High-Spectral-Resolution NMR Using NV Centers in Diamond

DOMINIK BUCHER, DAVID GLENN, RONALD WALSWORTH, Harvard University — Nitrogen-vacancy centers grown or implanted at the surface of a diamond chip can be used to detect nuclear magnetic resonance (NMR) signals from molecules in a small volume \(<(10 \text{ nm})^3 - (10 \text{ um})^3\) above the surface. A key outstanding challenge in the field is to achieve sufficient spectral resolution (\(\sim 1\) ppm of the nuclear Larmor frequency) to distinguish features such as chemical shifts and J-couplings in the NMR spectra. We have developed a synchronized readout technique that satisfies this criterion for sample volumes on the order of \(\sim 1\) pL. We show that this technique can provide mHz spectral resolution in the detection of an oscillating magnetic field (with carrier frequency \(f = 4\) MHz) produced by a nearby coil, and demonstrate progress towards the detection of molecular NMR spectra with resolved chemical shifts.