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Single spin detection by magnetic resonance force microscopy

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Single spin detection by magnetic resonance force microscopy (MRFM) is based on ultrasensitive measurements of the attonewton magnetic force between a spin and a nearby magnetic tip. Interest in the technique is driven by potential applications to three-dimensional atomic resolution imaging and by fundamental interest in the detection and manipulation of individual quantum objects. This talk describes the basic principles of MRFM and discusses recent results that demonstrated the detection of an individual electron spin buried below the surface of a silicon dioxide sample. Various innovations that led to single spin detection will be described, including ultrasensitive force detection, spin-friendly micromechanical cantilevers and methods to measure and control statistical polarization in small spin ensembles. Future prospects for quantum state readout and for extension to nuclear spin detection will be discussed. This work was performed in collaboration with H. J. Mamin, R. Budakian and B. W. Chui.