

Experimental Generation of Squeezed Cat States with an Operation Allowing Iterative Growth

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Quantum optics provides useful tools to quantum information processing. In the continuous variables approach, some exotic states with complex quantum structures exhibit really interesting quantum properties, opening new perspectives. For instance, such states allow an implementation of the quantum gates required for quantum computing by only using beam-splitters and photodetectors. The cat state, which is a superposition of two coherent states with opposite phase and was named so in reference to the famous Schrödinger gedankenexperiment, is one of these states. The main challenge is to be able to generate them efficiently. Within the frame of the PALM HAQI project, we have demonstrated that such a cat state can be produced by the “fusion” of two photons: two single-photon states are mixed on a symmetric beamsplitter, leading to the photon coalescence effect, and a homodyne measurement projects the state on a cat state. This operation can be iterated, increasing the complexity of the generated state, and this could be performed efficiently with a reliable quantum memory.

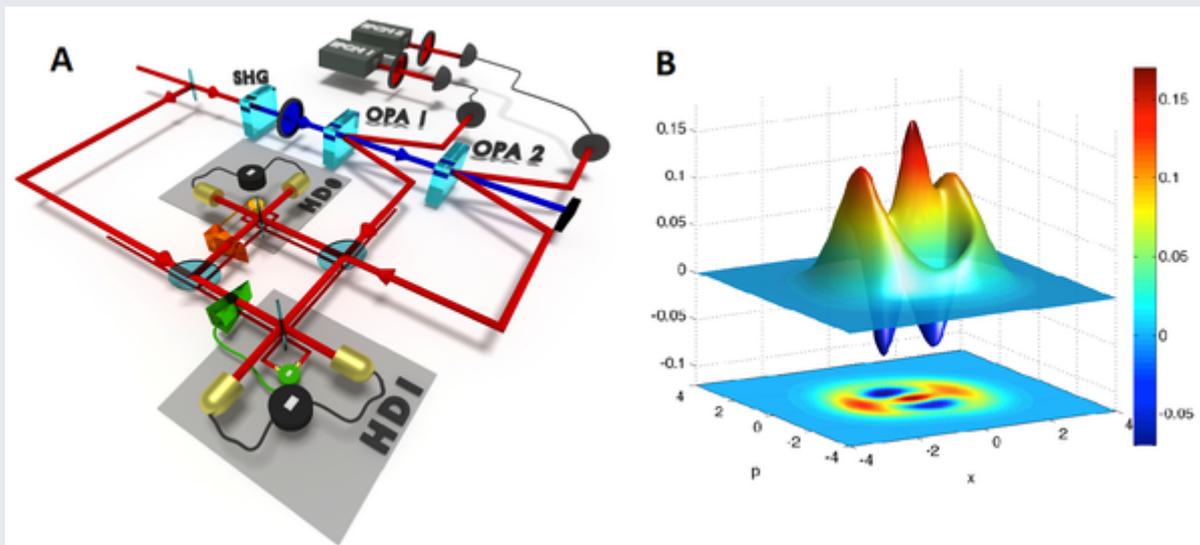


Figure: (A) Experimental set-up for producing a cat state from the coalescence of two single-photon states [from PRL 114, 193602, 2015]. A picosecond laser beam is frequency-doubled (SHG) in order to pump two optical parametric amplifiers (OPA) and to produce two photon pairs by parametric down-conversion. This allows the generation of two single-photon states by conditional generation (detection events on SPCM 1 and 2), which are mixed on a symmetric beam-splitter and analyzed by two homodyne detections. (B) Wigner function of the cat state generated by this setup.

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