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A Two-dimensional Lattice Ion Trap for Quantum Simulation TONGYAN LIN, Massachusetts Institute of Technology, KENNETH BROWN, Georgia Institute of Technology, XIE CHEN, GRACE CHEUNG, CHRISTOPHER PEARSON, ISAAC CHUANG, Massachusetts Institute of Technology — Quantum simulations offer the possibility of answering quantum spin system dynamics questions which may otherwise require unrealistic classical resources to solve. Such simulations may be implemented using well-controlled systems of effective spins, including, as we demonstrate, two-dimensional lattices of locally interacting ions. We present experimental results from a model ion lattice system, realized as a surface electrode rf trap with a square lattice geometry. Using 440 nm diameter charged microspheres, we loaded a 30×36 lattice with a spacing of 1.67 mm. When the trap is driven at 2 kHz and 375 volts, we observe isolated ion secular frequencies of 170 Hz perpendicular to the trap, and Coulomb repulsion between ions at different lattice sites consistent with numerical modeling. These results, when scaled to single-atom ion charge-to-mass ratios, and linewidths achievable using standard microlithography, are promising for quantum simulations with planar ion trap lattices.

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