

Abstract Submitted
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Quantum Key Distribution and the Quest for the Holy Modes¹

STONE OLIVER, Miami University, YIYU ZHOU, MOHAMMAD HASHEMI, ROBERT BOYD, Institute of Optics, University of Rochester — Quantum key distribution (QKD) offers a method of 100% secure information transmission. Although previous work has shown successful implementations, a limitation of the work is that a linear polarization is typically used to encode bit information, which encodes only 1 bit per photon. If Laguerre Gauss (LG) modes replace polarization states in quantum key distribution as the mechanism for encoding, then in theory any number of bits could be encoded in a single photon's transverse phase structure. A major barrier to implementing this setup has been the ability to sort single photons in arbitrary LG modes, although recent work by Mirhosseini et. al. has realized an orbital angular momentum sorter, and here we demonstrate a radial mode sorter via single path interferometry; we report on an effective method of radial mode sorting utilizing a fractional Fourier transform. We demonstrate sorting for the radial modes and superposition modes tested (up to $p=3$) with a cross talk ranging from 3-15%. This setup can be easily integrated with the orbital angular momentum sorter in order to characterize light of arbitrary transverse structure. Future work will entail applying this work to create a QKD using LG modes.

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