Manipulation of nanoparticles using time-dependent electric and magnetic fields: theory and simulations

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The interaction of time-dependent fields with nanoparticles gives rise to a variety of interesting phenomena. In this talk I will address the problem of manipulation of the lattice structure of nanoparticles as a consequence of femtosecond laser excitation, and magnetization reversal induced by time-dependent magnetic fields.

In particular, the possibility using femtosecond laser pulses to eliminate defects at the nanometer scale will be discussed. As an example,a microscopic calculation of the ultrafast, nonequilibrium healing of 5-7-5-7 defects in carbon nanotubes will be presented.

The ability of magnetic field pulses to achieve magnetization reversal on sub-nanosecond time scales has been demonstrated experimentally by different groups. From the theoretical point of view it is of interest to investigate which pulse-shape is the optimal one in order to induce a magnetization inversion on the shortest time.

In this work we perform model calculations to search for the optimal shape of a magnetic pulse to induce ultrafast magnetization reversal of a Stoner particle. The magnetization dynamics is described with the help of the Landau-Lifshitz equation, and the optimal field shape is obtained by using genetic algorithms.