Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Quantum simulation with an array of transmon qubits: Bose-Hubbard model[1] SHAY HACOHEN-GOURGY, VINAY RAMASESH, QNL, University of California, Berkeley, CLAUDIA DE GRANDI, STEVEN GIRVIN, Departments of Physics and Applied Physics, Yale University, IRFAN SIDDIQI, QNL, University of California, Berkeley — Chains of capacitively-coupled transmons can emulate the Bose-Hubbard Hamiltonian when one considers the full level-structure of the circuit. Here, each individual transmon plays the role of a lattice site, with the excitation level of each transmon corresponding to the number of bosons occupying that particular site. The transmon's anharmonicity gives rise to the attractive contact-interaction term, while the capacitive coupling realizes the hopping amplitude. We implement such a chain of 3 capacitvely-coupled transmons in a single 3D microwave cavity. In our parameter regime, the ground state of the 3-excitation subspace is one in which all excitations lie on a single qubit. Using cavity-assisted bath engineering, it should be possible to cool from an initial state in this subspace to the ground state. We present the current status of this goal.

[1]This work is supported by AFOSR, Army Research Office W911NF1410011 and NSF DMR-1301798

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Date submitted: 13 Nov 2014 Electronic form version 1.4