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Thermodynamic State Variables In An Ultracold Plasma[1] SANAT KUMAR TIWARI, NATHANIEL R. SHAFFER, SCOTT D. BAALRUD, Department of Physics and Astronomy, University of Iowa, Iowa city, Iowa — Pressure and internal energy are evaluated for a quasi-equilibrium ultracold plasma medium using classical molecular dynamics simulation. A two-component plasma model is employed in which Coulomb collapse is avoided by adding a repulsive core to the attractive Coulomb potential. As the recombining plasma is composed of free and bound electrons and ions, a method is proposed to separate the contributions of both species while evaluating thermodynamic state variables. The partial pressure and partial internal energy associated with the free charges are found to be independent of repulsive core scale length when it is sufficiently small. The partial pressure due to free charges closely follows the one-component plasma model, reaching negative values at strong coupling, but the total system pressure is always positive. Apart from the quasi-equilibrium studies, we also employ a two-temperature plasma model that is more realistic representation of ultracold plasma. Effects of mass and temperature ratio on thermodynamic state variables will be presented.

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