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Visible-Wavelength Multi-Species Trapped-Ion Quantum Logic COLIN BRUZEWICZ, ROBERT MCCONNELL, JONATHON SEDLACEK, JULES STUART, JOHN CHIAVERINI, JEREMY SAGE, MIT Lincoln Laboratory — Large-scale quantum information processing using trapped ions will likely utilize multiple atomic species to permit sympathetic cooling of shared ion motion and to facilitate quantum state measurement without decohering unmeasured qubits. Using the techniques of quantum logic spectroscopy, we demonstrate state transfer and subsequent readout using a memory (Ca^+) and auxiliary (Sr^+) ion in a surface-electrode ion trap. This method obviates the need for fluorescence detection of the memory ion, massively reducing the amount of resonant scattered light as a source of decoherence in other nearby memory ions. Further, the necessary lasers for manipulation of Ca^+ and Sr^+ are all in the visible and near-infrared portion of the spectrum and may permit the use of integrated photonic waveguides to route light throughout a trap array without the need for free-space optics.

Colin Bruzewicz
MIT Lincoln Laboratory

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