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[L] Transient electronic structure and spin polarization in lanthanide metals

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On which timescale do the band structure and spin polarization of a ferromagnet change after femtosecond laser excitation and how do they affect the magnetization dynamics? To answer these questions we perform time-, spin-, and angle-resolved photoemission experiments with optical laser pulses and higher-order harmonic radiation.
We have studied ultrafast demagnetization in the local-moment ferromagnets where equilibration of the laser excited state involves more than one timescale, because optical transitions occur in the valence band but the magnetic moment is dominated by the localized 4f electrons.
Following excitation by ultrashort near-infrared pulses, we directly map the transient exchange splitting of the Gd and Tb valence bands near the center of the bulk Brillouin zone. Simultaneously we record the magnetic linear dichroism of the 4f photoemission line. This allows us to compare the magnetization dynamics of 4f core and 5d6s valence electrons in one measurement. To probe the spin polarization, we utilized the unique magnetic properties of the 5d_z^2 surface states. In spin- and time-resolved photoemission with 6.3-eV laser pulses we confirm that the exchange splitting of the Gd and Tb surface state follows that of the 5d6s valence bands. In contrast, the spin polarization of the surface state appears to reflect the magnetization of the 4f core levels.

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