SPECTRAL CHARACTERIZATION OF WEAK COHERENT STATE SOURCES BASED ON TWO-PHOTON INTERFERENCE

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Weak coherent states (WCSs) are a practical and inexpensive way to probabilistically create single-photon pulses. They are created with a faint laser and are largely employed in quantum cryptography systems for quantum key distribution (QKD) [1].

Two-photon interference between single photons was first observed using photon-pairs emitted through spontaneous parametric down conversion. By feeding a beamsplitter with identical single photons in its input ports a decrease in the coincidence counts at the outputs occurs due to the photon bunching effect, known as the *Hong-Ou-Mandel* (HOM) dip [2]. When the photons have different frequencies, a quantum beat pattern is expected [3], but the effect cannot be observed unless the coherence time of the single photons is long enough with respect to the detectors timing resolution [4].

Two-photon interference can be observed even when coherent states are employed in a setup where coincidence detections are used to post-select two-photon states from mixed states. When two coherent states are used, the interference visibility is bounded to 50% for two spatial modes, due to multi-photon emission [5].

Here we demonstrate a method for the spectral characterization of coherent states in the weak regime based on two-photon interference in a beamsplitter [6]. Two WCS sources, reference and test, are fed into a beamsplitter and the interference pattern is obtained by measuring coincidence counts in a HOM interferometer. A theoretical model was derived considering the interference of frequency-displaced photons in a beam splitter [4]. It fits the interference pattern revealing the frequency mismatch and coherence length of the source under characterization.

The parameters of the model fit to the interference pattern are compared to the spectrum obtained from the optical beat of bright versions of the optical sources in a photodiode, observed in an electrical spectrum analyzer. Our results show the equivalence between both techniques for different frequency mismatch between optical sources.

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