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Recent Progress in Quantum Teleportation Experiments

JIAN-WEI PAN, Hefei National Laboratory for Physical Sciences at the Microscale, USTC

Quantum teleportation is central to quantum communication, and plays an important role in a number of quantum computation protocols. Significant experimental progresses have been achieved since the seminal proposal by Bennett et al. in 1993. The very first experimental demonstrations were given by Innsbruck and Rome group with photonic realizations. Besides, teleportation has also been demonstrated by use of coherent light fields, with a complete Bell state measurement through nonlinear photonic interactions, trapped ions, between distant matter qubits etc. After the first Innsbruck experiment, we have managed to teleporting freely flying qubits without the need to detect the teleported photon. With five-photon and six-photon entanglement, an open-destination teleportation and a two-qubit composite system teleportation were implemented in 2004 and 2006. The combination of quantum teleportation and quantum memory of photonic qubits is essential for large-scale quantum communication and quantum computation. We have further achieved teleportation between photonic and atomic qubits in 2008. Since teleportation has only been realized in fiber with a level of hundreds meters, optical free-space link is highly desirable for extending the transfer distance. We have made a free-space quantum teleportation over 16 km which confirms the feasibility of space-based experiments.