SFB1242

SFB 1242 Nichtgleichgewichtsdynamik kondensierter Materie in der Zeitdomäne

UNIVERSITÄT DUISBURG ESSEN

Open-Minded

04.12.2025 / 11 Uhr s.t., Raum MB 242
Campus Duisburg

Towards novel ultrafast spintronic devices

Prof. Dr. Markus Münzenberg

University of Greifswald

Magnetization manipulation is an indispensable tool for both basic and applied research. I will discuss an actual overview on ultrafast magnetism and THz spintronics [1]. The dynamics of the spin response depends on the energy transfer from the laser excited electrons to the spins within the first femtoseconds. Due to the non-equilibrium electron distribution in layered nanoscale spintronic devices, ultrafast spin currents are generated and contribute to the laser driven spin dynamics. Ultrafast laser-driven spin currents can be converted via the spin-Hall effect into a charge current burst [2] that can even compete with state-of-art THz emitters [3]. They allow to map topological spin structures, and their THz dynamics, potentially with sub micron resolution as we recently demonstrated [4]. But ultrafast laser pulses can also trigger the movement of vortices in magnetic nanooscillators. This allows realizing novel concepts for photonic integration for spin-based neuromorphic devices. We have also recently shown that attosecond lasers are breaking new frontiers and records towards the observation of coherent spin processes on ever shorter time scales, reaching Petaherz light frequency spintronics. Using light wave coherent charge transfer, driven by a few cycle laser pulse, I will report the first coherent attosecond magnetism in layered spintronic devices [5]. These experiments, the fastest spin-dynamics observed experimentally, fit perfectly to the time scales for time resolved DFT, from theoretical sides revealing a coherent electron transfer at interfaces *in operando*. This opens up applications of coherent spin current processes. We acknowledge funding by SpinAge, Horizon 2020 FET Open and META-ZIK Plasmark-T, BMBF Unternehmen Region.

[1] J. Walowski and M. Münzenberg, Review, J. Appl. Phys. **120**, 140901 (2016).
[2] T. Kampfrath, et al. Nature Nanotech. **8**, 256 (2013).
[3] T. Seifert, et al. Nature Photon. **10**, 483–488 (2016).
[4] F.-F. Stiewe, et al. Appl. Phys. Lett. **120**, 032406 (2022).
[5] F. Siegrist et al. Nature **571**, 240 (2019).

Für diese Zeit steht eine Kinderbetreuung nach vorheriger Anmeldung zur Verfügung.

Contact: Prof. Dr. Björn Sothmann, Faculty of Physics
Phone: +49 (203) 37-93330 / Mail: bjoerns@thp.uni-due.de