Electronic Correlations in a Rydberg Gas

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I will report the results of simulations of the many atom wave function when a cold gas is excited to highly excited states. Through a judicious choice of states, we have been able to simulate the many body wave function by direct numerical solution of Schrodinger's equation even though more than 1018 quantum states are possible in when the interaction energy between excited atoms is comparable to the energy bandwidth of the laser. We have examined how the correlation depends on the laser intensity, going from low intensity to an intensity where the excitation population saturates. We have investigated the spatial correlation of the excitations for a large system and for small systems. We also computed how the fluctuations in the fraction of excited atoms depend on the intensity, detuning, and density of atoms.