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Coupling a single spin in diamond to the quantum motion of a mechanical cantilever STEVEN BENNETT, SHIMON KOLKOWITZ, QUIRIN UNTERREITHMEIER, Harvard University, PETER RABL, IQOQI-University of Innsbruck, ANIA BLESZYNSKI-JAYICH, University of California, Santa Barbara, JACK HARRIS, Yale University, MIKHAIL LUKIN, Harvard University — We present theoretical considerations for a magnetized mechanical cantilever coupled to a single electronic spin associated with a nitrogen-vacancy (NV) defect center in diamond. This coupled system has recently been implemented in an experiment where the NV spin was used to detect the thermal motion of a magnetic force microscope cantilever at room temperature, reading out the spin state optically using the spin-selective fluorescence of the NV. The possibility to extend this system to the quantum regime opens the door to applications such as readout and transfer of quantum information, as well as interesting theoretical questions. For example, it should be possible to reach the regime of strong coupling between the spin and the motion of the cantilever, in analogy to cavity quantum electrodynamics. We discuss the prospects for reaching the strong coupling regime and the conditions for measuring the onset of quantum effects, such as measuring the zero point motion of the cantilever using the spin as a detector.

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