Abstract Submitted
for the DAMOP16 Meeting of
The American Physical Society

High resolution quantum metrology via quantum interpolation

ASHOK AJOY, YIXIANG LIU, KASTURI SAHA, LUCA MARSEGLIA, JEAN-CHRISTOPHE JASKULA, PAOLA CAPPELLARO, Massachusetts Institute of Technology — Nitrogen Vacancy (NV) centers in diamond are a promising platform for quantum metrology – in particular for nanoscale magnetic resonance imaging to determine high resolution structures of single molecules placed outside the diamond. The conventional technique for sensing of external nuclear spins involves monitoring the effects of the target nuclear spins on the NV center coherence under dynamical decoupling (the CPMG/XY8 pulse sequence). However, the nuclear spin affects the NV coherence only at precise free evolution times – and finite timing resolution set by hardware often severely limits the sensitivity and resolution of the method. In this work, we overcome this timing resolution barrier by developing a technique to supersample the metrology signal by effectively implementing a quantum interpolation of the spin system dynamics. This method will enable spin sensing at high magnetic fields and high repetition rate, allowing significant improvements in sensitivity and spectral resolution. We experimentally demonstrate a resolution boost by over a factor of 100 for spin sensing and AC magnetometry. The method is shown to be robust, versatile to sensing normal and spurious signal harmonics, and ultimately limited in resolution only by the number of pulses that can be applied

Ashok Ajoy
Massachusetts Institute of Technology

Date submitted: 29 Jan 2016 Electronic form version 1.4