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Narrow-band THz spin dynamics in ferromagnetic metallic thin films

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The interaction between magnetism and light is receiving considerable interest in recent years, after the groundbreaking experiments that showed that ultrashort (~100 fs) infrared light pulses can be used to demagnetise or even switch the magnetisation of thin film ferromagnets. However, to date no clear and commonly accepted understanding of the fundamental physical processes governing the ultrafast magnetization has been reached, partly because accurate modelling of the infrared fs laser-induced highly non-equilibrium state remains a key obstacle.

We will present recent experiments where we used strong THz fields, rather than infrared pulses, to excite ultrafast magnetisation dynamics in thin film ferromagnets, and probed it with the time-resolved magneto-optical Kerr effect. We used narrow-band THz pulses produced at the High-Field High-Repetition-Rate Terahertz facility @ ELBE (TELBE) to drive magnetisation dynamics in an amorphous CoFeB sample. Our results show that demagnetisation is strongly dependent on the frequency of the THz pulses and that there is a competition with frequency dependent re-magnetising effects, and that the number and type of defects affect the process. Our measurements illustrate the relation between charge- and spin-dependent scattering of conduction electrons, deepening our understanding of ultrafast spin dynamics.

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