Theoretical modeling of thermophysical and x-ray spectral properties of dense ionized matter

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To appropriately simulate the processes and effects occurring at high energy densities, one needs to develop a handful of theoretical methods to calculate high-accuracy atomic data and x-ray emission spectra of multielectron ions in hot plasmas, provide realistic representation of dense ionized matter over a wide range of temperatures and densities along with the consistent description of its thermophysical properties (thermodynamical, optical, dielectric, transport, and structural) and fast-ion energy losses. RFNC-VNIITF efforts in this direction are based on the use of the well-mastered up-to-date models to generate the necessary data on atomic structure and atomic processes, chemical-picture-based model of nonideal plasmas, average atom models providing various methods to include ion-ion correlations, pseudoatom molecular dynamics modeling, average-atom collisional-radiative model of non-LTE plasmas, and a new version of the line-shape model for multielectron ions allowing for the main line-broadening mechanisms in plasmas.

We present a review of theoretical work performed at RFNC-VNIITF in the direction discussed and provide a number of comparisons of the modelled thermophysical and x-ray spectral properties the experimental and other theoretical data.