Max-Planck-Institut für Struktur und Dynamik der Materie

Max Planck Institute for the Structure and Dynamics of Matter

Wednesday, Jan. 11, 2017 – 11:00 h
CFEL Seminar room IV (Bldg. 99)

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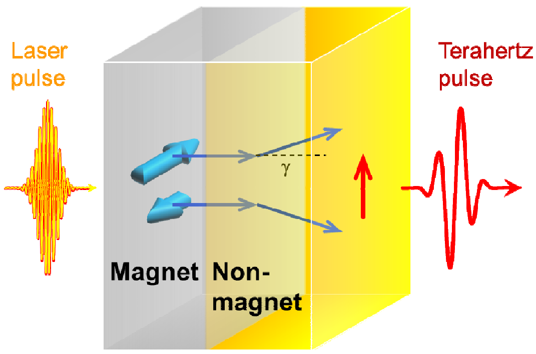
Ultrafast spintronics with terahertz radiation

Terahertz (THz) electromagnetic radiation is located in the gap that separates the realms of electronics (<1 THz) and optics (>30 THz). Sub-picosecond THz pulses are capable of probing and even controlling numerous low-energy excitations such as phonons, excitons and Cooper pairs. Here, we consider experiments showing that THz radiation is also a very useful and versatile tool in the fields of spintronics and ultrafast magnetism.

First, we optically launch ultrafast spin transport and study its conversion into charge currents by means of the inverse spin Hall effect [Nature Nanotech. 8, 256 (2013)]. The charge current can be detected by sampling the concomitantly emitted THz radiation. This approach allows us to monitor ultrafast spin currents and provides a quick and easy estimate of the strength of the spin Hall effect in a contact-free manner. In addition, optimization of the spintronic structure has led to new, efficient and scalable emitters of THz pulses that fully cover the range from 1 to 30 THz without gap [Nature Photon. 10, 483 (2016)]. Second, we address spin-lattice coupling by selective excitation of optical phonons in the model ferrimagnetic insulator $Y_3Fe_5O_{12}$ (YIG) and find a quenching of magnetic order on a time scale as short as 1 ps. This observation attests to a highly efficient coupling of crystal lattice and electron spins in this material.



Host: Sebastian Loth

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