北京大学量子材料科学中心

International Center for Quantum Materials, PKU

ICQM Weekly Seminar

Spin transport and spin transfer torque in textured magnetic materials from first principles

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Venue: Room 607, Conference Room A , Science Building 5
地点：理科五号楼607会议室

Abstract

A magnet can point up or down in a magnetic field. In magnetic materials, information is stored digitally by using two such "states" to represent ones and zeros. A proposal to store information in high-density "racetrack" memories has focused attention on how electric currents in a magnetic material are affected by twisting of the magnetism (so-called a "domain wall") in between regions ("domains") where the magnetism is either all "up" or all "down". However, disordered itinerant ferromagnetic alloys are not readily amenable to theoretical investigation because of their complexity. The study of disordered magnetic domain walls is more difficult still because the magnetization direction changes gradually over long length scales, of the order of 100-1000 nm. In a recent work, we investigate diffusive transport through a number of domain wall profiles of the important magnetic alloy Ni80Fe20, Permalloy, taking into account simultaneously non-collinear magnetism, alloy disorder, and spin-orbit coupling fully quantum mechanically, from first principles. In addition to observing the known effects of magnetization mistracking and anisotropic magnetoresistance, we discover a new contribution to the resistance of a domain wall that comes from spin-orbit-coupling mediated spin-flip scattering in a textured diffusive ferromagnet. Our analysis of the numerical results indicates the finding is generally applicable to other magnetic materials where the effect might be significantly enhanced by using heavier element with larger values of the spin-orbit coupling. This work also has implications for understanding spin-transfer torque in magnetic domain walls.

About the Speaker

袁喆, 1998-2002年本科就读于清华大学物理系，2005年在清华大学物理系获理学硕士学位，2008年在瑞典Chalmers理工大学获理学博士学位。2009至今在荷兰Twente大学从事博士后研究。主要研究兴趣包括第一性原理电子结构计算，及其在自旋相关的电子输运，自旋转矩和磁化动力学研究中的应用，也包括固体和表面电子激发态的研究以及大规模并行计算。