Terahertz spin and charge photocurrents in topological spintronic structures

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To take advantage of the electron spin in future electronics, spin angular momentum needs to be transported and detected. In this respect, topological Weyl semimetals and topological insulators are considered as promising materials for spin-current generation and spin-charge interconversion. To probe the initial ultrafast elementary steps that lead to the formation of spin and charge currents, we launch and measure transport by employing ultrashort optical and terahertz electromagnetic pulses (Fig. 1). Based on this approach [1], new insights into important spintronic phenomena such as spin-current generation in Weyl semimetals [2], spin-charge conversion in ferromagnet/topological-insulator heterostructures and photocurrents in three-dimensional topological insulators [3] can be obtained. Interesting photonic applications such as the generation of ultrashort terahertz electromagnetic pulses also emerge [4].

References

[1] Rouzegar et al., Phys. Rev. B 106 (2022) 144427
[2] Bierhance et al., Appl. Phys. Lett. 120 (2022) 082401
[3] Braun et al., Nature Commun. 7 (2016) 13259
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Figures

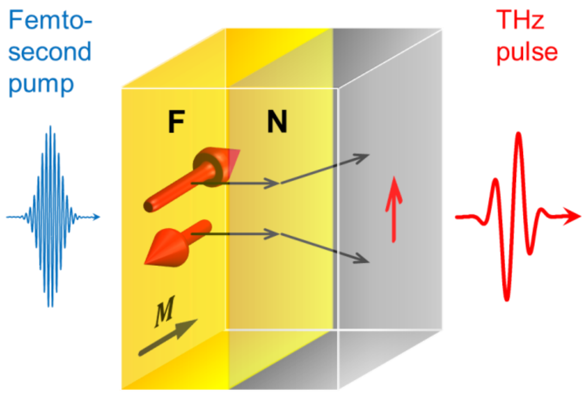

Figure 1: Schematic of ultrafast spin and charge photocurrents in F|N stacks. A femtosecond laser pulse drives spin transport from a ferromagnetic metal layer F into a non-ferromagnetic layer N. Spin-charge conversion results in an in-plane charge-current burst that emits a detectable terahertz electromagnetic pulse [1].