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Ultrafast Magnetization Dynamics of Gadolinium: Towards a Complete Picture

We designed and performed a time- and angle- resolved photoemission experiment to investigate the electronic structure of a ferromagnetic Gadolinium film during ultrafast laser-induced demagnetization and subsequent thermal recovery.
To get a complete picture of the magnetization dynamics we track the binding energy of the exchange-split valence band, which mediates the exchange interaction between the 4f orbitals for adjacent atoms and investigate in addition in the same experiment the polarization of the 4f system by magnetic linear dichroism. This "complete"picture of the magnetic system allows us to evaluate current theories of magnetization dynamics. Comarison with published MOKE and XMCD data give insight to the magnetic properties measured by these methods in the non-equilibrium regime during the first picoseconds.

Methods: We use a 10kHz Ti:sapphire laser system (1.5 mJ/pulse) to create high harmonic radiation in an argon gas. For the presented data we used the 23rd harmonic at 36eV photon energy to perform time- and angle- resolved photoemission. The desired harmonic is selected by an XUV monochromator, giving an ultimate energy resolution of approximately 100 meV.
The 10nm thick Gadolinium film was grown epitaxially on W(110) by e-beam evaporation. In plane magnetization of the sample is done without changing the position of the sample by a free standing coil.

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