LONG-PULSE PLASMA SOURCE FOR OPEN TRAP SMOLA WITH HELICOIDAL FIELD [[1]](#footnote-1)\*)

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The key problem of plasma confinement in linear open systems is the low energy lifetime of the plasma caused by the longitudinal loss of particles and energy. To solve this problem the concept of helical plasma confinement was proposed, based on multi-mirror confinement with moving magnetic mirrors in the plasma reference system [1, 2]. Theoretically the exponential dependence of the efficiency of loss suppression on the length of the helicoidal field section is predicted, leading to significant increase in the effective mirror ratio in an open trap [1]. SMOLA device has been designed and developed for experimental verification of this confinement concept at the BINP SB RAS [2]. The SMOLA device consists of input expander with discharge forming system (plasma source), transport section with helical and straight solenoids for decelerating or accelerating the plasma flow depending on direction of plasma rotation and exit expander with radial segmented endplate. The helical section with a length of 216 cm contains 12 periods of the helicoidal field and operates in the magnetic field range B*max* = 0.1 - 0.3 T.

The plasma source is an axially symmetric system with a hot LaB6 cathode, which should create a plasma flow with a density of n ~ 10-19 m-3 and a temperature of T ~ 5 eV [3]. Setting the appropriate initial parameters in the plasma source is necessary for stable generation of the plasma flow and the operation of the de. These parameters are the cathode temperature, the flow of the working gas feeding the source, the supply voltage of the anode - cathode, and the magnitude of the cathode magnetic insulation.

A series of experiments was carried out to determine the dependences of the plasma parameters on the initial experimental conditions and to set the stable operation mode of the SMOLA device. For studying the physics of helical confinement, probe and optical diagnostics are used. In the experiment the technological diagnostics are used, there are vacuum and electrical measurements and so on. Using probe (Langmuir and Mach) and optical (visual spectrometers with spatial resolution) diagnostics, plasma parameters such as density, temperature and rotation speed are measured. Technological diagnostics make it possible to determine the parameters of discharge current, gas and plasma flow, cathode temperature, etc. All these systems are necessary to verify the plasma formation and the plasma dynamics physics.

In the report, the dependences of the plasma density, its flow, discharge current, and other parameters of the discharge system on the initial experimental values of the plasma source are described.

References

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2. A.V. Sudnikov et al. SMOLA device for helical mirror concept exploration // Fusion Engineering and Design 122C (2017) pp. 86-93, DOI: 10.1016/j.fusengdes.2017.09.005.
3. A.V. Sudnikov et al., First Experimental Campaign on SMOLA Helical Mirror // Plasma and Fusion Research, V.14, 2402023 (2019), DOI: 10.1585/pfr.14.2402023.

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVII/Lt/ru/EX-Ustyuzhanin.docx) [↑](#footnote-ref-1)