TECHNISCHE UNIVERSITÄT CHEMNITZ

Institut für Physik

Physikalisches Kolloquium

- Online-Veranstaltung -

Mittwoch, 03.02.2021, um 11:15 Uhr

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Magnetization Dynamics of single ferromagnetic nanostructures

Designing future spintronic devices or entities made of magnetic nanostructures requires the knowledge of their static and dynamic properties. Moreover, finite-size effects become important, i.e., the magnetic properties change when the surface layers dominate over the bulk (volume) contribution of the sample. For nanostructures this concerns also the side walls. Regarding magnetization dynamics even subtle variations of the magnetic landscape strongly influence the spin wave spectrum.

Nevertheless, the precise magnetic characterization of a single nanostructure like a nanowire or dot is still an experimental challenge. Time-resolved laser-based techniques work at their limit of spatial resolution. X-ray microscopy requires synchrotron sources and special substrates. Broadband ferromagnetic resonance (FMR) usually lacks the necessary sensitivity to measure single submicron structures. Measurements of arrays of such elements often might be no alternative due to array inhomogeneity either. Here, I will show that microresonator-based FMR [1-3] can overcome some limitations. The optimized filling factor of planar microresonators boost the sensitivity by several orders of magnitude to allow for measuring even a single Fe-filled carbon nanotube (Fe-CNT) [1] with an inner diameter of just 40 nm.

In the second part I will show, how focused ion beams help in optimizing the magnetic landscape by micromilling the side walls of magnetic nanostrips. Together with micromagnetic simulations this offers various paths to tune and influence localized spin waves giving new insights into these confined modes.

[1] K. Lenz et al., Small 15, 1904315 (2019)
[2] A. Banholzer et al., Nanotechnology 22, 295713 (2011).
[3] R. Narkowicz et al., Rev. Sci. Instrum. 79, 084702 (2008).