Optical cooling using the dipole force

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Abstrak

This thesis unifies the dissipative dynamics of an atom, particle or structure within an optical field that is influenced by the position of the atom, particle or structure itself. This allows the identification and exploration of the fundamental ‘mirror-mediated’ mechanisms of cavity-mediated cooling leading to the proposal of a range of new techniques based upon the same underlying principles. It also reveals powerful mechanisms for the enhancement of the radiation force cooling of micromechanical systems, using both active gain and the resonance of a cavity to which the cooled species are external. This work has implications for the cooling not only of weakly-scattering individual atoms, ions and molecules, but also for highly reflective optomechanical structures ranging from nanometre-scale cantilevers to the metre-sized mirrors of massive interferometers.