Abstract Submitted
for the DAMOP15 Meeting of
The American Physical Society

A 2D Array of 100's of Ions for Quantum Simulation and Many-Body Physics in a Penning Trap JUSTIN BOHNET[1], BRIAN SAWYER, JOSEPH BRITTON, JOHN BOLLINGER, NIST, Boulder — Quantum simulations promise to reveal new materials and phenomena for experimental study, but few systems have demonstrated the capability to control ensembles in which quantum effects cannot be directly computed. One possible platform for intractable quantum simulations may be a system of 100's of $^{9}Be^{+}$ ions in a Penning trap, where the valence electron spins are coupled with an effective Ising interaction in a 2D geometry. Here we report on results from a new Penning trap designed for 2D quantum simulations. We characterize the ion crystal stability and describe progress towards bench-marking quantum effects of the spin-spin coupling using a spin-squeezing witness. We also report on the successful photodissociation of BeH^{+} contaminant molecular ions that impede the use of such crystals for quantum simulation. This work lays the foundation for future experiments such as the observation of spin dynamics under the quantum Ising Hamiltonian with a transverse field.

[1]supported by a NIST-NRC Research Associateship.

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Date submitted: 30 Jan 2015 Electronic form version 1.4