

Abstract Submitted  
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**Quantum Nonlinear Optics without Photons** VINCENZO MACR,  
universit di messina — Here we propose a physical process analogous to spontaneous parametric down-conversion, where one excited atom directly transfers its excitation to a couple of spatially separated atoms with probability approaching one. The interaction is mediated by the exchange of virtual rather than real photons. This nonlinear optical process is coherent and reversible, so that the couple of excited atoms can transfer back the excitation to the first one: the analogous for atoms of sum-frequency generation. The parameters used here correspond to experimentally-demonstrated values in circuit QED. This approach can be expanded to consider other nonlinear inter-atomic processes as the four-qubit mixing and is an attractive architecture for the realization of quantum devices on a chip.

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