Modeling of the Charge Exchange Recombination Spectroscopy Measurements for ITER [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2023.50.2023.1.1.269

Pavlova G.S., Serov S.V., Tugarinov S.N.

Institution “Project Center ITER”

The diagnostic of Charge Exchange Recombination Spectroscopy (CXRS) is used on many modern tokamaks and will be used on ITER device to measure concentration, temperature and velocity of hot plasma ions [1, 2]. In ITER plasma H isotopes and low-Z elements are fully stripped of electrons and do not emit line spectrum, therefore application of passive spectroscopy is limited to the outer regions of plasma, where cold particles are present. In the case of active spectroscopy, high-energy beam of atoms (e.g. H) is injected into the plasma and its atoms act like donors of electrons for plasma ions. Due to reaction of charge exchange between plasma ions and beam atoms, hydrogen-like ions in excited state appear, and then go to the states with lower energy and cause light emission. CXRS spectra analysis becomes more difficult due to different effects (e.g. halo effect), that can distort the shape of active spectral line and induce additional errors in calculation of plasma parameters.

In this work, a modelling was carried out to evaluate the influence of halo effect on the CXRS measurement accuracy on ITER. Simulation of Spectra (SOS) [3] and FIDASIM [4] codes were used. Both codes allow to calculate all components of CXRS spectra using different methods and models. The comparison of modelling results was conducted. It was noticed that modeled spectral lines have significant differences in their intensities. The cause of the discrepancy was explained. Contribution of halo effect to active spectral line was calculated and it was concluded that halo effect should not be neglected in the case of ITER. The halo-induced errors of plasma parameters measurement were also evaluated.

References

1. S.N. Tugarinov et al. Plasma Physics Reports, 2004, Vol. 30, No. 2, pp. 128–135. Translated from Fizika Plazmy, 2004, Vol. 30, No. 2, pp. 147–154.
2. S.V. Serov, S.N. Tugarinov, M. von Hellermann. Proc. of 45nd EPS Conference on Plasma Physics 2 – 6 July 2018. 42A. –– European Physical Society, 2018. –– P4.1012.
3. von Hellermann M. et al. Atoms, 2019, v. 7, №1.
4. Geiger B. et al. Plasma Physics and Controlled Fusion, 2020, v. 62, №10.

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/E/ru/JQ-Pavlova.docx) [↑](#footnote-ref-1)