Brillouin light scattering

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In this practical session we will investigate spin-wave excitations in ferromagnetic microstructures using Brillouin light scattering (BLS) microscopy which is a well established spectroscopic tool for the characterization of spin waves. BLS is the inelastic scattering of light from spin waves and has several benefits: the ability to measure thermal spin waves, to map the spin-wave intensity with high spatial resolution, the possibility to simultaneously detect the spin-wave frequency and wave vector, and the possibility to monitor the spin-wave intensity with temporal resolution.

In the introductory part of the session we will introduce the concept of inelastic scattering of photons from spin waves. In addition, we will discuss the dispersion relation of spin waves in magnetic thin films and introduce the external excitation of spin waves via microwave currents in antennas embedded in magnetic microstructures.

In the experimental part we will

1. introduce the setup for BLS microscopy.
2. explore thermal spin-wave spectra and identify individual resonances and their dependence on the external magnetic field.
3. contact the sample with microwave probes and excite spin waves via antenna structures on the sample.
4. explore propagation characteristics - like propagation length and the occurrence of different width modes - in a spin-wave waveguide.
5. explore the intrinsic nonlinearity of the spin-wave system.

Recommended reading:

[1] S. O. Demokritov, B. Hillebrands, A. N. Slavin, *Brillouin light scattering studies of confned spin waves: linear and nonlinear confnement*, Physics Reports 348 (2001)

[2] T. Sebastian, K. Schultheiss, B. Obry, B. Hillebrands, H. Schultheiss, *Micro-focused Brillouin light scattering: imaging spin waves at the nanoscale*, Frontiers in Physics 3 (2015)