Probing the spin of a single atom with tunneling electrons

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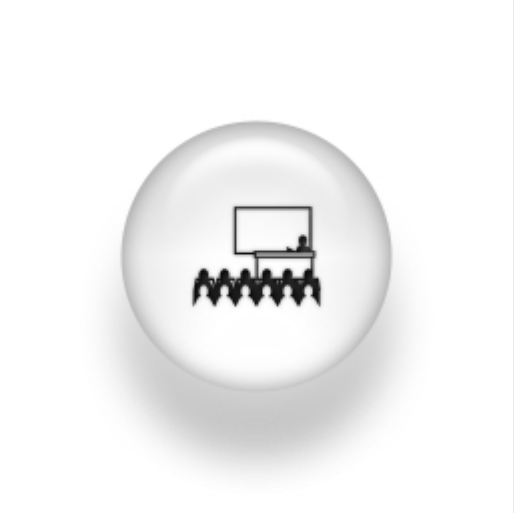

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ABSTRACT:
Recent [1-3] work shows that inelastic electron scanning tunneling microscope (STM) probes the elementary spin excitations of a single and a few magnetic atoms in a thin insulating layer. In this talk I discuss how this new type of spectroscopy can be modeled using a phenomenological spin-assisted tunneling Hamiltonian [4]. Within this formalism, the inelastic dI/dV lineshape is related to the spin spectral weight of the probed magnetic atom. This accounts for the spin selection rules observed experimentally. The theory agrees well with existing STM experiments for single Fe and Mn atoms as well as linear chains a few Mn atoms. The magnetic anisotropy in the inelastic dI/dV and the marked odd-even N effects are accounted for by the theory. I discuss ultimate origin of both the magnetic anisotropy and the spin-assisted tunneling Hamiltonian in terms of a generalized Anderson model in the cotunneling regime and I compare with results for a similar model in the sequential tunneling regime [5].

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[2] C. F. Hirjibehedin, C. P. Lutz, A: J. Heinrich, Science 312, 1021 (2006)
[3] C. Hirjibehedin, C-Y Lin. A.F. Otte, M. Ternes, C. P. Lutz, B. A. Jones, A. J. Heinrich, Science 317, 1199 (2007)
[4] J. Fernández-Rossier Theory of single spin inelastic tunneling spectroscopy, arXiv: 0901.4839
[5] J. Fernández-Rossier and R. Aguado, Phys. Rev. Lett. 98, 106805 (2007)