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Spontaneous Parametric Down-Conversion Beam Shaping

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Spontaneous parametric down-conversion (SPDC) has been (and continues to be) a very popular mechanism for generating entangled biphotons for applications in fields ranging from quantum key distribution and quantum computing to quantum imaging. In a nutshell, if ones impinges a crystal (characterised by a nonlinear, second-order susceptibility tensor) with a pump photon, there is a small probability that the crystal will spontaneously down-convert the pump photon into 2 new photons (called signal and idler photons) subject to conservation of energy. There are other conserved quantities as well, notably orbital angular momentum (OAM). It has been observed that the OAM of the signal and idler photons violate Bell's inequality and so SPDC can be used to generate entangled biphotons in the OAM degree of freedom. Typically, one only observes entanglement in a 2-dimensional OAM subspace. We study whether it's possible to engineer arbitrary entangled qudit states by changing the spatial profile of the pump beam.

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