

ERC Advanced Grant for HITS group leader



Astrophysicist **Friedrich Röpke**, head of the Physics of Stellar Objects (PSO) group at HITS, has been selected to receive a prestigious scientific grant: The European Research

Council (ERC) awarded him an ERC Advanced Grant of €2.5 million for his project ExCEED. Röpke's proposal is one of only 13.2% of projects that were selected for funding. "We are very happy for Fritz and proud of this success story," stated HITS Scientific Director **Tilmann Gneiting**, "because ERC grants reflect high quality research, and now, researchers in six of thirteen groups at HITS work on or participate as beneficiaries in ERC grants."

Friedrich Röpke studied Physics at the University of Jena and the University of Virginia, Charlottesville/USA, and received his PhD in 2003 from the Technische Universität München. After postdoc stays in Germany and the U.S., he became leader of an Emmy Noether research group at the Max Planck Institute for Astrophysics in Garching. Three years later, he got appointed professor of astrophysics at the University of Würzburg. Since 2015, he has served as Group Leader at HITS and, at the same time, professor of astrophysics at Heidelberg University.

Friedrich Röpke and his group perform three-dimensional hydrodynamic simulations to improve our understanding of physical processes in stars. In the ExCEED project ("Explaining Common-Envelope Evolution and Dynamics in binary stellar systems"), he explores the enigmatic common-envelope phase in binary stellar evolution: When the primary star in a close binary system evolves into a giant, it can engulf its companion. The core of the giant star and

the companion then orbit each other inside a common stellar envelope and transfer orbital energy onto it. Their orbital separation shrinks and the envelope is eventually ejected. This leaves behind a close binary of two stellar cores – the progenitor of many fascinating objects in astrophysics such as supernovae and gravitational-wave emitting mergers of compact objects. Despite its importance for many branches of astrophysics and astronomy, the physical mechanism of this common envelope evolution remains poorly understood, which leads to large uncertainties in the modeling of binary stars. Closing this fundamental knowledge gap in stellar evolution theory is the goal of the ExCEED project.

The ERC is the premier European funding organization for excellent frontier research. It offers four core grant schemes, with the ERC Advanced Grant supporting established, leading principal investigators to pursue ground-breaking, high-risk projects.



Via Data

The HITS blog can be found on the "Scilogs" portal at <https://scilogs.spektrum.de/via-data/>.

HITS

Klaus Tschira Guest Professors at HITS

The Klaus Tschira Guest Professorship Program aims to promote international exchange and scientific collaboration at HITS. Since last year, HITS has invited international

renowned researchers for a sabbatical or a longer research stay. This year, two U.S. scientists are at the Institute: chemist **Olexandr Isayev** (Carnegie Mellon University), who works closely with the CCC group (led by **Ganna "Anya" Grynova**) and participated in the SIMPLAIX workshop in early May. And

astrophysicist **Philipp Podsiadlowski** (University of Oxford, see "Beyond the limits"), who researches and publishes together with the SET group (led by **Fabian Schneider**).

HITSters won poster prize

Jannik Buhr and **Eric Hartmann** (both MBM) have won the poster prize at the Computer Simulation and Theory of Macromolecules Workshop held in Hünfeld, Germany. They presented their work on the "KIMMDY 2.0, Kinetic Monte Carlo Reactive Molecular Dynamics Framework".



New employees and visiting scientists

Postdoc:

Master students:

Administration:

IT Services:

Visiting scientist:

Klaus Tschira Guest Professors:

HITS Journalist in Residence:

Marc-Oliver Pohle (CST), Jie Yu (TOS)
Johanna Buck, Christina Goß (both MBM)
Jessica Herbert (Accounting Assistant)
Christiane Luttermann (Team Assistant)
Jaewoon Jung (RIKEN Center, Kobe, Japan)
Olexandr Isayev (Carnegie Mellon University, USA), Philipp Podsiadlowski (University of Oxford, UK)
Anil Ananthaswamy (USA, India)

HITS groups (06/2023): Astrominformatics (AIN), Computational Carbon Chemistry (CCC), Computational Molecular Evolution (CME), Computational Statistics (CST), Data Mining and Uncertainty Quantification (DMQ), Groups and Geometry (GRG), Machine Learning and Artificial Intelligence (MLI), Molecular Biomechanics (MBM), Molecular and Cellular Modeling (MCM), Natural Language Processing (NLP), Physics of Stellar Objects (PSO), Scientific Databases and Visualization (SDBV), Stellar Evolution Theory (SET), Theory and Observations of Stars (TOS).

HITSters

As they live and breathe: Long-chain fatty acids in cellular respiration

They are tiny and highly efficient energy factories operating inside our cells. Often referred to as 'powerhouses', mitochondria extract most cellular energy from nutrition. HITS researchers, together with colleagues from the University of Oulu (Finland), and the University of Warsaw (Poland) have now succeeded in demonstrating how long-chain

fatty acids regulate the amount of energy drawn in this process called cellular respiration. The discovery is ground-breaking as the importance of long-chain fatty acids produced by mitochondria in cellular respiration had not been previously known and the results open up a completely novel approach. "This information helps us understand diseases that involve impaired mitochondrial function and cellular respiration much better than before," says M. Tanvir Rahman (University of Oulu), the lead author on the paper published in

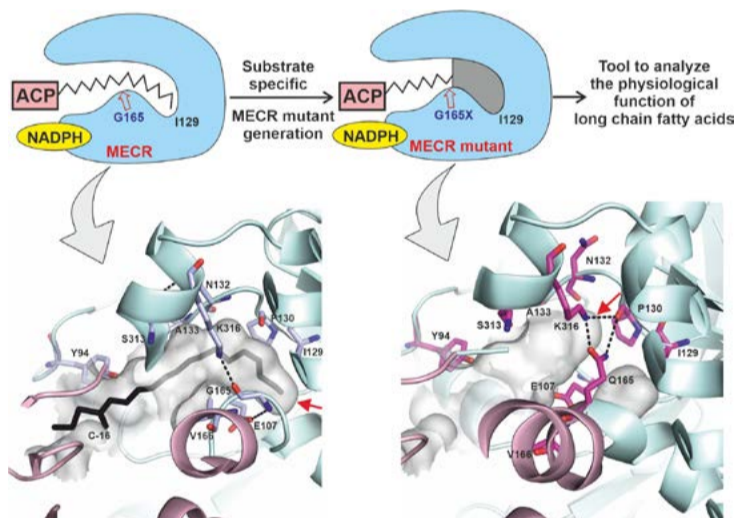
Nature Communications.

The study is part of a more extensive research project investigating the connection between cellular respiration and the cell's nutritional state. The scientists used a protein engineering method, in which the mutants of the so-called MECCR enzyme involved in mitochondrial fatty acid

synthesis were designed using computational molecular modeling, along with structure determination by crystallography, and other experiments to validate the predictions.

The experiments in this interdisciplinary study were carried out by biochemists and crystallographers from the Faculty of Biochemistry and Molecular Medicine of the University of Oulu and Biocenter Oulu, while the molecular modeling was done by computational biophysicists from HITS and the University of Warsaw. "This study really demonstrates the value of combining computational and experimental approaches to reveal complex biomolecular mechanisms," says **Rebecca Wade** (Molecular and Cellular Modeling group). The study has received funding from the Academy of Finland, the Sigrid Jusélius Foundation, the Jane and Aatos Erkko Foundation, the Mary and Georg C. Ehrnrooth Foundation, Finnish Cultural Foundation, the Klaus Tschira Foundation, the Polish National Science Centre, and the BIOMS Center for Modelling and Simulation in the Biosciences at Heidelberg University.

Tanvir Rahman, M., Kristian Koski, M., Panecka-Hofman, J. et al. An engineered variant of MECCR reductase reveals indispensability of long-chain acyl-ACPs for mitochondrial respiration. *Nat Commun* 14, 619 (2023). <https://doi.org/10.1038/s41467-023-36358-7>



Research

Beyond the limits - Philipp Podsiadlowski, Klaus Tschira Guest Professor



Outside his office window lies the lush, spring green part of the HITS garden, with redwoods, copper beeches and maples. "I've been here several times, but now I am happy to spend a longer time in this stimulating atmosphere", says **Philipp Podsiadlowski**, an astrophysicist with a record of three decades in star evolution research and former professor at the University of Oxford. "And this program is more

organized than in other places I have been before because the dynamics come from the host", the native German says. He arrived at HITS at the beginning of May, as one of the two Klaus Tschira Guest Professors in 2023 (see "HITSters").

Since 2022, the Klaus Tschira Guest Professorship Program aims to enhance international exchange and scientific collaboration at HITS. Internationally renowned scientists are invited for sabbaticals or extended research stays. They collaborate with scientists at HITS, develop joint research projects, and engage with the wider scientific community at the institute and in the Heidelberg region.

Philipp Podsiadlowski is spending his stay to refresh long-standing collaborations with the SET group led by **Fabian Schneider** and the PSO group led by **Friedrich Röpke**. "We have several ongoing projects and started new ones since I have arrived", he says. His main focus now is on how massive stars "die" and on the so-called common envelope evolution of binary star systems – an important problem in astrophysics that is still poorly understood. "Moreover, I am working with SET researchers **Eva Laplace**

and **Vincent Bronner** in a new project on different types of supernovae that could be connected to the same progenitor."

In May, Podsiadlowski gave a talk at the HITS colloquium on how stars end their lives, met researchers from other groups and had conversations over lunch with HITS Scientific Director **Tilmann Gneiting**. He has split his stay in two parts, leaving in June to spend some time for scientific meetings and workshops in the UK, the U.S., and Germany. He will return to HITS in October, when he will visit other institutes in Heidelberg and give a colloquium at the University.

"I want to understand the physics of stars and the 'cold cases' of astronomy, problems that have not been solved for decades", he says. "With more compute power, we have the chance to deal with these problems, and computational research like that performed at HITS is very valuable for my goals." Meanwhile our own star, the Sun, has bathed the garden in a silvery light. "This institute allows scientists to grow and build up strong groups", he resumes. "It's a great place to do research."

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Beyond the limits



The Charts