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Experimental demonstration of topological error correction[1]
XING-CAN YAO, WEI-BO GAO, YOU-JIN DENG, YU-AO CHEN, Hefei National Laboratory for Physical Sciences at Microscale and Department of Modern Physics, University of Science and Technology of China, China, JIAN-WEI PAN, Hefei National Laboratory for Physical Sciences at Microscale and Department of Modern Physics, University of Science and Technology of China,China, AUSTIN FOWLER, CQC2T, School of Physics, University of Melbourne, VIC 3010, Australia, ROBERT RAUSSENDORF, Department of Physics and Astronomy, University of British Columbia, Vancouver, BC, V6T 1Z1, Canada — Scalable quantum computing can only be achieved if qubits are manipulated fault-tolerantly. Topological error correction—a novel method which combines topological quantum computing and quantum error correction—possesses the highest known tolerable error rate for a local architecture. This scheme makes use of cluster states with topological properties and requires only nearest-neighbor interactions. Here we report the first experimental demonstration of topological error correction with an eight-photon cluster state. It is shown that a correlation can be protected against a single error on any qubit, and when all qubits are simultaneously subjected to errors with equal probability, the effective error rate can be significantly reduced. This demonstrates the viability of topological error correction. Our work represents the first experimental effort to achieve fault-tolerant quantum information processing by exploring the topological properties of quantum states.

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