Interferometric measurement of a biphoton state with continuous-variables by homodyne detection

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The ability to characterize quantum properties of a physical system plays a central role in the foundations of quantum physics and applications in quantum information science. Especially, the characterization of nonclassical characterization of light such as anti-bunching, entanglement, and squeezing, is of great interest in quantum optics and constitutes a useful resource in quantum technology. Furthermore, owing to vast potential applications in quantum communications, quantum information processing, foundations of physics, and quantum metrology, the reconstruction of wave function of a biphoton state has attracted a great deal of attention.

In order to measure the wave function of a biphoton state, we interfer the biphoton state from an optical paremetric oscillator with a coherent auxiliary state. The second-order correlation function for the interfered field is theoretically modelled and calculated by introducing a loss parameter. In experiment, the second-order correlation function values are measured with a pair of homodyne detectors. A set of second-order correlation function values for the interfered field are recorded when the displacement of coherent state is varied. Both magnitude and argument of the complex parameter of the wave function for the measured biphoton state are reconstructed by fitting a set of second-order function values with our proposed model through least square method. The reconstructed results, shown in Fig. 1, have a reasonable agreement with the predicted results from viewpoint of OPO. This may introduce another approach to characterizing a biphoton state in the regime of continuous variables.

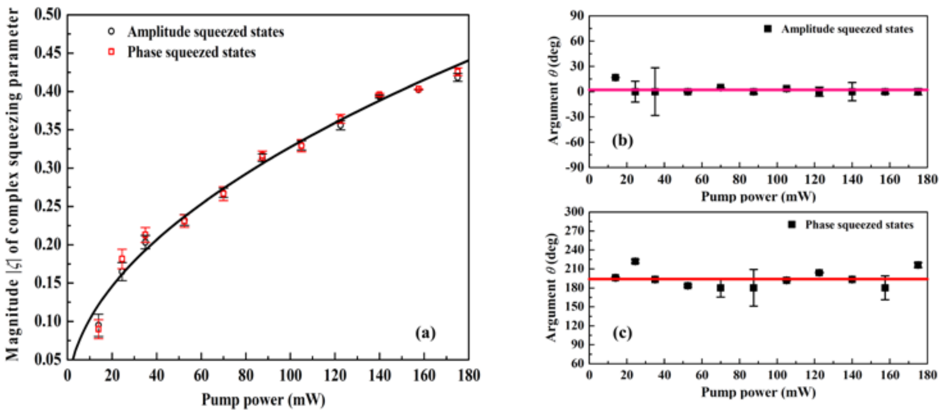

Fig. 1 Reconstructed magnitude $|\zeta|$ and argument θ of the complex parameter for the biphoton state with the pump power increasing. In (a), the squares and circles are the fitted magnitude $|\zeta|$ from amplitude and phase squeezed states, curves are theoretical calculation results. (b) and (c) are the fitted argument θ from amplitude and phase squeezed states, respectively.