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A Free-Space Quantum Optical Link for Daytime Operation using Atomic Line Filters JUSTIN BROWN, CHRISTOPHER EVANS, DAVID WOOLF, JOEL HENSLEY, Physical Sciences Inc. — Quantum key distribution (QKD) can provide secure optical data links using the established BB84 protocol, though solar background limits the performance through free space. Despite time-gating the photon signal, limiting the field of view through geometrical design of the optical system, and spectral rejection using interference filters, the solar background continues to dominate under daytime atmospheric conditions. We overcome this limitation by introducing an atomic line filter (ALF) based on a warm rubidium vapor combined with an attenuated laser source tuned to the passband of the filter. By adjusting the optical rotation through the vapor, the ALF transmits a narrow spectral region ($\Delta\nu \sim 1$ GHz) between crossed polarizers that improves upon the $\Delta\nu \sim$50 GHz bandpass of an interference filter. We generate 1 ns pulses at 10 MHz along four polarization channels attenuated to a photon occupancy of μ=0.5 per pulse. We observe quantum bit error rates (QBERs) less than the functional threshold of $\sim$ 11% under daytime conditions simulated in a laboratory with link losses up to 28 dB. We project that with spatial filtering from a telescope system (<100 μrad), this link could function with losses up to 35 dB under the brightest daytime scenarios.

Justin Brown
Physical Sciences Inc.

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