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über

Coherent optical spin manipulation in topological systems reaching attosecond time scales

Abstract:

Magnetization manipulation is an indispensable tool for both basic and applied research. I will discuss some of the knobs to tune topological systems by using dynamics at ultrafast time scales, and show in my presentation 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 [1]. 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]. Similar concepts can be used in topological insulators to generate spin-currents controlled by the photon's helicity in Hall bar devices [4]. Attosecond lasers are breaking new frontiers and records towards the observation of coherent spin processes on ever shorter time scales. These phenomena originate from coherent charge transfer, driven by a few cycle laser pulse, and they are relevant for all materials and interfaces, from semiconductors and metals to molecules. Finally, I will report the first coherent attosecond magnetism in layered spintronic devices [5], both, from experimental and theoretical sides revealing coherent electron transfer at interfaces, and will connect to possible applications of coherent processes.

[1] J. Walowski and M. Münzenberg, *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] T. Schumann, et al. arXiv:1810.1279.
[5] F. Siegrist et al. *Nature* **571** (2019).

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