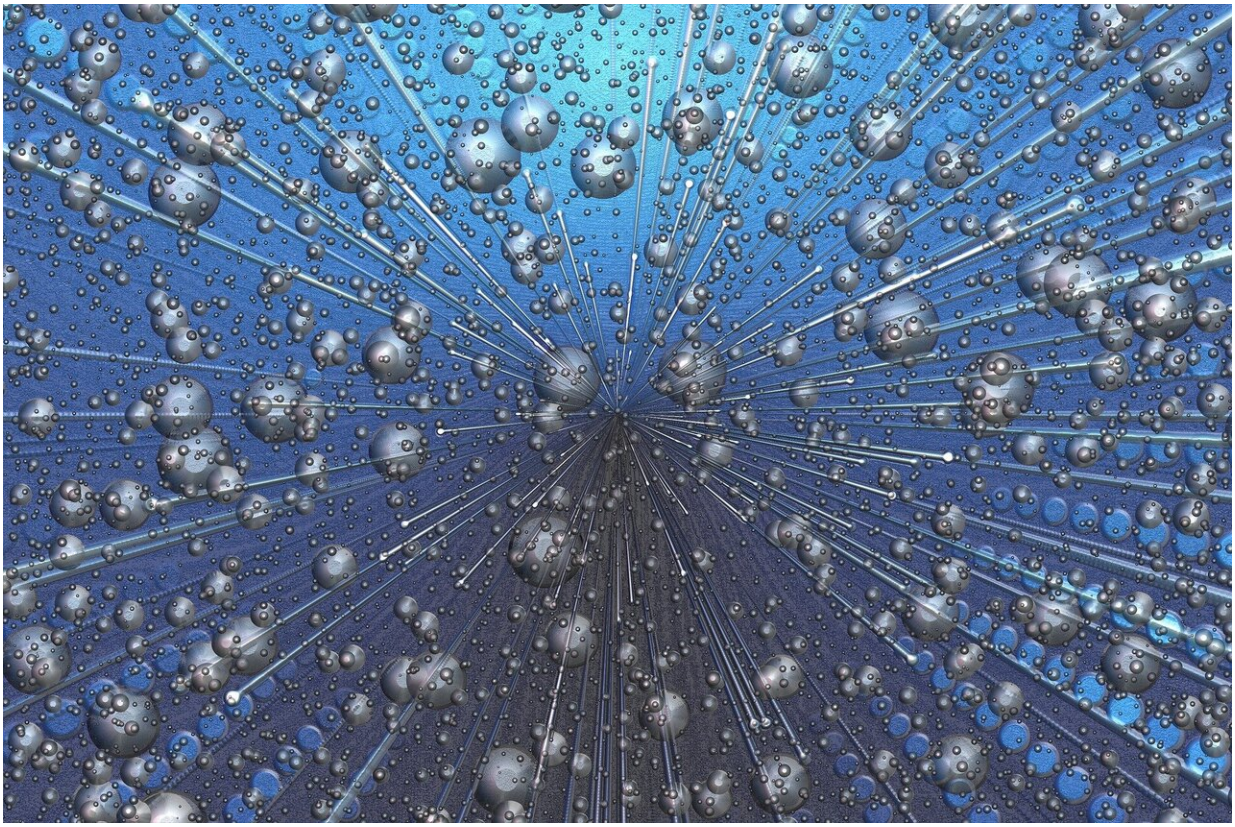
Researchers realize efficient generation of high-dimensional quantum teleportation

January 8 2021



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In a study published in *Physical Review Letters*, a team led by academician Guo Guangcan from the University of Science and Technology of China (USTC) of the Chinese Academy of Sciences

(CAS) has made progress in high dimensional quantum teleportation. The researchers demonstrated the teleportation of high-dimensional states in a three-dimensional six-photon system.

To transmit unknown quantum states from one location to another, quantum teleportation is one of the key technologies to realize long-distance transmission.

Compared with two-dimensional systems, high-dimensional system quantum networks have the advantages of higher channel capacity and better security. In recent years more and more researchers of the quantum information field have been working on generating efficient generation of high-dimensional quantum teleportation to achieve efficient high-dimensional quantum networks.

As early as 2016, the researchers from USTC experimentally showed that nonlocality can be produced from single-particle contextuality through two-particle correlations which do not violate any Bell inequality by themselves, and generated high-fidelity three-dimensional entanglement. In 2020, 32-dimensional quantum entanglement and efficient distribution of high-dimensional entanglement through 11 km fiber were respectively achieved to lay a solid foundation for scalable quantum networks.

In a linear optical system, auxiliary entanglement is the key to realizing high-dimensional quantum teleportation. The researchers exploited the spatial mode (path) to encode the three-dimensional states that has been demonstrated to extremely high-fidelity, and used an auxiliary entangled photon pair to perform the high-dimensional Bell state measurement (HDBSM), demonstrating the teleportation of a three-dimensional quantum state using the spatial mode of a single photon.

In this work, the fidelity of teleportation process matrix could reach

0.5967, which is seven standard deviations above the fidelity of 1/3, which proves the teleportation is both non-classical and genuinely three dimensional.

This study paves the way to rebuild complex quantum systems remotely and to construct complex quantum networks. It will promote the research on high-dimensional quantum information tasks. Entanglement-assisted methods for HDBSM are feasible for other high-dimensional quantum information tasks.

More information: Xiao-Min Hu et al, Experimental High-Dimensional Quantum Teleportation, *Physical Review Letters* (2020). DOI: 10.1103/PhysRevLett.125.230501

Provided by University of Science and Technology of China