



EINLADUNG zum IFP-SEMINAR

THz spectroscopy of spin waves in high magnetic field

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Host: David Szaller
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Abstract:

Spin waves are collective spin excitations in magnetic materials with a long range spin order. They can be probed by inelastic neutron scattering. Also, the spin wave may absorb a single photon, usually in the THz spectral range. THz spectroscopy has become an important tool to study spin waves in multiferroic materials with magnetoelectric coupling. Spin wave may acquire electric dipole moment through the magnetoelectric coupling. Both, the magnetic- and electric-dipole activity of the spin wave are probed by the photon whereas neutrons scatter off the magnetic fluctuations only. Non-reciprocal directional dichroism of the THz radiation is a direct manifestation of magnetoelectric coupling as the photon interacts simultaneously with the magnetic- and electric-dipole moment of the spin wave. Another advantage of THz spectroscopy is the possibility to combine it with a high magnetic field using a superconducting magnet in a small laboratory while the neutron scattering needs a large scale facility.

In this talk we will give an overview of our experimental capabilities. A specific example, spin waves in a room temperature multiferroic crystal BiFeO₃ [1], their non-reciprocal directional dichroism[2,3], and amplitudes[4], will be given.

References

- [1] U. Nagel, Randy S. Fishman, T. Katuwal, H. Engelkamp, D. Talbayev, Hee Taek Yi, S.-W. Cheong, T. Rõõm, Terahertz Spectroscopy of Spin Waves in Multiferroic BiFeO₃ in High Magnetic Fields, Phys. Rev. Lett. 110, 257201 (2013), <http://link.aps.org/doi/10.1103/PhysRevLett.110.257201>
- [2] I. Kézsmárki, U. Nagel, S. Bordács, R. S. Fishman, J. H. Lee, Hee Taek Yi, S.-W. Cheong, and T. Rõõm, Optical diode effect at spin-wave excitations of the room-temperature multiferroic BiFeO₃, Phys. Rev. Lett. 115, 127203 (2015) <http://link.aps.org/doi/10.1103/PhysRevLett.115.127203>
- [3] Randy S. Fishman, Jun Hee Lee, Sandor Bordács, Istvan Kézsmárki, Urmag Nagel, and Toomas Rõõm, Spin-Induced Polarizations and Directional Dichroism of Multiferroic BiFeO₃, Phys. Rev. B 92, 094422 (2015) <http://link.aps.org/doi/10.1103/PhysRevB.92.094422>
- [4] Randy S. Fishman, Toomas Rõõm, Rogerio deSousa, Normal Modes of a Spin Cycloid or Helix, arXiv:1809.09680 (2018) <https://arxiv.org/abs/1809.09680>