Lecture plan: IBS summer school
Lecturer: Indrakshi Raychowdhury

IR Lecture 1: Why quantum computation for quantum field theory? Hamiltonian lattice gauge theory from first principles

Motivation: what quantum computers are meant to solve here.ContinuumYang–Mill theory: conventions, Canonical derivation of the Yang–Mills Hamiltonian, Spatial lattice variables. The Kogut–Susskind Hamiltonian, Plaquette term from the continuum magnetic field, Staggered fermions in Hamiltonian lattice gauge theory, Lattice Gauss law, Introduce Schwinger model as an example of each.

Lecture 2: by Jesse (Schwinger model, details, algorithm)

Lecture 3: by IR

IR Lecture 2: From U(1) Schwinger model to SU(2) prepotentials, and the first appearance of loop–string–hadron variables.

Why SU(2) is different, Schwinger bosons for SU(2), Prepotentials on a link, Local singlets from prepotentials, The one-dimensional SU(2) LSH basis, Derivation of the Abelian link constraint , First form of the SU(2) LSH Hamiltonian.
Lecture 4: by Jesse (algorithm for SU(2) LSH)

Lecture 5: by IR

IR Lecture 3: SU(2) LSH

SU(2) LSH operator algebra, 1+1 D to 2+1 dimension, generalize in higher dimensions, introduction to SU(3) LSH.

IR Lecture 4: SU(2) LSH implementation
LSH dynamics, ED results, motivation for tensor network calculations, TN scope and results, limitation of TN, Quantum simulation: first results with approximation; validation of approximations, hardware results, benchmarking (students will reproduce these in one tutorial).

Tutorial Day 1: JW mapping, Derivation of purely fermionic version of Schwinger model, generalizing that for SU(2)

Tutorial day 4: https://quantum.cloud.ibm.com/docs/en/tutorials/loop-string-hadron-dynamics