Abstract Submitted
for the DAMOP20 Meeting of
The American Physical Society

Quantum sensing in a physically rotating frame.[1] ROBERT SCHOLTEN, ALEXANDER WOOD, LLOYD HOLLENBERG, ANDREW MARTIN, University of Melbourne — We describe quantum measurement and control of a physically rotating quantum system, where the rotation period is comparable to the T2 decoherence time of the quantum system. We use the NV center in diamond, rotating at rates up to 500,000 rpm, comparable to the nuclear spin precession frequency, to induce pseudo-fields large enough to cancel the conventional magnetic field for proximal nuclear spins while having minimal effect on the NV qubits. We have also demonstrated T2-limited sensing of static magnetic fields by upconversion of the DC field to the physical rotation frequency, allowing application of spin-echo measurement for durations 100 times longer than Ramsey experiments in a non-rotating system. Most recently, we show the first direct measurement of a quantum phase induced by physical rotation, without transduction through magnetic fields or ancillary spins. Our results highlight the profound connection between physical rotation and quantum spin through the theory of angular momentum.

[1]This work was supported by the Australian Research Council Discovery Scheme (DP190100949)

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Date submitted: 30 Jan 2020 Electronic form version 1.4