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Plug-and-Play Planar Ion Traps for Scalable Quantum Computation and Simulation JASON AMINI, DOUGLAS DENISON, S. CHARLES DORET, DANIEL FAIRCLOTH, HARLEY HAYDEN, TYLER KILLIAN, DAVID LANDGREN, Ga Tech Research Institute, KEVIN MARTIN, Ga Tech School of ECE, TRUE MERRILL, Ga Tech Dept. of Chemistry, ARKADAS OZAKIN, C. S. PAI, Ga Tech Research Institute, FAYAZ SHAIKH, Ga Tech School of ECE , CHRIS SHAPPERT, CURTIS VOLIN, KEN WRIGHT, ALEXA HARTER, RICHART SLUSHER, Ga Tech Research Institute — At the heart of most ion-based quantum information processing and simulation efforts is an RF-Paul trap to confine the ion qubits. Cutting edge experiments are transitioning from a few qubits to a few tens of qubits with many more qubits envisioned for the future. The underlying ion traps need to both grow with the experiments and provide additional features that can simplify and extend these experiments. The Georgia Tech Research Institute (GTRI) is developing modeling and fabrication processes for these new generations of ion traps using silicon VLSI technology in surface- electrode geometries. Verified by detailed in-house trap characterization, GTRI has fabricated traps that approach the plug- and-play ideal and demonstrate reliable ion loading and transport, long dark lifetimes, and stable ion chains. Additional features are in development including junctions, integrated GHz range current guides for global qubit rotations, and micromirrors for light collection.

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