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Long-distance quantum networks using ultra-cold atoms NEAL SOLMEYER, Army Research Laboratory, 2800 Powder Mill Rd., Adelphi, MD 20783, XIAO LI, Joint Quantum Institute, Univ. of MD, College Park, MD 20740, QUDSIA QURAISHI, Army Research Laboratory, 2800 Powder Mill Rd., Adelphi, MD 20783 — The generation of entanglement between distantly located quantum memories via frequency converted single photons could enable many applications in quantum networking, including quantum teleportation, distributed quantum computing and potentially distributed precision timing. A quantum network with three or more nodes has yet to be demonstrated and moreover hybrid networks leverage advantages of different platforms. With an existing memory at the Army Research Laboratory (ARL), based on weak Raman scattering in a Rb magneto-optical trap, we are building a second node at the Joint Quantum Institute (JQI), connected to ARL by a 13 km optical fiber. The second node will be a higher photon-rate node based on Rydberg excitations of a Rb ensemble in an optical dipole trap (N. Solmeyer et. al., arXiv:1511.00025) and the first node will be upgraded to a Rydberg system soon. In the near term, we plan to generate entanglement between the second and a third node, based on a similar experimental setup, 100 m away at the JQI. For the ARL-JQI link we are presently working on quantum frequency conversion from IR photons to telecom wavelengths. Separately, we are pursuing frequency conversion from 493 nm photons to 780 nm to be used in a hybrid quantum network between ions and neutral atoms.

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