

# Villum Young Investigators 2019



Postdoc  
**Albert H. Werner**  
 University of Copenhagen, Department of Mathematics  
**Granted DKK 10m**  
 Condensed Matter Physics

## Exotic Phases in Interacting Quantum Many-Body Systems: Disorder and Topological Characterization

Interactions and impurities can profoundly change the physical properties of quantum many-body systems. Both effects can lead to the formation of new phases of matter that have no counterpart in our daily experience. The aim of the project is to analyse the interplay of disorder and interactions in quantum systems in terms of their transport and correlation properties with advanced mathematical tools from quantum information theory. The grant will fund the recipient, one postdoc and two PhD students.



Postdoc  
**Cornelia Jaspers**  
 Technical University of Denmark, DTU Aqua  
**Granted DKK 10m**  
 Earth System Science

## Gelatinous zooplankton: Overlooked player in marine food webs, favoured under global change?

Soft-bodied zooplankton, such as jellyfish, raise public attention as they increasingly impact coastal ecosystems and human welfare, but remain largely ignored in marine sciences. The aim of the project is to investigate the current role of gelatinous zooplankton, their response and adaptation capacity to changing environmental conditions. Critical knowledge gaps will be filled, elucidating global change effects on marine systems. The grant will fund the recipient, one postdoc, one PhD student and equipment.



Postdoc  
**Beate Kraft**  
 University of Southern Denmark, Department of Biology  
**Granted DKK 10m**  
 Evolutionary, Population and Environmental Biology

## A newly discovered microbial oxygen production pathway: Physiology and environmental significance

The discovery of a new oxygen-producing pathway that does not need light motivates this project. This oxygen production pathway is performed by one of the most abundant and important groups of microbes in the environment. The aim of the project is to investigate what drives oxygen production by these microbial key players and its ecological significance. The grant will fund the recipient, one postdoc and two PhD students.



Postdoc  
**Martin Gustavsson**  
 University of Copenhagen, Department of Biomedical Sciences  
**Granted DKK 9.7m**  
 Molecular and Structural Biology and Biochemistry

## Allosteric control of G protein – coupled receptors

Allosteric regulation, where binding of one ligand to a protein affects the binding of a second ligand at a different site, is a key concept in biology. G protein-coupled receptors (GPCRs) are important allosteric proteins with multiple allosteric sites. GPCRs span the cell membrane and are targets for around 30% of currently approved drugs. The aim of the project is to uncover the binding and regulation of GPCRs by allosteric ligands. The grant will fund the recipient, one postdoc and two PhD students.



Postdoc  
**Matthias Oliver Wilhelm**  
 University of Copenhagen, Niels Bohr Institute  
**Granted DKK 9.6m**  
 Fundamental Constituents of Matter

## Thermodynamics of Strongly Coupled Quantum Field Theories

In the first, extremely hot split seconds our Universe existed, the elementary particles quarks and gluons existed freely in an exotic state known as quark-gluon plasma. Shortly after though, when the Universe expanded and cooled down, they started being confined to form the nuclei of the atoms that surround us. The aim of the project is a better theoretical understanding of the quark-gluon plasma and its transition to ordinary matter. The grant will fund the recipient, two postdocs and one PhD student.



Postdoc  
**Tonni Andersen**  
 University of Copenhagen, Department of Plant and Environmental Sciences  
**Granted DKK 10m**  
 Molecular and Structural Biology and Biochemistry

## Passage cells – novel players in plant nutrient homeostasis and interaction with the environment

Plant roots interact with surrounding soil microbes and establish a microbiome much like in human guts. While not much is known about this, communication with microbes might occur through recently described 'passage cells'. The aim of the project is to investigate the role(s) of passage cells in biotic interactions in detail. Such knowledge is highly applicable as agricultural tools for nutrient usage optimisation through manipulation of soil bacteria composition. The grant will fund the recipient, one postdoc and one PhD student.



Postdoc  
**Mehdi Mehrali**  
 Technical University of Denmark, DTU Nanotech  
**Granted DKK 10m**  
 Materials Engineering

## 3D Printable Green Concrete: not only Green but also Intelligent!

The emergence of 3D printing has provided sophisticated tools to open new technology avenues in the fields of construction and interior design. The aim of the project is to introduce a sustainable composite; not only to overcome the limitations of existing 3D printable concretes, but also provide other functionalities during the life cycle of buildings and structures. The grant will fund two postdocs and three PhD students.



Postdoc  
**You Zhou**  
 University of Copenhagen, Niels Bohr Institute  
**Granted DKK 10m**  
 Fundamental Constituents of Matter

## Creating a smallest droplet of early universe in the Laboratory

In the early Universe, a microsecond after the Big Bang, a special quark-gluon plasma (QGP) type of matter existed. Recent surprising results suggest that QGP may be created in the collisions between protons at ultra-relativistic energies. The project will apply new sophisticated correlation techniques to the coming data collected at the Large Hadron Collider (LHC), to reveal this fundamental puzzle. The grant will fund one postdoc and two PhD students.



Assistant Professor

### Fernando Racimo

University of Copenhagen, Natural History Museum of Denmark

**Granted DKK 9m**

Evolutionary, Population and Environmental Biology

#### Paleo-Phenomics: tracing complex trait co-evolution in ancient humans and dogs

Humans and dogs have been cohabiting and interacting in the same environments for thousands of years. In this project, we will trace the evolution of traits in these two species, as they simultaneously expanded throughout the world. Unlike most previous approaches, we will focus on 'complex' traits, which are affected by multiple genes – each of small effect – across the genome. The project will rely on a combination of two types of datasets – ancient genomes and biobank-based gene-trait associations – to trace how different phenotypes evolved over time and space. Ultimately, the aim is to understand whether the same or different traits and genes were targeted by natural selection as both species conquered new environments across our planet. The grant will fund one postdoc and two PhD students.



Assistant Professor

### Lasse Jakobsen

University of Southern Denmark, Department of Biology

**Granted DKK 9.2m**

Evolutionary, Population and Environmental biology

#### Acoustic flight control: Active information filtering in echolocating bats

Filtering away irrelevant information is crucial to any sensory system because it allows the brain to focus on only the information essential to a given task. Bats are ideal animals to study such filtering because bats broadcast their sensory perception through their echolocation. The aim of the project is to investigate how freely flying bats actively control this filtering through dynamic call emission and echo reception. The grant will fund one postdoc, one PhD student, two technicians and equipment.



Assistant Professor

### Kedar Nath Natarajan

University of Southern Denmark, Department of Biochemistry and Molecular Biology

**Granted DKK 9.9m**

Genetics, Genomics, Bioinformatics and Systems Biology

#### Cracking the cell cycle code: The journey from a single-cell to an organism

The 'cell cycle' is a fundamental process in all organisms and its dysregulation may lead to cancers and developmental disorders. The cell cycle drives the development of a single-cell into diverse cell types and generates the 37 trillion cells in our body. The aim of the project is to decode how cell cycle interplays and drives cell-fate decisions during embryonic development, especially at single-cell level. The grant will fund two postdocs and one PhD student.



Assistant Professor

### Michele Burrello

University of Copenhagen, Niels Bohr Institute

**Granted DKK 10m**

Condensed Matter Physics

#### Architectures for non-Abelian anyons

Topological materials are a new generation of quantum systems that, at low enough temperature, display a surprising stability. In such systems, novel particles are predicted to emerge: They are called anyons and offer a great potentiality for quantum computation. The aim of the project is to design and realise new quantum devices for the creation and manipulation of these exotic particles. The grant will fund four postdocs, one PhD student and material costs for experiments in superconducting nanodevices.



Associate Professor

### Adnan Halim

University of Copenhagen, Department of Cellular and Molecular Medicine

**Granted DKK 10m**

Molecular and Structural Biology and Biochemistry

#### Exploring a novel type of protein glycosylation on cell-surface adhesion molecules and receptors

Living organisms produce and display sugar molecules on their cell surfaces. Sugars fulfil important biological roles; however, the understanding of their precise molecular functions is incomplete. The aim of the project is to investigate the functions of a new type of sugar modification (mannose) on proteins. Furthermore, to enhance the understanding of brain defects and other neurological diseases caused by deficiencies in mannose sugars. The grant will fund the recipient, two postdocs and one technician.



Associate Professor

### Christa Gall

University of Copenhagen, Niels Bohr Institute

**Granted DKK 9.8m**

Universe Sciences

#### Searching for the Known Unknowns: Lightening up the Dusty universe

Astrophysical transients, such as massive stars exploding as supernovae, are the spotlights of the Universe, which is filled with small solid particles, 'cosmic dust', of unknown origin. The project will enlighten some of the known unknowns such as the nature of hitherto unknown transients and their role in the Dusty Universe. The aim of the project is to quantify the properties of dust across cosmic time. The grant will fund one postdoc, one PhD student and interaction with international collaborations.



Associate Professor

### Andreas Laustsen

Technical University of Denmark, DTU Bioengineering

**Granted DKK 10m**

Molecular and Structural Biology and Biochemistry

#### Paving the way for novel snakebite antivenoms based on human antibodies

Snakebite envenoming affects millions of victims globally. Existing antivenoms are hyper-allergenic, as they are based on antibodies isolated from the blood of immunized horses. The aim of the project is to develop fully human monoclonal antibodies with specialised toxin-binding abilities. These antibodies may be used for the further development of a new generation of antivenoms to save snakebite victims worldwide. The grant will fund two postdocs and two PhD students.



Associate Professor

### Jan Frahm

Aarhus University, Department of Mathematics

**Granted DKK 10m**

Mathematics

#### Symmetry Breaking in Mathematics

'Symmetry breaking' describes the process of passing from a state of high symmetry to one with less symmetry, and it plays an important role in modern theoretical physics. The aim of the project is a mathematical description and study of symmetry breaking in terms of representations of reductive Lie groups, with possible applications to questions in partial differential equations and analytic number theory. The grant will fund the recipient, one postdoc and two PhD students.



Associate Professor  
**Karina Krarup Sand**

University of Copenhagen, Department of Chemistry

**Granted DKK 9.9m**

Earth System Science

**Distribution of antibiotic resistance genes in the environment:  
The role of mineral facilitated horizontal gene transfer**

Antibiotic resistance genes are propagated to most of our environments at a rate we did not predict. We believe that minerals serve as unrecognised hotspots for propagation. Minerals can enhance the gene lifetime, transport them across environments and facilitate their transfer to bacteria. The aim of the project is to investigate these processes and build the necessary foundation for preventing further spread of antibiotic resistance in our environments. The grant will fund two postdocs, one PhD student and equipment.



Associate Professor  
**Mathias Clausen**

University of Southern Denmark, Department of Chemical Engineering, Biotechnology and Environmental Technology

**Granted DKK 9.9m**

Molecular and Structural Biology and Biochemistry

**Microscopic investigation of food during culinary preparations**

The aim of the project is to investigate the molecular origin of food texture. The biological materials that we eat will be studied using modern light microscopy to visualise and quantify the complex nano- and microscopic organisation of food biomolecules. Furthermore, the molecular re-organisation that food undergoes during culinary preparations will also be investigated. The grant will fund two postdocs, one PhD student and microscopy equipment.



Associate Professor  
**Martin Schiller**

University of Copenhagen, Natural History Museum of Denmark

**Granted DKK 7.5m**

Earth System Science

**Deciphering the role of mass transport processes in creating a habitable planetary system**

The abundance of planets outside our Solar System tells us that planet formation is a normal outcome of the mass transport of material to form a central star. However, little is known about the key conditions required to form a habitable planet such as Earth. The aim of the project is to shed light on the key processes in the dynamic environment where Earth grew by utilising inclusions in meteorites as tracer particles. The grant will fund one postdoc, two PhD students and equipment.



Associate Professor  
**Wolf Eiserhardt**

Aarhus University, Department of Bioscience

**Granted DKK 10m**

Evolutionary, Population and Environmental Biology

**Explaining the biological hyper-diversity of Tropical rainforests using the Tree of Life**

The tropical rainforest is the biologically richest nature on Earth, harbouring 50% of all living species, for unknown reasons. This mysterious richness can be explained using the Tree of Life, which shows the evolutionary history of species. The aim of the project is to reconstruct the Tree of Life for plants and use it for the first time to explain the richness of rainforests at a global scale. The grant will fund four researchers working together to solve this long-standing biological riddle.



Associate Professor  
**Yunhong Ding**

Technical University of Denmark, DTU Photonics

**Granted DKK 10m**

Electrical engineering, Electronic engineering, Information Engineering

**Silicon-Lithium Niobate Hybrid Integrated Quantum Photonics (QUANPIC)**

Quantum photonic technologies are expected to be orders of magnitude faster at solving certain problems than conventional computers. QUANPIC aims to develop the key components of very high efficiency active multiplexing-based single photon source, very large-scale programmable quantum processor. QUANPIC will furthermore investigate complex quantum information processing applications, based on silicon-lithium niobate hybrid quantum photonics. The grant will fund three postdocs, one PhD student and equipment.

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funds younger talented researchers at Danish universities. Researchers with ambitions of creating their own, independent research identity.

