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**Sensing thermal motion of a mechanical resonator using a single spin qubit in diamond** SHIMON KOLKOWITZ, Harvard University, ANIA BLESZYNSKI JAYICH, UC Santa Barbara, PETER RABL, University of Innsbruck, STEVEN BENNET, QUIRIN UNTERREITHMEIER, Harvard University, JACK HARRIS, Yale University, MIKHAIL LUKIN, Harvard University — We present experimental results demonstrating the detection of the motion of a magnetized mechanical cantilever using a single spin qubit associated with a nitrogen-vacancy (NV) defect center in diamond. This setup is predicted to enable strong, coherent coupling between the NV electronic spin and the motion of the cantilever, allowing for the mechanical analog of cavity quantum electrodynamics [1]. To this end, we use the NV spin to detect both driven and 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. This method utilizes the high sensitivity of the NV spin precession to Zeeman shifts caused by the a.c. magnetic field induced by the motion of the cantilever. Finally, we discuss potential applications of our approach to the realization of quantum spin transducers using arrays of coupled spin-cantilever pairs [2]. 1. Rabl, P. *et al.* Strong magnetic coupling between an electronic spin qubit and a mechanical resonator. *Physical Review B* **79**, 41302 (2009). 2. Rabl, P. *et al.* A quantum spin transducer based on nanoelectromechanical resonator arrays. *Nature Physics* **6**, 602–608 (2010).

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