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Long-distance atom-photon entanglement and its coherence properties H. WEINFURTER, M. WEBER, J. VOLZ, W. ROSENFELD, M. KRUG, F. HOCKE, F. HENKEL, (1) SEKTION PHYSIK, LUDWIG-MAXIMILIANS-UNIVERSITY, D-80799 MUNICH, GERMANY COLLABORATION, (2) MAX-PLANCK-INSTITUTE FOR QUANTUM OPTICS, D-85748 GARCHING, GERMANY COLLABORATION — The distribution of entanglement between quantum memories at remote locations is one major challenge for the first demonstration of a quantum repeater. Entanglement between matter and light [1] is crucial for achieving this task. Here we report the observation of entanglement between a single trapped atom and a single photon, separated 300 m via an optical fiber. The entanglement is verified by appropriate correlation measurements of the atom-photon pair after communicating the photon through the fiber. In addition we measured the temporal evolution of the atomic density matrix after projecting the atom-photon pair via a state measurement of the photon onto a well defined atomic spin state. We find that the atomic Zeeman qubit decoheres after 100 μs. Our results represent important steps towards the realization of entanglement between single neutral atoms at distances of several 100 m.
[1] J. Volz, M. Weber, D. Schlenk et al., Phys. Rev. Lett. **96**, 030404 (2006).

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