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Correlated photon generation via four-wave mixing in a birefringent semiconductor waveguide DANIEL ROGERS, Joint Quantum Institute, University of Maryland and National Institute of Standards and Technology, JULIUS GOLDHAR, University of Maryland, CHRISTOPHER RICHARDSON, Laboratory for Physical Sciences, University of Maryland, ALESSANDRO RESTELLI, JOSHUA BIENFANG, CHARLES CLARK, Joint Quantum Institute, University of Maryland and National Institute of Standards and Technology — The next generation of quantum cryptography will benefit from a fast and practical source of entangled photon pairs. Current methods of generating entanglement, whether in bulk nonlinear crystals or microstructure optical fibers, pose significant challenges to integration into fieldable quantum communications systems. In order to meet the demands of speed and practicality, we investigate third-order nonlinearity in a semiconductor waveguide as a source of correlated and ultimately entangled photon pairs. This device offers the advantages of a fast nonlinear response based on the optical Kerr effect and the relative ease of coupling to standard optical fibers. It is potentially useful for free-space and fiber-optic quantum key distribution as well as a host of other applications such as correlated photon metrology and two-photon interferometry. We show the feasibility of using phase-matched four-wave mixing in a birefringent AlGaAs waveguide to generate correlated photon pairs at wavelengths compatible with silicon detectors. We demonstrate the operation of such a device, consider the effects of loss and two-photon absorption, and evaluate the implications of birefringent phase matching.

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