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Gain-enhanced optical cooling in cavity optomechanics LI GE, Department of Electrical Engineering, Princeton University, Princeton, New Jersey 08544, USA, SANLI FAEZ, FLORIAN MARQUARDT, Max-Planck-Institute for the Science of Light, Günther-Scharowsky-Straße 1/Bau 24, DE-91058 Erlangen, Germany, HAKAN TURECI, Department of Electrical Engineering, Princeton University, Princeton, New Jersey 08544, USA — We study the optical cooling of the mechanical motion of the resonator mirror in a cavity-optomechanical system that contains an optical gain medium. We find that the optical damping caused by radiation pressure force is vanishingly small if the active medium is pumped incoherently above its lasing threshold. In addition, we find that the spontaneous emission of the active medium always tends to increase the final effective temperature of the mechanical motion. In the presence of an additional seeding signal, i.e. a coherent drive of fixed frequency within the width of the gain curve however, we find that the cooling rate can be enhanced significantly with respect to that of a passive cavity. We attribute this effect to a reduced effective optical damping in the presence of incoherent pumping.

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