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Experimental Teleportation-Based Quantum Gate KAI CHEN, ALEXANDER GOEBEL, CLAUDIA WAGENKNECHT, YU-AO CHEN, JIAN-WEI PAN, PHYSIKALISCHES INSTITUT, RUPRECHT-KARLS-UNIVERSITAET HEIDELBERG, GERMANY TEAM, HEFEI NATIONAL LABORATORY FOR PHYSICAL SCIENCES AT MICROSCALE AND DEPARTMENT OF MODERN PHYSICS, USTC TEAM — For large scale quantum computation, the coupling of physical qubits to the environment imposes a major challenge for a real- life implementation. Teleportation-based scheme offers an alternative way for scalable quantum computing. Most attractively, this architecture allows for realizations of universal quantum gates in a fault-tolerant manner as shown by Gottesman and Chuang, and in fact serves as an important basis for measurement-based quantum computing. We report a proof-in- principle experimental implementation of this architecture by demonstrating a teleportation based two-qubit CNOT (controlled NOT) gate through linear optics with 6-photon scheme. By preparation of high-fidelity four-photon cluster states and applying two Bell state measurements with an arbitrary input of two qubits, the desired quantum gate operations are teleported onto the remaining two qubits of the cluster states. Our novel architecture and experimental demonstration for teleportation- based linear optics quantum computing could serve as an essential basis toward resource-efficient, scalable quantum computation and yielding fault tolerance automatically.

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