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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 in 2+1d, and here report our results. In this talk, 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 briefly discuss how the quantum simulation of the $SO(3)$ QLM in 1+1d and 2+1d may be efficiently performed by variational methods.

Primary author: VAN GOFFRIER, Graham (University College London)

Co-authors: Dr CHAKRABORTY, Bipasha (University of Southampton); Dr BANERJEE, Debasish (Saha Institute of Nuclear Physics); Dr HUFFMAN, Emilie (Perimeter Institute for Theoretical Physics); Mr MAITI, Sandip (Saha Institute of Nuclear Physics)

Presenter: VAN GOFFRIER, Graham (University College London)

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