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Canonical Momenta in Digitized SU(2) Lattice Gauge Theory

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Lattice simulations using the Hamiltonian formulations are becoming increasingly important as they offer potential solutions to long-standing obstacles such as the sign problem. In particular, they are avenues to solving questions requiring real-time dynamics, string breaking, finite fermion densities, or highly curved space-time geometries amongst many others. Hamiltonian formulations of lattice gauge theories are usually studied using tensor networks. However, quantum computing approaches are being developed and investigated with great anticipation as a means of overcoming classical bottlenecks like heavily entangled states requiring large bond dimension in tensor networks.

In this talk, I will present an approach to modeling canonical momenta in digitized SU(2) Lattice Gauge Theory which leads to diagonalized gauge field operators in the discretized theory. I believe that this is a particularly interesting approach for future quantum computing applications as the method is generalizable to arbitrary SU(N) and U(N) theories and ensures that gauge links remain unitary operators, i.e., they can be implemented directly as gates on (universal) quantum devices. Additionally, the proposed discretization schemes retain canonical commutation relations which under naive discretization schemes are broken.

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