Controlling Magnetism by Light

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Manipulation and control of magnetism by light is one of the key topics of modern research in condensed matter with direct and far-reaching implications for magnetic recording industry. Of particular interest for both fundamental and applied science is the use of femtosecond laser pulses to fully control the magnitude and orientation of a spin ensemble on ultimate time and length scales [1,2].
The recent years have witnessed spectacular demonstrations of how ultrashort bursts of light can affect the magnetic order parameter ranging, for instance, from ultrafast demagnetization [3] to laser-induced magnetization generation [4] and from coherent spin dynamics at THz frequencies [5] to all-optical magnetization switching [6,7], just to name a few.
Despite of all these breakthroughs, the microscopic processes behind such ultrafast spin phenomena remained poorly understood and controversially discussed. Moreover, the ultimate speed of controlling the spins remains also largely unexplored.

Here, I will review the latest developments in our projects on ultrafast magnetism employing selective excitations and probing of spins using time-resolved techniques spanning the entire spectral range from soft X-rays to THz radiation. A particular focus will be placed on driving magnetization-switching phenomena using these novel light sources.

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