PRSE Magnetics Seminar

"Anatomy of Spin-Orbit Torque"

Dr. Vivek Amin

The National Institute of Standards and Technology—Gaithersburg

Thursday, Oct. 10th at 11:00 a.m.

Physics Conference Room

Abstract

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. Spintronics, or spin electronics, offers a possible solution to this problem by using spin currents or spin waves rather than conventional charge currents to manipulate information. A key ingredient in spintronics is spin-orbit coupling: the relativistic coupling between a particle's spin and orbital moments. Spin-orbit coupling permits conduction electrons to extract a virtually unlimited amount of angular momentum from the crystal lattice, potentially enabling energy efficient information processing. In this talk, I will discuss the electrical manipulation of a ferromagnet's magnetization through spin-orbit coupling. This phenomenon, known as spin-orbit torque, could help harness all the advantages of different electronic memories (e.g. speed, nonvolatility, radiation hardness) into one device. The present understanding of spin-orbit torque is incomplete because there is no consensus among theory and experiment over the important mechanisms. We review the traditional spin-orbit torque mechanisms and then show that novel interfacial or bulk effects are needed to explain recent experiments. Shedding light on these mechanisms will help clarify the nature of spin-orbit torque, creating exciting new possibilities for current-controlled magnetization dynamics with attractive applications for information processing.

Biography

Vivek Amin is a Research Scientist at the National Institute of Standards and Technology, Gaithersburg, and the University of Maryland, College Park. 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. He uses computational and analytical methods to study spin transport in quantum condensed matter systems, with focus on spintronics and neuromorphic computing.