DOI: 10.34854/ICPAF.51.2024.1.1.091

INVESTIGATION OF PLASMA FORMING IN OPEN MAGNETIC TRAP WITH A HELICOIDAL FIELD SMOLA *)

[1,2]Ustyuzhanin V.O., [1]Ivanov I.A., [1]Inzhevatkina A.A., [1]Sudnikov A.V., [1]Tolkachev M.S.

[1]*Budker Institute of Nuclear Physics SB RAS, Novosibirsk, Russia,*
V.O.Ustyuzhanin@inp.nsk.su
[2]*Novosibirsk State University, Novosibirsk, Russia*

The SMOLA device (Spiral Magnetic Open Trap) is an experimental device for verifying the concept of confining rotating generation in a magnetic field with helical symmetry (helical confinement) [1]. Theoretically, the concept of helical plasma confinement predicts an exponential dependence of the efficiency of loss suppression on the length of the magnetic system with a helical field, leading to a significant increase in the effective mirror ratio in an open trap [2]. In 2017 – 2022 experiments on this device the possibility of suppressing the plasma flow by a helical magnetic system and the correlation of experimental scalings to theoretical estimates were demonstrated [3, 4].

The SMOLA device consists of 3 parts: a plasma source with an input expander, a transport section with a helical mirror (12 periods of a helical field) and an output expander with a radially segmented plasma receiver. The plasma flow in the device is formed by the axially symmetric plasma source with a thermionic LaB_6 cathode and a copper anode [5]. Magnetic field coils in the source magnetically isolate the anode from the cathode and form a magnetic mirror at the entrance to the expander. Also, the cathode and the anode of the plasma gun, together with other electrodes of the device, realise the radial electric field necessary for E×B rotation of the plasma. The plasma formed by the source has the following parameters: $n = 10^{12} \div 10^{13}$ cm^{-3}, T_e=10 ÷ 30 eV and T_i=3 ÷ 7 eV [5].

For investigation of the formation processes and further dynamics of plasma, a complex of probe, optical and vacuum diagnostics is used. The electron temperature, ion density, electric potentials and electric field in the plasma are measured using the electrical probe system. The probes also make it possible to study plasma oscillations. The ion temperature is calculated by determining the Doppler shift of the plasma's own radiation using spectrometers with high spatial resolution. Gas measurements are carried out using gas-discharge vacuum gauges.

The results of a study of plasma formation in the SMOLA device in different modes of operation of the plasma source will be presented in the report.

References

[1]. A.D. Beklemishev, Fusion Science and Technology, 2013, V.63, N.1T, P.355
[2]. Sudnikov A.V. et al., Fusion Engineering and Design, 2017, vol. 122, pp. 86-93.
[3]. Sudnikov A.V. et al., Journal of Plasma Physics, 2020, vol 86, Issue 5, 905860515.
[4]. Sudnikov A.V. et al., Journal of Plasma Physics, 2022, vol 88, Issue 1, 905880102
[5]. Journal of Plasma Physics, 2021, vol 87, Issue 2, 845870201.

*) abstracts of this report in Russian