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Cooling of gram scale objects

NERGIS MAVALVALA, Massachusetts Institute of Technology

Laser cooling of macroscopic mechanical oscillators has applications in high precision measurements, gravitational wave detectors, and exploration of the classical-quantum transition. We describe a series of cooling experiments, inspired by gravitational wave detectors, to trap and cool gram scale mirror oscillators. To approach quantum limits of oscillators with such a high mass requires the use of a variety of cooling techniques that employ frictionless forces, both to trap the mirror by increasing its effective mechanical resonant frequency, and to cool the mirror by damping its motion within the trap. The frictionless forces are created from either radiation pressure in a detuned optical resonator, or from electronic feedback forces in an active servo. As the experiments approach the quantum regime, an assortment of non-classical behavior and effects should become evident, such as quantum radiation pressure noise, and squeezing and entanglement of the light and mirror states. We will discuss the prospects for observation of these effects in our current apparatus, and also with expected upgrades.