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**Phonon Fluctuations in a Bose-Einstein Condensate Subject to Repeated Weak Measurements** EMINE ALTUNTAS, SHANGJIE GUO, HILARY HURST, YUCHEN YUE, FRANCISCO SALCES-CARCOBA, CHRISTOPHER BILLINGTON, IAN B. SPIELMAN, Joint Quantum Institute, National Institute of Standards and Technology, and University of Maryland — Weak measurements are minimally destructive measurement techniques that present new opportunities for understanding the system-reservoir dynamics of many-body systems. Weak measurements yield a controlled reservoir and consequently allow time-resolved study of the system evolution. We experimentally study the phonon fluctuations that result from the quantum backaction induced by repeated weak measurements in quasi-one dimensional Bose-Einstein condensates (BECs). We use partial transfer absorption imaging (PTAI) technique to obtain minimally destructive and multiple successive *in situ* images of the same BEC. We describe the reciprocal space analysis of the density profiles and present the resultant space-time separated density-density correlation functions. Further we discuss feedback control protocols for future applications of Hamiltonian engineering using weak measurements and feedback.

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