Contribution ID: **116** Type: **Oral Presentation**

Robust qutrit quantum states in atmospheric turbulence

Thursday, 12 July 2012 11:40 (20 minutes)

Abstract content
   (Max 300 words)

Entanglement is an important resource for free-space quantum communication. Unfortunately, two-photon states that are entangled in terms of their transverse modal profiles loose their entanglement during propagation through a turbulent atmosphere. For qubit states the remaining entanglement after some distance of propagation is proportional to the initial amount of entanglement. For qutrit states the situation is more complicated. Here we investigate qutrit states that are defined in terms of Laguerre-Gaussian modes with the three lowest azimuthal indices (1,0,-1) and with the radial index equal to zero. We show that maximally entangled states in this qutrit Hilbert space are not the best at retaining their entanglement. Instead, we find that the states that retain the most entanglement at a specific propagation distance are slightly less than maximally entangled at the beginning. We will show how one can find such an optimal states and how it depends on the propagation distance and the other parameters in the problem.

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Session Classification: Photonics

Track Classification: Track C - Photonics