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Spin Modulated Molecular Electronics: Opportunities and Challenges

Abstract:
In the past few decades, the ultimate push for ultra light and ultra small electronic device components for information storing and processing have prompted intense research efforts in examining and developing alternative materials, phenomena, and paradigms for electronics applications. Among the various potential candidates, organic-molecule-based electronics have demonstrated the promise to meet the physical challenges imposed by quantum mechanics in the ultimate miniaturization of electronic devices. The availability of virtually infinite number of organic molecules, each with a unique electronic structure, provides an exciting class of novel materials that allow controlled transport of electrons—key to the operation of an electronic device. However, most experiments and theory on molecular devices thus far have focused on the charge state of the electron to control the device functionality. In addition to charge, electron has another degree of freedom, spin. The spin coherence length in organic molecule is expected to be larger than in conventional metals and semiconductors due to weak spin-orbit and hyperfine interaction in organic molecular systems. It is consequently highly advantageous to learn how to control the electron transport in molecular devices offered by spin degrees of freedom. In this talk, I will discuss the physics of such devices and will highlight some of the fundamental issues associated with realizing them. Specifically, I will review the current status of this emerging field including our own theoretical work on Quantum transport of spin through organic molecules and its future implication.

Biography:
Ranjit received his Ph.D. in Theoretical Condensed Matter Physics in 1998 from the University at Albany, State University of New York (SUNY). From 1999-01, he was working as a postdoctoral fellow for the US Air Force Research Laboratory under a contract through the University of New Mexico. From 2001-04, he was a research associate at the Rensselaer Polytechnic Institute, New York. In 1996, he was a visiting scientist at Center for Fundamental and Materials Research at Michigan State University, and in summer 2006 he was a visiting researcher at International Center for Young Scientist, National Institute for Materials Science (NIMS), Japan. Since 2004, he is an assistant Professor in the department of Physics at Michigan Tech. Ranjit’s research focuses on understanding controlled electron transport in metal-molecule junction using first-principles approach.