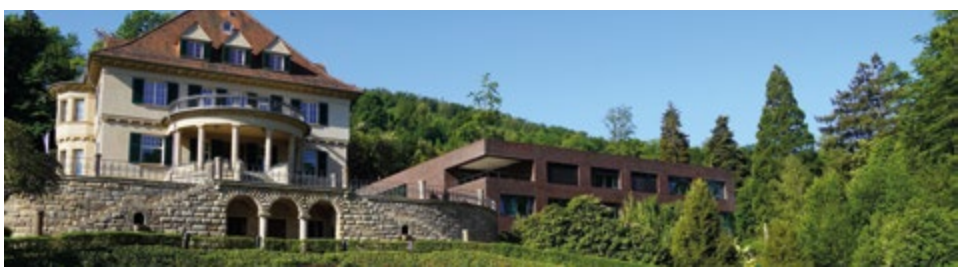
HITS during corona times

This year should have been a time to celebrate, but unfortunately, the pandemic put a stop to all the plans we had made: We have been forced to postpone the events for our 10th anniversary year, and like many other institutes, we have had to cancel already-planned outreach activities and public talks. So what is it that HITS researchers are doing during corona times? Exactly what you would expect: They are doing research on "corona." The HITSters are helping to combat the virus with software tools and methods. Moreover, they are participating in large-scale projects designed to map the disease and collect all necessary data for the scientific community.

Rebecca Wade and the Molecular and Cellular Modeling group are collaborating on potential drugs for treating SARS-CoV-2, the virus that causes COVID-19. The researchers are searching for the molecular "Achilles heel" of the virus via their established computational methods. They have been awarded supercomputing time for their research focusing on certain molecules that could impact the treatment of the viral infection (see "HITSters").

Wolfgang Müller and the Scientific Databases and Visualization (SDBV) group are playing a key role in the data management of several international and national projects related to SARS-CoV-2. The researchers are contributing to the "COVID-19 disease map," an international effort to explore the molecular processes underlying the virus–host interactions in the disease. The consortium includes 196 contributors from 31 countries. The HITSters are contributing to the project by providing the SEEK software suite for scientific data management in the life sciences. Moreover, SDBV member **Martin Golebiewski** is also working in the RDA COVID-19 Clinical Subgroup of the international Research Data Alliance (RDA), a group of about 80 scientists from all around the world.



All these endeavors are being pursued by people who are accustomed to working with and providing computational methods and tools. HITSters have thus been very busy during corona times – times when data-driven and computer-based research can be performed virtually risk-free.

Via Data
The HITS blog for its 10th anniversary year can be found at https://scilogs.spektrum.de/via-data/.

HITS

Supercomputing time for HITS research against COVID-19

Rebecca Wade (MCM) was awarded 3,250,000 core hours on the Marconi cluster at Cineca, one of the largest computing centers in Europe, for the research project "DyCoVin – Interactions and dynamics of SARS-CoV 2 spike-heparin complex."

The goal of the project is to pinpoint the role of certain molecules involved in the process of SARS-CoV2 infection by using realistic computer simulations. The researchers aim to characterize the structure and dynamics of putative binding patches for heparin-like compounds on the spike receptor. This approach could impact the treatment of the viral infection because heparin is also used in the treatment of other lung diseases, with recent clinical trials suggesting that inhaled heparin is beneficial and safe in the treatment of lung diseases. The project is being pursued in collaboration with HITS visiting scientist **Giulia Paiardi** (MCM) and her tutor, Marco Rusnati (University of Brescia, Italy).

New employees and visiting scientists

AIN: Jan Plier, postdoc
CST: Johannes Bracher, visiting scientist (KIT Karlsruhe, Germany)

HITS groups (06/2020): *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).*

HITSters

Stretched beyond the limits

It is a common phenomenon we know from cracked sneakers and burst tires, and when it occurs it is usually in the wrong place at the wrong time: worn-out materials can cause anything from mild annoyance to fatal accidents. But while fatigue is well understood in synthetic materials, we know much less about such processes in mammalian tissue, An international team led by HITS group leader **Frauke Gräter** (Molecular Biomechanics, MBM) has now shown that mechanical stress can similarly deteriorate collagen tissue. The findings, published in *Nature Communications*, might help to advance material research and biomedicine.

Synthetic polymers subjected to mechanical stress generate mechanoradicals by rupture of chemical bonds. But could these harmful and highly reactive radicals also form in our tissues when stretched? HITS scientists tackled this question by taking a closer look at collagen, the protein that provides structural and mechanical stability to all our connective tissues, including bones, tendons, ligaments, and skin. "It is under perpetual mechanical load and as such the perfect candidate", says Frauke Gräter. Together with colleagues from Homburg, Frankfurt and Seattle, Gräter's team showed in a series of especially devised experiments that excessive mechanical stress on collagen produces radicals that are known to cause damage and oxidative stress in the body.

"We managed to mount and pull a rat tail fascicle directly in the Electron-paramagnetic resonance cavity to monitor radical formation due to force in real time", explains first author **Christopher Zapp** (MBM) the experimental set-up. Additional Molecular Dynamics simulations helped to explain the observations: Chemical bonds break when collagen is stretched, but the resulting harmful radicals are quickly scavenged by nearby aromatic residues. "Not only did we find stable radicals in collagen tissue, but we also discovered so-called DOPA residues in collagen, a modification that protects collagen against further damage." The DOPA radicals then finally convert into hydrogen peroxide, an important oxidative molecule. Collagen is therefore not only a mere bearer of force; indeed, it can also control its consequences.

The study suggests that collagen has evolved as a radical sponge to combat damage. "We have shown that collagen protects itself from the radicals. Still, stretching this mechanism beyond its limits can eventually lead to oxidation-mediated pathologies from pain to inflammation", explains co-author and HITS alumna **Agnieszka Obarska-Kosińska**.

Zapp, C., Obarska-Kosińska, A., Rennekamp, B. et al. Mechanoradicals in tensed tendon collagen as a source of oxidative stress. Nat Commun 11, 2315 (2020). https://doi.org/10.1038/s41467-020-15567-4.

Research

Behind the Scenes: The HITS Garden

The meeting place: the rhododendron grove, a wall as high as a house made entirely of flowers in brilliant purple hues. "Nature designed this place," **Andrea Baumgärtner** says with a smile. She is here with her colleagues, **Markus Kohlbecker** and **Milan Bašić**, all of whom work for "KT Abrechnungsdienste" and together make up the garden team for the HITS campus and the Villa Bosch. Our interview constitutes the next chapter in our series "Behind the Scenes," which sheds light on the teams that make life at HITS so much better in one way or another.

What is the everyday life of the garden team like?
AB: *We begin at 7:30 a.m., but in the summer or on snowy winter days, we begin as early as 6:00 a.m.*
MK: *First thing I do is to get behind the wheel of our compact utility machine and clean the sidewalks around the property. The machine can be used as a sweeper or a snowplow. We really work well together, which contributes to our success as a team. I mow the lawns, cut the hedges, and take care of the watering system.*
AB: *I mostly work on the planting and make sure that everything looks harmonious. We take care of 45,000 m² of land in total, 32,000 m² of which is on the HITS property alone.*

What makes a good gardener?
AB: *You really need a soft spot for the flora as well as for the fauna in the garden, so we are always happy to see tadpoles, squirrels, and grass snakes. The fire salamanders have a "nursery" on the premises. You have to respect nature: Even parasites are part of the balance and play their role.*
MK: *Take the rose bushes, for example. They are often full of lice. The ladybug larvae eat the lice. So we don't interfere with that. But we do when it comes to toad migration: There are holes in the HITS wall facing the street that the toads use to enter the property. The waterfall in the garden is only switched on after the mating season is over.*

What is something special or interesting about the garden?
MK: *The huge variety: from the historical, neo-baroque garden with its symmetrical design to the natural-growth area, which invites visitors to take a stroll.*
AB: *The garden is different every day, and there is always something new to see. And if you sit in front of the computer all day, the garden can motivate you to get you on your feet and out doing something good for your lungs, as well as your eyes.*

Do you have a favorite tree that has a special place in your heart?
MK: *Yes, it´s the tulip tree down by the pond.*
AB: *I have a special place in my heart for a lot of the plants, especially now that it's spring. But my favorite one is the little flowering dogwood near the HITS terrace.*

What do the HITSters that you run into have to say?
AB: *HITSters have been approaching us more often over the years. Some HITSters are "regular guests" at the garden and have a lot of nice things to say about it.*

What should people know about the HITS garden?
AB: *The garden has 150 trees and a lot of green areas, which absorb a lot of CO2. Even the roof of the main building is green. The idea behind the garden is to create a balance between natural growth and a planned design.*
MK: *We have planted or taken care of a lot of trees, but some of them have grown all on their own. Without our work, this place would be a forest within a few years. There used to be a hiking trail below the HITS property that is now completely overgrown.*
AB: *Apropos "overgrown": The rhododendron is a good example of what can happen if you don't intervene. It was planted 100 years ago and then simply continued to grow for many decades. That's how this magnificent grove came into being. We always think about that when we plant new things now.*

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Behind the Scenes

HITS

The Charts

2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 & 2020
10 years HITS

Ausgabe 2 /2020