Ultrafast Magneto-acoustics

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Ultrafast dynamics in ferromagnetic materials

In this presentation, I talk about the magnetization dynamics of a ferromagnetic nickel film at room temperature excited by acoustic pulses generated with femtosecond laser pulses. In order to clearly discriminate between the thermal and the acoustic pulse effects on the magnetization dynamics, the ultrafast change of magnetization is detected from both the front and back sides of the nickel film. The propagating strain associated with the acoustic pulses modifies the magnetic anisotropy and induces a precession of the magnetization. We model the time-dependent magnetoacoustic response of the metallic film by combining a three temperature model for the temperatures of the charges, the spins, and the lattice, the wave equation for the strain, and the Landau-Lifshitz-Gilbert equation for the magnetization. It is shown that the precession dynamics can be controlled by matching the precession period with the round trip time of the acoustic echoes. The calculation of the time-dependent precession torque allows understanding the underlying physics.