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$g^{(2)}$ Measurement of Neutral Rubidium Wavelength Single Photons from a Trapped Barium Ion via Quantum Frequency Conversion

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Networks using quantum memories and photonic interconnects [1] rely on detection of photons and performance is improved when photon transmission loss is minimized. Additionally, networking different types of quantum memories for hybrid networking requires overcoming the disparate photon frequencies emitted by each memory. Here, we convert 493 nm photons (50 dB/km fiber loss) emitted from a single trapped $^{138}Ba^{+}$ ion to a 780 nm wavelength (3 dB/km fiber loss) resonant with the D2 transition in ^{87}Rb atoms. The frequency conversion is performed using difference frequency generation in a PPLN waveguide into which 493 nm photons from the ion and a high intensity pump at 1343 nm are coupled. An end-to-end conversion efficiency of 19% is obtained with CW light and 2.3% with ion photons, with the difference attributable to running at a lower pump power to maximize the SNR. We performed a $g^{(2)}(\tau)$ measurement of the non-converted and converted photons and, in both cases, observed $g^{(2)}(0) <1$ [2]. This work and QFC work reported in Ca^{+} [3,4] provides a pathway for hybrid neutral-ion atomic quantum networks utilizing features of both systems.

[1] J. D. Siverns et. al, J. Quant. Info. 16, 314 (2017) [2] J.D. Siverns et. al, arXiv:1801.01193 (2018) [3] T. Walker, et. al., arXiv:1711.09644 (2017) [4] M. Bock, et. al., arXiv:1710.04866 (2017)

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