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**Simulating Strongly Correlated Fermions and Spins with an Optimally Controlled Superconducting Device** MATTHEW SCOGGINS, ARMIN RAHMANI, Western Washington University — Numerical solutions to complex many-body models are severely limited by classical computational power. Using controllable quantum devices may help with the simulation of these models. One approach, known as the variational quantum algorithm, is based on tailoring evolution to prepare the a priori unknown ground states of model Hamiltonians. In this work, we address the challenge of finding patterns in optimal variational protocols, where an optimal protocol minimizes the total time it takes to get from the ground state of one device to the ground state of another target device. Using a classical computer, we simulate the evolution of superconducting 'gmon' qubits and use Monte-Carlo (MC) simulations to find this optimal protocol for finite systems sizes. The MC method finds optimal protocols that are roughly bang-bang, as predicted by theory. We compare the MC method with an adiabatic method and show that it reaches the ground state in shorter times. Further research will identify patterns in these protocols that can be extrapolated to larger system sizes in order to inform efficient large-scale simulations on the quantum device.

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