3:30 pm • Friday March 23, 2012 • 2241 Chamberlin Hall • Coffee at 4:30 pm

Andreas Heinrich

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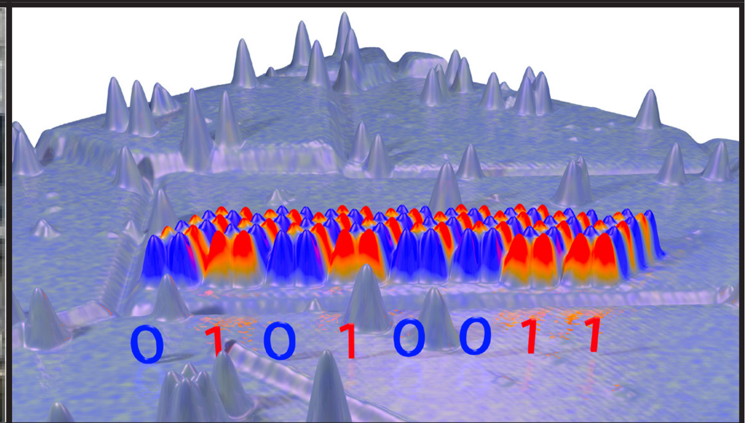
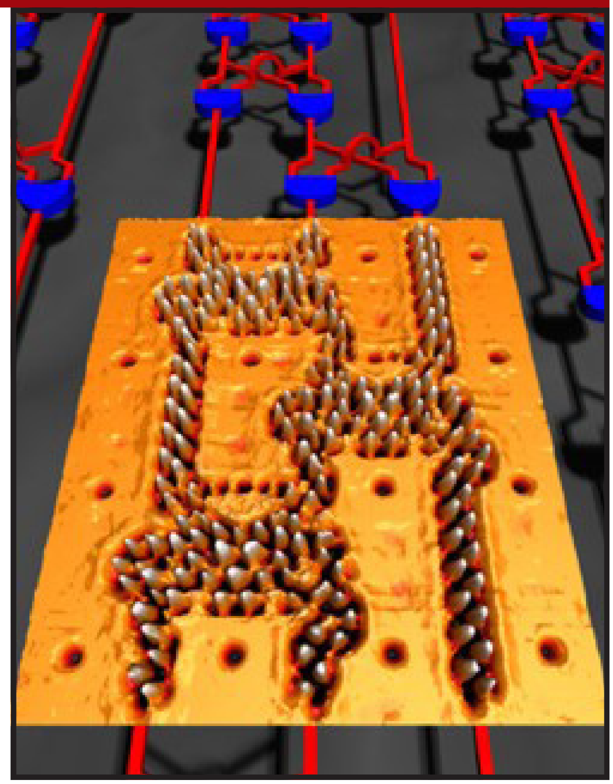


The quantum and classical properties of spins on surfaces

Department of Physics Colloquium



The scanning tunneling microscope has been an extremely successful experimental tool because of its atomic-scale spatial resolution. In recent years this has been combined with the use of low temperatures, culminating in precise atom manipulation and spectroscopy with microvolt energy resolution. A cluster of magnetic atoms on a surface behaves similar to a classical magnetic particle: it's magnetization points along an easy-axis direction in space and magnetization reversal requires sufficient thermal energy to overcome a barrier. In this talk we will discuss how many atoms it takes to create such creates, which offers crucial insights into the size limits of stable magnetic nanoparticles. When the number of atoms becomes too small we observe quantum tunneling of magnetization – in the present case of the "classical" Neel vector. Single atoms that are slightly decoupled from conducting substrates behave more like quantum mechanical entities. These can be studied with inelastic tunneling spectroscopy, a technique we coined spin-excitation spectroscopy. With this approach it is possible to measure the energy eigenstates of the quantum spin Hamiltonian that describes spins on surfaces with high precision. We will introduce its application to the measurement of the Zeeman energy, to magneto-crystalline anisotropy, and to spin-spin coupling via a superexchange interaction.

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