# MA 21: Magnetic textures: Transport and dynamics I

Time: Tuesday 14:00–15:30 Location: H38

MA 21.1 Tue 14:00 H38

**Formation of skyrmions and their interplay with magnetoelectric terms at a TI/FM heterostructure** — •Marius Scholten[1], Ilya Eremin[1], and Flavio S. Nogueira[2] — [1]Institut für Theoretische Physik III, Ruhr-Universität Bochum,Bochum, Germany — [2]Institute for Theoretical Solid State Physics, IFW Dresden, Dresden, Germany

We investigate the interface of a hybrid heterostructure consisting of a topological insulator and ferromagnet. As has been shown recently, the interface of such a system can host skyrmions as a consequence of an emerging Dzyaloshinskii-Moriya interaction at temperatures above the Curie temperature [1]. Here, we analyze what happens in the magnetically ordered phase and in the presence of the long-range Coulomb interaction between the Dirac electrons. Due to the opening of the gap in the Dirac spectrum in the magnetically ordered phase the magnetoelectric Chern-Simons action emerges, which opens up the possibility of magnetoelectric manipulation of skyrmion structures on the interface.

[1] Flavio S. Nogueira, Ilya Eremin, Ferhat Katmis, Jagadeesh Moodera, Jeroen van den Brink, Volodymyr Kravchuk, Phys. Rev. B 98 060401(R) (2018).

MA 21.2 Tue 14:15 H38

**Photoinduced magnetization dynamics in the skyrmion-host lacunar spinel GaV4S8** — •Fumiya Sekiguchi[1], Vladimir Tsurkan[2], István Kézsmárki[2], and Paul H. M. van Loosdrecht[1] — [1]Institute of Physics 2, University of Cologne, 50937 Cologne, Germany — [2]Experimental Physics V, Center for Electronic Correlations and Magnetism, University of Augsburg, 86135 Augsburg, Germany

Skyrmions are particle-like non-trivial spin textures with an intriguing topological nature. GaV4S8 is a multiferroic lacunar spinel hosting cycloid and Néel-type skyrmion magnetic ground states, in addition to a ferromagnetic state. Using time resolved magneto-optical Kerr effect experiments we have studied the magnetization dynamics in the ordered magnetic phases of this material induced by ultrafast modulation of the optical anisotropy. In this contribution we will focus on the change of the coherent spin precession and demagnetization dynamics across the phase transition among cycloid, skyrmion lattice and ferromagnetic phases.

MA 21.3 Tue 14:30 H38

**Designing skyrmion dynamics by anisotropic spin-orbit torques** — •Jan-Philipp Hanke[1], Frank Freimuth[1], Stefan Blügel[1], and Yuriy Mokrousov[1,2] — [1]Peter Grünberg Institut and Institute for Advanced Simulation, Forschungszentrum Jülich and JARA, 52425 Jülich, Germany — [2]Institute of Physics, Johannes Gutenberg University Mainz, 55099 Mainz, Germany

Skyrmions are perceived to hold bright promises as nano-scale information carriers in energy-efficient technologies. This renders a rigorous understanding and reliable control of their dynamics by the spin-orbit torques vital. Using advanced *ab initio* methods [1,2], we assess the role of these current-induced torques for the dynamics of topological spin textures in magnetic trilayers and topologically non-trivial materials. We discover that the common interpretation of the skyrmion Hall effect as a phenomenon originating in the damping-like torques has to be reformulated, as anisotropic field-like torques can alter the dynamical properties of skyrmions drastically [3]. While increasing the velocity of skyrmions typically relies on driving larger currents, we further elucidate a promising alternative that exploits emergent nodal points forming at the Fermi energy of transition metals to move skyrmions efficiently with low current densities [4]. We acknowledge funding under SPP 2137 “Skyrmionics” and project MO 1731/5-1 of Deutsche Forschungsgemeinschaft (DFG).

[1] J.-P. Hanke *et al*, Phys. Rev. B **91**, 184413 (2015). [2] J.-P. Hanke *et al*, J. Phys. Soc. Jpn. **87**, 041010 (2018). [3] J.-P. Hanke *et al*, under review (2019). [4] J.-P. Hanke *et al*, Nat. Commun. **8**, 1479 (2017).

MA 21.4 Tue 14:45 H38

**Chirality-induced linear response properties in hexagonal $Mn_3Ge$** — •Sebastian Wimmer, Sergiy Mankovsky, and Hubert Ebert — LMU München, Dept. Chemie, München, Deutschland

Taking the non-collinear antiferromagnetic hexagonal Heusler compound $Mn_3Ge$ as a precursor, the contributions to linear response phenomena arising solely from the chiral coplanar and non-coplanar spin configurations are investigated in first-principles calculations. Orbital moments, X-ray absorption, anomalous and spin Hall effects, as well as corresponding spin-orbit torques and Edelstein polarizations are studied depending on a continuous variation of the polar angle relative to the Kagome planes of corner-sharing triangles between the non-collinear antiferromagnetic and the ferromagnetic limits. By scaling the speed of light from the relativistic Dirac case to the non-relativistic limit the chirality-induced or topological contributions can be identified in the absence of spin-orbit coupling.

MA 21.5 Tue 15:00 H38

**Thermoelectrical detection of magnetization reversal in Co/Ru/Pt nanowires with interfacial Dzyaloshinskii-Moriya interaction** — •Alexander Fernández Scarioni[1], Sibylle Sievers[1], Xiukun Hu[1], William Legrand[2], Fernando Ajejas Bazan[2], Vincent Cros[2], and Hans W. Schumacher[1] — [1]Physikalisch-Technische Bundesanstalt, Braunschweig, Germany — [2]Unité Mixte de Physique, CNRS, Thales, Univ. Paris-Sud, Université Paris-Saclay, Palaiseau, France

Recently it was shown that inside a nanopatterned Hall cross individual skyrmion can be electrically detected by their contribution to the anomalous Hall effect (AHE) [1]. While AHE detection is intrinsically limited to Hall crosses it was recently shown that the anomalous Nernst effect (ANE), the thermoelectric analogue of the AHE, allows sensitive nano-scale characterization of the magnetization also in various nanowire geometries [2]. Here we compare ANE and AHE for the characterization of out-of-plane magnetization reversal loops in nanowires (ANE) and nanopatterned Hall crosses (AHE) of Co/Ru/Pt multilayers with interfacial Dzyaloshinskii-Moriya interaction. Both ANE and AHE loops show similar characteristics proving the suitability of ANE as a characterization tool. Comparison to magnetic force microscopy allows to correlate the loop features to the presence of stripe domains and skyrmions in the nano structures. The prospects for ANE detection of individual skyrmions inside the nanostructures will be discussed. [1] D. Maccariello, et al, Nat. Nanotech. 13, 233-237 (2018) [2] P. Krzysteczko, et al, Phys, Rev, B 95, 220410 (2017)

MA 21.6 Tue 15:15 H38

**Nonreciprocity of spin waves due to the Dzyaloshinskii-Moriya interaction** — •Flaviano José dos Santos, Manuel dos Santos Dias, and Samir Lounis — Peter Grünberg Institut and Institute for Advanced Simulation, Forschungszentrum Jülich & JARA, D-52428 Jülich, Germany

Can spin-wave measurements help to distinguish the occurrence of skyrmions from antiskyrmions in magnetic materials? The stabilization of one or the other is related to the details and symmetries of the Dzyaloshinskii-Moriya interaction (DMI) [1], which can be determined by measuring its effect on the spin-wave properties [2]. In ferromagnets, the DMI induces a chiral asymmetry on the spin-wave energies of opposite wavevector [3], we then say that the spin-wave spectrum is nonreciprocal [4]. This phenomenon allows us to determine the DMI strength and its sign. However, it is not clear how these DMI-induced asymmetries manifest in complex noncollinear magnetic structures, such as spin spirals and skyrmion lattices. We provide a complete picture on when and how the DMI induces nonreciprocal spin waves in these systems, and how they shall manifest in spin-resolved inelastic electron scattering experiments. Furthermore, we demonstrate an important connection between angular momentum and chiral handedness of a spin-wave mode, which allows us to predict the occurrence of nonreciprocal spin-wave spectrum. – [1] Hoffmann et al., Nat. Comm. 8, 308 (2017). [2] Di et al., PRL 114, 047201 (2015). [3] Udvardi et al., PRL 102, 207204 (2009). [4] Gitgeatpong et al., PRL 119, 047201 (2017). [5] Dos Santos et al., PRB 97, 024431 (2018).