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Tesis: "GENERAL STUDY OF CLASSICAL AND NONCLASSICAL CONTRIBUTIONS OF TWO PHOTON ABSORPTION PROCESS IN ORGANIC MOLECULES"

Resumen:

At present, the non-linear optical phenomenon known as two-photon absorption (TPA) has garnered significant technological attention due to its potential applications in areas such as laser scanning, multiphoton microscopy, photodynamic therapy, micro-engraving, and more. Recent theoretical and experimental investigations have suggested an intriguing extension of TPA involving correlated or entangled photons, referred to as entangled two-photon absorption (ETPA). However, the scholarly discourse is marked by a robust debate concerning the actual magnitude of the ETPA effect, and even the empirical detection of such an effect. This study introduces a pioneering method to probe the presence of ETPA, utilizing changes in the visibility of the Hong-Ou-Mandel (HOM) interferogram as a quantitative measure. Employing a nonlinear material – specifically, the dye Rhodamine B (RhB) interacting with entangled photons at approximately ~ 800nm – the conditions conducive to observing alterations in HOM interferogram visibility due to ETPA are exhaustively explored. This innovative experimental approach has the distinct advantage of distinguishing linear optical losses that mimic ETPA effects from the authentic ETPA signal. These linear losses often manifest as artifacts in alternative experimental setups.

Findings from this research reveal that ETPA induces changes in HOM interferogram visibility, even in resonant conditions, at a magnitude less than 1%. In physical terms, this implies that deviations in the Joint Spectral Function (JSI), which characterizes the quantum state of photons, are less probable when the spectral sample bandwidth significantly deviates from the corresponding photon spectrum. Consequently, the proposed experimental method, which relies on the interference of two photons and remains impervious to linear optical losses affecting HOM dip visibility, offers an inventive and alternate avenue for detecting alterations in photon symmetry within correlated photon-pair states due to ETPA. Additionally, a model is presented wherein the sample is conceptualized as a notch-type two-photon spectral filter function adhering to the energy conversion prerequisites stipulated by ETPA. This theoretical framework effectively elucidates experimental observations, establishing favorable alignment between theory and empirical results.