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Thermodynamics of non-Abelian D_4 lattice gauge theory via Quantum Metropolis Sampling

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The possibility to use fault-tolerant Quantum Computers in the "Beyond the NISQ era" is a promising perspective: it could bring the implementation of Markov Chain Monte Carlo (MCMC) quantum algorithms on real machines. Then, it would be possible to exploit the quantum properties of such devices to study the thermodynamic properties of the system. This also allows us to avoid the infamous sign problem, which plagues classical Monte Carlo simulations of several interesting systems - such as the QCD in the presence of an external electric field or a finite chemical potential. In this work, we discuss the effectiveness of Quantum Metropolis Sampling in the study of thermodynamic properties of a non-Abelian gauge theory, based on the discrete D_4 symmetry group. This is the first study of a non-Abelian Lattice Gauge Theory by means of a quantum MCMC algorithm: we simulate the behavior of an ideal quantum Computer, aiming to demonstrate the feasibility of such simulations.

Topical area

Quantum Computing and Quantum Information

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