Quantum Effects on Confined Charges

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Abstract

A quantum system of N Coulomb charges confined within a harmonic trap is considered over a wide range of densities and temperatures. A recently described construction of an effective classical system is applied in order to exploit the rather complete classical description via liquid state theory and Monte Carlo. Here, the effects of quantum mechanics on that description are described with attention focused on the origin and nature of shell structure. The analysis extends from the classical strong Coulomb coupling conditions of dusty plasmas to the opposite limit of low temperatures and large densities characteristic of "warm, dense matter". The transition from shell structure due to Coulomb correlations to that due to exchange effects is described.