LINEAR AND QUADRATIC OPTOMECHANICS WITH AN ARRAY OF ULTRACOLD ATOMIC ENSEMBLES

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Atomic ensembles have a number of advantages as optomechanical oscillators . They can be cooled to their motional ground state using atomic cooling techniques, have very low thermal coupling to the surrounding environment, and can be probed in the single-photon strong coupling regime. We present an experiment using an integrated atom-chip/cavity device operated with atoms initialized in their motional ground state. Strong magnetic-field gradients from the atom chip allow us to prepare atomic ensembles centered on locations that are primarily either linearly or quadratically coupled to the cavity field. In addition, we can alter the light-atom coupling strength of neighboring atomic ensembles in a 1D array by using a magnetic resonance technique to address the atomic spin. We also present ongoing studies of the linear optomechanical gain of the atom-cavity device driven by near shot-noise fluctuations of the light.