

Non-equilibrium electron and spin dynamics in magnetically ordered films probed by fs x-ray pulses

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Investigations of fs laser excited non-equilibrium states are performed using soft x-ray pulses with 100 fs duration from the BESSY II femtoslicing facility. Time-resolved x-ray absorption spectroscopy (XAS), x-ray magnetic circular dichroism (XMCD), and recently resonant x-ray diffraction enable detailed measurements of the dynamic properties of magnetically ordered systems. Tuning the x-ray energy to individual absorption edges we study the laser induced changes of the valence electrons by XAS. Circularly polarized x-rays are used in XMCD measurements to follow the sub-picosecond quenching of spin and orbital angular momentum through a sum rule analysis. In Ni we found a transient increase of the spin-orbit coupling just after laser excitation, which persists during the demagnetization process. An element-resolved measurement of the magnetization dynamics in NiFe results in two different time scales for the Ni and Fe spins, demonstrating the strong influence of the laser-induced non-equilibrium state onto the exchange interaction.

Author: STAMM, Christian (Helmholtz-Zentrum Berlin für Materialien und Energie)

Co-authors: ESCHENLOHR, Andrea (Helmholtz-Zentrum Berlin für Materialien und Energie); DÜRR, Hermann (SLAC National Accelerator Laboratory); RADU, Ilie (Radboud University Nijmegen); WIETSTRUK, Marko (Max Born Institut); PONTIUS, Niko (Helmholtz-Zentrum Berlin für Materialien und Energie); KACHEL, Torsten (Helmholtz-Zentrum Berlin für Materialien und Energie)

Presenter: STAMM, Christian (Helmholtz-Zentrum Berlin für Materialien und Energie)

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