Local magnetic measurements in smola helical mirror device [[1]](#footnote-1)\*)

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One of the latest ideas for improving plasma confinement in open magnetic mirrors is active plasma flow suppression by plasma rotation in a multi-mirror helical magnetic field [1]. SMOLA helical mirror device was constructed in BINP to explore this concept. The device consists of the entrance expander with the plasma source, the transport section with straight and helical solenoids and the end expander with segmented biased end plate [2]. The main plasma parameters are the following: plasma density *ni* ~ 1019 m–3, electron temperature *Te* ~ 5 eV, the guide magnetic field in the helical section *Bmax* = 0.1 – 0.3 T, radial electric field is up to *Er* ~ 100 V/cm, plasma beam radius *r* ~ 5 cm, mean magnetic field corrugation *Rmean* = 1.5 – 2. The first experimental results are consistent with two main theory predictions for the helical mirror confinement: a reduction of the axial plasma flow and the inward particle pinch [3].

A perturbation of the azimuthal magnetic field at a frequency of ~ 20 kHz was detected by single magnetic probe in the transport section. If the helical solenoid is turned on, the perturbation frequency increases approximately 1.2 times. To explore this phenomenon, a multichannel azimuthal magnetic measuring system has been developed. The system consists of 8 evenly distributed along the azimuthal coordinate magnetic probes (100 turns of winding per coil, the length and the diameter of the coil are 5 mm both) on the radius 70 mm from the device axis. The effective area of the probe and the resolution of the ADC make it possible to detect magnetic field disturbances at a frequency of 20 kHz with an amplitude of 1 μT or more. The self-resonant frequency of the measuring system is more than 1 MHz. Using the signal recorded by the measuring system, the first 3 azimuthal modes of the longitudinal current perturbation in the device can be calculated. Also it is possible to use two additional probes, displaced by 15° and 120° in the azimuthal coordinate from the first probe, for the diagnostics of higher spatial disturbance modes.

The report presents mathematical methods for interpreting the signal of the magnetic measuring system and the results of studying the spatial structure of the current in the SMOLA device plasma beam.

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. 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/Mu/ru/AP-Lomov.docx) [↑](#footnote-ref-1)