Quantum Storage of High-Dimensional Entanglement

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Entangled quantum states in high-dimensional space show many advantages compared with states entangled in two-dimensional space. They enable communication with higher channel capacity and afford a more secure quantum key distribution. Quantum memory of high-dimensional entanglement is essential for long-distance high-capacity communication. However, the realization of storing a high-dimensional entanglement is still lacking. Here, we report such an implementation for photonic entangled states encoded in orbital angular momentum space and demonstrate entangled memories between two 1-meter separated atomic ensembles. We reconstruct the density matrix for a three-dimensional entanglement, obtaining a storage fidelity of 83.9\(\pm\)2.9\%. More importantly, we confirm the successful storage of a state entangled in more than 3-dimensional space by using entanglement witnesses. This experiment represents a significant step in achieving a high-dimensional quantum network.