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Squeezing , mixed mode squeezing , amplitude squared squeezing and principal squeezing in a non-degenerate parametric oscillator (Article)

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Abstract

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The Hamiltonian and hence the equation of motion of the field operators of a non-degenerate parametric oscillator (NDPO) under the influence of classical pump are formulated. The coupled operator differential equations involving the signal and idler modes are decoupled at the expense of fourth order differential equations involving the c-numbers. Without using the rotating wave approximation, the analytical solutions of the field operators are obtained. These solutions are approximated up to the second orders in dimensionless coupling constant. We investigate the squeezing, mixed mode squeezing, amplitude-squared squeezing, and the principal squeezing of the thermal and coherent light coupled to the NDPO. By using the input composite number state, we establish that the percentage and the range (interaction time) of squeezing is considerably increased with the increase of the signal photon number. For initial composite number state, the amplitude squared squeezing for Y_s quadrature is obtained at the cost of canonically conjugate Z_s quadrature. The percentage of amplitude squared squeezing increases significantly with the increase of signal excitation (photon). The so-called normal squeezing and the principal squeezing are also indicated for the NDPO coupled with the initially prepared composite coherent states not in the composite number states. In spite of the shortcomings of the analytical solutions, we obtain squeezing, amplitude squared squeezing and other nonclassical effects which are unavailable under the rotating wave approximation. In order to give the feelings about the analytical results (expressions), we give some symbolic calculations relevant to the possible experimental situations. © 2017 Elsevier GmbH

Author keywords

Mixed mode squeezing | Nondegenerate parametric oscillator | Principal squeezing | Rotating wave approximation | Squeezing

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