EBERHARD KARLS
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Universitätsklinikum
Tübingen

Press release

Five new Starting Grants from the European Research Council awarded to University of Tübingen

Five scientists from both the University and the University Hospital have won substantial funding

University of Tübingen
Public Relations
Christfried Dornis
Director
Phone +49 7071 29-76788
Fax +49 7071 29-5566
christfried.dornis[at]uni-tuebingen.de

Janna Eberhardt
Research reporter
Telephone +49 7071 29-77853
presse[at]uni-tuebingen.de

www.uni-tuebingen.de/aktuell

Tübingen University Hospital
Communication and media
Bianca Hermle
Director
Telephone +49 7071 29-81032
Fax +49 7071 29-25024
bianca.hermle[at]med.uni-tuebingen.de

www.medizin.uni-tuebingen.de/presse

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Scientists from the University and the University Hospital have once again proved especially successful attracting Starting Grants in the recent round of awards from the European Research Council (ERC): five new projects have now been awarded this year. The Starting Grants bring with them substantial project funding. “The fact that researchers at the University of Tübingen were once again so successful in the EU-wide competition for the attractive Starting Grants is testament to their extraordinary achievements, their great innovative strength and their wealth of ideas. Three of the five grantees belong to one of our Clusters of Excellence,” said the President of the University of Tübingen, Professor Dr Dr h.c. (Dōshisha) Karla Pollmann.

The new ERC Starting Grants:

- **Junior Professor Dr. Josef Leibold**, Internal Medicine VIII
  Project: ‘EXPLOITsen’ to improve CAR-T-cell therapy in the treatment of solid tumors
- **Professor Dr. Marius Lemm**, Department of Mathematics
- Project: ‘MathQuantProp’ on mathematical investigation of propagation of information in quantum physics
- **Junior Professor Dr. Isabel Monte**, Center for Plant Molecular Biology
  Project: ‘FRIENEMIES’ on the transformation of a pathogen into a beneficial organism in the context of plant evolution
- **Dr. Claire Vernade**, ‘Machine Learning: New Perspectives for Science’ Cluster of Excellence
  Project: ‘ConSequentIAL’ to develop adaptable artificial intelligent systems
- **Dr. Florian Wimmers**, Interfaculty Institute of Biochemistry
  Project: ‘OrAIOn’ explores the interaction of cancer medications and vaccines, aiming to improve infection prevention in patients

Starting Grants can be awarded for up to 1.5 million euros over a period of five years. With its Starting Grants, the ERC provides additional funding for outstanding young scientists' research careers.

Josef Leibold – Outsmarting tumor cells for better cancer treatments

Josef Leibold. Photo: Beate Armbruster

Josef Leibold's project "Harnessing Senescence to Improve Cell-based Therapies against Cancer" (EXPLOITsen) is receiving 1.5 million euros in total over a period of five years from the ERC. He is aiming to put tumor cells into 'hibernation' mode, followed by an immune cell therapy directed against the cancer cells.

The number of new cases of cancer in Europe is expected to rise significantly in the coming years, and new treatment concepts are urgently needed. Mobilization of the body's own immune system against cancer cells is a highly-promising approach. "One specific strategy is to modify the T or NK cells genetically with chimeric antigen receptors, or CARs for short," explains Leibold. Using CARs, the immune cells detect a surface molecule on the tumor cells resulting in a specific immune response against them.

"Resounding successes have been achieved with CAR T cell therapy in hematological tumors, but not in solid tumors," he says. Tumor cells are often heterogeneous, and the immune cells struggle in the hostile microenvironment surrounding the solid tumors. With his project EXPLOITsen Leibold and his team aim to tackle precisely these challenges.

"My approach makes use of the ability to place tumor cells in a sort of hibernation, known as senescence, for use in a combination therapy. In this state the tumor cells are no longer able to divide," explains Leibold. He wants to combine the induction of this specific cell state with the actual CAR immune cell therapy. By genetic modifications, the CAR immune cells will be individually adapted to the properties of senescent tumor cells and at the same time prepared for the microenvironment of solid tumors, which is hostile to the immune system. This combinatorial approach can eventually result in efficient elimination of the tumor cells. The project has the potential to establish CAR immune cell therapy in solid tumors and to enable new treatment options for patients with hard-to-treat cancerous diseases.

Contact:
Junior Professor Dr. Josef Leibold
Tübingen University and University Hospital
Internal Medicine VIII – Medical Oncology and Pneumology – Functional Immunogenomics
'Image-guided and Functionally Instructed Tumor Therapies' Cluster of Excellence (iFIT)
Phone +49 7071 29-82711
josef.leibold[at]med.uni-tuebingen.de

Marius Lemm –Mathematical solutions for quantum physics models

Marius Lemm. Photo: Friedhelm Albrecht/University of Tübingen

In a thunderstorm, we see the lightning before we hear the thunder – light therefore transmits information at a higher speed than sound. This has been known for a long time. How fast information propagates in quantum many-body systems, however, still raises many questions. In his project 'The Mathematics of Quantum Propagation' (MathQuantProp), Marius Lemm wants to apply mathematical methods to investigate quantum systems which are currently of great interest in physics. He is being funded by the ERC with almost 1.5 million euros over a period of five years.

Although he is primarily a mathematician, says Lemm, he maintains close contacts with physics: "Over the past 20 years, great progress has been made in experimental quantum physics in the controlled generation of models and high-resolution measurements. I am interested in whether key statements such as those about the propagation of information in such systems can be proven mathematically." What sets the speed limit in the system? Or is there no speed limit in these models? "Answers to such questions allow us to derive certain capabilities and limitations of the systems in applications, for example for quantum algorithms," he explains. Quantum physics models are an attempt to understand the microscopic relationships in nature, which can be described from the perspective of quantum physics.

Lemm is dealing with quantum particles and phenomena such as bosons, indistinguishable particles that can move through space both bouncing and continuously. "The decisive interplay is that of intuition and the formalism of mathematics, in which you approach the goal of a proof step by step," says Lemm. The mathematical approach changes the way we think about physical problems and identify special cases. In this way, progress could be achieved through reciprocal impetus from both fields, for example, systems with unusually fast information propagation could become useful for quantum technologies.

Contact:
Professor Marius Lemm
University of Tübingen
Department of Mathematics
Tel. +49 7071 29-78563
marius.lemm[at]uni-tuebingen.de

Isabel Monte – From plant pathogen to beneficial organism along plant evolution

Isabel Monte. Photo: Friedhelm Albrecht/University of Tübingen

Isabel Monte's project stems from an unexpected discovery: the fungus (ascomycetes) *Trichoderma*, which has been used for biological control to promote growth, defense and stress tolerance of flowering plants including crops can have an entirely converse, harmful or even fatal effect on bryophytes and ferns (seedless plants). With her project "When your enemy becomes your friend: Evolution of the interaction between fungi and land plants" (FRIENEMIES) she wants to investigate *Trichoderma's* transformation from plant pathogen to beneficial organism at the molecular level. The project is being funded for a period of five years with in total 1.5 million euros.

Bryophytes and ferns have independently evolved from flowering plants for millions of years. "My team and I identified *Trichoderma* as the first known example of a fungus that has such a contradictory effect on seedless plants and flowering plants," reports Monte. Flowering plants which make up the vast majority of our crop plants have been extensively studied at a molecular level with regard to their interaction with fungi and other microorganisms. All kinds of relationships, from harmful plant parasites to mutualism, in which both the plant and the microbe benefits from living together, have been found. "Bryophytes and ferns have recently become models to study the evolution of molecular plant-microbe interactions, and are essential for our research on the molecular mechanisms underlying *Trichoderma* pathogenicity on seedless plants" she says.

Monte is planning to investigate two species of bryophytes and one fern whose genome has been sequenced, along with multiple strains of *Trichoderma* to discover the molecular basis for the pathogenic relationship between non-seed plants and fungi. "In the next step we will study the shifts in the relationship towards mutualism, which probably began with the evolutionary diversification of flowering plants 100 million years ago. Our project aims at understanding the complex and dynamic interactions between land plants and microbes during evolution." Her project is essentially basic research, however knowledge about the relationship of seedless plants to *Trichoderma* could benefit the planting of roofs with moss or controlling undesirable bryophyte growth in greenhouses, for example.

Contact:
Junior Professor Dr. Isabel Monte
University of Tübingen
Center for Plant Molecular Biology – Plant Physiology
Evolution of Plant Signaling Lab
Tel. +49 7071 29-73222
isabel.monte[at]zmbp.uni-tuebingen.de

Claire Vernade – Algorithms that adapt to dynamic environments


Claire Vernade. Photo: private

Computer scientist Claire Vernade wants to guarantee that machine learning systems are both robust and adaptable in evolving, real-world environments. Machine learning has already led to impressive developments in areas ranging from language modeling to drug discovery. However, it still lacks important capabilities: “To fully realize the potential of artificial intelligence (AI), we need systems that can autonomously adapt and remain reliable even when the data distribution changes or when faced with novel situations,” explains Vernade. Her project ‘ConSequentIAL’ (Continual and Sequential Learning for Artificial Intelligence), is receiving roughly 1.25 million euros funding over a period of five years.

This project builds on techniques developed in the field of reinforcement learning, which involves an agent – the software entity being trained – navigating an environment to reach predefined goals and being able to learn through trial and error. “My project is focused on creating AI agents that can make intelligent decisions about when and how to collect new data in order to learn about and adapt to new circumstances – an ability known as ‘exploration’ in reinforcement learning.”

Vernade wants to build theoretical foundations to combine this ability with existing machine learning models. This will enable algorithms to progressively integrate new and different data, and search for new solutions. The long-term goal is to create powerful machine learning systems that help science and society solve complex problems.

Contact:
Dr. Claire Vernade
University of Tübingen
Faculty of Science – Department of Computer Science
‘Machine Learning: New Perspectives for Science’ Cluster of Excellence
claire.vernade[at]uni-tuebingen.de

Florian Wimmers – New ways to enhance infection prevention in cancer

Florian Wimmers.
Photo: private

With his project, Organoid- and AI-based Identification of Oncology Drug-Vaccine Interactions (OrAIOn), Florian Wimmers aims to explore new ways to enhance infection prevention in cancer patients. The ERC is supporting this important research with a grant of 1.5 million euros over a period of five years.

Infectious diseases pose a significant threat to global health, with the top three alone accounting for over 12 million deaths in 2021. “Cancer patients are particularly vulnerable, as they often do not receive sufficient protection from vaccines,” explains Wimmers. This vulnerability may be partly due to the immunosuppressive effects of many cancer medications, which can weaken the immune system and potentially diminish the effectiveness of vaccines.

Together with his team, Wimmers aims to systematically investigate how cancer medications impact the effectiveness of vaccines. To achieve this, they are utilizing an innovative tonsil organoid model that replicates the vaccine response in the human body. Tonsil organoids mimic the processes that typically occur in the lymph nodes – the central hubs of the immune system. By examining the effects of a broad range of cancer medications on these organoids, the team will gain deeper insights into how the immune systems of cancer patients respond to vaccines and what specific interactions occur.

“Another key aspect of our project is the development of a Virtual Lymph node using advanced AI algorithms,” Wimmers explains. This virtual model will have the ability to predict vaccine responses that have not yet been tested in the laboratory. “This approach allows us to identify potential interactions between cancer medications and vaccines on an unprecedented scale,” he adds. Such insights could significantly accelerate the development of personalized vaccine recommendations.

Wimmers and his team will publish their findings in a comprehensive database with validated interactions between cancer medications and vaccines. In the long-term the results of this project will not only enable more precise vaccine recommendations for cancer patients but will also contribute to the development of novel and more effective vaccines for everyone.

Contact:
Dr. Florian Wimmers – Emmy Noether Research group leader
University of Tübingen
Interfaculty Institute of Biochemistry – Department of Molecular Medicine – Systems Immunology Lab
‘Image-guided and Functionally Instructed Tumor Therapies’ Cluster of Excellence (iFIT)
Phone: +49 7071 29-74175
florian.wimmers[at]uni-tuebingen.de
https://thewimmerslab.com