STRUCTURAL TRANSITION IN DUSTY YUKAWA CRYSTALS

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The model of a Coulomb crystal: point like atomic nuclei and electrons background is used in astrophysics in theory of neutron stars and white dwarfs. Polarizability of electrons in a Coulomb crystal is usually described by the Thomas-Fermi formalism (e.g., [1]). It is shown that in this approach the model of a Coulomb crystal is similar to the strongly-coupled dusty Yukawa system which was described in [2]. The only difference is that in astrophysical applications electrons are thought to be degenerated while in Hamaguchi and Farouki model — nondegenerated (this leads to $\kappa \equiv \sqrt{4\pi e^2 \partial n_e / \partial \mu_e}$ changes while equations for electrostatic and total free energies as function of κ and Γ stay the same). Hence, far from the melting point structural transition between bcc and fcc Yukawa lattices could be described analytically by the simple harmonic approximation. Importance of corrections $\propto \kappa^4$ to the Yukawa potential in this approach is discussed. Analytical equations also allow to consider low temperature effects (results received in [2] are valid at temperatures greater than the plasma temperature) and other lattices (for example, hcp and MgB_2 lattices).

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1. Baiko D.A. // Phys. Rev. E. 2002. V. 66. id. 056405.
2. Hamaguchi S., Farouki R.T., and Dubin D.H.E. // Phys. Rev. E. 1997. V. 56. P. 4671-4682.