Physics Colloquium

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Quantum Coherent Electronic Technologies

Friday, November 2, 2:30 p.m.

210 Robeson Hall

Electrons in most materials experience dramatic and frequent scattering from other electrons, phonons, and a variety of other excitations. Such scattering events often rapidly dissipate any memory the electron had of its quantum state, so the electrons can be described as an ensemble that is near local thermal equilibrium. If the electrons can retain a good memory of their quantum state, however, then they are quantum coherent and can be used for very unusual and exciting tasks such as quantum computing. Realizing these quantum technologies has traditionally been expected to require very special elements such as superconducting devices or very high mobility transistors, as well as very low temperatures, in order to avoid rapid loss of quantum coherence (decoherence). Over the past fifteen years we and others have identified remarkable examples of room-temperature quantum coherent behavior in condensed matter electronic systems, usually involving spin coherence. Predicting the behavior of these spin coherent systems requires integrating theoretical techniques to cope with energy scales ranging from far smaller than the thermal energy to far larger. I will describe some examples of quantum coherent technologies and identify some of the features they share.