

Abstract Submitted
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Development of a performant simulations framework for modeling realistic gate operations in neutral atom quantum computers
ALEXANDER PAPAGEORGE, JONATHAN KING, PETER BATTALIGNO, ROBIN COXE, STANIMIR KONDOV, KRISH KOTRU, BRIAN LESTER, MICKEY MCDONALD, REMY NOTERMANS, COLM RYAN, PRASAHNT SIVARAJAH, BENJAMIN BLOOM, Atom Computing, Inc — Individually addressable neutral atoms, trapped in holographically defined optical tweezers, provide access to coherent, controllable quantum objects that possess a rich and complex Hilbert space. Furthermore, interactions between nearby atoms can be activated to create many-body entangled states. Such a collection of controllable interacting atoms can be a superb platform for studies in quantum information processing. Given the complexity of the system it is imperative that theory and numerical simulations be used to develop and verify proposed control schemes; full numerical simulations can be difficult to construct given the complicated atomic structure, and are time-consuming to perform especially when dissipation is included. We present a simulations framework, written in the Julia programming language, that leverages several features of the language including metaprogramming and native parallelization to study and prescribe coherent control of 87Sr . We use this framework to concisely build and efficiently simulate pulse sequences that effect single qubit and two-qubit entangling gates, demonstrating high fidelity gates using experimentally accessible control parameters.

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