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Controlling Magnetism by light[1]

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From the discovery of sub-picosecond demagnetization over a decade ago to the recent demonstration of magnetization reversal by a single 40 femtosecond laser pulse, the manipulation of spins by ultra short laser pulses has become a fundamentally challenging topic with a potentially high impact for future spintronics, data storage and manipulation and quantum computation. In addition, when the time-scale of the perturbation approaches the characteristic time of the exchange interaction ($\sim$ 10-100 fs), the magnetization dynamics enters a novel, highly non-equilibrium, regime, which was recently demonstrated by both fs optical and X-ray experiments. Theoretically, this field is still in its infancy, using phenomenological descriptions of the none-equilibrium dynamics between electrons, spins and phonons via 2- or 3-temperature models and atomistic spin simulations. A proper description should include the time dependence of the exchange interaction and nucleation phenomena on the nanometer length scale. Such developments need to be supported by experimental investigations of magnetism at its fundamental time and length scales, i.e. with fs time and nanometer spatial resolution. Such studies require the excitation and probing of the spin and angular momentum contributions to the magnetic order at timescales of 10fs and below, a challenge that could be met by the future fs X-ray FEL's but in some cases also with purely optical techniques.

Recent references:

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