

## PHYSIKALISCHES KOLLOQUIUM

### Sommersemester 2026

Das Kolloquium findet (soweit nicht anders angegeben) **jeweils montags um 14:15 Uhr im Röntgen-Hörsaal** des Physikalischen Instituts, Hubland Campus Süd, Universität Würzburg **und online via Zoom** statt.

Zugangsdaten siehe <https://www.physik.uni-wuerzburg.de/aktuelles/veranstaltungen-aus-der-physik/physikalisches-kolloquium/>

**29.06.2026**

#### **Vorstellungsvortrag im Rahmen des Habilitationsverfahrens**

Dr. Patrick Härtl

Julius-Maximilians-Universität Würzburg, Experimentelle Physik II

#### **Nanoscale analysis of magnetic domains and spin textures in rare-earth metal films**

#### **Abstract**

Magnetic thin films are central to modern sensor and data-storage technologies, where continued miniaturization demands a microscopic understanding of magnetization processes, including saturation, remanence, and coercivity. In structurally disordered systems, defect-mediated domain-wall pinning obscures intrinsic magnetic behavior. Epitaxial films grown on single-crystalline substrates provide a controlled platform to disentangle structural and magnetic contributions. Prototypical and frequently studied magnetic elements are the 3d transition metals iron, cobalt, and nickel. In contrast, the twelve magnetic rare-earth metals (REMs) with their partially filled 4f shells have been investigated to much lower extent, in spite of their important role in numerous key technologies, ranging from high-performance permanent magnets to renewable energy and advanced electronics. From a general physics point of view their complex exchange interactions and rich magnetic phase behavior also make them model systems for fundamental studies of magnetic order. Our knowledge of the surface magnetic domain structure of REMs is surprisingly sparse. Until recently, real space studies had been available for a few REMs only, i.e. dysprosium (Dy), gadolinium (Gd), and neodymium (Nd). In my talk I will present methodological advances and selected studies [1-5] demonstrating how impurities, structural defects, and epitaxial constraints govern magnetic ordering

in REM films and give an outlook on the technological relevance of REM–3d transition-metal alloys. Advancing real-space magnetic imaging and integrating it with element-specific spectroscopy will open pathways to resolve ultrafast and nanoscale magnetic phenomena in rare-earth materials with unprecedented precision. Such insights are expected to guide the intentional design of REM heterostructures and hybrid REM–3d alloys with tailored anisotropy, tunable exchange interactions, and robust thermal stability. Beyond deepening our fundamental understanding, these efforts will help establish rare-earth thin films as versatile building blocks for next-generation spintronic devices, energy-efficient information technologies, and adaptive magnetic architectures.

[1] P. Härtl et al., Phys. Rev. B 105, 174431 (2022) [Gd]

[2] P. Härtl et al., Phys. Rev. Lett. 133, 186701 (2024) [Gd]

[3] P. Härtl et al., Phys. Rev. B 110, 184405 (2024) [Tb]

[4] P. Härtl et al., Phys. Rev. B 112, 024416 (2025) [Eu]

[5] P. Härtl et al., Phys. Rev. B 112, 174402 (2025) [Ho]

Für die Dozentinnen bzw. Dozenten der Fakultät

Prof. Dr. Neuenfeld, Dr. Feichtner, Dr. Ünzelmann, Hr. Plote, Hr. Schwarzkopf