STUDies OF THE ELECTRIC POTENTIAL AND ELECTRIC FIELDS IN THE PERIPHERY PLASMA OF THE T-10 TOKAMAK DURING THE OH AND ECRH HEATING REGIMES

1Grashin S.A., 1,3Drabinskiy M.A., 1,2Melnikov A.V., 1,2Sergeev N.S., 1,3Khabanov F.O.

1National Research Centre “Kurchatov Institute”, Moscow, Russia, [Grashin\_SA@nrcki.ru](mailto:Grashin_SA@nrcki.ru)  
2National Research Nuclear University “MEPhI", Moscow, Russia  
3Moscow Institute of Physics and Technology, Dolgoprudny, Russia

Measurements in SOL (Scrape-Off Layer) made by the electric Langmuir Probes near the Last Closed Flux Surface (LCFS) indicate [1, 2] that the anomalous convective non-diffusive transport has a main role in particle transport across the magnetic field. High turbulent heat and particle fluxes determinates the thermal loads on the plasma facing tokamak elements and is supposing to enhance there damage and erosion.

Radial distributions of the plasma density, temperature, potential and electric fields (radial and poloidal), should be investigated to clarifies the mechanism of particle and heat transport as well as particle balance in tokamak. Fluctuations of this parameters determinates the heat and particle fluxes in the periphery plasma. On T-10 tokamak characteristics of the peripheral plasma were investigated during the OH and ECRH operation by a movable Langmuir Probe System and by a High Ion Bean Probe (HIBP) [3].

The dependences of the plasma parameters near LCFS from the basic discharge parameters (average density, plasma current, toroidal field) were investigated. The comparison of these dependences (scalings) for T-10 operation with tungsten and carbon limiters has been done. Peripheral plasma parameters can be estimated from such scalings if the direct Longmuir probes measurements are absent.

Near the LCFS electron temperature was about *T*e *=*30–60 eV, and electron density – about   
*n*e ~ 1019 m−3 during the OH operation. Longitudinal heat flux value *Q|| =* 0.5–1.5 МW/m2 corresponded to low level estimation of the heat loads in the ITER diverter.

The radial electric field *Er* has a positive sign in the SOL near the LCFS and a value of 5–10 kV/m. With density rise *Er* and *φ* became more negative due to the changing of the particle transport processes in this region.

Strong fluctuations of all measured plasma parameters observed in the SOL of T-10. Fluctuations had highly intermittent character. A relative level of the intermittent turbulence was as high as 50% for OH regime and rise with start of ECRH. The radial turbulent particle flux *Γr*. near the LCFS was of ~1022 m–2·s–1 and represents the significant part of the total radial particle flux. The strong destruction of the tungsten limiters observed on the T-10 due to the combination of the high heat and particle turbulent fluxes from the edge plasma toward the limiters surface.

References

1. O.E. Garcia et al., Turbulence and intermittent transport at the boundary of magnetized plasmas. Physics of Plasmas 12, 2005, doi: 10.1063/1.1925617
2. Kirnev G.S., Budaev V.P., et al. Journal Of Nuclear Materials 337-339 (2005).
3. Melnikov A.V., Electric potential in the plasma of fusion devices. Ed. by Lysenko S.E., Moscow: NRNU MEPhI, 2016 (p. 260) [in Russian].