Bright multiplexed source of indistinguishable single photons with tunable GHz-bandwidth at room temperature

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We realize a spatially multiplexed, heralded, single-photon source based on four-wave-mixing in hot atomic ^{85}Rb vapor. The scheme we employ, utilizing the nearly Doppler-free configuration of the $5S_{1/2} \rightarrow 5P_{3/2} \rightarrow 5D_{5/2}$ orbital transition, was introduced and originally demonstrated by Yoon-Seok *et al.* [1]. The source generates photons with high rate and low noise (see Fig. 1), which are inherently compatible with the commonly employed D2 line of Rb. We verify the indistinguishability between a pair of photons generated in two (multiplexed) channels of the source using a Hong-Ou-Mandel interference measurement. Varying the optical depth, we demonstrate a five-fold tunability of the photons temporal width.

We currently work on demonstrating the storage and retrieval of the single photons in a quantum memory. This memory can be coupled to Rydberg atoms for realizing a quantum gate operation between the stored photons. As a preliminary result, we demonstrate the conversion of a stored coherent field into a non-classical field with sub-Poissonian photon statistics.

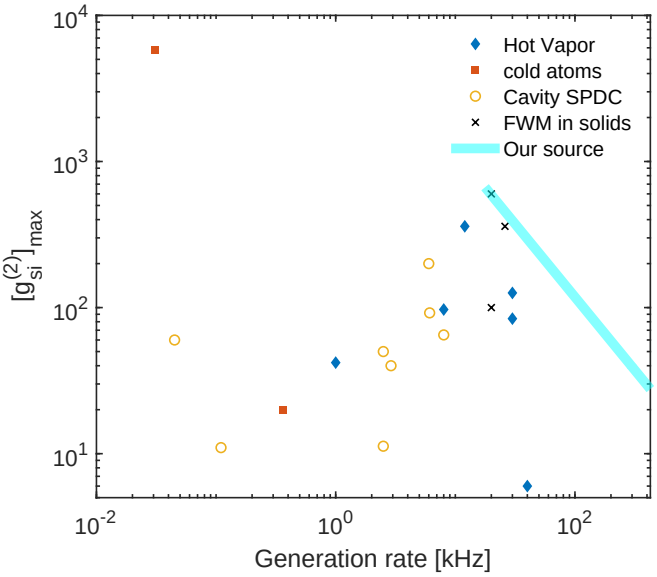

Figure 1. Comparison of the peak of the normalized cross-correlation $[g^{(2)}_{s,i}]_{max}$ versus the rate of detected photon pairs (no corrections) for different heralded single-photon sources. We consider sources with a bandwidth on the order of a few GHz or smaller, capable in principle of interfacing efficiently with atomic ensembles.

[1] Y.-S. Lee, S. M. Lee, H. Kim, and H. S. Moon, "Highly bright photon-pair generation in Doppler-broadened ladder-type atomic system," Opt. Express 24, 28083-28091 (2016).