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论文

非线性光学腔中的相位调制光机械动力学

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摘要:

研究了Fabry-Perot光学腔中包含一个光学参量放大器来增强腔场与机械振子之间的耦合的光机械动力学行为.在解析边带机制下用量子郎之万方程具体研究了振子的涨落光谱、光学多稳态行为、机械阻尼与修正共振频移和基态冷却.通过数值解讨论了辐射压力诱导机械振子和腔场的稳态振幅所展现的光学多稳态行为,同时也分析了辐射压力引起的修正共振频移和机械阻尼与参量增益、输入激光功率和参量相位这三个因素的关系.此外,随着调节泵浦场的参量相位,振子的涨落光谱呈现简正模式分裂.通过精确求解最终有效声子数论证了基态冷却.结果表明,机械振子的冷却由初始浴温度、机械品质因数和参量相位这个三个因素控制.参量相提供一个新的方法来操控非线性光机械动力学.

关键词: 腔光机械 辐射压力 光学多稳态 简正模式分裂 冷却

Phase Modulation Optomechanical Dynamics Induced by Radiation-pressure in Nonlinear Optical Cavity

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Abstract:

A cavity optomechanical system containing an optical parametric amplifier is investigated under resolved sideband regime,which enhances the coupling between the movable mirror and the cavity field.The radiation-pressure inducing the movable mirror and the steady-state amplitude of the cavity field displaying an optical multistable behavior are studied.The modification of mechanical frequency and mechanical damping rate are analyzed induced by radiation pressure,which will change with the change of parametric gain,input laser power and parametric phase.In addition,the fluctuation spectrum of the movable mirror is also analyzed presenting the normal mode splitting with modulating the parametric phase of the driving field.Moreover,an accurate scheme is used to calculate the final effective mean phonon number that demonstrates the ground state cooling.The results show that the cooling of the mirror is dominated by the initial bath temperature,high mechanical quality factor and parametric phase.The parametric phase shows a new way to control the dynamics of nonlinear optomechanical cavity.

Keywords: Cavity optomechanics Radiation pressure Optical multistability Normal mode splitting Cooling

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