MA 14: INNOMAG e.V. Dissertationspreis 2019 / Ph.D. Thesis Prize

Die Arbeitsgemeinschaft Magnetismus der DPG hat einen Dissertationspreis ausgeschrieben, welcher auf der Frühjahrstagung der DPG 2019 in Regensburg vergeben wird. Ziel des Preises ist die Anerkennung herausragender Forschung im Rahmen einer Promotion und deren exzellente Vermittlung in Wort und Schrift. Im Rahmen dieser Sitzung tragen die besten der für ihre an einer deutschen Hochschule durchgeführten Dissertation Nominierten vor. Im direkten Anschluss entscheidet das Preiskommittee über den Gewinner des INNOMAG e.V. Dissertationspreises 2019. Talks will be given in English!

Time: Tuesday 9:30–11:30 Location: H48

MA 14.1 Tue 9:30 H48

Spin-charge coupled transport in two- and three-dimensional Rashba systems — •Sebastian Tölle — Institute of Physics, University of Augsburg, 86135 Augsburg, Germany

Recent progress in the theoretical description of two- and three-dimensional systems with Rashba spin-orbit coupling is described. Based on a Boltzmann-like quasiclassical approach, the transport equations are derived and applied to the following three - experimentally relevant - setups. First, a generalization of the spin-motive force due to a proximity induced magnetization in a quasi two-dimensional electron gas is derived, highlighting, in particular, a novel 'inverse-spin-filter' contribution as the result of a consistent treatment of spin-orbit contributions to the Elliott-Yafet collision operator [1]. Second, a two-dimensional Rashba system laterally attached to a ferromagnet is considered. In this setup, current-induced spin-polarizations significantly affect the boundary conditions at the interface, leading to a non-trivial asymmetric magnetization-dependence of the magnetoresistance [2]. In the third setup, the Rashba system is extended to the third dimension and placed on top of a ferromagnetic insulator. Several qualitative features of related experiments are reproduced. In particular, it is shown that the anisotropy of the spin relaxation, enhanced due to the mass anisotropy, plays a major role for the interpretation of the observed signals [3].

[1] S. Tölle et al., Phys. Rev. B 95, 115404 (2016).
[2] S. Tölle et al., Ann. Phys. (Berlin) 530, 1700303 (2018).
[3] S. Tölle et al., New J. Phys. 20, 103024 (2018).

MA 14.2 Tue 10:00 H48

Spin-Orbit-Induced Dynamics of Chiral Magnetic Structures - Skyrmion Dynamics in Thin Film Devices at Varying Temperatures — •Kai Litzius — Institute of Physics, Johannes Gutenberg-University, 55099 Mainz, Germany — Graduate School of Excellence Materials Science in Mainz, 55128 Mainz, Germany — Max Planck Institute for Intelligent Systems, 70569 Stuttgart, Germany

Magnetic skyrmions are nanoscale magnetic quasi-particles with spherical topology. They are promising candidates for future spintronic devices such as the skyrmion racetrack memory. Interfacial systems, as studied here, cannot only provide a Dzyaloshinskii-Moriya interaction that stabilizes skyrmions, but also efficient spin dynamics, making them extremely promising for applications. This talk will provide an overview over the progress within the field of skyrmionics during the past four years. Special focus will be placed on the discovery of a sizable and drive dependent skyrmion Hall angle (SkHA) and the different theoretical models that have been put forward for the creep [1,2] and viscous flow [3] regime to explain this behavior. By X-ray microscopy with temperature control, we find that the underlying mechanism of the SkHA is independent of the temperature and identify the different mechanisms that lead to distinctly different angles in the creep and the flow regimes. Furthermore, we find highly temperature dependent skyrmion speeds and that higher temperatures are beneficial for efficient skyrmion motion. References: [1] Jiang et al., Nat. Phys. 13, 162-169 (2017). [2] Reichhardt & Reichhardt, New J. Phys. 18, 095005 (2016). [3] Litzius et al., Nat. Phys. 13, 170-175 (2017).

MA 14.3 Tue 10:30 H48

Topological properties of complex magnets from an advanced ab-initio Wannier description — •Jan-Philipp Hanke — Peter Grünberg Institut and Institute for Advanced Simulation, Forschungszentrum Jülich and JARA, D-52425 Jülich

Our understanding of many fundamental effects in solids has been revolutionized by the advent of Berry phases [1]. In particular, the recent discovery that Berry phases in momentum space relate to orbital electronic properties allows us to predict from theoretical arguments pronounced orbital magnetism in various situations, ranging from Rashba systems to Chern insulators [2-4]. We demonstrate that the combined complex geometry of real and momentum space manifests in topological orbital magnetism in non-collinear magnets, which offers new avenues for magnetization manipulation and large current-induced orbital responses in antiferromagnets [2,3]. By developing and applying advanced ab-initio methods [5,6], we finally predict that in insulators with non-trivial topologies the magnitude of magneto-electric effects in terms of spin-orbit torques can significantly exceed that of conventional metallic magnets, which lays out highly attractive perspectives for energy-efficient magnetization control of nanomagnets [7].

[1] M. Berry, Proc. R. Soc. Lond. A **392**, 45 (1984). [2] J.-P. Hanke et al, Phys. Rev. B **94**, 121114(R) (2016). [3] J.-P. Hanke et al, Sci. Rep. **7**, 41078 (2017). [4] D. Go, J.-P. Hanke et al, Sci. Rep. **7**, 46742 (2017). [5] J.-P. Hanke et al, Phys. Rev. B **91**, 184413 (2015). [6] J.-P. Hanke et al, J. Phys. Soc. Jpn. **87**, 041010 (2018). [7] J.-P. Hanke et al, Nature Comm. **8**, 1479 (2017).

MA 14.4 Tue 11:00 H48

Making Magnonic Spin Currents useful - propagation, manipulation and detection — •Joel Cramer — Institut für Physik, Johannes Gutenberg-Universität Mainz, Mainz, Germany — Graduate School of Excellence Materials Science in Mainz, Mainz, Germany

Magnon-based spintronic applications enable a promising alternative to charge-driven devices for information transport and processing [1]. I discuss different key aspects of magnon spintronics necessary to functionalize such spin currents. First, the efficient interconversion of spin and charge information by the (inverse) spin Hall effect in the binary alloy $Cu_{1-x}Ir_x$ [2] is demonstrated. In this material, the spin Hall effect exhibits a complex composition dependence with a maximum spin Hall angle near 40% Ir content. I will further compare and show that DC and THz spin currents exhibit similar behavior, revealing the functionality of spin-charge conversion up to THz speeds. Regarding magnon logic as a key feature of magnon spintronics, the spin-dependent (inverse) spin Hall effect in metallic ferromagnets like Co or $Co_{60}Fe_{20}B_{20}$ is demonstrated. In ferromagnetic resonance spin pumping [3] and non-local spin transport [4] measurements, it is shown that the spin detection efficiency strongly depends on the angle between that ferromagnet's magnetization and the spin current polarization. The distinct properties of spin-up and spin-down electrons in the ferromagnet allow one to implement a spin valve like effect using magnon detection with an amplitude of up to 120%. [1] Chumak *et al.*, Nat. Phys. 11, 453 (2015) [2] Cramer *et al.*, Nano Lett. 18, 1064-1069 (2018) [3] Cramer *et al.*, Nat. Commun. 9, 1089 (2018) [4] Cramer *et al.*, arXiv:1810.01227 (2018)