

Exploring Frontiers of Quantum Science with Programmable Atom Arrays

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We will discuss the recent advances involving programmable, coherent manipulation of quantum many-body systems using neutral atom arrays excited into Rydberg states, allowing the control over 200 qubits in two dimensions. These systems can be used for the realization and probing of exotic quantum phases of matter and exploration of their non-equilibrium dynamics. Recent advances involving the realization and probing of quantum spin liquid states - the exotic topological states of matter have thus far evaded direct experimental detection, and the observation of quantum speedup for solving optimization problems will be described. In addition, the realization of novel quantum processing architecture based on dynamically reconfigurable entanglement and the steps towards quantum error correction will be discussed. Finally, we will discuss prospects for using these techniques for the realization of large-scale quantum processors.