Time telescope for photonic interconnects

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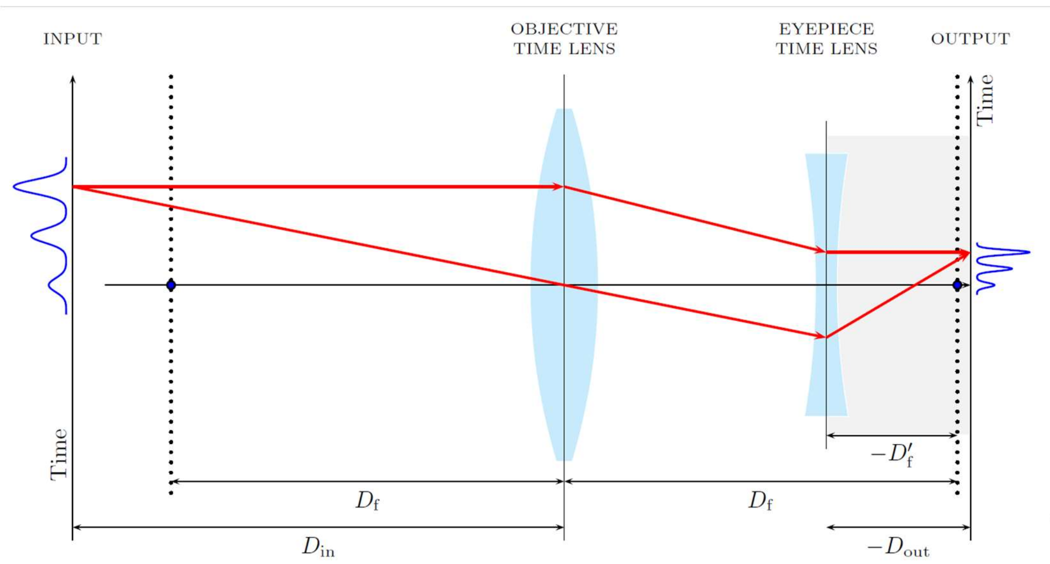
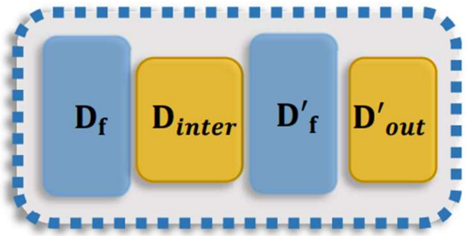
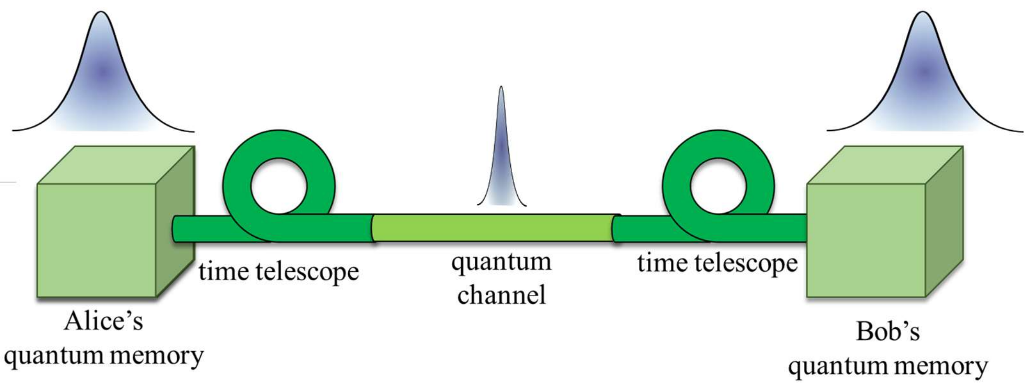
Theoretical model and proposition



Geometrical optics representation of the erecting compressing time telescope. The grey area shows a dispersive medium with a negative GDD, resulting in the creation of a real image at the output. This element is not possible in the spatial domain because negative diffraction does not exist while negative dispersion does.



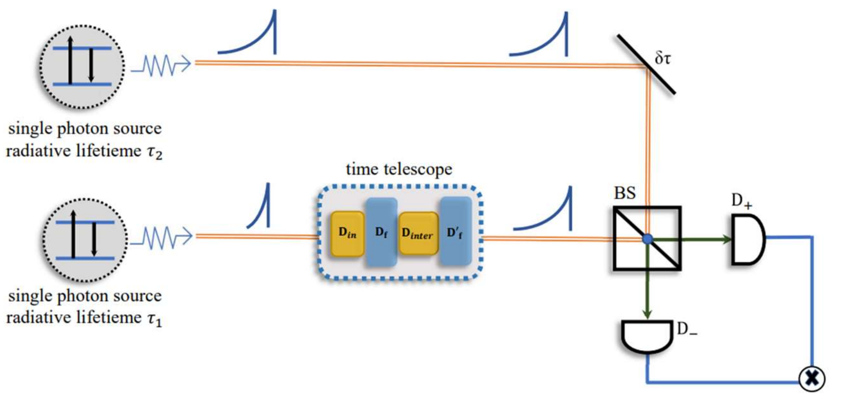
Erecting compressing time telescope with no input dispersive medium. Either D_{in} or $D_{out}{}'$ can be made equal to zero to minimize the number of elements.

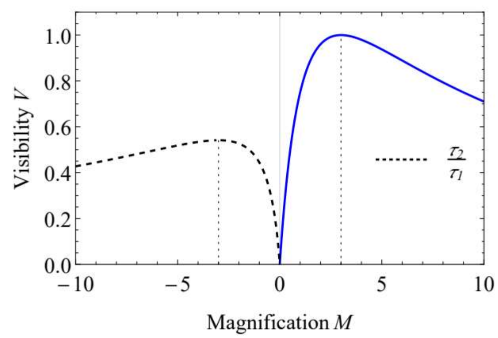


Converting picosecond-scale pulses in the telecommunication band, optimal for high-rate fiber transmission, to nanosecond scale pulses in the visible range processed by quantum memories. The pulses can be made identical leaving the encoded quantum information untouched.

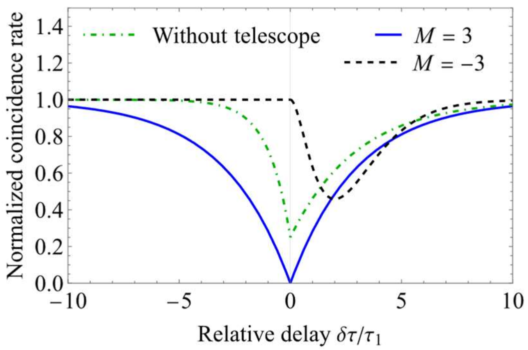
Shivang Srivastava, Dmitri B. Horoshko, and Mikhail I. Kolobov, "Erecting time telescope for photonic quantum networks," Opt. Express 31, 38560-38577 (2023)

Implementations and results

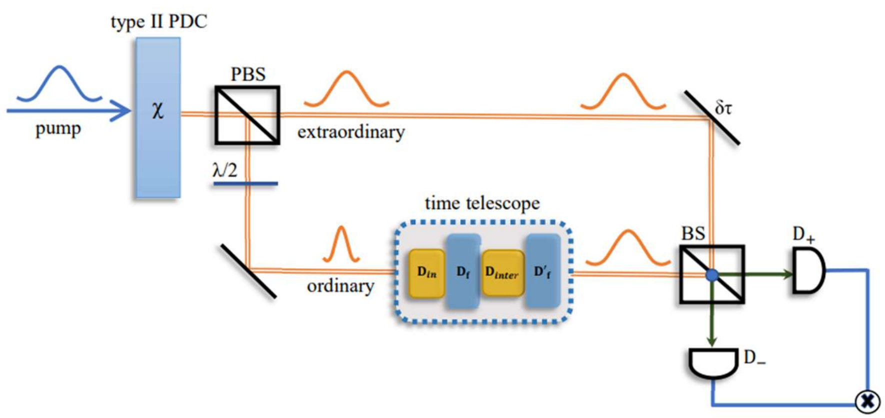


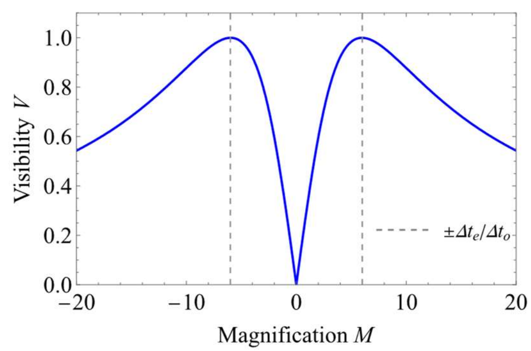


HOMI visibility as a function of magnification. The inverting time telescope ($M < 0$) fails to reach the unit visibility, while the erecting one ($M > 0$) succeeds at $M = \tau_2/\tau_1 = 3$.

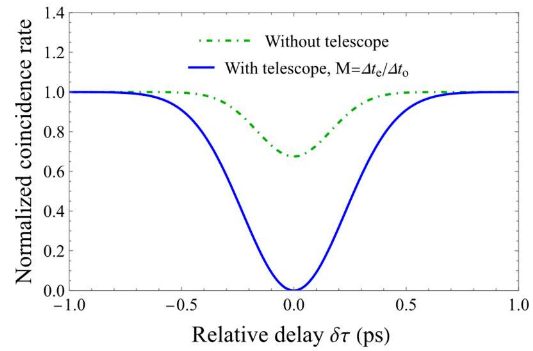


Normalized coincidence count rate plotted against the relative delay for different values of magnification. The erecting time telescope ($M = 3$) performs much better than the inverting one ($M = -3$).





HOMI visibility of two unentangled photons generated in a 5-mm-long KDP crystal pumped by pulses of 62 fs at 415 nm as a function of the time telescope magnification M. The visibility reaches the maximum at the optimal magnification $|M| = \Delta t_e/\Delta t_o$ for both the erect and inverted images.



HOMI coincidence rate. Since the photons have highly different durations, the HOMI visibility without time telescope is low. However, a time telescope applied to one of the photons can make the photons indistinguishable and achieve the unit HOMI visibility.

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Thank you for your attention!