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An atomic source of single photons in the telecom band[1]

CHRISTOPHER PHENICIE, ALAN DIBOS, MOUKTIK RAHA, JEFF THOMPSON, Princeton University — Single atoms are ideal sources of single photons and long-lived memories for quantum networks. However, most atomic transitions are in ultraviolet-visible wavelengths, where propagation losses in optical fibers prohibit long distance transmission. A notable exception is the Er^{3+} ion, whose 1.5 μm transition is exploited in fiber amplifiers that drive telecommunication networks. However, an optical interface to single Er^{3+} ions has not yet been achieved because of the low photon emission rate (<100Hz). Recently, we have observed the emission of single photons from a single Er^{3+} ion in a solid-state host [1]. This was enabled by interfacing Er^{3+} ions with silicon nanophotonic cavities, which enhances the photon emission rate by a factor of more than 300. Dozens of distinct ions can be addressed in a single device based on inhomogeneous variations in their transition frequencies. We will also discuss ongoing progress on characterizing the spin dynamics of this system, spin-photon entanglement, and interactions between nearby Er^{3+} defects. These results are a significant step towards long-distance quantum networks and deterministic quantum logic for photons based on a scalable silicon nanophotonics architecture. [1] Dibos, A.M. et al, arxiv: 1711.10368

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