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A QUANTUM LOOK AT DIFFERENCE-FREQUENCY GENERATION

In today's growing field of quantum communication, a major quest is trying to increase the bandwidth of information that can be sent. An interesting avenue is looking at nonlinear optical processes which also allows one to incorporate the spatial degrees of freedom of light. A widely used nonlinear process is spontaneous parametric down conversion (SPDC), which is a source for entangled photons. As it is considered a quantum effect, the process is well defined in the quantum regime. A less explored topic is the stimulated version of down conversion, which is also called difference-frequency generation (DFG) in classical nonlinear optics. Although it is considered a classical effect, it can have interesting applications in quantum theory, e.g. the process is currently used to achieve optimal quantum cloning. It is therefore important to be able to formulate this process using standard quantum optics notation, so it can be integrated in quantum schemes. In this talk, I will give a brief description of difference-frequency generation, before deriving a quantum optical description for the process, based off the standard description for SPDC. Using this new approach, I introduce prospective applications for DFG, specifically where it is used for measurement-free error correction, a new type of teleportation scheme and potentially as an anti-linear quantum channel.

Apply to be considered for a student ; award (Yes / No)?

Yes

Level for award;(Hons, MSc, PhD, N/A)?

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