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The Impact of the Local Environment on the Kondo Screening of a High-Spin Atom

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Spin 1/2 Kondo systems have been investigated extensively in theory and in a variety of experimental geometries. However the magnetic atoms that give rise to the Kondo effect in metals often have a larger spin, which makes the properties of the system more complex. Using low-temperature scanning tunneling microscopy and spectroscopy, we explore the Kondo effect of individual high-spin magnetic atoms on small islands of the thin insulator copper nitride (Cu_2N) in Cu(100) surfaces. Using a combination of elastic spectroscopy to probe the local density of states features arising from the Kondo screening and inelastic tunneling spectroscopy to study the higher energy spin excitations, we determined the spin of the atom and explore its impact on the Kondo resonance [1]. We find that the local magnetic anisotropy plays a decisive role in the physics of Kondo screening. In addition, we find that the splitting of the Kondo peak matches the splitting of the underlying unscreened spin levels, and surprisingly does not show any evidence of a renormalization of energy scales even though large renormalizations have been predicted for lower spin system. In addition, we find remarkably large variations in the strength of both the Kondo screening and magnetic anisotropy for Co atoms on both small and large Cu_2N islands. In both cases, the anisotropy and Kondo screening are inversely related: the Kondo resonance weakens as the anisotropy increases. For small islands, the Kondo screening is strongest near the center of the island, while for large island this trend is reversed. We examine the possible origins of this phenomenon, including variations in the physical and electronic structure of the Cu_2N surface.

[1] AF Otte et al., Nature Physics 4, 847 (2008).