Towards the simulation of molecular collisions with a superconducting quantum computer\(^1\)

MICHAEL GELLER, University of Georgia

I will discuss the prospects for the use of large-scale, error-corrected quantum computers to simulate complex quantum dynamics such as molecular collisions. This will likely require millions qubits. I will also discuss an alternative approach [M. R. Geller et al., arXiv:1210.5260] that is ideally suited for today’s superconducting circuits, which uses the single-excitation subspace (SES) of a system of \(n\) tunably coupled qubits. The SES method allows many operations in the unitary group \(SU(n)\) to be implemented in a single step, bypassing the need for elementary gates, thereby making large computations possible without error correction. The method enables universal quantum simulation, including simulation of the time-dependent Schrodinger equation, and we argue that a 1000-qubit SES processor should be capable of achieving quantum speedup relative to a petaflop supercomputer. We speculate on the utility and practicality of such a simulator for atomic and molecular collision physics.

\(^1\)Work supported by the US National Science Foundation CDI program.