

Improved spherical atomic models for the opacity of warm/hot dense plasmas

In the recent decades, there is an increasing interest in the properties of material under extreme conditions of temperature and density (T- ρ). The physical description of stars and planets formation and evolution, controlled fusion experiments and laser-material interaction requires the knowledge of the equation of state, opacity, ionization degree and some other physical quantities in a wide range of T- ρ for many materials. Since there are no experimentally measured databases for these quantities, in such wide ranges of T- ρ , these physical quantities are calculated, theoretically, using computational simulations. A popular theoretical approach for calculating the required quantities for plasmas relies on spherical models, like the ion-sphere average atom (ISAA) model [1]. In this simplified model, the electron-electron (e-e) interaction is approximated by the LDA/GGA exchange-correlation potential, and the interaction with the surrounding plasma ions is poorly described through the boundary condition of the ISAA's eigenfunctions. I will present an improved ISAA model which uses approximate optimized effective potentials, like KLI-SIC and KLI-EXX [2], for the e-e potential and the hyper-netted chain (HNC) [3] approximation for realistic description of the ion-plasma interaction. Also, improved opacity calculations, which are based on the improved potentials, will be presented for astrophysical systems and laser-plasma experiments, using the CRSTA code [4].

[1] Balazs F. Rozsnyai, Phys. Rev. A 5, 1137 (1972); D.A. Liberman, Journal of Quantitative Spectroscopy and Radiative Transfer, 27, 335 (1982).

[2] J. B. Krieger, Yan Li, and G. J. Iafrate, Phys. Rev. A 45, 101 (1992); J. B. Krieger, Yan Li, and G. J. Iafrate, Phys. Rev. A 46, 5453 (1992).

[3] S. Ichimaru, Rev. Mod. Phys. 54, 1017 (1982).

[4] G. Hazak and Y. Kurzweil, High Energy Density Phys. 8, 290 (2012); Y. Kurzweil and N. Polack-Schupper, Phys. Plasmas 29, 012704 (2022).

Presenting Author

Yair Kurzweil

Presenting Author Affiliation

Nuclear Research Center - Negev

Presenting Author Gender

Male

Country

Israel

Presenting Author Email Address

yairkurz@gmail.com

Primary author: Dr KURZWEIL, Yair (Researcher)

Presenter: Dr KURZWEIL, Yair (Researcher)

Session Classification: Poster Session

Track Classification: High Energy Density Plasmas and Powerful Light Sources