



TECHNISCHE UNIVERSITÄT  
IN DER KULTURHAUPTSTADT EUROPAS  
CHEMNITZ

# Institut für Physik Physikalisches Kolloquium



**Donnerstag, 24.04.2025, 15:30 Uhr**

Ort: Reichenhainer Str. 90;

Zentrales Hörsaal- und Seminargebäude, Raum C10.013

**Jun.-Prof. Dr. Manuel Gruber**

University of Duisburg-Essen, Faculty of Physics and CENIDE



**GAEDE-PREISTRÄGER 2024**

## Exploring Spin and Orbital Degrees of Freedom in Molecules

Molecular complexes with magnetic properties have attracted considerable interest due to their potential for (quantum) technological applications. Among these, spin-crossover (SCO) complexes are particularly compelling, as they can exhibit two stable configurations with distinct magnetic moments, electronic structures, and optical properties. This multifunctionality makes them highly appealing for both fundamental studies and applications.

In this talk, I will present our investigations into ultrafast spin-state switching in molecular films induced by optical excitation. By probing the dynamics at the Fe  $L_3$  absorption edge—which is directly sensitive to the spin state—we leverage the unique capabilities of x-ray free-electron lasers (XFELs) to track the sub-picosecond switching process in real time [1].

I will then discuss experiments on individual SCO complexes adsorbed on surfaces, where switching is triggered by electron injection using a low-temperature scanning tunneling microscope (STM). Studying the switching at the single-molecule level provides valuable insights into the underlying microscopic mechanisms and the influence of the local environment on switching behavior [2].

In the final part of the talk, we will explore molecular systems that exhibit unusually large orbital magnetic moments, sometimes comparable to or even exceeding their spin moments. These systems include transition-metal complexes [3] as well as metal-free molecules [4]. While the orbital contribution to magnetism has often been overlooked, we show that it plays a critical role and offers promising new opportunities for molecular spintronics.

### References

- [1] Kämmerer et al., ACS Nano 18, 34596 (2024)
- [2] Johannsen et al., ACS Nano 15, 11770 (2021)
- [3] Li et al., ACS Nano 17, 10608 (2023)
- [4] Li et al., Phys. Rev. Lett. 133, 126201 (2024)

Alle Zuhörer sind ab 15:15 Uhr zum Kaffee vor dem Hörsaal eingeladen.

