Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Heralded entanglement between two single atoms at remote locations MARKUS WEBER, JULIAN HOFMANN, WENJAMIN ROSENFELD, LMU Munich and Max Planck Institute of Quantum Optics, Germany, CHRISTIAN KURTSIEFER, University of Singapore, NORBERT ORTEGEL, MICHAEL KRUG, HARALD WEINFURTER, LMU Munich and Max Planck Institute of Quantum Optics, Germany — Entanglement between single trapped atoms at large distances 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 Rb-87 atom in an optical dipole trap and generate a spin-entangled state between the atom and a single spontaneously emitted photon [1]. These photons are collected with high-NA objectives, coupled into single-mode optical fibers, and guided to the same fiber beam splitter (BS) where they interfere. A coincident detection of two orthogonally polarized photons leaving the BS allows us to project them onto two out of four maximally entangled Bell states. This Bell-state-projection on the photons swaps the entanglement onto the atoms. Here we report the faithful generation and analysis of entanglement between two single trapped atoms at remote locations. The observed entanglement fidelity is high enough, opening up the possibility for a first loophole-free 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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Date submitted: 05 Dec 2011 Electronic form version 1.4