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High-dimensional quantum cloning of photons

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Optimal quantum cloning machines are realized in linear optical systems by means of the symmetrization method, a method involving the two-photon interference effect at a beam splitter. Optimal quantum cloning has been realized with two-dimensional quantum states, qubits, and four-dimensional quantum system comprised of polarization and orbital angular momentum qubits. Nonetheless, no experimental demonstration of high-dimensional quantum cloning has hitherto been realized. Here, we perform optimal quantum cloning of photonic orbital angular momentum states belonging to Hilbert spaces with dimensions ranging from two to seven. Moreover, we perform full quantum state tomography of high-dimensional cloned states and a cloning attack on a high-dimensional quantum cryptography protocol.

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