

# Ultrafast magnetization dynamics in GdFeCo: system with tunable angular momentum

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Many peculiarities of the magnetization dynamics are related to the fact that a certain amount of angular momentum is associated with each magnetic moment. A typical way to reverse the magnetization is to apply a magnetic field opposite to  $M$ . In such configuration the final state is well-defined, however the reversal only occurs in the presence of damping that transfers the corresponding angular momentum to the lattice.

Alternatively, the field can be applied in the orthogonal geometry thus creating a torque that changes the angular momentum directly. This accelerates the reversal though the latter may become non-deterministic, the problem getting worse at short times and strong fields [1].

Here I present our recent studies of the questions of angular momentum in ferrimagnetic rare-earth – transition metal alloys where both magnetization and angular momenta are temperature dependent. Depending on their composition, such ferrimagnets can exhibit a magnetization compensation temperature  $T_M$  where the magnetizations of the sublattices cancel each other and similarly, an angular momentum compensation temperature  $T_A$  where the net angular momentum vanishes. At the latter point, the frequency of the homogeneous spin precession diverges. As a consequence, ultrafast heating of a ferrimagnet across its compensation points results in a subpicosecond magnetization reversal [2].

Moreover, we have experimentally demonstrated that the magnetization can be reversed by a single 40 femtosecond circularly polarized laser pulse, without any applied magnetic field. This optically induced ultrafast magnetization reversal is the combined result of laser heating of the magnetic system to just below the Curie point and circularly polarized light acting as a magnetic field with amplitudes of up to several Teslas. The direction of this opto-magnetic switching is determined only by the helicity of light. The dependence of this novel reversal pathway on the net angular momentum of the sample will also be discussed.

1. I. Tudosa *et al.*, Nature **428**, 831 (2004).
2. C.D. Stanciu *et al.*, Phys. Rev. Lett. **99**, 217204 (2007).
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4. A.V. Kimel *et al.*, Nature **435**, 655 (2005).