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Entangled Bessel-Gaussian beams

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Abstract

Orbital angular momentum (OAM) entanglement is investigated in the Bessel-Gaussian (BG) basis. Having a readily adjustable radial scale, BG modes provide an alternative basis for OAM entanglement over Laguerre Gaussian modes. We show that the OAM bandwidth in terms of BG modes can be increased by selection of particular radial wavevectors and leads to a flattening of the spectrum, which allows for higher dimensionality in the entangled state. We demonstrate entanglement in terms of BG modes by performing a Bell-type experiment and showing a violation of the Clauser-Horne-Shimony-Holt inequality for the L (Azimuthal index of the mode) $= \pm 1$ subspace. In addition, we use quantum state tomography to indicate higher-dimensional entanglement in terms of BG modes.