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Observation of quantum entanglement between a photon and a single electron spin confined to an InAs quantum dot[1] JOHN SCHAIBLEY, ALEX BURGERS, GREG MCCRACKEN[2], LUMING DUAN, PAUL BERMAN, DUNCAN STEEL, University of Michigan, ALLAN BRACKER, DANIEL GAMMON, Naval Research Lab, LU SHAM, University of California, San Diego — A single electron spin confined to a single InAs quantum dot (QD) can serve as a qubit for quantum information processing. By utilizing the QD's optically excited trion states in the presence of an externally applied magnetic field, the QD spin can be rapidly initialized, manipulated and read out. A key resource for quantum information is the ability to entangle distinct QD spins. One approach relies on intermediate spin-photon entanglement to mediate the entanglement between distant QD spin qubits. We report a demonstration of quantum entanglement between a photon's polarization state and the spin state of a single electron confined to a single QD. Here, the photon is spontaneously emitted from one of the QD's trion states. The emitted photon's polarization along the detection axis is entangled with the resulting spin state of the QD. By performing projective measurements on the photon's polarization state and correlating these measurements with the state of the QD spin in two different bases, we obtain a lower bound on the entanglement fidelity of 0.59 (after background correction). The fidelity bound is limited almost entirely by the timing resolution of our single photon detector. The spin-photon entanglement generation rate is 3×10^3 s^{-1}.

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