CONTROLLING MAGNETISM BY LIGHT:

from fundamentals to nanoscale engineering

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From the discovery of sub-picosecond demagnetization almost two decades ago to the more 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. The realization that femtosecond laser induced all-optical switching (AOS) as observed in ferrimagnets exploits the antiferromagnetic exchange interaction between their sublattices, opens the way to engineer new magnetic materials for AOS. Because their dynamics is governed by the exchange interaction, antiferromagnetic materials give rise to the fastest dynamics and, by proper choice of materials, can also lead to very low energy requirements for switching. Another challenge is how to bring the optical manipulation of magnetic media to the required nanoscale, which may be possible using plasmonic or wave-shaping techniques. Recent results with engineered hybrid magnetic materials and nanofocusing will be discussed, showing the practical potential of AOS.

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