Habitable: More than just a game

What makes a planet habitable? How do you keep it habitable, how do you develop life, and what strategic decisions put it in danger? Members of the HITS research group "Stellar Evolution Theory" have tackled these existential questions to playfully test the habitability of planets. The result is a board game that combines astronomy and the climate crisis. The international team was awarded a prize for the idea in a competition for the German Science Year "Our Universe." They received funding of 10,000 euros to implement their idea. The scientists first acquired theoretical knowledge about the design, structure and possibilities of board games in a workshop with an experienced game developer. Then they developed "Habitable" step by step with game test events at HITS and elsewhere. The target groups for Habitable, in which players can explore exoplanets and create a habitable planet, are families, game fans, astronomy enthusiasts and educators, who have been able to test the game extensively during various events organized by the team and have repeatedly provided valuable suggestions for improvement through their feedback. The online version is now available worldwide on the "Tabletopia" platform and can be played free of charge for one year. The prototype of the board game will be completed soon and presented at a final event at the end of the year.

"Just one year after the initial idea, we are happy and relieved to have reached the home stretch," says **Eva Laplace**, on whose idea the game is based. The other team members are **Vincent Bronner**, **Jan Henneco**, **Rajika Kuruwita**, **Julian Saling**, **Simon Speith**, **Duresa Temaj**, and **Dandan Wei**.

"Habitable" is a strategy game for three to five players, the aim is to make planets sustainably habitable and to enable and develop life on them. Whoever achieves the most "life points" at the end is the winner. What distinguishes "Habitable" from many other board games is that it is based entirely on scientific findings – from astronomy, but also from climate research.

Online Game on Tabletopia: https://tabletopia.com/games/habitable

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

HITS

Prestigious award for Tilmann Gneiting

CST group leader and current HITS Scientific Director **Tilmann Gneiting** receives the 2024 Ulf Grenander Prize by the American Mathematical Society (AMS). With the prize that is awarded every three years, the AMS recognizes exceptional theoretical and applied contributions in stochastic theory and modeling. "Gneiting's foundational work on statistical post-processing for numerical weather forecasts provides the basis for current practice worldwide", the AMS state in their official announcement. The prize will be awarded at the Joint Mathematics Meetings in San Francisco in January 2024.

The 2nd HITS Independent Postdoc

Since October 2023, **Fabian Grünewald** is the second fellow of the HITS Independent Postdoc program. The program offers an opportunity for highly talented young scientists wanting to transition from PhD student to junior group leader. Born in Germany, Fabian studied chemistry at the University of Groningen, The Netherlands, and received his Ph.D. with distinction in physical/computational chemistry in 2023. Fabian's research interests focus on the in-silico design and understanding of polymeric materials at the interface of biology and traditional material science by means of computer simulations.

New employees and visiting scientists

HITS Independent Postdoc:	Fabian Grünewald
PhD students:	Riccardo Beccaria (MCM), Iliana Cortes (HITS Scholarship, AIN), Isabel Gernand (DMQ), Gregor Lauter (CCC), Luise Häuser (HITS Scholarship, CME)
Master students:	Benjamin Barth (MLI), Max Heller (SET), Steven Schürstedt (MLI), Nicolas Wolf (MBM), Anastasiya Kapinskaya (TOS)
Visiting scientists:	Robert Fisher (PSO, University of Massachusetts/Dartmouth), Sebastian Müller (AIN, Heidelberg University)

HITS groups (12/2023): *Astroinformatics (AIN), Computational Carbon Chemistry (CCC), Computational Molecular Evolution (CME), Computational Statistics (CST), Data Mining and Uncertainty Quantification (DMQ), 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

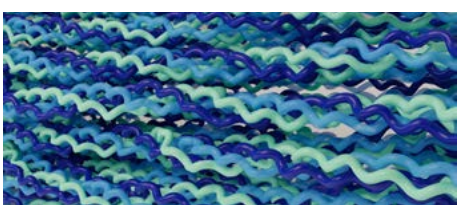
The sacrifice within – how collagen's weak bonds help protect tissue

One of the more unusual ways objects can increase longevity is by sacrificing a part of themselves: From dummy burial chambers used to deceive tomb raiders, to a lizard's tail breaking off to enable its escape. Sacrificial parts can also be found within collagen, the most abundant protein in our bodies. Scientists of the Molecular Biomechanics group (MBM) at HITS have revealed how the rupture of weak sacrificial bonds within collagen tissue helps to localize damage caused by excessive force, minimize negative impacts on the wider tissue, and promote recovery. Their work was published in *Nature Communications* and *Angewandte Chemie*, international edition.

"Collagen's remarkable crosslink chemistry appears to be perfectly adapted to handling mechanical stress," explains MBM group leader **Frauke Gräter**. "Our findings indicate that weak bonds within the crosslinks of collagen have a strong propensity to rupture before other bonds. This serves as a protective mechanism."

Collagen comprises roughly 30 percent of all proteins in the human body. Structurally, it resembles a triple-braided helix: Three chains of amino acids intertwine to form a strong and rigid backbone. Each collagen fibre contains thousands of individual molecules that are staggered and bound to each other by crosslinks, contributing to collagen's mechanical stability. "It was thought that collagen crosslinks are susceptible to rupture, however little was known about the specific sites of bond ruptures", says group member **Benedikt Rennekamp**, a co-author of the study.

Introducing the first HITS wet lab
The HITS scientists aimed to unravel these puzzles with complementary computational and experimental techniques: They used computer simulations of collagen across multiple biological scales and under different mechanical forces. And they validated their findings via gel electrophoresis and mass spectrometry experiments conducted on rat tails, flexors, and Achilles tendons. To directly put predictions from simulations to test, the MBM group opened the first HITS wet lab, hosted at INSEAM, Heidelberg University. Led by postdoc **Markus Kurth**, team members



Andrea Sassoli, **Nuriza Suleimenova** and **Aysecan Ünal** determine the extent of ruptures in stretched collagen and the consequences to the tissue. "Collagen translates mechanical stress into controlled rupture, creating radicals, a particular species of chemicals that is known to form in stretched polymers and can signal damage to the tissue", says Frauke Gräter. "We have only just started to understand how the collagen in connective tissues such as tendons and other mechanosensing proteins translates force into biochemical reactions."

Rennekamp B., Karfusehr C., Kurth M. et al. Collagen breaks at weak sacrificial bonds taming its mechanoradicals. Nat Commun 14, 2075 (2023). https://doi.org/10.1038/s41467-023-37726-z

Kurth M, Barayeu U, Gharibi H, Kuzhelev A, Riedmiller K, Zilke J, Noack K, Denysenkov V, Kappl R, Prisner TF, Zubarev RA, Dick TP, Gräter F (2023). DOPA Residues Endow Collagen with Radical Scavenging Capacity, Angew. Chem. Int. Ed. 2023, e202216610

Research

Beyond the limits – Anil Ananthaswamy, HITS Journalist in Residence 2023

He started in April 2023 and stayed for 6 months: Indian-American science journalist Anil Ananthaswamy was the 11th HITS Journalist in Residence. During this time, he provided an internal seminar for HITS researchers and gave a public talk on "ChatGPT and its ilk". He also explored the scientific environment in Heidelberg and Germany. Shortly before his departure, he gave a video interview for the institute's social media channels, revealing his thoughts and impressions about HITS, Heidelberg, and Germany.

Why did you apply for the program?
I heard about the program from Eva Wolfangel who was a colleague of mine at the MIT Knight Science Journalism Fellowship in 2019/2020. When I looked at the program, I was very impressed by the fact that the program did not require the Journalist in Residence to write about the research happening at HITS. They were really respecting the ethics of journalistic independence and that was very important. Also, when I looked at the research groups, there was one particular research group on Astroinformatics and another one on AI and ML that were both topics of great interest to me. Basically, because of those reasons I decided to apply.

What were your main projects at HITS?
Before I came to HITS, I had just finished the draft of my book on the mathematics of machine learning. I wanted to write some code to be able to explain the simple algorithms and math that is described in the book. And that's what I've been working on. Also, I learned a lot about generative AI, because I had to moderate a session on generative AI at the Heidelberg Laureate Forum. Those two have been my main projects here.

Who or what inspired you at HITS?
*I think the two people who come to mind are **Kai Polsterer**, the head of the Astroinformatics group, and **Jan Stühmer**, the group leader for the AI and ML group. I had wonderful, animated, and engaging conversations with them. I also worked with Jie Yu who was a postdoc in **Saskia Hekker's** group. All these people, the conversations and the work were very inspiring.*

What's your message to future Journalist in Residence candidates?
My message for anyone who is coming here as Journalist in Residence would be to think in advance and deeply about how you are going to utilize these 3-6 months. It's a very nice place to work. Also, Germany is a very easy place to get around, despite the delays in train travel. It's a great opportunity to plan on giving talks or visiting labs elsewhere in the country.

What will you miss most about HITS?
HITS is a wonderful institute. I'll really miss the peace and quiet of this place to be able to think deeply about things that you are working on. I will also miss Heidelberg. It's a wonderful city.

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Beyond the limits

HITS

The Charts

Ausgabe 4 /2023