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Structural and dynamical properties of recombining ultracold neutral plasma[1] SANAT KUMAR TIWARI, NATHANIEL R. SHAFFER, SCOTT D. BAALRUD, University of Iowa — An ultracold plasma (UCP) is an evolving collection of free charges and bound charges (Rydberg atoms). Over time, bound species concentration increases due to recombination. We present the structural and dynamical properties of an evolving UCP using classical molecular dynamics simulation. Coulomb collapse is avoided using a repulsive core with the attractive Coulomb potential. The repulsive core size controls the concentration of bound states, as it determines the depth of the potential well between opposite charges. We vary the repulsive core size to emulate the quasi-static state of plasma at different time during the evolution. Binary, chain and ring-like bound states are observed in the simulation carried out at different coupling strengths and repulsive core size. The effect of bound states can be seen as molecular peaks in the radial distribution function (RDF). The thermodynamic properties associated with the free charges can be analyzed from RDF by separating free from bound states. These bound states also change the dynamical properties of the plasma. The electron velocity auto-correlation displays oscillations due to the orbital motion in bound states. These bound states act like a neutral species, damping electron plasmon modes and broadening the ion acoustic mode.

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