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New opportunities in quantum computing and simulation with Rydberg atom arrays

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Abstract

I will present recent developments in quantum information processing and explorations of quantum many-body phenomena using Rydberg atom arrays, which provide precise and coherent control of hundreds of atoms in two dimensions, along with individual addressability and reconfigurable geometry. I will first describe our realization of a logical-qubit quantum processor. Useful quantum computing will likely require large quantum computers with very low error rates, potentially achievable with quantum error correction (QEC). In QEC, errors are suppressed by nonlocally encoding information on logical qubits. By leveraging the reconfigurability of atom arrays, we carry out complex circuits on the logical qubit level. I will then describe the use of neutral atom arrays to explore quantum many-body physics, including analog simulation of the ordering dynamics of a quantum magnet, as well as digital exploration of topological order and fermionic dynamics. These results highlight the promise and versatility of neutral atom platforms for fundamental science and technological advancements.

Bio

Tom Manovitz is an experimental physicist working in quantum computing, quantum simulation, and precision metrology. He completed his PhD at the Weizmann Institute and is currently a postdoctoral fellow as part of the Harvard Quantum Initiative. His research focuses on leveraging ultracold atoms—ranging from ions trapped in oscillating electric fields to neutral atoms held in optical tweezers—to explore and control complex quantum phenomena and develop quantum computing. His contributions include the construction of quantum computers, the development of high-fidelity quantum gates, the investigation of quantum phase transitions and non-equilibrium many-body dynamics, the study of topological states of matter, and the use of entangled states for precision measurements of atomic properties.

Host

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