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Magnetic switching by magnetic fields is slow and inefficient because of the weak interaction and the long range of magnetic fields. Thermally- or optically-driven switching promises a new route to fast and localized switching, potentially revolutionizing the way information is written in a magnetic medium. Beyond this technological interest ultrafast interaction between magnetic materials and electromagnetic waves and the following exchange of angular momentum in the material is of fundamental importance: Currently, lack of quantitative experimental data about the exchange of angular momentum between spin moment, orbital moment, and lattice precludes us from achieving a complete understanding of ultrafast magnetism.

Earlier experiments, which made use of the time-resolved magneto-optical Kerr effect (TR-MOKE), indicated the possibility of triggering a sub-picosecond demagnetization by heating the system with a femtosecond laser pulse. However optical techniques do not distinguish and quantitatively measure spin and orbital moment. Time resolved x-ray magnetic circular dichroism (TR-XMCD) can overcome this problem. It is element specific, sensitive to ferro- and antiferromagnetism, allows us to independently measure spin and orbital momenta, and can be used to probe buried layers in a multi-layer structure. At the Lawrence Berkeley National Laboratory (Advanced Light Source, Beamline 4.0.2) a TR-XMCD setup has been realized and tested. A time resolution of about 1 ps has been achieved using an x-ray streak camera. A 30-fs IR laser pulse has been used to excite the sample. First test experiments have been carried out on FeGd thin films, showing the possibility of detecting a thermally induced reorientation transition. In this poster the TR-XMCD setup is presented, together with first experimental results.

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