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Remote Entanglement between a Single Atom and a Bose-Einstein Condensate STEFAN RIEDL, MATTHIAS LETTNER, MARTIN MÜCKE, CHRISTOPH VO, CAROLIN HAHN, SIMON BAUR, JÖRG BOCHMANN, STEPHAN RITTER, STEPHAN DÜRR, GERHARD REMPE, Max-Planck-Institut für Quantenoptik, Hans-Kopfermann-Straße 1, 85748 Garching, Germany — Entanglement between stationary systems at remote locations is a key resource for quantum networks. Here we report on an experiment where entanglement is established between a single atom inside a cavity and a Bose-Einstein condensate (BEC) located in two different laboratories. To achieve this, a single photon is generated from the atom-cavity system, such that the polarisation qubit of the photon is entangled with the atomic spin state. The photon is transported through a fibre to the BEC and converted into a collective excitation by a Raman process based on electromagnetically induced transparency. After a variable delay, the produced matter-matter entanglement is converted into photon-photon entanglement by creating two single photons, one from each atomic system. The observed overall fidelity of 95% and the matter-matter entanglement lifetime of 100 μs demonstrates the excellent performance of this novel hybrid system.

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