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# Improving the quality of heralded single-photon sources with cascaded downconversion

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Single photons play an important role in several quantum technologies, acting as flying qubits to transfer quantum information for both computing and communication applications. In many cases, it is acceptable for these single photons to be produced randomly, as long as they are accompanied by heralding signals announcing their creation. Such heralded single photons sources are straightforward to implement with pairs of photons produced by spontaneous parametric downconversion, by detecting one photon from a pair to announce the presence of its partner. However, the quality of single photons produced in this way is limited. Detector dark counts and multi-pairs events inevitably lead to cases where, instead of preparing a state with one photon, several photons or no photons at all are produced. To address this issue, we propose the use of a second downconversion stage to precertify the presence of a heralded single photon. We show the additional heralding signal provided by this scheme leads to sources with improved single-photon properties, as quantified by the heralded second-order correlation function, g(2). Significantly, we find that this improvement is present even at equal single-photon production rates, and can be achieved with current detectors and downconversion crystal. Our results are most relevant to applications in which single photon with high number purity are essential.

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