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Rydberg Wavepacket Evolution in an Ensemble of Cold Dipole-Dipole Coupled Atoms[1] TAO ZHOU, SHA LI, R.R. JONES, Department of Physics, University of Virginia, Charlottesville, VA — Abstract: We have studied the evolution of Rydberg wavepackets in the presence of interatomic dipole-dipole interactions in a cold Rb gas. In the experiments, Rb atoms in a MOT are laser excited to 32s states. The Rydberg atoms are then exposed to a picosecond mm-wave pulse that creates a coherent superposition of states, predominantly 32s+32p, within individual atoms. The wavepackets are allowed to evolve for a variable time, T <15 ns, before their exposure to a second mm-wave pulse. The second pulse coherently transfers population among the Rydberg levels, resulting in a delay-dependent interference in the probability for detecting atoms (via selective field ionization) in the constituent states in the wavepacket. In the independent atom picture, the probability amplitudes of the superimposed states are continually modified by the dipole-dipole interactions between atoms. The predominant interactions result in excitation exchange, sp→ps, between atom pairs during the evolution time T. Experimentally we observe a suppression of the delay-dependent interference oscillations in the population in different Rydberg states. The degree of suppression for a given T increases with increasing atom density. Numerical simulations suggest that the dipole-dipole coupling leads to complex interferences which dephase due to the variation in the separations between neighboring atoms in the MOT.

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