

DOI: 10.34854/ICPAF.52.2025.1.1.093

PROBE MEASUREMENTS IN EXPERIMENTS WITH AN ADDITIONAL GAS PUFFING IN THE OPENING OF THE LOWER HYBRID ANTENNA OF THE FT-2 TOKAMAK ^{*)}

Deryabina M.V., Shatalin S.V., Lashkul S.I., Altukhov A.B., Esipov L.A.,
Dyachenko V.V., Konovalov A.N.

Ioffe Institute, St. Petersburg, Russia, deryabina.mv@edu.spbstu.ru

The absorption of slow waves in the frequency range of the lower hybrid resonance is the basis of one of the high frequency methods of heating tokamak plasma (Lower-Hybrid Heating, LHH) [1], and is also widely used for non-induction current excitation (Lower-Hybrid Current Drive, LHCD) [2]. One of the experimental problems is the effective penetration of the LH wave into the main plasma without excessive losses in the boundary layer (Scrape-Off Layer, SOL).

The report presents the results of probe measurements of SOL deuterium plasma parameters in experiments to study the effect of gas puffing near a radiating antenna on the effectiveness of the interaction of the LH wave with the plasma of the FT-2 tokamak [3]. The additional deuterium puffing is accompanied by an increase in the collision frequency ν and the formation of a flat radial density profile (decrease in $\text{grad } n$). The increase in ν should lead to the suppression of parametric decay instability [4], which is one of the reasons preventing the effective absorption of the LH wave. According to the simulation results, a decrease in $\text{grad } n$ in SOL under the conditions of experiments on FT-2 improves the coupling of the LH wave to the plasma and leads to the formation of a more favorable spectrum of longitudinal decelerations N_{\parallel} , increasing the efficiency of LHH and LHCD. For additional gas puffing, a pulse valve installed directly near the antenna was used. An identical valve was installed at the location of a movable multielectrode Langmuir probe [5], which made it possible to perform probe measurements in conditions like those near the LH antenna.

As a result of the measurements, the evaluation of the radial profiles of the electron density and temperature in SOL during the LH pulse is obtained. The toroidal inhomogeneity of plasma parameter in SOL at local gas puffing is established. The formation of a profile with a lower value of radial $\text{grad } n$ near the frontal area of the antenna because of additional gas puffing directly in the section of the antenna location is confirmed. The gas puffing in the LH antenna section was also accompanied by suppression of the parametric decay instability.

Using measurements of the ion saturation current collected by a stationary single probe in the LH antenna section, a sharp decrease in n was detected during the LH pulse (the effect of plasma «displacement» from the SOL region under the influence of LH wave pressure). The degree of «displacement» was directly dependent on the incoming LH power. The ion current, simultaneously measured in the adjacent section, didn't demonstrate such a feature.

The operation of the FT-2 tokamak is carried out within the state assignments FFUG-2024-0028, the probe measurements were carried out within the state assignments FFUG-2021-0001.

References

- [1]. Golant V.E., Fedorov V.I. High-frequency methods of plasma heating in toroidal thermonuclear installations, Energoatomizdat, M., 1986
- [2]. Fisch N.J. Phys. Rev. Lett., 1978, 41, 873
- [3]. Lashkul S.I., Altukhov A.B., Gurchenko A.D., et al. Plasma Phys. Rep., 2022, 48, 453
- [4]. Castaldo C. et al. Nucl.Fusion, 2016, 56 016003
- [5]. Shatalin S.V., Vekshina E.O., Vicente J., et al. Plasma Phys. Rep., 2011, 37, 371

^{*)} [abstracts of this report in Russian](#)