Observation of Opto-mechanical Strain in a Cold Atomic Cloud

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We report the observation of the optomechanical strain applied to 87Rb atoms when illuminated by an intense, far detuned homogenous laser beam. In this regime the atomic cloud acts as a lens which focuses the laser beam. As a back action, the atoms experience a force opposite to the beam deflection, which depends on the atomic cloud density profile. We experimentally demonstrate the basic features of this force, distinguishing it from the well-established scattering and dipole forces. The observed strain saturates, ultimately limiting the momentum impulse that can be transferred to the atoms. This optomechanical force may effectively induce inter-particle interactions, which can be optically tuned.