

Rydberg-atom physics and technology

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Due to their strong and long-range dipole-dipole interactions, Rydberg atoms have become a versatile experimental platform to study equilibrium and non-equilibrium dynamics of interacting spin systems both in unitary and dissipative settings. After discussing different fundamental interactions between Rydberg atoms, including Rydberg blockade and antiblockade, Ising and XY interactions, as well as XY interactions with dynamical gauge fields, I will review suggested and experimentally implemented realizations of various many-body quantum spin Hamiltonians and dissipative models using arrays of trapped Rydberg atoms and in gases. I will discuss some specific and very different applications in detail. This includes the classical facilitation dynamics of Rydberg excitations in the presence of dissipation, resembling epidemic models with an absorbing-state phase transition and self-organized criticality. Furthermore I will discuss the realization of topological lattice models and quantum spin liquids.