



# TRR 80 Seminar

Am Dienstag, den 21. November um 16:00 Uhr

spricht

***Dr. Axel Lubk***

**IFW Dresden**

über das Thema

## ***Advanced Holographic Tomography for 3D Magnetic Imaging in Magnetic Textures***

TEM methods reconstructing the beam electrons' phase, and hence electric or magnetic fields imprinting Aharonov-Bohm phase shifts, play a prominent role in material science; and a large number of different phase retrieval setups, such as off-axis and transport-of-intensity inline holography, permitting the investigation of a multitude of object geometries and fields, have been developed. Moreover, the inevitable information loss occurring when projecting a 3D field into a 2D TEM hologram has been (partly) overcome by combining Electron Holography with Tomography (EHT) [1–4], typically consisting of the acquisition of a set of holograms under different viewing angles (tilt series), followed by a numerical back-projection of the recorded data into 3D space. Here, we report on novel developments in EHT overcoming physical and technological limitations, previously limiting the technique in particular for the retrieval of 3D magnetic textures, such as skyrmions.

In the first part we focus on the reconstruction of magnetic vector fields. We present EHT reconstructions all three Cartesian components of a magnetic vector field in Co/Cu layered magnetic nanowires in 3D from two perpendicular tilt series. We discuss the crucial experimental steps including dedicated tomographic specimen holder developments and generalizations of tomographic reconstruction algorithms, allowing for a concomitant reconstruction of all electric and magnetic field components in one step. Additionally, we present tomographic data of the 3D texture in magnetic Skyrmions occurring in thin films of FeGe.

In the second part we present the details about a recently developed dedicated liquid-Helium cryo TEM, facilitating holographic magnetic field mapping down to 6K under the application of external magnetic fields. We show magnetic field mappings in GaV<sub>4</sub>Se<sub>8</sub> at low temperatures, exhibiting unusual magnetic textures, such as cycloidal phases of different periods and Skyrmions coupled to ferroelectric polarisations.

- [1] P. A. Midgley and R. E. Dunin-Borkowski, Electron tomography and holography in materials science, *Nature Materials* 8, 271 (2009).
- [2] D. Wolf, A. Lubk, F. Röder, and H. Lichte, Electron holographic tomography, *Current Opinion in Solid State and Materials Science* 17, 126 (2013).
- [3] A. Lubk et al., Nanometer-scale tomographic reconstruction of three-dimensional electrostatic potentials in GaAs/AlGaAs core-shell nanowires, *Phys. Rev. B* 90, 125404 (2014).
- [4] D. Wolf, A. Lubk et al., 3D Magnetic Induction Maps of Nanoscale Materials Revealed by Electron Holographic Tomography, *Chemistry of Materials* 27, 6771 (2015).

Gäste sind herzlich willkommen.

Der Vortrag findet im Seminarraum S-288 / Institut für Physik, Universität Augsburg statt.

Gastgeber: Prof. Dr. István Kézsmárki  
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