Abstract Submitted
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Quantum control and simulation with 2-dimensional arrays of trapped ions[1] J.W. BRITTON, B.C. SAWYER, J.G. BOHNET, J.J. BOLLINGER, NIST, A.C. KEITH, Univ. Colorado and NIST, D. MEISER, Tech-X Corp. — Trapped ions, when cooled to sufficiently low temperatures form crystalline arrays. We describe our efforts to extend the quantum control techniques developed with small linear chains of ions in rf traps to larger two-dimensional crystals of hundreds of ions formed in a Penning trap. Our qubit is the 124 GHz electron spin-flip transition in the ground state of Be^+ in the 4.5 T magnetic field of the Penning trap. We control the spins with an effective transverse magnetic field generated with 124 GHz microwaves. Spin-dependent optical dipole forces (ODF) are used to engineer long range Ising interactions between the ion qubits and to characterize the motional degrees of freedom of the trapped ions. We will discuss the design and implementation of a new Penning trap that employs an m=3 rotating wall and enables the application of an ODF with lower spontaneous emission. We will also discuss simulation work that provides information on the temperature of the in-plane modes.

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