Contribution ID: **102** Type: **Poster Presentation**

Generation of hyper-entangled photon states for quantum key distribution

Tuesday, 4 July 2017 17:10 (1h 50m)

Quantum entanglement is a phenomenon that occurs when the states of individual particles become linked to one another. Thus, performing a measurement on one particle has an immediate effect on its entangled partner/s, irrespective of the distance between the particles. In this experiment, pairs of entangled photons are produced by spontaneous parametric down conversion. The quality of entanglement is verified by performing measurements on the entangled photon states. The measured states should violate the Bell inequality which would be conclusive verification that the photons are entangled [1]. Encoding photons through polarisation coupled to high-dimensional spatial modes allows for the generation of hyper-entangled states [2]. Higher-dimensional spatial modes is experimentally generated using liquid crystal technology. Quantum entanglement enhances the security of the quantum key distribution process. Hyper-entangled states promotes secure data transfer over the quantum channel.
Here, we present the experimental verification of entanglement and the creation of higher dimensional states for quantum communication.

Reference
[1] J. Clauser, R. Holt, M. Horne and A. Shimony, “Proposed Experiment to Test Local Hidden-Variable Theories,” Phys. Rev. Lett., 23(15), 880-884 (1969).
[2] J. T. Barreiro, N. K. Langford, N. A. Peters, and P. G. Kwiat, “Hyper-Entangled Photons,” in Frontiers in Optics, OSA Technical Digest Series (Optical Society of America, 2005), paper LMB3

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Session Classification: Poster Session 1

Track Classification: Track F - Applied Physics