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Remote Hybrid Ion-Rydberg Photonic Quantum Interference JOHN HANNEGAN, ALEXANDER CRADDOCK, JAMES SIVERNS, DALIA ORNELAS, ANDREW HATCHEL, J.V. PORTO, STEVE ROLSTON, Joint Quantum Institute, QUDSIA QURAISHI, Army Research Lab — The interfacing and entangling of disparate quantum systems will likely be necessary to construct practical quantum networks. Two systems of particular interest in quantum networking are trapped ions and neutral Rydberg atoms. A hybrid trapped ion-Rydberg ensemble network achieved through remote photonic interference [1] combines advantages of both systems. Using a trapped ion and Rydberg ensemble, located in separate buildings and connected via optical fiber, we demonstrate Hong-Ou-Mandel interference between photons originating from each system. This interference is shown using both randomly generated photons and those generated on-demand. To overcome the vast spectral disparity between our two sources, we employ quantum frequency conversion of the barium ion photons [2]. This work paves the way for remote ion-Rydberg ensemble entanglement. [1] Duan, L-M., et al., Nature 414.6862 (2001). [2] J. D. Siverns, et al., Phys. Rev. Applied 11, 014044 (2019).

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