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论文

Kerr介质中耦合V型三能级原子与相干态光场作用场的量子性质

李可,令维军

(天水师范学院 物理系,甘肃 天水 741001)

摘要:

研究了Kerr介质中相干态光场与耦合V型三能级原子相互作用过程中场的量子性质.利用量子光学中光场与原子相互作用的耦合Tavis-Cummings模型,对系统的动力学过程进行了求解.讨论了系统初始状态、失谐量、原子间偶极相互作用强度及Kerr系数对光场量子性质随时间演化的影响.数值计算结果表明:初态中场的平均光子数比较小时,光场能够展现出明显的量子效应|初始时刻原子激发态概率幅从小变大时,光场的反聚束效应变得越明显,而光场的压缩深度会先增大后减小|失谐量的变化对场的量子性质的影响不大,只是改变光场二阶相关函数和压缩参量振荡的周期|原子间耦合强度的增大使光场的反聚束效应减弱和光场的压缩深度变浅|Kerr系数的增大会增强光场的反聚束效应,而使光场的压缩深度变浅.

关键词: 量子光学 耦合V型三能级原子 二阶相关函数 光场压缩 相干态光场 Kerr 介质

Quantum Properties of the Field in the System of Coupled V-type Three-level Atoms Interacting with Coherent Field in Kerr Medium

LI Ke,LING Wei-jun

(Physics Department of Tianshui Normal university,Tianshui,Gansu 741001,China)

Abstract:

The quantum properties of the light field in the system of two coupled V-type atoms interacting with coherent field in Kerr medium were studied.The solution describing the dynamics process of the system was gained by means of the coupled Tavis-Cummings model in quantum optics.Influences of the initial state,the detuning of the field,the coupling strength of dipole-dipole interaction between atoms and Kerr coefficient on the second-order correlation function and the squeezing parameter of the field were discussed.Numerical calculation results show:when the average photon number of the field in the initial state is smaller,the field exhibits apparent quantum effect|when the probability amplitude of the excited states of the atoms in the initial state changing from small to large,the anti-bunching effect of the field becomes more obvious,but the squeezing depth increase at first and then decrease|the detuning changing create small influence on the quantum properties of the field,its changing only change the oscillating period of the second-correlation function and the squeezing parameter of the field|the increasing of the coupling strength between the atoms weaken the anti-bunching effect of the field and make the squeezing depth become shallow|the increasing of Kerr coefficient enhances the anti-bunching effect of the field,but makes the squeezing depth become shallow.

Keywords: Quantum optics Coupled V-type three-level atoms Second-order correlation function Radiation squeezing Coherent field Kerr medium

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通讯作者: 李可

作者简介:

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