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Probing the motion of a mechanical resonator via coherent coupling to a single spin qubit

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Mechanical systems can be inuenced by a wide variety of extremely small forces, ranging from gravitational to optical, electrical, and magnetic. If the mechanical resonator is scaled down to nanometer-scale dimensions, these couplings can be harnessed to monitor and control individual quantum systems. In this talk, I will describe experiments in which the coherent evolution of a single electronic spin associated with a Nitrogen Vacancy (NV) center in diamond is coupled to the motion of a magnetized mechanical resonator. Specifically, we have used coherent manipulation of the NV spin to sense the resonator's Brownian motion under ambient conditions. Potential applications of th is technique include the detection of the zero-point uctuations of a mechanical resonator, the realization of strong spin-phonon coupling at a single quantum level, and the implementation of quantum spin transducers.