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Nuclear magnetic resonance of external protons using continuous dynamical decoupling with shallow NV centers[1] CHARLES DE LAS CASAS, KENICHI OHNO, DAVID D. AWSCHALOM, Institute for Molecular Engineering, University of Chicago — The nitrogen vacancy (NV) center in diamond is a paramagnetic defect with excellent spin properties that can reside within a few nanometers of the diamond surface, enabling atomic-scale magnetic resonance sensing of external nuclear spins. Here we use rotating frame longitudinal spin relaxation ($T_{1\rho}$) based sensing schemes, known as Continuous Dynamical Decoupling (CDD), to detect external nuclear spins with shallow NV centers (<5 nm from the surface). Distinguishing neighboring nuclear spins from each other requires the NV center be near enough to create differences in the hyperfine shifts and coupling strengths of the nuclei. However, spin coherence time and consequently the sensitivity of dynamical decoupling techniques degrade sharply as NVs become shallower. We use strong continuous driving to overcome this fast decoherence and detect an ensemble of external nuclear spins using a single shallow NV center with a short T_2 ($<2\mu$s) at magnetic fields as high as 0.5 Tesla. The increased sensitivity of this method relative to pulsed dynamical decoupling techniques demonstrates the benefits of CDD for sensing with very shallow NV centers.

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