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### **Ultrafast magnetization dynamics in lanthanide ferromagnets: From bulk to surfaces<sup>1</sup>**

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The intense research on femtosecond laser-induced magnetization dynamics resulted in rich ultrafast phenomena [1]. A microscopic description of the underlying elementary processes, however, remains a challenge. Most efforts focus on the  $3d$  transition metal ferromagnets and related compounds. This talk discusses recent work on the lanthanide ferromagnets Gd and Tb. Their magnetic moment is dominated by  $4f$  electrons which are localized at the ion core. Their spin-lattice coupling is determined by the angular momentum of the  $4f$  electrons. Using femtosecond x-ray magnetic circular dichroism at the femtosecond slicing facility at the BESSY II storage ring in Berlin, Germany, we measure the ultrafast change in the magnetic moment, which occurs on two specific timescales [2]. The faster one is 0.75 ps. It is driven by hot electrons and is identical for both lanthanides. The slower one is different for Gd (40 ps) and Tb (8 ps) due to the stronger spin-lattice coupling in Tb. The talk also discusses time-resolved non-linear optical studies on Gd(0001) and Tb(0001) surfaces [3]. We find a coherent surface phonon which is strongly coupled with the ultrafast magnetic response and pronounced differences compared to the bulk dynamics which are attributed to spin-polarized transport effects.

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[2] M. Wietstruk *et al.*, <http://arxiv.org/abs/1010.1374>.

[3] A. Melnikov and U. Bovensiepen, in *Dynamics at solid state surfaces and interfaces* Vol. 1, edited by U. Bovensiepen, H. Petek, M. Wolf (Wiley-VCH, Weinheim, 2010); A. Melnikov *et al.*, *J. Phys. D: Appl. Phys.* **41**, 164004 (2008).

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