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Formulation of SU(N) Lattice Gauge Theories with Schwinger Fermions

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The recent advancements towards scalable fault-tolerant quantum computing have brought excitement about simulating lattice gauge theories on quantum computers. However, digital quantum computers require truncating the infinite-dimensional link Hilbert space to finite dimensions. In this talk, we focus on the $\mathrm{SU}(N)$ gauge theory coupled to N_f flavor of quarks and propose a formulation of the gauge field using Schwinger fermions. Remarkably, the resulting theory can be expressed purely in terms of gauge-invariant operators. This formulation applies to any $\mathrm{SU}(N)$ gauge group in any spacetime dimension. To explore the potential for reproducing the continuum physics, we study this model at $N = 2$ in two spacetime dimensions, where the low-energy continuum physics is expected to be described by a coset Wess-Zumino-Witten (WZW) model. Using tensor network methods, we find that the critical theory can indeed be understood as an $\mathrm{SU}(2)_1$ WZW model.

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