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A Narrow-Linewidth Atomic Line Filter for Free Space Quantum Key Distribution under Daytime Atmospheric Conditions JUSTIN BROWN, DAVID WOOLF, JOEL HENSLEY, Physical Sciences Inc — Quantum key distribution can provide secure optical data links using the established BB84 protocol, though solar backgrounds severely limit the performance through free space. Several approaches to reduce the solar background include time-gating the photon signal, limiting the field of view through geometrical design of the optical system, and spectral rejection using interference filters. Despite optimization of these parameters, the solar background continues to dominate under daytime atmospheric conditions. We demonstrate an improved spectral filter by replacing the interference filter ($\Delta\nu \sim$50 GHz) with an atomic line filter ($\Delta\nu \sim 1$ GHz) based on optical rotation of linearly polarized light through a warm Rb vapor. By controlling the magnetic field and the optical depth of the vapor, a spectrally narrow region can be transmitted between crossed polarizers. We find that the transmission is more complex than a single peak and evaluate peak transmission as well as a ratio of peak transmission to average transmission of the local spectrum. We compare filters containing a natural abundance of Rb with those containing isotopically pure ^{87}Rb and ^{85}Rb. A filter providing $> 95\%$ transmission and $\Delta\nu \sim$1.1 GHz is achieved.

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