Interferometric diagnostics of plasma density on the “SMOLA” facility [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2020.47.1.063

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One way to improve the suppression of longitudinal plasma loss in open systems is to use a helicoidal configuration of magnetic field lines, which can lead to particle drift not on the periphery, but on the installation axis (pinching of plasma column). The initial reason for the drift is the radial heterogeneity of the leading magnetic field due to the finite plasma pressure and the   
radial-directional electric field (always present in open traps). The criterion for radial pinching in the case of holding plasma in the system is the presence of a minimum plasma potential on the axis (it is necessary to set a negative potential) and if the angle between the velocity of particles and the field lines (helicoidal) of the magnetic field is greater than π / 2. It should be noted that when the potential sign on the axis changes, the plasma flow will not be suppressed, but accelerated —   
this fact can be used, in particular, to create efficient plasma engines.

In order to prove this concept of plasma confinement, in 2017 the "SMOLA" facility was constructed at the BINP SB RAS (Spiral Magnetic Open Trap (*LovushkA on Russian*)). The plasma source in this facility is a plasma gun based on LaB6, a thermocathode installed in one of the expansion volumes. The formed plasma flow through the input mirror (~ 500 ÷ 700 G) is introduced into the helicoidal section of the facility, which is a combination of a helicoidal and an external solenoidal magnetic field. After that it is output to the second expansion volume, where the plasma receiver is located. The plasma receiver is sectionalized with the possibility of establishing and changing the plasma potential in the system.

Typical parameters of the experiment are the value of the leading magnetic field *Bz* ≈ 500 G,   
the depth of modulation of the magnetic field *R* ~ 1, the plasma density *ne* ≈ 1013 cm-3, the value of the radial electric field *Er* < 50 V / cm, the duration of the injection τ ≈ 500 µs.

To obtain information about the linear plasma density, a microwave interferometer is used, which is based on the Mach–Zehnder scheme. The operating frequency of the probing beam can range from 38 to 53 GHz. Since, simultaneously with interferometric diagnostics, the shape of the plasma cord is registered at the plant (by the visible area of excited hydrogen atoms). The resulting radial profile of plasma density distribution can be entered into the aggregate data processing system.

Further, for detailed study of the processes of radial transport of particles in plasma, it is planned to create an interferometric system that simultaneously receives information from several   
spatial-spaced optical paths (chord). This diagnosis will be located in the inlet expansion volume just before the injection of the plasma flow into the screw section.

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