Abstract Submitted
for the DAMOP17 Meeting of
The American Physical Society

Development of a Phonon Toolbox on a Surface Electrode Trap[1]

K. WRIGHT, K. BECK, D. ZHU, K. COLLINS, C. MONROE, University of Maryland — We report on our current experimental progress towards using a surface electrode trap for quantum simulation with Yb^+ ions. Currently, we are developing a toolbox for creating, manipulating and reading out phonon occupations in all normal modes of a three ion chain. Using shuttling, composite pulse sequences, and state distillation, we prepare given phonon number-states in these modes and show that these states preserve spin-motion coherence. The prepared state is read out either through a single sideband operation or through a STIRAP process. The sideband operation gives a binary measurement of phonon(s) vs. no phonon occupation; the STIRAP process is sensitive to the number-state occupation. We also engineer coherent couplings between normal modes through optical dipole forces, manipulating the prepared state to sample interacting Bosonic modes.

[1]This work is supported by ARO with funding from the IARPA LogiQ program.

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Date submitted: 27 Jan 2017 Electronic form version 1.4