

Theoretical investigation of ultrafast laser-induced magnetization dynamics in many-electron systems

Daria Popova, Dr. Andreas Bringer, Prof. Stefan Blügel

*Institut for Solid State Research & Institute for Advanced Simulation,
Forschungszentrum Jülich and JARA, 52425 Jülich, Germany*

Ultrafast optical control of a magnetic state of a medium is presently a subject of intense research. It is of importance for the development of novel concepts for high-speed magnetic recording and information processing. Series of experiments has revealed direct optical control on magnetization via inverse Faraday effect [1]. In these experiments femtosecond circularly polarized high-intensity laser pulses are used to excite the sample. But the mechanism of the orbital momentum transfer from light to the medium, which defines the fundamental time limit on magnetic switching, is still not understood.

In order to get insight to the origin of the inverse Faraday effect we investigate the magnetization dynamics of atoms, which are components of materials used in experiments, excited by femtosecond circularly polarized Gaussian-shaped laser pulses. We study the stimulated Raman-like scattering process, which was suggested to be responsible for the magnetization reversal by light [2]. The time-dependent Schrödinger equation is solved up to the second order using the Volterra iteration method to describe the action of the laser light on the system. The time evolution of the probability of excitation from the ground state to an excited level and back to the ground state with a different magnetic state is calculated. We show, that due to this process the magnetization of the system changes after the action of the laser pulse on it.

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[1] A. V. Kimel et al., *Nature* **435**, 655 (2005).

[2] F. Hansteen et al., *Phys. Rev. B* **73**, 014421 (2006).