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Reduced Hamiltonian Simulation for Near-term Quantum Computers DIANA CHAMAKI, MEKENA METCALF, Lawrence Berkeley National Laboratory, NATHAN WIEBE, Pacific Northwest National Laboratory, OJAS PAREKH, Sandia National Laboratories, WIBE DE JONG, Lawrence Berkeley National Laboratory — Previous methods for simulating fermionic Hamiltonians on quantum computers are based on a one-to-one mapping between fermions and qubits. The number of qubits required to simulate the Hamiltonian using such methods can be reduced by exploiting symmetries. However, the Hilbert space using these methods still includes unnecessary states and can be even further reduced. We use combinatorial techniques to map a Hamiltonian onto states rather than qubits, and then we use this technique in algorithms for near-term quantum devices. Specifically, we use our mapping to solve for the ground state energy of various molecules using the Variational Quantum Eignesolver (VQE) and were successfully able to reduced the number of qubits required to do so by a significant amount.

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