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Fast Ion Transport and Separation in a Cryogenic Surface Electrode Trap[1] SUSANNA L. TODARO, National Institute of Standards and Technology, University of Colorado Boulder, DIETRICH LEIBFRIED, DANIEL H. SLICHTER, ANDREW C. WILSON, DAVID J. WINELAND, National Institute of Standards and Technology, Boulder CO — Significant progress has been made in trapped-ion quantum computation, but scaling to increasingly large numbers of qubits remains a challenge. In one proposal, the "quantum CCD" architecture, ion qubits are transported between trapping zones dedicated to memory, readout, or gate operations. In most prior quantum CCD experiments, ion transport between zones and ion separation into multiple wells have been performed adiabatically. These processes generally take an order of magnitude more time than typical laser-driven gate operations. While faster ion transport has been previously achieved in multizone 3D Paul traps, separation experiments have only operated in the adiabatic regime so far. We report progress towards diabatic transport and separation of ions in a cryogenic surface-electrode trap with a 40 μm ion-electrode distance, which allows the strong electric field and quartic potential components useful for fast separation to be generated more readily.

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