Measurement-induced strong Kerr nonlinearity for weak quantum states of light

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Abstract: Strong nonlinearity at the single photon level represents a crucial enabling tool for optical quantum technologies. In this poster, we report on experimental implementation of a strong Kerr nonlinearity by measurement-induced quantum operations on weak quantum states of light.

Nonlinear optical interactions represent a major tool for generation and manipulation of optical fields in both classical and quantum domains, and they form a basis of countless photonics devices. A fundamental nonlinear interaction is represented by a Kerr nonlinearity. Strong Kerr nonlinearity would enable, e.g., generation of macroscopic superpositions of coherent states [1] or complete Bell state measurement in quantum teleportation [2]. However several works pointed out that the very nature of light-matter interaction may prevent achievement of a sufficiently strong Kerr nonlinearity in certain configurations for weak quantum optical fields [3]. With our setup we are able to implement a coherent superpositions of sequences of photon additions and subtractions [4] (schematic view in Fig.1).

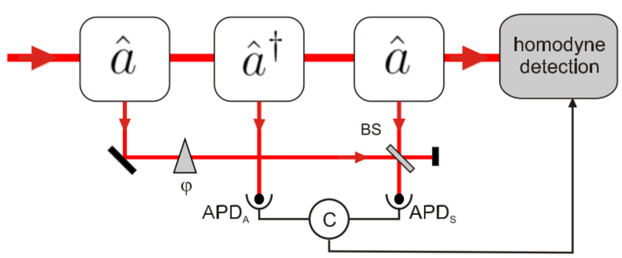

Fig. 1. Schematic view of the main blocks used for implementing arbitrary coherent superpositions of sequences of conditional photon additions and subtractions.

With this apparatus we can experimentally emulate a strong Kerr nonlinearity by measurement-induced quantum operations on weak quantum states of light. Specifically, we emulate this interaction on the smallest nontrivial subspace spanned by the vacuum, single-photon, and two-photon states.

References

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