TECHNISCHE UNIVERSITÄT DRESDEN

IFMP Institut für Festkörper- & Materialphysik

# IFMP Seminar

**Date:** Tuesday, January 26, 2020, at 14:50
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https://selfservice.zih.tu-dresden.de/l/link.php?m=54644&p=0ff53870 (TUD)
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**Speaker:** **Toni Helm**
*Helmholtz-Zentrum Dresden Rossendorf and MPI-CPfS*

**Title:** **Mesoscale experiments with FIB-cut crystalline quantum materials under challenging conditions**

**Abstract:** In order to uncover and understand the physics of topical quantum materials, experiments are pushed to their limits in terms of setup dimensions and resolution. One major challenge for investigations of such materials is the size and shape of real-life single crystals. Another hurdle to experiments is that most of the interesting physics occurs on length scales much smaller than the actual sample dimensions. In our approach, we apply focused ion beam (FIB) micromachining for the fabrication of micron-scale devices from bulk single crystals. Our research focuses on the mesoscale regime, i.e., the typical sizes of our structures are in the range of 0.1 – 100 µm. This range covers many of the relevant length scales in quantum materials, such as coherence lengths in superconductors, domain sizes in quantum magnets or the mean-free-paths in clean metals.

In this talk, I will exemplify some of our recent projects that benefited from FIB assisted patterning and uncovered new physics in topical materials. For example, we are able to explore highly conductive heavy-fermion metals under challenging conditions, such as pulsed magnetic fields and high pressures, with unprecedented quality [1,2]. Furthermore, I will show how we can contribute to the field of unconventional magnetism. As an example, I will present very recent results from electrical-transport experiments that we combined with microscopic magneto-sensitive imaging tools. This enabled us to reveal the topological transport signature of skyrmionic textures in the multi-skyrmion Heusler $Mn_{1.4}PtSn$ and in the hard magnet MnBi [3,4].

[1] F. Ronning, T. H. et al., Nature **548**, 313–317 (2017), *Electronic in-plane symmetry breaking at field-tuned quantum criticality in $CeRhIn_5$*
[2] T. Helm, et al., Nat. Commun. **11**, 3482 (2020), *Pressure-induced critical suppression of high-field nematicity in $CeRhIn_5$*
[3] M. Winter, T. H. et al., To be published (2021)
[4] Y. He, T.H. et al., unpublished, Preprint at arXiv:2011.06340 (2020), *Topological Hall effect arising from the mesoscopic and microscopic non-coplanar magnetic structure in MnBi*

Host: M. Rahn