

Integrated quantum control architecture for ultra-fast camera readout of neutral atom arrays

Presenting Author
Ramon Szmuk

Co-authors: Yonatan Cohen, Alex Kotikov

Quantum Machines, Yigal Alon St 126, Tel Aviv, Israel

ramon@quantum-machines.co

Abstract

Neutral atoms arrays are a promising platform for quantum computation and simulation. Although their qubit quality can be high even in large numbers, the path to neutral atom quantum computers satisfying the DiVincenzo criteria is brimmed with challenges. One of the major roadblocks is the necessity to precisely assemble 2D arrays of neutral atoms and perform a readout well within the boundaries of coherence time. Here we demonstrate camera readout times in the order of a few milliseconds, two orders of magnitude lower than typical T_2^* times. This readout includes everything from frame capturing, processing, and feedback pulses. We show that such a fast camera readout can be achieved by combining a dedicated FPGA processor architecture with real-time control capabilities and an integrated camera readout module optimized to handle such fast operations. The possibility for a unified control platform to perform a universal set of quantum gates and such a fast readout well within coherence time directly enables the implementation of quantum error correction schemes on atom arrays.