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Cavity Optomechanics with a Bose-Einstein Condensate KRISTIAN BAUMANN, FERDINAND BRENNECKE, ETH Zurich, CH, STEPHAN RITTER, Max-Planck-Institut für Quantenoptik, Garching, D, TOBIAS DONNER, JILA, University of Colorado and National Institute of Standards and Technology, Boulder CO, USA, CHRISTINE GUERLIN, TILMAN ESSLINGER, ETH Zurich, CH — In our experiment we couple a Bose-Einstein condensate with an ultrahigh-finesse optical cavity. The tremendous degree of control over atomic gases achieved in Bose-Einstein condensates combined with the rich field of cavity quantum electrodynamics opens access to a wealth of new physics. In the dispersive regime, our system realizes a model of cavity optomechanics. This research field typically studies the coupling of the mechanical motion of one of the cavity mirrors to the light field. In our case, the mechanical oscillator is given by a coherent density modulation of the atomic cloud. We have observed this density modulation and strong optical nonlinearities, present at the single photon level. Furthermore our mechanical oscillator naturally starts in its ground state, from which a single motional excitation can cause a shift of the cavity resonance on the order of the cavity linewidth. Our system is promising to study the quantum regime of cavity optomechanics.

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