EQUATION OF STATE FOR MULTICOMPONENT CLASSICAL PLASMAS

Y. Rosenfeld

An equation of state for D-dimensional ν-component plasmas that interpolates very effectively between the Debye-Huckle and ion-sphere limits was derived. Extensive analysis for three-dimensional (D=3) two-component (ν=2) plasmas was made. General expressions for the screening factors $H_{ij}(0)$ in terms of the equation of state and exact bounds for the correlation energy, that improve upon previous bounds, were derived.

MEAN SPHERICAL MODEL FOR THE D-DIMENSIONAL ν-COMPONENT CLASSICAL PLASMA[1]

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The relation between the structure and the thermodynamics of strongly coupled D-dimensional ν-component classical plasmas (with D-dimensional Coulomb potential) was considered, and an exact solution of the mean spherical model (MSM) with continuous pair functions was given. The function describing the interaction energy between two uniformly charged D-dimensional spheres at distance r plays a key role for strongly coupled plasmas, similar to that of the Debye-Huckle screened Coulomb potential for weak coupling, and provides the analytic form for the MSM direct correlation functions. Exact lower bounds for the one-component plasmas, that are very effective for arbitrary coupling, were derived.

REFERENCE:

1. Rosenfeld, Y., Phys. Rev. A25, 1206 (1982)

EXTREMUM CONDITION FOR THE MEAN-SPHERICAL MODEL

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It was shown that within the mean-spherical model, the condition of continuity of the pair functions is equivalent to a condition of extremum for a free energy functional. The equivalence between the condition of extremum for the energy and the condition of continuity for the pair functions plays a key role in finding a formal exact solution of the mean spherical model for D-dimensional ν-component classical plasmas, and is an important feature of the mean spherical model for soft potentials[1] in general.

REFERENCE:

1. Rosenfeld, Y. and Achcroft, N.W., Phys. Rev. A20, 2162 (1979)

LASER-DRIVEN SHOCK WAVE STUDIES. PART I. PROPAGATION IN ALUMINUM AND POLYETHYLENE SLABS

S. Eliezer, L. Gitter, A.D. Krumbein and D. Salzmann

The propagation properties of laser-driven shock waves in pure polyethylene and aluminum slab targets were studied for a set of laser intensities and pulse widths. The laser-plasma simulations were carried out by means of a 1-D Lagrangian hydrodynamic code. It was shown that the various parts of a laser-driven compression wave undergo different thermodynamic trajectories: the shock front portion is closer to the Hugoniot curve, whereas the rear part is closer to an adiabat. It was found that the shock front is accelerated into the cold material until $t \simeq 0.8\tau$ (τ is the laser pulse width) and only later is a constant velocity propagation attained. Scaling laws were obtained for the pressure and temperature of the compression wave, which are in good agreement with those published in other works.

LASER-DRIVEN SHOCK WAVE STUDIES. PART II. PROPAGATION IN LAYERED TARGETS

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Calculations of pressure, compression and shock wave motion were carried out for laser-driven slab targets composed of CH_2 on aluminum and aluminum on CH_2 in the intensity range of 10^{13} to 10^{14} W/cm^2 using a one-dimensional hydrodynamics code. High compressions were found to occur at the interface of CH_2 on Al targets due to impedance mismatch, but were not found when the layers were reversed. The persistence time of the high pressure on the interface in the CH_2 on Al case is long enough relative to the characteristic times of the plasma to have an appreciable influence on the shock wave propagation into the aluminum layer. It was also found that the pressure and compression on the interface can be optimized by adjusting the CH_2 layer thickness.