Multiplexed distribution of light-matter quantum correlations over the metropolitan area of Barcelona

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Multiplexing in different degrees of freedom is one of the most promising ways to increase the rate of heralded entanglement between distant quantum nodes, which otherwise may be limited by the communication time [1]. In this talk, I will present recent experiments on the multiplexed distribution of light-matter quantum correlations over the metropolitan area of Barcelona [2]. Our quantum network testbed consists of a solid-state quantum memory array, a source of entangled photons, and a deployed fiber link covering a distance of 39.1km between ICFO and the Collersolla tower. The quantum memory array features ten independent quantum memory cells with on-demand control and temporal multiplexing [3,4]. The photon-pair source emits non-degenerate entangled photon-pairs at 606nm and 1550nm. We store the signal photons at 606nm in the quantum memory array and demonstrate quantum correlations of each cell with the corresponding telecom photon (Fig.1). We then distribute quantum correlations over the metropolitan area by sending the telecom photons into the deployed fiber while the correlated signal photon is stored in the array. Due to the combination of spatial and temporal multiplexing, the distribution rate of quantum correlations increases within the communication time by more than a factor six with respect to a single quantum memory (Fig. 2). Our results highlight the prospects this system for the distribution of long-distance entanglement at high rates.

References

[1] A. Ortu et al., Quant. Sci. Technol., 7, 035024 (2022)
[2] A. Mneimneh et al., in prep. (2026)
[3] M. Teller et al., npj Quant. Inf., 11, 92 (2025)
[4] M. Teller et al., PRX, 15, 031053 (2025)

Figures

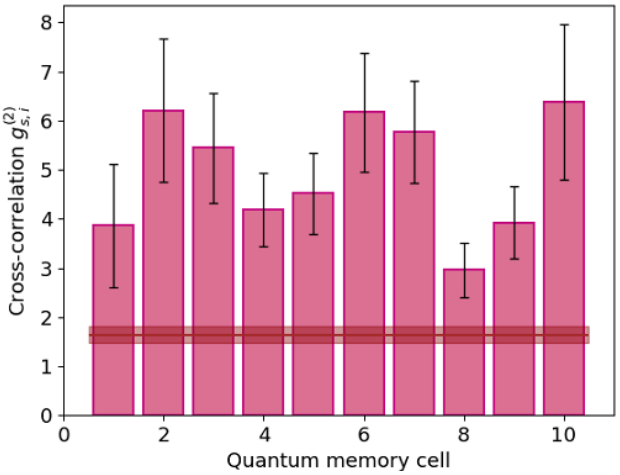

Figure 1: Cross-correlation between a telecom photon and each quantum memory cell. The horizontal line indicates the classical bound.

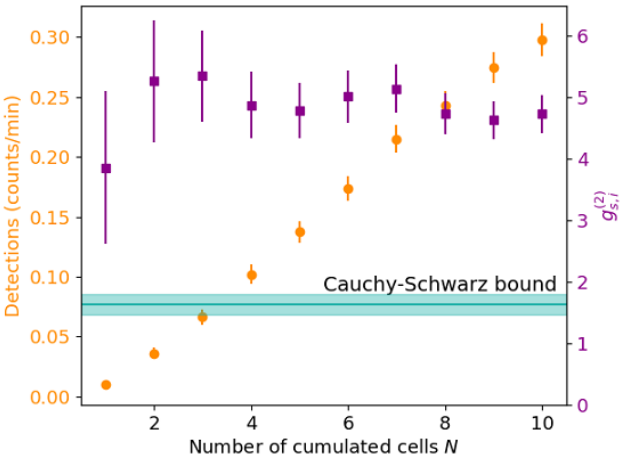

Figure 2: Rate of coincidence events of retrieved 606nm and telecom photons detected after 39.1km of deployed fiber as a cumulative function of the memory cells. The cross-correlation is averaged over the cells.