Cheng Yan Gao et al., J Laser Opt Photonics 2018, Volume 5
DOI: 10.4172/2469-410X-C1-023

Multi-photon self-error-correction hyperentanglement distribution over arbitrary collective-noise channels

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Entanglement, the quintessential quantum correlations between two quantum systems, has been widely used in quantum communication over the past decades. The distribution of entanglement is a crucial module in many *quantum information processing* protocols. However, in a practical transmission, entanglement is easily influenced by the noise in quantum channel, which will turn the maximally entangled state into a mixed state. To overcome the influence from channel noise, we present a self-error-correction hyperentanglement distribution scheme for three-photon system in both spatial and polarization degrees of freedom with linear optical elements and Pockel cells. In our scheme, the three-photon system is initially prepared in a spatial-polarization hyperentangled state and subsequently encoded into time-bin entangled state which is rather robust and hard to be affected by the channel noise. After transmitting over the noisy channels, the time-bin entanglement is transformed into spatial-polarization hyperentanglement. Thus, with our scheme, the parties in quantum communication can share maximally hyperentangled states in spatial and polarized degrees of freedom with the success probability of 100% in principle.

Recent Publications

1. Ren B C, Wang G Y and Deng F G (2015) Universal hyperparallel hybrid photonic quantum gates with dipole-induced transparency in the weak-coupling regime. Physical Review A 91:032328.
2. Wang G Y, Liu Q and Deng F G (2016) Hyperentanglement purification for two-photon six-qubit quantum systems. Physical Review A 94:032319.
3. Li T and Deng F G (2016) Error-rejecting quantum computing with solid-state spins assisted by low - Q optical microcavities. Physical Review A 94:062310.
4. Deng F G, Ren B C and Li X H (2017) Quantum hyperentanglement and its application in quantum information processing. Science Bulletin 62:46-68.
5. Gao C Y, Wang G Y, Zhang H and Deng F G (2017) Multi-photon self-error-correction hyperentanglement distribution over arbitrary collective-noise channels. *Quantum Information Processing* 16:11.

Biography

Cheng Yan Gao is a first year PhD candidate in Department of Physics at Beijing Normal University, P R China. She majors in quantum optics and quantum communication and she is interested in quantum communication theory, quantum error correction and quantum repeater. In 2017, she published two papers on quantum error correction as the first author; one was published in *Quantum Information Processing* and the other was published in the *Journal of Physics B: Atomic, Molecular and Optical Physics*.

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