THERMOS Toolkit: Simulation of non-stationary Plasma [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2020.47.1.070

Kim D.A., Vichev I.Yu., Solomyannaya A.D., Grushin A.S.

Keldysh Institute of Applied Mathematics (Russian Academy of Sciences), [kimda@kiam.ru](mailto:kimda@kiam.ru)

Modern high energy density experimental facilities, such as NIF, ORION, DESY, provide more and more experimental data with one of the distinct feature being very short characteristic times (femto- and picoseconds) of laser interaction with matter. In this case, the rates of elementary atomic processes can be significantly lower than the rate of change of thermodynamic parameters, as a result of which the plasma does not have time to attain equilibrium within the characteristic times of temperature and density change.

Modeling of such non-stationary plasma requires solving the system of rate equations at each time step in order to determine the ionic composition and spectral distribution of emission.

The THERMOS Toolkit [1,2] is a software package designed to calculate atomic data and spectral properties of high-temperature plasma, including the capability of non-stationary plasma simulations. In case of dense plasma, the non-stationary rate equations system is solved consistently with ionization potential depression. For these problems a specialized algorithm has been developed for cutting off or adding states of ions at each time step.

The presented model of non-stationary plasma has been tested on a number of problems discussed at the NLTE [3,4] and RPHDM international workshops, which are specializing on non-LTE plasma. Comparison of calculation results obtained using THERMOS code with the most advanced codes for cases of non-stationary neon, aluminum, and vanadium plasmas showed good agreement.

Calculations have been performed at HPC MVS-10P (JSCC RAS). The study has been supported by RFBR (project 20-01-00485).

References

1. THERMOS – Software package and database. <http://keldysh.ru/thermos/en/>
2. Vichev, I. Yu. et al. (2019). On certain aspects of the THERMOS toolkit for modeling experiments. High Energy Density Physics, 100713. DOI:10.1016/J.HEDP.2019.100713
3. The Non-LTE Code Comparison Workshop. <http://nlte.nist.gov/>
4. Hansen, S.B. et al. Review of the 10th Non-LTE Code Comparison Workshop. High Energy Density Physics, S1574181819300357 (2019) DOI:10.1016/j.hedp.2019.06.001

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVII/It/ru/CC-Kim.docx) [↑](#footnote-ref-1)