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# Ultrafast dynamics of magnetic anisotropy and magnetic structure in ferrimagnetic CoTb thin films

*Wednesday, 8 October 2025 15:00 (25 minutes)*

Since the discovery of ultrafast demagnetization occurring on sub-picosecond timescales [1], numerous intriguing phenomena have been observed, especially in ferrimagnetic rare-earth (RE)–transition metal (TM) alloys [2]. In these materials, the two sub- systems exhibit distinct ultrafast magnetization dynamics when subjected to a femtosecond infrared pulse. For exemple, this has also been observed in CoTb thin films [3], but Co and Tb were probed separately so far, preventing the study of a possible difference in the onset of the Co and Tb demagnetization as seen in other alloys [4]. Furthermore, the optically-induced change of the magnetic structure observed in [3] highlights the need for systematic measurements.

We performed time-resolved Small-Angle X-ray Scattering (Tr-SAXS) at the DIPROI beamline (FERMI) to study CoTb alloys after femtosecond laser excitation. Using FERMI's dual-wavelength X-ray pulses, we probed simultaneously Co 3d and Tb 4f electrons at their respective absorption edges (58.9 eV and 150.5 eV), enabling element-specific, nanometer-resolved magnetization dynamics. By fitting the azimuthal integration of the scattered intensity we can extract the dynamics of the magnetization amplitude, domain size and domain size distribution for both TM and RE. We observed two demagnetization regimes: a fast sub-ps quenching and a slower picosecond-scale reduction, linked to anisotropy changes. Additionally, we detected a 2% domain size reduction within 500 ps and the emergence of a surface acoustic wave mediated by sample roughness [5].

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