APPLICATION CAPABILITIES OF NEUTRAL PARTICLE ANALYSIS FOR THE TOKAMAK WITH REACTOR TECHNOLOGIES [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2022.49.1.175

1Afanasyev V.I., 2Goncharov P.R., 1Melnik A.D., 1Mironov M.I., 1Navolotsky A.S., 1Nesenevich V.G., 1Petrov M.P., 1Petrov S.Ya., 1Chernyshev F.V.

1Ioffe Institute, Saint Petersburg, Russia, val@npd.ioffe.ru
2Peter the Great St.Petersburg Polytechnic University, Saint Petersburg, Russia,
 p.goncharov@spbstu.ru

At present, the neutral particle analysis (NPA) is one of the main methods of ion diagnosis in hot plasmas. This method allows one to study both the ion energy distribution function and the hydrogen isotope composition. Atomic analyzers have been successfully used at the largest magnetic confinement devices all over the world, e.g. JET [1, 2], TFTR [3], JT-60U [4]. A complex of atomic analyzers currently being developed at the Ioffe Institute is included in the list of priority diagnostics for the ITER tokamak [5, 6].

The present report discusses the possibilities of using the NPA for studying the plasma parameters and additional heating at a new Russian plasma machine – the Tokamak with Reactor Technologies (TRT), the development of which began in 2021 [7]. Numerical simulation of neutral beam deposition is used to obtain the source function of fast deuterons and to calculate spatial, energy and angular dependence of the deuteron velocity distribution function, taking into account diffusion and slowing down of ions in velocity space due to Coulomb collisions with background plasma electrons and ions. The fast ion population resulting from the ICRH heating is estimated. On the basis of the obtained results and the data on the spatial distribution of neutralization target densities, the energy distribution and the intensity of charge-exchange atomic fluxes along the analyzers’ lines of sight are calculated. The corresponding counting rates are obtained. The calculations refer to the TRT discharge scenarios analyzed in [8].

References

1. M.P. Petrov, V.I. Afanasyev, S. Corti et al. 19th EPS Conference on Controlled Fusion and Plasma Physics, vol.16C(II), 1031 (1992).
2. V.I. Afanasiev, A. Gondhalekar, P.Yu. Babenko et al. Rev. Sci. Instrum. 74, 2338 (2003).
3. M.P. Petrov, R. Bell, R.V. Budny et al. Phys. Plasmas. 6, 2430 (1999).
4. V.I. Afanassiev, Y. Kusama, M. Nemoto et al. Plasma Phys. Controlled Fusion. 39, 1509 (1997).
5. V.I. Afanasyev, F.V. Chernyshev, A.I. Kislyakov et al. Nucl. Instr. Meth. Phys. Res. A. 621, 456 (2010).
6. S.Y. Petrov, V.I. Afanasyev, A.D. Melnik et al. Phys. Atom. Nuclei. 80, 1268 (2017).
7. A.V. Krasilnikov, S.V. Konovalov, E.N. Bondarchuk et al. Plasma Phys. Rep. 47, 1092 (2021).
8. V.M. Leonov, S.V. Konovalov, V.E. Zhogolev et al. Plasma Phys. Rep. 47, 1107 (2021).
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLIX/E/ru/IH-Nesenevich.docx) [↑](#footnote-ref-1)