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**Experimental Atom-Photon Entanglement:** MARKUS WEBER, JUERGEN VOLZ, WENJAMIN ROSENFELD, STEFAN BERNER, FLORIAN HENKEL, Department of Physics, LMU Munich, Germany, CHRISTIAN KURTSIEFER, Department of Physics, National University of Singapore, HARALD WEINFURTER, Department of Physics, LMU Munich and Max-Planck Institute of Quantum Optics, Germany — Entanglement between light and matter is a key resource for new applications in quantum communication and information forming the interface between atomic quantum memories and photonic quantum communication channels [1,2]. Especially for applications like quantum networks or the quantum repeater, atom-photon entanglement enables one to generate entanglement between atoms at remote locations [2,3]. Here we report the observation of high-fidelity entanglement between a single optically trapped $^{87}$Rb atom and a single spontaneously emitted photon at a wavelength of 780 nm. To verify the entanglement we introduce a single atom state analysis. This technique is used for full state tomography of the atom-photon qubit-pair. The efficiency of the atomic state detection and the observed entanglement fidelity are high enough to allow in a next step the generation of entangled atoms at large distances, ready for a final loophole-free test of Bell's inequality. [1] B. Blinov et al., Nature **428**, 153 (2004). [2] J. Volz & M. Weber et al., Phys. Rev. Lett. **96**, (2006). [3] C. Simon et al., Phys. Rev. Lett. **91**, 110405 (2003).

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