Abstract Submitted
for the DNP20 Meeting of
The American Physical Society

**Quantum Algorithms for Simulating the Lattice Schwinger Model**[1] ALEXANDER SHAW, Oak Ridge National Lab, University of Maryland - College Park, PAVEL LOUGOVSKI, Oak Ridge National Lab, JESSE STRYKER, Institute for Nuclear Theory, University of Washington, NATHAN WIEBE, University of Washington, Pacific Northwest National Lab — The Schwinger model is a testbed for the study of quantum gauge field theories. We give scalable, explicit digital quantum algorithms to simulate the lattice Schwinger model in both NISQ and fault-tolerant settings. In particular, we analyze low-order Trotter formula simulations of the Schwinger model, using recently derived commutator bounds, and give upper bounds on the resources needed for simulations. We give scalable measurement schemes and algorithms to estimate observables which we cost in both settings by assuming a simple target observable: the mean pair density. Finally, we bound the root-mean-square error in estimating this observable via simulation as a function of the diamond distance between the ideal and actual CNOT channels. This work provides a rigorous analysis of simulating the Schwinger model, while also providing benchmarks against which subsequent simulation algorithms can be tested.

[1]AS and PL were supported by the U.S. D.O.E (ASCR) Quantum Algorithm Teams, Quantum Computing Application Teams, and Accelerated Research in Quantum Computing programs, under proposals ERKJ333, ERKJ347, and ERKJ354. JRS was supported by DOE Grant No. DE-FG02-00ER41132, and by the NSF GRF under Grant No. 1256082. NW is supported by the Google Quantum Research Award. AS was further supported by the US D.O.E Office of Science Award DE-SC0020271.

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Date submitted: 26 Jun 2020 Electronic form version 1.4