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Exploring frontiers of quantum science using programmable atom arrays

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Abstract

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-dimensional arrays. Recent results involving the realization of exotic phases of matter, study of quantum phase transitions and exploration of their non-equilibrium dynamics will be presented. In particular, we will report realization and probing of quantum spin liquid states - the exotic states of matter have thus far evaded direct experimental detection. Finally, most recent progress involving testing quantum optimization algorithms and realization of novel architecture based on dynamically reconfigurable entanglement will be described. Prospects for scaling up these techniques, including realization of large-scale quantum processors and quantum simulators will be discussed.