Implementation of a Quantum Variational Eigensolver in Superconducting Qubits
for the MAR16 Meeting of
The American Physical Society

Hybrid Quantum-Classical Approach to Molecular Excited States On Superconducting Qubits JARROD MCCLEAN, Computational Research Division, Lawrence Berkeley National Laboratory, MOLLIE SCHWARTZ, CHRIS MACKLIN, IRFAN SIDDIQI, Quantum Nanoelectronics Laboratory, University of California, Berkeley, JONATHAN CARTER, WIBE DE JONG, Computational Research Division, Lawrence Berkeley National Laboratory — Quantum computers promise to dramatically advance our understanding of correlated quantum systems. Unfortunately, many proposed algorithms have resource requirements not yet suitable for near-term quantum devices. The variational quantum eigensolver (VQE) is a recently proposed hybrid quantum-classical method for solving eigenvalue problems and more generic minimizations on a quantum device leveraging classical resources to minimize coherence time requirements. However, this algorithm has so far focused only on the quantum ground state and has almost exclusively been studied in ideal closed system conditions. We briefly review the original VQE approach and introduce a simple extension requiring no additional coherence time to approximate excited states. Moreover, we show how the same method can be used to mitigate the effects of noise in a real system and how this algorithm can be applied in practice on a superconducting qubit architecture.

Jarrod McClean
Computational Research Division, Lawrence Berkeley National Laboratory

Date submitted: 06 Nov 2015 Electronic form version 1.4