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Abstract for an Invited Paper
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Towards the simulation of molecular collisions with a superconducting quantum computer[1]

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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.

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