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Efficient separation of the orbital angular momentum eigenstates of light MEHUL MALIK, University of Vienna, MOHAMMAD MIRHOSSEINI, University of Rochester, ZHIMIN SHI, University of South Florida, ROBERT BOYD, University of Rochester, UNIVERSITY OF ROCHESTER COLLABORATION, UNIVERSITY OF VIENNA COLLABORATION, UNIVERSITY OF SOUTH FLORIDA COLLABORATION, UNIVERSITY OF OTTAWA COLLABORATION — The orbital angular momentum (OAM) modes of light show great promise as a means to extend quantum communication and computation into the high-dimensional regime. OAM modes reside in a discrete, unbounded state space and have the potential to dramatically increase the information capacity of QKD systems. Furthermore, the use a large alphabet increases the tolerance of a QKD system to eavesdropping attacks. A key capability for the use of OAM modes in communication is the ability to efficiently sort single photons based on their OAM content. Here we show an experimental technique that uses two optical transformations in order to do this. The first transformation, demonstrated by Berkhout et al. in 2010, employs a Cartesian to Log-polar transformation to map the azimuthal phase profile of an OAM mode to a tilted planar wavefront, whose tilt is proportional to the OAM quantum number. The second transformation creates seven adjacent copies of the transformed plane-wave mode, resulting in a mode with a larger size as well as a larger phase ramp. The transformed modes are then focused by a lens to spots with greater than 92% separation efficiency (97% in theory). We use a similar technique to sort modes in the angular basis, which is mutually unbiased with respect to the OAM basis.

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