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**The Effect of Energy Level Structure on Many-Body Interactions among Rydberg Atoms** THOMAS CARROLL, JON WARD, ALEXANDER MELLUS, Ursinus College, MICHAEL NOEL, Bryn Mawr College — Ultracold highly-excited atoms in a magneto-optical trap are strongly coupled by the dipole-dipole interaction. We have developed a computational model of systems of Rydberg atoms in order to study the many-body nature of the interactions, the effect of the spatial arrangement of the atoms, and the energy level structure of the atoms. The model has been implemented on a parallel computer and can simulate experimentally realizable systems including 10-20 atoms. In this work, we focus on a system with two nearly degenerate initial states. We examine the time evolution and the dependence of the interactions on the size of the energy gap between the initial states.

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