Dresden University of Technology

Faculty of Physics

PHYSICS COLLOQUIUM



Speaker: **Dr. Darius Pohl**
Deputy Director
Dresden Center for Nanoanalysis (DCN)
TU Dresden

Topic: **Electrons with a Twist: Accessing Atomic-Scale Magnetic Circular Dichroism in a TEM**

Time and place: Tuesday, January 19, 2027, **2:50 pm** – hybrid event
The colloquium will be held in REC/C213.
Online participation possible:
Zoom-Meeting: Meeting-ID: 642 8554 1414 / passcode: w8$nSJjy
https://tu-dresden.zoom-x.de/j/64285541414?pwd=6UOwTkSBlWvNv16PgF2K1qZtoUC8cS.1

Host: Prof. Lukas Eng

Abstract: Imaging and directly identifying the elemental origins of magnetism at the atomic scale remains a central challenge in condensed matter physics. Electron magnetic circular dichroism (EMCD), the electron wave counterpart of X-ray magnetic circular dichroism (XMCD), enables element-specific measurement of spin and orbital magnetic moments with nanometer-scale resolution in transmission electron microscopy (TEM) [1]. However, quantitative measurements of these inherently weak dichroic signals are frequently hindered by stringent requirements for optimal experimental conditions [2] and dominant noise contributions in the spectra [3]. Electron vortex beams (EVBs), which carry quantized orbital angular momentum [4], have emerged as a promising tool for advancing EMCD measurements. Because EVBs can be tightly focused to sub-nanometer dimensions [5]. Despite this theoretical promise, a definitive experimental demonstration at the atomic scale has been lacking.
In this presentation, I will discuss our recent experimental progress alongside the theoretical framework necessary to establish the prerequisites for EVB-EMCD measurements. I will present the first experimental realization of two-dimensional, atomic-scale EMCD mapping using EVBs [6]. We validate this breakthrough using a complex ferrimagnet ($BaFe_{11}TiO_{19}$). By acquiring spectra from individual Fe atomic columns, we successfully resolve the antiparallel alignment of the magnetic sublattices and elucidate the specific role of non-magnetic Ti doping.

[1] P. Schattschneider et al., Nature 441, 486-488 (2006).
[2] S. Schneider et al., Phys. Rev. Mat. 2(11), 113801 (2018).
[3] H. Makino et al., UM, 114372 (2026).
[4] J. Verbeeck, H. Tian and P. Schattschneider, Nature 467, 301-304 (2010).
[5] D. Pohl et al., Sci. Rep., 7(1), 934 (2017).
[5] D. Pohl et al., arXiv:2509.17897.

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Bio: Dr. Darius Pohl is the Deputy Director of the Dresden Center for Nanoanalysis (DCN) at TU Dresden. He earned his PhD in Physics from TU Dresden in 2013. His research expertise bridges physics and materials science, focusing heavily on analytical transmission electron microscopy (TEM), electron vortex beams, and the in-situ characterization of nanomaterials. Previously, he served as Deputy Head of Department Metastable and Nanostructured Materials at the IFW Dresden. Dr. Pohl is an active educator who currently leads multiple DFG-funded research projects. He has authored more than 100 peer-reviewed journal publications, maintains an h-index of 34, and has won multiple microscopy awards.