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Efficient teleportation between remote single-atom quantum memories STEPHAN RITTER, CHRISTIAN NÖLLEKE, ANDREAS NEUZNER, ANDREAS REISERER, CAROLIN HAHN, GERHARD REMPE, Max-Planck-Institute of Quantum Optics — Teleportation is a prerequisite for the transfer of quantum information over large distances when the losses inherent in any quantum channel preclude a direct transfer. We demonstrate teleportation between two single-atom quantum memories in distant laboratories. By implementing a time-resolved photonic Bell-state measurement (BSM), which is based on two-photon quantum inference, we achieve a teleportation fidelity of 88 %, largely determined by our entanglement fidelity. The problem of limited photon collection efficiency in free space is overcome by trapping each atom in an optical cavity. Compared to previous experiments with remote single material qubits, our approach boosts the overall efficiency by almost five orders of magnitude. This results in success probabilities not predominantly limited by the photon generation and collection efficiency but by the transmission and detection losses inherent in the photonic BSM.

Stephan Ritter
Max-Planck-Institute of Quantum Optics

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