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Sideband cooling micromechanical motion to the quantum ground state JOHN TEUFEL, NIST Boulder, TOBIAS DONNER, JILA, University of Colorado and NIST, DALE LI, NIST Boulder, KONRAD LEHNERT, JILA, University of Colorado and NIST, RAYMOND SIMMONDS, NIST Boulder — Accessing the full quantum nature of a macroscopic mechanical oscillator first requires elimination of its classical, thermal motion. The flourishing field of cavity opto- and electromechanics provides a nearly ideal architecture for both preparation and detection of mechanical motion at the quantum level. We realize such a system by coupling the motion of an aluminum membrane to the resonance frequency of a superconducting, microwave circuit. By exciting the microwave circuit below its resonance frequency, we damp and cool the membrane motion with radiation pressure forces, analogous to laser cooling of trapped ions. The microwave excitation serves not only to cool, but also to monitor the displacement of the drum. A nearly shot-noise limited, microwave Josephson parametric amplifier is used to detect the mechanical sidebands of this microwave excitation and quantify the thermal motion of the oscillator as it is cooled with radiation pressure forces to its quantum ground state.

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