648th ASRC Seminar

Date：Tuesday, October 21, 15：00 ～ 16：00

Location：：Room 302, ASRC bldg.

Speaker：Prof. Dr. Mathias Kläui
(University of Mainz and Tohoku University)

Title: Spin-orbit induced topological magnetization dynamics for Green IT

Abstract: In our information-everywhere society IT is a major player for energy consumption and novel spintronic devices can play a role in the quest for Green IT. Reducing power consumption of mobile devices by replacing volatile memory by fast non-volatile spintronic memory could improve speed and a one-memory-fits-all approach drastically simplifies the microelectronic architecture design [1]. For this we develop new highly spin-polarized materials and characterize the spin transport using THz spectroscopy [2]. Topological spin structures that emerge due to the Dzyaloshinskii-Moriya interaction (DMI), such as chiral domain walls and skyrmions possess a high stability and are of key importance for magnetic memories and logic devices [1,2]. We have investigated in detail the dynamics of topological spin structures, such as chiral domain walls that we can move synchronously with field pulses [3]. For current-induced dynamics we find that spin-orbit torques dominate the dynamics. We determine these independently of the DMI [4,5] showing that the sign of the DMI is opposite for stacks with CoFeB compared to stacks with a CoFe as the magnetic layer due to B diffusion at the interface. For strong DMI novel topologically stabilized skyrmion spin structure emerge. We demonstrate for the first time that a train of skyrmions in a “racetrack”-type device can be moved due to spin-orbit torques reliably [6] and whose dynamics is governed by the topology [7]. Finally, we study thermal heat currents as a source of spin currents and find a strong dependence of the measured signal on both the bulk and the interface [8].

[1] S. S. P. Parkin *et al.*, Science **320**, 190 (2008); O. Boulle *et al.*, Mater. Sci Eng **R 72**, 159 (2011). [2] M. Jourdan *et al.*, Nature Comm. **5**, 3974 (2014); Z. Jin *et al.*, Nature Phys. **11**, 761 (2015). [3] J.-S. Kim *et al.*, Nature Comm. **5**, 3429 (2014). [4] R. Lo Conte *et al.*, Appl. Phys. Lett. **105**, 122404 (2014); R. Lo Conte *et al.*, Phys. Rev B **91**, 014433 (2015). [5] T. Schulz *et al.*, Appl. Phys. Lett. **107**, 122405 (2015). [6] S. Woo *et al.*, Nature Mater. **15**, 501 (2016). [7] F. Büttner *et al.*, Nature Phys. **11**, 225 (2015). [8] E.-J. Guo *et al.*, Phys. Rev. X **6**, 031012 (2016).

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