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Many-body effects in strongly interacting systems of Rydberg atoms JOVICA STANOJEVIC, ROBIN CÖTÉ, University of Connecticut, Storrs, CT 06269 — We investigate the effects of strong interactions in ultracold Rydberg gases. Strong Rydberg-Rydberg interactions have been proposed to entangle large numbers of atoms, which can be used to implement fast quantum gates. The laser excitation of a macroscopic sample of ultracold atoms to high-lying Rydberg states can be dramatically suppressed by their strong long-range interactions. This leads to a local blockade effect, where a single excited Rydberg atom prevents excitation of its neighbors. Recently, large inhibitions of Rydberg excitations due to van der Waals interactions have been observed. We explore the dynamics of strongly interacting systems with many excited atoms. Including many-body correlations is essential for such systems. Besides the inhibition of Rydberg excitation, we are particularly interested in the conditions for collective oscillations. These oscillations should be much faster than the ordinary Rabi flopping for isolated atoms and should depend on the number of atoms in the sample. We discuss different analytical and numerical techniques used for solving the many-body Hamiltonian.

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