ANALYSIS OF ACCURACY OF CALCULATIONS OF RADIATION LOSSES BY LIGHT IMPURITIES IN THE NEAR-WALL AND DIVERTOR PLASMA IN TOKAMAKS [[1]](#footnote-1)\*)

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The relevance of improving the accuracy of calculating the radiation losses (RL) on impurities in installations for magnetic confinement of thermonuclear plasma is due to the fact that the line radiation of light impurities (nitrogen, neon, argon) in existing and planned experiments with thermonuclear plasma is used, firstly, to cool the divertor plasma in order to protect the divertor plates and, secondly, to cool the entire plasma during emergency quenching of the discharge by massive injection of an inert gas.

In this work, we study the effects of the influence of the structure of atomic levels on various methods for calculating the RL for the line radiation of light impurities (nitrogen, neon, argon). The need to refine the algorithms for using all databases for calculating the RP of low-temperature plasma is demonstrated. This problem is certainly relevant for atoms and ions of light and medium-weight elements, since the simplification of the structure of atomic levels used in calculations is present to some extent in all databases. This conclusion is based on the analysis of the OPEN-ADAS database [1], the most developed and widely used in the world fusion research, for calculating the plasma RL. In particular, it is shown that for argon in the range of relatively low temperatures T, which is typical for divertor plasma in the stationary regime and for the entire plasma at the stage of discharge quenching, the direct summation of the contribution of strong lines to the RL can exceed (up to several times for argon ions with charge + 3 and +2 at Т ~ 3-10 eV) RL in the model of atomic levels, simplified by grouping them and, accordingly, moving the lower excited levels to higher energy values relative to the ground state of the ion.

In general, the effects of simplifying the kinetic model for calculating RL in the case of grouping of atomic levels, when averaging the position of excited states leads to an overestimation or underestimation of RL in the case of displacement of strongly radiating excited states with higher or lower excitation energies, respectively, are analyzed. A realistic model is formulated for detailing the structure of atomic levels to correctly take into account their multiplet structure with simultaneous reduction in the number of radiative transitions taken into account when calculating specific radiative losses.

References

1. OPEN-ADAS database, [https://open.adas.ac.uk/](https://open.adas.ac.uk/adf15)
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/Mu/ru/CK-Kukushkin.docx) [↑](#footnote-ref-1)