Theory of ultrafast demagnetization after fs laser pulses

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Experimentally it has been found that a ferromagnetic metallic film is strongly demagnetized within a few hundred fs after exposure to a fs laser pulse. The talk reviews the theories of this ultrafast demagnetization, especially the scattering of the excited electrons at phonons and magnons. These calculations are performed by the ab-initio spin-density functional electron theory for Ni and Fe, and they are based on Fermi's golden rule for transition rates. The application of this rule on the fs time scale is critically discussed in view of results from quantum-kinetical density-matrix calculations. It is shown that the experimentally observed demagnetization rates cannot be explained by spin-flip scatterings of electrons exclusively at phonons [1] or exclusively at magnons [1]. A combination of individual spin-flip electron-phonon and spin-flip electron-magnon processes is shown to be a potential candidate for the explanation of ultrafast demagnetization.

References:

[1] C. Illg et al., Phys. Rev. B **88**, 214404 (2013); M. Haag et al., appears in Phys. Rev. B