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Influence of Signal and Noise on Statistical Fluctuationof Single-Mode Laser System

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Abstract: On the basis of calculating the steady-state mean normalized intensity fluctuation of a signal-mode laser system driven by both colored pump noise with signal modulation and the quantum noise with cross-correlation between its real and imaginary parts, we analyze the influence of modulation signal, noise, and its correlation form on the statistical fluctuation of the laser system. We have found that when the amplitude of modulation signal weakens and its frequency quickens, the statistical fluctuation will reduce rapidly. The statistical fluctuation of the laser system can be restrained by reducing the intensity of pump noise and quantum noise. Moreover, with prolonging of colored cross-correlation time, the statistical fluctuation of laser system experiences a repeated changing process, that is, from decreasing to augmenting, then to decreasing, and finally to augmenting again. With the decreasing of the value of cross-correlation coefficient, the statistical fluctuation will decrease too. When the cross-correlation form between the real part and imaginary part of quantum noise is zero correlation, the statistical fluctuation of laser system has a minimum. Compared with the influence of intensity of pump noise, the influence of intensity of quantum noise on the statistical fluctuation is smaller.

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Key words: signal, noise, single-mode laser, the steady-state mean normalized intensity fluctuation

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