

Time-resolved pump-probe techniques

Theo Rasing

Radboud University, Nijmegen, Netherlands

[*th.rasing@science.ru.nl](mailto:th.rasing@science.ru.nl)

Magnetization dynamics covers a broad range of timescales, from the slow, microsecond, dynamics of domain wall motion, the subnanosecond precessional macroscopic dynamics to the ultrafast femto/picosecond dynamics related to single spin dynamics driven by the strong exchange fields. This lecture will introduce the concepts of how to probe the spin and magnetization dynamics in magnetic materials, in particular the ultrafast regimes, from stroboscopic repetitive dynamics to single-shot magneto-optical imaging.

Lecture topics:

1. Introduction: stochastic/deterministic dynamics
2. Stroboscopic imaging.
3. Magneto-optical setups
 - a. Faraday/Kerr effects
 - b. Magnetic Second Harmonic Generation
 - c. XMCD
4. Examples
5. Outlook

Recommended reading:

- [1] Y. Hashimoto, A. R. Khorsand, M. Savoini, B. Koene, D. Bossini, A. Tsukamoto, A. Itoh, Y. Ohtsuka, K. Aoshima, A. V. Kimel, A. Kirilyuk and Th Rasing: Ultrafast time-resolved magneto-optical imaging of all-optical switching in GdFeCo with femtosecond time-resolution and micrometer spatial-resolution. Review of Scientific Instruments, 85 (2014).
- [2] A. I. Kirilyuk, A. V. Kimel and T. Rasing: Ultrafast opto-magnetic excitation of magnetization dynamics. Ieee Transactions on Magnetics, 44 (2008), 1905-1910.
- [3] Alexey V. Kimel, Andrei Kirilyuk and Theo Rasing: Femtosecond opto-magnetism: ultrafast laser manipulation of magnetic materials. Laser & Photonics Reviews, 1 (2007), 275-287.