Plasma flow in an open trap with the helical magnetic field [[1]](#footnote-1)\*)

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Linear magnetic systems for plasma confinement recently regained research interest. Several new experimental linear devices are being designed or constructed today. All of them are based on the concept of the gas-dynamic trap with an improved confinement. Therefore, the suppression of the axial losses is of significant interest. One of the methods of the loss suppression is the concept of the dynamic multiple-mirror confinement by the controlled plasma rotation in the helical magnetic field [1]. Theory predicts exponential dependence of the plasma flow suppression effectiveness on the helical mirror length, and, therefore, significant rise of the effective mirror ratio [2].

The concept is being explored on the experimental device SMOLA in Budker INP. Detailed description of the device is given in [3]. An ability to suppress the plasma outflow and an agreement of the experimental scalings with the theory at guide magnetic field Bmax ≈ 0.7 Т, low corrugation ratio (Rmean < 1.5) and low rotation velocity were demonstrated previously [4]. Significant flow suppression was demonstrated at high velocity and corrugation ratio up to Rmean = 1.7. The increase in plasma density in the entrance trap by the factor of 1.6 was observed [5]. The effective mirror ratio of the helical section was *Reff* > 10. Particle flux returning by the helical mirror section towards the confinement zone was observed. At high corrugation ratios, the axial flux direction is different at the magnetic axis and in the periphery of the plasma in the helical section. These effects were observed both at plasma density corresponding to ion mean free path *λ* ~ *h* and at higher free path with respect to Coulomb scattering. The observation of the helical mirror effect at low density may be the result of the anomalous scattering due to two-stream instability.

The latest experimental results on plasma flow in the helical mirror are presented. These results include the experiments at high rotation velocity and low density.

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.D. Beklemishev. Radial and axial transport in trap sections with helical corrugation // AIP Conf. Proc. 1771 (2016) 040006, doi: 10.1063/1.4964191.
3. 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.
4. A.V. Sudnikov, et al. Preliminary experimental scaling of the helical mirror confinement effectiveness// J. of Plasma Physics, 86(5), 2020, 905860515
5. A.V. Sudnikov, et al. Plasma flow suppression by the linear helical mirror system // J. of Plasma Physics, in press.

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