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Quantum dynamics of a f-deformed cavity-field beyond the rotating wave approximation

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Abstract

The aim of this study is to investigate dynamical properties of a two-mode f-deformed cavity- field coupled to an effective two-level atom with and without the rotating wave approximation. The first section discusses the theoretical model of the interaction between a two-mode cavity-field and an effective two-level atom within the framework of an f-DJCM without the rotating wave approximation. After that, we obtain the reduced density matrix of the cavity-field with and without the rotating-wave approximation. Then, we have investigated the effect of the counter-rotating terms on temporal evolution of various non-classical properties of the cavity-field, i.e., photon-counting statistics, the cross correlation between the modes of the field, and the quantum fluctuations of the quadrature components. Particularly, we compare the numerical result for three different values of the deformation parameter q (q=1, q=1.1, q=0.9) with and without applying the rotating wave approximation. By using of the numerical method, we concluded that even under the condition in which the RWA is considered to be valid, there are the significant effects of virtual-photon field on the photon-counting statistics, the cross correlation between the modes of the field, and the quantum fluctuations of the quadrature components.

Keywords: f-deformed Jaynes-Cummings model, rotating wave approximation, counter-rotating terms, virtual-photon processes

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