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Quantum Interactions of a Torsional Nanomechanical Resonator with a Single Spin[1] BRIAN D'URSO, SHONALI DHINGRA, University of Pittsburgh — While the motions of macroscopic objects may ultimately be governed by quantum mechanics, the distinctive features of quantum mechanics can be hidden by thermal excitations and coupling to the environment. We present a system consisting of a torsional nanomechanical resonator with quantum behavior introduced to the system by coupling the resonator with a single spin through a uniform external magnetic field. The spin originates from a nitrogen vacancy (NV) center in a diamond nanocrystal which is positioned on the resonator. The quadratic coupling is maximized by utilizing a low moment of inertia resonator and an avoided level crossing. This coupling results in quantum non-demolition (QND) measurements of the resonator and spin states, enabling a bridge between the quantum and classical worlds. Furthermore, it provides a high-fidelity readout of the NV center spin and a potential means of observing the discrete states of the resonator. We will describe the potential for these measurements and report on the experimental progress made towards observing this coupling in the torsional resonator-NV system.

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