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Modal loss analysis of spin-orbit transduction of entangled photonic qubit in special fibers BRIAN KIRBY, MICHAEL BRODSKY, U.S. Army Research Laboratory, Adelphi, MD, NENAD BOZINOVIC, SIDDHARTH RAMACHANDRAN, Department of Electrical & Computer Engineering, Boston University, Boston, MA — The ability to switch entanglement between different degrees of freedom of the same photon is essential for tying various quantum technologies into operational quantum networks. We report the reversible conversion of one photon in a pair of polarization entangled photons into an Orbital Angular Momentum (OAM) encoding. The photons are initially prepared using a conventional nonlinear scheme at 1550nm band, and are each routed into separate optical fibers. One photon propagates through single mode fiber, the other is sent through a specially designed vortex fiber, which supports OAM modes. Conversion from polarization to OAM and back is achieved using long-period gratings at each end of the vortex fiber. Using full state tomography, we find that our conversion procedure produces a photon pair that remains close to the initial state with fidelity of 0.95. Some loss in fidelity is a product of varying modal loss in the conversion process and temporal drifts during the tomography. We model these two loss mechanisms, and using parameters extracted from the data, are able fit the experimental results with a fidelity of 0.94-0.96.

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