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Observation of optical quantum measurement backaction on a mechanical resonator THOMAS PURDY, ROBERT PETERSON, PEN-LI YU, CINDY REGAL, JILA-University of Colorado and NIST, and Department of Physics, University of Colorado, Boulder — Quantum mechanics provides an inextricable link between measurement and backaction on the subsequent dynamics of a system. Here we continuously monitor the position of a membrane microresonator in a cavity optomechanical system. We observe a fluctuating backaction force on the resonator which rises with measurement strength in accordance with the minimum allowed by the Heisenberg position-momentum uncertainty limit. For our optically-based position measurement the backaction takes the form of a fluctuating radiation pressure due to optical shot noise. We demonstrate radiation pressure shot noise that is comparable to in magnitude to thermal fluctuations at frequencies near the mechanical resonance. Additionally, we observe temporal correlations between fluctuations in the radiation force and resonator position, which we interpret as a non-demolition measurement of the intracavity photon field fluctuations. We will also discuss possible methods to lower the technical noise floor in all measurement quadratures.

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