Investigation of Plasma Conductivity in Open Magnetic Trap with a Helicoidal Field SMOLA [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2023.50.2023.1.1.056

1,2Ustyuzhanin V.О., 2Beklemishev A.D., 2Ivanov I.A., 2Inzhevatkina A.A., 2Sudnikov A.V., 2Tolkachev M.S., 2Khristo M.S.

1Novosibirsk State University, Novosibirsk, Russia, vikust9623@gmail.com,
2Budker Institute of Nuclear Physics SB RAS, Novosibirsk, Russia

At present, one of the unsolved problems in research related to the magnetic confinement of plasma in open systems is the effective suppression of the longitudinal flow of particles and energy. One of the new methods for suppressing longitudinal losses is dynamic multiple-mirror confinement of a rotating plasma in a magnetic field with helicoidal symmetry [1]. In this conception the plasma rotates due to the E×B drift and in the rotating plasma reference frame the longitudinal velocity of the magnetic mirrors is comparable to the longitudinal velocity of the plasma flow. The direction of the speed of movement depends on the directions of the electric and magnetic fields. In the improved confinement mode, the plasma flow velocity is directed along the plasma density gradient, while in the acceleration mode, it is opposite. At the INP SB RAS, this method is being experimentally verified at the SMOLA device [2]. The results obtained at the device agree [3] with theoretical estimates.

The SMOLA device consists of 3 parts: a plasma source with an input expander, a transport section, where the required configuration of the helical magnetic field is set, and an output expander, where the plasma exits, hitting a radially segmented plasma receiver. The plasma formed by the source has the following parameters: n = 1012 ÷ 1013 cm-3, Te=10 ÷ 30 eV and Ti=3 ÷ 7 eV [4]. One of the plasma parameters important from the point of view of the efficiency of the method under study is the electrical conductivity. Taking it into account makes it possible to estimate the balance of particles, potentials, and currents in the device.

To study the plasma conductivity, the complex of probe, optical and vacuum diagnostics is used. The electron temperature and ion density of the plasma are measured using double Langmuir probes. The temperature of the ions is calculated by determining the Doppler shift of the plasma's own radiation using spectrometers with high spatial resolution. The study of the radial and longitudinal distribution of the electric potential and field in plasma is carried out by a system of double emission probes. The longitudinal distribution of currents in the installation is recorded using current sensors. Gas measurements are carried out using gas-discharge vacuum gauges.

The results of studying the plasma conductivity in the SMOLA device, obtained in the latest experimental series in the mode of confining and accelerating the plasma flow will be presented in the report.

References

1. A.D. Beklemishev. Helicoidal System for Axial Plasma Pumping in Linear Traps // Fusion Science and Technology, V.63, N.1T, May 2013. P.355
2. Sudnikov A.V. et al., 2017, "SMOLA device for helical mirror concept exploration", Fusion Engineering and Design, vol. 122, pp. 86-93.
3. Sudnikov A.V. et al., 2020, "Preliminary experimental scaling of the helical mirror confinement effectiveness", Journal of Plasma Physics.
4. Ivanov I.A. et.al., 2021, "Long-pulse plasma source for SMOLA helical mirror", Journal of Plasma Physics.
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/Mu/ru/BW-Ustyuzhanin.docx) [↑](#footnote-ref-1)