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Detection of orbital angular momentum states of entangled photons by means of local interferometry

Radiation carrying Orbital Angular Momentum (OAM) formalized in the late 20th century opened important perspectives in both classical and quantum domains. The enormous advantage is due to the additional degree of freedom characterized by an unlimited number of states that can be encoded using single photons. Generally, detection of OAM states in quantum experiments is performed using direct conversion of the states into the fundamental TE00 modes or by using geometric log-polar transformations with suitable refractive optical elements. Unfortunately, in these cases the entire radiation wavefront is required for conversion. Detection of quantum states cannot easily be performed without intercepting the entire wavefront, therefore, the natural divergence of light poses a fundamental limitation for the transfer of OAM states over long-distances. Within the ADAMANT and MOONLIGHT projects, we present a new strictly local sensing approach that exploits the transverse properties of radiation carrying orbital angular momentum to detect OAM states. Experimental results prove the effectiveness in distinguishing the OAM states of entangled photons generated via Parametric Down Conversion by receiving only a small portion of the radiation wavefront. The proposed approach exploits local interferometry in a very stable monolithic implementation, with important benefits in advanced quantum sensing for OAM states.

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