UNL Department of Physics and Astronomy presents:

Spin Orbit Torque Driven by Planar Hall Current

PRESENTED BY
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Refreshments will be served in the JH 1st Floor Vending Area at 3:30

ABSTRACT

Spintronics is a multi-disciplinary field at the intersection of such fields as physics, chemistry, engineering, material science, and nano- and quantum-science. Energy-efficient manipulation of magnetization is a central problem in spintronics as it has the potential to enable high-speed, non-volatile memories as well as novel computing schemes such as neuromorphic, non-Von Neumann, and quantum computing. Additionally, spintronic systems are very useful for fundamental studies of non-linear and chaotic dynamics at the nanoscale[1]. One exciting area of current research is spin-orbit torque[2], where the quantum-mechanical spin-orbit interaction can be used to allow one to manipulate magnetization using electric current via charge-to-spin conversion.

In this talk, I will report the discovery of a spin-orbit torque arising from planar Hall current in the ferromagnetic material of a magnetic multilayer[3]. The magnitude of planar Hall torque is similar to that of the giant spin Hall torque[4] and is large enough to excite auto-oscillations of the ferromagnetic layer, allowing one to create a nanoscale source of microwave radiation known as a spin torque oscillator. We demonstrate that spin torque oscillators based on planar Hall torque are more efficient than those based on spin Hall. The discovery of planar Hall torque expands the class of materials for energy efficient manipulation of magnetization by giant spin-orbit torques.

References

1. Montoya, Eric Arturo *et al.* Magnetization reversal driven by low dimensional chaos in a nanoscale ferromagnet. *Nat Commun* **10**, 543 (2019).

2. Gambardella, P. & Miron, I. M. Current-induced spin–orbit torques. *Proc. R. Soc. A* **369**, 3175–3197 (2011).

3. Safranski, C., Montoya, E. A. & Krivorotov, I. N. Spin–orbit torque driven by a planar Hall current. *Nature Nanotech* **14**, 27–30 (2019).

4. Liu, L. *et al.* Spin-Torque Switching with the Giant Spin Hall Effect of Tantalum. *Science* **336**, 555–558 (2012).

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