Abstract Submitted
for the DAMOP20 Meeting of
The American Physical Society

New Methods for Quantum Simulation of Spin Systems with Trapped Ions TOM MANOVITZ, YOTAM SHAPIRA, NITZAN AKERMAN, ROEE OZERI, ADY STERN, Weizmann Institute of Science — By simulating the behavior of quantum systems with highly controlled engineered quantum machines, one can study the complex behavior of a variety of quantum phenomena. Ions in a linear Paul trap have proven to be a leading platform for such simulations, primarily relying on a set of spin Hamiltonians produced using the Molmer-Sorensen interaction. In this work, we significantly extend the range of Hamiltonians that can be directly simulated in trapped ions using a simple variation of the standard scheme. For N ions our method can produce a Hamiltonian with a general form $\sum_{n=1}^{N-1} \Omega_n e^{i(\phi_n - \omega_n t)} \sum_{i=1}^{N-n} \sigma_i^+ \sigma_{i+n}^- + h.c.$ where parameters $\{\Omega_n, \phi_n, \omega_n\}$ can be fully controlled. Using this form, it is possible to generate Hamiltonians with closed boundary conditions; $d > 1$ dimension Hamiltonians; and Hamiltonians with gauge field (Aharonov-Bohm) terms. An assortment of interesting physical models previously unreachable with analog simulations in trapped ions are made possible using our scheme.

Tom Manovitz
Weizmann Institute of Science

Date submitted: 30 Jan 2020 Electronic form version 1.4