

Abstract Submitted
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Large conditional single-photon cross-phase modulation KRISTIN BECK, MAHDI HOSSEINI, YIHENG DUAN, VLADAN VULETIC, Massachusetts Inst of Tech-MIT — Deterministic optical quantum logic requires a nonlinear quantum process that alters the phase of a quantum optical state by π through interaction with only one photon. Here, we demonstrate a large conditional cross-phase modulation between a signal field, stored inside an atomic quantum memory, and a control photon that traverses a high-finesse optical cavity containing the atomic memory. This approach avoids fundamental limitations associated with multimode effects for traveling optical photons. We measure a conditional cross-phase shift of up to $\pi/3$ between the retrieved signal and control photons, and confirm deterministic entanglement between the signal and control modes by extracting a positive concurrence. With a moderate improvement in cavity finesse, our system can reach a coherent phase shift of π at low loss, enabling deterministic and universal photonic quantum logic. Preprint: arXiv:1512.02166 [quant-ph]

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