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Quantum simulation and computing with atomic arrays

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The realization of large-scale controlled quantum systems is an exciting frontier in modern physical science. Such systems can provide insights into fundamental properties of quantum matter, enable the realization of exotic quantum phases, and ultimately offer a platform for quantum information processing that could surpass any classical approach.

Recently, reconfigurable arrays of neutral atoms with programmable Rydberg interactions have become promising systems to study such quantum many-body phenomena, due to their isolation from the environment, and high degree of control. I will show how these techniques can be used to study quantum phase transitions by realizing quantum spin models with system sizes up to 51 qubits.
Furthermore, I will discuss the prospect for quantum information processing with arrays of atoms and present our recent results on the creation of a 20 qubit GHZ entangled state.

Prospects for scaling this approach beyond hundreds of qubits and the implementation of quantum algorithms will be discussed.

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