Bachelor/Master project: Magnetization Dynamics of the Skyrmionic Mott insulator Cu_2OSeO_3

The Optical Condensed Matter Physics group at the II. Physikalisches Institut of the University of Cologne is looking for a highly motivated bachelor or master student in Physics interested in studying magnetization dynamics in the Skyrmionic Mott insulator Cu_2OSeO_3.

Skyrmions are topologically protected magnetic structures which appear as whirl-like nanostructures (A. Rosch, 2013). The combination of different magnetic interactions gives rise to these intriguing magnetic structures with sizes between 20-90nm. Skyrmions promise to be of great technological value in the form of nano-sized, easily writeable and readable bits (N. Nagaosa, 2014). Apart from the technological interest, these magnetic structures also open new avenues in fundamental research in light-matter interaction, magnetization dynamics and chirality.

Left: A moving Skyrmion spin structure (A. Rosch 2013). Right: Phase diagram of bulk Cu_2OSeO_3 (S. Seki, 2012)

The goal of this thesis work is to use time-resolved Magneto Optic Kerr Effect spectroscopy (tr-MOKE) to study the magnetic properties and demagnetization dynamics of the Skyrmionic Mott insulator Cu_2OSeO_3 (S.Seki, 2012). MOKE is the optical phenomenon by which the polarization of light changes to elliptic polarization when reflected from a magnetic structure. The time-resolved version provides valuable insights in the demagnetization dynamics of the different magnetic phases (such as the Skyrmion phase) of Cu_2OSeO_3 on relevant ultrafast timescales for magnetic and electronic interactions (A. Kirilyuk, 2010).

As a master student you will be involved in state-of-the-art ultrafast magneto-optical experiments (working with low temperatures, high magnetic fields, and femtosecond lasers) and in analyzing and modelling the obtained experimental results.

For more information contact Prof. Dr. Paul H.M. Van Loosdrecht (pvl@ph2.uni-koeln.de)

(A. Rosch, 2013) Skyrmions: Moving with the current, Nature Nanotechnology **8**
(N. Nagaosa, 2014) Topological properties and dynamics of magnetic Skyrmions, Nature Nanotechnology **8**
(S. Seki, 2012) Observation of Skyrmions in a Multiferroic Material, Science **336**
(A. Kirilyuk, 2010) Ultrafast optical manipulation of magnetic order, Rev. Mod. Phys. **82**