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Iterative generation of non-classical states of light

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Mesoscopic quantum states of light, which may contain several photons and present a complex quantum structure, could open very interesting new prospects in quantum optics. Optical Schrödinger cat states for instance, which are quantum superpositions of two coherent states (figure), could be used in quantum computing as they allow an implementation of all basic quantum gates by using only classical photonics tools: beamsplitters, phase shifters, photon counters. We show the possibility to generate such states very efficiently through the iteration of a quite simple operation: the superposition of two states on a beamsplitter, followed by a heralding quadrature measurement in one output port of this beamsplitter. We will discuss the potential of synchronized optical cavities in the pulsed regime to generate complex mesoscopic quantum states through such iterative schemes. Single-photons are a main resource for these targeted protocols, but pure states in well-defined spatio-temporal modes are required in order to perform relevant homodyne measurements. We will present a setup for high-rate single-photons generation, based on exaltation cavities in the pulsed regime, and discuss the way to synchronize this source with another cavity in order to have a quantum memory and to implement new kinds of innovative quantum protocols.

Figure: *Theoretical Wigner Function of an Optical Schrödinger cat state, constituted by two coherent states clearly separated in the figure, and by oscillations in the center that are a signature of the quantum nature of the superposition.*

Biography

Rosa Tualle-Brouri is Professor at Institut d'Optique Graduate School. She is a recognized expert in quantum information and quantum optics and was, from October 2010 to October 2015, a Junior Member of the Institut Universitaire de France. She's leading the effort of the Continuous-Variable team in the Quantum Optics group which obtained several "world firsts" in the fields of continuous variables quantum cryptography and non-Gaussian states conditional generation.

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