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Low Noise Quantum Frequency Conversion from Rb Wavelengths to Telecom O-band XIAO LI, Univ of Maryland-College Park, NEAL SOLMEYER, DANIEL STACK, QUDSIA QURAISHI, U.S. Army Research Laboratory, Adelphi, MD — Ideal quantum repeaters would be composed of long-lived quantum memories entangled with flying qubits. They are becoming essential elements to achieve quantum communication over long distances in a quantum network. However, quantum memories based on neutral atoms operate at wavelengths in the near infrared, unsuitable for long distance communication. The ability to coherently convert photons entangled with quantum memories into telecom wavelengths reduces the transmission loss in optical fibers and therefore dramatically improves the range of a quantum repeater. Furthermore, quantum frequency conversion (QFC) can enable entanglement and communication between different types of quantum memories, thus creating a versatile hybrid quantum network. A recent experiment has shown the conversion of heralded photons from Rb-based memories to the telecom C-band [Nat. Commun. **5**, 3376]. We implement a setup using a nonlinear PPLN waveguide for the QFC into a wavelength region where the noise-floor would be limited by dark counts rather than pump photons. Our approach uses a pump laser at a much longer wavelength. It has the advantage that the strong pump itself and the broad background in the PPLN can be nearly completely filtered from the converted signal. Such low background level allows for the conversion to be done on the heralding photon, which enables the generated entanglement to be used in a scalable way to multiple nodes remotely situated and to subsequent protocols.

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