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Heralded entanglement of two remote atoms MICHAEL KRUG, JULIAN HOFMANN, NORBERT ORTEGEL, LEA GERARD, KAI REDEKER, FLORIAN HENKEL, WENJAMIN ROSENFELD, MARKUS WEBER, HARALD WEINFURTER, LMU, Munich, MPQ, Garching — Entanglement between atomic quantum memories at remote locations will be a key resource for future applications in quantum communication. One possibility to generate such entanglement over large distances is entanglement swapping starting from two quantum memories each entangled with a photon. The photons can be transported to a Bell-state measurement where after the atomic quantum memories are projected onto an entangled state. We have set up two independently operated single atom experiments separated by 20 m. Via a spontaneous decay process each quantum memory, in our case a single Rb-87 atom, emits a single photon whose polarization is entangled with the atomic spin. The photons one emitted from each atom are collected into single-mode optical fibers guided to a non-polarizing 50-50 beam-splitter and detected by avalanche photodetectors. Bunching of indistinguishable photons allows to perform a Bell-state measurement on the photons. Conditioned on the registration of particular two-photon coincidences the spin states of both atoms are measured. The observed correlations clearly prove the entanglement of the two atoms. This is a first step towards creating a basic node of a quantum network as well as a key prerequisite for a future loophole-free test of Bell's inequality.

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