Delay-Line Quantum Memories for *N*-Photon State Preparation

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Low-loss delay-line quantum memories are a key resource for large-scale photonic quantum state preparation and computation. To illustrate this point, we present a novel scheme for *N*-photon state preparation (Fig. 1) based on a frequency-binned heralded photon pair source, active time multiplexing with a high-efficiency delay-line quantum memory, and configurable discrete dispersion [1]. This scheme is presented in the context of frequency-bin-encoded quantum computation but is readily generalized to alternate encodings. We discuss the scaling of this scheme and progress toward its experimental implementation.

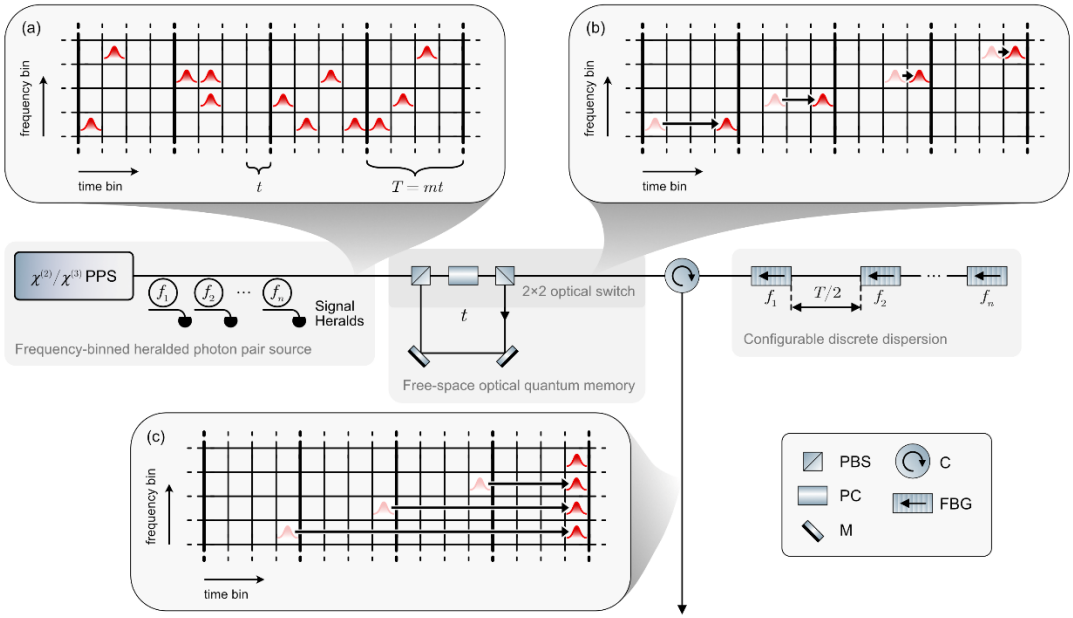

Fig. 1: *Schematic of frequency-bin-encoded N-photon generation [1]. Photons randomly distributed across frequency and time bins (a) are multiplexed in time (b) and frequency (c) via a delay-line quantum memory and fiber Bragg gratings (FBG). PBS, polarizing beamsplitter; C, circulator; PC, Pockels cell; M, mirror.*

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References

[1] A. Fischer, *et al*., arXiv:2603.03576 (2026).