

On-line SPICE-SPIN+X Seminars



Wednesday, 27th April 2022, 15:00 (CET)

The seminar will be via Zoom ([Meeting ID: 869 3554 1254](#)) and live streamed in the SPICE YouTube Channel.

Ilya Krivorotov,
University of California at Irvine

Planar Hall Torque



Spin-orbit torques (SOTs) in bilayers of ferromagnetic (FM) and nonmagnetic (NM) materials, such as spin Hall [1] and Rashba [2, 3] torques, enable energy efficient manipulation of magnetization by electric currents. In this talk, I will discuss the discovery [4] of a damping-like SOT arising from planar Hall current in FM conductors [5, 6]. The magnitude of this planar Hall torque (PHT) is similar to that of the giant spin Hall torque in FM/Pt bilayers and strong PHT can be present in a system with negligibly small spin Hall torque such as FM/Au bilayers. We also show that PHT is large enough to cancel magnetic damping of the FM and excite auto-oscillations of the FM magnetization. The discovery of PHT expands the class of materials and systems for energy efficient manipulation of magnetization by giant SOTs.

- [1] Liu L. et al. (2012) Spin-torque switching with the giant spin Hall effect of tantalum. *Science*. 336, 555
- [2] Miron I. M. et al. (2011) Perpendicular switching of a single ferromagnetic layer induced by in-plane current injection. *Nature* 476, 189.
- [3] Kurebayashi H. et al. (2014) An antidamping spin-orbit torque originating from the Berry curvature, *Nature Nanotech.* 9, 211.
- [4] Safranski C., Montoya E.A., Krivorotov I.N. (2019) Spin-orbit torque driven by a planar Hall current. *Nat. Nanotech.* 14, 27.
- [5] Taniguchi T., Grollier J., Stiles M.D. (2015) Spin-Transfer Torques Generated by the Anomalous Hall Effect and Anisotropic Magnetoresistance. *Phys. Rev. Appl.* 3, 1.
- [6] Ochoa H., Zarzuela R., Tserkovnyak Y. (2021) Self-induced spin-orbit torques in metallic ferromagnets, *J. Magn. Magn. Mater.* 538, 168262.