Ultrafast demagnetization: understanding magnetic states out of equilibrium

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Femtosecond lasers allow to observe magnetization dynamics on unprecedently short timescale. It has been commonly described employing the three temperature model. By means of ab initio calculations we look at situations when the demagnetized system deviates significantly from the assumptions of this model.

The observed decrease of magnetooptical signal can be ascribed to three possible effects: a reduction of exchange splitting (longitudinal spin excitation), disorder of magnetic moments (transversal spin excitation), and the increase of electronic temperature. High harmonics has been used to understand the nature of the magnetic state in demagnetized Co and disentangle the three above contributions by a careful comparison to an ab initio predicted spectrum [1]. In Gd metal pumped by a fs laser we have studied how the relation between 4f and 5d magnetization is changed compared to a thermal state, employing first principles exchange interaction between atomic moments, as well as the intra-atomic exchange between 4f and 5d orbitals [2].

References:

[1] E. Turgut et al., Phys. Rev. B 94, 220408 (2016)

[2] Frietsch, B. et al. , Nat. Comm. 6, 8262 (2015)