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Entangling two single atoms at remote locations J. HOFMANN, N. ORTEGEL, M. KRUG, F. HENKEL, M. WEBER, W. ROSENFELD, H. WEINFURTER, LMU Munich, MPQ Garching, Germany — Entanglement between distant atomic quantum memories is a key resource for future applications in quantum communication, like quantum networks and the quantum repeater. We have set up two independently operating atomic traps situated in two neighboring laboratories separated by 20 meter. On each side we capture a single neutral Rb-87 atom in an optical dipole trap and generate a spin-entangled state between the atom and single spontaneously emitted photon [1]. The photons are collected with high-NA objectives into single-mode optical fibers and guided to the same 50:50 fiber beam-splitter (BS) where they interfere. A coincident detection of two orthogonally polarized photons allows us to project the atoms onto two out of four maximally entangled Bell-states. This Bell-state projection swaps the entanglement onto the atoms. In order to determine the performance of the Bell-state projection we measure polarization dependent cross-correlations of photon-pairs leaving the BS. We observe a two-photon visibility of 90.8%. This result marks an important step towards the successful entanglement of two atoms at large distances, ready for a new test of Bell's inequality [2].
[1] J. Volz, et al., Phys. Rev. Lett. 96, 030404 (2006).
[2] W. Rosenfeld, et al., Adv. Sci. Lett. 2, 469 (2009).

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