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Quantum Simulations of Abelian Gauge Theories

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We propose an implementation of a two-dimensional Z2 lattice gauge theory model on a shallow quantum circuit, involving a number of single- and two-qubit gates comparable to what can be achieved with presentday and near-future technologies. The ground-state preparation is numerically analyzed on a small lattice with a variational quantum algorithm, which requires a small number of parameters to reach high fidelities and can be efficiently scaled up on larger systems. Despite the reduced size of the lattice we consider, a transition between confined and deconfined regimes can be detected by measuring expectation values of Wilson loop operators or the topological entropy. At the end we will discuss extensions to ZN aas well as non-abelian theories with finite group.

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