IONIZATION EQUILIBRIUM OF DENSE NON-IDEAL PLASMAS

Seitkozhanov Y.S.,[*1,2] ***Shalenov E.O.,***[2] ***Dzhumagulova K.N.***[1,2]

[1]*KazNU, Almaty, Kazakhstan,* [2]*SU, Almaty, Kazakhstan*

[*]*seytkozhanov@gmail.com*

The study of non-ideal plasmas presents both challenges and unique opportunities to understand the complex behaviors of matter under extreme conditions. Recent advancements in experimental techniques [1, 2] have significantly enhanced the accuracy of theoretical models that describe such plasmas, making it essential to examine their thermodynamic, optical, and transport properties.

This work focuses on the ionization equilibrium of dense aluminum plasmas, considering the ionization potential depression (IPD) caused by strong coupling effects. The Saha equation is solved using the algorithm proposed by Zaghloul et al. [3]. The IPD is calculated using the formalism introduced in [4], where the ionic static structure factor serves as an indicator of the ionic micro-field and provides a correction to average atom models. Our approach substitutes the Wigner-Seitz radius with the ion sphere radius, which better describes the behavior of individual ions. Additionally, we calculate the attractive screening correction to the bare ion-ion interaction [5] using an interpolation formula for ion and electron screening lengths, transitioning from the Debye length in classical plasmas to the Thomas-Fermi length in strongly degenerate plasmas.

This research is supported by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan (Grant No. AP19676689).

---

1. Ciricosta O., Vinko S. M., Chung H.-K., et al. Measurements of Continuum Lowering in Solid-Density Plasmas Created from Elements and Compounds // Nat Commun. 2016. V. 7. P. 11713.
2. Kraus D., Fletcher L. B., Galtier E., et al. X-Ray Scattering Measurements on Imploding CH Spheres at the National Ignition Facility // Phys. Rev. E. 2016. V. 94. P. 011202.
3. Zaghloul M. R., Bourham M. A., Doster J. M. A Simple Formulation and Solution Strategy of the Saha Equation for Ideal and Nonideal Plasmas // J. Phys. D: Appl. Phys. 2000. V. 33. P. 977-984.
4. Lin C. Quantum Statistical Approach for Ionization Potential Depression in Multi-Component Dense Plasmas // Physics of Plasmas. 2019. V. 26. P. 122707.
5. Gregori G., Ravasio A., Holl A., Glenzer S. H., Rose S. J. Derivation of the Static Structure Factor in Strongly Coupled Non-Equilibrium Plasmas for X-Ray Scattering Studies // High Energy Density Physics. 2007. V. 3. P. 99-

104.