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INFLUENCE OF ENERGY-DEPENDENT EXCITATION RATES ON ACTIVE SPECTROSCOPY MEASUREMENTS OF ITER PLASMA PARAMETERS *)

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In the ITER tokamak it is planned to measure plasma parameters with active spectroscopy diagnostic [1, 2]. The diagnostic allows to evaluate concentration, temperature and velocity of light ions in the plasma via analysis of charge-exchange (CX) emission spectrum that appears when high-energy beam passes through the plasma.

The profile of active CX spectral line which contains information about plasma parameters can be distorted due to influence of different effects like, for example, halo effect [3] or energy-dependent cross-section effect [4]. The influence of cross-section effect becomes noticeable in the cases where plasma temperature is comparable with injected beam energy, and collision energy cannot be assumed equal to beam energy. Due to energy-dependent emission rate, for thermal ions with different velocities the probability of CX reaction between the plasma ions and beam atoms with subsequent photon emission is different. Therefore, Doppler broadened profile of active CX line can be distorted, and it leads to additional errors in plasma parameters measurement.

In this work the errors caused by cross-section effect were evaluated via modelling in SOS [5] and FIDASIM [6] codes. The halo effect was also considered. The modelling was carried out for CXRS Edge diagnostic system of ITER tokamak. According to modelling results in some cases the cross-section effect can cause the multifold increase in the observed velocity and the 15% decrease in observed temperature.

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References

[1]. Fonck R.J., Darrow D.S., and Jaehnig K.P., Phys. Rev., 1984, A 29, 3288.
[2]. Isler R.C., Plasma Phys. Controlled Fusion, 1994, 36, 171.
[3]. Hogan J.T., Journal of Nuclear Materials, 1982, 111 & 112, 413-419.
[4]. Howell R.B., B: Review of Scientific Instruments, 1988, 59.8, 1521—1523.
[5]. von Hellermann M. et al, Atoms, 2019, 7, 30.
[6]. Geiger B. et al, Plasma Physics and Controlled Fusion, 2020, 62, 105008.

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