HARVARD UNIVERSITY
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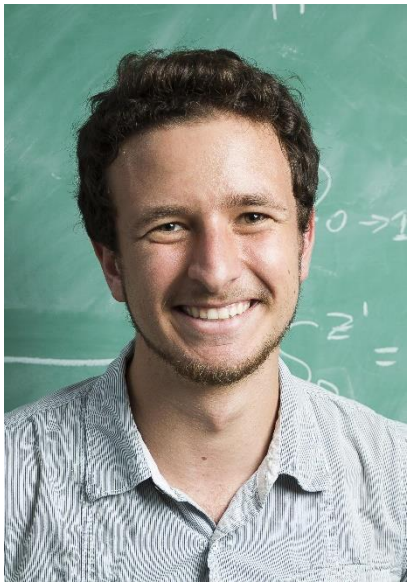
Mathematical Picture Language Seminar



Tuesday, April 16

4:30 p.m. Boston time

Jefferson 256

Dolev Bluvstein
Harvard University

Logical Quantum Processor Based on Reconfigurable Atom Arrays

Abstract: Suppressing errors is one of the central challenges for useful quantum computing, requiring quantum error correction for large-scale processing. However, the overhead in the realization of error-corrected "logical" qubits, where information is encoded across many physical qubits for redundancy, poses significant challenges to large-scale logical quantum computing. In this talk we will discuss recent advances in quantum information processing using dynamically reconfigurable arrays of neutral atoms. With this platform we have realized programmable quantum processing with encoded logical qubits, combining the use of 280 physical qubits, high two-qubit gate fidelities, arbitrary connectivity, and mid-circuit readout. Using this logical processor with various types of error-correcting codes, we demonstrate that we can improve logical two-qubit gates by increasing code size, outperform physical qubit fidelities, create logical GHZ states, and perform computationally complex scrambling circuits using 48 logical qubits and hundreds of logical gates. We find that this logical encoding substantially improves algorithmic performance with error detection, outperforming physical qubits at both benchmarking and quantum simulations. These results herald the advent of early error-corrected quantum computation, enabling new applications and inspiring a shift in both the challenges and opportunities that lay ahead.

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