Ultrafast laser-driven demagnetization: A theoretical perspective

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Through excitation of materials with ultrashort laser pulses it might be possible to reach novel, transient states of matter that cannot be reached under equilibrium conditions. One prominent example is that of ultrafast laser-induced demagnetization which was discovered 20 years ago. Femtosecond laser excitation of a ferromagnetic transition metal was found to cause an ultrafast magnetization quenching within about 300 fs, much faster than the equilibrium spin-lattice relaxation time. The origin of the unexpectedly fast demagnetization is not understood and is currently a topic of intense debates. In this talk I will give a survey of recent theories and discuss in more detail the electron-phonon spin-flip scattering and the superdiffusive transport models, in connection to insightful measurements that help to bring the problem's solution closer. I will provide an outlook on future ultrafast magnetic processes, including all-optical magnetization reversal and laser-imparted magnetization.