

## SEMINAR

SINGLE ATOM SPIN DETECTION OF  
QUANTUM MAGNETS EMBEDDED IN A  
SEMICONDUCTOR

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Scanning tunneling spectroscopy is an atomic-scale technique which has been applied to investigate individual magnetic impurities embedded in various III-V semiconductor systems. In order to extract magnetic information, these techniques rely on relating the probed electronic structure, such as the charge density near the impurity, to the underlying magnetic properties of the system. While fruitful, this strategy has proven to be susceptible to a variety of effects, such as strain and tip-induced charging effects, which influence the overall measured wavefunction. A more direct approach would involve coupling spin-polarized tunneling electrons generated from a tip into a single magnetic atom to read out and manipulate its spin. While this principle has been applied for magnetic impurities coupled to both metallic substrates and thin insulating layers, the application to atomic spins in semiconductor heterostructures, which form the basis for a majority of developments in the field of spintronics, are so far missing. Here, utilizing ultra-low temperature spin-polarized STM (300mK) in high magnetic fields (12T), we measure spin-flip excitations of a single atom coupled to a semiconductor two-dimensional electron system (2DES). These excitations exhibit a significant zero-field splitting resulting from substrate-induced magnetic anisotropy. Furthermore, we observe an asymmetry in the spin-resolved Landau levels of the 2DES measured at the atom which we relate to these measured excitations and the magnetization of the atom. Using a recently developed quantum magnetic model [6] which accounts for magnetic anisotropy combined with the spin state of both the tunneling electron and polarization of the tip, we demonstrate this probed asymmetry is a reflection of the magnetization of the single atom. Within the context of these findings, we find a good agreement between the measured magnetic moment and magnetic anisotropy with first principles calculations.

## REMEMBER

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