“Magnetic Resonance with Single Nuclear-Spin Sensitivity”

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Our method of nanoscale magnetic sensing and imaging makes use of nitrogen-vacancy (NV) color centers a few nanometers below the surface of a diamond crystal. Using individual NV centers, we perform NMR experiments on single protein molecules, labeled with carbon-13 and deuterium isotopes. In order to achieve single nuclear-spin sensitivity, we use isolated electronic-spin quantum bits (qubits), that are present on the diamond surface, as magnetic resonance "reporters". Their quantum state is coherently manipulated and measured optically via a proximal NV center. This system is used for sensing, coherent coupling, and imaging of individual proton spins on the diamond surface with angstrom resolution, under ambient conditions, at room temperature. Our approach may enable magnetic structural imaging of individual complex molecules, and realizes a new platform for probing novel materials, and manipulation of interacting spin systems.