Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Variational quantum algorithms with significantly fewer measurements RYAN BABBUSH, Google, JARROD MCCLEAN, Lawrence Berkeley National Labs, NAN DING, Google, NATHAN WIEBE, Microsoft Research, SERGIO BOIXO, HARTMUT NEVEN, Google — Variational quantum algorithms provide an approach for using near-term quantum hardware to model diverse physical systems. Systems of interacting fermions, e.g. most materials and chemical reactions, are natural targets due to classical intractability at small sizes and the scientific value of solutions. However, recent work has cast doubt on the viability of chemistry applications due to an extremely large number of measurements that may be required. We overcome this problem by developing strategies which reduce the required measurements by orders of magnitude. Our approach involves an adaptive Bayesian model, simultaneous operator measurement, careful selection of basis functions and insights from N-representability theory. Most improvements are obtained by upper-bounding the required resources and then transforming the problem representation in a fashion that minimizes those upper-bounds. Our results suggest that even for some classically intractable molecules, energies can be measured to chemical precision using existing technology.

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Date submitted: 10 Nov 2016 Electronic form version 1.4