Single Electron Spin Detection by Magnetic Resonance Force Microscopy

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Is it possible to build a microscope that can look below surfaces and image molecules and materials with atomic resolution in three dimensions? Such a microscope would revolutionize structural molecular biology and be an important tool for nanoscale science and technology. Magnetic resonance force microscopy (MRFM) is an attempt to address this "holy grail" of microscopy.

In this talk, we describe the basic principles of MRFM and discuss recent results that demonstrate the detection of an individual electron spin buried within a silica sample. We review various innovations that set the stage for single spin detection, including ultrasensitive force detection and novel spin manipulation techniques. We also discuss using MRFM for real-time control of spin fluctuations. Finally, we consider some of the many challenges remaining before 3D atomic imaging and real-time quantum state readout can be realized.

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