Astronomy Award for HITS researcher Fabian Schneider

Astrophysicist **Fabian Schneider**, head of the junior group "Stellar Evolution Theory" (SET) at HITS, has received the Ludwig Biermann Award of

the Astronomische Gesellschaft (AG), the professional German national association of astronomy and astrophysics. The AG promotes activities in science and research, fosters the exchange of information between its members, and supports the dissemination of science to the public and through education. The Ludwig Biermann Award is granted in recognition of outstanding young astronomers. This year's award recognizes Fabian Schneider for his work in studying the evolution of massive stars, binary stars, and supernovae, which has led to numerous and widely cited publications. "In addition, his research achievements and pioneering projects have enabled him to compete for several prestigious grants, and he is considered an internationally recognized expert in his field," the AG stated.

"This prize fills us with great joy as it adds to the series of awards that Fabian Schneider has already received," says HITS Scientific Director **Frauke Gräter**. Fabian Schneider has spent his career investigating the turbulent lives of massive stars. The astrophysicist conducted research as a "Hintze Research Fellow" at Oxford University after earning his doctorate in Bonn, received a postdoctoral research fellowship at Christ Church College (also in Oxford), and then joined the Center for Astronomy at Heidelberg University as a Gliese Fellow. While in Heidelberg, Schneider was also a visiting scientist at HITS in the PSO group headed by Friedrich Röpke. Last year, he was awarded an ERC Starting Grant by the European Science Council ERC. With funds of about 1.5 million euros, he has been building his own junior research group at HITS since January 2021.

Binary massive stars: Cosmic powerhouses

Astrophysicists are particularly interested in massive stars. These stars are cosmic powerhouses that explode in spectacular supernovae and leave behind some of the most exotic forms of matter: neutron stars and black holes. Mergers of neutron stars and black holes are now routinely observed thanks to gravitational-wave observatories. But there are still a lot of questions that remain unanswered.

Together with his group, Fabian Schneider is investigating these questions with a particular focus on binary stars. These stars form the vast majority of all massive stars. During their lifetime, they can reach a stage during which their outer layers are transferred onto a companion star. This mass transfer profoundly changes the evolution of both stars and even leads to the merger of both binary components in about 25 percent of massive stars.

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

HITS

HITS researcher appointed as Schiemann Fellow of the Max Planck Society

Ganna (Anya) Gryn'ova, head of the Computational Carbon Chemistry (CCC) group at HITS, has been elected a Schiemann Fellow of the Max Planck Society. The program fosters the careers of excellent female scientists. The Elisabeth-Schiemann-Kolleg includes mentoring, networking, scientific exchanges, and regular plenary meetings. Ganna Gryn'ova is one of five fellows who have been admitted to the Kolleg this year.

Within the Elisabeth-Schiemann-Kolleg, scientific members of the Max Planck Society foster the careers of excellent female scientists after their postdoc phase and help them succeed on their path to becoming a tenured professor or a director of a research institution. The support of the Elisabeth-Schiemann-Kolleg is non-material in nature (i.e., the fellows are not supported financially).

HITSters in the "City Cycling Challenge"

In July, the "City Cycling Challenge" took place, a Germany-wide campaign aimed to draw greater attention to cycling in the public discourse and to improve the local cycling infrastructure in general. In Heidelberg, more than 1,700 local participants cycled 361,825 km. The HITS cycling team with team captain **Stefan Richter** (MCM) achieved an impressive 19th rank out of 78 participating teams. In the category kilometers per person they even ranked 6th with 299 kilometers per cyclist. The Team also saved more than 700 kg of Co_2 this way.

New employees and visiting scientists

CCC: Stiv Llenga, doctoral student
CME: Anastasis Togkousidis, scholarship holder; Xinyi Zhang, master's student
CST: Ghulam Abdul Qadir, postdoc; Melanie Schienle, visiting scientist (KIT Karlsruhe, Germany)
NLP: Wei Liu, scholarship holder
PSO: Marco Vetter, Freyja Walberg, master's students

HITS groups 09/2021: *Astroinformatics (AIN), Computational Carbon Chemistry (CCC), Computational Molecular Evolution (CME), Computational Statistics (CST), Data Mining and Uncertainty Quantification (DMQ), Groups and Geometry (GRG), 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

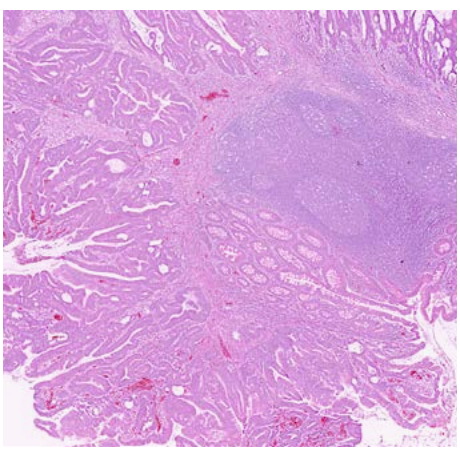
Mathematical Oncology: Exploring the Origin of Colon Cancer

Colon cancer is one of the most-common forms of cancer worldwide. The processes during cancer initiation, however, remain clinically obscure. In two studies, HITS researchers **Saskia Haupt** and **Vincent Heuveline** (both DMQ) together with colleagues from Heidelberg and Leipzig modeled the biological processes of early colon-cancer development using computer simulations. The simulations helped to unravel the otherwise-unseen process of cancer formation. The research results were published in "PLOS Computational Biology" and "Computational and Systems Oncology."

"We focused on the most-commonly inherited colorectal cancer syndrome – Lynch syndrome – and examined its development on two different scales," explained Saskia Haupt, first author of the two studies. In the first project, the team developed a mathematical model for computing different molecular pathways of carcinogenesis using medical datasets. The model is based on ordinary differential equations and uses what is known as the "Kronecker product," which allows for precise mathematical analysis of data and subsequent medical interpretation. The results of the recent computations are consistent with current clinical tumor data and can thus provide important clues about the different stages of cancer formation. The new approach can also be applied to other organs in the future with some modifications.

In the second study, the scientists more-closely examined the origin of colorectal cancer. The human colon consists of several million cells that divide rapidly. Mutations can occur that occupy an entire colonic crypt – a mucosal cavity with an accumulation of over one thousand cells in the colon wall. The individual mutated crypts can then develop into cancer. The research team created a computational model to simulate these mutational processes within a colonic crypt on a computer.

The simulations revealed that mutations in an active stem cell almost always take over the entire colonic crypt within a few weeks. However, when a mutated stem cell is replaced by a non-mutated stem cell, it is possible for the previous mutation to disappear (at least partially) from the crypt due to cell renewal. Stem-cell replacement could thereby explain why some mutant crypts do not further develop into cancer. The study thus supports the assumption that cancerous tissue alterations in Lynch syndrome can regress spontaneously.



Haupt S, et al. (2021) Mathematical modeling of multiple pathways in colorectal carcinogenesis using dynamical systems with Kronecker structure. PLOS Computational Biology 17(5): e1008970. doi.org/10.1371/journal.pcbi.1008970

Haupt S, et al. (2021): A computational model for investigating the evolution of colonic crypts during Lynch syndrome carcinogenesis, Comput Syst Oncol. 2021; DOI: 10.1002/cso2.1020

Research

Behind the Science: KIT

Last year, we introduced the teams that make life more pleasant and enjoyable for researchers at HITS "behind the scenes." Now, it is time to shed light on the board that makes the existence of the Institute possible through its work "in the background": the HITS shareholders. In this issue, the Karlsruhe Institute of Technology (KIT) takes center stage with its representative, **Hanns-Günther Mayer**.

Mr. Mayer, how did KIT become a shareholder of HITS?
Our close cooperation began with the joint appointments of Alexandros Stamatakis in 2012 and Tilmann Gneiting in 2013. With the articles of association drafted in November 2014, this cooperation gained legally solid and sustainable footing. Since then, KIT has been a shareholder, with a voting share of 15 percent.

What is KIT's interest in being formally associated with HITS as a shareholder?
As the only German University of Excellence that conducts national large-scale research, we combine excellent teaching with cutting-edge research and innovation. As an internationally renowned interdisciplinary institute, HITS is an ideal partner for us to work with on some of our central tasks. A good example is the "COVID-19 Forecast Hub," which KIT professor Melanie Schienle established together with Tilmann Gneiting and his group at HITS.

How and where can KIT and HITS benefit from each other?
Both institutes benefit from joint appointments: We gain excellent scientists who are also simultaneously professors at KIT as HITS group leaders, thereby enabling them to integrate students and doctoral candidates into their research projects. HITS, on the other hand, benefits from the steady stream of young talent. Speaking of which, we have just completed the appointment process for a junior professorship in Machine Learning, which is connected with a group-leadership position at HITS. If everything goes smoothly, we will be able to fill the position this year.

What makes HITS so exciting for you?
For me, it is exciting to help shape a privately financed, multidisciplinary research institute in the spirit of the founder, Klaus Tschira, and to participate in the shareholders' meeting as a supervisory and steering body. Being able to work with absolute research freedom is a great opportunity for the working scientists but poses a great challenge at the same time. As a representative of KIT in the shareholders' meeting, I have the opportunity to follow the research priorities set by the group leaders, to support these leaders in their selection, and thereby to participate in the long-term, future-oriented development of HITS.

Imprint | Dr. Peter Saueressig (V.i.S.d.P.), saueressig@h-its.org, Tel. +49 6221 533 245 | Pictures: HITS, Annette Mück, ATB Heidelberg | www.h-its.org

Behind the Science