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Simulating an SO(3) Quantum Link Model with Dynamical Fermions in 2+1 Dimensions

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Quantum link models (QLMs) are generalizations of Wilsonian lattice gauge theory which can be formulated with finite-dimensional link Hilbert spaces, and which can be embedded onto local spin Hamiltonians for efficient quantum simulation by exact imposition of the Gauss Law constraint. Previously, SO(3) QLMs have been studied in 1+1d and shown to reflect key properties of QCD and nuclear physics, including distinct confining/deconfining phases and hadronic bound states. We have conducted one of the first simulations of SO(3) QLMs with dynamical fermions in 2+1d, and here report our results. We review the construction of a gauge-invariant state space for 1+1d and 2+1d SO(3) QLMs, and show how knowledge of discrete symmetries facilitates exact diagonalisation of the spin-Hamiltonian. We also comment on how the quantum simulation of the SO(3) QLM in 1+1d and 2+1d may be efficiently performed by variational methods.

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