Abstract Submitted
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Realizing Quantum Computation Using Continuous Variables in Trapped Ions[1] JEREMY METZNER, ALEX QUINN, DANIEL MOORE, DAVE WINELAND, DAVID ALLCOCK, University of Oregon — Instead of encoding quantum information in the internal electronic "spin" states of trapped ions, it is possible to encode solely within the ions' harmonic vibrational modes. Like spin qubits, this system is capable of universal quantum computation given an appropriate set of operations. Operations such as phase shift, displacement, squeezing[1], and "beam splitting"[2] have been performed quickly and with high fidelity, using only electric fields acting on the ions' charge. Part of our investigation will be to put this set of operations together and demonstrate a basic computation algorithm. However, to have full realization of universal continuous variable quantum computing, there is a need for a non-gaussian operation. In order to produce such an operation, a Hamiltonian that is at least third order in the bosonic-mode raising and lowering operators, is needed. In principle higher order potentials can create this type of operation, for example, generation of a quartic potential will create a non-linear phase shift, but typical ion traps are inefficient at generating these potentials. We will be working on design and detailed simulations of microfabricated surface-electrode traps to see if this approach is feasible. [1]- S. C. Burd et al. Science Vol. 364, Issue 6446, pp. 1163 [2]- D. J. Gorman et al. Phys. Rev. A 89, 062332 (2014)

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Jeremy Metzner
University of Oregon

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