITE LIBRE DE BRUXELLES - BEL

Are you experienced? An exploration into the functions and value of consciousness

Why would we do anything at all if the doing was not doing something to us? In other words: What is consciousness good for? Here, reversing classical views according to which subjective experience is a mere epiphenomenon that affords no functional advantage, I propose that the core function of phenomenal experience is to enable subject-level valuation: "What it feels like" is endowed with intrinsic value. Thus, I argue that it is only in virtue of the fact that conscious agents experience things and care about those experiences that they are motivated to act in certain ways and that they prefer some states of affairs vs. others. Conscious experience functions as a mental currency of sorts that makes it possible for agents to compare vastly different states of affairs in a common subject-centred mental quality space — a feature that explains that consciousness is unified. While my previous work was focused on the how question of consciousness, here, I propose to focus on the even more challenging question of the why of consciousness. EXPERIENCE will address this issue by pursuing a rich interdisciplinary program rooted in integrative philosophy of mind and in innovative cognitive neuroscience methods applied to the interactions between affect and consciousness in perception and action. The project is articulated over four work packages, each addressing a specific claim: (1) Subjective experience has intrinsic value, (2) The phenomenal field is valenced, (3) All intentional action is motivated by subjective experience & (4) Subjective experience has functional effects. EXPERIENCE is high-risk, for the function of subjective experience is largely unexplored territory, and high-gain, for it promises to question entrenched distinctions and to move the scientific approach of conscious a step closer to what we all know: That subjective experience matters. In fact, in many respects, it is the only thing that matters, as without it, life would simply not be worth living.

Link to the ERC project webpage: http://erc-xp.ulb.be

Keywords of the ERC project: consciousness, feeling, function, valence, affect, cognitive neuroscience

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101075690	**DISOBEY**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Emilie Caspar**
Host Institution:	UNIVERSITEIT GENT - BEL

The Disobedient Brain: The social neuroscience of non-compliance to immoral orders

The core goal of this project is to unravel the mechanisms of disobedience. To understand the factors that prevent an individual from complying with immoral orders, research should focus on two critical axes: (1) which social and situational factors support disobedience and (2) which individual traits and neuro-cognitive processes support disobedience. While the first axe has been extensively addressed in past literature, the second axe has scarcely been approached. DISOBEY is uniquely focused on developing a social neuroscience approach to understanding the mechanisms through which resistance to immoral orders may develop in a given situation. Two main neuro-cognitive processes will be considered: the sense of agency that one experiences when performing a voluntary action and the empathic response towards others' pain. The main hypothesis is that individuals who retain a high sense of agency and empathy for pain under coercion are more likely to resist immoral orders despite potential social costs. To validate this hypothesis, MRI and neuromodulation techniques will be used. The project will include WEIRD (Western, Educated, Industrialized, Rich & Democratic) adults, as well as very unique and rare non-WEIRD populations, such as military, genocide perpetrators, survivors and their offspring in Rwanda, and 'Righteous' individuals who rescued lives from extermination during genocides. Including these populations will also allow to validate my hypothesis beyond WEIRD societies, with individuals who actually experienced the disastrous consequences of obedience during real-life events. With this project I aim to pioneer a new area of research that will have deep societal implications. In the future, I intend to develop specific education programs in the future, with the NGOs I am currently working with, for both military members and civilians in vulnerable societies that seek to prevent illegitimate violence on the ground of compliance to authority.

Link to the ERC project webpage:

Keywords of the ERC project: Social Neuroscience

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101076054	**GENERALISE**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Thomas Schindler**
Host Institution:	UNIVERSITEIT VAN AMSTERDAM - NLD

Generalisation into sentence and predicate positions

Generalisations are fundamental to every scientific discipline: 'Every cell has a plasma membrane', 'Every electron has a negative charge', 'Every natural number has a unique successor'. By means of generalisation we turn a statement about a particular individual into a statement about a class of entities. Generalisations are essential to valid deductive reasoning. They are the building blocks of virtually every scientific theory, and therefore essential to understanding, explaining, and making predictions.

The most basic and best understood form of generalisation is generalisation over objects (e.g. cells, electrons, numbers). In formal logic, this form of generalisation is achieved via first-order quantifiers, i.e. operators that bind variables in argument position. But many theoretical contexts require generalisation into sentence and predicate positions, a high-level form of generalisation where we make a general statement about a class of statements (e.g. mathematical induction, laws of logic).

There are two competing methods for achieving this form of generality (i.e. higher-order logic and self-applicable theories of truth, properties, and sets respectively). As both methods come with their own ideological and ontological commitments, it makes a substantial difference which one is chosen as the framework for formulating our mathematical, scientific, and philosophical theories.

Some research has been done in this direction but it is still very much in its early stages. This research project will significantly advance this foundational project. It will provide the first sustained systematic investigation of the two methods from a unified perspective, and develop novel formal tools to articulate deductively strong theories. Due to its foundational character, it will have an impact on many disciplines, especially the foundations of mathematics, logic, formal semantics, metaphysics, philosophy of language, and theoretical computer science.

Link to the ERC project webpage: https://projects.illc.uva.nl/GENERALISE/

Keywords of the ERC project: logic, theoretical philosophy

Keywords that characterize the scientific profile of the potential visiting researcher/s: logic, theoretical philosophy

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101077927	**DivCon**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Christine Howes**
Host Institution:	GOETEBORGS UNIVERSITET - SWE

Divergence and convergence in dialogue: The dynamic management of mismatches

Human interaction is deceptively simple to engage in, yet surprisingly challenging to account for theoretically. Existing theories of language and cognition cannot fully account for the complex dynamics of verbal and non-verbal behaviours in interaction, which is becoming even more apparent with our increasing use of computer-mediated communication, such as the currently ubiquitous Zoom calls. With DivCon, my vision is to transform our basic understanding of human interaction by showing how successful dialogue is driven by incremental, local and dynamic processes of mismatch management.In our everyday interactions, we continuously make predictions about what will happen next, based on how our own and others' behaviour affects the world, to open up new possible courses of action. In dialogue, these predictions are about sounds, words, inferences and even non-speech actions such as gestures or eye gaze. If our expectations are not met, we have to ascertain if the mismatching input can be resolved, or integrated as a surprising but rewarding outcome (as in the case of humour). DivCon will produce a suite of corpus and experimental data for exploring the timely issues of communication via different forms of computer-mediated communication, including text-based chats, video calls and virtual reality meetings. To do this, the project will create a novel experimental platform for experiments in real time live multimodal interactions using avatars and virtual reality. The formal arm of the project will develop a precise theory of divergence and convergence in interaction which unifies verbal and non-verbal dialogue phenomena including gesture, gaze, feedback and laughter, using core notions of prediction and underspecification. This model will be implementable in conversational AI –an important step in the path to genuinely adaptive conversational AI systems, which are still beyond the reach of researchers despite the promise of recent decades.

Link to the ERC project webpage: https://www.christinehowes.com/research/divcon

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101086188	**BrainScape**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Simone Kühn**
Host Institution:	MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV - DEU

How the physical environment shapes the human brain

BrainScape constitutes a timely approach to study a widely unexplored aspect in the neurosciences, namely whether and how the physical environment that surrounds us day in, day out impacts our brain, well-being and mental health. BrainScape aims to spearhead the emerging field of Environmental Neuroscience and will make an impact by building a knowledge base for evidence-based urban planning to promote healthy living environments with significant practical implications. Given that our environment is undergoing rapid changes (urbanization, climate change), understanding how these changes may impact humanity is a crucial challenge of our time. First evidence suggests that long-term as well as day-to-day variations in exposure to solitary environmental factors (e.g. air pollution) may be relevant. The goal of BrainScape is twofold: (1) to identify the "active ingredients" of the environment by introducing a more holistic understanding of the environment, as a multi-layered complex phenomenon and (2) to gain insight into the pathways and mechanisms by which the environment affects the brain and mental health. To accomplish this, BrainScape will utilize existing large-scale cross-sectional and longitudinal neuroimaging data sets (UK Biobank, NAKO, HCHS, IMAGEN) to identify the most important features of the physical environment. These features will be at the core of prospective controlled studies, including a discordant monozygotic twin study. Here we will combine the assessment of objectively experienced (e.g., wearable sensors) and subjectively perceived environment with brain plasticity measured using 7 T MRI. The identification of the most influential environmental salutogenic features will inform a targeted intervention study and experiments in highly controlled lab environments using innovative VR technology combined with fMRI and fNIRS. The results will unravel the "active ingredients" of nature and the neural mechanisms by which they affect human beings.

Link to the ERC project webpage: https://www.mpib-berlin.mpg.de/research/research-centers/environmental-neuroscience

Keywords of the ERC project: environmental neuroscience, brain plasticity

Keywords that characterize the scientific profile of the potential visiting researcher/s: neuroscience, environmental science, geoscience

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101087869	**PassiveValueMarkers**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Tom Schonberg**
Host Institution:	TEL AVIV UNIVERSITY - ISR

Identification and change of passive value markers in the laboratory and naturalistic environments

When you look at a given object - are you calculating its value even if not prompted to doWhen you look at a given object - are you calculating its value even if not prompted to do so? Most theories of valuation claim that choice, prompt or in general elicitation are needed to induce valuation. However, the well-known mere exposure effect dating back to 1968, suggests that merely viewing an item can induce valuation and even enhance value. In this proposal I aim to demonstrate that valuation is an early and automatic process relying on visual, attentional and motor systems. PassiveValueMarkers offers a novel framework to identify biomarkers of value of individual items passively, without elicitation. The aims of PassiveValueMarkers are: 1) Identifying behavioural and neural passive markers for individual items using computational modelling in and influencing these markers ; 2) Detecting passive markers of value in gaze pattern analysis behaviourally and in the brain using fMRI; 3) Considering the gap that exists between laboratory studies and the real world, I will identify passive value markers in naturalistic virtual reality environments. The overreaching aim of this proposal is to develop a new theoretical framework on individual passive value construction and change. To do so, I will use a unique combination of neuroimaging, computational modelling, gaze-tracking analysis and virtual reality. This research will directly address an understudied area of how value for individual items is formed by the brain without active prompt or elicitation. Uncovering the mechanisms of passive value representation at the single item level and individualized per participant, will allow to design closed loop manipulations at the item level. This approach will serve as the basis for developing novel evidence-based methods for enhanced preference modification in healthy participants and in disorders with abnormal valuation such as addictions, mental illness, and eating disorders.

Link to the ERC project webpage:

Keywords of the ERC project: Value, fMRI, Eye tracking, Virtual Reality

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101115798	**SynPrePro**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Alejandro Tabas**
Host Institution:	BCBL BASQUE CENTER ON COGNITION BRAIN AND LANGUAGE - ESP

Empirical and mechanistic foundations for synergistic predictive processing in the sensory brain

Humans effortlessly process over 200 spoken words per minute in casual conversation. Speech recognition algorithms still fail at this challenging task. Our superior performance stems from our capacity to predict what the speaker may say next. Understanding how the brain uses these predictions to process the sensory input is crucial to understand perceptual function and dysfunction: dyslexia, autism and psychosis have all been linked to an impaired handling of predictions. Hierarchical predictive coding (HPC) is the current leading framework to understand how predictions help us processing sensory inputs. However, HPC is only compatible with the function and organisation of the cerebral cortex. This is a decisive shortcoming: while only cortical stages have the foresight to perform conceptually accurate predictions, only subcortical stations have the temporal properties required to correctly process fast sensory inputs. SynPrePro will reformulate HPC as an integrated theory explaining how cortical and subcortical stages work together to proficiently process fast and complex sensory inputs like speech. I will use a unique experimental-theoretical approach to study the human auditory pathway as a model for sensory pathways in four work packages (WPs). WP1 will use cutting-edge human neuroimaging to unravel the implementation of HPC in the auditory pathway. WP2 will use innovative model-based neuroimaging to identify the mechanisms responsible for the generation of conceptually accurate and temporally precise predictions. In WP3 I will develop a ground-breaking computational model to identify the neural mechanisms implementing HPC in the thalamocortical loop. WP4 will use big-data analytics to disentangle how cortical and subcortical stages work together to swiftly process speech. The outcomes will turn the cortical paradigm of HPC into an integrated theory of cortico-subcortical interactions, revolutionising our understanding of perceptual function and dysfunction.

Link to the ERC project webpage:

Keywords of the ERC project: cognitive neuroscience, computational neuroscience, bayesian cognition, auditory system, subcortical processing

Keywords that characterize the scientific profile of the potential visiting researcher/s: cognitive neuroscience, computational neuroscience

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101116408	**OutOfSpace**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Luca Rinaldi**
Host Institution:	UNIVERSITA DEGLI STUDI DI PAVIA - ITA

Structuring spatial knowledge through domain-general, non-spatial learning mechanisms

Is space the main organizer of our mental reality? The answer to this question is apparently "yes". According to recent views, nearly any type of knowledge would be organized through low-dimensional geometries relying on the same computations that are at play in the navigation of the physical space, as attested by the involvement of the hippocampal-entorhinal region in high-level cognition. From an evolutionary standpoint, spatial processing mechanisms might have thus developed from originally mapping the navigable environment to representing cognitive spaces. Moving beyond this spatiocentric view of the human mind, OutOfSpace will test the fascinating yet apparently counterintuitive hypothesis that non-spatial associative learning mechanisms are active (if not the main) ingredients in structuring spatial representations. To pursue this aim, OutOfSpace will employ cognitively plausible computational models (i.e., distributional semantic models) based on non-spatial associative learning mechanisms to extract latent knowledge from natural language; this non-spatial information will be then used to predict a variety of spatial representations, using a pioneering interdisciplinary approach that combines computational, behavioural, eye tracking, fMRI, TMS-EEG and intracranial EEG work in both sighted and blind individuals. OutOfSpace will thus make a breakthrough on two fronts: (i) probing whether language - a non-spatial learning environment - can encode and recode spatial knowledge without the need for a dedicated spatial memory system; (ii) attesting the strict interplay between spatial and non-spatial learning mechanisms in structuring mental representations. More generally, these findings will open the venue to developing a more comprehensive, empirically-based cognitive neuroscience framework for processing and representing spatial information.

Link to the ERC project webpage:

Keywords of the ERC project: Semantic memory; spatial memory; cognitive maps; computational models

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101116562	**CongUbangi**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Sara Pacchiarotti**
Host Institution:	UNIVERSITEIT GENT - BEL

The Congo-Ubangi watershed : An interdisciplinary approach to the genesis of a linguistic accretion zone in Central Africa

Central Africa's Congo-Ubangi watershed spans multiple ecozones in the northern margins of the rainforest. It is a major hotbed of linguistic, cultural and human genetic diversity with deep occupation history. This linguistic accretion zone is home to a complex mosaic of genealogically and typologically diverse languages spoken by small-size communities with different societal organizations, material cultures, and subsistence specializations. Despite the myriad of new insights it could generate about language evolution and deep human past, it is poorly known due to difficulty of access and an astonishingly intricate configuration. The aim of CongUbangi is to understand the present-day interconnections between language, material cultures and genes in the Congo-Ubangi watershed and project them as far back into the past as possible through a holistic, localized and locally-enforced interdisciplinary approach. The project team's core scientific expertise covers linguistics, ethnoarchaeology, and archaeology. Genetic and paleoenvironmental expertise is added through inter-university collaboration. CongUbangi will realize a breakthrough in our understanding of how linguistic diversity correlates with cultural and genetic diversity and why it originated and persisted in this specific ecoregion for millennia. New bodies of evidence from mutually-feeding disciplines will be integrated to determine whether (i) language shift is an adaptive strategy in response to environmental stress and (ii) past environmental changes impacted the synchronic distribution of linguistic enclaves. By untangling one of the most historically intricate areas of the continent, it will contribute to scores of theoretical and methodological issues in a large array of disciplines and blaze research trails in previously unimaginable directions. Beyond research, it will foster the preservation of small-scale autochthonous languages and cultures facing increasing extinction threats.

Link to the ERC project webpage: https://www.congubangi.ugent.be/

Keywords of the ERC project: linguistics, genetics, archaeology, Central Africa

Keywords that characterize the scientific profile of the potential visiting researcher/s: Central Africa, archaeology, population genetics, linguistics, computational methods

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Project ID:	Project Acronym:	Evaluation Panel:
101122484	**CreateKnow**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Lisa Genzel**
Host Institution:	STICHTING RADBOUD UNIVERSITEIT - NLD

Creating Knowledge

In this project I want to unravel how we build-up and update our knowledge networks depending on the amount of previous experience we have by testing my new theory on experience dependent learning. Current theory postulates memories to be stored initially as sets of neural representations spanning the hippocampus and weakly interacting neocortical modules. The spontaneous reactivation of new memories during a consolidation phase, would lead to strengthening of the neocortical memory trace. Consequently, pre-existing knowledge is proposed to be coded in the brain as a cortical network of neurons that allows for more efficient consolidation of new information. I recently developed a new theory, proposing that the existence of previous knowledge and therefore the extent of the cortical memory network, is a gradient of experience instead of being either present or not. The size and complexity of the knowledge network would influence where in the brain memories are encoded and how fast they are consolidated. I propose combining my innovative behavioural paradigm – the HexMaze - that enables investigatory access to various levels of experience, with different techniques in three species to test this theory. In mice, with immediate early gene expression techniques to visualize and manipulate the brain-wide memory network with the resolution of individual neurons. In rats, with electrophysiology to measure and manipulate memory reactivations during sleep as the mechanisms to enable consolidation. In humans, with targeted memory reactivation and magnetic resonance imaging to follow the evolution of learning over one year. The combination of species with their respective methods enables to observe effects as well as test for causality. The unique combination of meaningful behaviour with appropriate, precise techniques would provide ground-breaking insight into how we create and update our knowledge networks and change the way we view and test memory.

Link to the ERC project webpage:

Keywords of the ERC project: memory, cross species

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101123661	**SynSig**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Sigal Zilcha-Mano**
Host Institution:	UNIVERSITY OF HAIFA - ISR

An individual-specific understanding of how synchrony becomes curative

Human beings constantly go in and out interpersonal interactions in their daily lives; these interactions are assumed to have critical effects on mental health. But how such interactions affect mental health is poorly understood. SynSig suggests that interpersonal synchrony is an individual-specific mechanism underlying curative relationships. It seeks to go beyond the one-size-fits-all "the higher the synchrony the better" theoretical assumption underlying the state of the art research. It is the first to propose that individuals have their own individual-specific trait-like synchrony signature as manifests across interacting partners. It further proposes that to make interactions curative, it is necessary to induce an individual-tailored correction to such a signature. That is, the amount and direction of the changes in synchrony must be guided by the individual's synchrony signature. To develop an individual-specific understanding of synchrony, SynSig focuses on curative interactions encapsulated in time and space: the therapeutic relationship between the client and therapist. It will investigate the existence of individual-specific synchrony signature and how individual-tailored correction of the signature serves as the mechanism transforming relationships into curative ones. It will implement multimodal markers (motion, acoustic, physiological, facial expression) for disentangling the trait-like synchrony signature and state-like deviations from it, of individuals participating in multiple dyadic interactions with humans and virtual humans. The first multimodal feedback system on momentary deviations from the signature will be developed and used to facilitate individual-tailored changes in synchrony and draw causal inferences between such changes and mental health outcomes. The findings will provide new insights into the multi-layered individual-specific nature of synchrony, and bring us closer to understanding how human connections affect our mental health.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101125379	**Volta**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Nathan Faivre**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Unraveling how evidence accumulation determines conscious experience using voltammetry

Consciousness entails the phenomenal experience we have of the world and ourselves. Although it is at the heart of major philosophical, scientific and ethical issues, our understanding of the neural mechanisms of consciousness remains limited. The study of consciousness is compartmentalised, with researchers focusing on isolated sub-aspects of the problem, via restrictive paradigms that ignore the temporal dynamics of conscious experience, its metacognitive component, or its dependence on levels of consciousness. Moreover, we know virtually nothing about the single-neuron and neurochemical basis for consciousness in humans.

VOLTA will advance beyond these empirical and theoretical limitations by conducting a multidimensional and multiscale study of consciousness. The project builds on a computational framework I recently developed linking consciousness to evidence accumulation. It will utilise the clinical context of pharmaco-resistant epilepsy to collect unprecedented behavioural and neural data. Individuals with epilepsy will participate in novel behavioural paradigms quantifying multiple dimensions of conscious experience, including its temporal dynamics, metacognitive components, and existence under sleep and anaesthesia. These experiments will be combined with triple neural recordings that simultaneously characterise #1 the global activity of neural populations, #2 spiking activity of individual neurons, and #3 electrochemical activity by measuring neuromodulator release with voltammetry. These unprecedented recordings will provide a multiscale map of the neurobiological basis of consciousness. My team and I, assisted by international experts, will interpret this rich dataset in light of seven preregistered hypotheses derived from my computational framework.

In summary, VOLTA will carry out a first-of-a-kind within-subject study to reveal the electrophysiological and electrochemical mechanisms of the multiple dimensions of consciousness.

Link to the ERC project webpage: https://nfaivre.netliy.com

Keywords of the ERC project: consciousness, metacognition, electrophysiology, decision-making

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101141656	**TOTALBODY**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Lauri Nummenmaa**
Host Institution:	TURUN YLIOPISTO - FIN

Multisystem imaging of whole-body emotion circuits with total-body positron emission tomography

The goal of the TOTALBODY project is to establish the interacting biological networks supporting human emotions and their disorders across the brain and periphery using novel total-body positron emission tomography (PET) approach. The body-to-brain axis maps visceral signals onto emotions, driving complex motivated behaviours. Negative emotions are risk factors for cardiovascular diseases (CVDs) Conversely, CVDs are associated with anxiety, highlighting the link between negative emotions, bodily functions, and somatic health. Systems-level interaction between brain and peripheral organs could thus be a key pathway underlying psychiatric disorders, but it remains poorly understood. TOTALBODY tackles this question from ground-breaking viewpoint by implementing novel total-body PET approach for measuring the physiology of the emotion circuits across the brain and body, creating an innovative multisystem biology approach for studying emotions. We simultaneously map activity in the brain and peripheral organs during pharmacologically and psychologically induced emotions in a large sample (n=240) of healthy volunteers and patients with generalized anxiety disorder (GAD). Links between CVDs, GAD, and whole-body emotion circuit activation are mapped in a clinical study involving 300 patients with suspected CVD. The data are analysed using state-of-the art multi-organ modelling framework developed in the context of the project. Advanced pattern recognition techniques implemented on the whole dataset (540 subjects) are used for discerning the central-peripheral pathways associated with future onset of anxiety and CVD. Anxiety and CVDs constitute a major burden for health and well-being worldwide. This unique large-scale analysis of the central-peripheral axis of anxiety and cardiac functioning enables delineating biological and psychological mechanisms that generate the central and peripheral anxious state and burden the cardiovascular system predisposing individuals to CVD.

Link to the ERC project webpage: emotion.utu.fi

Keywords of the ERC project: emotion, positron emission tomography, brain, imaging, cardiovascular function, anxiety

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101142133	**VALENCE ASYMMETRIES**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Isidora Stojanovic**
Host Institution:	UNIVERSIDAD POMPEU FABRA - ESP

Valence asymmetries: the positive, the negative, the good and the bad in language, mind and morality

An asymmetric behavior between the positive and the negative has been evidenced in psychology, for information processing, attention, recognition and decision making, in philosophy, for judgments about morality and intentionality, and in linguistics, for a range of lexical, syntactic, semantic and pragmatic phenomena. Negative information grabs our attention, we process it more carefully, we recall it with greater precision. We easily blame others for the negative side-effects of their actions, but do not praise them for the positive ones. It takes many nice words to overthrow one nasty remark. When we say that something is "not good", we usually imply that it is bad, but by saying "not bad" we do not imply that it is good. Valence asymmetries have arisen on many horizons but have seldom been brought into correspondence, and are at odds with most theories of value. The present project is a pioneering attempt to secure the premises for a cross-fertilization between the different accounts of valence asymmetries. It will deploy methods from philosophy (argumentation and conceptual analysis), formal semantic and value-theoretic models, and experimental methodology from psycholinguistics and moral psychology. It has three main objectives: - highlight the fundamental role that valence plays beyond emotion, in particular, in value judgments and language; - examine what the different asymmetries have in common, and whether they call for a unified explanation; - show that valence asymmetries are not necessarily irrational, but often derive from a fundamental asymmetry between positive and negative value, and, as such, are a key component of our cognitive and linguistic architecture. Furthermore, we will (a) articulate the relationship among the notions of valence, value and polarity; (b) put forward a novel account of the asymmetry of negation; (c) unearth new asymmetries in the realm of morality, virtue and vice; and (d) provide an account of valence reversals.

Link to the ERC project webpage: https://www.upf.edu/web/valence-asymmetries

Keywords of the ERC project: valence, emotion, value, meaning, morality, cognition

Keywords that characterize the scientific profile of the potential visiting researcher/s: value theory, emotion, experimental pragmatics, psycholinguistics, moral psychology

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Project ID:	Project Acronym:	Evaluation Panel:
101162166	**Lo-Rig**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Timotheus Bodt**
Host Institution:	THE PROVOST, FELLOWS, FOUNDATION SCHOLARS & THE OTHER MEMBERS OF BOARD, OF THE COLLEGE OF THE HOLY & UNDIVIDED TRINITY OF QUEEN ELIZABETH NEAR DUBLIN - IRL

Biactantial Agreement in the Endangered Gongduk and Mönpa Languages of Bhutan

Gongduk and Mönpa are two Sino-Tibetan languages of Bhutan with no known relatives within the language family. Despite their unique morphosyntactic feature of biactantial verbal agreement, both languages have been largely overlooked in the literature. Gongduk and Mönpa are also at a high risk of extinction. Therefore, it is of absolute necessity that we write their descriptive grammars, based on a natural speech corpus, before they disappear forever. When a people lose mastery of their mother tongue, they often suffer from a loss of identity, and subsequently a plethora of emotional, mental, and social problems. Realising that the description of the world's languages can provide indigenous communities with the basic set of materials to promote their linguistic heritage and counteract such negative developments, the United Nations has declared 2023-2032 the International Decade of Indigenous Languages. At the same time, linguistic description offers science the opportunity to conduct ground-breaking typological and historical linguistic research. The exhaustive description of Gongduk and Mönpa will enable us to compare their verbal agreement systems to those of other Sino-Tibetan languages and infer the implications for the origin and development of verbal agreement and the language family as a whole. Bhutan's unique cultural and linguistic heritage forms one of the cornerstones of its national identity and development philosophy. Technological advances present both a risk and an opportunity for safeguarding this heritage. The Lo-Rig project team will apply and develop innovative methods that speed up and simplify the transcription of recorded texts, using technologies such as Automatic Speech Recognition, and software applications for the subsequent analysis and dissemination of under-resourced, endangered languages. They will also train Bhutanese linguists, contributing to a more sustainable future of Bhutan's languages, and produce outputs for language promotion.

Link to the ERC project webpage: https://www.tcd.ie/slscs/research/research-projects/lo-rig/

Keywords of the ERC project: linguistics; Trans-Himalayan; Bhutan; language revitalisation; language endangerment; verbal agreement

Keywords that characterize the scientific profile of the potential visiting researcher/s: Automatic Speech Recognition; low-resource languages; language revitalisation

Project ID:	Project Acronym:	Evaluation Panel:
101170162	**DYNALANG**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Andrea Martin**
Host Institution:	MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV - DEU

Integrating structure and statistics in language processing: an ecological neural dynamics and manifolds approach

Language is a vital aspect of human life. Whether it is processed predominantly by its structure (grammar) or statistics (word probabilities) is a contention long debated in Psychology and Linguistics, reignited by the rise of statistics-based models like ChatGPT. Crucially, the brain preserves linguistic structure (speech sounds, grammar, pragmatics) while adapting to the statistics of a changing environment (new words, slang, diverse accents). Unraveling our ability to encode both structure and statistics is key to neurocomputational theories of language. Contemporary neuroscientific models excel at harnessing statistical properties of text, but overlook both linguistic structure and face-to-face language use— the source of the 'true' statistics the brain relies on. DYNALANG pioneers a new path for the neuroscience of language by using neural dynamics to integrate structure with ecologically-valid statistics. In contrast to existing approaches, it hypothesizes that structure and statistics support each other. It uses MEG and dual-EEG across four typologically-distinct languages and behaviors(listening, speaking, multimodal conversation) to discern the boundary conditions for integrating structure and statistics, forming the basis of innovative models reflecting the brain's statistical experience. DYNALANG harnesses neural dynamics, the intricate patterns in interconnected neuronal activity, as the brain's intrinsic computational method for information integration. DYNALANG develops manifold language models— latent spaces where neural and behavioral dynamics combine with linguistic annotations, whose dimensions and geometry isolate neural computations. DYNALANG will give unique insight into how speech and gesture form language in the brain, envisioning linguistic representation as dynamic rather than static. This will fundamentally change computational and neurobiological theories of language, impacting future brain-computer interfaces, clinical prostheses, and AI.

Link to the ERC project webpage:

Keywords of the ERC project: spoken language processing, psycholinguistics, computational modelling, magnetoencephalography, neural oscillations, neural manifold models, temporal response functions

Keywords that characterize the scientific profile of the potential visiting researcher/s: language, linguistics, neuroscience, category theory, manifolds

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Project ID:	Project Acronym:	Evaluation Panel:
101171291	**LaDy**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Kristof Strijkers**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Language in the Dyad. Linking linguistic and neural alignment.

Current research in linguistics, psychology, and neuroscience predominantly focuses on the individual, neglecting the dynamic interplay between interlocutors as the primary form of communication. This project aims to address this limitation by investigating language and the brain in their most functional context, the dyad. The objective is to connect the cognitive mechanisms of dialogue with the neurophysiology of interacting brains. The central theme of this project is the concept of alignment, since it is observed in both behaviour and brain activity. Linguistic alignment concerns the convergence of language use between interlocutors. Neural alignment refers to correlated brain activity between speakers and listeners. While tempting to assume both phenomena are related, at present this is an open question. This project sets out to investigate whether neural alignment is the brain's signature of linguistic alignment, and whether prediction is the mechanism that can link neural and linguistic alignment. To achieve these objectives, the project employs a novel paradigm combining EEG hyper-scanning with interactive dyadic language games. Preliminary results highlight the feasibility of this novel paradigm to assess interactive naming behaviour. Using this approach, three work packages will explore (1) neural alignment for basic linguistic components, (2) the impact of prediction on alignment, and (3) the emergence of neural alignment in spontaneous linguistic interactions. This interdisciplinary proposal has ground-breaking potential: If successful, the project will significantly advance our understanding of language in interaction, shed light on the role of prediction in the dyad, and provide a brain basis for models of dialogue and conversation. In sum, this comprehensive approach seeks to unravel the intricate connections between neural and linguistic alignment while exploring the role of prediction as a fundamental driver of these phenomena.

Link to the ERC project webpage:

Keywords of the ERC project: psycholinguistics, neurolinguistics, language production, alignment, dialog

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101171380	**RUNES**	**SH4** The Human Mind and Its Complexity

Principal Investigator:	**Dr Giovanni Petri**
Host Institution:	Northeastern University - London - GBR

Reconstruction and Unification of Neural and Ecological Systems

In the last two decades, network science has revolutionized our understanding of diverse biological, social, and technological systems, becoming a cornerstone across various scientific and technological domains. Traditional network models, however, predominantly focus on pairwise interactions, often overlooking the complexity of higher-order interactions (HOIs) that involve more than two elements. This oversight is significant, as emerging evidence increasingly demonstrates that HOIs are not only prevalent but also critically influence the emergent behaviors of complex systems, thereby impacting our ability to comprehend and forecast their dynamics.

RUNES aims to pioneer a novel paradigm in network science, tailored to the intricacies of higher-order systems. This project will develop a holistic mathematical, methodological, and empirical framework to effectively understand, predict, and manipulate HOIs. This will involve redefining existing network models to incorporate higher-order interactions, combining information-theoretic and topological perspectives, and formulating new dynamical processes on these advanced substrates.

Concurrently, RUNES will innovate in developing model-informed statistical methods for inferring HOIs from data, enabling us to discern their unique structures and functions. This framework will be applied in two groundbreaking contexts: firstly, in experimental behavioral science, where we will quantify the impact of HOIs in controlled human group experiments; secondly, in neuroscience, where we will investigate the higher-order functional topology of the brain across various conditions, ages, and species.

RUNES' new science of higher-order real-world complex systems will directly impact how we think about and deal with structural and dynamical patterns in many contexts, including epidemiology, artificial intelligence, economy and medicine.

Link to the ERC project webpage: https://nplresearch.github.io/

Keywords of the ERC project: higher-order networks, information integration, complex systems,

Keywords that characterize the scientific profile of the potential visiting researcher/s: inference, cognitive AI, AI agents, social coordination, foundations of network science

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Project ID:	Project Acronym:	Evaluation Panel:
101039904	**EXILED-EMPIRICISTS**	**SH5** Texts and Concepts

Principal Investigator:	**Dr Sander Verhaegh**
Host Institution:	TILBURG UNIVERSITY- UNIVERSITEIT VAN TILBURG - NLD

Exiled Empiricists: American Philosophy and the Great Intellectual Migration

In the 1930s, hundreds of European academics fled to the United States, escaping the quickly deteriorating political situation on the continent. Among them were a few dozen philosophers from a variety of different schools: logical empiricists, phenomenologists, and critical theorists. Especially the first group would have a tremendous impact on American philosophy. Although the local intellectual climate had been dictated by distinctively American traditions such as pragmatism, U.S. philosophers soon began to advance views that were heavily indebted to the empiricists, thereby transforming the American philosophical landscape. Historians have reconstructed the fate of the exiled empiricists. Still, little attention has been paid to the American context in which their movement came to full bloom. This is remarkable since any account of the empiricists' success requires an explanation of why the Americans were so susceptible to their views. What explains the surprisingly positive reception of logical empiricism? And why were the Americans more receptive to empiricism than to phenomenology or critical theory? This project shifts the perspective from the migrant philosophers to the local philosophical climate by 1) quantitatively analyzing thousands of American journal publications and 2) qualitatively examining the archives of dozens of key U.S. philosophers and institutions. Today, it seems natural to carve up the philosophical landscape into an 'analytic' and a 'continental' tradition. Yet few philosophers realize that this deeply engrained distinction is relatively new; it first became popular in the United States in the years after the intellectual migration. In studying the unique American melting pot of philosophical schools (e.g. pragmatism, logical empiricism, phenomenology, critical theory), this project offers a broader, unifying perspective on 20th-century philosophy, thereby transcending the school-based barriers that have often shaped its historiography.

Link to the ERC project webpage: https://exiledempiricists.wordpress.com/

Keywords of the ERC project: logical empiricism; intellectual migration; pragmatism; american philosophy

Keywords that characterize the scientific profile of the potential visiting researcher/s: logical empiricism; intellectual migration; pragmatism; american philosophy

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Project ID:	Project Acronym:	Evaluation Panel:
101040059	**NoJoke**	**SH5** Texts and Concepts

Principal Investigator:	**Dr Mirco Göpfert**
Host Institution:	JOHANN WOLFGANG GOETHE-UNIVERSITAET FRANKFURT AM MAIN - DEU

Humour as an epistemic practice of the political present

Something weird is happening in politics. Satirical parties, comedic journalism and memeification are gaining more and more traction; the slippages between parody and sincerity, play and earnestness, real and fake, ridicule and seriousness have proliferated at a dizzying rate. Global entanglements, new technologies, and the surge in populist politics are producing a cacophony of intricate cognitive, social, and economic dissonances bordering on the absurd. The underlying hypothesis of NoJoke is that these dissonances, and the comical reactions produce, have become formative phenomena of the political present; they have seeped into the social fabric and into the ways in which people appropriate their lifeworlds and make sense of themselves and others as political actors. The practice of humour, NoJoke argues, can help us to make sense of the political present; it offers a unique methodology of discovery, a specific education by attention with regards to dissonances that elude conventional academic methods. Bringing together insights from the anthropology of politics and the political, from studies on humour, satire and laughter, and from anthropological advances in ontology, epistemology and methodology, NoJoke will conduct research with humour and humourists, and not merely on them, and establish a radically new approach to the study of the political present. Through a long-term comparative study with caricaturists, comedians, writers of satire, satirical politicians and comedic journalists in Berlin, Brussels, Budapest, Caracas, Johannesburg and the Iranian diaspora, it will follow three objectives: (1) to explore the intrusion of humour and humourists into the field of politics; (2) to articulate a theory of humour as an epistemic practice ? a mode of perception, creation and anticipation ? in and of the political present; (3) to launch an alternative practice of academic knowledge production by converting the heuristic of punchlines into a practice of theory.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101040938	**GOLEM**	**SH5** Texts and Concepts

Principal Investigator:	**Dr Federico Pianzola**
Host Institution:	RIJKSUNIVERSITEIT GRONINGEN - NLD

Graphs and Ontologies for Literary Evolution Models

The "Graphs and Ontologies for Literary Evolution Models" (GOLEM) project will create statistically robust models explaining how fiction evolves, based on the analysis of millions of stories and the effects they have on readers. This is the first time in history that this kind of data is available on such a large scale, thanks to the fact that readers all over the world use digital and social media to share fictional stories and to comment on them, e.g. on fanfiction websites or on publishing platforms like Wattpad. GOLEM will use computational literary studies and cultural evolution theory to create accurate models of how the (formal and content-related) cultural traits found in fiction spread and combine. The basis of this evolutionary analysis of fiction will be a knowledge graph database – an infrastructure of interlinked data about stories and reader response – which will be used to test hypotheses related to the accumulation of cultural traits in stories and their effectiveness in achieving cognitive and emotional effects on readers. State-of-the-art machine learning algorithms and advanced statistical modelling tools will be employed to create a major breakthrough in computational literary studies, possibly also contributing to the revision of cultural evolution theories. By focusing on the relations between stories in five different languages, collected from countries in all continents, GOLEM will provide an unprecedented insight into how storytelling, one of the most ancient cultural systems, evolves. Literary history and criticism have offered refined accounts of how fiction works, mostly relying on case studies of limited extent. It is now time to provide robust statistical evidence of the anthropological function of fiction and of how it adapts to different circumstances and cultures, empowering readers to cope with their cultural or societal contexts.

Link to the ERC project webpage: https://golemlab.eu/

Keywords of the ERC project: digital humanities, computational literary studies, semantic web, narrative, NLP

Keywords that characterize the scientific profile of the potential visiting researcher/s: NLP, semantic web, digital humanities, literary studies, reading research, cultural sociology

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Project ID:	Project Acronym:	Evaluation Panel:
101041284	**THINGSTIGATE**	**SH5** Texts and Concepts

Principal Investigator:	**Dr Tintin Wulia**
Host Institution:	GOETEBORGS UNIVERSITET - SWE

Things for Politics' Sake: Aesthetic Objects and Social Change

THINGSTIGATE aims to theorize how aesthetic objects mediate sociopolitical transformation. In a world where affective imagination increasingly sways society and politics, it is urgent to grasp the link between imagination, emotions, and sociopolitical institutions. Art for social change, 'socially engaged art', is pertinent, but its theories now dwell on usefulness. Imbued in a post-object relational art tradition despite the material turn in humanities and social sciences, these theories overlook aesthetic objects' role in social processes. Tackling this, THINGSTIGATE draws on empirical hypotheses to assess aesthetic objects as a pivot of imagination, emotions, institutions. It extends aesthetic cosmopolitanism in confronting the imagined community of the nation-state as an institution. How do aesthetic objects behave in social relations, instigate change through imagination, intervene in the nation-states' institutionalizing paths? How can they transform the imaginaries of a specific nation-state, and of a world beyond the nation-states? The study's novel interdisciplinary methodology dissects the making of sociopolitical cultures by empirically tracing socially engaged objects – physical and digital – while they are in action, via artistic practice-based research. A posited framework will link imagination, institutions, and a relational objects typology distilled from major archives worldwide. It is then tested in two quantitative and qualitative fieldwork streams: iterative – via Make Your Own Passport workshop series in highly diverse public spaces in Sweden, Italy, and USA– and longitudinal –via 1965 Setiap Hari, a transnational social media initiative for Indonesia. The study's impacts are manifold: in opening up a new, theoretically grounded methodological field of artistic practice-based research, it will advance the discourse on humans' relations with others in sociopolitical imagination and institution, a long debate since antiquity, in art and beyond.

Link to the ERC project webpage: https://www.gu.se/en/research/things-for-politics-sake-aesthetic-objects-and-social-change-thingstigate

Keywords of the ERC project: art and sociopolitical change, socially engaged art, social practice, things-in-common, aesthetic objects, aesthetic agency

Keywords that characterize the scientific profile of the potential visiting researcher/s: artistic researcher

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101042052	**ORE**	**SH5** Texts and Concepts

Principal Investigator:	**Dr Veli-Matti Karhulahti**
Host Institution:	JYVASKYLAN YLIOPISTO - FIN

An Ontological Reconstruction of Gaming Disorder: A Qualitative Meta-Phenomenological Foundation

Videogames have become one of the most prevalent forms of cultural production around the world. While their role in teaching and physical culture ("esports") keeps growing, the health debates on videogame play, or gaming, culminated in 2019 with the World Health Organization's historical decision to add "gaming disorder" to the International Classification of Diseases. This made gaming, next to gambling, the first and only cultural product with a diagnostic category of addictive use. The above echoes a greater conflict between culture and human development: how can science address potential problems in intensive technology use, when intensive use is also globally integrated into healthy everyday living? To build a foundation for answering this question, I pursue a Meta-Phenomenological Taxonomy of intensive gaming on three levels of lived experience: play, health, and design interaction. The taxonomy is "meta-phenomenological" in the sense that it is structured on the experiences of intensively gaming individuals. These experiences surface in distinct sociocultural contexts in interaction with specific videogame designs, which are the studied meta-areas. This interdisciplinary project is cross-cultural, longitudinal, and qualitative. Participants with and without health problems (n=240) will be followed for three years in South Korea, Slovakia, and Finland. In collaboration with clinical experts, phenomenological interviews are carried out with diaries that include gaming activity logs. The design structures of the videogames in the participants' lives are analyzed to map out the phenomenological forest of health and play with specific design interactions. The elements are refined into a taxonomy that not only serves as a new foundation for "gaming disorders" but also situates such instances in the colorful spectrum of diverse lives and designs at large—providing grounds for sustainable future theory development at the intersection of health, culture, and design.

Link to the ERC project webpage: https://ore.jyu.fi

Keywords of the ERC project: psychiatry, qualitative research, technology use, clinical psychology, gaming

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101042729	**PhiSci**	**SH5** Texts and Concepts

Principal Investigator:	**Dr Paul Kurtz**
Host Institution:	UNIVERSITEIT GENT - BEL

Philology as Science in 19th-Century Europe

Philology once defined what it meant to be scientific – and it may yet once again. Increasingly a broad array of scholars using digital methods cite the historical accomplishments of philology as a model for systematic study around unwieldy and heterogenous textual corpuses. Despite this renewed interest, there is still no systemic account for the huge range of activity and aegis, data and networks, that propelled philology to its status as a model or even the 'queen of science' in C19 Europe. In drawing on history of science, media studies, information studies and diverse textual methods, this project offers that holistic account of how and why philology as a 'science in the making' achieved such extraordinary success. It articulates the widely sought yet unachieved bridge that would permit rigorous interdisciplinary exchange between philology – its historical and contemporary iterations – and present-day endeavors in the fields of digital humanities, critical data studies, infrastructure studies and de/post-colonial studies. PhiSci takes philology seriously as a science and gives it the kind of treatment that has dominated history of science for the last generation. Pioneering a novel account of philology from the French Revolution to First World War, it pursues a central question: How did local ensembles of protocols, representation, instrumentation and cooperation consolidate into robust programs for the genesis of stable knowledge and knowledge communities? It gives special attention to heterogeneity and universality in key concepts and practices and to physical aspects like media and infrastructure: elements undervalued or rarely grasped in terms of their epistemic work for producing data, evidence and facts. PhiSci will thus explain how philology operated as a relational system that – in the diversity of its data and perpetual flux in its projects and personnel –projected unity that enabled it to wield a scientific authority greater than the sum of its parts.

Link to the ERC project webpage: https://www.metaphilology.ugent.be

Keywords of the ERC project: History of Science, Cultural History, Media History, History of Philology

Keywords that characterize the scientific profile of the potential visiting researcher/s: History of Science, Cultural History, Media History, History of Philology

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101043730	**BICROSS**	**SH5** Texts and Concepts

Principal Investigator:	**Dr Christina Maria Kreinecker**
Host Institution:	KATHOLIEKE UNIVERSITEIT LEUVEN - BEL

The Significance of Bilingual Manuscripts for Detecting Cross-Language Interaction in the New Testament Tradition

BICROSS is an interdisciplinary project linking Greek, Latin, Syriac, Coptic, Gothic, Armenian and Arabic philology, New Testament textual criticism, manuscript studies, ancient history and digital humanities. Little is known about the bilingual New Testament manuscripts, although translations occur remarkably early. Their physical and textual characteristics, relations, tendencies and impact remain understudied despite their centrality to the understanding of the transmission of the New Testament and its reception in different cultures. For centuries New Testament manuscripts have been studied from a monolingual perspective which has obscured the fact that the textual transmission did not take place solely within the boundaries of a single-language tradition but also across languages. Uncovering and establishing the mutual exchange and cross-language interaction require a new multilingual approach to the New Testament tradition. BICROSS breaks through the current monolingual limitation by shifting the discipline's focus to the overall New Testament tradition. Accepting the possibility that each variant reading could have had its potential source in a reading from a different language tradition and may likewise have caused a dependent reading in any of the other language traditions breaks new ground. The project's bold and pioneering cross-language approach brings a fresh perspective to the discipline's current search for new paradigmatic concepts to explain the relations of New Testament readings and manuscripts at large. BICROSS develops specific digital tools to process the vast and linguistically complicated manuscript data in order to pioneer an examination of the entire New Testament bilingual tradition on a larger scale than has ever been possible. The results will provide new insights into the formation and transmission of New Testament texts and will influence the understanding of historical, cultural and linguistic exchange in the East and West.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101044244	**Fish-A**	**SH5** Texts and Concepts

Principal Investigator:	**Dr André Tavares**
Host Institution:	UNIVERSIDADE DO PORTO - PRT

Fishing Architecture: The Ecological Continuum between Buildings and Fish Species

To what extent can fish produce architecture? This project sets out to trace a socioecological history of North Atlantic architecture in relation to fisheries, elucidating the relationships between marine environments and terrestrial landscapes and assessing the ecological impact of fishing constructions and the natural resources they depend upon. Fishing Architecture covers a broad spectrum in terms of both geography and time, a choice that was made to avoid deterministic analysis and engage with transnational phenomena. Thus, the focus is on the North Atlantic—its shores housing diverse architectural cultures and its waters home to a wealth of fish species—and follows a time frame that runs from the industrialization of fisheries in the early 19th century to the full globalization of the industry at the end of the 20th. The extant scholarship on marine ecology, fisheries, and fishing communities includes extensive research on fish populations, navigation systems, technology, bioeconomics, architecture, and cultural practices. Yet, comprehensive interdisciplinary analysis of the field is hindered by its own specialization. Facing the impending challenges of the environmental predicament, this project will use the material history of architecture as a powerful tool for advancing interdisciplinary research and, along with it, our understanding of the ecological impacts of human activity. The assessment will be organized along five analytical axes: (1) marine ecosystems; (2) fishing technology; (3) food processing; (4) politics; and (5) consumption habits, effectively avoiding the conventional architectural approach to understanding the built environment. This strategy allows us to identify critical knowledge gaps to be worked on and, most significantly, fosters a fresh perspective on construction in which fishing landscapes and buildings are understood as material traces of dynamic socioecological relationships and as part of the continuum between land and sea.

Link to the ERC project webpage: https://fishingarchitecture.com/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101053993	**ENDURE**	**SH5** Texts and Concepts

Principal Investigator:	**Dr David Gregory**
Host Institution:	NATIONALMUSEET - DNK

Sustainable preservation of underwater archaeological sites: A novel approach to cultural heritage management

Cultural heritage is the legacy of tangible, intangible and natural heritage assets of a society that is inherited from past generations. Preserving the remains of the past for the benefit of future generations is common in international heritage policy. Current management practice advocates preserving underwater cultural heritage (UCH) where it lies on the seabed, in situ. However, this practice is questioned due to a lack of understanding of the entangled threats posed by multiple natural and anthropogenic drivers. In a rapidly changing ocean environment and increasing human exploitation of the marine environment, it is necessary to develop new concepts for assessing and preserving this resource. With over 3,000,000 shipwrecks and thousands of submerged prehistoric sites lying on the floors of the world's oceans, ENDURE aims to disentangle both natural and anthropogenic decay processes, determine their cumulative and interactive effects on UCH and proposes a novel conceptual framework to preserve this heritage based on site entropy. This will be achieved by: 1) Detect, visualise and interpret the products of natural and anthropogenic decay of shipwrecks and submerged prehistoric sites using marine remote sensing techniques integrated with natural and anthropogenic variables in a GIS platform; 2) Determine key natural processes and rates of decay of archaeological materials in situ and in the laboratory; 3) Remotely identify and rank simultaneous decay processes, including increasing threats to hidden and largely inaccessible heritage sites using ecosystem modelling, and 4) Propose novel intervention methods to mitigate threats to UCH and where not possible, strategies for curated decay. Ultimately, ENDURE's holistic structured framework can be synergistically integrated and implemented by stakeholders and marine practitioners for a sustainable preservation of the marine environment and the world's underwater cultural legacy for future generations.

Link to the ERC project webpage: www.endureerc.com

Keywords of the ERC project: underwater cultural heritage, management, deterioration, preservation

Keywords that characterize the scientific profile of the potential visiting researcher/s: 3D documentation and visualisation and structural modelling of cultural heritage

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101054750	**LAUDARE**	**SH5** Texts and Concepts

Principal Investigator:	**Dr Francesco Zimei**
Host Institution:	UNIVERSITA DEGLI STUDI DI TRENTO - ITA

The Italian Lauda: Disseminating Poetry and Concepts Through Melody (12th-16th centuries)

The lauda, a vibrant expression of popular piety, is the poetic-musical genre that from the second half of the twelfth century marked the birth and the spread of singing in the Italian language. It was based on melodies of varied origins, but mostly functional in orally conveying – through minstrels, lay confraternities and preachers – the dissemination of texts and (not only spiritual) concepts among a largely illiterate population. Despite this 'volatility', a good corpus of laude has been preserved in written form for ritual needs, sometimes with musical notation, forming an impressive repository of 'frozen orality'. While realizing the importance and vastness of this heritage, scholars for over a century have been mainly engaged in alternatively considering it either from a literary or a musical point of view. Therefore, no systematic research has yet to shed light on the specific nature of the phenomenon, its dynamics of creation and transmission and all indicators that make it a reliable mirror of society, culture and mentality in medieval and early Renaissance Italy. The LAUDARE project aims to approach the Italian lauda in its intrinsic intermediality by collecting the whole corpus of texts handed down with music up to the mid 1500s and comprehensively exploring the dynamics of composition and transmission of poems and related tunes according to the mechanisms of orality. An open access database, making searchable the entire corpus, will allow wide-ranging surveys such as the territorial impact of a text and/or its musical setting as well as the diffusion of melodic patterns and text formulas. The results will be collected in a specific volume. Other expected outputs are a handbook, at least ten open access articles, three workshops and two international conferences with proceedings, one of which will have involved related disciplines such as medieval and religious history, linguistics, palaeography, iconography, anthropology, and urban studies.

Link to the ERC project webpage:

Keywords of the ERC project: Italian lauda, music, poetry, oral tradition, digital humanities

Keywords that characterize the scientific profile of the potential visiting researcher/s: OMR (optical music recognition)

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101076547	**CATNEMI**	**SH5** Texts and Concepts

Principal Investigator:	**Dr Steffen Hven**
Host Institution:	FILMUNIVERSITAT BABELSBERG KONRAD WOLF - DEU

Cinematic Atmospheres: Towards a New Ecology of the Moving Image

Cinema is not just a representational but also an operational medium. Its global success is indisputably tied to its ability to embed its audience in affectively charged, atmospheric worlds and filmmakers carefully design their narrative worlds through ambient soundscapes, music, colorations, filters, camera movements, production design, mise en scène, rhythmical editing, and countless other features that arrange the emotional and affective experiences of the audience. Marginalized in film studies due to their ontologically indeterminate nature, cinematic atmospheres operate affectively and prior to cognitive, critical, and analytical reflection. This project examines cinematic atmosphere production in all its experiential, aesthetic, and ethical implications as an attractive but also problematic, even harmful, and ideologically loaded enterprise. It raises critical awareness of the basic atmospheric operations of cinema in a time when the medium is relocated into new media environments and its techniques are reused within ecologies that are not cinematic per se such as news broadcasting, videoconferencing, sports refereeing, and even terrorist recruitment. This project i) develops a broad conceptual understanding of cinematic atmospheres as a way of organizing the perceptive, affective, and cognitive epistemic access to the world of the film, and ii) mobilizes this understanding to develop a method for the study of the operations and techniques that constitute cinematic atmosphere production before iii) expanding this method to deal with the question of how these cinematic operations and techniques for atmosphere production are no longer the property of cinema alone but increasingly employed outside of the narrative-aesthetic domain at the service of larger socio-cultural, economic, and political forms of organizing perception, cognition, and affect from art installations to social media.

Link to the ERC project webpage: https://catnemi.projekte-filmuni.de

Keywords of the ERC project: cinema, atmosphere, elemental media, film phenomenology, media philosophy, Böhme

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101088497	**STEMMA**	**SH5** Texts and Concepts

Principal Investigator:	**Dr Erin Mccarthy**
Host Institution:	UNIVERSITY OF GALWAY - IRL

Systems of Transmitting Early Modern Manuscript Verse, 1475–1700

STEMMA offers the first large-scale quantitative analysis of the circulation of early modern English poetry in manuscript between 1475 and 1700. It addresses a significant gap by developing innovative computational methods for studying the social and material forces that informed literary culture. Scholars have tended to address individual manuscripts as case studies. In contrast, STEMMA revolutionizes the study of manuscript poetry by taking a data-driven approach to identify patterns and trends at scale. At its centre is the poet John Donne, whose reluctance to circulate his verse makes the survival of at least 4,249 manuscripts of his work all the more puzzling; the poems of his next most-circulated contemporary survive in fewer than 1,000 witnesses. To understand how Donne's poems, and early modern poetry more generally, circulated throughout the English-speaking world, the project synthesizes six of the most comprehensive datasets about early modern manuscripts and applies insights from social network analysis and graph theory to model the larger transcontinental communications system. The project's objectives are to provide the first comprehensive study of early modern English manuscript verse circulation; to combine, augment, and enrich the most important bibliographical datasets and return them as Linked Open Data; to develop transferable and extensible methods for analysing the circulation of manuscript poetry; to offer a thoroughly revised account of the production and circulation of literary manuscripts after the introduction of print; to provoke a reassessment of historical metanarratives that privilege print and obscure the diverse agents who participated in early modern literary culture; and to facilitate new modes of research and discovery. The project offers benefits for scholars of early modern Europe as well as those working on computational and digital projects addressing a range of time periods, national traditions, and disciplinary orientations.

Link to the ERC project webpage: stemma.universityofgalway.ie

Keywords of the ERC project: network analysis, graph theory, knowledge graphs, literary history, manuscript studies, interdisciplinary

Keywords that characterize the scientific profile of the potential visiting researcher/s: network analysis, graph theory, bibliographic coupling, mathematical modelling, Bayesian, community detection, knowledge graphs, natural language processing, computational linguistics, data visualization, graph algorithms, interdisciplinary

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101088956	**FILM AND DEATH**	**SH5** Texts and Concepts

Principal Investigator:	**Dr Susana Viegas**
Host Institution:	UNIVERSIDADE NOVA DE LISBOA - PRT

Film-Philosophy as a Meditation on Death

FILM AND DEATH defends the hypothesis that to film-philosophize is to learn to die. This will be achieved by rethinking the innovations that film brings to recent philosophies of death and the metaphysics of time. A new paradigm for understanding the relationship between film and philosophy is proposed that claims 1) that film-philosophy's methodology is a meditation on death, and 2) that 'films think' and have their own ways of creating novel thoughts that are not our own. One of these thoughts concerns death, a phenomenon of which we have no image but that film renders visible as a death-image (a direct image of passing time, facing the impossibility of any representation). We will assert that the cinematic experience is in itself equal to awareness of one's own mortality, as a memento mori, without which we would not philosophize at all. The project has three key aims: 1) to demonstrate that film-philosophy contains significant philosophical insights; 2) to show that such insights are best understood by means of film's novel ways of thinking of time, finitude, and death; and 3) to argue that film's thinking about finite time gives new meaning to philosophy's traditional role as a meditation on death. To support this, a new conceptual map for studying the ways in which death and time are linked through moving images is proposed. The project will offer a contemporary view on death as a cultural phenomenon that has shaped twentieth-century thinking in general and films in particular, putting the usual anthropocentric definitions of death into perspective. A timely undertaking given the ever-growing presence of film and moving media in our lives, it will probe and question our own paradoxical existential condition as members of a thanatophobic society that rarely focuses on death in the everyday but discusses it readily when it is depicted in movies and TV.

Link to the ERC project webpage:

Keywords of the ERC project: Film, death, philosophy, media

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101116087	**ERASMOS**	**SH5** Texts and Concepts

Principal Investigator:	**Dr Raf Van Rooy**
Host Institution:	KATHOLIEKE UNIVERSITEIT LEUVEN - BEL

From Chrysoloras' Latin to Erasmus' Greek: Renaissance classical bilingualism as a European phenomenon (1397-1536)

ERASMOS hypothesizes that, in contrast to the tenet, the great age of Latin-Greek bilingualism, especially in its written form, is not to be situated in antiquity. Instead, classical bilingualism flourished in the Renaissance, a pivotal period in canonizing classics. After 1397, when M. Chrysoloras started teaching Greek in Florence, classical bilingualism developed into an authorial ideal championed by writers like Erasmus (d.1536). This ideal pervaded countless genres, far beyond classical standards. It turned into a common practice shaping Europe's cultural identities across the Republic of Letters, where Latin-Greek code-switching occurred on a daily basis. ERASMOS opens a new research avenue on Renaissance classical bilingualism in its own right, which offers broader opportunities. The project has 3 main aims. (1) It inventories classical bilingual sources from the long 15th century (1397–1536) in a database, in order to create a new detailed heatmap of European humanism. (2) It develops digital tools for the analysis of literary multilingualism, leading to a new form of digital humanities-assisted close-reading. Most notably, the novel "tongueprint" tool will allow us to automatically calculate the linguistic make-up of texts. This tongueprint aims to further integrate multilingualism into Neo-Latin studies by cross-fertilizing the field with historical sociolinguistics. (3) ERASMOS analyzes through DH-assisted close-reading the forms and functions of classical bilingualism, in comparison to its ancient pendant, thus testing the core project hypothesis. ERASMOS, in sum, brings cultural-historical and digital-conceptual innovation. The tools developed will benefit humanities studies more broadly and will help us save a key part of European cultural history from oblivion. The project promises major advances in the study of Europe's classical bilingualism, which connected the continent's brightest minds in an age that fell prey to divisive ideological forces.

Link to the ERC project webpage: https://www.dalet.be/erasmosplus

Keywords of the ERC project: Latin, Greek, code-switching, bilingualism

Keywords that characterize the scientific profile of the potential visiting researcher/s: classicist looking to expand their chronological horizon

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101117068	**ARTIVES**	**SH5** Texts and Concepts

Principal Investigator:	**Dr Kamila Krakowska Rodrigues**
Host Institution:	UNIVERSITEIT LEIDEN - NLD

City tales: an art-based participatory framework for studying migration-related diversity

This project will study imaginaries of diversity portrayed by Afro-European artists in Lisbon and Rotterdam in their films, performances and (oral) stories. These stories are not sufficiently related to in the mainstream discourses and the hypothesis is that the arts offer a particularly vibrant textual weft for exploring competing imaginaries of postcolonial urbanity. The two European ports are chosen since they position themselves as 'open-to-the-world' in light of their maritime history and ensuing migration dynamic. Yet they significantly differ in the ways that their municipalities frame their multiculturalism. I will build the framework of 'urban artives' – archives of situated stories – to explore non-essentializing conceptualizations of migration-related diversity. By close reading creative forms of storytelling; interviewing and following artists in their city wanderings; digitally mapping spaces of inspiration, production, and performance; and producing two creative outputs, ARTIVES will 1) trace transnational networks of belonging embodied in the local cultural scene and 2) test the possibilities and limitations in relating to these stories in ways that break away with 'migrantising' (Wiest 2020) conceptions of society. This research will transpose recent developments in the field of Critical Archival Studies, namely attempts to account for the transitory nature of identity formation in records' preservation, to the fields of qualitative culture-oriented Urban Studies and Migration and Transnationalism Studies. In this way, ARTIVES will bridge the symbolic, material and affective aspects of how urban communities realize their sense of belonging and claim agency within highly diverse cities. Furthermore, the project will offer a best practice for working with community-driven knowledge contributing to the ongoing debate in Cultural Anthropology and Cultural Studies on how power relations are implicated in participatory research.

Link to the ERC project webpage: https://artives.eu/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101117761	**avataResponsibility**	**SH5** Texts and Concepts

Principal Investigator:	**Dr Mihaela Constantinescu**
Host Institution:	UNIVERSITATEA DIN BUCURESTI - ROU

Avatar agency. Moral responsibility at the intersection of individual, collective, and artificial social entities in emergent avatar communities.

This project investigates how avatar agency impacts practices of ascribing moral responsibility in emergent avatar communities (Metaverse, augmented Metaverse, and Human-Cybernetic Avatar societies). These communities challenge traditional frameworks of agency and moral responsibility. The unprecedented persistent and continuous use of multiple avatars by both humans and organisations, has the potential to permeate prior boundaries of the physical, the augmented and the virtual world. We propose a dynamic normative framework of ascribing moral responsibility that is grounded in a philosophical conceptualisation of avatar agency. This framework considers the way interactions between avatars, individuals, and organisations generate intertwined and mutual ascriptions of moral responsibility, potentially enhancing or, on the contrary, diminishing human agency and responsibility in emergent avatar communities. We construct our approach along five main objectives: 1) to clarify avatar agency and related responsibility pertaining to individual, organisational, and artificial members of emergent avatar communities; 2) to delineate the way avatar agency enhances or restrains individual agency and responsibility; 3) to correlate the way interactions between social entities in avatar communities generate mutually enhancing (or perhaps decreasing) ascriptions of moral responsibility to all participants; 4) to evaluate the extent in which the ethical characteristics of the community environment can generate normative attributions of responsibility; 5) to project normative evaluations of blaming and praising practices in avatar communities. The successful delivery of this ethical framework is an original contribution to the problem of moral responsibility and bears direct implications for future regulation, impacting societal moral practices of accountability and blaming.

Link to the ERC project webpage: https://avataresponsibility.ccea.ro/

Keywords of the ERC project: moral responsibility, avatars, digital duplicates, robotics, LLMs, responsibility gaps

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101141330	**DEEP CULTURE**	**SH5** Texts and Concepts

Principal Investigator:	**Dr Tobias Blanke**
Host Institution:	UNIVERSITEIT VAN AMSTERDAM - NLD

Deep Culture - Living with Difference in the Age of Deep Learning

In 2022, the world appeared transformed by a new consumer artificial intelligence (AI), which has dazzled observers with the ability to generate text, images or music. This transformation has been brought about not by general AI but by deep learning, a specific subset of machine learning that has come to dominate AI scientifically and commercially. This has given rise to an emergent 'deep culture', which is produced with universal data extraction and on an industrial scale. While these developments have led to much public anxiety, we lack an understanding of the fundamental shift in cultural relations through deep learning, and what this means for cultural production and analysis. DEEP CULTURE is the first project to develop 'deep culture' as an object of study as well as a method and capacity to attend to this historical moment. It claims that the relations between culture and deep learning can be reconfigured if humanistic ideas are included, which address the complexities of culture and values of difference. To this end, the project advances a radical interdisciplinary framework at the intersection of digital humanities, cultural studies and computer science. DEEP CULTURE has three main objectives: i) to develop a critical inquiry about deep culture through epistemic translations of keywords and practices in deep learning; ii) to advance methodologies for a critical inquiry with deep culture by reconfiguring current deep learning techniques and practices through humanistic ideas and values; iii) to promote productive, critical relationships with and beyond deep culture by collectively contesting deep learning's cultural enactments and co-producing new ones with diverse publics. Empirically, the project is situated at three archival sites: historical, real-time and incidental archives. Based in Amsterdam, DEEP CULTURE is led by the first Distinguished University Professor in AI and Humanities and an expert on interdisciplinary research collaborations.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101141906	**SAIGA**	**SH5** Texts and Concepts

Principal Investigator:	**Dr Grażyna Jurkowlaniec**
Host Institution:	UNIWERSYTET WARSZAWSKI - POL

Scholars, Animals, Images, Geographies, and the Arts: De-exoticizing Eastern Europe in the Early Modern Period

Building on Claude Lévi-Strauss's oft-cited claim that "animals are good to think with," SAIGA sets out to forge a zoological trail in the understanding of Eastern Europe between the sixteenth and late eighteenth centuries. Focusing on animal representations, the project will shed new light on the role of images in the production and transfer of knowledge. The project will highlight the region's underrated contributions to the development of natural history by examining the overlooked Eastern European nodes in networks of scholars. By investigating various patterns of transmission of knowledge from East to West, this study will consider the vital role of Eastern informants, both trusted experts and unreliable amateurs. With animals as the primary object of investigation, the project will direct attention to the arduous processes of discovering Eastern European fauna. While some species had already been recorded by ancient authors (though seldom if ever seen), other species were only documented in the early modern period, turning Eastern Europe into a rewarding research opportunity for naturalists. Tracing the replication of images of Eastern European fauna, the project seeks to understand how early modern naturalists accounted for the discrepancies among ancient, medieval, and contemporaneous sources, and how their strategies of verification varied between the sixteenth and eighteenth centuries. Mapping this knowledge transfer onto the articulation of early modern geographies—which also attempted to make sense of the regions situated between Europe and Asia—the project promises to move the study of Eastern Europe beyond the paradigm of "demi-Orientalism," which all too often imposes a modern othering lens onto the earlier past of the region. Finally, the project will foreground the role of the arts, above all various printmaking techniques, in projecting the image of the region as an environmental and cultural landscape defined and distinguished by its animals.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101142242	**PRIMA**	**SH5** Texts and Concepts

Principal Investigator:	**Dr Elena Pierazzo**
Host Institution:	UNIVERSITE DE TOURS - FRA

Manuscript Culture in the Age of Print

The PRIMA project will redefine our understanding of how culture was produced and disseminated in Early Modern Europe (1575-1800). PRIMA will uncover the importance and the scale of manuscript production and publication for literature, science, music, and other areas, for a period when print is believed to be the dominant (if not the only) technology for publication. By investigating the indissoluble connection between text and carrier, PRIMA will explore how manuscripts have shaped society for much longer than believed. The PRIMA project will unveil the rich manuscript culture that hides in the plain sight of scholars and answer why so many manuscripts were produced, by whom, for whom and how. We will assess the existence of modern scriptoria, uncover monastic writing practices in the modern period, and focus on manuscript production within universities and academies. For literature, particularly satyric and lyric poetry and theatre, it is our argument that manuscript dissemination is the norm and that print is exceptional. We will focus particularly on Italy while allowing for significant openings towards other cultures. Italian manuscript production and consumption are both exceptionally rich and understudied. Adopting qualitative and quantitative methods and innovative computational approaches for data mining, production, and retrieval will ensure the project's feasibility. The investigation of post-print manuscripts will uncover unknown works, which will help redefine our understanding of literary production for the 17th through the 18th centuries by fighting teleological prejudices about the inferiority of manuscripts with respect to print from the 16th century onwards. Finally, PRIMA will also investigate cases of print/manuscript hybridisation, where manuscripts imitate print or include printed sections. The project's main outcomes are the creation of a new discipline and a centre for Modern Manuscript Studies, a book collection and an OA.

Link to the ERC project webpage: https://prima.hypotheses.org/

Keywords of the ERC project: Digital Humanities, Codicology, paleography, cultural studies, computational philology

Keywords that characterize the scientific profile of the potential visiting researcher/s: manuscript studies, digital humanities, textual scholarship,

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101142318	**MesOr**	**SH5** Texts and Concepts

Principal Investigator:	**Dr Martin Worthington**
Host Institution:	THE PROVOST, FELLOWS, FOUNDATION SCHOLARS & THE OTHER MEMBERS OF BOARD, OF THE COLLEGE OF THE HOLY & UNDIVIDED TRINITY OF QUEEN ELIZABETH NEAR DUBLIN - IRL

Mesopotamian Orality and the Anthropology of Writing

This project seeks to understand the interplay between writing and orality in Ancient Mesopotamia (c. 3400 BCE – AD 100): what was written down, what circulated only in the oral realm, aThis project seeks to understand the interplay between writing and orality in Ancient Mesopotamia (c. 3400 BCE – AD 100): what was written down, what circulated only in the oral realm, and why. The result will be a cohesive model of orality and writing in Ancient Mesopotamia, which will in turn shed light on ancient societies with less documentation, enabling a much-needed 'leap forward' in the study of ancient writing and orality beyond Mesopotamia alone. It will also open up a new sub-field within Mesopotamian studies, and offer new ways of thinking about Mesopotamian writings. MESOR's goals will be met by three work packages. First, it aims to establish the facts about what sort of things were usually written down, and what sort of things were not; and about how this varied across time, place, context, and type of written document. Secondly, the project aims to interpret and explain the distribution which it identified. To take some simple examples: Why are there no cuneiform graffiti? Why do cuneiform sources hardly mention begging? What did and did not get embraced by the 'written tradition'? The project will be the first time such questions are addressed in an organic and systematic way. Use will be made of wide-ranging ethnographic parallels. Thirdly, the project will work out the implications and applications of its findings. These extend across all aspects of the lived experience, from administration to education to religion. The project's methods will unite traditional close reading with corpus-driven quantitative data analysis, and its investigation will transcend established disciplinary boundaries: it will combine Akkadian and Sumerian philology, the anthropology of reading and writing, the history of literacy studies, orality studies, and socio-cultural history.

Link to the ERC project webpage:

Keywords of the ERC project: orality; anthropology of writing; ancient studies; Mesopotamian studies; cuneiform; pre-modern studies; studies of traditional societies; textualisation; anthropology

Keywords that characterize the scientific profile of the potential visiting researcher/s: ANY OF THE FOLLOWING: orality; anthropology of writing; ancient studies; Mesopotamian studies; cuneiform; pre-modern studies; studies of traditional societies; textualisation; anthropology

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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101161846	**GLUE**	**SH5** Texts and Concepts

Principal Investigator:	**Dr Nicolai Knudsen**
Host Institution:	AARHUS UNIVERSITET - DNK

The Glue of Society: A Social Ontology of Social Cohesion

Social cohesion is a key concept in how we think about the social world. And yet, we have a very poor conceptual understanding of what social cohesion is, how it relates to other social phenomena, and which role it plays in maintaining social order and facilitating cooperation. To date, this challenge has not been taken up by social ontology. Contemporary social ontology primarily focuses on understanding the nature of collective cooperation in which people coalesce around a joint purpose in such a way that we can attribute attitudes and actions to them as a collective rather than as an aggregation of individuals. But social cohesion is not only a function of collective cooperation but also the extent to which a social system enables mutually sustaining cooperation among agents with separate goals. Call this converging cooperation.

It seems then that social cohesion is a key concept in how we think about the social world that lies beyond the scope of social ontology in its current form. Responding to this impasse, the aim of the GLUE project is to secure philosophical clarification of the concept of social cohesion and to account for its role in constituting and maintaining the social world.

The primary research questions are:

1) What is social cohesion, and which distinct social phenomenon might it refer to?

2) What are the semantically explanatory relations between (a) social cohesion and (b) the concepts often used in social ontology and the social sciences to account for collective cooperation?

3) How can a clearer account of social cohesion be used to foster social stability?

Combining descriptive, explanatory, and critical approaches to social ontology, GLUE (a) enriches our typology of social dynamics, (b) expands the scope of social ontology beyond collective cooperation, (c) introduces concepts that can help identify and mitigate forms of social destabilisation, and (d) develops a new and integrative research method for social ontology.

Link to the ERC project webpage:

Keywords of the ERC project: social cohesion, social ontology, philosophy, group agency, cooperation

Keywords that characterize the scientific profile of the potential visiting researcher/s: social ontology, political philosophy, moral philosophy, sociology, social cohesion, social order

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Project ID:	Project Acronym:	Evaluation Panel:
101162044	**AFROPRESS**	**SH5** Texts and Concepts

Principal Investigator:	**Dr Cedric Van Dijck**
Host Institution:	VRIJE UNIVERSITEIT BRUSSEL - BEL

Recovering Global Exchanges from Sub-Saharan Africa's Cultural and Political Magazines in the Age of Black Internationalism, 1918-68

Sub-Saharan Africa is often bypassed in global histories and its print cultures seldom approached through a transnational lens. To recover a lost history of global engagement, AFROPRESS will turn to the subcontinent's cultural and political magazines from the period 1918-68—a vast, yet slowly disappearing archive. These magazines played key roles in effecting change, from fuelling decolonisation to creating literary and artistic canons. AFROPRESS advances the hypothesis that magazines shaped this transformation through their global orientation, that is, the way they reached out, across borders within and beyond Sub-Saharan Africa, to Black internationalist and anticolonial networks. It will examine these dynamics in five countries: Congo-Brazzaville, Democratic Republic of Congo, Uganda, South Africa and Madagascar. Recent efforts in digitising periodicals from these countries have created the perfect opportunity to explore these sources, often for the first time. To address gaps in the digital record, and to study the multifaceted nature of a range of periodicals, AFROPRESS will assemble a team with expertise in literary and periodical studies as well as art, book, social and political history. Its innovative strategy combines interviews with historical actors and research in diverse national and private archives across Europe and Sub-Saharan Africa. In so doing, AFROPRESS will break new ground on three levels. (1) Analytically, it will be a milestone in our understanding of the globally interactive nature and agency of cultural and political magazines from Sub-Saharan Africa. (2) Methodologically, it will open up periodical studies to further interdisciplinary inquiry and develop a model of exchange triangulating periodical studies, world literature and postcolonial and African studies. (3) Empirically, it will recover little-known sources that demand scholarly engagement, serving as a prompt for further digitisation efforts.

Link to the ERC project webpage: www.afropress.eu

Keywords of the ERC project: African literature; Comparative literature; periodical studies; media history; decolonisation

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101171014	**EDGE**	**SH5** Texts and Concepts

Principal Investigator:	**Dr Bryan Roberts**
Host Institution:	LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE - GBR

Philosophical Foundations of the Edge of the Universe

The EDGE project is a philosophical study of the concept of an edge or boundary as it relates to the universe on the largest scale. But what does an edge refer to when the region is the entire universe? Despite widespread use of this boundary, there is little agreement about how to interpret it: some have called it “heuristic”; others “incoherent’; and still others a “law of nature”. There is no unified perspective on the general nature of boundary conditions in physics, and no agreed-upon conceptual foundation for how they apply to the entire universe. We propose an ambitious but credible programme to overcome this challenging problem. We begin with a classification of the properties, uses, and epistemology of boundaries as they are generally used in physics, from the separation of mind and world to the interaction of two coupled systems, and over a wide range of theories. We then turn to cases in which the boundary of the entire universe plays a substantial role in the frontiers of physics. These threads will form the basis for a general framework for understanding boundaries in physics, establishing shared features as well as the dimensions along which they differ. This will finally allow us to produce the first general analysis of what the edge of the universe means in physics: its ontology, its uses, and how we know about it. The pay-off of this project is a path-breaking new analysis in philosophy, which establishes a major new account of our universe at its farthest fringes. In physics, it stands to help clarify the pathway for those physicists actively developing the frontiers of science by using boundaries of this kind. More generally, it will establish a novel, accessible account of our place in the universe in comparison to the farthest reaches of our imagination. The ambition of the EDGE project is to produce such an account that is philosophically rigorous, scientifically sound, and still manages to capture a sense of wonder about the cosmos.

Link to the ERC project webpage: https://edgeoftheuniverse.org

Keywords of the ERC project: philosophy, physics, cosmology, boundary conditions

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
805098	**J-InnovaTech**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Aleksandra Kobiljski**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Beyond Eureka: The Foundations of Japan's Industrialization, 1800-1885

Beyond Eureka seeks to challenge current understanding of how Japan became a global industrial power along with the model of how innovation takes place. Japan was the first Asian nation to industrialize and in a space of several decades went from a relatively isolated agrarian economy to an industrialized nation. The key assumption of this project is that a grasp of the salient features of the technological landscape during the pivotal period between 1800 and 1885 is an important tool for understanding Japan's industrialization. To date, this transitional period has been widely acknowledged as crucial for later development but remains empirically poorly understood. Recognizing the complexity of causation, this project seeks to use technology as a site for forging a more nuanced understanding of the emergence of Asia's first industrial power. By bringing technological change into historical focus, the project challenges the notion of innovation as necessarily a matter of disruption. In Japanese, for example, there is no conceptual or cultural equivalent to Eureka, to stand for a unique, distinct moment of individual ingenuity. If we choose the Eureka moment to epitomize the conception of innovation, early examples in Japanese industry are few and far between. Instead, a small but growing body of research shows that a sophisticated and patient examination of archives can reveal innovative processes in place of what historiography has described as borrowing, imitation or adaptation. This project seeks to foreground innovation as a long-term process of accumulation in which the new only could only work by taking root and embedding itself within the old, not by replacing it and starting from scratch. The team, comprising the PI and five postdoctoral fellows, will combine expertise and previously unexamined archives to bring depth and nuance to not only to the specific case of Japanese industrialization, but also more broadly of innovative processes in human past.

Link to the ERC project webpage: https://www.j-innovatech.cnrs.fr/the-project/

Keywords of the ERC project: history, technology, innovation

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
950414	**CALIPHALFINANCES**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Marie Legendre**
Host Institution:	THE UNIVERSITY OF EDINBURGH - GBR

The Finances of the Caliphate: Abbasid Fiscal Practice in Islamic Late Antiquity

This project offers an ambitious new account of a seminal period in Islamic history. It will for the first time provide a view from below on Abbasid fiscal history through a study of papyrus documents in Greek, Coptic and Arabic written in Egypt, a field in which the PI is a leading scholar. The Abbasids were the second longest ruling dynasty in Islamic history (750-1258). The first centuries of their rise to power are of key importance for the history of Islam, as the earliest surviving literary texts written by Muslims (religious, legal and fiscal treatises, grammars and poetry) were composed at this time and in their capital, Baghdad. They have been the preferred sources for scholars working on this period. As a result, our current view of Abbasid state structures is a view from the top. State policies, however, were not decided by the caliphal centre and Baghdadi administrators alone. CALIPHAL FINANCES will refocus scholarship on the totality of Abbasid administration. It will be the first large-scale research project on Abbasid administrative and fiscal history to make use primarily of documentary sources. Egyptian papyri are concerned with everyday arrangements for fiscal collection in secondary urban centres and villages of the Nile valley. Capitalising on this material, the project will study the organisation of tax collection, tax rates and categories of taxpayers. The project team will trace how provincial revenues reached the caliph, incorporating information found in provincial chronicles with that in the papyri. Connections between administrators and local elites, religious and linguistic communities, their convergence on fiscal questions, their loyalty or resistance to the caliphate will all be assessed. In a field largely dominated by religious history, CALIPHAL FINANCES will renew our understanding of the dynamics of change in pre-modern state structures, with a focus on the complexity of local agency.

Link to the ERC project webpage: https://blogs.ed.ac.uk/caliphalfinances/

Keywords of the ERC project: early Islam, Abbasids, taxation, economic history, papyri

Keywords that characterize the scientific profile of the potential visiting researcher/s: early Islam, economic history

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Project ID:	Project Acronym:	Evaluation Panel:
101039920	**AFREXTRACT**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Iva Pesa**
Host Institution:	RIJKSUNIVERSITEIT GRONINGEN - NLD

Environmental Histories of Resource Extraction in Africa: Understanding Cultural and Political Responses to Environmental Transformation

Resource extraction industries have propelled environmental transformation across Africa, most notably between 1950 and 2020. The undeniably dramatic effects of mining and oil drilling on landscapes and lifeworlds have elicited radically divergent cultural and political responses, from apparent acquiescence to violent protest and accusations of ecocide. Yet the nature of the relationship between environmental change and human response in African localities remains extremely poorly conceptualised. AFREXTRACT addresses this gap by analysing how various actors in three emblematic sites - the Witwatersrand, the Copperbelt and the Niger Delta - have experienced and responded to environmental change. The first study to investigate this comprehensively and comparatively, AFREXTRACT demonstrates that insights from environmental history, political ecology and environmental humanities are crucial to topical debates about coloniality/decoloniality and the Anthropocene. Our main objectives are: 1) to identify the causal factors informing human response to environmental transformation through three in-depth case studies (gold mining in South Africa; copper mining in Zambia; oil drilling in Nigeria); 2) to analyse how cultural expression (specifically literature and music) has made sense of environmental change; 3) to conceptualise varieties of environmentalism beyond a binary of resistance and resignation. AFREXTRACT will combine archival research with oral history, literary analysis and ethnomusicology to document changing values regarding the environment. A new analytical framework will facilitate engagement with global discussions about extractivism, colonialism/postcolonialism, environmental inequality and climate change. As resource extraction and its toxic legacies are set to continue, a historical understanding of these issues is imperative.

Link to the ERC project webpage: https://www.rug.nl/research/icog/research/research-centres/research-centre-for-historical-studies/projects/afrextract/?lang=en

Keywords of the ERC project: environmental history; extraction; Africa

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101042034	**BE4COPY**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Marius Buning**
Host Institution:	UNIVERSITETET I OSLO - NOR

Before Copyright: Printing Privileges and the Politics of Knowledge in Early Modern Europe

BE4COPY examines the long-term history of printing privileges from a cross-disciplinary and European perspective. These privileges provided exclusive rights for the production of books and images: they can be considered one of the precursors of what we now call 'copyrights'. Introduced around 1470, shortly after the invention of the printing press, privileges were abolished around 1789, when new notions of ownership emerged alongside new ideas about political representation. The BE4COPY project studies the changing nature of the printing privilege over the course of these turbulent 300 years. The intimate relationship between legal frameworks and the politics of knowledge is the primary focus of the project. Although numerous studies have examined printing privileges in their local context, there are to date no historical studies that have examined how different European systems of printing privileges were interrelated. BE4COPY will change that and thus contribute to a better understanding of the origins of copyrights as a specific form of shared European heritage. It does so by (1) examining the distribution of printing privileges on a European scale, exposing existing trade routes and political alliances, and (2) rethinking the relationship between legal protection and political interests. How did shifting discourses of expertise and stewardship influence the proprietorship of intellectual creations' How did the interplay between law, economy, and politics shape the production of knowledge? And how did 'authorship' and 'ownership' eventually emerge in that context as twin categories? BE4COPY employs an innovative archive-based approach centred around the cross-cutting themes of 'Censorship and Promotion', 'Travelling Ideas and People', and 'Authorship and Readership'. The project adds a new layer to our evolving understanding of copyright and opens up new perspectives regarding the question of how knowledge was produced and shared in early modern Europe.

Link to the ERC project webpage: https://www.hf.uio.no/iakh/english/research/projects/before-copyright/

Keywords of the ERC project: History of print; book history; legal history; early modern history; history of copyright; theory of intellectual property

Keywords that characterize the scientific profile of the potential visiting researcher/s: Early modern legal history; history of print and publishing; printing privileges and pre-copyright regimes; knowledge circulation and censorship; non-proprietary regimes of knowledge ownership

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Project ID:	Project Acronym:	Evaluation Panel:
101043939	**UseFool**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Lucia Raggetti**
Host Institution:	ALMA MATER STUDIORUM - UNIVERSITA DI BOLOGNA - ITA

Knowledge and manipulation of nature between usefulness and deception in the Arabo-Islamic tradition (9th-15th century)

The UseFool project studies the knowledge and manipulation of nature applied to entertainment and fraud, as described in the Arabic technical literature dealing with the practice of charlatans and performers along the streets and in the markets. At the core of UseFool's textual corpus are four Arabic handbooks composed between the 6th/12th and the 9th/15th century, combined with other sources, such as the handbooks for the inspector of the market that focus on artisanal impostures. The project will reconstruct the refined technical notions mastered by marginal social groups, showing how the lightly dismissed 'popular knowledge' was actually a form of 'street science'. The project's goal is to write a new chapter in the cultural, social, and material history of knowledge looking through the lens of Arabic technical literature. UseFool proposes a new interdisciplinary approach to its sources: this begins from a philological and textual analysis that focuses on their technical contents, expands to the reconstruction of the material dimension of the procedures through hands-on replication, and completes its all-round approach with the re-enactment of the performative and theatrical dimension entailed in the different forms of deception. In this way, UseFool will assess the interaction between the narrative component and actual practice in this textual tradition. The project will also map the sources of this technical literature on deception, in order to reconstruct lines of transmission in a long time span and across different cultures. The project reflects on the roots of the handbooks on entertainment and fraud in the antique and late antique heritage, with the aim of providing a searchable and organized structure to the lore of natural properties. UseFool also expands its horizon to the close relationship between the Arabic and the Latin Mediaeval technical sources, with the aim of deepening our understanding of their transmission in a longue durée perspective.

Link to the ERC project webpage:

Keywords of the ERC project: mediaeval Arabic science - Arabic philology - Replication&Re-enactment

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101044932	**NEPI**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Adrian Wüthrich**
Host Institution:	TECHNISCHE UNIVERSITAT BERLIN - DEU

Network epistemology in practice

The present project will contribute to research in the history and philosophy of science through extensive use of state-of-the-art tools from the digital humanities. The project will focus on an investigation of recent research practice in particle physics at the European Center for Nuclear Research (CERN) in order to gain a better understanding of how knowledge is generated and validated in very large scientific collaborations. The main working hypothesis of the project is that collective research processes can be characterized, in epistemologically relevant terms, through a bird's eye view analysis of the collaboration's internal communication. The internal communication will be reconstructed from born-digital documents (e-mails, internal wiki pages, etc.) which accrue in the research practice of the collaboration. Abstracting from the case study, the project will also develop historiographic guidelines that can be transferred to future epistemological studies of modern scientific collaborations. Last but not least, the project will contribute to the philosophy of collective knowledge generation, in particular to recent issues in "network epistemology", by adapting the theoretical models to better fit important real-world cases. Until recently, it was nearly impossible to capture large-scale and complex research processes, such as the ones at CERN, and make them accessible for epistemological analysis. Almost all the studies of the research practice at CERN or similar cases have so far been restricted to the analysis of published articles, selected interviews and participant observation. Accompanied by historiographic guidelines and practical strategies (both of which are lacking at the moment) for best practices in the history and philosophy of science based on born-digital sources, the application of digital tools and computational methods may finally help us attain a maximally comprehensive picture of recent research practice in particle physics and beyond.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101044932

Keywords of the ERC project: history and philosophy of science, digital humanities, computational humanities, social epistemology, born-digital sources, network analysis

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101045774	**WomatWork**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Elena Vezzadini**
Host Institution:	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS - FRA

Women at work: for a comparative history of African female urban professions (Soudn, Tanzania and Ghana), 1919-1970

WomAtWork represents the first comparative investigation into the history of female urban popular professions in three African countries – Ghana/Gold Coast, Sudan, and Tanganyika/Tanzania – over the course of fifty years (1919-1970). Not only is this topic under-studied in African history, but these professions (i.e. midwives, beauticians, wedding singers, market vendors, craftswomen) are also characterised by fascinating and unsettling aspects. For example, notions such as a set price for a service and fixed working times or workplace did not apply to many of them.

WomAtWork aims first to discover the peculiarities of these labour patterns and see their historical transformations as a result of political changes and the introduction of new technologies and commodities. Secondly, it examines professional subjectivities, the work ethos, norms and values of women at work. Finally, it questions the relationship between these professionals and their communities – including in the light of the social stigma sometimes attached to them – as well as the nexus between these labourers and protest, charting when and why they laid down their tools.

Based on an innovative methodology, this project seeks to overcome the invisibility of women in official archives by weaving together different threads of sources. It begins inside those photographic archives connected with institutions that had conscious agendas of representation and routines of intense textual production (for example, missionary stations). In some cases, these visual and textual sources lead to networks or families of women professionals, whose oral history will be solicited. Third, the project aims to analyse the vernacular press combined with oral accounts.

Through these objectives and methodologies, WomAtWork will be a participant in the mission of writing a more democratic, more inclusive history, one that firmly establish the centrality of women's labour in African his

Link to the ERC project webpage: https://womatwork.hypotheses.org/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: post-doc, PhD

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Project ID:	Project Acronym:	Evaluation Panel:
101052761	**DISPERSALS**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Nuno Bicho**
Host Institution:	UNIVERSIDADE DO ALGARVE - PRT

Dispersals, resilience, and innovation in Late Pleistocene SE Africa

Genetic evidence suggests that successful modern human migration out of Africa is believed to have started c. 70,000 years ago, populating the whole world, at different rates and times. This incredible voyage took place because of human's unique resilience, versatility, and innovation, both biological and cultural, to external stimuli, including ecological and environmental changes. The main objective of DISPERSALS is to investigate the migration and dispersal dynamics of early Homo sapiens in Africa and archaeologically evaluate the genetic model that southern African human populations were the genesis of the successful out-of-Africa some 70,000 years ago. This will be accomplished by investigating cultural and biological continuity/discontinuity issues and human population movements in the last c. 100,000 years in the poorly studied Limpopo and the Save river basins, central Mozambique, an area mediating the two key regions of human development, i.e., southern and eastern Africa. DISPERSALS will compare the human occupation and ecology between central Mozambique and eastern and southern Africa using a multi-scale approach based on the study of regional diachronic cultural traits. It will reconstruct regional population patterns, followed by comparative quantitative population genetics combined with GIS computational network analyses. The results will be then integrated through Agent-based modeling, based on the incremental creation, elimination, or reorientation of network links to simulate a quantitative framework to study the evolution of population dispersal across southern-eastern Africa. The project will be crucial in providing ground-breaking high-resolution archaeological, chronological, and paleoenvironmental data. DISPERSALS will deliver a fundamental perspective on the key processes that triggered migrations and dispersals within Africa and out-of-Africa which ultimately resulted in the human diaspora over the entire planet.

Link to the ERC project webpage: https://dispersals.icarehb.com/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101054659	**Tied2Teeth**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Leslea Hlusko**
Host Institution:	CENTRO NACIONAL DE INVESTIGACION SOBRE LA EVOLUCION HUMANA - ESP

Expanding our understanding of human evolution through pleiotropy

Teeth dominate the fossil and bioarchaeological records because they consist mostly of inorganic material. Consequently, dental anthropology has long been essential in our investigation of the human past. Variation in the anatomy of teeth is instrumental for differentiating species, identifying biological affinities between populations, making inferences about dietary adaptations, and timing key developmental life stages. However, recent advances in genetics, genomics, and developmental biology undermine many assumptions built into anthropologists' study of the dentition by revealing extensive pleiotropy—when one gene influences more than one anatomical structure simultaneously. However, this is not a setback but rather an advantage. In this project, we will use the pleiotropies that involve teeth to open windows to the evolution of human anatomies far beyond the dentition. I will employ three methodological approaches that utilize pleiotropy to probe different aspects of human paleobiology. The first approach will use quantitative genetic analyses to calibrate the extent to which cranial evolution is genetically correlated with dental evolution. In the second approach, we will employ large historical morphological datasets combined with the modern insight from genome-wide-association-studies (GWAS) to explore how the evolution of soft-tissue anatomy may have driven changes in the dentition. Finally, we will turn to the fossil record. Using traits that were defined using a pleiotropic approach, we will test the hypothesis that environmental selection influenced dental variation during two key time periods within the evolution of genus Homo. This project modernizes the study of the human past by incorporating the phenomenon of dental pleiotropy. By combining these three different approaches and a range of time scales, we turn the conundrum of pleiotropy into a powerful tool for studying human evolution.

Link to the ERC project webpage: https://www.lesleahlusko.org/the-erc-project-tied2teeth/

Keywords of the ERC project: evolution, paleoanthropology, paleontology, quantitative genetics, evolvability, dentition

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101054963	**OPEN BORDERS**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Borut Klabjan**
Host Institution:	ZNANSTVENO-RAZISKOVALNO SREDISCE KOPER - SVN

Cold War Europe Beyond Borders. A Transnational History of Cross-Border Practices in the Alps-Adriatic area from World War II to the present.

This project aims to rethink the history of Cold War Europe by examining the development of transnational cross-border cooperation from the end of World War II to the present. Overcoming traditional narratives of a clear-cut European separation symbolised by the Berlin Wall, a decentralised analysis of recent European history will show us that the question of a divided continent should be reframed. The final objective is to challenge a dichotomous vision of two separate Europes, “East” and “West”, from a new, border perspective. To this end, a highly qualified team of senior and junior scholars under my guidance will focus on the Alps-Adriatic region, a historical area that is now shared by Austria, Italy, Slovenia and Croatia. This case involves a relatively narrow geographical area but an unusually broad typological range of subjects. During the Cold War it was divided among socialist but non-aligned Yugoslavia, capitalist but neutral Austria, and NATO and EEC member Italy. Its development from the "southern end" of the Iron Curtain in 1946 to the "most open border" during the Cold War and a precursor to present-day Schengen Europe, represents a paradigmatic case to study an alternative attitude towards borders, frontiers and boundaries. Drawing on Cold War and borderland studies, social history and the history of European integration, which up till now have not found common ground, our innovative conceptual elaboration will demonstrate the interplay between top-down politics and bottom-up initiatives, thus offering a new, and more nuanced history of Cold War Europe from the border perspective. Reconsidering the European past from this transnational angle, both in terms of geographic and methodological perspectives, will allow us to rediscover the human face of European integration and will offer us a new platform for contemporary discussions on sovereignty, territoriality and belonging and on the future role of borders in Europe and in the world.

Link to the ERC project webpage: https://erc-openborders.eu/

Keywords of the ERC project: Borders, History, Cold War, cross-border cooperation, transnational, Central Europe, Alps-Adriatic

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101076246	**FLEXI**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Fangzhe Qiu**
Host Institution:	UNIVERSITY COLLEGE DUBLIN, NATIONAL UNIVERSITY OF IRELAND, DUBLIN - IRL

Fluid texts and scholars' digests: (re)production of law in medieval Ireland

FLEXI investigates how the fluid, multifarious law texts were (re)produced and accepted as sources of law in medieval Europe, using four sets of late medieval Irish law texts called the 'digests' as its main object of study. The digests contain texts quoted from diverse sources, and organise them into a systematic review of the legal tradition. They represent the law in operation in the form of highly variegated and complex intertextual networks, and therefore are an ideal sample for studying the dynamics between fluidity and unity in medieval law texts. FLEXI focuses on how law texts were (re)produced, studied, and transmitted in medieval Ireland. It is not only the first in-depth study of the Irish digests, but also a ground-breaking attempt to synthesise philology, comparative legal history, network theories, and digital techniques to revolutionise the research of medieval law texts. FLEXI traces and measures the sources used in these digests quantitatively, using linked data model and network analysis to reveal their compilatory principles and text reuse patterns. This is an innovative approach to probe the intellectual universe of the jurists. It evaluates the variation within the digests and examines the interpretative techniques by which the jurists justified and harmonised the variation. FLEXI also looks for possible influences from other legal traditions such as the Canon Law and the Civil Law on the compilatory principles of the digests, and makes comparison with medieval Welsh law on how inherited materials were treated and updated in Ireland and Wales. Finally, FLEXI tests and develops software for automated detection of parallel texts (text reuse) for early Irish texts. The toolkit and software developed by FLEXI will offer a long-needed digital solution to the processing of early Irish texts, because it can quickly identify similar texts from the vast corpus of Irish materials, thus revealing intertextual relationships hidden from the human eye.

Link to the ERC project webpage: https://www.ucd.ie/icsf/en/research/europeanresearchcouncilprojects/flexi/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101077946	**ImBod**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Edmund Hayes**
Host Institution:	UNIVERSITEIT LEIDEN - NLD

Embodied Imamate: Mapping the Development of the Early Shiʿi Community 700-900 CE

The Shiʿi Imams played a key role in early Islam. Revered scholars descended from the Prophet Muḥammad, they posed an existential threat to the legitimacy of the ruling caliphs in the 8th and 9th century CE. Their leadership defined the quietist yet oppositional Imami Shiʿi community scattered throughout the Islamic empire. Imami Shiʿism was a key part of the turbulent thesis and antithesis which formed Islam, and it remains greatly influential until today. Remarkably, there is no comprehensive history of the Imamate. There are a number of reasons for this, central among which are that scholarship on Imami Shiʿism has approached it as a doctrinal and intellectual phenomenon. However, religious groups are also fundamentally social phenomena. ImBod will result in the first comprehensive history of the Shiʿi Imamate. It will position the Imamate as a social phenomenon, framing it as an interaction between two aspects which are rarely explicitly theorised: the Imams, and the Imami community who recognised them. ImBod will identify and study the key spheres in which the Imams and the Imami community operated, including the Imams' household, elite Arab clans (especially the Prophet's family and the dynasties of the caliphs), the network of Imamic agents, the scholars, and the communities who came to be associated with Shiʿi Islam through kinship, conversion and migration. ImBod will map out overlapping networks of interaction across these spheres and identify key actors and institutions responsible for mediating and performing the Imamate in the community. ImBod will not conceive of the Imamate as an essence, but as a set of social processes, some, but not all, instigated and controlled by the Imams themselves. Crucially, ImBod will study these processes as performed spatially and embodied materially by actors and physical objects linked to the Imams. ImBod will enrich Islamic history by providing a paradigm for studying how religious authority was embedded in society.

Link to the ERC project webpage:

Keywords of the ERC project: Islam, history

Keywords that characterize the scientific profile of the potential visiting researcher/s: Islam, history

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101087820	**DEMFAM**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Jana Tschurenev**
Host Institution:	FREIE UNIVERSITAET BERLIN - DEU

Democratising the Family? Gender Equality, Parental Rights, and Child Welfare in Contemporary Global History

Through the lens of 'shared and equal parenting', DEMFAM studies the transformation of gender and the family in contemporary global history. First, it studies a shift from hierarchical to egalitarian conceptions of family relations, or a democratisation of the family. This entails the equalisation of parental rights within and outside the domain of heterosexual marriages, which coincided with the harmonisation of the rights of marital and non-marital children. The emergence of post-familial care arrangements, secondly, led to a denser regulation, or juridification of co-parenting. Inner-familial power shifts were accompanied by a reconfiguration of family-state relations. The project investigates the development of judicial and extra-judicial institutions (including family courts, social work interventions, and mediation agencies) which aimed to promote parental cooperation and safeguard child welfare in familial conflict situations. Finally, it shows how parental rights assumed centre stage in the twenty-first century's 'gender wars', or the politicisation of gender, sexuality, and the family in struggles over national and religious identity, liberalism, and democracy. DEMFAM analyses these (limited and contradictory) transformative processes across different political-economic and legal systems within a shared global environment. The project develops a social history of law reform on different political scales to understand global dynamics of divergence and convergence in the transformation of gender and the family. It combines the analysis of transnational knowledge circulation (including policy transfer, civil society mobilisation, and scientific expertise) with the comparative study of family change in Western Europe (FRG, UK), Central Eastern Europe (the GDR, Poland), and South Asia (India). Integrating research on post-colonial legal pluralism, and on (post-)socialist gender and family politics, DEMFAM opens new horizons for global gender history.

Link to the ERC project webpage: www.democratising-the-family.eu

Keywords of the ERC project: child welfare; best interest of the child; gender equality; parenting; child custody; family law; global history;

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101087832	**PollutedPast**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Olalla Lopez-Costas**
Host Institution:	UNIVERSIDAD DE SANTIAGO DE COMPOSTELA - ESP

Environmental metal pollution revealed in archaeological human remains

Environmental metal pollution threatens us all. While discussions of further prevention continue, the historical dimension is rarely considered. The long history of metal contamination has been well traced in natural archives (e.g. lake sediments and peat). However, there is a need for long-term studies directly on humans remains to fully understand how metal pollution affected the life of our ancestors. PollutedPast will fill this gap by linking new research on skeletal remains from archaeological sites with research done using natural archives. The overall objective is to determine the severity of metal pollution in preindustrial populations. This will be achieved by meeting four prerequisites: 1) availability of high chronological resolution studies in natural archives, 2) periods of contrasting pollution levels, 3) areas with contrasting pollution histories, and 4) availability of well-suited and studied osteological collections. The investigations will concentrate on collections from NW and SE Spain, and SE Sweden, selecting individuals from Roman to Late Medieval times. Individuals at risk (babies, those with chronic infectious diseases) will also be targeted. The methodological approach is based in a revolutionary combination of techniques. Multielemental (>30) and high-resolution (every 200µm) analyses of bones, bioapatite and teeth will provide critical insights into metals incorporation. Lead, copper and mercury, metals different sources and biogeochemical cycles, will be researched in depth and compared with well-reconstructed pollution histories in natural archives from the selected areas. Lead isotopes will be used, aided by mixing models, to trace the sources and estimate the proportion of pollution-lead in skeletons. This project will generate ground-breaking knowledge about the long-term impact of metal contamination – by mining and metallurgy - and explore how differences in resources management may have had consequences regarding human societies.

Link to the ERC project webpage: https://pollutedpast.zuir.es/

Keywords of the ERC project: pollution, archaeology, paleoenvironment, history, ancient texts, mercury, lead, bioarchaeology

Keywords that characterize the scientific profile of the potential visiting researcher/s: pollution, archaeology, paleoenvironment, history, ancient texts, mercury, lead, bioarchaeology, pollen

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101088128	**SUSPICIO**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Martin Biersack**
Host Institution:	UNIVERSIDAD DE GRANADA - ESP

Creating Suspects. Security Politics and Colonial Rule in the Spanish Empire

SUSPICIO proposes an entirely new hypothesis in the field of modern history as well as in Hispanic studies: that security became a key concept of governance in the late Spanish Empire (ca.1770–1820). This phenomenon began in the last quarter of 18th century when Spain felt the threat of losing its American colonies through external events that questioned the colonial rule, including US independ-ence and the influence of the French revolution. The perception of threat and the Spanish government's distrust of their own population in America gave rise to extensive security regulations and measures in order to protect the colonial order. With my extensive expertise in both archive research and Hispanic studies, SUSPICIO will, for the first time, study thus far neglected sources of political crime. The novel approach to these sources will ana-lyse how the colonial administration identified and judged those individuals who were perceived to be a threat to the order, i.e., who were categorised as 'suspects'. There was no longer the requirement for a rebellious act to already have occurred in order to make an individual an enemy of the state, but ra-ther the mere suspicion that a person would perhaps – in the future – act against the state. SUSPICIO will study to what extent the creation and persecution of 'suspects' polarised the people so that, rather than preserving the colonial rule, it had a debilitating effect. By regarding the ambivalence and counterproductive effects of security politics, the project promises a new interpretation of the dis-solution of the Spanish Empire. Its case may serve as an example, even for today, of how supra-national political entities can collapse under the pressure of security concerns, even though these secu-rity measures were meant to preserve them.

Link to the ERC project webpage: https://wpd.ugr.es/~suspicio/

Keywords of the ERC project: Security, Surveillance, Suspicion, Colonial Spanish America, Age of Revolution, Treason

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101088489	**WO-NAM**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Chiara Bonfiglioli**
Host Institution:	UNIVERSITA CA' FOSCARI VENEZIA - ITA

Women and Non-Alignment in the Cold War era: biographical and intersectional perspectives

WO-NAM will provide crucial insights into the history of women's participation in the Non-Aligned Movement during the Cold War era, studying the roles of female leaders, women's movements and women's organizations. It will redefine existing interpretations of Cold War history and historiography by conducting groundbreaking research on the significance of Non-Aligned networks in shaping transnational debates on women's rights within international institutions. Bringing together women's and gender history, global history, and intellectual history, the project will answer the following research questions: what was the role of female activists and leaders within the Non-Aligned Movement? How did women's organizations contribute to nation-building, modernization, and development in their respective Non-Aligned countries? What was the significance of the Non-Aligned Movement in transnational Cold War debates on women's rights before and during the UN Decade for Women (1975–1985)? How did women's internationalism within the Non-Aligned Movement contribute to an intersectional vision of women's rights, which viewed women's oppression as inseparable from wider global inequalities? WO-NAM will draw on rich and diverse archival collections on women's activism in its focus on the case studies of Yugoslavia, Egypt, Tunisia, India, and Cuba. It will have four research strands: female leaders and activists' biographies, grassroots and state-sponsored women's organizations, international conferences at UN and NAM level, and transnational knowledge production. In taking Non-Aligned women's networks as its vantage point, WO-NAM will be the first project to address how female leaders and activists from the Global East and the Global South intervened in a variety of international institutions that were part of, or affiliated to, the United Nations, in order to shape ongoing debates on women's rights, family planning, and development.

Link to the ERC project webpage: https://pric.unive.it/projects/wo-nam/home

Keywords of the ERC project: Women's History, Cold War History, Women's Internationalism, Non-Alignment

Keywords that characterize the scientific profile of the potential visiting researcher/s: Women's history, Gender history, Cold War history, Global History

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101088962	**SHIPs**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Emmanuel Nantet**
Host Institution:	UNIVERSITY OF HAIFA - ISR

Ships Harbouring in Ports

Until the emergence of the modern container ship, vessels spent a significant part of their lifespan in a harbour. The time period when a ship sets anchor in a harbour is key as the entire harbour was designed to offer mooring and all the facilities required for her stay. Yet, a harbour was not merely the accumulation of standings structures made of stone, concrete, or wood that helped ships make fast in Roman harbours. Associated activities extended beyond their principal basin, taking place on a far larger scale and in an agglomeration of different areas than previously conceived by scholars and archaeologists. These together constituted a harbour system, one of the most significant foundations of ancient economies. The project's aims are 1) to identify the various operational parts of harbours, 2) to consider how the functions carried out there were combined into a larger area, and 3) to consolidate a set of tools that together comprise a unified methodology, which can be applied to examples elsewhere. Beyond these larger concerns, the project explores specific issues regarding ships when mooring in harbours: what type of vessels did they include? What were their needs and what structures could fulfil them? Did they change according to the different seasons of the year? The project comprises an investigation of what we term a "harbour system," relying on the three case studies of Caesarea, Terracina, and Port-Vendres, and considers the specificities of each site and their individual environmental context. The end goal is that the interdisciplinary methodology developed by our project at the above sites explored within a comparative framework can be later adapted and applied to similar harbour sites elsewhere.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101089123	**STONE**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Saša Čaval**
Host Institution:	ZNANSTVENORAZISKOVALNI CENTER SLOVENSKE AKADEMIJE ZNANOSTI IN UMETNOSTI - SVN

Unde venis? Unraveling the enigma of stećci tombstones

Stećci are medieval tombstones dispersed throughout Bosnia and Herzegovina, Croatia, Montenegro and Serbia. Still preserved in situ in tens of thousands in the landscapes, they are common grave markers of the Late Medieval and early Ottoman (12th C - 16th C) Western Balkans' plural societies. Although erected in the geographical region known for the 'medley of peoples,' stećci are not attributed to any ethnic or religious group and have always been considered enigmatic, lacking a clear, explicit belonging. The sheer number and dispersed distribution have hampered stećci scholarship, confining our understanding of this heritage to visual information and historical overviews. This multi-scale, multi-proxy archaeological project will integrate innovative and multidisciplinary approaches to study medieval funerary archaeology. The principal goal is to understand the social life of the society that left us these remarkable monuments. Focusing on medieval Herzegovina, the cradle of the stećci phenomenon, the proposed research into the social lifeways of these monuments will redefine the scholarship of the medieval Western Balkans funerary culture and situate it within a European context, significantly raising its visibility within international scholarship and the public domain. In addition to increasing our understanding of stećci, STONE will establish a discipline of medieval epigraphy in the Western Balkans; introduce epiconography, a conceptually innovative approach to study inscriptions and decorations on stećci; use a prehistoric landscape approach to investigate medieval landscape and initiate a paradigmatic shift away from the current culture-historical approach to the study of past societies. The proposed research will serve as a propulsive force within Western Balkan medieval archaeology, enabling it to make a decades-long leap to align with current medieval European funerary and research trends.

Link to the ERC project webpage: stecci-stone.eu

Keywords of the ERC project: archaeology, medieval period, funerary landscape, palimpsestic landscape, tombstone

Keywords that characterize the scientific profile of the potential visiting researcher/s: early career scholar

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101096539	**BOSTAN TREE**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Guy Bar Oz**
Host Institution:	UNIVERSITY OF HAIFA - ISR

Bioarchaeology of Orchards and Sustainable Terroir in the Arid Near East – Trends in Ecology and Evolution

Engaging with the myriad challenges linked to global warming and the unchecked expansion of drylands, the project seeks to develop models for implementing past agricultural know-how in modern socioeconomic contexts. Our novel methodology fuses cutting-edge interdisciplinary scientific approaches from the humanities and natural sciences with an inclusive citizen science framework to examine the ecological history and cultivar diversity of relic 'heritage horticulture' in four distinct arid regions in southern Israel. Focusing on the bioarchaeology of trees, we will define the historical, biological and environmental principles of dryland heritage horticulture systems and create a method for the exploration, analysis and ultimate dissemination of the crucial data they contain. When combined, this exceptional compendium of perspectives—coupling broad socio-geographical scientific viewpoints with more precise biogenetic, archaeological, and natural science analytics—can expand our understanding of the factors that drove the sustainability of heritage horticulture in marginal areas. The outcome of our study—an archaeologically informed grasp of ancient agrarian resilience—can transform the field of environmental history and impact present-and-future agricultural dynamics. Indeed, viewing trees as a singular analytical unit is unprecedented, as is our interdisciplinary survey of both the dormant and living artifacts contained within these archaeological contexts. Hence, deep knowledge of how bygone farmers related to the landscape and managed their limited resources, particularly the terrain, soil and water, holds vital implications for climate change adaptation and current-day food security. Moreover, the unique history of dryland farming and its remarkable development in marginal regions can inspire landscape policy management initiatives and community engagement programs that promote cultural heritage restoration and landscape reclamation.

Link to the ERC project webpage: bostantree.com

Keywords of the ERC project: Vegetation history, bioarchaeology, landrace fruit trees

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101097003	**VOICES**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Jane Ohlmeyer**
Host Institution:	THE PROVOST, FELLOWS, FOUNDATION SCHOLARS & THE OTHER MEMBERS OF BOARD, OF THE COLLEGE OF THE HOLY & UNDIVIDED TRINITY OF QUEEN ELIZABETH NEAR DUBLIN - IRL

Life and Death, War and Peace, c.1550-c.1700 Voices of Women in Early Modern Ireland

VOICES aims to recover the voices and interrogate lived experiences of women in early modern Ireland. Ireland formed part of the British, European and Atlantic world and women there responded to similar sets of transformative processes as other early modern women - proto-globalisation, state formation, confessionalisation, warfare, commercialisation, environmental change, and so on – which facilitates interrogation that is comparative, connected, and entangled. Two ambitious research questions underpin this pioneering project which focuses on Ireland as a case study. (1) What role did women play in a society undergoing profound economic, political, and cultural transformation? (2) What were their experiences of recurring social upheaval, bloody civil war and extreme trauma, especially sexual violence, and how have these been politicised? Our novel approach derives in large part from the interrogation of previously inaccessible historical data, now available digitally. This windfall is exceptional, but the resulting data is unstructured. Innovative technologies transform this unstructured data into knowledge that can be interrogated and visualised. VOICES will then transform the field of history by allowing us to: • recover the marginalised voices, lifecycles, and identities of women in Ireland and assess their contribution to the household, regional and national economies; and relationship to the land (WPs1, 2); • situate the experiences of women in the broader analytical framework of Europe, Britain, and the Atlantic world (WPs1-4); • lay the foundations for further future scholarship on the family, gender, identity, memory, emotion, and trauma in the early modern period (WPs1-4); • produce ontologies that outline key concepts and entities that relate to women and violence that can be reproduced across time and place, which makes VOICES the exemplar of the new and longstanding research questions now answerable by digitisation and associated methodologies (WP0)

Link to the ERC project webpage: https://voicesproject.ie/

Keywords of the ERC project: Ireland women digital humanities

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101097511	**SCAVENGERS**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Jordi Rosell**
Host Institution:	FUNDACIO PRIVADA INSTITUT CATALA DE PALEOECOLOGIA HUMANA I EVOLUCIO SOCIAL - ESP

Carnivores in human settlements: a new and different way to address the Middle Palaeolithic record

Anthropogenic sites often emerge from overlapping actions and/or occupations that include disruptive processes. Consequently, the palimpsests that arise can have a disorderly appearance, which may complicate the interpretation of such sites. The problem is worsened when some agents, such as carnivore scavengers, act on the archaeological record, causing the remains to disappear and leaving no obvious signs of their passage. Such occurrences have important consequences for archaeological studies, especially when trying to apply ethnographically-derived postulates created in high-resolution temporal contexts. However, new interpretations that are more complete can overcome this problem if the behaviour of scavengers is modelled using controlled experimental programs with wild carnivores (neo-taphonomy). SCAVENGERS consists of monitoring experimental reproductions of hearth-related assemblages (like those described in archaeological contexts) exposed to different species of wild carnivores: hyenas, lions, bears, wolves, and other smaller carnivores. The results will then be subsequently tested on different Middle Palaeolithic assemblages using Artificial Intelligence through computer techniques based on convolutional neural networks. However, the main aim is to generate cross-sectional data that can be applied to all periods and geographic areas, overcoming the limits of traditional archaeological methods to make accurate inferences about past human behaviour. The results of this project will contribute to the development of a new paradigm, changing some basic ideas about prehistory. There is a risk of generating a huge and unmanageable quantity of variables from neo-taphonomy. However, accumulated information and experience will provide valuable data and information for other areas of knowledge, such as those related to naturalistic studies, animal behaviour, and management of natural resources/parks.

Link to the ERC project webpage: https://scavengers.cat/en/ https://scavengers.cat/ca/

Keywords of the ERC project: Prehistory, Middle Palaeolithic, Neotaphonomy, Wild Carnivores

Keywords that characterize the scientific profile of the potential visiting researcher/s: Zooarchaeology, Statistics, Machine Learning

European Research Council Executive Agency Established by the European Commission	Project ID:	Project Acronym:	Evaluation Panel:
	101115642	**BT**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Birgit Nemec**
Host Institution:	UNIVERSITAT WIEN - AUT

Beyond Thalidomide: The Patient as an Agent of Change

Beyond Thalidomide will trace the historical rise of patient engagement with drug related disability through the second half of the twentieth century to understand how a novel empowered group transformed conceptions of (reproductive) health and disease in science and society. The project will map the conditions in which patient became engaged with antenatal drug use, and reconstruct how their action has created political and scientific urgency since 1960. This multifaceted engagement resulted in clashes of expertise that connected actors in the 'Global South' and 'North', from Latin American countries through Central Africa, India, and Europe, and the enforcement and stabilization of the development of approaches in reproductive health in the light of the democratic and civil societal challenges they pose, beyond traditional accounts of expert-led, iatrogenic risk management.

BT will address these aims trough analysis of four interlinked fields of patient engagement:

1. Monitoring, and the surveillance of exogenous factors for birth defects
2. Prevention, and the management of risks of antenatal drug use in health care systems
3. Marketing, and the making of pharmaceutical products
4. Legal Action, and court intervention

Mapping these fields of acting, BT will create an ambitious digital collection of patient life stories and a comprehensive integrated record of how patients engage. BT will, or the first time, deliver a global history of drug related disability 'from below', which examines the shifting contours of 'patients' as actors. This project takes a ground-breaking approach to the historiography of reproductive health, combining high-impact global case studies with innovative research tools to explore the political, ethical and social challenges of this alternative perspective.

Link to the ERC project webpage:

Keywords of the ERC project: history of drugs, history of reproductive health and justice, patient history, history of risks related to drugs, disability history

Keywords that characterize the scientific profile of the potential visiting researcher/s: history of drugs, history of reproductive health and justice, history of patient groups, patient activism, history of risks related to drugs, disability history

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Project ID:	Project Acronym:	Evaluation Panel:
101117265	**DEPOP**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Yuliya Hilevych**
Host Institution:	RIJKSUNIVERSITEIT GRONINGEN - NLD

Coping with decline: Comparative social-historical analysis of depopulation and community welfare in Europe, 1950-2022

The shrinking population and closure of schools and hospitals are among the main signs of regional depopulation. Although this phenomenon has been widespread in Europe since the 1950s, affecting both rural and urban communities, historical studies of depopulation are still scarce. How communities have responded, and indeed coped, with the decline in population and welfare over the past 70 years is uncharted territory. DEPOP will break new ground by illuminating regional depopulation as a potent example of a slow burn crisis, occurring over extended periods of time. We will: map out demographic trajectories of depopulation and their links to welfare provision; investigate community strategies to cope with depopulation; and develop a new framework to study community welfare in the slow burn crises as depopulation. Slow burn crises occur over extended periods and may thus be less visible than one-time shocks and disasters. There is currently no approach to examine how communities cope with slow burn crises. DEPOP will develop a novel multi-level approach by drawing on and developing methodologies in compositional demography, which is rooted in the historical concept of communication communities. DEPOP will look at communities in depopulating regions in Finland, the Netherlands, and Ukraine. We will analyse: (macro-level) population trajectories and state welfare provision data, available as reports and regional statistics; (meso-level) collective coping strategies through social organisations, collected through their archives and witness seminars, and (micro-level) individual coping strategies, examined through oral histories. DEPOP's historical approach and findings will offer the first-of-its-kind comparative framework to study communities affected by the slow burn crisis of depopulation. This will help us to advance our understanding of why some communities have historically been more resilient than others when faced with slow burn crises.

Link to the ERC project webpage: http://www.rug.nl/let/depop

Keywords of the ERC project: population decline, welfare decline, social history, demographic history

Keywords that characterize the scientific profile of the potential visiting researcher/s: population decline, welfare decline

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Project ID:	Project Acronym:	Evaluation Panel:
101117864	**RECONPAX**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Carolien Stolte**
Host Institution:	UNIVERSITEIT LEIDEN - NLD

Reconciling Peace: International Coalitions for Peace in the Era of Decolonization, 1918-1970

How did peace movements act upon the interlinked processes of decolonization and the Cold War? And how did these processes, in turn, impact the ability of peace movements to come together in large international organizations for peace? RECONPAX studies attempts to build large international coalitions for peace in the period 1918-1970. It departs from the assumption that, while peace activists reached out to each other in pursuit of shared goals, they did not necessarily share common methods. Attempts to include organizations from the decolonizing world in existing international bodies brought different understandings of peace work to the surface. In short, the necessary preconditions for a peaceful international order were both locally and historically contingent. This project brings historical depth to an issue of continuing relevance to the international order. It challenges the historiographical focus on the Cold War as the primary factor in the development of international peace organizations. It does so in two ways: by taking a longue durée perspective that incorporates precedents set by peace movements after the First World War; and by turning the lens on decolonization rather than on superpower competition. RECONPAX hypothesizes that the challenges posed by decolonization and the end of empire were the dominant drivers of success and failure in building international coalitions for peace. A four-person team consisting of two PhD researchers, a Postdoc and the PI will study these dynamics from four different, complementary vantage points, all divisive issues in the peace organizations of the postwar decades: conscientious objection to military service in the decolonizing world (PhD1), non-proliferation in the decolonizing world (PhD2), peace in maternalist thought (Postdoc), and peace in anti-imperialist thought (PI). Together, they will reveal how these issues shaped the possibilities and constraints of international coalition building.

Link to the ERC project webpage: peace.lucdh.eu

Keywords of the ERC project: history, peace, decolonization, pacifism, anti-nuclearism

Keywords that characterize the scientific profile of the potential visiting researcher/s: global history, intellectual history, peace history

Project ID:	Project Acronym:	Evaluation Panel:
101124398	**Home**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Wei Chu**
Host Institution:	UNIVERSITEIT LEIDEN - NLD

Eastern Central Europe's earliest shelters

From penthouses to igloos, homes are a cornerstone of human society, deeply entrenched in our evolutionary past. Their staggering array of architecture simultaneously shape and reflect our sociocultural traditions, structure our local economies, and have enabled us to inhabit all four corners of the earth. Yet surprisingly little is known about their earliest forms—Palaeolithic shelters. This is because no systematic attempts have been made to target their early archaeological signatures. HOME will search for a diversity of Palaeolithic shelters during the Late Pleistocene through informed systematic surveys and excavations of archaeological sites in East-Central Europe, a place where early mammoth bone structures suggest precocious shelters, but where the record remains inconclusive. This project's goal is to uncover and assess a variety of Palaeolithic shelters with the aim to understand the diverse ways that humans lived and survived in some of the coldest, harshest climates. The objectives are to: (1) Recognize the factors that influence the location and design of forager shelters through a goal-directed study of ethnographic documentation. (2) Develop new geophysical methods to identify open-air shelter residues in large-scale archaeological surveys. (3) Determine how one of the earliest unambiguous built structures, a mammoth bone structure, was used with the latest techniques in archaeological science. (4) Compare and contrast how these open-air shelters relate to a regional cave occupation through targeted excavations. The results will elucidate how our ancestors adapted to past climate change and expanded into new biomes, ultimately leading to our ubiquitous population of the earth. In addition to its significance to archaeology and anthropology, the outcomes have implications for theories of culture, evolution and human resilience by helping us understand the physical building blocks of early societies.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101125532	**AviArch**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Beatrice Demarchi**
Host Institution:	UNIVERSITA DEGLI STUDI DI TORINO - ITA

Avifauna in archaeoecological networks

We love birds but probably do not worry enough about our relationship to them. Across the world, we are threatening their critical ecosystem functions, including birds' positive impact on our wellbeing, and poultry has become our favourite meat, yet industrial-scale breeding has consequences for human and bird health. Arguably, this lack of concern is due to our ignorance of the deep historical roots of these relationships. Our interaction with birds, for their plumage, eggs, meat, song, or spirit, extends back to prehistory. At the same time, avifauna responded to climate shifts, and to our modifications of the landscape. This has created a tangled archaeological record, which makes understanding bird-human relationships all but impossible. Building upon and moving beyond my expertise in biomolecular archaeology, AviArch will explore, from a bird's eye view, the transition to agriculture in Epipalaeolithic/Neolithic southwest Asia and the emergence of urban life and trade routes in Bronze Age Crete. AviArch will reveal the variety of birds in past human systems by using new techniques for the identification of avifauna, integrating zooarchaeology, palaeoproteomics and AI. My sites have been carefully chosen to target biodiversity hotspots with a rich archaeological record intersecting socio-ecological changes of human-bird relationships. We will combine ecological, morphological, and behavioural traits for each bird, to produce the most refined exploration of human-avian relationships yet attempted in archaeology. Using network analysis and underpinned by multispecies theory, AviArch's archaeoecological models will discover how environmental shifts affected people, and anthropogenic- and climate-driven changes affected birds. By transforming the ways in which past bird-human interactions are studied, AviArch promises to improve human adaptivity, avian conservation strategies, and make us worry and marvel about these beautiful creatures a little more.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101126337	**CityLife**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Christina Papageorgopoulou**
Host Institution:	DIMOKRITIO PANEPISTIMIO THRAKIS - GRC

A bio-archaeological study of 1,800 years of resilience and adaptation to urbanity

CityLife explores, from a bioarchaeological perspective, how historical populations adapted to an urban environment and developed resilience to the disadvantages of urban life. By exploiting the vast amount of information contained in human skeletal remains, the project will clarify the roles of biological factors in the durability and sustainability of pre-industrial urban societies. Newly developed osteological, chemical isotope, and genomic methods will be used in this project, together with cutting-edge tools for statistical evaluation. CityLife will evaluate the living conditions, economy, population structure, pathogen load, and immune defenses in a sample of more than 4,500 skeletons from a hotspot of European urban culture: Thessaloniki. This city in northern Greece still exists today, and in historic times it formed a bridge between the Roman West and the Byzantine East. Thessaloniki offers the unique constellation to study urban life from 300 BC to AD 1,500 and thus to draw inference about an urban population in a single place continuously over 1,800 years. The main objectives of the project are to a) infer urban living standards by studying secular changes in anthropometric indexes, infant diet, childhood stress, and trauma in a combined manner; b) investigate the resilience and sustainability of urban food systems by reconstructing individual diets and local supply networks; d) investigate social structures, religious cohabitation, and migration by genetically reconstructing the degree of kin and non-kin relationships; and e) explore the effects of pathogen exposure on human evolution and health by studying genes associated with increased immunological response and the oral microbiome. CityLife will examine empirically tangible aspects of biocultural development to answer the simple question of how humans became urban species.

Link to the ERC project webpage: https://citylife-erc.hs.duth.gr/

Keywords of the ERC project: bioarchaeology, palaeogenomics, urbanization, stable isotopes, urban history, biological standards of living, social organization, paleeoproteomics, oral microbiome, trauma analysis, geometric morphometrics

Keywords that characterize the scientific profile of the potential visiting researcher/s: bioarchaeology, palaeogenomics, urbanization, stable isotopes, urban history, biological standards of living, social organization, paleeoproteomics, oral microbiome, trauma analysis, geometric morphometrics

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Project ID:	Project Acronym:	Evaluation Panel:
101141770	**PLIODIS**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Gabriele Macho**
Host Institution:	VRIJE UNIVERSITEIT BRUSSEL - BEL

Pliocene Hominin Dispersal to southern Africa: Choice or Chance?

Modern humans are unique in their ability to adapt to, and to thrive in, different environments. This trait facilitated their dispersal out-of-Africa to higher latitudes, i.e. to temperate and seasonal habitats, during the Pleistocene. However, there are Plio-Pleistocene hominins at higher latitudes in South Africa (SA) from ~3.7Ma onwards. Did human behavioural/physiological flexibility evolve early in our evolutionary history? Alternatively, did Pliocene hominins occupy such temperate zones due to different palaeoclimatic conditions in deep time and/or due to stochastic events? To untangle these questions this project will: (1) determine the geomorphological and palaeoecological changes in the Kalahari/proto-Limpopo basin, (2) create dynamic palaeo-precipitation/-vegetation models from various archives, (3) carry out detailed anatomical, functional and morphometric analyses of the hominin fossil record and (4) combine the datasets to appraise species diversity (functional adaptations), geneflow (hybridization) and dispersal scenarios (palaeobiogeography). 3 key working hypotheses underlie the proposal: 1. >2.6Ma East African (EA) hominin ranges expanded/contracted in accord with wet and dry phases; periodically, the southernmost populations became reproductively isolated. Early SA hominins represent descendants of Australopithecus anamensis and Australopithecus afarensis, respectively. 2. ~2.6-1.5Ma With the onset of the Northern Hemisphere Glaciation and the re-organisation of the drainage pattern within the Kalahari basin, dispersal corridors repeatedly closed (vicariance) and opened, resulting in intermittent levels of gene flow (i.e. hybridization) between EA and SA hominins. 3. <~1.5Ma Tectonic and hydrographic changes led to the Zambezi River becoming a powerful barrier during the Pleistocene. SA hominins younger than 1.5Ma are likely the result of endemism; competitive exclusion amongst these hominins resulted in exploitation of distinct ecological niche

Link to the ERC project webpage:

Keywords of the ERC project: Palaeoanthropology; hominin evolution; Plio-Pleistocene; functional morphology

Keywords that characterize the scientific profile of the potential visiting researcher/s: functional morphology

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Project ID:	Project Acronym:	Evaluation Panel:
101168587	**INASIA**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Małgorzata Kot**
Host Institution:	UNIWERSYTET WARSZAWSKI - POL

Were They Modern Humans? The Problem of the Initial Upper Palaeolithic in West Central Asia

The Initial Upper Palaeolithic (IUP) is a term describing lithic assemblages dated roughly to 50–40 kya in the Near East, Central Europe and North-Eastern Asia, which show traits of the emergence of blade technology, traditionally associated with the expansion of modern human groups. Several sites with IUP traits have also been recently recognised in West Central Asia (Uzbekistan and Tajikistan), but astonishingly they date to a period between 77 and 43 kya (Obi-Rakhmat, Khudji, Katta Sai 2, Khodjakent, Kuksaray 2, Ertash Sai 2).

Through this project, we aim to answer the question of whether there were indeed modern human groups who lived in Western Central Asia at this time and left behind lithic assemblages with IUP traits. This would make them the earliest known modern human migration waves into Eurasia. Alternatively, these assemblages were produced by Neanderthals or even Denisovans, who inhabited Central Asia prior to modern human expansion. This would question the widely repeated hypothesis of a relationship between blade technology and modern human groups.

To answer the question, we will study new cave sites in the region to collect palaeoecological, zooarchaeological and palaeoanthropological data. Using a multidisciplinary approach, we plan to reveal not only who made these IUP assemblages, but also study their subsistence strategies and settlement continuity between 77 and 43 kya within the changing palaeoenvironmental conditions.

By answering this question, we will either confirm an early modern human migration to Eurasia and challenge the current paradigm of Euro-Levantine blade technology emergence, or alternatively challenge the other major paradigm of a direct relationship between blade technology emergence with modern human expansion. In either case, we will clarify to what extent the phenomena we call the Upper Palaeolithic “revolution” was driven solely by modern humans, and whether it was stimulated by interactions with Neanderthals and/or Den

Link to the ERC project webpage: inasia.uw.edu.pl/

Keywords of the ERC project: archaeology, Stone Age, Palaeolithic, interdisciplinary studies, paleoclimatic studies, paleoenvironment, human evolution

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101169739	**PIONEER**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Margit Simon**
Host Institution:	NORCE RESEARCH AS - NOR

Palaeoenvironments of Human Behavioural Evolution in Africa

The emergence of Homo sapiens' behavioural complexity represents a fundamental milestone in the evolution of humankind. Still, the causes of this critical transformation remain debated. For the African Middle Stone Age (MSA, ~300 000–40 000 years) a key question is whether and how climate variability contributed to the increasing behavioural complexity in modern humans. However, behavioural-environmental hypotheses remain untestable because the existing palaeoclimatic datasets are spatially, stratigraphically, and causally disconnected from the archaeological record. PIONEER will overcome this impediment by developing a new analytical framework that allows testing of previously untestable hypotheses and thereby advances our understanding of human behavioural evolution. To achieve this, cutting-edge analytical (leaf wax isotope analyses) and computational approaches (climate- and agent-based modelling (ABM)) will be combined with African archaeology. Fundamental to my approach are high-resolution climate records from within the archaeology-bearing sediments, thus directly connecting environmental- and archaeological records. PIONEER will test behavioural-environmental hypotheses by interlinking several activities: 1) establish unprecedented high-resolution datasets of past vegetation and palaeohydrology changes from five key cave sites, inhabited by early Homo sapiens, located along the South African coast 2) create a high-resolution spatial representation of the environments experienced by our ancestors from novel climate simulations 3) explore likelihoods for different behavioural-environmental scenarios via ABM Although PIONEER focuses on the South African MSA, my approach is applicable to most archaeological timeframes and locations. Consequently, PIONEER will transform future studies of climate-human interactions, clarifying key aspects of early human behaviour.

Link to the ERC project webpage:

Keywords of the ERC project: Human evolution; Middle Stone Age; behavioural innovation; palaeoclimate; environmental change; biomarker analysis; leaf-wax isotopes; sedimentary ancient DNA (sedaDNA); metagenomics; metabarcoding; agent-based modelling; palaeoenvironmental reconstructio

Keywords that characterize the scientific profile of the potential visiting researcher/s: Palaeoecology; Quaternary environmental change; archaeological science; climate modelling; agent-based modelling; human–environment interactions; palaeoclimate reconstruction; vegetation dynamics; behavioural evolution; Middle Stone Age research; computat

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Project ID:	Project Acronym:	Evaluation Panel:
101170033	**INTEMPO**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Raul Carstocea**
Host Institution:	NATIONAL UNIVERSITY OF IRELAND MAYNOOTH - IRL

Insurgent Temporalities: Fascism as a Global Anti-Universalist Project

Deploying a complex methodological apparatus drawing on transnational history, this project breaks new ground by providing an original global history of fascism (1919-1945). INTEMPO argues that the fascist national revolutions were part of a global project of overhauling the liberal international order and replacing it with a fascist one. It does so by approaching transnational fascism through the lens of temporality, showing the centrality of a specific temporal structure to fascist ideology. Fascists everywhere repurposed a historical or mythical past, saw their present as a watershed moment in world history, and aimed to accelerate it toward a redemptive future of eternal plenitude when time would stand still. Despite significant variation related to the different national contexts in which fascist movements and regimes emerged, the compatibility of this temporal structure – translating spatially into distinct but similarly compatible projections of a 'New Order' – allowed mutual recognition and enabled international cooperation that transcended fascism's ultra-nationalism. The project further shows how fascism's temporal imagination resolutely opposed the universal time regime associated with the spread of capitalism, liberalism, and colonial expansion. Fascist temporalities and their revolutionary potential are consequently used as an entry point for elucidating fascism's restructuring of space – social space internally and geopolitical space internationally – and its complex engagement with capitalism and colonialism, respectively. The focus on temporality, underpinning analysis of the diverse forms that interactions between fascist movements and regimes took, allows us to operate across different spatial scales of analysis, from the local through the national to the global. INTEMPO inaugurates a new research agenda in four distinct fields: fascism studies, global history, the history of empire and colonialism, and the interdisciplinary study of temporality.

Link to the ERC project webpage:

Keywords of the ERC project: Fascism; temporality; global history; colonialism; conceptual history; corporatism; violence; genocide

Keywords that characterize the scientific profile of the potential visiting researcher/s: Fascism; nationalism; global history; modern history; colonialism; temporality; violence

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Project ID:	Project Acronym:	Evaluation Panel:
101170543	**FeMMiWork**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr Brigitte Le Normand**
Host Institution:	UNIVERSITEIT MAASTRICHT - NLD

Women Migrants from the Northern Mediterranean and Work in Postwar Northwestern Europe

A key assumption about postwar migration in Europe is incorrect – that nearly all who moved from the European South to work in the booming northwestern European economies were men. In fact, anywhere between 25 and 30% were women, but their role was erased by policy-makers, and subsequently by researchers, who framed labour migration as male. The resulting epistemological fog has led to claims that the feminisation of migration is a recent phenomenon. Women's work trajectories, and experiences of work, were distinctly gendered. Rectifying the record involves not only rescuing the forgotten stories of women working legally in factories. It also involves rethinking the notion of labour migration by focusing on invisible and informal, and yet crucial, labour, such as domestic work by women classified as dependents. By creating a counter-archive comprised of documents, oral history, and creative writing, this project will reconstruct the histories of women migrants. Four researchers will engage in systematic comparison of the trajectories and experiences of women from southern Europe (Italy, Yugoslavia) and Turkey, living and working in two destination states (France, West Germany) between 1955 and 1985. Using a transnational framework that considers relationships to multiple places, we will examine how gender and ethnic/national difference intersected to shape women's experiences. By recognizing and analysing the central place of women from Southern Europe and Turkey in building the northwestern European economies in the postwar boom years, the study examines the genesis of what sociologists call "counter-geographies of globalization." In de-centering European history by focusing on migrant women from Europe's periphery, it will change our understanding of the evolution of Europe after the Second World War. Through interdisciplinary critical engagement, it promises to generate new insights into the evolving role of gendered labour in globalization processes.

Link to the ERC project webpage:

Keywords of the ERC project: guest workers; women migrants; life histories; labour migration; informal work; counter archive;

Keywords that characterize the scientific profile of the potential visiting researcher/s: history; creative research methods; oral history; distant reading; gender studies

Project ID:	Project Acronym:	Evaluation Panel:
101171213	**WILDHIST**	**SH6** The Study of the Human Past

Principal Investigator:	**Dr David Pretel**
Host Institution:	AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS - ESP

Wild Rubber in the Industrial Age: A Global History of Production, 1820s-1940s

Rubber connected rainforests, factories and research laboratories during the industrial age. This entangled history has been widely acknowledged, yet its complex material background remains poorly understood. WILDHIST is the first multi-scale and multi-sited historical analysis of the exploration, extraction, processing, transport and manufacturing of wild rubber in a long-term frame. The project hypothesis is that wild rubber industries in the tropical rainforests of Africa and Latin America were key sites in the broader dynamics of industrialisation and scientific research from the 1820s to the 1940s, forming an integral part of the expanding global networks of knowledge exchange. While most studies offer a fragmentary perspective, this unique project brings rainforests, industries and laboratories into a single analytical focus, thereby shedding light on their historical entanglement. WILDHIST combines an analysis of contrasting non-plantation histories of rubber production in the Amazon, Congo Basin and so-called Maya Forest with broader histories of transnational interaction. The project rethinks and rewrites the global history of wild rubber by systematically and critically exploring a rich array of written, visual and oral sources located throughout the world. Its trans-local, interdisciplinary, comparative, digital and visual methodology will provide a truly comprehensive and nuanced historical account of how rubber was transformed into commodities and then final goods for local, regional or global markets. The project has three objectives: 1) Studying the actors, techniques, skills, knowledge and relations of production at rainforests' rubber frontiers; 2) Reconstructing, mapping and analysing the transnational chains of rubber production, including networks of science and expertise; 3) Exploring the visual representation of rubber production throughout the world using tools of digital and spatial humanities.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101171213

Keywords of the ERC project: rubber, rainforest frontiers, Africa, Latin America, transnational history, technologies of production, scientific research, industries.

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101039222	**SUperSAFE**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Carmelo D'Agostino**
Host Institution:	LUNDS UNIVERSITET - SWE

SUrrogate measures for SAFE autonomous and connected mobility

SUperSAFE "SUrrogate measures for SAFE autonomous and connected mobility" will address the problem of the safety evaluation of the interaction between conventional vehicles and connected and automated vehicles (CAVs). The project builds on the notion that vehicle automation is posing new risks that the traditional accident-based and proactive safety analysis methods are unable to investigate. In SUperSAFE, I will select the relevant variables drew on the newly identified risks posed by CAVs, and with these I will develop a new proactive method based on surrogate measures of safety for studying the effects of the physical and digital infrastructure on the interaction between road users in a mixed-mobility environment. Also considering the benchmarks for cities' liveability and transport sustainability that include road casualties as a primary factor, the European White Paper on Transport calls to reach zero fatalities by 2050 following Vision Zero's policy (zero serious casualties). Recent statistics indicate a reduction of traffic accidents but also that this development has slowed and additional efforts are required. At the same time, CAVs are already a reality. Tendency towards vehicle automation is even more evident in the European policies which encourage member states to push with the introduction of vehicles with advanced driver assistance systems. However, the road towards full automation is still not open because there is a fear of crashes/injuries and low acceptance of potential CAV accidents. This is mainly because the CAVs' behaviour vis-a-vis the conventional vehicles on the road and the digital and physical infrastructure is still unknown. To meet these rapidly approaching needs, I propose SUperSAFE, which will contribute to attaining the aforementioned European goals by developing a scientifically rigorous method of estimating risk based on the road users' real needs to improve traffic safety in the transition period to fully automated driving.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101039222

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101040939	**STORIES**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Liang Yang**
Host Institution:	LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN - DEU

Spatial-Temporal Dynamics of Flood Resilience

Existing studies on flood-society relations overwhelmingly concentrate on risk, exposure, vulnerability, damage, loss, and adaptation needs, most of which adopt a negative perspective. The fact that various human societies have well survived and continuously developed in flood prone areas (e.g., coasts, river deltas, flood plains, hilly valleys) is far less studied. Closing this research gap requires a deeper historical perspective to investigate the resilience of human society to floods, i.e., flood resilience and its changes. The Tea-Horse Road (THR) area, a flood hotspot across the mountainous Southeast Tibetan Plateau, is an ideal natural laboratory to study the spatial-temporal dynamics of flood resilience due to its long and uniquely documented history with extensive hazard experiences. STORIES will set up a theoretical framework on the multi-spatial-temporal features of flood resilience at the THR region, which covers the spatial differences (household, community, city and region) over the past 600 years regarding the governance, technology, society, and culture perspectives of flood resilience. A set of quantitative proxy data, historical archives, literature re-analysis, statistical data, observation data and field survey data will be integrated into both the empirical study in the case areas and the agent-based modelling across the cases. Specifically, STORIES aims to 1) establish a theoretical understanding of the spatial-temporal scales of flood resilience; 2) investigate the spatial patterns and temporal evolution of flood resilience at the THR cases; 3) model the spatial-temporal dynamics of flood resilience using agent-based models; 4) transfer and generalize the research findings of the THR cases to the Mekong River Delta and beyond. By doing so, STORIES will present pioneering work to shape the emerging research field of flood resilience, offering new and multi-dimensional knowledge on the dynamic nature of flood-society relations.

Link to the ERC project webpage: www.erc-stories.com

Keywords of the ERC project: flood, resilience, climate, geography, hydrology

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101043572	**WasteMatters**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Olli Pyyhtinen**
Host Institution:	TAMPEREEN KORKEAKOULUSAATIO SR - FIN

Ontologies of Waste: A Relational Study of How Waste Comes to Matter for Humans, Society, and Future

The future world imagined by the circular economic model is a world without waste, provided that materials and energy circulate efficiently enough through society. The project WasteMatters disrupts the waste-as-resource paradigm prevalent in the circular economy related politics, business, and scholarship alike, and examines our contemporary trashscapes beyond the idea(l) of the eternal redemption of waste. Its novel approach is to analyse the leaky realities of waste as integral to the human condition and as constitutive of society. The project explores the implications of waste throughout society and what waste does for/to us; what kind of relations, agencies, and spatiotemporal scales it assumes, prompts, enacts, and sustains; to what kind of futures society commits itself with it; and what humans become with waste. The project develops a new methodology, more-than-human ethnography, to be able to attend to the vibrant nature and active role of waste in how we live together. The research will be carried out through four sub-studies across various sites (in Sweden and Finland), which function as important nodal points in the management and circulation of wastes: households, businesses, biogas plants, waste incinerators, and a nuclear waste repository and, to attend to the multiplicity of waste, the project will focus on four kinds of waste: food waste, plastic waste, waste incineration ash, and nuclear waste. Through the research design, the project will generate ground-breaking insight into waste as both constitutive of society and as something that disturbs it. The empirical, methodological, and conceptual insights will be combined to enable a leap in theory building to develop a new relational theory of waste that pays attention to the multiple spatiotemporal scales of society and human actions, ultimately leading to a paradigm change from the circular economy to waste matter society.

Link to the ERC project webpage: https://projects.tuni.fi/wastematters/

Keywords of the ERC project: waste; waste studies; ethnography; circular economy; scales; more-than-human studies

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101043931	**REBOUNDLESS**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Daniela Pigosso**
Host Institution:	DANMARKS TEKNISKE UNIVERSITET - DNK

Towards the prevention of rebound effects within complex socio-technical systems

Society´s most well-intended efforts to solve sustainability challenges have not yet achieved the expected gains due to rebound effects, which are unintended consequences of interventions that arise due to induced changes in system behaviour. Rebound effects are widely acknowledged, but fundamental scientific gaps hamper their prevention. REBOUNDLESS aims to develop the reboundless design theory, a paradigm shift in design science that will establish the scientific knowledge for preventing rebound effects by: - Explaining systemic rebound effect mechanisms triggered by sustainable design strategies. - Modelling and simulating the magnitude of rebound effects arising from design decisions. - Enabling the design of resilient systems by means of reboundless design strategies. The reboundless design theory will provide novel methodologies, simulation models and strategies for the design of reboundless solutions (i.e. products, product/service-systems and socio-technical systems that are resilient to rebound effects). Building on the strong foundation of systems theory, REBOUNDLESS is uniquely positioned to bridge the interdisciplinary gap in the interplay of sustainable design and rebound effects, qualitative and quantitative models, engineering and social sciences, theory and practice. The reboundless design theory will be the starting point of a prominent research field, with extensive applicability within and beyond sustainable design (e.g. sustainability assessment, sustainability transitions, policy-making). Never before has there been a stronger global focus on solving the pressing sustainability challenges, but the expected positive societal impact will not be achieved unless rebound effects are prevented. Building on my 15-year track-record on sustainable design theory and practice, REBOUNDLESS will give me the opportunity to enable the urgently needed shift towards the design of sustainable and resilient systems.

Link to the ERC project webpage: https://reboundless.eu/

Keywords of the ERC project: rebound effects, design for sustainability

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101044703	**EUNICE**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Massimo Tavoni**
Host Institution:	POLITECNICO DI MILANO - ITA

Debiasing the uncertainties of climate stabilization ensembles

Mathematical models have become central tools in global environmental assessments. To serve society well, climate change stabilization assessments need to capture the uncertainties of the deep future, be statistically sound and track near-term disruptions. Up to now, conceptual, computational and data constraints have limited the quantification of uncertainties of climate stabilization pathways to a narrow set, focused on the current century. The statistical interpretation of scenarios generated by multi-model ensembles is problematic due to availability biases and model dependencies. Scenario plausibility assessments are scant. Simplified, single-objective decision criteria frameworks are used to translate decarbonization uncertainties into decision rules whose understanding is not validated. EUNICE aims to transform the methodological and experimental foundations of model-based climate assessments through quantification and debiasing of uncertainties in climate stabilization pathways. Our approach is threefold: construct, consolidate and convert. We first apply simulation and statistical methods for extending scenarios into the deep future (beyond the current century and status quo), quantifying and attributing deep uncertainties. We consolidate model ensembles through machine learning and human ingenuity to eliminate statistical biases, pin down near-term correlates of long-term targets, and identify early signals of scenario plausibility through prediction polls. Finally, we use decision-theoretic methods to convert model-generated maps of the future into resilient recommendations and experimentally test how to communicate them effectively. By advancing the state of the art in mathematical modelling, statistics, and behavioural decision-making, we strengthen the scientific basis of climate assessments, such as those of the IPCC. The approach and insights of EUNICE can be applied to other high-stakes environmental, social and technological evaluations.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101044906	**GREENTRAVEL**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Tuuli Toivonen**
Host Institution:	HELSINGIN YLIOPISTO - FIN

GREENER URBAN TRAVEL ENVIRONMENTS FOR EVERYONE: From measured wellbeing impacts to Big Data analytics

Greenery is an integral part of healthy and liveable urban environments. Availability of greenery is a question of environmental justice and equity. The benefits of greenery have been clearly shown in the residential context, but exposure to greenery in everyday urban travel environments has been studied much less, if at all. The project will produce a novel understanding of the quality, availability and wellbeing impacts of green urban travel environments. Furthermore, it will produce knowledge on how equitably green exposure during travel and related wellbeing impacts are available to urban populations. It provides approaches and analysis on where to add greenery to advance equity. The project draws on the recent developments in urban informatics: It employs cutting edge technologies from immersive Virtual Reality to Big Data mining, but also critically evaluates it. Controlled VR experimentations and carry-on sensors will be used to reveal if and why green travel environments matter for people and what greenery features are relevant, also considering seasonal variations. The understanding will be backed up with more traditional surveys. Computer vision on street-view images and 3D models will be used to map relevant greenery features, from the human perspective and considering seasonalities. Mobile Big Data will be leveraged to study the mobility flows of the urban population and to reveal the equity of green exposure during these everyday trips, also considering different transportation modes. Finally, advanced spatial prioritization and green routing tools will identify the future potential for greener travel environments for everyone. When successful, the project will produce transformational knowledge on the importance, availability and equity of green urban travel environments. It will produce completely new open methods and transferable procedures for analysing green travel environments in Europe and beyond.

Link to the ERC project webpage: https://www.helsinki.fi/en/researchgroups/digital-geography-lab/projects/greentravel

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: Spatial analysis, gis, urban green, street greenery, transportation, active travel

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Project ID:	Project Acronym:	Evaluation Panel:
101053836	**SOLROUTES**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Luca Queirolo Palmas**
Host Institution:	UNIVERSITA DEGLI STUDI DI GENOVA - ITA

Solidarities and migrants' routes across Europe at large

Unauthorized migration has always been a contentious issue in the EU. Yet, many of the policies adopted thus far have proved ineffective in containing arrivals and blocking circulations of migrants and refugees within the EU. Furthermore, unauthorized migration has continued to challenge EU borders even during the pandemic.

SOLROUTES' core research question is: how can the turbulence, persistence, and intensity of unauthorized movements and of the production of migrants' routes across "Europe at Large" – originating from the externalization of EU borders to non-EU countries – be understood?

The project addresses this challenge from an innovative angle, through an ethnographic exploration of the nexus between unauthorized movements and the networks of solidarity with migrants in transit, which involve actors and practices that have been addressed just recently in migration studies. This will be achieved by exploring and observing 50 crucial nodes in migration routes within Europe, in selected countries on its fringes (Turkey, Tunisia, Morocco) and in the Outermost Regions of the EU (French Guiana, Mayotte).

SOLROUTES will aim to: a) explore the functioning, articulations, and representations of local and trans-local networks which share shelter, knowledge and resources with migrants in transit; b) assess how routes are continuously reshaped by the encounter between unauthorized movements and solidarity networks; c) develop a large-scale multi-sited ethnographic approach based on live and collaborative methods and digital research; d) develop an innovative theory in migrations studies on the nexus between solidarity with migrants in transit and unauthorized movements, contributing to structure the emerging perspective of solidarities studies; e) generate Special Features – a web series, an art exhibit, a graphic novel – linked to the research, offering new narratives for policy makers, local communities, and other relevant audiences in the spirit of public sociology.

Link to the ERC project webpage: www.solroutes.eu

Keywords of the ERC project: solidarity border abolitionism undocumented migration routes ethnography visual sociology

Keywords that characterize the scientific profile of the potential visiting researcher/s: solidarity abolitionism undocumented migration routes ethnography visual sociology

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Project ID:	Project Acronym:	Evaluation Panel:
101075838	**COeXISTENCE**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Rafal Kucharski**
Host Institution:	UNIWERSYTET JAGIELLONSKI - POL

Playing urban mobility games with intelligent machines. Framework to discover and mitigate human-machine conflicts.

AI-driven technologies are ready to enter urban mobility. They promise relief to the notoriously congested transport systems in pursuing sustainability goals. Since AI already outperforms humans in the most complex games (chess and Go) it is likely to win the urban mobility games as well, outperforming us e.g. in: route choices (to arrive faster), mode choices (to reduce costs), pricing strategies and fleet management (to increase market shares and profits). Tempting us and policymakers to gradually hand over our decisions to intelligent machines. The consequences of this ongoing revolution are challenging to predict and largely unknown. While the abundance of previous studies proves the positive potential of AI in urban mobility (from autonomous vehicles via optimal routing up to fleet management), the negative impact is overlooked. Conversely, our scenario of interest is the machine-dominated urban mobility system, where (collective) decisions of machine intelligence improve system-wide performance, yet at the cost of humans, now facing e.g. longer travel times, greater monetary costs or being nudged to change natural travel habits into the optimal ones - desired by the machine-centred system. Such scenarios, however, need to be discovered. To this end, COeXISTENCE embarks on the interdisciplinary expedition inside the virtual environment of urban mobility, where machines and humans play the game for limited resources. In the four pre-identified games I will explore the conflict scenarios, demonstrate them on reproducible case-studies, quantify with proposed measures and finally mitigate with a proposed multi-objective reinforcement learning framework, where machines learn to mitigate conflicts while simultaneously reaching their inherently selfish objectives. Reaching the projects' objectives will be ground-breaking when new phenomena are discovered and lead to breakthrough when they are mitigated pushing the system towards the synergy of COeXISTENCE.

Link to the ERC project webpage: https://www.rafalkucharskilab.pl/research/coexistence/

Keywords of the ERC project: game theory
transportation
machine learning
game theory
traffic

Keywords that characterize the scientific profile of the potential visiting researcher/s: game theory
transportation
machine learning
game theory
traffic
optimization

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Project ID:	Project Acronym:	Evaluation Panel:
101077353	**Geoformations**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Susan Murphy**
Host Institution:	THE PROVOST, FELLOWS, FOUNDATION SCHOLARS & THE OTHER MEMBERS OF BOARD, OF THE COLLEGE OF THE HOLY & UNDIVIDED TRINITY OF QUEEN ELIZABETH NEAR DUBLIN - IRL

Geographies of dynamic governance assemblages in development cooperation civil society spaces

Interacting socio-political, economic, and environmental crises are destabilizing efforts to attain the global vision entailed in UN Agenda 2030. The need for adaptive and inclusive development cooperation governance has never been stronger. As complex needs accelerate due to the coronavirus pandemic, rapidly changing climates, and increasing levels of conflict and human insecurity, trust and legitimacy in traditional institutions and actors is weak and declining. In efforts to achieve greater development effectiveness, the international development cooperation sector is shifting towards new ways of working, including increased localization, decolonization, greater coherence across the humanitarian-development-peace nexus, and adapting development practice to support deeper engagement with civil society actors. However, how these changes affect governance structures and processes within non-profit non-governmental and civil society organizations (CSOs) is not well understood. With an estimated 37,000 autonomous entities, understanding how, why, and in what ways CSOs assemble governance structures and interact to ensure effective and appropriate governance of development programs is critically important to trust and legitimacy in this sector. To date, no research has systematically examined the relational and spatial dynamics of CSO governance chains. Nor have comprehensive evaluation frameworks for such assemblages yet been developed. Using core geographical concepts of place, space, and scale, drawing upon ground-breaking methodologies of assemblage thinking and critical realist evaluation, combined with innovations in organizational theory through issue framing, GEOFORMATIONS will provide radical new insights into the governance geographies of place-based development cooperation practices which can be used to radically redesign international development cooperation governance theory, policy, and practice.

Link to the ERC project webpage: https://geoformations.eu

Keywords of the ERC project: governance; civil society organisations; development cooperation

Keywords that characterize the scientific profile of the potential visiting researcher/s:

Project ID:	Project Acronym:	Evaluation Panel:
101077492	**BeyondSDG**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Prajal Pradhan**
Host Institution:	RIJKSUNIVERSITEIT GRONINGEN - NLD

Transformation towards long-term sustainability beyond Sustainable Development Goals

Countries are not on track to meet the 2030 Agenda for Sustainable Development that comprises 17 Sustainable Development Goals (SDGs) and 169 targets to be achieved by 2030. Although SDGs aim to shift the world onto a sustainable and resilient path, countries are not yet able to make transformative changes for long-term sustainability that requires building social prosperity and foundations within planetary boundaries. Failing to achieve SDGs will negatively affect billions of people and worsen environmental conditions and socio-economic problems. Therefore, BeyondSDG aims to understand the necessary conditions for long-term sustainability, including achieving SDGs, based on the following specific objectives: i) identify critical targets for prioritising SDGs; ii) investigate the effects of (under)achieving SDGs on long-term sustainability beyond 2030; and iii) identify sustainability targets for the post-2030 development agenda. For this, BeyondSDG will apply a threefold scientific approach that combines statistical analysis of empirical and modelled data, qualitative analysis of literature, and knowledge co-creation with stakeholders, including sectoral experts and policymakers, based on systems thinking. This combination of three approaches is complementary and essential to deal with the complex topic of long-term sustainability. Consequently, BeyondSDG will lead to a breakthrough in interdisciplinary research by combining approaches from sustainability science, earth system modelling, and environment and resource management. Mainly, it will bring the following ground-breaking findings: critical targets where adequate actions can lead to progress across most SDGs, negative impacts of underachieving SDGs on people, the planet, and prosperity, required extra efforts for long-term sustainability besides achieving SDGs, and sustainability targets for the post-2030 Agenda based on lessons learned from SDGs, state-of-the-art science, and stakeholder partnerships.

Link to the ERC project webpage: https://beyondsdg.eu/

Keywords of the ERC project: SDGs

Keywords that characterize the scientific profile of the potential visiting researcher/s: SDG interactions

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Project ID:	Project Acronym:	Evaluation Panel:
101078710	**ASYKNOW**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Marry-Anne Karlsen**
Host Institution:	UNIVERSITETET I BERGEN - NOR

Contested Knowledges in and through Asylum Litigation

Migration, and particularly the question of asylum, has become one of the most pressing and polarizing issues of our time. Scholars have highlighted how the high level of contestation and politicization in this area has increased the demand for a wide range of expert knowledge. At the same time, this situation has thrown expert knowledge into a terrain of conflict. Consequently, the notion that expert knowledge provides a proper foundation for legal decision-making regarding asylum is under pressure. ASYKNOW will develop new conceptual tools for understanding the role of expert knowledge in asylum governance by investigating the ways in which knowledge about asylum seekers and migration is constituted and contested through asylum litigation. The project moves beyond traditional approaches to expert knowledge in migration scholarship, which has largely examined the content of decisions and adopted a one-directional approach to expert knowledge as an instrumental and/or symbolic tool of states' domination. Instead, a focus on asylum litigation allows us to examine 1) how knowledge claims attain meaning and authority through the relational dynamics between differently situated actors, 2) how legal thresholds and tactics evolve as they pertain to the use of expert knowledge, and 3) how types of knowledges and knowledge claims facilitate or challenge states' ability to exercise power over bodies and spaces. ASYKNOW brings together theoretical concepts, methodological approaches, and findings from geography, anthropology, law, and Science and Technology Studies (STS) – that have hitherto remained fairly separate with regard to the study of migration – into a novel and productive dialogue. Methodologically, the project adopts an ambitious in-depth comparative research design that innovatively combines an ethnography of legal processes with legal archaeology. Empirically, the research will focus on litigation of asylum-related cases in Norway, Sweden, Denmark, and Germany.

Link to the ERC project webpage: https://www4.uib.no/en/research/research-projects/contested-knowledges-in-and-through-asylum-litigation-asyknow

Keywords of the ERC project: asylum, expert knowledge, courts, evidence

Keywords that characterize the scientific profile of the potential visiting researcher/s: migration research, ethnography, law,

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Project ID:	Project Acronym:	Evaluation Panel:
101097924	**CLIMGROW**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Jeroen Van Den Bergh**
Host Institution:	UNIVERSITAT AUTONOMA DE BARCELONA - ESP

Climate Policy vs Economic Growth: Opinions, Models, and Novel Strategies

Climate change has revived the debate on growth-vs-environment which may intensify in coming years. This project studies to what extent concerns about economic growth, ranging from pro- to anti-growth, hamper social-political support for ambitious climate policy, and how this can be amended. Using surveys, experiments and interviews, it assesses whether beliefs about growth-vs-environment affect policy opinions of distinct stakeholders (voters, policymakers, journalists, etc.), and if this is moderated by preferences regarding instrument types, such as standards, taxes or subsidies. The project further tests the role of information by comparing the effect of distinct beyond-GDP metrics on views about growth vs climate policy. In addition, it studies how growth concerns relate to the design of pledges in the Paris Agreement, as these demarcate national climate policies. Based on collected data and derived insights, the project then undertakes system-dynamics and agent-based modelling to study the co-dynamics of climate-policy design and support. This will create models of the "dynamic policy-support cycle" (DPSC), comprising policy design, economic and emission impacts, opinion dynamics (i.e. support/resistance), and policy adaptation. It involves comparing growth strategies and climate policies using distinct beyond-GDP metrics, and connecting this to stakeholder opinion dynamics. Informed by the model results, in a third part the project explores whether an agrowth strategy, which is precautious towards both economic and climate risks, can increase support for ambitious climate policy. Given stakeholder diversity, we perform interviews to decide about tailored strategies in this respect. Similar proposals to agrowth, notably under the label of "post-growth", will be examined as well. The ultimate aim is to learn about dynamic packages with climate-policy instruments and a/post-growth measures that culminate in majority support for ambitious climate policy.

Link to the ERC project webpage: https://portalrecerca.uab.cat/en/projects/climate-policy-vs-economic-growth-opinions-models-and-novel-strat-2

Keywords of the ERC project: climate policy, growth debate, modelling, surveys

Keywords that characterize the scientific profile of the potential visiting researcher/s: climate policy, growth, modelling

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Project ID:	Project Acronym:	Evaluation Panel:
101116116	**Materials-GRoWL**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Tomer Fishman**
Host Institution:	UNIVERSITEIT LEIDEN - NLD

Materials-GRoWL: Gauging the Rest-of-World's Lifecycles of construction materials

This project, Materials-GRoWL, will assess the current and future construction material uses that compose human settlements of the Global South, which is sometimes indiscreetly aggregated as the Rest of the World (RoW) in global studies. This is crucial, because construction materials have global environmental impacts: half of yearly consumption of all raw materials, significant shares of carbon emissions, and major contributors to land use change. Most of their future demands and thus environmental and societal impacts will occur in the global south. This is also challenging, because understanding the lifecycles of construction materials – how many and which materials, where are they used, to what ends, and with which impacts – has been daunting due to limited data and research frameworks. The Global South has been neglected so far, and the little understanding we have is incomplete, uncertain, and incoherent. Thus the environmental and socioeconomic risks related to construction material use in the RoW countries now and in upcoming decades are only generically studied or remain unknown. Materials-GRoWL will: 1. Develop novel methodologies to produce high-resolution construction material data in the Global South and link these to the societal services and human needs they provide; 2. Compare future material use developments to 2070 under a suite of different socioeconomic and wellbeing pathways; 3. Identify environmental and socioeconomic risks imposed on and by construction material accumulation; and 4. Form an exchange framework for cross-transfer of material use knowledge. Materials-GRoWL will overcome the severe data and methodological challenges that held back the study of construction material use in the Global South. It will provide data and methods crucial for addressing the SDGs and material prerequisites of decent living standards. The results will link the development of the built environment with its impacts to inform further research, policy and action

Link to the ERC project webpage: https://www.universiteitleiden.nl/en/research/research-projects/science/materials-growl-gauging-the-rest-of-the-worlds-lifecycles-of-construction-materials

Keywords of the ERC project: building materials, material flow analysis, global south, construction, sustainable resources, circular economy, , urban development, urban sustainability, developing countries

Keywords that characterize the scientific profile of the potential visiting researcher/s: industrial ecology, sustainability science

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Project ID:	Project Acronym:	Evaluation Panel:
101117700	**ATRAPA**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Oriol Marquet**
Host Institution:	UNIVERSITAT AUTONOMA DE BARCELONA - ESP

The active travel backlash paradox: opposition and acceptability determinants of built environment-based sustainable travel interventions

Transport policy is a contentious issue. In recent years, ambitious proposals aiming at reducing car use and creating a more sustainable, equitable, and healthy transportation system have been met with strong opposition movements. However, little is known about the factors and nature of these opposition movements. At the same time, mayors, and elected leaders worldwide, who have pushed for ambitious built environment-based travel demand policies, have later been vindicated by major re-election wins. This would suggest the existence of an "active travel backlash paradox", one where loud opposition movements might be concealing substantial silent support towards measures that aim to transform the built environment, in order to make it more walkable and cyclable. Validating the existence of this paradox, and expanding our understanding of opposition and acceptability factors towards built environment-based sustainable travel interventions, has major implications both locally and globally. To this end, the ATRAPA project sets out to (1) test the existence of the paradox and (2) to further our understanding of opposition and acceptability towards built environment travel demand interventions. To do so I will use a multi-scale, multi-method design to be applied in eight leading European cities. Thanks to highly disaggregated spatial election data and geolocated information on land-use transformations, I will be able to assess the associations between voting behaviour and built environment-based sustainable travel interventions. In parallel, I will use an international public opinion survey and interviews with experts to understand, the socioeconomic, individual, and contextual factors behind acceptability/opposition levels. This will assist in understanding their causes, and their spatial and social distribution, and permit exploration of much-needed future least-opposition pathways towards efficient and widely-accepted sustainable transport policies.

Link to the ERC project webpage: https://webs.uab.cat/atrapa/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101125503	**COMFAM**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Anna Oksuzyan**
Host Institution:	UNIVERSITAET BIELEFELD - DEU

Linked Lives: Consequences of Long Commuting for the Health of All Family Members

Passive commuting–regularly recurring travel between home and work by a motorized vehicle or public transportation–is an integral part of our lives. Commuting may take a toll on the health of commuters and their family members. Current research offers a limited understanding of whether commuting's health impacts are socially patterned. Information about whether long commuting affects family members is scarce. A comprehensive inquiry into this topic is needed to understand what commuting means for population health.
COMFAM's main objectives are: 1) to investigate the impact of long commutes on commuters' physical health, 2) to investigate whether long commutes have adverse effects on non-commuting partners' health and well-being, 3) to assess the effects of parental long commutes on children's health and social outcomes, 4) to examine whether changes in commuting during and after the COVID-19 pandemic have brought any changes to the health and well-being of the family members, and 5) to examine whether the health effects of long commutes differ across population subgroups, and whether these effects are short- or long-term.
COMFAM is ambitious and highly innovative. It will use high-quality Nordic register data, enabling us to examine comprehensive objective indicators of health, investigate the heterogeneous health effects of long commuting, and employ novel methods to address endogeneity and help establish a causal pattern. We will also leverage rich survey data from the UK, US, and Germany to investigate mechanisms that may underlie commuting-health relationships and assess health declines not yet requiring medical treatment.
COMFAM is also important. In addition to impacting population health, the negative health effects of commuting may reduce employee performance, induce premature exits from the labor force, and set children on problematic trajectories. Thus, the findings will have far-reaching public health, social, and economic implications across nations.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101125503

Keywords of the ERC project: long commutes, health, family members

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101162722	**GeoNuFE**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Teva Meyer**
Host Institution:	UNIVERSITE DE HAUTE ALSACE UHA - FRA

Critical Geopolitics of Nuclear Fuel Supply in Europe

How do countries build their nuclear fuels supply policies? The ongoing political renaissance of nuclear power through the world raises concerns about European Union states' ability to fill their needs. Despite efforts to build a common strategy, EU members follow diverging paths to secure their supplies. However, energy security studies are so far unable to explain this heterogeneity, creating miscomprehensions between countries and ill-informing energy policies. First, we lack any empirically informed works on the geopolitics of nuclear power. Second, all theoretical frameworks studying supply security were built over hydrocarbons. But if we want to decarbonize our societies, we will first have to decolonize these tools from the grip of fossil fuels. Third, while critical security studies have called for more space-sensitive approaches, engagement with political geography theories remains limited. GeoNuFE aims at filling these gaps by questioning the variables behind the spatial heterogeneity of nuclear fuel supply strategies. To do so, I develop an innovative analytical framework bridging "critical security studies" and "critical geopolitics" through their ongoing turn to new materialist approach and assemblage. GeoNuFE will compare four countries: France, Finland, the UK, and Hungary, following three steps. [1] I'll confront the current fossil-fuel informed theories to actors of the nuclear sector to build the first ever analytical framework of "objective supply security" adapted to it, and apply it to the four countries. [2] I'll identify the influence of EU membership by digging into how the Euratom Supply Agency, who is responsible for allowing supply contracts to member states, produces and performs "security". [3] I will trace and compare the geopolitical assemblage which explains the supply strategies in each country. Expected results will provide essential knowledge of the geopolitical dimensions of energy transitions to better inform EU energy policies.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101163144	**Relative Health**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Ingrid Van Dijk**
Host Institution:	LUNDS UNIVERSITET - SWE

Long-Run Inequalities in Health and Survival Between Families and Across Generations

Worldwide life expectancy has increased strongly over the past decades, but social inequalities in health and mortality are large and increasing. In contrast to trends in socioeconomic inequality and social mobility, long-term developments in inequality in health and mortality have been poorly documented. “Relative Health” aims to quantify the level of inequality in health and mortality from a family perspective 1800-today. Characteristics that affect health and mortality accumulate in families, and thus the level of inequality in health and mortality can be quantified by addressing similarities within families in health and mortality (same-generation relatives) and intergenerational persistence of health and survival (ancestors and descendants).

The project has four main objectives:

1. Develop new ways to measure inequality in health and mortality using a revolutionary new perspective, inequality between families and intergenerational persistence;
2. Using these, describe for the first time long-term trends in health and mortality inequality;
3. Identify mechanisms that shape these inequalities between families and across generations;
4. Identify the role of contextual characteristics in shaping inequalities between families, including the level of social mobility and social inequality.

State-of-the-art population reconstructions cover up to 9 generations of relatives (grandparents, parents, children) in Sweden, Netherlands, and US 1800-today and contain lifespan and health information. The project lays the groundwork to generalize these estimates of family health inequality to many contexts with less abundant data sources, using survey data. These contain indicators of health and mortality for focal individuals, their siblings and children for a range of low- and middle-income countries covering 4 decades (DHS, 1984-2018). Overall, the project seeks to transform our understanding of social inequality in health and mortality across time and space.

Link to the ERC project webpage: https://www.ingridvandijk.com/relative-health/

Keywords of the ERC project: Health inequalities, demography, long-term developments

Keywords that characterize the scientific profile of the potential visiting researcher/s: health, survival, demography, inequality

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Project ID:	Project Acronym:	Evaluation Panel:
101163333	**SINGLE**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Ariane Ophir**
Host Institution:	CENTRO DE ESTUDIOS DEMOGRAFICOS - ESP

Understanding the Demography and Stratification of Singlehood in Europe

Amid declining marriage and fertility rates, singlehood is rapidly gaining scholarly attention. Yet, singlehood scholarship is remarkably fragmented and underdeveloped. Existing theories are divided between narratives of singlehood as an unfavorable outcome or an empowering life choice. Moreover, existing frameworks are limited by a glaring inconsistency in the measurement of singlehood, an overwhelming focus on young adults, and a general neglect of cross-national and intersectional approaches. These limitations undermine our ability to establish a comprehensive, holistic framework that answers fundamental questions: (1) what the scope of singlehood is in the adult population and (2) how social stratification is reproduced within the single population. SINGLE proposes to resolve these tensions by taking an unprecedented, comprehensive, comparative approach that bridges demographic and sociological debates and pays attention to the diverse challenges and opportunities that single life offers. First, SINGLE takes a population approach by establishing a Demography of Singlehood framework that will produce and disseminate estimates of the prevalence, composition, and duration of singlehood across Europe using various large-scale secondary data sources. Through novel data collection, SINGLE will also offer pioneering insights into singles' self-identification and motivation to be single to improve our understanding of selection and terminology in singlehood research. Second, SINGLE takes a stratification approach to expand our understanding of social inequality within the single population. SINGLE will disentangle how demographic, economic, and cultural forces systematically shape singles' unequal outcomes within and across countries. By documenting singles' time use, well-being, perceived pressure to partner, and access to support systems, SINGLE will reframe our knowledge of the complexity and diversity of European singlehood.

Link to the ERC project webpage: https://arianeophir.wixsite.com/arianeophir/other-and-future-projects

Keywords of the ERC project: Family Demography - singlehood - stratification - welfare regimes - comparative - survey design

Keywords that characterize the scientific profile of the potential visiting researcher/s: family formation - fertility - social stratification - immigration - life course - computational sociology - experimental methods - social demography

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Project ID:	Project Acronym:	Evaluation Panel:
101164292	**IMMERSION**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Rico Krueger**
Host Institution:	DANMARKS TEKNISKE UNIVERSITET - DNK

Explaining human decision-making by combining choice and process data

Decision-making is a core element of human activity, and the decisions we make can have significant consequences for ourselves, others, and the world we live in. Thus, the ability to explain and predict decision-making is vital for improving individual and societal outcomes, especially when addressing global challenges like climate change, sustainable energy, ageing populations, and public health. Mathematical models of decision-making can help us to understand and predict human behaviour. Despite significant progress, several scientific challenges persist in the applicability of advanced behavioural models to real-world problems. Many models focus on predicting decision outcomes rather than explaining the decision process itself. Information contained in neurophysiological process data that emerge during decision-making are often ignored, and methods for collecting behavioural data fail to create realistic impressions of scenarios representing the future. IMMERSION aims to advance the study of human decision-making by developing new innovative methods for combining choice and process data. This includes new models for integrating choice and process data, new statistical inference procedures tailored to such models, and new methods for collecting rich behavioural data in immersive experiments. The proposed research will create a paradigm shift in behavioural research with impacts on many application domains. IMMERSION will equip researchers with a new powerful toolkit for extracting deep behavioural insights from rich data using advanced models. The proposed research includes substantial empirical work applying IMMERSION's methodological innovations to real-world problems with implications for the human-centric design of future transport systems. This work includes case studies to explain and predict human decision-making in the contexts of transportation infrastructure development, pedestrian-autonomous vehicle interactions and pedestrian wayfinding.

Link to the ERC project webpage: https://immersion.dtu.dk

Keywords of the ERC project: decision-making, virtual reality, transport, modelling

Keywords that characterize the scientific profile of the potential visiting researcher/s: decision-making, virtual reality, transport, modelling

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Project ID:	Project Acronym:	Evaluation Panel:
101170110	**Egressibility**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Enrico Ronchi**
Host Institution:	LUNDS UNIVERSITET - SWE

Egressibility: a paradigm shift in evacuation research

The Egressibility project aims at a paradigm shift in the field of building evacuation research by addressing the critical need for inclusive emergency evacuation. While accessibility and universal design have contributed to significant developments in creating inclusive built environments, this research will transform current evacuation design into universally accessible evacuation design, particularly focusing on vulnerable groups such as older populations and people with disabilities. This project is a timely initiative, aiming at shifting the field of evacuation to Egressibility by establishing a scientific discipline dedicated to the safety and security of every person during emergency evacuation, aligning with the broader goals of creating a resilient and inclusive built environment in Europe and beyond. With natural hazards becoming more frequent and more severe due to climate change, ageing populations and geopolitical uncertainties threatening European security, the demand for efficient and inclusive emergency evacuations has never been more pressing. To date, egress provisions and building design tools are still considering adult healthy populations as starting point. By using qualitative and quantitative methods including virtual reality and inclusive machine learning (following the principles of ethical artificial intelligence), the project addresses equal access to safety for all individuals, irrespective of their functional abilities. Egressibility stands at the intersection of technology and a growing awareness of diversity. The Egressibility project will provide a scientifically rigorous approach allowing a paradigm shift in evacuation research and inform policy making and design. This will enable a future in which technology can be used to ensure an inclusive and safe use of the built environment. Egressibility is not merely an academic pursuit; it is a commitment to a fair and equal society.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101170110

Keywords of the ERC project: evacuation, crowd dynamics, machine learning, evacuation simulation, disabilities, virtual reality

Keywords that characterize the scientific profile of the potential visiting researcher/s: machine learning, virtual reality, EEG, disabilities, BCI, eye-tracking, human behaviour, SVM, GSR

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Project ID:	Project Acronym:	Evaluation Panel:
101170578	**MINE-THE-GAP**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Victor Maus**
Host Institution:	WIRTSCHAFTSUNIVERSITAT WIEN - AUT

Enabling Global-Scale Mine-Level Indicators from Satellite Observations

The global surge in mining, driven by decarbonisation and digitalisation, has uncovered a critical gap in our understanding of its environmental and social impacts and risks. Despite the seemingly abundant knowledge about mining operations, they remain largely unmeasured, even within the European Union, posing a challenge to sustainable development efforts. Essential indicators, such as geographical locations, waste generation, and details of extracted minerals and commodities, are surprisingly scant worldwide. Satellite images and artificial intelligence algorithms are prominent technologies to fill this knowledge gap. However, scaling the mapping of mining indicators to the global level remains a challenge due to the small size and low quality of training sets. The MINE-THE-GAP project will lay the foundations of an innovative methodology to scale up the production of mine-level indicators. Methodologically, the project presents a breakthrough by integrating high-precision data products from various satellite sources to substantially enrich training sets that will enable the creation of scalable artificial intelligence models to effectively map mine land use, waste generation, and types of extracted minerals and commodities. This approach will allow the production of mine-level indicators that are timely, locally relevant, and globally reliable, and ensure the continuous improvement of models beyond the project's timeline as new high-precision data becomes available. For the first time, MINE-THE-GAP will unlock new avenues in sustainability research, overcoming previous obstacles due to the lack of essential geoinformation on mining. The project will create the basis for scalable mining site monitoring, essential for enforcing European supply chain transparency laws and achieving the United Nations' Sustainable Development Goals.

Link to the ERC project webpage: https://mine-the-gap.github.io

Keywords of the ERC project: data science, geoinformatics, remote sensing, mining, sustainability, global environmental change

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101170823	**RiDe**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Laur Kanger**
Host Institution:	TARTU ULIKOOL - EST

Rise and Demise of Industrial Modernity

Contemporary societies are underpinned by industrial modernity: a set of commonly shared ideas, institutions and practices related to the natural environment and technoscience. Having historically unleashed massive leaps in productivity, economic growth and societal welfare, many traits of industrial modernity have now become maladapted to the current socio-ecological polycrisis. As a result science and technology promise to solve the grand challenges of climate change, resource depletion and loss of biodiversity with one hand, only to keep intensifying them with another. There is thus a fundamental need to rethink industrial modernity. Attempts to detect signs of this fundamental shift currently remain fragmented within and between disciplines like sustainability science, innovation studies, or history of technology. RiDe will use a new Deep Transitions framework from the sustainability transitions field to provide an overarching synthesis on the acceleration, crisis and transformative prospects of industrial societies from 1900 to the present. It focuses on 3 questions: 1) what are the major historical continuities and emerging ruptures in industrial modernity? 2) what are the mechanisms through which technoscience keeps blocking transformative environmental practices? 3) in which countries is major transformative change most likely to occur? RiDe will 1) use a mixed method research design, combining text mining, databases, stylized narrative explanation, and process-tracing, which; 2) enables it to discover new empirical patterns in the evolution of industrial modernity, and; 3) develop a composite index for identifying countries currently least hindered by the historical legacy of industrial modernity. The results will be synthesized into the first macro-level middle-range process theory in transitions studies, offering a new comprehensive, historically-informed and empirically-backed interpretation of industrial modernization for sustainability science.

Link to the ERC project webpage: https://www.deeptransitions.ut.ee/

Keywords of the ERC project: sustainability, transitions studies, deep transitions, industrial modernity, mixed methods

Keywords that characterize the scientific profile of the potential visiting researcher/s: socio-technical change, macro-historical trends, sustainability transitions, text mining, quantitative time-series

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101171152	**3MARS**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Oded Cats**
Host Institution:	TECHNISCHE UNIVERSITEIT DELFT - NLD

Behavior, Network, Market and Policy Dynamics in Multi-Modal, Multi-Layer and Multi-Class Air and Rail Transport Systems

The long-distance transport market is currently experiencing rapid changes and innovative services and policies are fundamentally reshaping how we travel. The discrepancy between the relevance of long-distance travel for emission reduction policy goals and the lack of related knowledge to support the design, planning and policy making of long-distance transport systems hinders the development of successful pathways.

In order to understand, forecast, devise policies and evaluate developments related to long-distance travel, there is an urgent need for new paradigms which consider strategic behaviour, network development strategies, policy trajectories and co-evolution of markets where revenue management and coopetition are prevalent. This requires developing comprehensive and cutting edge methods for designing and assessing policy interventions by integrating behavioural, network development and market dynamics, for which the PI is well-positioned.

This research program develops and tests theories and models of transport systems in the uncharted domain of long-distance transport markets with Multi-layer, Multi-modal and Multi-class Air and Rail Systems (3MARS).

3MARS will unravel crucial behavioural aspects; develop novel models for the assignment of multi-class flows for a multi-layer multi-modal network; conceptualize and operationalise the market relations and dynamics between supply and demand and amongst service providers and the evolution thereof; develop network design and revenue management techniques in competition-collaboration settings; design and assess supply- and demand-side policy interventions, and the interactions between all of those system components and phenomena.

The proposed program will result in a series of theoretical and methodological breakthroughs in the field of transport modelling and, methodological and empirical contributions in the fields of travel behaviour, environmental and sustainability policy, and network and market.

Link to the ERC project webpage: https://www.tudelft.nl/citg/over-faculteit/afdelingen/transport-planning/labs/smart-public-transport-lab/3mars

Keywords of the ERC project: Transport; Market dynamics; Network modelling; Policy; Travel Behavior

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101171955	**WICE**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr Inta Mierina**
Host Institution:	LATVIJAS UNIVERSITATE - LVA

Welcoming immigrants in Central and Eastern Europe: lessons from Russia's invasion of Ukraine

The negative attitudes towards immigration in Central and Eastern European (CEE) countries were on clear display during the 2015/2016 immigration crisis, particularly in the Visegrád Group countries, but also in the Baltics. Against this backdrop, the overwhelming support for Ukrainians fleeing the war in CEE has come as a surprise to many. It has highlighted the huge inequalities in the treatment of Ukrainians vs. other third country asylum seekers and clearly revealed conditionality of migration and integration systems as well as their potential for change. While there have been countless examples of populist leaders being able to successfully stoke hostility towards immigrants, there is little evidence to indicate what can systematically decrease anti-immigrant sentiments in CEE on such a broad scale. Making use of the unique historical conditions, the project draws from scientific disciplines often overlooked in research on attitudes towards migrants (memory studies, history, security studies, political science, behavioural economics, communication etc.) aiming to generate an original understanding of societal attitudes that go beyond 'xenophobia' and 'prejudice', and raises broader questions about the relationship between structural, political, cultural, economic, ideological, and agential influences on attitudes towards immigration. The project is based on case studies of three CEE countries (Poland, Latvia, Hungary) and Italy as a benchmark case. While most previous research focuses on negative narratives surrounding immigration, this project seeks to learn from the experience with Ukrainian refugees in CEE and looks for practical solutions on how to effectively counter the negative narratives. In addition to qualitative research methods, it relies on a novel experimental survey design based on full factorial analysis to test how attitudes are influenced by different characteristics of migrants and different framing (information treatment)

Link to the ERC project webpage: www.wice.lu.lv

Keywords of the ERC project: migration, migrant reception, xenophobia, social inclusion, prejudice, discrimination, integration, solidarity

Keywords that characterize the scientific profile of the potential visiting researcher/s: migration, integration, migrant reception, xenophobia, social memory, solidarity, geopolitics

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101219172	**InsubordinateFINANCE**	**SH7** Human Mobility, Environment, and Space

Principal Investigator:	**Dr James Christopher Mizes**
Host Institution:	INSTITUT DE RECHERCHE POUR LE DEVELOPPEMENT - FRA

Insubordinate Finance? The postcolonial politics of financial centers in the Global South

Cities in the global North have served for centuries as the command-and-control centers of global finance. They have long determined the unequal access to credit and often harsh conditions of debt repayment for people, businesses, and states across the world. This control has maintained colonial power inequalities that many scholars now characterize as 'international financial subordination'. Yet in recent years, an increasing number of officials, citizens, and professionals across the Global South have mounted a surprising opposition to the Northern subordination of Southern finance. Since the turn of the new millennium, financial centers located in cities across the Global South have expanded dramatically in number, complexity, and size. These insubordinate financial centers claim to offer an alternative to the exclusion, extraction, and domination that has long characterized their (neo)colonial financial relations with the North. At the heart of this alternative is a new generation of Southern financial professionals seeking to create new networks, innovate new devices, and envision new futures for postcolonial economies. To take stock of these novel trends, InsubordinateFINANCE will examine the politics of financial sector deepening in 11 case study cities across Latin America, Africa and Southeast Asia. It will develop an innovative 'provincializing finance approach' that combines the insights of postcolonial theory, ethnography, and science and technology studies to answer a field-defining research question: Are Southern financial centers vectors of global financial subordination or do they offer independence from Northern financial dominance? Given the potential for a shift towards such an insubordinate finance to reconfigure global power relations and inequalities, it is important to asses where, how, to what extent, and with what effects this shift is taking place. This project's aim is simple yet ambitious: to upend how we think about global finance.

Link to the ERC project webpage: https://insubordinate.financial/

Keywords of the ERC project: financial markets, politics, public problems, value, experts, expertise, cities, risk, crisis, Global South

Keywords that characterize the scientific profile of the potential visiting researcher/s: economic anthropology, science and technology studies, urban geography

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101162754	**RESPIRE**	**SH8** Studies of Cultures and Arts

Principal Investigator:	**Dr Magdalena Górska**
Host Institution:	UNIVERSITEIT UTRECHT - NLD

RESPIRE: Planetary Breathing in Asphyxiating Times

We live in a time of multispecies suffocation. This is not a metaphor but a material process of contemporary multispecies living and dying on this planet. RESPIRE will address the fact that we do not know what this planetary multispecies suffocation consists of and will investigate how we can comprehend and transform it. It will do so through extensive fieldwork that includes collaboration with natural scientists, organisations, artists, and stakeholders. This approach is needed because the natural sciences study environmental problems but address them separately from social issues and do not offer an overall understanding of multispecies suffocation. The humanities offer important analyses of the effects of environmental and social degradation but no perspective for analysing planetary multispecies suffocation.

RESPIRE's hypothesis is that to describe and understand multispecies suffocation, we need approaches that address social and environmental issues as interrelated, and need to strengthen the scientific role of the humanities and arts, which specialise in challenging established norms and beliefs.

We will analyse multispecies suffocation through the 'planetary lungs' and their related problems: forests (deforestation), ocean (dead-zones – low oxygen areas), and soil (peatlands). Our inductive inquiry from humanities and art-based research perspectives will deliver fundamental research that will contribute to future research on social and climate change-related issues by producing a socio-environmental interdisciplinary approach and revealing the respiratory and multispecies dimensions of current challenges. RESPIRE will also develop new respiration-focused methodologies, concepts, and innovative pathways for a more breathable future. The project will further develop the emerging field of Critical Respiratory Studies, in which the PI is one of the leading scholars, and bring a humanities and arts perspective to the natural sciences.

Link to the ERC project webpage: https://www.uu.nl/staff/MAGorska

Keywords of the ERC project: planetary, breathing, suffocation, breath, socio-environmental, justice, feminist, queer, postcolonial, decolonial

Keywords that characterize the scientific profile of the potential visiting researcher/s: socio-environmental, justice, feminist, queer, postcolonial, decolonial

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101169641	**GAMEINDEX**	**SH8** Studies of Cultures and Arts

Principal Investigator:	**Dr Jaroslav Švelch**
Host Institution:	UNIVERZITA KARLOVA - CZE

Politics and aesthetics of indexical representation in digital games and VR

Many contemporary digital games and VR experiences – including the Assassin's Creed series of historical games – claim to provide realistic representations of places or people. But how is this realism achieved and which places and people get included? To answer this question, GAMEINDEX focuses on indexical representations – traces of real-life objects or people in the simulated worlds of digital games and VR. Such indices include 3D scans of buildings or the likenesses and performances of actors who provide motion capture data. GAMEINDEX will investigate indexical representation in digital games and VR using the following methods: 1) ethnographic on-site research of indexical techniques, such as motion capture and photogrammetry, 2) qualitative analyses of selected games that represent peripheral locations or groups of people, 3) analysis of the public discourse about indexical techniques. In the final step, the project will synthesize empirical findings into a theory that will chart the relationships between production practices, game content, and public discourse, elucidating political and aesthetic dimensions of indexicality. Due to the pressures to succeed on the globalized market, games have underrepresented and misrepresented peripheral locations and underprivileged groups of people. So far, studies of representation in games have focused on tropes and stereotypes within the games' content. Thanks to its focus on indexicality, GAMEINDEX will provide a breakthrough in the study of media representations by transcending close readings and content analysis and studying how representation arises in the production process. The resulting theory will serve as a tool for critique, helping us understand how real locations and people are being exploited and reconfigured into entertainment products. At the same time, it will provide inspiration for developers to create more diverse and just representations of real-world phenomena.

Link to the ERC project webpage: https://gameproductionstudies.fsv.cuni.cz/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101170859	**ReWorkChange**	**SH8** Studies of Cultures and Arts

Principal Investigator:	**Dr Elisabetta Costa**
Host Institution:	UNIVERSITEIT ANTWERPEN - BEL

Remote Work and Social Change: An Anthropological Approach

Remote work has become normalised as an important aspect of people's lives across different professions, social classes and geographic regions. In the knowledge economy, work is now less tied to specific physical locations and is re-spatialised in new hybrid ways. But what are the consequences of remote work and always-on-connectivity on people's everyday lives? How do these affect social institutions such as the home, family, household and friendship, and broader processes of social change? ReWorkChange aims to answer these questions by delivering a comparative ethnographic study of the societal consequences of remote work, defined as work tasks performed outside the traditional office setting. Most research on remote work has been carried out in the fields of management and organisational studies and is limited to case studies in the global north. In contrast, ReWorkChange's scope is far radically more comprehensive and wide-ranging. The project will build on practice theories to conduct a comparative study of the consequences of remote work on people's everyday lives in six countries with an advanced knowledge economy: China, India, Italy, Mexico, the Netherlands and Turkey. It will provide rich and compelling ethnographic evidence of everyday practices to generate theories of social institutions and a broader theory of remote work and social change. The PI has extensively explored family life, kinship, love, romances, gendered relations, home and homeland as mediated practices, in Lebanon, Turkey, Italy and the Netherlands. Additionally, she has previously worked towards the conceptualisation of digital media and social change. She is, hence, the ideal candidate to achieve the ambitious goal of exploring and theorising the impact and implications global processes of digitalisation and transformations of work have on cultures and societies worldwide.

Link to the ERC project webpage: https://www.uantwerpen.be/en/projects/reworkchange/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101171427	**DIACHRONY**	**SH8** Studies of Cultures and Arts

Principal Investigator:	**Dr Yoel Greenberg**
Host Institution:	THE HEBREW UNIVERSITY OF JERUSALEM - ISR

Towards a Diachronic Music Theory

This proposal argues for a quantum shift in the way we theorize about music. In the past three decades, music theory has been dominated by synchronic theories based upon typologies. The value of these theories notwithstanding, there are three significant "blindspots" that arise from a purely synchronic perspective. First, synchronic approaches are incapable of explaining trends – they at best capture "snapshots" along a timeline, but cannot explain processes: how one snapshot progressed to another. Second, music written between two snapshots is evaluated in synchronic approaches either according to a defunct model, or according to one that had not yet come into existence, as often occurs with the music of the generation between Bach and Mozart. Third, such snapshots mask trends during their period of interest behind a false façade of stability. I propose to address this problem through a diachronic methodology, designed to focus not on definitions and synchronic typologies, but rather on processes of change over time. To this end I will carry out a corpus study of unprecedented scope, covering 1700 works between 1680-1819. In two overlapping subprojects based upon the same corpus, I will examine trends in four fields: large-scale form; phrase structure; cadences (musical units signifying closure); and schemata (stock musical phrases). Tracing the diachronic process of change across the decades of the corpus, I will reveal the forces that propelled music from one style to another, and through this, the tensions with which composers were faced and to which they responded. Furthermore, my novel diachronic approach will enable a more flexible mode of accounting for the fuzzy limits of theoretical definitions and histories. Lastly, with its original conceptual premises and its corpus-based methodology, this project will serve as a model for a new approach to music theory, encouraging the embrace of a diachronic perspective in other fields of music theory too.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
856488	**SEACHANGE**	**SYG** Synergy

Principal Investigator:	**Dr James Scourse**
Host Institution:	THE UNIVERSITY OF EXETER - GBR

Quantifying the impact of major cultural transitions on marine ecosystem functioning and biodiversity

The seas are changing. Marine conservation seeks to protect valuable habitats but the pristine state of marine ecosystem functioning and biodiversity – that is, the system as it operated before there was any large scale human impact – is conjectural. Conservation management strategies are often based on highly altered ecosystems where the degree of human-induced change is unknown. In SEACHANGE, we propose a structured and systematic approach to the reconstruction of marine ecosystem baselines to quantify the impact of anthropogenic cultural transitions on marine biodiversity and ecosystem functioning. SEACHANGE will address two key questions: 1) What was the nature of long-term changes in prehistoric marine biodiversity and ecosystem functioning over a 3000-year period in NW Europe and the degree of human impact associated with major socioeconomic changes across the Mesolithic-Neolithic boundary? 2) What has been the scale and rate of marine biodiversity loss and changes to ecosystem functioning as a result of fishing intensity and marine habitat loss during the last 2000 years (including the Industrial Transition) in the North Sea and around Iceland, eastern Australia and the west Antarctic Peninsula? To address these questions we will analyse: 1) absolutely-dated annually-resolved bivalve shell series ("sclerochronologies"); 2) marine sediment cores; 3) archaeological midden (waste) materials including shells and bones. We will date these samples precisely and undertake zooarchaeological and palaeoecological, stable isotope geochemical and environmental DNA/DNA metabarcoding analyses. We will compare the data with historical and archival sources, and we will generate numerical ecosystem simulations. We will identify how depleted the current marine environment is compared with that before large scale human impact and what measures are needed, and how long will it take, for marine biodiversity to recover.

Link to the ERC project webpage: https://seachange-erc.eu/

Keywords of the ERC project: marine, biodiversity, ecosystem functioning, marine historical ecology, stable isotopes, environmental DNA

Keywords that characterize the scientific profile of the potential visiting researcher/s: Antarctica, Iceland, marine, zooarchaeology, stable isotopes, historical ecology, DNA

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
951375	**ArtMotor**	**SYG** Synergy

Principal Investigator:	**Dr Heiner Linke**
Host Institution:	LUNDS UNIVERSITET - SWE

Artificial Motor Proteins: toward a designed, autonomous protein motor built from non-motor parts

Molecular motors and machines are essential for all cellular processes that together enable life. Built from proteins, with a wide range of properties, functionalities and performance characteristics, biological motors perform complex tasks and can transduce chemical energy into mechanical work more efficiently than human-made combustion engines. Sophisticated studies of biological protein motors have led to much structural and biophysical information and the development of models for motor function. However, from the study of highly evolved, biological motors it remains difficult to discern detailed mechanisms, for example about the relative role of different force generation mechanisms, or how information is communicated across a protein to achieve the necessary coordination. A promising, complementary approach to answering these questions is to build synthetic protein motors from the bottom up. Indeed, much effort has been invested in functional protein design, but so far, the 'holy grail' of designing and building a functional synthetic protein motor has not been realized. The purpose of ArtMotor is to design and build functional, synthetic protein motors capable of moving and transducing energy, based on existing, non-motor protein modules of known molecular function. Harnessing the synergy of expertise in computational protein design, structural and molecular biology, and single-molecule detection, we will use a two-pronged approach to (a) construct relatively simple protein motors that will require external control, while (b) construct, step by step, an autonomous protein motor capable of moving along a track. Such a functional, synthetic protein will constitute a ground-breaking advance in synthetic biology, physics and engineering. In addition to gaining new insights into mechanisms of energy transduction in proteins, we will also inspire other, complex protein designs that may lead to advances in fields from enzyme design to nano-engineering.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
951388	**QUANTA**	**SYG** Synergy

Principal Investigator:	**Dr Francesco D'Errico**
Host Institution:	Université de Bordeaux - FRA

Evolution of Cognitive Tools for Quantification

Exact quantification, including the ability to count, depends on both conceptual breakthroughs and cognitive tools such as numeral systems. These tools appear in striking diversity across cultures and manifest in different modalities (verbal, body-based, written, or material). To address the tantalizing questions of when, why, and how they emerged and evolved, we test two previously untestable key hypotheses: that conceptual breakthroughs and tools co-evolved, with different modalities coactively scaffolding the breakthroughs; and that the tools diversified in response to changing cultural requirements. Reconstructing this evolution is the prime goal of QUANTA. Addressing its ambitious objectives requires an unprecedented synergetic combination of (i) archaeological, ethnographic, and linguistic insights into numeral systems worldwide, including prehistoric artefacts and symbols, and on contemporary contexts in which quantification occurs and changes; (ii) a cognitive framework for deriving evolutionary hypotheses from system properties; (iii) powerful computational (phylogenetic) methods for testing these hypotheses and thereby reconstructing cultural evolution; and (iv) innovative means to substantially extend the temporal scope of these methods into the past, to include the first attested instances of quantification. To achieve this goal, QUANTA brings together four leading PIs with unique and complementary expertise in exactly these means. By integrating an evolutionary approach with a cognitive perspective on quantification, QUANTA will transform this research field. Its novel strategy will, for the first time ever, yield substantiated insights into the emergence and evolution of numeral systems, thus advancing our understanding of human cognition and its dependence on cultural tools. While the highly interdisciplinary, multi-method approach renders this a high-risk project, QUANTA has the potential to bridge the gap between previously incommensurable fields.

Link to the ERC project webpage:

Keywords of the ERC project: cognitive archaeology, counting, numerical cognition, prehistoric technology, cross-cultural analysis

Keywords that characterize the scientific profile of the potential visiting researcher/s: cognitive archaeology, counting, numerical cognition, prehistoric technology, cross-cultural analysis

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
951424	**Water-Futures**	**SYG** Synergy

Principal Investigator:	**Dr Phoebe Koundouri**
Host Institution:	ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS - RESEARCH CENTER - GRC

Smart Water Futures: designing the next generation of urban drinking water systems

The world population living in urban settlements is expected to increase to 70% of 9.7 billion by 2050. Historically, as cities grew, new water infrastructures followed as needed. However, these developments had less to do with real planning than with reacting to crisis situations and urgent needs, due to the inability of urban water planners to consider long-term, deeply uncertain and ambiguous factors affecting urban development and water demand. These, coupled with increasingly uncertain climate conditions, indicate the need for a more holistic and intelligent decision-making framework for managing water infrastructures in the cities of the future. This project aims to develop a new theoretical framework for the allocation and development decisions on drinking water infrastructure systems, so that they are socially equitable, economically efficient and environmentally resilient, as advocated by the UN Agenda 2030, Sustainable Development Goals. The framework will integrate real-time monitoring and control with long-term robustness and flexibility-based pathway methods, and incorporate economic, social, ethical and environmental considerations for sustainable transitioning of urban water systems under deep uncertainty with multiple possible futures. The Water-Futures team will build on synergies from the four research groups, transcending methodologies from water science, systems and control theory, economics and decision science, and machine learning, into an integrated decision and control framework, to be implemented as an open-source research toolbox. The new science outcomes will be applied to three case studies exemplifying different types of urban water systems: a mature, relatively stable system; a mature and rapidly expanding system; and a relatively recent supply system in a developing country with high growth and special challenges, including limited resources, intermittent supply and high water losses.

Link to the ERC project webpage: https://waterfutures.eu/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
951424	**Water-Futures**	**SYG** Synergy

Principal Investigator:	**Dr Dragan Savic**
Host Institution:	KWR WATER B.V. - NLD

Smart Water Futures: designing the next generation of urban drinking water systems

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Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
951424	**Water-Futures**	**SYG** Synergy

Principal Investigator:	**Dr Barbara Hammer**
Host Institution:	UNIVERSITAET BIELEFELD - DEU

Smart Water Futures: designing the next generation of urban drinking water systems

The world population living in urban settlements is expected to increase to 70% of 9.7 billion by 2050. Historically, as cities grew, new water infrastructures followed as needed. However, these developments had less to do with real planning than with reacting to crisis situations and urgent needs, due to the inability of urban water planners to consider long-term, deeply uncertain and ambiguous factors affecting urban development and water demand. These, coupled with increasingly uncertain climate conditions, indicate the need for a more holistic and intelligent decision-making framework for managing water infrastructures in the cities of the future. This project aims to develop a new theoretical framework for the allocation and development decisions on drinking water infrastructure systems, so that they are socially equitable, economically efficient and environmentally resilient, as advocated by the UN Agenda 2030, Sustainable Development Goals. The framework will integrate real-time monitoring and control with long-term robustness and flexibility-based pathway methods, and incorporate economic, social, ethical and environmental considerations for sustainable transitioning of urban water systems under deep uncertainty with multiple possible futures. The Water-Futures team will build on synergies from the four research groups, transcending methodologies from water science, systems and control theory, economics and decision science, and machine learning, into an integrated decision and control framework, to be implemented as an open-source research toolbox. The new science outcomes will be applied to three case studies exemplifying different types of urban water systems: a mature, relatively stable system; a mature and rapidly expanding system; and a relatively recent supply system in a developing country with high growth and special challenges, including limited resources, intermittent supply and high water losses.

Link to the ERC project webpage: https://waterfutures.eu/

Keywords of the ERC project: Explainable AI, Machine Learning for critical infrastructure, online learning, trustworthy machine learning

Keywords that characterize the scientific profile of the potential visiting researcher/s: XAI, machine learning in critical infrastructure

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
951424	**Water-Futures**	**SYG** Synergy

Principal Investigator:	**Dr Marios Polycarpou**
Host Institution:	UNIVERSITY OF CYPRUS - CYP

Smart Water Futures: designing the next generation of urban drinking water systems

The world population living in urban settlements is expected to increase to 70% of 9.7 billion by 2050. Historically, as cities grew, new water infrastructures followed as needed. However, these developments had less to do with real planning than with reacting to crisis situations and urgent needs, due to the inability of urban water planners to consider long-term, deeply uncertain and ambiguous factors affecting urban development and water demand. These, coupled with increasingly uncertain climate conditions, indicate the need for a more holistic and intelligent decision-making framework for managing water infrastructures in the cities of the future. This project aims to develop a new theoretical framework for the allocation and development decisions on drinking water infrastructure systems, so that they are socially equitable, economically efficient and environmentally resilient, as advocated by the UN Agenda 2030, Sustainable Development Goals. The framework will integrate real-time monitoring and control with long-term robustness and flexibility-based pathway methods, and incorporate economic, social, ethical and environmental considerations for sustainable transitioning of urban water systems under deep uncertainty with multiple possible futures. The Water-Futures team will build on synergies from the four research groups, transcending methodologies from water science, systems and control theory, economics and decision science, and machine learning, into an integrated decision and control framework, to be implemented as an open-source research toolbox. The new science outcomes will be applied to three case studies exemplifying different types of urban water systems: a mature, relatively stable system; a mature and rapidly expanding system; and a relatively recent supply system in a developing country with high growth and special challenges, including limited resources, intermittent supply and high water losses.

Link to the ERC project webpage: https://waterfutures.eu

Keywords of the ERC project: smart water systems, automation and control, fault diagnosis, machine learning

Keywords that characterize the scientific profile of the potential visiting researcher/s: smart water systems, automation and control, fault diagnosis, machine learning

European Research Council
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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101071386	**GlycanSwitch**	**SYG** Synergy

Principal Investigator:	**Dr Manfred Wuhrer**
Host Institution:	ACADEMISCH ZIEKENHUIS LEIDEN - NLD

Glycans as Master Switches of B Cell Activity in Autoimmunity

Autoimmune diseases including rheumatoid arthritis (RA) are often life-threatening disorders with increasing disability having a negative impact on patients' quality of life. Mechanisms leading to the breach of tolerance in development of autoimmunity are still largely unknown. Protein glycosylation is an essential regulatory mechanism in the immune system. We recently demonstrated that N-glycosylation of the variable region (Fab) of autoantibodies is a hallmark of RA development and progression. We also demonstrated that autoantibodies acquire these Fab glycosylation signatures already many years before disease onset. We herein hypothesize that Fab glycosylation at the level of the B cell receptor is a key molecular switch promoting the selection, activation and proliferation of autoreactive B cells leading to the concomitant breach of immunotolerance. Within GlycanSwitch, we will map the Fab glycome of various types of RA autoantibodies and autoreactive B cells. We will study the factors and underlying cellular mechanisms that regulate Fab glycosylation of B cell receptors and autoantibodies. We will investigate the immunological effects of Fab glycosylation and the impact in B cells signalling and activation in the context of molecular and cellular interacting partners in the immune microenvironment. Finally, we will test in relevant mouse models how Fab glycosylation of autoantibodies and autoreactive B cells contributes to the breach of tolerance. We expect that the obtained insights into the role of glycans as key checkpoint for the selection of autoreactive B cells and the rise of autoimmunity will provide leads for targeted therapeutic interventions as well as rationales for the early detection of RA and autoimmune diseases in general. We foresee that the knowledge generated will allow us to embark on a targeted prevention clinical study in patients at risk for RA to turn off the GlycanSwitch leading to chronic RA.

Link to the ERC project webpage: https://glycanswitch.com/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101071386	**GlycanSwitch**	**SYG** Synergy

Principal Investigator:	**Dr Gordan Lauc**
Host Institution:	GENOS DOO ZA VJESTACENJE I ANALIZU - HRV

Glycans as Master Switches of B Cell Activity in Autoimmunity

Autoimmune diseases including rheumatoid arthritis (RA) are often life-threatening disorders with increasing disability having a negative impact on patients' quality of life. Mechanisms leading to the breach of tolerance in development of autoimmunity are still largely unknown. Protein glycosylation is an essential regulatory mechanism in the immune system. We recently demonstrated that N-glycosylation of the variable region (Fab) of autoantibodies is a hallmark of RA development and progression. We also demonstrated that autoantibodies acquire these Fab glycosylation signatures already many years before disease onset. We herein hypothesize that Fab glycosylation at the level of the B cell receptor is a key molecular switch promoting the selection, activation and proliferation of autoreactive B cells leading to the concomitant breach of immunotolerance. Within GlycanSwitch, we will map the Fab glycome of various types of RA autoantibodies and autoreactive B cells. We will study the factors and underlying cellular mechanisms that regulate Fab glycosylation of B cell receptors and autoantibodies. We will investigate the immunological effects of Fab glycosylation and the impact in B cells signalling and activation in the context of molecular and cellular interacting partners in the immune microenvironment. Finally, we will test in relevant mouse models how Fab glycosylation of autoantibodies and autoreactive B cells contributes to the breach of tolerance. We expect that the obtained insights into the role of glycans as key checkpoint for the selection of autoreactive B cells and the rise of autoimmunity will provide leads for targeted therapeutic interventions as well as rationales for the early detection of RA and autoimmune diseases in general. We foresee that the knowledge generated will allow us to embark on a targeted prevention clinical study in patients at risk for RA to turn off the GlycanSwitch leading to chronic RA.

Link to the ERC project webpage: https://glycanswitch.com

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101071601	**OCEAN**	**SYG** Synergy

Principal Investigator:	**Dr Christian Robert**
Host Institution:	UNIVERSITE PARIS DAUPHINE - FRA

On intelligenCE And Networks

Until recently, most of the major advances in machine learning and decision making have focused on a centralized paradigm in which data are aggregated at a central location to train models and/or decide on actions. This paradigm faces serious flaws in many real-world cases. In particular, centralized learning risks exposing user privacy, makes inefficient use of communication resources, creates data processing bottlenecks, and may lead to concentration of economic and political power. It thus appears most timely to develop the theory and practice of a new form of machine learning that targets heterogeneous, massively decentralized networks, involving self-interested agents who expect to receive value (or rewards, incentive) for their participation in data exchanges. OCEAN will develop statistical and algorithmic foundations for systems involving multiple incentive-driven learning and decision-making agents, including uncertainty quantification at the agent's level. OCEAN will study the interaction of learning with market constraints (scarcity, fairness), connecting adaptive microeconomics and market-aware machine learning. OCEAN builds on a decade of joint advances in stochastic optimization, probabilistic machine learning, statistical inference, Bayesian assessment of uncertainty, computation, game theory, and information science, with PIs having complementary and internationally recognized skills in these domains. OCEAN will shed new light on the value and handling of data in a competitive, potentially antagonistic multi-agent environment, and develop new theories and methods to address these pressing challenges. OCEAN requires a fundamental departure from standard approaches and leads to major scientific interdisciplinary endeavors that will transform statistical learning in the long term while opening up exciting and novel areas of research.

Link to the ERC project webpage: https://oceanerc.com/

Keywords of the ERC project: privacy; approximate Bayesian inference; generalized Bayesian inference; MCMC methods

Keywords that characterize the scientific profile of the potential visiting researcher/s: decision theory; statistical computing; Bayesian methodology

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Project ID:	Project Acronym:	Evaluation Panel:
101071726	**Medgreenrev**	**SYG** Synergy

Principal Investigator:	**Dr Aleks Pluskowski**
Host Institution:	THE UNIVERSITY OF READING - GBR

Re-thinking the Green Revolution in the Medieval Western Mediterranean (6th - 16th centuries)

As Mediterranean societies prepare for the impacts of climate change over the next few decades, a case study to inform their future resilience is associated with one of the defining events in world history: the emergence of Islam in the 7th century, the subsequent Arab (and later Berber) conquests of the southern and western Mediterranean, their associated population movements and the environmental adaptations that enabled these new societies to flourish. The introduction of new forms of agriculture that transformed the economies of the conquered regions has been previously framed as the "Green Revolution". Moving beyond the limited focus of earlier research, with its restricted spatial and chronological scope, this project will adopt an integrated ecological approach, encompassing plants, animals and soils, from production through to consumption, and compare the impact and legacy of environmental transformations associated with long-term societal change in the western Mediterranean (Iberia and Morocco), beyond the initial Arab/Berber conquests. Adopting a broader chronological span, from the century before the conquests through to the century after the dissolution of the last Islamic polity in Iberia, the transition from Islamic to Christian regimes in Iberia will be compared, for the first time, with the persistence of Islamic polities in northwest Africa, against the backdrop of climatic fluctuations. This will enable relationships between environmental transformations and sequences of political and demographic change to be effectively contextualised. The synergy between our groups will combine regional specialisms with a wealth of scientific expertise, enabling us to conduct the first long-term and inter-regional study of how conquest, migration and encounters with resident populations and landscapes drove environmental transformation in the western Mediterranean during this formative period in world history.

Link to the ERC project webpage: https://cordis.europa.eu/project/id/101071726

Keywords of the ERC project: Archaeology, environmental archaeology, landscape archaeology, medieval, Mediterranean, Spain

Keywords that characterize the scientific profile of the potential visiting researcher/s: environmental archaeology, geoarchaeology, landscape archaeology

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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101071936	**UNLEASH**	**SYG** Synergy

Principal Investigator:	**Dr Juan Valcarcel**
Host Institution:	FUNDACIO CENTRE DE REGULACIO GENOMICA - ESP

Harnessing the splicing code for targeted control of gene expression

Alternative splicing (AS) of mRNA precursors plays important roles in tissue-specific gene regulation and biological regulatory mechanisms, as it can radically alter protein expression, cell phenotypes and physiological responses. Altered splicing also contributes to disease mechanisms, ranging from neurodegeneration to cancer. Drugs modulating AS have recently provided the first therapy for Spinal Muscular Atrophy, a common genetic disorder, illustrating the huge potential for treating many other diseases of unmet need, if only we understood the mechanisms controlling splice site selection and how to regulate them with small molecules. Unfortunately, despite decades of research, a comprehensive understanding of the mechanisms that control specificity of AS is lacking. This gap in basic knowledge prevents opportunities to harness splicing modulators as tools to study gene function, novel therapeutics or other biotech applications. This Project addresses head-on the major technical challenges that have limited progress in the AS field. Building on extensive preliminary data, we will use a multidisciplinary approach that combines chemical, structural, cellular, systems biology and machine learning to characterize mechanisms of splice site selection and identify targets for modulating these mechanisms using tool compounds. The outcomes will define key regulatory sequences, splicing factors and molecular interactions involved, thereby illuminating how the splicing machinery efficiently accommodates, yet also discriminates between, a wide range of splice site sequences. This will enable future applications harnessing splice site selection. Our primary goal is to answer the central question, 'Is it generally possible to modulate splicing with high specificity using small molecules?' Success will transform our basic understanding of human gene expression and unleash major opportunities for Pharma to develop new therapeutics.

Link to the ERC project webpage: https://www.unleashsplicing.com

Keywords of the ERC project: RNA splicing, biological chemistry

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101072180	**Green2Ice**	**SYG** Synergy

Principal Investigator:	**Dr Anders Svensson**
Host Institution:	KOBENHAVNS UNIVERSITET - DNK

When was Greenland 'green'? – Perspectives from basal ice and sediments from ice cores.

Green2Ice will investigate the deepest and oldest ice and basal sediments drilled from the Greenland Ice Sheet (GrIS). Ice cores have been drilled the last 55 years, but the deepest ice containing basal materials has been preserved until now, and still holds undeciphered paleoclimatic messages. The breakthrough of Green2Ice is to develop and apply cutting edge dating methods on this unique sample collection and hence to reconstruct the age and the stability of the GrIS. A hypothesis to test is if the present GrIS formed at the time of the Mid Pleistocene Transition, 1,2 - 0.8 million years ago. One innovation of Green2Ice is to gain paleo-information of the past size of the GrIS to constrain future tipping points. This knowledge will reduce the uncertainty on estimates of future sea level rise. Green2Ice will bring together four PIs from three world leading institutions with complementary skills to lift this strongly interdisciplinary program. We will drill a replicate core at GRIP, to supplement the available material from five existing ice cores and ensure retrieval of sediments and rock material from beneath the GrIS summit. We will develop, improve and apply novel dating techniques (cosmogenic and radiogenic nuclides, OSL/IRSL, modeling of gas and isotope diffusion) to place constraints on past waxing and waning of the GrIS. State-of-the-art methodologies on fossil remains, organic matter, in situ produced and consumed greenhouse gases, and ancient bio-molecules will provide insights on the types of ecosystems and environmental conditions that emerged during ice-free conditions. Interpretation will include ice sheet modelling with data benchmarking to establish the climatic sensitivity of the GrIS. Earth system modelling and collaboration with the groups preparing the IPCC AR7 will bring the knowledge of the past into the future. The rare and unique basal ice and material can only be used once. This is the main high risk high gain component of Green2Ice.

Link to the ERC project webpage: https://www.green2ice.eu/

Keywords of the ERC project: Greenland
Ice core
Ice sheet
Chronology

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101118531	**Cartohostbug**	**SYG** Synergy

Principal Investigator:	**Dr Eduardo Villablanca**
Host Institution:	Karolinska Institutet - SWE

Functional cartography of intestinal host-microbiome interactions

Microbiome-host crosstalk is crucial for gut homeostasis and its dysregulation is a hallmark of diseases such as colorectal cancer (CRC) and inflammatory bowel disease (IBD). Despite its key relevance for a holistic understanding of the human superorganism and its (patho-)physiology, how local host-microbiome interactions form specific niches in the gut and how these niches function at the cellular and molecular level remains unexplored, mainly due to a lack of suitable technologies. To fill this gap, we propose to jointly reconstruct the host transcriptional and microbiome compositional landscape of the human gut across a large number of healthy individuals as well as IBD and CRC patients. For this, we will leverage a combination of novel spatial profiling technologies for unbiased transcriptome sequencing and microbiome profiling at single-cell resolution in situ. First, we will spatially delineate local niches formed of specific microbes and host cells. To dissect this complex crosstalk into specific interactions, we will secondly use in vitro and in vivo models to introduce perturbations either on the host or the microbiome side. Finally, we will integrate the resulting data to deconvolute host-microbiome circuits computationally and to predict functional niches, in particular host responses to pathogens of relevance in IBD and CRC. Interesting predictions will be tested in organoid and animal models. Developing a spatially resolved computational model of the gut ecosystem will allow us to predict early local events in disease onset; from these we will identify and validate prognostic IBD and CRC biomarkers for future clinical translation. This work will revolutionize our understanding of intestinal host-microbiome interactions by adding a first-ever functionally resolved spatial dimension with clinical relevance for the future diagnosis and treatment of intestinal disorders.

Link to the ERC project webpage:

Keywords of the ERC project: host-microbiota, IBD, mucosal immunology

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101118536	**Host4Hypnozoites**	**SYG** Synergy

Principal Investigator:	**Dr Albert D Windhorst**
Host Institution:	Academisch ziekenhuis Amsterdam UMC - NLD

Parasite-host interactions regulating dormancy and reactivation of malaria parasites

What? Hypnozoites are dormant liver stage malaria parasites that can reactivate and cause repeated blood-stage infections without the bite of an infectious mosquito. We will, for the first time: - characterize the cellular environment contributing to dormancy at systems level (WP1) - explore the reactivation kinetic and tissue environment of hypnozoites within the natural host (WP2) - functionally characterize host & parasite factors governing dormancy or reactivation (WP3) Why? - Dormancy and reactivation of hypnozoites is an unresolved biological mystery since decades - Dormant parasites are a major obstacle to the curative treatment of malaria The challenge: Tracking the in vivo development and understanding the biology of these rare, quiescent parasites that normally reside inside the liver of the host The solution: A synergistic, multidisciplinary investigation, which is only possible if we combine the unique resources and complementary expertise of three leading laboratories in: - Radiopharmaceutical chemistry for the development of dedicated Positron Emission Tomography tracers for non-invasive investigation of the parasites in situ, as well as to capture infected tissue samples for systems level investigations - Systems biology for simultaneous multi-omics profiling of the parasite and the host cell at single-cell resolution and in the spatial context to be validated by parasitological assays - Parasitology for functional investigation through genetic engineering and manipulation of the parasites in vitro and validation within the natural host Anticipated project outcomes: - Detailed insights into the relapse characteristics of the parasite in vivo - Understanding how host and parasite factors collectively determine the fate of infection - Novel imaging, transfection and omics methods for malaria research and beyond - Opportunities for novel therapeutic strategies for awakening and killing these vicious pathogens

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101118625	**CultCryo**	**SYG** Synergy

Principal Investigator:	**Dr Alexander Friedrich**
Host Institution:	TECHNISCHE UNIVERSITAT DARMSTADT - DEU

The Cultures of the Cryosphere. Infrastructures, Politics and Futures of Artificial Cooling

Artificial cooling fundamentally shapes the world in which we live. Since the onset of the Cold War, cooling and freezing technologies have become increasingly vital for a wide array of everyday practices, from nutrition, health and reproduction to dwelling, telecommunication, scientific research and economic productivity. A global system of cold storages, cold chains and air-conditioned spaces has become an energy-intensive yet barely considered planetary infrastructure: an “artificial cryosphere”. Artificial cold has drastically restructured life both on a biological and social level, yet the far-reaching impact of this technology is still largely unexplored and unresearched. Recent studies estimate that global cooling demand will increase five-fold by 2050, dramatically exceeding our future energy budget and urgently calling for change. CultCryo argues that avoiding the impending global cooling crisis will be impossible if we do not understand how the planetary infrastructure of artificial cold is deeply interwoven in cultural practices. Thus, in order to analyze the constitution of “cryogenic cultures”, we will undertake four interdisciplinary multi-sited case studies in the domains of food supply, air conditioning, biomedicine and computing. We develop innovative approaches using mixed-methods rooted in the history of technology, geography, digital history of concepts, ethnography and the philosophy and ethics of technology. Breaking ground for an innovative interdisciplinary field of research, CultCryo will provide the first geographical mapping of the cryosphere, a historical reconstruction of its emergence, an ethnographic account on its cultural constitution, and a philosophical analysis and ethical assessment of its underlying norms and values. Thereby, we develop a corpus of urgently needed knowledge to critically analyze a pressing global phenomenon while also identifying alternatives towards a more sustainable future of artificial cold.

Link to the ERC project webpage: https://cryocultures.org

Keywords of the ERC project: social studies of cooling and freezing technologies, philosophy and ethics of technology, history of technology and culture, digital geography, digital humanities

Keywords that characterize the scientific profile of the potential visiting researcher/s: history of technology, social anthropology, philosophy of technology, digital humanities, bioethics, technology assessment

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101118768	**DEMI**	**SYG** Synergy

Principal Investigator:	**Dr Matthias Arenz**
Host Institution:	Universität Bern - CHE

Directed Evolution of Metastable Electrocatalyst Interfaces for Energy Conversion

It is our aim to transform the research field of electrocatalysis from the established "initial (as-synthesized) state approach" to a data-centric understanding of the metastable active interface of electrocatalysts, constantly evolving under reaction conditions. We want to overcome the limitations of elemental or binary alloy catalysts by exploring and exploiting high entropy materials (HEM) as a discovery platform for sustainable materials, with the aim to identify in the extremely large, multidimensional search space new electrocatalysts that are both stable and active. To understand and control the active interface of HEM electrocatalysts, we combine the core expertises of the PIs: theoretical modelling and simulations, high-throughput synthesis and characterization, nanoparticle synthesis, electrochemical operando techniques as well as machine learning. Our synergistic approach will significantly advance these individual competences by key conceptual innovations: (i) Evolutionary screening of micro-libraries to efficiently identify stable materials covering the complete HEM composition space; (ii) Accelerated atomic-scale characterization of HEM surfaces by combining combinatorial HEM synthesis with atom probe tomography; (iii) High-throughput operando experiments with thin film material libraries; (iv) Developing inverse activity-structure relationships and theoretical descriptors for metastability; v) Implementing active learning approaches based on materials informatics and using a semantic data lake. We will establish a theory of metastability as a core concept for the understanding of electrocatalysis for the most important energy conversion reactions: oxygen reduction and evolution, and CO2 reduction. Instead of passively accepting the degradation of catalysts during operation, we will direct the evolution through the highly multidimensional space towards long-lasting, active HEM interfaces.

Link to the ERC project webpage: https://www.ruhr-uni-bochum.de/erc/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: electrocatalysis

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101118769	**HYDROSENSING**	**SYG** Synergy

Principal Investigator:	**Dr Eilon Shani**
Host Institution:	TEL AVIV UNIVERSITY - ISR

DISCOVERING HOW PLANTS SENSE WATER STRESS

Water stress is an increasing probleWater stress is an increasing problem for global agriculture given the impact of climate change. Despite the fundamental importance of water, exactly how plants sense its availability remains unknown. This new knowledge is vital for designing more climate resilient crops, yet currently remains a critical gap in scientific understanding. Our unique synergy is ideal to take on this ambitious project and discover how plants sense water after identifying membrane proteins from a proof-of-principle multi-targeted genetic screen designed to reveal components of the water-sensing (hydrosensing) machinery. We hypothesise changes in plant hydraulic fluxes driven by transient water stress are sensed by a specialised cell type – termed phloem companion cells - that controls the synthesis and release of the abiotic stress signal ABA. Release of ABA by water stress is triggered by perturbations in plasma membrane-cell wall contact sensed by kinases like THESEUS1 (THE1) and additional missing components, which we will identify using our custom multi-targeted CIRSPR libraries. Our discoveries will unlock the mechanism enabling sensing of the most important molecule on the planet, WATER, in the most abundant lifeform biomass-wise, PLANTS. Solving how plants sense water demands a highly inter-disciplinary strategy that goes beyond the cutting edge by pioneering the development of innovative genome editing, functional imaging and structural biology approaches. The breadth and depth of capabilities and expertise to undertake this strategy necessitates a synergistic partnership between world-leading groups to go beyond the current state of the art. By pursuing this high-risk/high-gain strategy, our project promises to reveal common ‘design principles’ that underpin the core mechanism(s) for water stress signalling in plants. This new knowledge is crucial for international efforts to design climate-resilient crops and underpin global food security.

Link to the ERC project webpage: https://hydrosensing.eu/

Keywords of the ERC project: Plants, water stress, genetics, CRISPR, genome editing

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101118811	**PROTOS**	**SYG** Synergy

Principal Investigator:	**Dr Juan Manuel García-Ruiz**
Host Institution:	FUNDACION DONOSTIA INTERNATIONAL PHYSICS CENTER - ESP

The role of silica in the dawn of life on our planet

All information humankind has of the ancient past of our planet comes from analyzing the geological record encoded in rocks. There is, however, no rock record of the first 600 million years of Earth's history. Unlocking the secrets of this earliest period –the Hadean– is a fundamental task for science, as it is key to understanding how the planet became habitable, when the first forms of metabolism and self-replication developed, and life appeared. The lack of a geological record has led scientists to use computational modeling to make inferences about the conditions in Early Earth's environments. Less common are laboratory experiments specifically targeted to simulating Hadean conditions. Based on ubiquitous carbonaceous chert deposits in the oldest rock record, it is widely accepted that many early Archean aquatic settings were reducing and rich in silica and some basic carbon-based molecules. We reason that such aquatic conditions were already established during the early Hadean, and inevitably led to the existence of a large-scale factory of simple and complex organic compounds, many of them relevant to prebiotic chemistry and to the route to biomimetic hybrid microstructures able to self-organize and catalyze prebiotic reactions relevant to the origin of life. Our project is aimed at understanding the crucial role of silica in directing the geochemical and protobiological processes, creating habitats for early life, and preserving early biomass on Earth's surface during the first billion years of its history. PROTOS will use an array of laboratory experiments (the Hadean Simulator) to systematically study ab-initio reactions of water and gases with the earliest rock types in order to determine compositions of aquatic habitats and subsequent silica precipitation mechanisms, organic synthesis processes on silica/iron surfaces, and the preservation of the first remnants of life. PROTOS will change our view of the infancy of the planet.

Link to the ERC project webpage: https://protos-erc.eu/

Keywords of the ERC project: Hadean; early earth; mineral self-organization; serpentinization; silica; self-organization; prebiotic chemistry; life detection; origin of life

Keywords that characterize the scientific profile of the potential visiting researcher/s: Hadean; early earth; mineral self-organization; serpentinization; silica; self-organization; prebiotic chemistry; life detection; origin of life

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Project ID:	Project Acronym:	Evaluation Panel:
101118866	**DynaTrans**	**SYG** Synergy

Principal Investigator:	**Dr Thomas Gregor**
Host Institution:	Institut Pasteur - FRA

Transcription in 4D: the dynamic interplay between chromatin architecture and gene expression in developing pseudo-embryos

During mammalian embryogenesis, key events involving DNA and regulatory molecules over seconds and nanometers affect and are affected by, a major reorganization of the genetic material in the nucleus over hours and micrometers. How these scales are spanned and integrated into the course of development remains a major unresolved challenge. Progress in this quest is difficult, either because current model systems suffer from severe technical limitations or because existing analytical approaches probe individual spatial or temporal scales thus ignoring their evolving interactions. Traditional live imaging lacks the spatial resolution to accurately delineate chromosome organization at the scale of genes, while bulk molecular assays are ill-suited for studying development over time. Here, we propose a multi-disciplinary approach to the dynamics of developmental gene regulation to understand the details of the underlying mechanisms and their deployment over time. We combine and apply optical, molecular-genomic, and theoretical tools to recently available mammalian pseudo-embryos, allowing unprecedented precision in developmental staging, a large amount of material, and easy optical access. By focusing on select gene loci we track transcriptional activation and the interactions of distal DNA elements in real-time along with the associated chromatin dynamics using interaction profiles. Our datasets are iteratively distilled into mathematical models of increasing scope, converging towards an integrative dynamic polymer model that simultaneously captures long-timescale chromatin rearrangements as well as short-timescale motions of genetic regulatory elements and transcriptional activity. We then challenge these models via genome editing and temporally defined interventions by building light-controlled tools to affect the chromosome landscape. This project aims to reshape our view of how genes are regulated during mammalian development.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101118880	**Synergy-Plague**	**SYG** Synergy

Principal Investigator:	**Dr Nils Chr. Stenseth**
Host Institution:	Universitetet I Oslo - NOR

Reconstructing the environmental, biological, and societal drivers of plague outbreaks in Eurasia between 1300 and 1900 CE

Synergy-Plague is a multi-disciplinary project to bring our knowledge and understanding of plague, past and present, to new heights. Focussing on the environmental, biological, and societal aspects of plague outbreaks in Eurasia between circa 1300 and 1900 CE, it will address four main questions: (1) Why/how did plague re-emerge in 14th century Central Asia? (2) Why/how did plague re-occur and spread in Eurasia after the Black Death? (3) Why/how did clinical and demographic patterns of plague infection differ across space and time? (4) Why/how did plague disappear from Europe and the Middle East in the 18th and 19th centuries? Our project is based on the hypothesis that plague waves and clinical differences resulted from unique alignments of multiple events: environmental (climatic and soil-chemical), biological (from individual to ecosystem) and societal (demographic, socio-economic and political). Four PIs from the natural sciences and humanities, together with their team members, will jointly study how plague re-emerged in 14th century Central Asia and radiated repeatedly from Eurasian wildlife reservoirs in the following centuries, only to disappear in the 18th-19th centuries. We will develop and analyse new dendrochronological and (paleo-)soil data, textual documentary evidence, and epidemiological models. To understand how plague reached and spread in human populations, paleo-environmental and historical data together with relevant experimental work will be combined with statistical and mathematical modelling. To appreciate why clinical signs and mortality rates varied in space and time, historical evidence will be examined together with new entomological data and ancient DNA (aDNA) of historical plague strains (from humans and anthropophilic rodents). Synergy-Plague will revolutionise our understanding of plague and contribute to our ongoing struggle with epidemic diseases, present and future.

Link to the ERC project webpage: https://www.synergy-plague.org/

Keywords of the ERC project: Yersinia pestis in wildlife rodents and people (where it causes human plague) in Eurasia and North Africa; historical archive material; population ecology; molecular biology, mathematical and statistical modelling; reconstruction of climate variation in t

Keywords that characterize the scientific profile of the potential visiting researcher/s: population biologist; statistical modeller; mathematical modeller; deep interdiciplinarity

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101118890	**TalkingPhages**	**SYG** Synergy

Principal Investigator:	**Dr Jose Penades**
Host Institution:	IMPERIAL COLLEGE LONDON - GBR

Decoding communication between mobile genetic elements

Communication between organisms is one of the most sophisticated forms of social interactions. It has been recently discovered that bacterial viruses (phages) show multiple social attributes including the ability to communicate extracellularly with their progenies through a peptide-based system called arbitrium. This system is utilized by phages to guide life-cycle decisions, such as the transitions between their quiescence and virulence states. It has subsequently become clear that this system is not exclusive to phages but is also present in other mobile genetic elements (MGEs) and that its underlying design and function has diversified considerably. Despite the wide-ranging impact of these discoveries, the molecular basis of these new systems of communication, and their function in different MGEs, remain to be deciphered. More importantly, although it has been proposed that phages only communicate with their progeny, our preliminary results indicate that the arbitrium system can be used by phages and other elements to communicate with unrelated MGEs, sometimes present in different bacterial species. However, the prevalence and ecological role of this unprecedented inter-MGE communication is unclear. In the TalkingPhages project, we'll explore all these questions and establish the molecular basis used by arbitrium systems to shape MGE diversity, interactions amongst MGEs and bacterial ecology and evolution. Our team combines expertise in MGEs and communication systems using tools from genetics (Penadés), biochemistry (Marina) and eco-evolutionary dynamics (Eldar). By exposing the multi-layered network of communications between MGEs, which is amenable for exploration on multiple levels of resolution, this project would set a milestone in understanding the complex eco-evolutionary dynamics of MGEs and the relevance of their sociality, with potential impact on our understanding of virulence and resistance in clinically and agriculturally important bacterial species.

Link to the ERC project webpage:

Keywords of the ERC project: Phage communication, bacterial evolution

Keywords that characterize the scientific profile of the potential visiting researcher/s: phage biology, bacterial evolution, virulence, antibiotic resistence

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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101118911	**DarkQuantum**	**SYG** Synergy

Principal Investigator:	**Dr Igor García Irastorza**
Host Institution:	Universidad De Zaragoza - ESP

Quantum Technologies for Axion Dark Matter Search

The unresolved nature of the Dark Matter permeating our Universe is one of the most pressing questions of modern science. It is connected to our very understanding of reality at the most fundamental level. The axion DM paradigm has recently emerged as one of the most compelling hypothesis to solve this question: Dark Matter would be composed by very light and very feebly interacting axions. This paradigm is strongly motivated by theory, and predicts a clear signal in terrestrial experiments called axion haloscopes. Pioneering experiments have reached enough sensitivity to test some realistic axion models in limited mass ranges, so far without a positive signal. However, there is still a large viable axion parameter space to be explored. The methods used to date will be inefficient to perform such a challenging task. Here our DarkQuantum consortium proposes a new way of addressing this gap using quantum sensing technologies and hybrid quantum systems. Specifically, we will combine quantum technologies and well established particle physics environments at CERN or DESY devoted to the detection of axions in the galactic halo. Building quantum-enhanced setups in particle physics environments is extremely challenging and needs expertise from very different fields of physics. Our consortium brings together experts from quantum circuits, very-low temperature cryogenics, quantum measurements and particle physics, to build two quantum-enhanced haloscopes with unprecedented sensitivity and mass scanning range. The novel sensing strategies of the DarkQuantum project could lead to the experimental detection of axions for the first time. Such a fundamental discovery in connection with the long-standing DM problem would lead to a breakthrough in Physics

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Project ID:	Project Acronym:	Evaluation Panel:
101118919	**BatProtect**	**SYG** Synergy

Principal Investigator:	**Dr Emma Teeling**
Host Institution:	University College Dublin, National University Of Ireland, Dublin - IRL

Learning from Bats: New Strategies to Extend Healthspan and Improve Disease Resistance

The medical, financial, and emotional costs imposed by ageing and infectious diseases are major challenges for our societies. Strikingly, while past research has not provided solutions for extending human healthspan and preventing the harmful consequences of infections, nature has solved both problems in the only flying mammals – the bats. Among mammals, bats exhibit an exceptional longevity with little signs of age-related diseases. Despite being reservoirs for numerous deadly viruses, viral infections in bats are mostly asymptomatic due to unique immune system adaptations. The overarching goal of BATPROTECT is to achieve breakthroughs in our understanding of the molecular basis of bats' extended healthspan and disease resistance to ultimately discover new directions to improve human healthspan and disease outcome. BATPROTECT integrates a team of world-leading experts in bat biology, genomics, immunology and gerontology to synergistically: (i) elucidate the molecular mechanisms that bats use to slow down expected ageing; (ii) identify the driving molecular mechanisms behind bats' viral tolerance and limited age-related inflammation; (iii) uncover the genomic basis and evolution of extended healthspan and disease tolerance in bats; and, (iv) develop transgenic animal models to functionally validate the uncovered bat adaptations. We will generate 150 reference quality bat genomes, the novel immunological, bioinformatic, cellular and molecular tools required to take an integrative multi-omics approach and uncover the age and immune changes that occur in wild and captive bats across the ageing spectrum. We will identify the top regulators of longevity and immunity, using deep neural networks analyses, to functionally validate in our cellular systems and novel transgenic animal models- BatWorms and BatMice. Ultimately, we will provide a deeper understanding of extended healthspan and disease resistance and will pave the way for future therapeutics.

Link to the ERC project webpage: https://batprotect.eu/

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101118999	**Cat4CanCenter**	**SYG** Synergy

Principal Investigator:	**Dr Alexander Kros**
Host Institution:	Universiteit Leiden - NLD

Catalysis for Cancer Treatment.

The increased incidence and mortality of tumors that do not respond to standard of care or other targeted therapies is a major challenge in clinical management of these cancer patients. In order to provide innovative therapeutic avenues for treatment refractory patients, it is urgent to develop novel mechanisms of anticancer drugs mode of action that will overcome the drawbacks of current therapies. In Cat4CanCenter, we will merge the research fields of metal-based catalysis for drug development and innovative delivery routes with cancer biology and immunology, applied to one of the deadliest cancers, glioblastoma (GBM), a fatal primary brain tumor for which no curing therapy exists, due to its location within the brain parenchyma and complex tumor microenvironment. Many potential drugs failed in the clinic due to their inherent toxicity and off-target side-effects, which add up to the challenges in reaching the protected brain site. Recently, innovative catalyst design enabled synthetic transformations in the presence of biological molecules. In Cat4CanCenter we will develop four innovative approaches to treat GBM. This new methodology requires the design of cage protected catalysts that will be delivered to targeted cell types using advanced lipid nanoparticle technology. Next, the catalysts will convert nontoxic prodrugs into active drugs within the GBM bulk. Our groundbreaking strategy aims for successful therapies to treat glioblastoma, by developing complementary approaches to therapeutically tackle the complexity of this disease. The new strategies, catalysts and prodrIn this project we explore a new avenue to treat glioblastoma, which is the most difficult cancer to target. In a collaborative program we develop biomimetic transition metal catalysts (key expertise 1) that will be delivered using smart strategies such as lipid nanoparticles (key expertise 2) to generate cancer drug in vivo. The glioblastoma biology will be studies in detail (key expertise 3).

Link to the ERC project webpage:

Keywords of the ERC project: Drug delivery, lipid nanoparticles, RNA, supramolecular chemistry, glioblastoma

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101119062	**SWIMS**	**SYG** Synergy

Principal Investigator:	**Dr Gerhard Fettweis**
Host Institution:	Technische Universitaet Dresden - DEU

Stochastic Spiking Wireless Multimodal Sensory Systems

SWIMS vision is to propose a bio-inspired paradigm change for the design and hardware of future smart wireless multimodal sensory systems that will operate with stochastic spikes, offering a breakthrough with unrivalled energy efficiency at system level, for event detections and communication. The scientific breakthroughs proposed here are sine qua non advancements for a sustainable deployment of billions of future Internet of Things nodes to support smart economy and society development, with large energy savings and limited impact on environment. The synergistic interaction of four complementary skilled PIs enables the realization of a radically-novel end-to-end stochastic analog spiking neuromorphic concept for SWIMS nodes, offering solutions to challenges of sensor spiking signal generation, processing and communication with disruptive innovations at all levels, inspired by the biological model of a small insect. SWIMS involves many beyond state-of-the-art scientific advancements from technology to system level to enable a neuromorphic architecture with i) as input neuron layer, new heterostructure spiking sensor arrays based on transition metal oxides/2D semiconductor, covering infrared, ultraviolet, acoustic and electromagnetic detections, ii) hidden layers in tiny spiking neural networks based on novel CMOS Fe-FET concepts capable of efficiently dealing with inherent stochastic noise when processing spiking signals on-chip, iii) a spiking emitter as output layer for event-driven wireless transmission using optimized spike modulation and encoding, and iv) a modelling framework embedding stochastic effects in task-based electronic system design and biologically inspired recurrent neural networks. The synergistic interaction will enable unique design and experimental validations of first of their kind event-driven demonstrators with optimized all spiking multi-modal sensor nodes and energy consumption more than 100x lower than existing state of the art.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101119164	**SUBNORDICA**	**SYG** Synergy

Principal Investigator:	**Dr Svea Mahlstedt**
Host Institution:	Niedersächsisches Institut für historische Küstenforschung - DEU

Beyond submerged landscapes - defining human response to postglacial sea-level rise and climate change

The landscapes that extended for millions of square kilometres offshore of the world's coastlines due to low sea-level during the last glaciation and were then drowned by sea-level rise, are known to preserve valuable archives of landscapes, palaeoclimatic change and stratified archaeological remains, with the potential to transform understanding of human history in this period of dramatic change. The absence of archaeological sites across much of this vast area prevents realisation of this potential. In SUBNORDICA we propose a systematic approach to develop new methods for recreating the submerged landscapes and human settlement of NW Europe and assess the impact of postglacial sea-level rise. We will address two questions: (1) What changes to the topography and environment of the submerged landscape were brought about by rising sea level and climate change? (2) How was the distribution of archaeological settlements and other traces of cultural activity impacted by this changing palaeolandscape, and can we recover them in sufficient detail to investigate human impact and human response? Combining information from 4 regions in the southern North Sea and the southern Baltic, we will use artificial intelligence to develop machine-learning routines to (a) integrate existing and newly acquired geophysical and geological data to map key areas of the changing landscape, and (b) combine this information with data from known underwater archaeological sites to identify new targets of archaeological potential for more detailed investigation. Investigating these targets will use high-resolution geophysical methods, sediment coring, archaeological excavation, and geochronological, palaeoenvironmental, sedimentological and biological analyses of recovered deposits. We will reveal a new chapter in human prehistory, provide a world-leading model for the investigation of submerged landscapes, and offer improved policy guidance for underwater cultural heritage management.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: Landscape archaeology, underwater archaeology, paleo ethnology, sedimentology

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Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101119164	**SUBNORDICA**	**SYG** Synergy

Principal Investigator:	**Dr Katrine Juul Andresen**
Host Institution:	Aarhus Universitet - DNK

Beyond submerged landscapes - defining human response to postglacial sea-level rise and climate change

The landscapes that extended for millions of square kilometres offshore of the world's coastlines due to low sea-level during the last glaciation and were then drowned by sea-level rise, are known to preserve valuable archives of landscapes, palaeoclimatic change and stratified archaeological remains, with the potential to transform understanding of human history in this period of dramatic change. The absence of archaeological sites across much of this vast area prevents realisation of this potential. In SUBNORDICA we propose a systematic approach to develop new methods for recreating the submerged landscapes and human settlement of NW Europe and assess the impact of postglacial sea-level rise. We will address two questions: (1) What changes to the topography and environment of the submerged landscape were brought about by rising sea level and climate change? (2) How was the distribution of archaeological settlements and other traces of cultural activity impacted by this changing palaeolandscape, and can we recover them in sufficient detail to investigate human impact and human response? Combining information from 4 regions in the southern North Sea and the southern Baltic, we will use artificial intelligence to develop machine-learning routines to (a) integrate existing and newly acquired geophysical and geological data to map key areas of the changing landscape, and (b) combine this information with data from known underwater archaeological sites to identify new targets of archaeological potential for more detailed investigation. Investigating these targets will use high-resolution geophysical methods, sediment coring, archaeological excavation, and geochronological, palaeoenvironmental, sedimentological and biological analyses of recovered deposits. We will reveal a new chapter in human prehistory, provide a world-leading model for the investigation of submerged landscapes, and offer improved policy guidance for underwater cultural heritage management.

Link to the ERC project webpage: www.subnordica.eu

Keywords of the ERC project: Submerged palaeolandscapes, underwater archaeology, geoarchaeology

Keywords that characterize the scientific profile of the potential visiting researcher/s: Marine geophysicists, seismic interpretation, geoarchaeologist

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Project ID:	Project Acronym:	Evaluation Panel:
101166700	**EUROpest**	**SYG** Synergy

Principal Investigator:	**Dr Adam Izdebski**
Host Institution:	UNIWERSYTET MIKOLAJA KOPERNIKA - POL

A Novel Understanding of Pandemic Disease in Preindustrial Europe (1300-1800): Combining History, Machine Learning and Natural Sciences

Born from years of interdisciplinary collaboration, EUROpest aims to articulate the complex ways in which social-ecological systems shape epidemics. It builds on resilience and actor-network theories to advance its own eco-bio-social paradigm that embraces a multi-causal understanding of disease transmission and disease impacts on human societies and ecosystems. While striving to develop and validate a general theoretical model, it takes the well-documented and highly diverse world of late medieval and early modern Europe as its laboratory – investigating its interconnected climatic, cultural, demographic, economic, ecological, and pathogenic history. With regard to the latter, EUROpest assumes malaria, smallpox, tuberculosis and enteric diseases were major components of a disease baseline over which the most devastating disease, plague (Y. pestis), occurred. EUROpest will carry out regional case studies – from Spain to Lithuania, Greece to England – selected on the basis of available and procurable written, scientific and archaeological data. It will holistically consider the contexts of plague outbreaks identified in those regions, to understand how context both facilitated outbreaks and also shaped them, and their short- and medium-term impacts. EUROpest combines archival source analysis with archaeology, archaeogenetics, paleoecology and paleoclimatology, and subjects case studies to novel human-supervised machine-learning to identify the causal role of factors influencing regional outbreaks. As the contemporary imagination is guided in its understanding of epidemic disease by the outbreaks of the past, EUROpest's contribution will be critical to developing more nuanced and realistic scenarios of future pandemics, academic as well as popular. With EUROpest PIs already engaging policy makers, the mathematical precision of the eco-bio-social analysis EUROpest proposes will help design more successful and targeted interventions for future pandemic response.

Link to the ERC project webpage: https://humeco.umk.pl/pages/EUROpest/

Keywords of the ERC project: environmental history, human ecology, epidemics, climate change, aDNA

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

Established by the European Commission

Project ID:	Project Acronym:	Evaluation Panel:
101166880	**STARMORPH**	**SYG** Synergy

Principal Investigator:	**Dr Stéphanie Robert**
Host Institution:	Sveriges Lantbruksuniversitet - SWE

Unravelling Spatio-temporal Auxin Intracellular Redistribution for Morphogenesis (STARMORPH)

STARMORPH is a ground-breaking endeavour with the ambitious goal of understanding plant organ morphogenesis, which will pave the way to engineering plant growth. This is of paramount importance for enhancing agricultural and forestry yields and hence contributing to global food security and environmental sustainability. Plant organ morphogenesis involves differential growth, where various organ parts expand at different rates to create specific structures. A significant challenge lies in understanding these differential growth programs while considering the mechanical constraints imposed by the tissues. The plant hormone auxin plays a central role in differential growth. It forms concentration gradients within tissues, dictating the direction and rate of cell expansion. Mechanistically, auxin can either repress or promote growth in a tissue and concentration-dependent manner, but this biphasic behaviour remains largely unexplained. The extracellular space, cytosol, and nucleus have distinct auxin perception mechanisms and hence STARMORPH pitches an "auxin signature" concept, considering nuanced auxin levels in each compartment specifying an ensemble signal with quantitative and qualitative cell responses for morphogenesis. Currently, auxin subcellular compartmentalisation is poorly understood, and a key focus of the project is to provide a subcellular map of auxin dynamics within a growing organ to uncover how tissue mechanics interact with auxin-dependent growth processes, which will be pivotal for understanding plant morphogenesis. The STARMORPH project leverages a unique combination of plant, cell and synthetic biology, genetics, biophysics and organic chemistry expertise. This interdisciplinary collaboration aims to dissect plant morphogenesis from molecular to organ scales and has the potential to revolutionise our understanding of plant growth and development, with applications in biotechnology and plant engineering.

Link to the ERC project webpage:

Keywords of the ERC project: plant morphogenesis, auxin, cell wall, mechanics, signaling

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101166936	**GEOASTRONOMY**	**SYG** Synergy

Principal Investigator:	**Dr Stephen Mojzsis**
Host Institution:	UNIVERSITAT BAYREUTH - DEU

Exploring the chemical foundations for rocky exoplanets around Sun-like stars

Billions of rocky worlds likely exist around Sun-like stars in our Galaxy. Yet, attempts to understand these exoplanets lack information on the elements that compose them, the geodynamic processes that drive them, and the atmospheres that cloak them. To meet these cross-disciplinary challenges, three PIs at three institutes have combined forces to break new ground in understanding fully-formed silicate+metal+fluid (i.e. 'rocky') exoplanets. By synergizing astronomical data analysis with planetary geochemistry and experimental petrology and atmospheric physics/chemistry, we deviate from a purely theoretical approach via forward modeling. Instead, we blend Bayesian inference applied to telescope data and laboratory experiments with theory. Our thesis is straightforward: An exoplanet's geologic history can only be decoded indirectly through spectroscopic observations of its atmosphere. To take advantage of remote observations of such atmospheres by next-generation telescopes we must work to understand how and why exoplanets have the physical and chemical properties they do. We devote our closely aligned efforts towards three categories of worlds around Sun-like (FGK) stars well-studied by astronomers: sub-Neptunes (exoplanets smaller than Neptune), Super Earths (exoplanets slightly larger than Earth) and "ultra-short period" (USP) exoplanets that may harbour magma oceans and atmospheres. GEOASTRONOMY fuses principles of the Geosciences with Astrophysics. Our aim is to build the chemical foundations for the exoplanet community to understand secondary (outgassed), hybrid (commingled primary- and secondary-) and magma-ocean atmospheres of already assembled mature rocky exoplanets. The proposed work is urgent because new and emerging datasets, including those being collected by the James Webb Space Telescope, are already providing constraints on these three categories of atmospheres.

Link to the ERC project webpage:

Keywords of the ERC project: exoplanets, experimental petrology, nuclear astrophysics, planetary geochemistry, cosmochemistry

Keywords that characterize the scientific profile of the potential visiting researcher/s: chemical physics, physical chemistry, astrochemistry, astrophysics, geodynamics, petrology

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Project ID:	Project Acronym:	Evaluation Panel:
101166968	**MicroClock**	**SYG** Synergy

Principal Investigator:	**Dr Martha Merrow**
Host Institution:	LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN - DEU

The Bacillus subtilis circadian clock: from molecules to mutualism

Circadian clocks are biological timekeepers. They structure processes - from molecular pathways to behavioural attributes - over the 24h day. They are pervasive in eukaryotes yet remain almost completely unknown in bacteria. We propose to address this major knowledge gap by capitalising on our recent breakthrough discovery of a circadian clock in Bacillus subtilis. Our unpublished data reveal that robustness of the B. subtilis circadian clock increases when co-cultured with either the plant Arabidopsis, or the yeast Saccharomyces cerevisiae. We propose that the mutualistic interactions between microbes and other organisms in their environment utilise circadian clocks, allowing us to propose the new concept of "temporal mutualism". Within this project, we will identify and understand the molecular structure and function of the B. subtilis circadian clock (WP1), which will be the first detailed characterisation of a circadian clock in a non-photosynthetic bacterium. We will exploit the interactions that occur between B. subtilis and plant circadian clocks to define this new concept of temporal mutualism (WP2 and 3). Co-culture of B. subtilis with S. cerevisiae will identify regulatory nodes that are common to plant/bacterium and fungus/bacterium temporal mutualism (WP3). We will probe the novel hypothesis that biofilm enables intra-species temporal mutualism via differentiated cell populations within the matrix-bound structure (WP3). We will use circadian formalisms (behaviour), molecular systems analysis and state of the art technological approaches (e.g., combinations of microfluidics, microscopy, reporter gene technology and optogenetics), which is only possible through our interdisciplinary collaboration. This work will drive a paradigm shift, to open a completely new field that will change current thinking by bridging chronobiology with microbiology and ecology.

Link to the ERC project webpage: http://www.microclock.org

Keywords of the ERC project: circadian clock, chronobiology, bacillus subtilis

Keywords that characterize the scientific profile of the potential visiting researcher/s:

European Research Council
Executive Agency

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Project ID:	Project Acronym:	Evaluation Panel:
101167101	**REM@KE**	**SYG** Synergy

Principal Investigator:	**Dr Massimiliano Guido**
Host Institution:	Universita Degli Studi Di Pavia - ITA

Reconstructing Embodied Musical knowledge At the Keyboard

The fundamental objective of REM@KE is to reconstruct the sound and the function of lost musical instruments and to develop new theoretical, empirical, and practical tools to explore the embodied musical knowledge emerging from the relationships between these instruments and their performers. Among the great variety of objects of the past that inhabit museums, musical instruments are in a category of their own: if kept silent, music cannot be; if played, their materiality is endangered. These instruments are at risk of being silenced forever, as their conservation becomes the priority. To ensure access for future generations, a radical intervention is needed, to comprehensively study how they sounded and played when they were new, as well as their design principles and construction processes, so that they may be reconstructed, played, and heard both materially and virtually. To investigate the sound of these objects, we have developed a new research framework 'Cognitive and Digital Organology' (CaDO) that builds new bridges between organology, performance practice research, and cognitive sciences. CaDO will study the people involved with music, the instruments producing the sounds (interlocked into a system that evolves over time), in a space that is social, material, and digital. Embodied cognitive science will be used to examine how resources from the bodies of builders, players, educators, and listeners determine their musical experiences, fostering new relationships that are formed and transformed in acts of musicking. Thus, CaDO can inspire richer understandings of the experiences of those who engage with historical musical instruments and their replicas. By reinterrogating the relationship between instrument, gesture, and music REM@KE aims to reclaim the sound of historical instruments, improve our understandings of how we engage with them, and guarantee a better future for them.

Link to the ERC project webpage: remake.unipv.it

Keywords of the ERC project: Organology; Musicology; Cognitive Science; Digital Humanities; Keyboard Musical Instruments; Cultural Heritage

Keywords that characterize the scientific profile of the potential visiting researcher/s: Cognitive Science; Digital Twin for Cultural Heritage; Process Reconstruction; Artistic Research; Craftmanship

European Research Council
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Project ID:	Project Acronym:	Evaluation Panel:
101167181	**MetaDivide**	**SYG** Synergy

Principal Investigator:	**Dr Bert Poolman**
Host Institution:	Rijksuniversiteit Groningen - NLD

Metabolism-driven division of minimal cell-like systems

Building a synthetic cell from molecular components is one of the grand scientific and intellectual challenges of the 21st century, and requires interdisciplinary skillsets to design and integrate biochemical modules at different levels of hierarchy. Great progress has been made in the fundamental understanding and reconstitution of key features, such as metabolic reaction networks and replication machinery. However, their successful synergistic integration in minimal cells still lags far behind, due to often largely different experimental approaches. MetaDivide will bring together two groups of world-leading scientists with complementary expertise in biochemistry and biophysics to address this gap. Poolman and Schwille will combine their mastery of membrane systems and protein machineries to establish a blueprint for coupling metabolic networks to cellular modules for spatiotemporal regulation and force-induction for division. By this, we aim to reconstitute in a minimal system one of the most stunning and central features of cellular life: The autonomous division of proto-cellular compartments by encapsulated self-organizing macromolecular machinery, driven by a self-sustaining energy metabolism. We will test our hypothesis that the otherwise separately researched features of life: Metabolism, Cell Division and Genome Segregation are mechanistically linked in the emergence of cellular life. Besides the great technical advance in synthetic biology, this will be a huge accomplishment in the understanding of biological mechanisms in today's organisms, which in living cells are often obscured by their immense molecular complexity. Moreover, our new fundamental insights on the main principles underlying cellular life will advance application-driven research: By elucidating the mechanisms of out-of-equilibrium reaction networks and cell division, we will obtain insight that may inform the future development of generic small molecules to curb bacterial proliferation.

Link to the ERC project webpage:

Keywords of the ERC project: Bottom-up synthetic biology, out-of-equilibrium reaction networks, membrane transport, metabolic energy conservation, cell division

Keywords that characterize the scientific profile of the potential visiting researcher/s: Redesigning life-like systems, AI and synthetic biology, biomolecular condensates, reaction networks in confinement

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Project ID:	Project Acronym:	Evaluation Panel:
101167322	**TRANSDIFFUSE**	**SYG** Synergy

Principal Investigator:	**Dr Eusebio Valero**
Host Institution:	Universidad Politecnica De Madrid - ESP

DIscovering Flow control in TRANSonic difFUsing paSsagEs

The quest for carbon-neutral aviation propels us toward uncharted technological frontiers. In TRANSDIFFUSE, we present an ambitious program to develop an AI-driven model that may revolutionize propulsion technologies. As a synergistic consortium, we unite the numerical modelling prowess of Valero's team, the high-fidelity computational capabilities of Lehmkuhl's group, and Paniagua's experimental ingenuity.

TRANSDIFFUSE aims to develop new tools related to clean propulsion, specifically an AI-driven model called FluidGPT. In doing so, we expect to enable major advancements to the aeronautical and power generation sectors, including, for example, hydrogen pressure gain combustion (PGC) engines, which are compact, lightweight, high-efficiency turbines. In initiating FluidGPT, we aim to overcome challenges like those facing PGC, by exploiting the thing that has made compact turbomachinery so difficult to design: the troublesome transonic flows propelled from the combustor. With our model we aim to control and manipulate those transonic flows.

Our approach to FluidGPT is anchored in characterizing, predicting, and then manipulating the intricate, unsteady, inherently difficult transonic flows—thus unlocking the design and development of transonic diffusing passages, a notorious obstacle to designing turbomachinery passages in new, compact, efficient engines. FluidGPT will model the Navier-Stokes equations for such conditions, enabling the prediction and control of previously unmanageable flow behaviours. A complete model of the Navier-Stokes equations in transonic diffusing passages has never been achieved by the scientific community, and our model will be able to reproduce flow configurations never seen before.

Embracing innovation and synergy, TRANSDIFFUSE will also unlock new design guidelines and flow control techniques to surmount limitations across the aeronautical and power generation sectors. This program may redefine fluid dynamics modelling and control.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: Machine learning and artificial intelligence in fluid mechanics, large eddy simulation, flow stability, high order schemes, GPU parallelization.

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Project ID:	Project Acronym:	Evaluation Panel:
101167416	**AI4AMR**	**SYG** Synergy

Principal Investigator:	**Dr Ivo Gomperts Boneca**
Host Institution:	Institut National De La Sante Et De La Recherche Medicale - FRA

Deep learning analysis of imaging and metabolomic data to accelerate antibiotic discovery against antimicrobial resistance

Antimicrobial resistance (AMR) is one of the most pressing global health problems of our times. To counteract AMR, we urgently need new antibiotics, particularly with novel modes of action (MoA). However, while typical antibiotic screening pipelines can identify compounds that impair bacterial growth, they are unable to predict drug targets and MoA so must be followed up by time-consuming target identification steps. By synergizing our expertise in microbiology, genetics, advanced microscopy, metabolomics, medicinal chemistry, computational biology and artificial intelligence (AI), we propose to create a new pipeline at the forefront of the antibiotic discovery field that will be capable of informing simultaneously on the bioactivity and MoA of new antibiotic candidates. Working with seven pathogens, our improved acquisition strategies for both imaging-based high-content screening and metabolomics will generate a massive dataset of rich multidimensional phenotypes of libraries of genetic mutants and of bacteria exposed to a range of perturbants, at unprecedented scale. Deep learning analyses will then enable us to explore these massive datasets to correlate chemical-induced phenotypes to those from mutants, linking drugs to genes to elucidate the target/MoA of new drugs. This innovative pipeline will enable us to explore unique chemical spaces, including complex natural product extracts (without the need for isolation of individual components) and novel synthetic compounds. Promising candidates with novel MoA will be tested against drug-resistant clinical isolates and against a future pandemic 'pathogen X', demonstrating our pipeline as an AI-powered solution for achieving higher productivity in antibiotic discovery. AI4AMR will provide the community with a new pipeline to efficiently screen large compound libraries to identify novel antibiotics and define their MoA and target, helping directly to combat AMR.

Link to the ERC project webpage:

Keywords of the ERC project:

Keywords that characterize the scientific profile of the potential visiting researcher/s: