Quantum simulation using Rydberg atoms

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Rubidium atoms are arranged in a linear or zig-zag chain configuration and entangled through Rydberg-state excitation at the Rydberg dipole-blockade regime, to compute (or simulate) the quantum dynamics of massive entangled systems of as many as 30 qubits. The results are modeled with the quantum Ising Hamiltonian to understand the exotic phases and critical phenomena of these quantum magnets, probed with varying degree of frustration. Coherent control schemes of entanglements, towards quantum annealing and decoherence-free space projections, will be further discussed.