College of Natural Sciences & Mathematics
UNIVERSITY OF DENVER

Physics & Astronomy Colloquium

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Unconventional Spin-Orbit Torque

Information and communications technology is predicted to account for 10% to 20% of the world's power consumption within a decade. Alleviating this rise in power consumption requires rethinking the way we electronically process and store information. One promising route to develop energy-efficient storage/memory uses spintronic, or spin-electronic, devices. In this talk, I will discuss a write mechanism for spintronic memories whereby a charge current manipulates a ferromagnetic layer's magnetization through spin-orbit coupling. This mechanism, known as spin-orbit torque, is promising because it involves a transfer of angular momentum from the atomic lattice—a virtually infinite source of angular momentum—to the magnetic order. Since its inception, the list of spin-orbit torque mechanisms has grown beyond the conventional spin Hall and Rashba-Edelstein mechanisms to include "unconventional" mechanisms, arising from spin and orbital current generation in ferromagnetic layers, nonmagnetic layers, and their interfaces. We use micromagnetic, semiclassical, and first principles calculations to show that unconventional spin-orbit torques are potentially important for devices, from causing nonlocal spin torques in ferromagnetic trilayers to enabling large amplitude, easy-plane spin-orbit torque oscillators.

Short Biography

Dr. Vivek Amin is an Assistant Professor in the Department of Physics at Indiana University Indianapolis. He received a B.S. in Electrical Engineering from The University of Texas at Austin and a Ph.D. in Physics from Texas A&M University. Prior to joining IU Indianapolis, he worked as a postdoc and a research scientist with a joint position at the National Institute of Standards and Technology, Gaithersburg and the University of Maryland, College Park. Prof. Amin uses computational and analytical methods to study electronic transport in condensed matter systems, with focus on spintronics, quantum materials, and neuromorphic computing.