Studies of the helical mirror confinement in SMOLA linear machine [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2021.48.1.021

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The roadmap of the development of the linear machines for fusion was proposed in BINP recently. This roadmap assumes the construction of the stationary gas-dynamic trap and filling the database of the methods of the enhanced axial confinement. One of these methods 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 [3]. The main part of the device is single 216-cm-long helical plug, which contains 12 periods of the helicity. Helical and axial magnetic field ratio varies arbitrary. Plasma rotation is driven by the controlled profile of the radial electric field and is similar to the vortex confinement system in GDT, thus this system may be used for plasma stabilization. Plasma is confined between the helical plug and plasma gun, which is located in the maximum of the magnetic field. Flow suppression effectiveness may be determined by measuring of the plasma parameters change along the mirror in different regimes of the magnetic and electrical field. Project parameters are as follows: ni~1019 m-3, guide field in helical section up to Bmax = 0.1 – 0.3 T, radial electric field up to Er ~ 100 V/cm, plasma radius r ~ 5 cm, helicity period 18 cm, mean corrugation along the field line Rmean < 2.

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 mirror ratio (Rmean < 1.5) and low rotation velocity were demonstrated previously [4, 5]. Experimental dependencies of the effectiveness at higher mirror ratio and the rotation velocity close to the ion sound velocity are presented in this report.

This work was funded by Russian Science Foundation (project 18-72-10080).

References

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