Quantum Optics at INO Napoli: activities and perspectives

1. Nonclassical multimode light sources via quadratic interactions

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Quantum properties of light can be used in a variety of applications, from enhanced sensing to spectroscopy, metrology and quantum information. We present our activities and results about the realization of nonclassical multimode light sources via cascaded quadratic interactions. First, we generated quantum-correlated twin beams through an internally pumped optical parametric oscillation in a doubly resonant second-harmonic cavity and observed a noise reduction up to 5 dB in their intensity difference. Our system can be also operated to emit optical frequency combs, and the demonstration of two-mode correlations opens the way to the exploration of multimode correlations among the comb teeth. A second activity, at its inception, focuses on the realization of parallel generation of quantum correlations in different transverse modes of an optical cavity.

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2. Light Manipulation Lab Quantum Activities

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We present two main activities, one concerning the orbital angular momentum (OAM) optomechanical manipulation and another focused on the development of a smart quantum source. Opto-mechanical systems mediate interactions between optical and mechanical modes and are very attractive for the realization of quantum interfaces, transducers and memory elements. We are exploiting opto-mechanical coupling by using an ultra-low dissipation mechanical membrane, to realize transducers of Spin and OAM of light in different spectral region.

The smart quantum source responds to current technologic requests of overcoming the quantum limits also in view of the upcoming third-generation GW detector, Einstein Telescope (ET). We are realizing an innovative device to perform efficient generation of vacuum squeezed. The cutting edge squeezer will exhibit high stability exploiting the very low thermo-mechanical response of the material.

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