CINSaT

Center for
Interdisciplinary Nanostructure
Science and Technology

Newsletter No. 9 (December 2020)

UNIKASSEL
VERSITÄT

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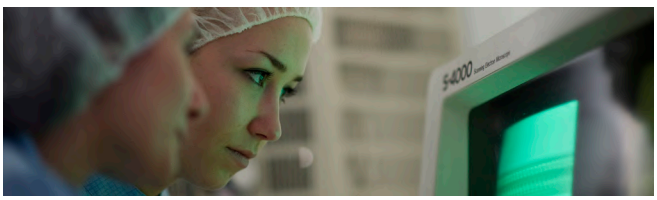

Cover image

Mostafa Aakhte (Developmental Genetics)

Live Imaging of a developing fly embryo by multi-view tiling light sheet microscopy

Preface

Welcome to the second newsletter in 2020. Although the Pandemic situation got worse in the last few months and despite all the challenges we are currently facing on due to home-office family stress, all-day video-meetings and following all the necessary rules to avoid Convid-19 infections, I would like to thank very much the article writers, who were largely motivated to spend some extra time for contributing to this issue with some interesting reports.

As usual, the issue starts with some general information from the management. There were only a few meetings, but these were of great impact. Among several changes in the membership status there was the first CINSaT internal workshop initiated by Prof. Dr. Arno Müller (focal point “Multiscale Bioimaging”) and Prof. Dr. Peter Lehman (focal point ”Photonics”). CINSaT also introduced two new supportive instruments, namely the emergency fund and a seed money program. The latter was used to support three promising projects of interdisciplinary nature. About the research topics supported by CINSaT will be reported in one of the next issues.

In the Education section the report is about the Communication School organised by the Graduate Academy, in which young scientists were introduced to various possibilities of science communication, written, rhetorical or visual. At the closing event, the Science Night (hold via Zoom), the scientists presented their acquired knowledge to the interested public. Members of CINSaT groups also took part in this program and you will find a short interview by one of the participants.

With RHODOLIVE a cooperation between the University of Kassel (Department of Biochemistry) and The University of Crete is presented. The project focuses on valorizing Olive Mill Wastewaters with microorganisms which then can be used for other applications.

In the next two sections, Prof. Dr. Georg Mayer, as a new CINSaT member, and Prof. Dr. Raffael Schaffrath introduce themselves and their research groups.

Under “Latest Reports” you can find the articles about the last CINSaT autumn colloquium and the workshops “Seeing is believing” as well as the first international LOEWE SMolBits workshop. All were held the first time by video and could be performed with great success.

“Embracing Diversity” is a new format in which early stage researchers from abroad will report about their experiences in Germany, differences to their home country and their everyday live at the University of Kassel.

We congratulate Malte Vollmer and Daqing Wang to their awards. You find more details about it in the “Awards” section. Finally, do not miss the nano arts, which was this time provided by the Technological Physics and the Developmental Genetics groups.

After enjoying reading this issue, I wish you a peaceful Christmas Holiday and a Happy New Year. Stay safe and healthy!

General

Latest information from the CINSaT Management

Here we report briefly about major issues from the CINSaT committees any major discussion results in their meetings.

(a) Steering Committee

Since the last newsletter we had several virtual meetings. The following issues can be reported:

- The executive board prepared the concept and regulations regarding evaluation of the new instruments “seed money” and “emergency fund”
- It was decided to hold the autumn colloquium in a virtual format.
- The steering committee prepared a statement for the SDG strategy of the University of Kassel.

(b) Research Coordination Committee

The committee supported the management in preparing for the autumn colloquium. The spokesmen of the focal points “Multiscale Bioimaging” and “Photonics” organised a first CINSaT internal workshop (see report on page 13 pp).
The Research Coordination Committee also helped with the evaluation of the seed money applications, a new funding format by CINSaT. After discussion in the evaluation meeting held on three applications were granted:

- “Development and application of automated computational adaptive optics methods in OCT and fluorescence microscopy” submitted by Prof. Dr. Arno Müller (Developmental Genetics - Faculty 10) and Prof. Dr. Peter Lehmann (Measurement Technology - Faculty 16)
- “Diamond-based platforms for biochemical measurements of time-resolved cell signalling” submitted by apl. Prof. Dr. Cyril Popov (Technological Physics - Faculty 10) and Prof. Dr. Friedrich Herberg (Biochemistry - Faculty 10)
- “Manufacture and modification of the properties of biopolymeric materials” submitted by Dr. Marilia Horn (Physical Chemistry of Nanomaterials - Faculty 10) and Prof. Dr. Hans-Peter Heim (Polymer Engineering - Faculty 15)

(c) Member Meeting

The last member meeting took place on 9th July 2020 via zoom. The major issues discussed were the following:

- The financial report for 2019 was presented. The CINSaT executive manager and the CINSaT speaker were released.
- Two new financial instruments within CINSaT were presented and introduced after discussion: an emergency fund to provide support for unforeseen emergency repairs of research equipment and a seed money program to support and initiate interdisciplinary projects within CINSaT.
- The associate memberships of PD. Dr. Mohamed Benyoucef and Dr. Alexander Wetzel were prolonged for three years.
- Prof. Dr. Philipp Demekhin changed status from associate to full membership.
- Dr. André Knie left the University of Kassel and thus the prerequisites for a CINSaT membership no longer apply. He has been granted Alumni status.

Additionally, two application presentations were held: PD Dr. Susanne Neupert held her presentation with the title “Neurochemical analysis of the insect brain” on 22nd of September and Prof. Dr.-Ing. Prof. H.c. Stefan Böhm held his talk during the CINSaT autumn colloquium. The title was “Influence of nanoscale structuring on cutting and joining of modern materials. The decision about both applications will be made during the next member meeting.

Education

Scientists as communicators

Two years ago, the Graduate Academy of the University of Kassel launched the Communication School project. The vision: empowering scientists to be communicators themselves.

One week different kinds of science communication

With the annual one-week further education program, which this year took place from September 23-29, the Graduate Academy enabled participants to learn more about science communication from different perspectives. From conventional workshops such as "How to write for a public audience" to voice exercises for dynamic speaking about building your own exhibits, the program offered a wide range of techniques and formats of science communication. Participants had the opportunity to put together their own curriculum with three workshops from a selection of nine workshops in total. In this way, they were able to create an individual program for their specific interests and needs in order to work out their own strategy of science communication. The daily get-togethers also introduced the participants to different formats, initiatives and institutions of science communication that already exist at the University of Kassel and beyond.

Science communication as an event

Like last year, the participants had the opportunity to prove their learned knowledge at the Science Night on November 17th and thus put together an exciting program for the public through their contributions in various formats. The entertaining evening program with presentations, videos, interactive actions and lots of first-hand knowledge attracted many interested people. Although the Science Night 2020 was held online due to the Corona pandemic, the number of visitors rose to a record of 250 compared to last year's Science Night and showed a growing interest in scientific research.

Video workshop with Ingo Knopf, NaWik (photo: Olinga OK)

Wrap it up

During the two years of the communication school, about 60 young researchers participated in the workshop weeks and learned more about different ways of science communication, connected with researchers from other disciplines and improved their skills or learned completely new ones. The communication school enabled the participants to be communicators themselves and motivated them to speak in front of a broad audience for an increasing exchange between science and the public. 21 of them used the opportunity to present their research to a public audience. About 400 spectators were thrilled by the scientists and their research at the University of Kassel, showing how valuable it is to present one's own research not only to a scientific but also to a public audience.

Get-together: SciComm at the University of Kassel (photo: Olinga OK)

Alexandra Fachinger (Science Bridge e.V.) with her talk about CRISPR/Cas

Short Interview: Dipl. Phys. Tillmann Kalas, Scientific Manager SFB1319 - ELCH

What motivated you to participate in the Communication School?
I have always enjoyed talking about physics and teaching others about the exciting phenomena we (scientists) observe. This has not changed now that it is no longer directly my own research. In addition, I want to accumulate expertise centrally in the SFB so that we can use it for our public relations projects, when needed.

Your top 3 learnings from the workshop week?
Keep sentences short and simple! Always relate and adapt to the audience. One does not need heavily priced devices for filming.

Why Science Communication? What means Science Communication to you?
Often people do have wrong expectations from science and the people doing it. These expectations originate often from their experiences in school or TV-Shows. In science communication one can correct those views and at the same time spark an interest in the material one shows. Further more and possibly more important: If scientists keep their knowledge within their own ranks or appear as a elite group, which does not share the knowledge, it will be much easier for others to steer public opinion in directions that are not really knowledge driven and advantageous for a society.

How would you describe the further education program in one sentence?
The further education program signals to early stage researchers within Uni Kassel the importance of science communication and reinforces the tendency to actually implement it in their everyday life.

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Further information
Communication School
www.uni-kassel.de/go/commschool

Science Night (Recording of the event, German only)
www.uni-kassel.de/go/sciencenight

New Projects

RHODOLIVE - Olive Mill Wastewater Biovalorization with *Rhodosporidium toruloides*

Waste products from food production, both as solid material and as wastewaters, represent an ever-growing challenge for societies all around the world and treatment of recyclable materials and contaminated industrial wastewaters with biotechnological methods has become a prospering field. The remediation of Olive Mill Wastewaters (OMWs), a by-product during the extraction process of olive oils, is a common problem particularly in the Mediterranean region. However, waste products such as phenolic compounds in the OMW can be challenging due to the high chemical oxygen demand and the related costs for the treatment of the contaminated water.

The project RHODOLIVE focuses on valorizing those OMWs with microorganisms. This biovalorization process aims for the simultaneous decontamination of toxic waste and the production of added value compounds. OMW phenolics as oleuropein, tyrosol, or *p*-coumaric acid exhibit a detrimental effect on plants and animals if released into the environment. Yet, certain organisms as the oleaginous and carotenoid producing yeast *Rhodosporidium toruloides* thrive on this wastewater. At the same time, some metabolic products of *R. toruloides* are considered highly valuable for agricultural, food, and pharmaceutical industry.

RHODOLIVE is an interdisciplinary project funded by ERA CoBioTech and consists of seven partners from six European countries. The partners also collaborate with specialists like Prof. I. Pavlidis, University of Crete, a former junior group leader of University of Kassel. Each partner contributes special expertise and Figure 1 outlines the general workflow of the project.

The Düzen company (Turkey), coordinator of this project, cultivated different strains of *R. toruloides* on OMW for several years prior to the start of the project. The strains adapted to this selective pressure and developed a higher tolerance for phenolic compounds. Based on this tolerance, a fermentation process of OMW in a bioreactor system was established.

Data of both the biomass production and dephenolisation of the fermented OMW are used by partner University of Latvia for a stoichiometric metabolic modeling approach. In a close collaboration with University of Kassel, the fermentation is optimized according to the predictions, and in return, new data for the model are generated. The optimizations consist of changes in cultivation conditions and identifying and manipulating metabolic bottlenecks using molecular biology. Figure 2 schematizes this process for the carotenoid production (lower half) and the provision of raw material as acetyl-CoA for this pathway, exemplarily with *p*-coumaric acid as carbon source (upper half). The ensuing extraction and analysis of phenolic compounds and

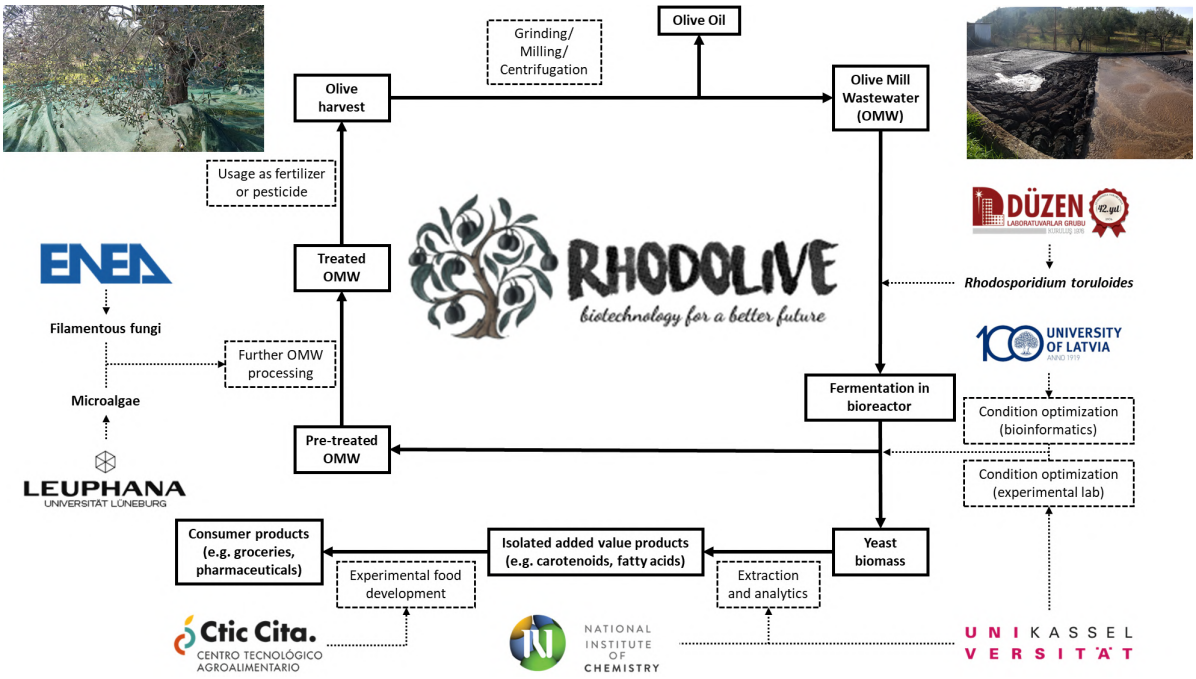

Figure 1: General workflow of the RHODOLIVE project.

carotenoids from the biomass is performed with the National Institute of Chemistry (NIC, Slovenia), whose focus is the provision of optimized protocols for HPLC analysis.

The isolated products are used by partner Ctic Cita in Spain in the development of enriched food products such as pasta doughs, which are then optimized according to customer demands. Aside from the biomass, the pre-treated OMW can be further processed by suitable microalgae and fungi identified by partner Leuphana University Lüneburg and the Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA), respectively. The treated OMWs might be used as a fertilizer or even pesticide on olive plantations and are currently tested by Düzen in cooperation with local olive agriculturists.

Further information

Website https://www.rhodolive.com

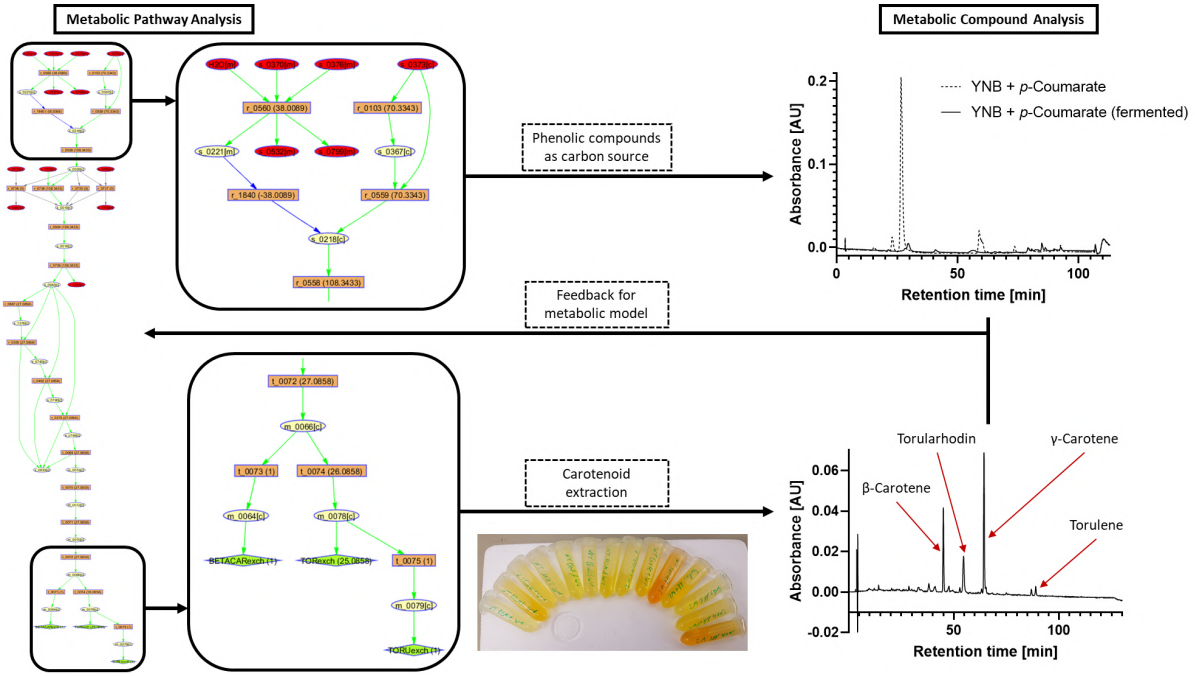

Figure 2: From stoichiometric metabolic modeling to metabolic compound analysis. Phenolic compounds are used as carbon sources in *R. toruloides* cultivation according to model recommendations. Simultaneously, end products as carotenoids are extracted from the grown biomass. Fermentation success and generated products are analyzed via HPLC and results are fed back into the model.

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New Members

Prof. Dr. Georg Mayer

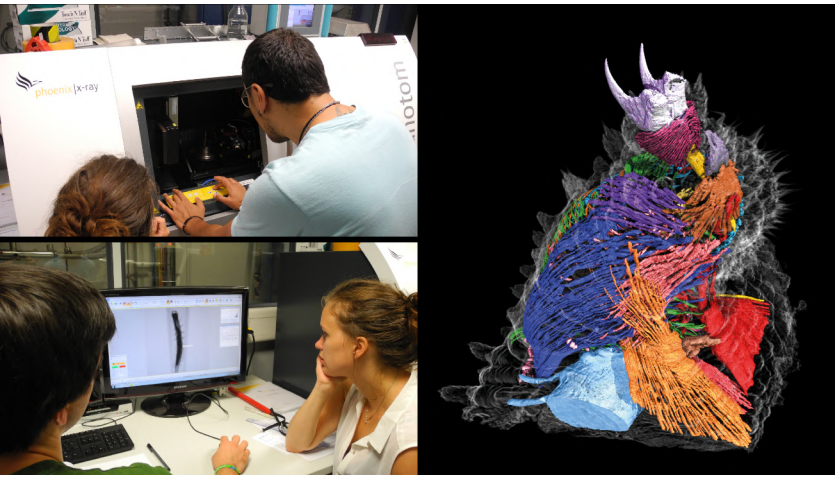
Prof. Dr. Georg Mayer is the head of the Department of Zoology and member of CINSaT since 2019. The major goal of his team is to unravel specific aspects of animal evolution at the molecular, cellular and organismic levels. The research of Mayer's team currently focuses on three ancient and enigmatic animal groups, including water bears (Tardigrada), velvet worms (Onychophora) and comb jellies (Ctenophora). These animals have long intrigued researchers worldwide and are still key to clarifying some fundamental questions in zoology, such as: Did nerve cells, sensory cells, muscle cells and gland cells evolve once, twice, or several times? Do comb jellies possess a through-gut? Are tardigrades miniaturized dwarfs? Which factors are responsible for their extreme survivability? How does the "superglue" of velvet worms work? When and how did jointed appendages arise? What are the closest relatives of the hyperdiverse arthropods?

Mayer's team explores these and various other questions by applying a wide range of methods to living and fossil representatives of these animal groups including immunohistochemistry, *in situ* hybridization, karyology, histology, vibratome and semi-thin sectioning, genomic, transcriptomic and phylogenetic analyses based on next-generation sequencing, micro- and nano-computed tomography combined with 3D reconstruction, and behavioral experiments. Light- (LM) and fluorescence microscopy (FM), confocal laser scanning microscopy (CLSM) as well as transmission- (TEM) and scanning electron microscopy (SEM) are the most common imaging methods used in Mayer's laboratory. Due to their wide repertoire of used techniques and contributions to the field, members of Mayer's group at the University of Kassel represent some of the world's leading experts on these obscure, albeit important animals.

Further information

Website http://www.uni-kassel.de/go/zoology

Representatives of three animal groups investigated in the Mayer laboratory: water bears (top left & bottom right), velvet worms (top right & bottom left), and a comb jelly (center).



Computed tomography experiments performed by members of Mayer's group include precise sample adjustment at the synchrotrone (top left), data acquisition (bottom left), and 3D-redenring of target structure (right)—in this case a velvet worm leg.

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Research Groups
Microbiology - Faculty 10

Cell Growth Control by Pathobiological Modifications of Biomacromolecules

Prof. Dr. Raffael Schaffrath heads the Division of Microbiology. He has been a Humboldt fellow since 1996 and joined the CINSaT in 2014. Using microbial models (bacteria, yeast/fungi), the research of his group has been focusing on organismic interaction between microorganisms and cell proliferation control in response to changes in environmental and/or intracellular cues. In doing so, they have provided new and innovative insights into both the physiological and pathobiological relevance of chemical modifications at biological macromolecules (DNA, RNA, proteins). Importantly, the studies revealed that microbial protein toxins (diphtheria toxin, tRNase ribotoxins) as well as low molecular weight antifungals (sordarin, rapamycin) often operate by hijacking complex modifications on their protein and tRNA target molecules to attack and inactivate processes (TOR signaling, mRNA translation, protein biosynthesis) that are essential for life.

As a logical spin-off from that expertise, research of the Schaffrath laboratory on more complex protein and tRNA modifications was further supported by two DFG Priority Programs [1784 *Chemical Biology of Native Nucleic Acid Modifications*; 1927 *Cooperative function of Fe/S Centers in Assembly, Biosynthesis, Catalysis & Disease*]. Here, the group investigates the option that rather than being constitutively active, different pathways for RNA and protein modifications may not only be regulated and induced according to cellular need but also undergo physiologically relevant cross-talk under specific growth conditions.

In a similar line of this research concept is *PhosMOrg*, a University of Kassel Zukunftsprojekt chaired by Prof. Schaffrath between four more CINSaT members (Profs. Fuhrmann-Lieker, Garcia, Herberg, Müller) and dealing with the regulation of macromolecules (DNA, RNA, proteins) and their associated biological functions through kinase dependent protein phosphorylations. Prof Schaffrath serves as DFG liaison officer for our University and is active member of the CINSaT focus group *Multiscale Bioimaging* (head: Prof. Arno Müller)

Further information

Website https://www.researchgate.net/profile/Raffael_Schaffrath
http://www.uni-kassel.de/fb10/de/institute/biologie/fachgebiete/mikrobiologie

The Microbiology Team 2019

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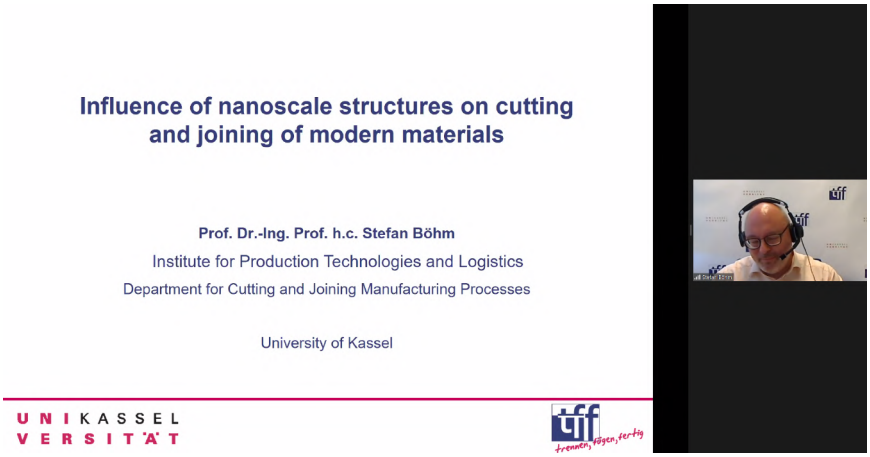
Latest Reports
Autumn Colloquium 2020

This year's CINSaT Autumn Colloquium inspired numerous professors, research assistants and students - virtually.

The annual CINSaT Autumn Colloquium was held on Wednesday, November 18, 2020. In contrast to other colloquia, this year's event was not held in the usual lecture hall 282 at the Heinrich-Plett-Strasse location, but virtually via zoom. In the auditorium, numerous professors, postgraduate and doctoral students as well as bachelor and master students from various disciplines were eagerly awaiting the presentations of the guest speakers.

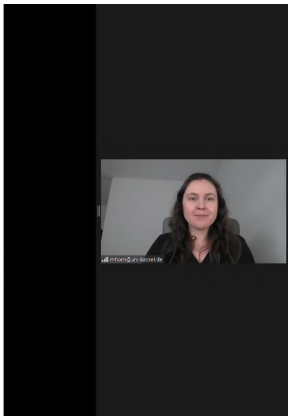
As in the past years, various disciplines could be served, whereby, as in the previous year, a young researcher was fortunately represented among the speakers. Due to the transfer from a face-to-face to a purely online event, the poster session, which was otherwise always very well attended, could unfortunately not take place.

The event began with a warm welcome speech by CINSaT speaker Prof. Dr. Johann Peter Reithmaier, who introduced the first part of the lecture series, Prof. Dr.-Ing. Prof. h.c. Stefan Böhm. Prof. Böhm gave his presentation "Influence of nanoscale structures on cutting and joining of modern materials" to the CINSaT members, which is part of the admission procedure as a full member. Starting with the field of surface modification on the micro- and nanoscale by means of laser, electron beam or pickling/etching, he led to the field of adhesive modification, e.g. to enable debonding on demand, but also fast healing, visualization of damage or energy storage. In the next section, he reported on electron beam welding in the micro and nano range, as well as surface modifications, such as cleaning, polishing or engraving, using



Prof. Dr.-Ing. Prof. h.c. Stefan Böhm

Dr. Marilia M. Horn

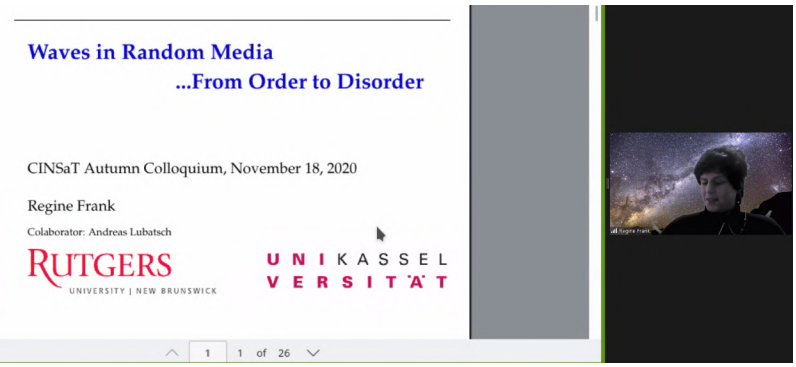


electron beams. As the last big topic he explained the additive manufacturing by laser metal deposition, before he briefly presented the LOEWE project Allegro, of which he is the speaker and which deals with high performance components made of aluminum and aluminum alloys. The overview of the equipment available in the working group as well as the already existing networking with CINSaT members at the end of his presentation was impressive

After a half-hour coffee break, which could be used to consume the provided snack bags and to relax the eyes, Dr. Marilia M. Horn gave a lecture entitled "Renewable resources for nanocomposites". The young researcher from the Working Group Physical Chemistry of Nanomaterials first gave a general introduction to renewable or recyclable materials, their production and use, before building a bridge to her own research topics. In addition to nanoparticles and hydrogels for the active drug delivery system based on chitosan, she reported on the functionalization of porous collagen scaffolds for supportive wound healing, as well as the modification of the properties of biopolymers to make biomass waste reusable and return it to the recycling cycle.

The last presentation of the event with the title "Waves in Random Media - From Order to Disorder" was held by Prof. Dr. Regine Frank from Rutgers University, New Brunswick, who currently holds a substitute professorship at the University of Kassel in the Working Group Physical Chemistry of Nanomaterials. In her lecture she first introduced the definition of order, disorder and randomness, before she then continued with some experimental work on the topic, focusing on the transport of light in disordered media using the example of ensembles of Mie spheres. The presented data was explained with the corresponding theory and results were compared.

In summary, this year's Autumn Colloquium was also very successful as an online event, although networking was missed during the breaks and poster session and will hopefully take place again in 2021.



Dr. Regine Frank

This year's program

„Seeing is believing“ - The first interdisciplinary Photonics-Bioimaging Workshop

Biological systems are inherently difficult to describe and manipulate and are controlled by highly dynamic mechanisms. These mechanisms have traditionally been investigated by focussing on their underpinning chemical reactions. In more recent years, the study of the physics underlying biological systems has come out of age. Such approaches rely upon the development of tools to image and manipulate its cellular and subcellular components with high precision. The rapid developments in the field of bioimaging have revealed a need to develop interdisciplinary approaches at the interface of biology and physics. CINSaT provides an excellent platform to bring together scientists working on complex multicellular biological systems and physicists, chemists and computational scientists to tackle problems in contemporary bioimaging. To this end, the CINSaT focal points ‘photonics’ and ‘multiscale bioimaging’ organised their first interactive workshop in the beginning of October 2020 with the theme ‘Seeing is believing’ to support interactions of young scientists from these different disciplines.

The aim of the workshop was to provide an opportunity to introduce biological systems, computational and physics approaches to identify areas of overlapping or complementary expertise and interests. The first workshop was kicked off by a brief welcome note by Arno Müller (speaker of the focal point ‘multiscale bioimaging’) followed by CINSaT coordinator Nina Felgen, who provided a short introduction into CINSaT’s recent funding initiative ‘seed money’ and its application process. Peter Lehmann (speaker of the focal point ‘photonics’) then gave a tutorial lecture on 3D imaging techniques, going through some basic physics of light microscopy ranging from brightfield to complex 3D-imaging using interferometrical and confocal optical principles. The next presentation by Roland Klassen (Microbiology) introduced the yeast *Saccharomyces cerevisiae* as a living model to study the dynamics of protein aggregation and filament formation, which can be induced in mutant yeast cells. These ACC1 protein filaments form in a nanometer range and little is known about their dynamics and physical properties and they are difficult to image without fluorescent tags, like GFP (**Fig. 1**).

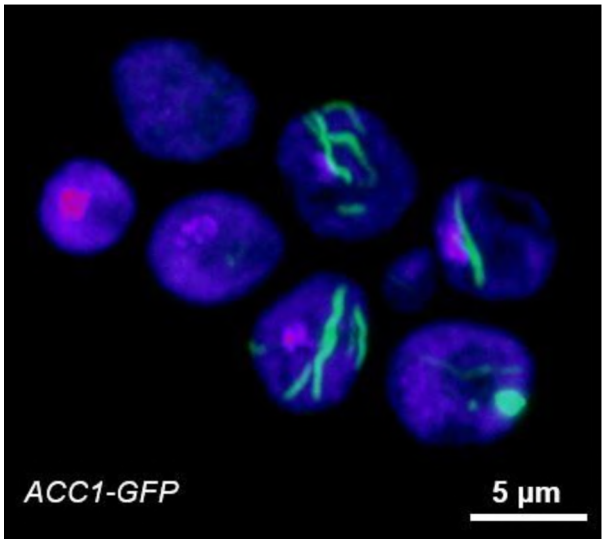


Figure 1: Confocal laser scanning image of a Saccharomyces cerevisiae strain expressing a GFP fusion of acetyl CoA carboxylase 1 (Acc1) treated with the Acc1 inhibitor drug Soraphen A. Filamentous Acc1-GFP aggregates are seen in green; Nuclei were stained using 4'-6-diamidin-2-phenyolindol (DAPI). *Image by Dr. Roland Klassen.*

Mostafa Aakhte (Developmental Genetics) then presented his results on the development and application of a custom designed Multi-view Tiling Light-Sheet-Microscope (MTLSM) system. He demonstrated that the MTLSM is able to provide live imaging of entire large specimens down to subcellular resolution. Recently, machine learning approaches were also introduced in order to further improve the interpretation of the MTLSM data (A. Körner, short presentation). Elham Gheisari (Developmental Genetics) then introduced a biological system in which MTLSM imaging and image analysis was applied to the tracking of the migration routes of migratory cells in the early fly embryo. Finally, Ramela Ciobotea, Cristian Sarpe and Bastian Zielinski (Experimental Physics III) presented data of a collaborative project of the Baumert and Müller teams in which the application of temporal laser tuning was used to determine the dynamics of a biological system. The scientists designed a setup for the application of femto-second laser pulses to developing fruit fly embryos in order to ablate subcellular structures in the range of a 500-1000 nm and follow - by confocal microscopy - the contractile behaviour of this system in distinct developmental stages (**Fig. 2**).

Because of the Covid-19 crisis, the workshop was held in a Zoom Conference format. In the future, we plan to continue to have these workshops, hopefully in 'face-to-face' setting, either within the frame of CINSaT activities, like the Spring meetings, or as stand-alone workshop. Everyone in CINSaT is welcome to attend the workshop and to contribute.

Some topics of interest are:

- Acquisition and processing of images;
- the basics of the interaction of light with biological material;
- computational approaches in acquisition and analysis (tracking, modelling);
- measuring physical parameters in living matter; imaging of molecular interactions and biosensing.

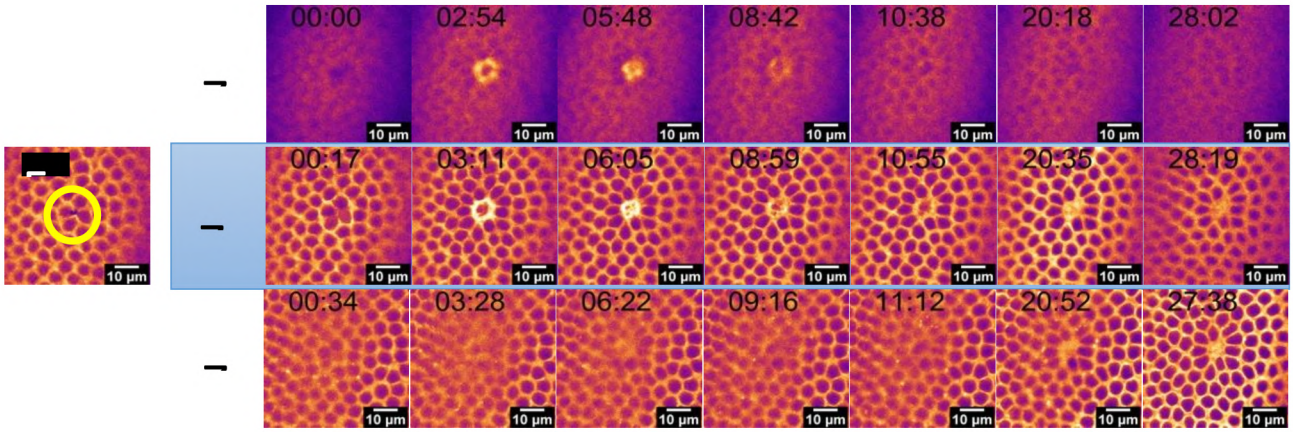


Figure 2: Confocal images of early fruit fly embryo expressing the Motor-protein non-muscle Myosin 2 tagged with GFP (Myo2-GFP) (orange color). The embryo has been damaged with a fs-Laserpulse (Fs Damage, centre of the yellow circle). The Myo2-GFP network reacts upon the damage over the time. This contractile response is developmentally controlled. *Image by Ramela Ciobotea and Ruby van Dijk.*

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First international LOEWE-SMolBits Workshop – Online via Zoom

In the framework of the LOEWE-Scalable Molecular Quantum Bits (SMolBits) project, the 1st international SMolBits workshop took place on November 12-13, 2020. This workshop has explored the emerging opportunities for interdisciplinary research on molecular quantum systems and for exchanging knowledge and information between scientists from Physics, Chemistry, and Engineering.

It was my great pleasure bringing together world-leading experts from across different disciplines. During the two-day virtual event, 10 international speakers from 7 countries gave talks on the latest scientific findings in the field of quantum technology. Topics covered: Single-photons and entangled photon pairs; single-molecule in cavities and devices; quantum information processing, cold atoms in cavities and fluorescence microscopy as well as quantum optics with single-molecule.

The workshop agenda included 5 sessions and 3 breaks.

Session 1: **Single-photon emitters**

Michel Orrit, Leiden University, Netherlands
Cryogenic Single-Molecule Spectroscopy

Stephan Götzinger, MPL, Erlangen, Germany
Single molecules as a basic resource for the generation and manipulation of single photons

Session 2: **Single molecule in cavities and devices**

Jörg Enderlein, Göttingen, Germany
Single molecule fluorescence in nanocavities and close to plasmonic surfaces

Costanza Toninelli, Florence, Italy
Integrated single-molecule devices

Session 3: **Joint Physics - SMolBits Colloquium**

Rainer Blatt, Universität Innsbruck, Austria
The Quantum Way of Doing Computations

We were happy that many participants attended the presentations (on average 55 attendees in each session) and used the breaks to exchange ideas via Zoom and to discuss their current research topics. As an organizer of this workshop, I have received very positive feedback, in fact it was a successful workshop.

Session 4: **Quantum optics with single molecule**

Wolfgang Wernsdorfer, KIT, Germany
Operation quantum states in single molecules

Alex Gaita, Valencia, Spain
Quantum coherent spin-electric control in molecular nanomagnets

Stefan Willitsch, Basel, Switzerland
Quantum technologies with trapped molecular ions

Session 5: **Cold atoms in cavities and fluorescence microscopy**

Guido Pupillo, Strasbourg, France
Theory of collective cavity dynamics for cold chemistry and materials science

Marcelle Koenig, PicoQuant, Berlin, Germany
Mapping Single Emitters in Confocal Fluorescence Microscopy

Many thanks to all speakers for sharing their time and experiences with us. This was a unique opportunity for all participants to hear about recent advances and evolving challenges in these research areas.

Further information

https://www.uni-kassel.de/forschung/ina/technische-physik/forschung/nano-optics/

https://www.unikassel.de/forschung/smolbits/workshop

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Embracing Diversity

Dr. Marilia M. Horn

In this new section young researchers talk about their experience in Germany, the University of Kassel and within the CINSaT and give insights to the differences and difficulties they faced during their career. The first interview partner is Dr. Marilia M. Horn from Brazil who is doing her postdoc in the group "Physical Chemistry of Nanomaterials" (Faculty 10).

Marilia, first of all: How does the current Corona situation affect your work?
It's very different I'd say, especially for lectures. Last semester I had to record at home and that was something new for me. I'm not into that technology and I had to download some software and adapt myself to this. After many years at university I had to work from home. It was very difficult for me, especially the first week, but later I got used to it, it went well and now we continue, the next semester will be the same.

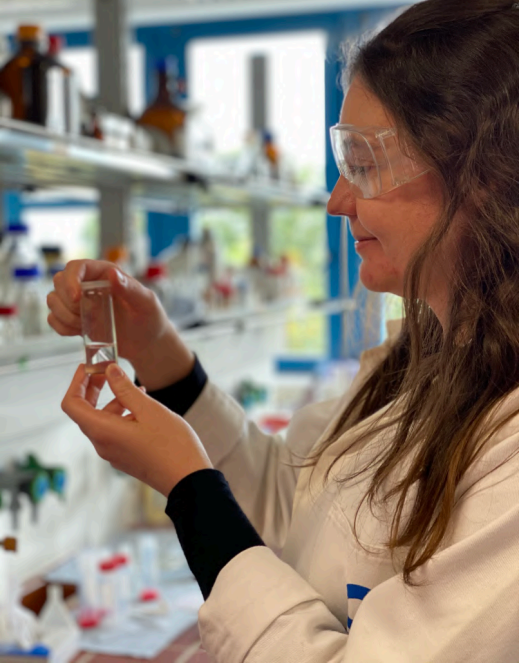
Did you have any practical courses that you supervised or did you have to cancel these?
Last semester we had lab courses, but we did everything online. I send some experimental results to the students and so they could perform the experiments in a theoretical way. They can read the script and look for information and I also offered a kind of online support if there were some questions. As soon as I was allowed to go back to the office and lab, I did. In natural sciences you just need to go to the lab to perform experiments. Even if I#; not in the lab everyday I'm there for the students, to support them.

You came as a postdoc to Germany. What did you do before this?
I basically did my studies in chemistry in Brazil (bachelor, master and PhD), later I went to France as a PostDoc. I had to come back to brazil because this was stated in the contract. Back in Brazil I continued at the same University where I did my studies. After four years as a PostDoc there my contract finished and I decided that it was time to go abroad again, because of the situation in Brazil. Not only the politics, but the research conditions. I applied for different positions and suddenly I received an invitation for a job interview. The process was really fast I'd say, because I did the interview in November 2017, in December I got the acceptance for the position and at the end of January I was here in Kassel.

What was your first impression when you came to the University of Kassel?
When I arrived here at the Campus for my first day I saw that the Campus was quite small. I'm used to it because usually the chemistry campus is quite small and outside of the city center. I was looking for the IBC building and recognized the nitrogen tanks, something that I already knew, to find the place.

What is your opinion about Germany and where do you see the major differences to your home country Brazil? Are there advantages and/or disadvantages?
I'd say the main advantage here is that not only PostDoc, but PhD student is considered a profession. In Brazil it's not the case. From PhD we have scholarships or you work for a project, but you don't have a job, you just got kind of a student contract. That's the main difference I see. In Germany you got more support from the government, from the University in general.
As a PostDoc in Brazil you have to apply for a project for financial support from the government. Sometimes you can have support from companies or the industry, but this is not so common and very difficult to get.
I see that in Germany you are more free in terms of teaching and supporting students. The regulations how a lesson has to look like are not that strict and you can put something "from yourself" into it. In Brazil as a PostDoc you cannot teach. Two years ago they start to allow this, because they did not have enough professors. I gave some lectures, because my former supervisor had some appointments during the lecture time and it was a practical course. But in theory, this was not allowed. Here, you have to do teaching and this is great! I improved a lot and like the contact to the students. It also forces me to study more, read more and this is good.
Also in the lab, when a student comes I can advise "do this, change that". This was not possible in Brazil officially. Because I was in the same lab where I already did my Bachelor's thesis I was allowed to, but in general, it is not. If students got a problem, they have to go to their supervisor which is usually the professor. The first person the students ask for help are PhD students or PostDocs but these are not allowed to make decisions. They can only tell how they would to it, but the students still have to ask the professor for permission.

Do you think that they are fundamental differences in the education system (school and university)?
I have some friends in Germany and I liked to ask how it works here. I see that in general the schools here focus a lot in the basic



education. When students finish High School they are very well prepared, much more than we are in Brazil. But something that I see differently is the way you enter University. In Germany, you take the grades from the High School, they check the grades when you apply and if your grades are good enough you can start there. In Brazil we have to do an exam to start at a University. And it's a very hard exam I'd say, because the public basic schools are very weak and so is the preparation. But: the public Universities are the best ones. So if you want to study at a public University you have to be very well prepared and normally you study at a private school. If you went to a public school, you have to teach a lot to yourself or attend a preparatory course. The grades from High School don't matter, only these from the exams. Things changed a lot since I started. Now they got a general exam from all the country for the federal Universities. When I applied for the state University of Sao Paolo they had a specific exam just for this University. There are two phases that you got to achieve: the first one is a general exam. Even if you apply for chemistry, you have to do an exam about history, mathematics, geography etc. and you have to achieve a certain score, a minimum, to get to the second step. In the second step you have the specific topics that are related to your study subject. So in my case these were chemistry, mathematics and Portuguese, because this was the teaching language.

If you don't pass the exam you can apply again but it is recommended to attend a preparatory course. There is no limitation about the maximum attempts. Also, if a sixty-year old person that did not attempt University at younger age do the exam and passes, he or she can start to study. After you managed to enter the university the system is very similar. We have practical courses and lectures, you have to do your Bachelor's thesis and so on. So it's just the entering process that differs a lot. In general, the Universities follow the same system.

It may sound funny but in Brazil, we love to do exams. Because for starting the Master courses we have to do exams to start. And as I mentioned the PhD is not a job position like it is here so you have to do an exam to start your PhD. Four years ago they start to only accept CV applications for the PhD, but if you want a scholarship you have to do the exam. I didn't know this, but I got a PhD student here from Brazil who told me this. He is doing an exchange with a specific program of the Brazilian government: The PhD students can choose where they want to go and stay one year doing research.

What is your impression about the scientific environment that you find in Kassel, especially within CINSaT?

I guess the best way to summarize this is my first contact with CINSaT. I started to work here in February 2018 and I was still in Brazil when Tom (Fuhrmann-Lieker) told me, he sent my name to a conference at the end of February where I should go to. I was worried because I got no results yet to present. He told me everything would be fine and that I could present some old results. At this moment I still did not know what this conference was exactly. I got contact with CINSaT because Tom gave me a newsletter and I read a bit, checked what other groups were doing and later I went to the CINSaT conference (spring colloquium). I went there and actually it was really good, because I could see what the other groups were working on. And I had my poster there that summarized my previous experiment. Many people went there and talked to me, they were curious and want to know my background to see what is possible to do together.

As a postdoc, you are supposed to develop yourself with independent research. How difficult is it for you? Did you get familiar with the German research system?

I'd say that the system is very different. I cannot apply for a Junior research group here, because I got more than four years after finishing my PhD. It is difficult for me to adapt because I want to do something more independent, and Tom gives me the opportunity to do so. I did my PhD eight years ago so I don't have that much options to apply for my own group. I was checking the DFG website and found one option I can apply to for some more independence. It would be good for my career to improve my skills. As I mentioned I had some PostDoc experience before so it was not my first contact with independent research. For me it was like a "soft" adaptation, I because I was used to supervise students and for a period I was contracted as a professor in Brazil, so I had teaching experience and improved my teaching skills.

To adapt myself here was not that hard. Teaching lectures did not cause any panic because I was prepared for that. My responsibilities increased here because I have to supervise PhD students and in addition I supervise my PhD student from Brazil directly. I also can work independently and take decisions. The

way of research here in Kassel, which is comparable to the German way in general, shows much more financial autonomy. The groups receive the money and can decide what to do with the money. This helps a lot in research, you know exactly how much you can spend.

In which area of nanoscience are you working? Tell me about your projects.

In our group here we have basically two main big areas of research: an optics part and a bio part. In the bio-part I work with biopolymers in general to prepare nanoparticles for drug-delivery systems. So it's chemistry and a very bit of biology. We have a project we want to apply to for financial support. It's related to green chemistry where nanostructural modifications of biopolymers shall substitute common materials and reduce waste and materials. The topic is not new, but sustainability and recycling are still hot topics. The other topic is related to hybrid materials. It's organic-inorganic materials with hydroxyapatite, the mineral found in our bones. This project is done with my previous research group in Brazil and Eduardo, my PhD student is also involved.

Did you get contact to other groups and students via your research topics?

For the nanoparticles that I fabricate for drug-delivery I got some support from the biology, because I use some equipment there. We don't have a project together, but I got support. For the green chemistry project, we work together with the engineering department and for the hybrid material part I am still in contact with my old group. It's an interdisciplinary network.

What are your plans for the future?

If it's possible to continue at the University, because I like the environment, get in contact with the students, the teaching and research part. If it's possible I would also like to continue in my topic, because I really like it and choose it already in 2004. I'm not against moving and can apply for a professorship or research position in another country. There is the phrase "in live you have to write a book, plant a tree and have a kid". I didn't write a book, but I wrote papers, so I would say this counts as accomplished. I planted a tree, so I only need to do the last one to complete the goals of live

Thanks a lot for the interview, I enjoyed it a lot!

If you want to share your experiences, too, just drop a mail at info@cinsat.uni-kassel.de

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Awards

Dr.-Ing. Malte Vollmer received DGM Prize for Young Talent

The Prize for Young Talent of the Deutsche Gesellschaft für Materialkunde e.V. (DGM) awards PhD students and young postdocs with outstanding research achievements in the field of material science and engineering. It was handed out to Dr.-Ing. Vollmer during the DGM Day 2020 on 21.09.2020.

Dr.-Ing. Malte Vollmer was able to convince the jury with his work in the field of process-microstructure-property relationships in iron-based shape memory alloys. During his PhD he exchanged ideas with world-leading researchers in this field, as demonstrated by a guest stay at Texas A&M University. The intensive work, especially on the Fe-Mn-Al-Ni alloy, resulted in the successful publication of a paper in Nature Communications in 2019. This paper was based on comprehensive studies, which Dr.-Ing. Vollmer successfully published in a series of papers in other highly ranked journals. He also participated on several international conferences with own talks and is active as a reviewer for renowned journals.

At the beginning of 2020, he completed his doctorate "Thermal processing and functional characterization of Fe-Mn-Al-Ni-based shape memory alloys" at the University of Kassel with distinction.

Dr.-Ing. Malte Vollmer (left) with the certificate and Prof. Dr.-Ing. Thomas Niendorf (photo: J. Niendorf)

SAMOP dissertation prize for Daqing Wang

The professional associations of the German Physical Society (DPG) that are united in the AMOP section (Atoms, Molecules, Quantum Optics and Plasmas of the DPG) award a dissertation prize every year. The aim of the prize is to recognize outstanding scientific work and its excellent presentation in a talk.
Daqing Wang, a young-scientist research group leader in the workgroup experimental physics I / Light matter interaction was awarded the SAMOP dissertation prize by the Germany Physical Society during the virtual “41. Tag der DPG“:

https://www.dpg-physik.de/auszeichnungen/preise-der-dpg-vereinigungen/preistraeger-dissertationspreis-samop

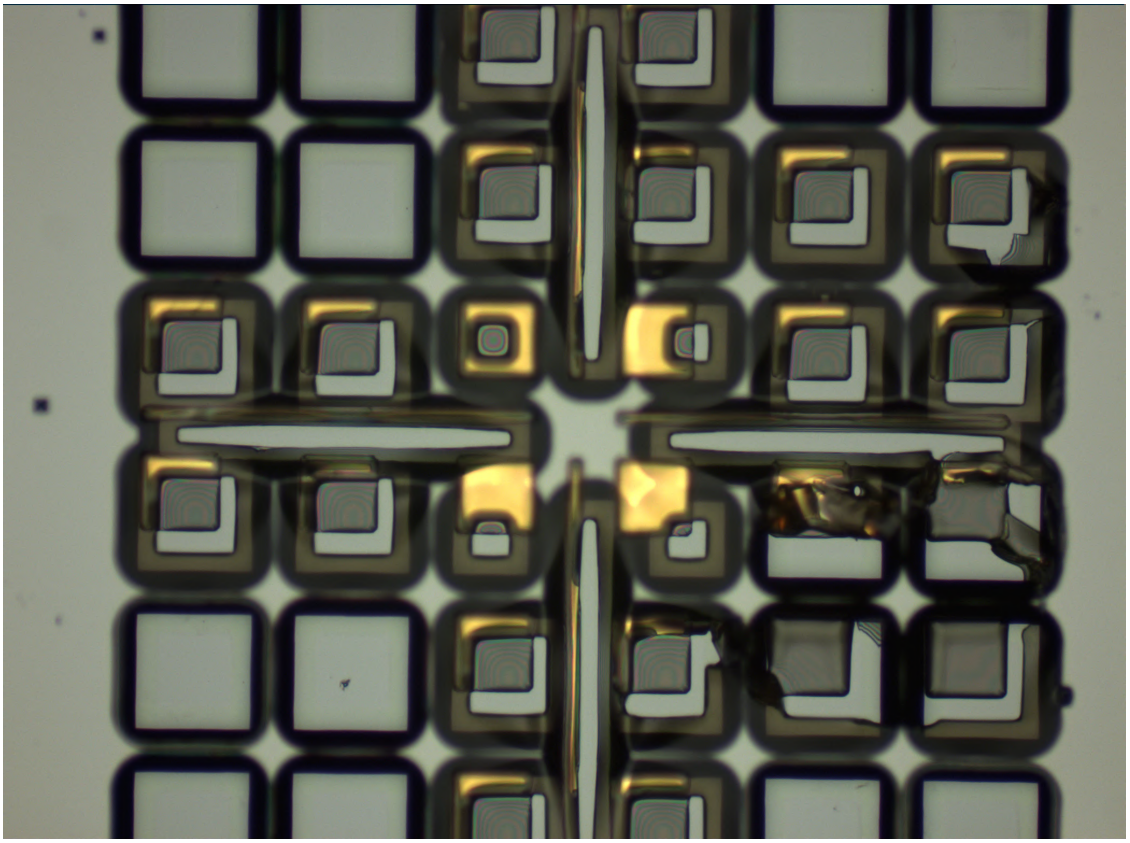
Daqing conducted his dissertation work at the Max-Planck Institute for the Science of Light, under the supervision of Prof. Dr. Vahid Sandoghdar. The topic of his dissertation was about the development of a miniaturized optical resonator. With this resonator, he was able to control the interaction of single photons and single molecules, and turning a complex molecule into a nearly ideal quantum two-level system. This work lays experimental foundations for future quantum photonic networks.

Daqing joined the group of Prof. Dr. Kilian Singer in October 2018. Since then he led an experiment on studying thermodynamics with single trapped and laser cooled ions. Later in 2019, he also started an independent young-researcher project within the framework of SFB 1319 ELCH.

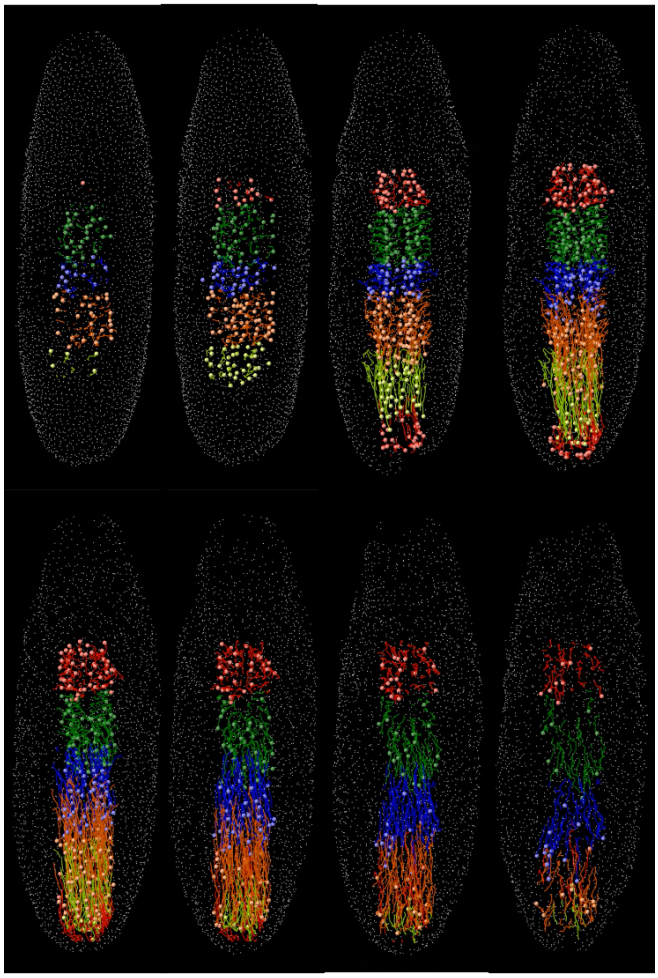
Daqing Wang with the certificate (photo: © DPG)

Nano Art

In this section, artistically appealing images from the CINSaT groups will be presented. If you obtain any kind of visually appealing and fascinating data during your experiments with focus on micro-and nanometer length scales, you are cordially invited to submit your contribution to the editors.



Light microscope image of a justage cross after
two lithographies and silicon etching
(Alexander Schmidt, Technological Physics)



Tracking of mesoderm precursor cells during gastrulation in the fly embryo
(Elham Gheisari, Developmental Genetics)

AFM Phase imaging of a SBS (poly(styrene-butadiene-styrene)) and PS (polystyrene) polymer blend sample
(Nina Felgen, Technological Physics)

Photo: Campus Heinrich-Plett-Straße, Press and Public Relations Office University of Kassel, Studio Blåfield

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