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Semi-Classical Theory of Radiation Pressure Cooling of a Mechanical Oscillator by dynamical Backaction NIMA NOOSHI, TOBIAS KIPPENBERG, Max-Planck-Institute of Quantum Optics, 85748 Garching, Germany — Laser cooling of the thermal motion of mechanical oscillators has been predicted by Braginsky almost three decades ago, and has recently been demonstrated experimentally for the first time in a series of experiments. Cooling arises when the mechanical oscillator is coupled to an optical high finesse cavity, which causes the mechanical mode to be viscously damped on the red detuned optical sideband. The ultimate goal of these experiments is to reach the quantum ground state of the mechanical oscillator. Using a semiclassical theory for radiation pressure induced laser cooling, and taking into account the quantum back action of the radiation field on the mechanical oscillator noise spectrum, we derive the conditions for which ground state cooling is possible. In addition we elucidate the physical origin of the cooling and identify the similarities with atomic laser cooling.

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