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Scalable Trapped Ion Quantum Computing using Multiple Ion Species JOHN WRIGHT, RICHARD GRAHAM, TOMASZ SAKREJDA, ZICHAO ZHOU, BORIS BLINOV, University of Washington — We are investigating the use of co-trapped Ytterbium and Barium ions to build a scalable quantum computer. The ground state hyperfine levels of Ytterbium-171 will be used as qubits, while Barium-138 will be used to sympathetically cool the system. Further, Ba-138 will be used to extend quantum operations over multiple traps (possibly in separate physical vacuum chambers) by performing photon-mediated remote ion-ion entanglement. The 493 nm transition of Ba+ allows the use of low attenuation fibers and fiber beamsplitters for this procedure. Operations within the Yb+ hyperfine manifold, as well as local interspecies entanglement, will be generated by stimulated Raman transitions driven by the second (532 nm) and third (355 nm) harmonics of a modelocked 1064nm YAG laser for Ba+ and Yb+, respectively. We report progress towards realizing this system in a standard Paul trap, as well as an analogous system in a microfabricated chip trap, where separate ion chains can be operated on simultaneously.

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