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Laser Demagnetization Dynamics in Gadolinium from Time Resolved Photoemission JOHN BOWLAN, BJÖRN FRIETSCH, MARTIN TEICHMANN, ROBERT CARLEY, MARTIN WEINELT, Free University of Berlin

— The field of ultrafast magnetization dynamics has seen rapid progress in recent years and has the potential to enable magnetic data storage systems orders of magnitude faster than those based on conventional read/write heads. The dynamics of laser demagnetization in ferromagnetic Gadolinium depend on the transfer of energy and angular momentum between the metallic valence electrons and the core-like $4f$ electrons. Angle-Resolved Photoemission (ARPES) with femtosecond XUV laser pulses produced by high harmonic generation enables the direct measurement of the electronic band structure on a sub-picosecond time scale in a “tabletop” setup. Photoemission allows the magnetization dynamics of the valence and $4f$ bands to be tracked independently of one another. Thus, time-resolved photoemission is an alternative to experimental methods such as surface magnetic second harmonic generation (MSHG), the magneto-optical Kerr effect (MOKE), and x-ray magnetic circular dichroism (XMCD). We applied this technique to study Gd(0001) films grown epitaxially on a W crystal. We find that the valence electrons demagnetize on a fs time scale, while the 4f electrons respond more slowly.

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