JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Seminar: Hard Condensed Matter Theory

Room: Galileo room, 01-128 (Staudinger Weg 9)
Time: Tuesday, 20.06.2017, 14:00

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Electrically and thermally induced spin currents in magnetic insulators

Spin currents in magnetic insulators are currently intensely investigated because of their potential to be the future information carriers replacing part of the conventional charge current based electronics [1]. Since there is no charge transport at all in magnetic insulators, only magnons, the quanta of spin waves, carry the spin information. Thus, heat dissipation is strongly reduced compared to the overall Joule heating of conventional charge transport. In order to connect the magnon spin system with conventional charge current based electronics, new techniques have been developed to inject and detect magnon spins in magnetic insulators, e.g. Y3Fe5O12 (YIG) or NiFe2O4 (NFO). The spin Hall effect in heavy metals, such as Pt, next to a magnetic insulator is used to generate a magnon spin current electrically, while the thermal generation of magnon spin currents is induced by the spin Seebeck effect [2,3].

In my talk, I will show how the spin Hall effect and the spin Seebeck effect can be used to generate and detect the spin transport in magnetic insulators in a local and nonlocal experiment [4-7]. Thus, we can observe quite long magnon spin diffusion lengths of several microns in both YIG [4] and NFO [5]. Furthermore, I will explain that the transport of magnon spins through an insulator provides similar transport phenomena as electrons in a metal depending on the direction of an external magnetic field. Here, we found a magnon anisotropic magnetoresistance in YIG that can be revealed in the nonlocal experiment [6]. In addition, I will show signatures of magnon-polarons in the nonlocal magnon spin transport in YIG. These magnoelastic coupled magnon-photon quasi particles have been recently detected via the local spin Seebeck effect [8], but show even more surprising features in the nonlocal experiment [7]. Finally, going from ferrimagnetic to antiferromagnetic insulators following the antiferromagnetic spintronics route [9], we could find a sign change in the local spin Hall magnetoresistance for Pt on the easy-plane bulk antiferromagnet NiO [10]. Thus, we are able to use the spin Hall magnetoresistance as a probe to identify and study easy-plane antiferromagnetic materials.

All interested are cordially welcome!

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[1] T. Kuschel, G. Reiss, Nature Nanotechn. **10**, 22 (2015) [2] K. Uchida *et al.*, Appl. Phys. Lett. **97**, 172505 (2010) [3] D. Meier, TK *et al.*, Nature Commun. **6**, 8211 (2015) [4] L. J. Cornelissen *et al.*, Nature Phys. **11**, 1022 (2015) [5] J. Shan, TK *et al.*, Appl. Phys. Lett. **110**, 132406 (2017) [6] J. Liu, TK *et al.*, Phys. Rev. B **95**, 140402(R) (2017) [7] L. J. Cornelissen, TK *et al.* (2017) [8] T. Kikkawa, *et al.*, Phys. Rev. Lett. **117**, 207203 (2016) [9] T. Jungwirth *et al.*, Nat. Nanotechnol. **11**, 231 (2016) [10] G. R. Hoogeboom, TK *et al.* (2017)