Simulating Quantum Field Theories using Quantum Computers

I would like to interact and collaborate with physicists at Snowmass surrounding the question of how effectively quantum computers can simulate quantum field theory. Recently, my collaborators and I have provided what we believe to be the first scalable simulation methods for simulating the Schwinger model which models electrodynamics in 1+1D and is a toy model for QCD. The results that we found were surprising in that the unbounded nature of the gauge fields in these models rendered the best quantum simulation algorithms somewhat impotent in these cases. Ideally I would like to discuss this work and followups with other attendees as well as discuss methods for simulating quantum dynamics more generally on quantum computers. In particular, I have come to suspect lately that quantum simulation in a lagrangian framework may not be efficient on a quantum computer. That is to say, given a quantum subroutine that in superposition can compute the action integral between two configurations it may not be possible to efficiently simulate dynamics without further assumptions. This is because of a novel type of sign problem that emerges in quantum simulations of path integrals. I'd like to interact with other physicists involving this problem to determine whether there's potential work arounds or if its possible to show that in some computational sense the path integral formalism is a weaker paradigm for simulation than the Hamiltonian formalism currently used in quantum simulation algorithms.

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