Spectral properties of dense helium plasma near the ionization threshold

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This paper examines the spectral properties of excited helium atoms in the region of transition from the discrete spectrum of bound states to the continuous spectrum of free-electron states.

To study the effects of density, photoionization of an isolated atom is first considered without accounting for interactions with plasma particles. Photoionization cross sections are calculated using the Burgess–Seaton formulas [1]. The results are compared with theoretical and experimental data. The calculated photoionization cross sections function is extrapolated into the discrete-spectrum region.

In a dense plasma, interactions of atoms with surrounding charged particles lead to changes in their energy structure and the population of excited states. These effects changes the spectrum near the ionization threshold. Particularly important is the reduction in the contribution of highly excited states due to their decreased populations of such states compared with the ideal distribution.

To investigate this effect, the results of the method of molecular dynamic modeling of plasma are used, which allows taking into account the influence of surrounding charged particles. The method of the variational model of the average atom VAAQP [2] is also used. The method is based on the theory of the density functional and describes an atom in a self-consistent potential, that accounts for the influence of the surrounding plasma.

The results are compared with experimental data on the spectrum of dense helium plasma [3].

[1] Burgess A and Seaton M J 1960 *Monthly Notices of the Royal Astronomical Society* **120** 121–151

[2] Blenski T and Cichocki B 2007 *Physical Review E* **75** 056402

[3] Korshunov O V, Chinnov V F, Kavyrshin D I and Ageev A G 2016 *Journal of Physics: Conference Series* **774** 012199