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$SU(2)$ Lattice Gauge Pair Hopping Constructs Suitable for Implementation on Quantum Computers

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A traditional approach for constructing a gauge field theory on a lattice employs a basic Wilson type procedure with additional enhancements to this formulation in order to improve computational performance and accuracy. This type of lattice gauge formulation has been successfully implemented on many different high performance computing systems and has yielded useful computational results. With the recent advances in quantum computing, the question that is now being asked is whether an equivalent type of gauge invariant formulation of a field theory can be constructed on a quantum computer. Using the Quantum Link Model (QLM) plus the concept of rishons, a gauge invariant mathematical construction of a lattice field theory will be summarized. In this formulation, the number of fermionic rishons per link plays an important role in the order of the gauge group that can be constructed. Using this formulation, it may be possible to implement a simple lattice field theory on a quantum computer. This talk will specifically focus on the $SU(2)$ QLM formulation, discuss the physics that may potentially be simulated on a quantum computer with this construct, and speculate on the prospects for having quantum computers become a part of the set of hardware platforms for lattice gauge theory simulations in the future.

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