Seminar: Hard Condensed Matter Theory

JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Room: Galilei Raum, 01-128 (Staudinger Weg 9)
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Dynamical amplification of magnetoresistances and Hall currents up to the THz regime

The quest for device miniaturization, decreased energy consumption, and improved speeds of processing and storage units naturally led to exploiting the connection between electric currents and magnetization dynamics. In this presentation, I demonstrate that ferromagnetic and antiferromagnetic excitations can be triggered by the dynamical spin accumulations induced by the bulk and surface contributions of the spin Hall effect [1]. I also analyze the general concepts of magnetoresistance and Hall effects together with spin-orbit-related mechanisms to demonstrate how dynamical currents can be dramatically enhanced and precisely controlled by applying ac electric fields and static magnetic fields, in a materials-specific approach [2]. Furthermore, I uncover how pure spin currents generated by the spin Hall effect can be dynamically manipulated, with effective conversion rates increasing up to 500% and reaching values larger than the giant ones obtained for static currents. The combination of in-silico material design and ultrafast dynamical effects is only achievable by a microscopic quantum mechanical theory, utilizing an approach based on the electronic structure. This work may also impact experimental techniques that use currents to probe and quantify magnetization precession and the torques that induce it.

[1] F. S. M. Guimarães et al., Phys. Rev. B **92**, 220410(R) (2015).
[2] F. S. M. Guimarães et al., Scientific Reports **7**, 3686 (2017)

All interested are cordially welcome!

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