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Photon-Photon Entanglement with an Atom-Cavity System JOERG BOCHMANN, Max-Planck-Institute for Quantum Optics, Germany, BERNHARD WEBER, HOLGER SPECHT, MARTIN MUECKE, CHRISTIAN NOELLEKE, STEPHAN RITTER, EDEN FIGUEROA, DAVID MOEHRING, GERHARD REMPE — We report on the implementation of a deterministic protocol where a single rubidium atom trapped within a high-finesse optical cavity mediates entanglement between two subsequent photons [1]. First, the atom is entangled with an emitted single photon. After a chosen time, the atomic state is mapped onto a second photon, thus generating an entangled photon pair. The cavity ensures controlled photon generation and high photon collection efficiencies. Compared to previous experiments [2], our single atom trapping scheme allows for the generation of 10^5 times more entangled photons per atom. We analyze the entanglement and coherence time of the atomic qubit using a Bell inequality measurement and quantum state tomography. A promising application of trapped atom-cavity systems is deterministic photonic coupling of distant atomic qubits [3]. We report on recent progress towards two-photon interference from two independent systems.

[1] B. Weber et al., PRL **102**, 030501 (2009)
[2] T. Wilk et al., Science **317**, 488 (2007)
[3] J.I. Cirac et al., PRL **78**, 3221 (1997)

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