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Phase Diagram of the Schwinger Model by Adiabatic Preparation of States on a Quantum Simulator

We argue the feasibility to study the phase structure of a quantum physical system on quantum devices via adiabatic preparation of states. We introduce a novel method and successfully test it in application to the Schwinger model in the presence of a topological θ-term. We explore the first-order-phase-transition and the no-transition regions of the corresponding phase diagram. The core idea of the method is to separately evolve the ground and the first excited states with a time-dependent Hamiltonian, the time-dependence of which interpolates between different values of θ. Despite our approach being a direct application of the adiabatic theorem, we are able to demonstrate its advantages in comparison to a different method from the literature that also employs adiabatic state preparation.

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