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Recent Progress with Cryogenic 2-D Ion Trap Arrays[1] J.F. NIEDERMEYER, J. KELLER[2], K.C. MCCORMICK[3], S.L. TODARO[4], F.W. KNOLLMANN, NIST, University of Colorado Boulder, D.J. WINELAND, NIST, University of Oregon, D.H. SLICHTER, A.C. WILSON, D. LEIBFRIED, NIST — Two-dimensional arrays of ions in individual microtraps are a promising technology for quantum computation and simulation. In collaboration with Sandia National Laboratories, we have developed micro-fabricated surface electrode traps that confine three ions on the vertices of equilateral triangles, with each ion confined in a separate potential well. This feature, and the small inter-ion distance (30 μm), allows for selective coupling between ions that can be dynamically changed during single experiments. In principle, this approach enables simulation of arbitrary, tunable spin-lattice Hamiltonians. Quantum simulations of bosons in synthetic magnetic fields can also be performed using motional excitation of the ions (phonons), and not internal ion states, as the controllable quantum system of interest. In an effort to reduce motional decoherence of the ions, as desired for these simulations, the traps are operated at cryogenic temperatures ($\sim$4 K). We report progress on trapping and manipulating ions in these 2D-array traps.

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