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Gauss' Law, Duality, and the Hamiltonian Framework of Lattice Gauge Theory

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Quantum computers have the potential to solve certain problems in lattice gauge theory that are thought to be exponentially hard for classical computers. The proposed starting point for such computations has been the Kogut-Susskind Hamiltonian supplemented by the Gauss law constraint, with a cutoff on electric field values. There are several disadvantages to this approach, including having to simulate the vast unphysical part of the Hilbert space. We consider pure U(1) gauge theory, and motivated to restrict the calculation to purely physical states, are immediately led to a duality transformation. This approach to formulating lattice gauge theory for quantum computers could have some advantages, and we speculate on how it might be extended to include matter and non-Abelian gauge groups.

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