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**Quantum-limited measurements of ultracold atoms in an optical cavity** SYDNEY SCHREPPLER, NICOLAS SPETHMANN, JONATHAN KOHLER, DAN STAMPER-KURN, University of California, Berkeley — The development of quantum-limited sensors for mechanical signals, such as position, momentum, and force, is a goal common to many active fields of research. Potential applications include strain measurements in large-scale gravitational wave detectors, quantum-limited Casimir force detection, and tests of quantum mechanics on biological structures. I will describe our recent experimental realization of the quantum-limited detection of an externally-applied classical force using an ultracold-atoms-based optomechanical system. The force sensitivity can be tuned across both fundamental measurement regimes, from one limited by probe shot-noise to one dominated by measurement backaction. Our detection technique additionally allows us to construct a phase-space representation of the quantum-limited imprecision of our measurements.

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