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Photon-mediated universal quantum gate between two neutral atoms in an optical cavity STEPHAN WELTE, BASTIAN HACKER, SEVERIN DAISS, STEPHAN RITTER, LIN LI, GERHARD REMPE, Max Planck Institute of Quantum Optics — Optical high-finesse resonators provide an efficient interface between flying photonic qubits and stationary matter qubits [1] in a future quantum network for secure quantum communication and distributed quantum computing. A prerequisite for the construction of a scalable network is that each node contains several qubits that are connected through universal quantum gate operations. We experimentally realized [2] such a gate [3] between two neutral Rubidium atoms strongly coupled to an optical resonator. The gate is mediated by one optical photon propagating in the network channel defined by the resonator mode. The reflection of the photon from the resonator creates an interaction that is independent of the interatomic distance. We demonstrate the functionality of our gate as a CNOT as well as its ability to maximally entangle two atoms. The presented gate mechanism has the potential to serve in an entanglement swapping protocol to generate entanglement over large distances in a quantum repeater. [1] A. Reiserer, G. Rempe, Rev. Mod. Phys. 87, 1379 (2015). [2] S. Welte, B. Hacker, S. Daiss, S. Ritter, G. Rempe, arXiv 1801.05980 (2018). [3] L.-M. Duan, B. Wang, H. J. Kimble, Phys. Rev. A 72, 032333 (2005).

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