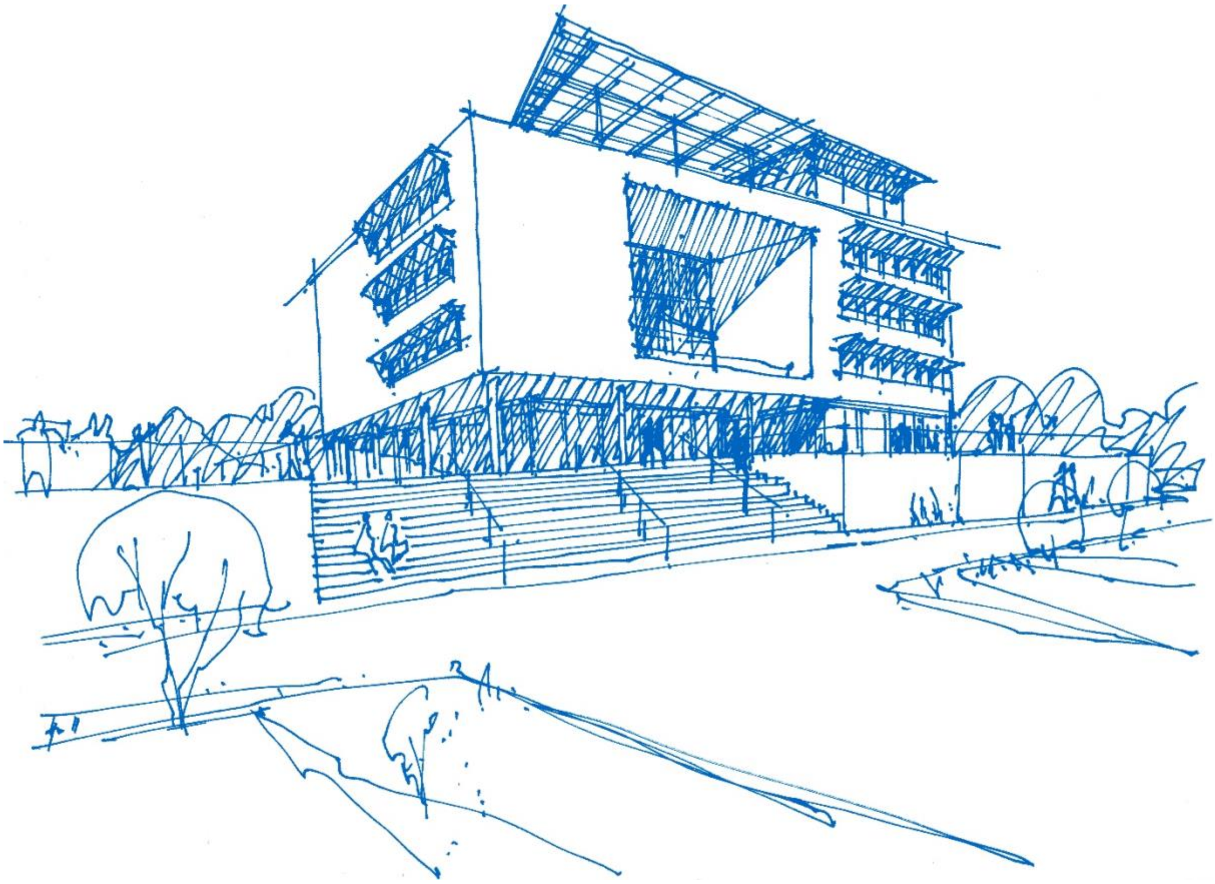
TUM Institute for Advanced Study
General Assembly

CareerDesign@TUM PostDoc Poster Session

April 29, 2024, 12-14
Venue: TUM-IAS Headquarters, 3rd floor



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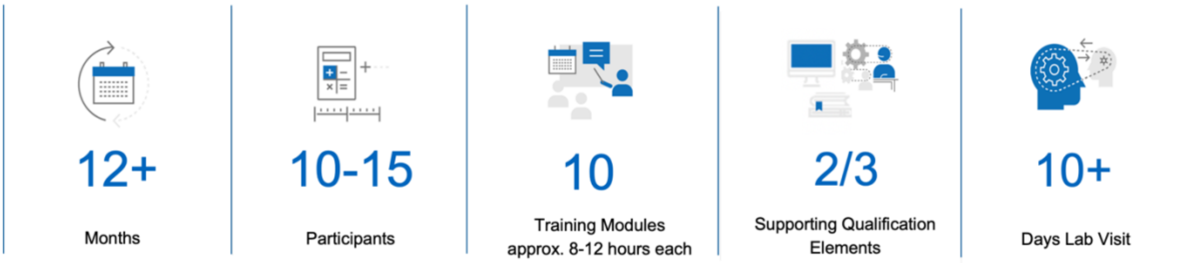
CAREERDESIGN@TUM

CareerDesign@TUM is a structured 12-month qualification program for mid-level academics in distinct fields of expertise (e.g. Research, Digitalization, Science Management etc.). The program hosted by the **TUM Institute for LifeLong Learning** provides a comprehensive opportunity for personal and professional development.

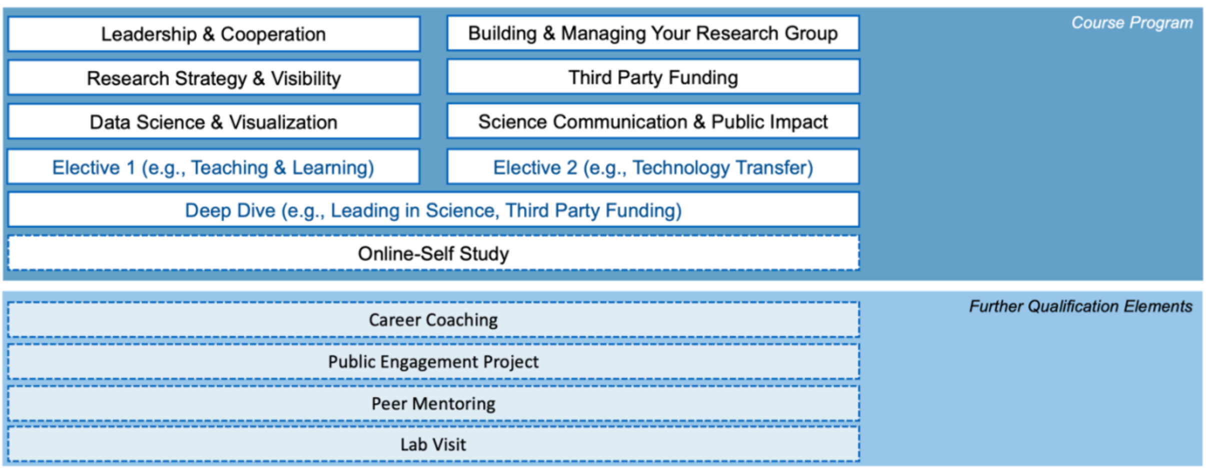
In the program, participants will develop interdisciplinary skills needed for a challenging and responsible job in academia and beyond. The program offers participants the chance to extend their knowledge, apply it in their field, and exchange ideas with colleagues from TUM and other organizations.



TUM RESEARCHER PROGRAM

People are at the heart of TUM's research and innovation agenda. An inspiring environment and optimal conditions for the work as a researcher are the basis for outstanding research achievements. We promote our participants' individual talents with our new structured qualification program, TUM Researcher, so that they can realize their full potential. With the 12-month qualification program **TUM Researcher**, we prepare researchers for a responsible (leadership) role in research.

The pilot program cohort was set up through a very competitive selection process. We could choose 16 postdocs from almost all TUM Schools, characterized not only by their academic excellence but also by their enormous commitment. These are extremely promising personalities to whom we offer the opportunity to further their education in shared learning spaces on various topics (e.g. third-party funding acquisition, leadership, and public engagement) and to exchange ideas on common, interdisciplinary challenges. The pilot program runs from November 2023 to November 2024.



Juliana Gonçalves Institute of Pathology, Technical University of Munich

Treatment Outcome Prediction in Bladder Resections Through Mass Spectrometry Imaging

Urothelial bladder cancer demonstrates responsiveness to immune checkpoint inhibitor (ICI) treatment; however, monotherapy elicits a response in only a minority of patients. Consequently, combining ICI treatment with other modalities such as radiation, along with molecular preselection of likely responders, presents potential avenues to further optimize ICI regimens.

In this clinical study, the combination of radiation with ICI treatment in the neoadjuvant setting was explored as a therapeutic option for bladder cancer. Mass spectrometry imaging was employed to evaluate resections from patients undergoing this treatment approach, aiming to identify molecular features that could predict treatment success. The outcomes were compared with DNA/RNA sequencing data.

48 samples were affixed to an ITO glass slide and subjected to deparaffinization and rehydration. Subsequently, tryptic digestion was performed, followed by matrix application using an HTX TM sprayer. Mass spectrometry proteomic data were recorded using a RapifleX MALDI-TOF (Bruker). Tissue sections were stained with hematoxylin and eosin, then scanned with a digital slide scanner (Aperio AT). Tumor regions were annotated, distinguishing between invasive carcinoma and non-invasive carcinoma regions. Data analysis was conducted using SCiLS Lab.

Invasive carcinomas from treatment responders exhibited a distinct mass spectrometry profile compared to non-invasive carcinoma samples. Collagen α-2(I) chain (*m/z* = 868.44, 1645.65, 2056.90) and collagen α-1(I) chain precursor (*m/z* = 2705.17 and 2869.27) showed higher expression in invasive carcinoma.

For non-invasive carcinoma, overexpression of histones and Keratin, type 2 cytoskeletal 7 (KRT7) was identified. However, a greater number of tryptic peptides from KRT7 was detected in the non-responder subgroup. A dedicated quantitative analysis is required to accurately determine the significance of KRT7 in tumor invasiveness.

The feature with the highest expression in treatment responders was *m/z* 1032.59, corresponding to Histone H3. Further investigation revealed that overexpression of histone H3 correlated with the histological annotations of the tumor region in responders.

Although various techniques, including DNA sequencing, RNASeq data, methylome data, and proteomic data, provided a breadth of information, collectively, they suggest involvement of keratin-associated pathways, collagen-related pathways, and genes associated with histone methylation.

CV

As a Postdoctoral Research Associate at the Pathology Institute of the Technical University of Munich, my primary focus revolves around characterizing tumor tissues using mass spectrometry imaging. This involves evaluating the molecular content and correlating it with histopathological features. Building upon my previous roles, I bring expertise in chemical biology and the development of cell assays. Furthermore, I have engaged in interdisciplinary research spanning nanotechnology and material science. My enthusiasm lies in advancing spatially resolved multiomic approaches, aiming to pioneer novel methodologies within this domain.

Stefan Pieczonka
Chair of Analytical Food Chemistry, School of Life Science,
Technical University of Munich (TUM)

Comprehensive Characterization of the Beer Metabolome

In my doctoral thesis, I consider food as complex systems embodying biological (raw materials), chemical (Maillard reaction), and biochemical (fermentation) origins. Utilizing ultra-high-resolution mass spectrometry (FT-ICR-MS), we can create a comprehensive picture of our food, covering thousands of molecular compositions. The fingerprint of this molecular world reveals insights into production processes, traceability, and authenticity.

CV

PostDoc at the Chair of Analytical Food Chemistry

Ensuring analytical quality control with industrial partners, acquire first research fundings, brewing and pet food research Supervision of student's Bachelor's, Master's, and Internships, lecture assistance

Bachelor & Master in Food Chemistry
PhD in Analytical Food Chemistry

Verena Streibel BMBF Junior Research Group Leader at Chair for Experimental Semiconductor Physics, Technical University of Munich

A Lab-Based NAP-XPS Setup for e-conversion to Probe Functional Interfaces under Working Conditions

Synchrotron-based near-ambient pressure X-ray photoelectron spectroscopy (NAP-XPS) has revolutionized our understanding of working functional interfaces. Recent technological advances make such systems available for use in standard labs, enabling flexible daily access for quick feedback during the process of material development for energy conversion applications. Within e-conversion, we have recently received a powerful and versatile lab-based NAP-XPS system. The instrument features a vertically mounted electron analyzer, operable in gas-phase or vapor environments of up to 100 mbar, while also being perfect for probing samples in contact with 'open' liquids. Three monochromatized X-ray sources - Al K_α (1487 eV), Ag L_α (2984 eV), Cr K_α (5410 eV) - allow us to probe surfaces as well as buried solid|solid, solid|liquid, and hybrid interfaces. A dedicated gas-phase manipulator enables *operando* experiments of heterogeneous (photo)catalysts in different gas atmospheres at temperatures between ~150 K and ~1270 K, e.g. for characterizing strong metal-support interactions and chemical material and surface catalytic transformations. A second, electrochemical manipulator features an 'open-liquid' three-electrode electrochemical cell, continuous electrolyte flow capabilities, and versatile connections for custom-made cells, thus allowing, e.g., *operando* measurements of lithium-ion batteries, characterization of solid|electrolyte interfaces, and observation of fuel cell activity origins and changes. In addition, surfaces and interfaces can be illuminated to investigate photo(electro)catalytic processes, modified photoelectrode properties or degradation processes, and the potential drop at illuminated semiconductor|electrolyte interfaces.

<u>CV</u>

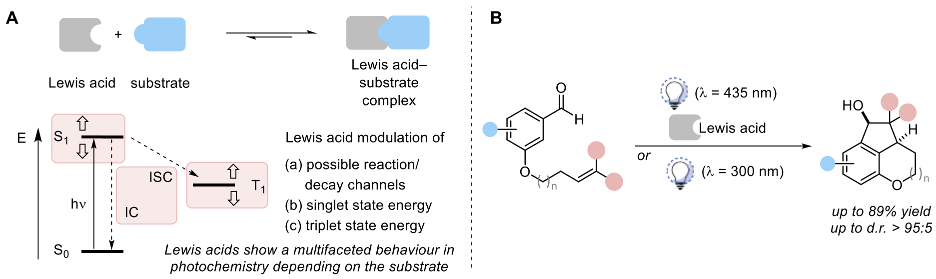
Independent BMBF Junior Research Group Leader at Chair for Experimental Semiconductor Physics
Supervision of PhD and Master students for the development of photoelectrode materials for photoelectrochemical applications

Diplom-Ingenieurin Materials Science @ TU Darmstadt
PhD in Physical Chemistry @ Fritz-Haber-Institut der MPG / TU Berlin
Postdoc in Theoretical Heterogeneous Catalysis @ Stanford University

Simone Stegbauer Chair of Organic Chemistry I, TUM

Chromophore Activation by Lewis Acid Coordination – Influencing the Photoreactivity of Aromatic Aldehydes

Lewis acids have been evolved as crucial additives, which can change the course of thermal organic reactions dramatically. The inherent Lewis acidity of semimetal or metal ions has granted them the ability to catalyze various organic functional group transformations and methods for carbon-carbon (C-C) bond formations. Lewis acids have developed from conventional to modern green catalysts unlocking numerous of chemical transformations and processes in various fields. As consequence, the application of Lewis acids as useful instruments in light-driven reaction of carbonyl-containing compounds increases dramatically. Different reaction parameters like the enantioselectivity of an intermolecular ortho photocycloaddition reaction of phenanthrene-9-carbaldehyde and the visible light-triggered cycloaddition/rearrangement cascade on 1-naphthaldehyde derivatives after addition of Lewis acids were studied. In addition, a fundamental change of the photochemical reactivity pattern of 1-naphthaldehyde and 2-naphthaldehyde with olefins was examined in presence of achiral Lewis acids.



Scheme 1: **A**: Modulation of the Lewis acid–substrate complex. **B**: Formal [3+2] photocycloaddition of benzaldehyde derivatives.

In a novel formal [3+2] photocycloaddition reaction of benzaldehyde derivatives, the influence of Lewis acids is under investigation. Both conditions, using energy-rich light of λ = 300 nm or using light in the visible range (λ = 435 nm) in presence of catalytic amounts (10 mol%) of Lewis acids, lead to the same products. However, reaction parameters like yields and diasteroselectivities were tremendously improved after addition of Lewis acids. Several electron-donating as well as electron-deficient substituents were tolerated. In order to shed light on the mechanism of this novel photoreaction, mechanistic studies and theoretical calculations are under examination.

<u>CV</u>

Scientist in the field of organic photochemistry
Responsible for laboratory courses of Bachelor program, apprenticeship training of upcoming lab technicians

Chemical laboratory technician by training
Bachelor in Biochemistry and in Chemistry,
Master in Chemistry
PhD in Organic Chemistry, Photochemistry

Philipp Gulde

Human Movement Science, TUM

Assessment and Rehabilitation in Neurological Disease

Understanding how and to what extend neurological diseases, like stroke or multiple sclerosis, impact independent living is key to develop and validate neurorehabilitation. Wearable technologies are employed to monitor everyday behavior of affected individuals, to associate it with clinical tests and patient reported outcomes, and to examine the impact of assistive technologies, like exoskeletons. This is currently employed in the TUM Innovation Network eXprt. Gained insights allowed to design studies on neural restoration, which are pursued with clinical partners.

CV

Post-doc at the chair of Human Movement
Science (School of Medicine & Health).
Funding, teaching, study supervision, project administration, clinical research

Currently: TUM Innovation Network eXprt

B.Sc. & M.Sc. in Sports Science
Ph.D. in Sports Science– Assessment of
motor behavior in neurological diseases
3a clinical research experience at a private, neurorehabilitation facility

Felicitas Sommer

Chair for Land Management, TUM
PI GreenDIA
Felicitas Sommer is initiator and project lead of "Green Data, Indicators, Algorithms: Connecting Green Finance and Smart Cities". GreenDIA is an interdisciplinary consortium research project with three partners. The Chair for Land Management (Prof. Walter de Vries, TUM), Chair for Remote Sensing (Prof. Michael Schmitt, Uni BW) and Chair for Data Science & Statistics in the Humanities (Prof. Frauke Kreuter, LMU). It investigates cross-sectoral standards and criteria of sustainability measurement with regard to land sealing and land use for residential buildings. It is funded by the Bavarian Research Institute for Digital Transformation (bidt) of the Bavarian Academy of Sciences.

Areas of Interest: Social and Cultural Anthropology; Anthropology of Law, Technology and Property; Sustainability Indicators and Knowledge in the Finance Sector, Urban Planning and Climate Adaptation

Renate Sachse

Institute for Computational Mechanics, Chair of Structural Analysis, TUM

Simulation-driven design process of biomimetic soft robot grippers

Soft robotics, an emerging field, focuses on creating flexible and adaptable robots inspired by the pliability found in living organisms. Developed through advancements in materials and fabrication techniques, soft robots offer unique capabilities such as delicate object manipulation and safe human interaction. With applications ranging from healthcare to manufacturing, soft robotics holds great potential for revolutionizing industries and addressing challenges beyond the reach of traditional rigid robots.

Soft robots have traditionally drawn inspiration from animals, but recently, the potential of plants as biological role models for soft robotics due to their continuous and energy-efficient actuation has been unleashed. Particularly noteworthy is the Venus flytrap's rapid and energy-efficient snapping mechanism, which researchers are now emulating to create biomimetic grippers. By replicating the plant's soft structure and swift closure, these grippers aim to delicately grasp objects with precision and efficiency, showcasing the evolving landscape of soft robotics and its diverse sources of inspiration.

In the design of biomimetic grippers inspired by the Venus flytrap, computer simulations play a key role in understanding the motion mechanisms of the biological role model. Employing a reverse biomimetics approach, simulation based on finite elements enable to decipher the plant's rapid and energy-efficient snapping mechanism, guiding the initial stages of gripper design. Insights gained from computational models enable to optimize the soft robotic gripper's performance, including aspects such as closure speed, force exertion, and energy efficiency.

<u>CV</u>

Postdoc at the Institute for Computational Mechanics including supervision of doctoral candidates and teaching
Bachelor & Master in Civil Engineering
PhD in Structural Mechanics

Aisha Aqeel Experimental Physics of Functional Spin Systems, TUM Cluster of Excellence MCQST
Emmy Noether Junior Research Group Leader, University of Augsburg

Magnetization dynamics of chiral magnetic insulators

Magnetic skyrmions are promising candidates as information carriers for future memory applications. These are particle-like topological solitons that can be envisaged as nanosized twists or knots in an otherwise uniform magnetic material. Skyrmions are found in chiral magnets with no inversion symmetry due to finite Dzyaloshinskii-Moriya interaction (DMI). The complex three-dimensional internal structure of magnetic skyrmions and their interaction with each other are imposed by a surrounding magnetic state of the host magnetic material. The detailed understanding of the dynamic magnetization of skyrmions in chiral magnets is crucial for their embodiment in practical devices.

We investigated the magnetization dynamics of low-temperature skyrmion state (LTS) [1,2] in a chiral magnetic insulator Cu2OSeO3 by broadband microwave spectroscopy. By combining results with the linear spin wave theory, we clearly identify the dynamic modes associated with skyrmions. Interestingly, our findings suggest that under decreasing fields the hexagonal skyrmion lattice becomes unstable, resulting in the formation of the elongated skyrmions [3]. These findings highlight how the study of dynamic properties may provide valuable insights to static properties, such as microscopic nature of magnetic textures.

Furthermore, we investigated the magnetization dynamics within heterostructures composed of a single crystal of Cu2OSeO3 and a polycrystalline ferromagnet NiFe (Py) thin film [4]. We have identified significant variations in the field dependence of LTS phase within the heterostructures. An important finding is that depositing Py onto Cu2OSeO3 eliminates the need for a specific field cycling protocol to induce the LTS phase [1,3], as can be observed without any field cycling. These findings carry substantial implications for future experiments focusing on the surface engineering of skyrmions in bilayer systems.

[1] A. Chacon, et al., Nature Physics 14, pages936–941 (2018),
[2] M. Halder, et al., Phys. Rev. B 98, 144429 (2018),
[3] A. Aqeel, et al., Phys. Rev. Lett. 126, 017202 (2021).
[4] C. Luethi, L. Flacke, A. Aqeel, et al., Appl. Phys. Lett. 122, 012401 (2023)

<u>CV</u>

Emmy Noether Junior Research Group on “Spintronics with chiral helimagnetic insulators” at the University of Augsburg
Junior group leader (Start Fellow) at Munich center of Quantum Science and Technology (MCQST)
Postdoc at Physics department TUM
Bachelor & Master in Physics
PhD in Physics

Daniel Dücker Munich Institute for Machine Learning and Robotics (MIRMI), TUM

Senior Scientist and Group Lead of the Environmental Robotics Group at MIRMI
Developping the Research Sector "Environment"

Bachelor & Master in Mechanical Engineering
MBA in Technology Management
PhD in Robotics with Focus on Underwater Systems

Technical University of Munich

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