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Antibunching of photons in a coherent radiation field coupled to a non-degenerate parametric oscillator beyond rotating wave approximation (Article)

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Abstract

View references (39)

Under the classical (strong) pump condition, the Hamiltonian involving the signal and the idler modes of a non-degenerate parametric oscillator is exhibited. Without using the usual rotating wave approximation (RWA), the analytical solutions of the field operators are used to investigate the antibunching of photons of the input radiation field coupled to the non-degenerate parametric oscillator. By using the symbolic calculation, the antibunching of photons for both the signal and idler modes are investigated. In particular, the effects of the inclusion of rotating wave approximated terms on the antibunching of photons are clearly indicated. To substantiate the analytical results, the temporal evolution of signal photon and idler photons , and the antibunching effects of the signal and idler modes are investigated numerically by using the QuTip 3.1.0. The exact numerical results obtained by QuTip 3.1.0 matches extremely well with those of the analytical results. The present article and hence the analytical method might be of use for investigating the situations of having ultra-strongly and deep-strongly coupled systems where the possibilities of using RWA is completely ruled out. © 2021, Indian Academy of Sciences.

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42.50.Ct | 42.50.Pq | 42.50.–p | Antibunching of photons | non-degenerate parametric oscillators | rotating wave approximation

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