UNH Materials Science Seminar

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Kingsbury Hall S145, University of New Hampshire

Electrical manipulation of single spins in semiconductors

Prof. Jian-Ming Tang
Department of Physics, UNH

Much progress has been made in probing spins at the atomic level. The ability to manipulate single spins in a solid-state environment provides a new pathway to study the fundamental physics of magnetism in solids and may lead to the development of nanoscale quantum devices. Scanning tunneling microscopy (STM) has proven its remarkable capability in probing the magnetic properties of single magnetic atoms on metal surfaces. On the other hand, integration of magnetic elements into semiconductors has potential applications in high-density storage, multifunctional devices, and scalable quantum computing. I will discuss our joint efforts with several STM groups to probe the local electronic structure near magnetic atoms substituted into a semiconductor. We observed the strong spatial anisotropy of the holes bound to the magnetic atom, and the anisotropic magnetic interaction between two magnetic atoms. The spin-spin interaction in these systems is unusual and long-ranged because it is mediated through the holes that are loosely bound to the magnetic atoms. The highly extended hole wave function is susceptible to external perturbation, such as electric or strain fields. Our results improve our understanding of ferromagnetism in semiconductors and pave the way for electrical manipulation of single ion spins in semiconductors.

Jian-Ming Tang is an assistant professor in the UNH Physics Department. He received his undergraduate degree in Physics from National Taiwan University and his Ph.D. in Physics from the University of Washington. He was a postdoc (2001-2004) and a research scientist (2004-2007) at the University of Iowa. His research interests include quantum vortex dynamics, high-temperature superconductors, and spin-dependent phenomena in semiconductors.

Host: Professor Olof Echt