Plasma flow in a helical magnetic field at variable rotation direction [[1]](#footnote-1)\*)

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Reduction of the axial particle and energy losses is one of the main tasks of the studies on the open magnetic traps for plasma confinement. One of the new methods of suppression of axial losses is dynamic multiple-mirror confinement of rotating plasma in a magnetic field with helical symmetry [1]. Theoretically, an exponential dependence of the loss suppression efficiency on the length of the section with a helical field is predicted, leading to a significant increase in the effective mirror ratio in the open magnetic trap [2]. The force acting on the plasma allows to increase the axial pressure gradient and depends on the fraction of the trapped particles and the rotation speed of the plasma. The inversion of the rotation leads to a change in the direction of the acting force and, therefore, to the absence of the effect of helical confinement.

The concept is being tested in Budker INP on SMOLA helical mirror. A detailed description of the device is given in [3]. Previously, the possibility of the plasma flow suppression by the helical magnetic mirror was demonstrated. The experimental scaling matches the theory. 1.6-fold increase in plasma density in the confinement region was observed [4, 5].

This report presents the results of a study of plasma flow at different directions of plasma rotation in a wide density range corresponding to the mean free path of the ion with respect to binary collisions from one period of the helical magnetic field *λ* ~ *h* to the full length of the helical magnetic system *λ* ~ *L*. With the direction of rotation corresponding to improved retention, suppression of the plasma outflow was observed over the entire density range. The presence of a helical mirror effect at low plasma density may correspond to the occurrence of anomalous scattering caused by two-stream instability. With the inverted direction of rotation and the axial force, the flow significantly depends on the plasma density. The largest flux was observed at intermediate densities corresponding to the mean free path of ions with respect to binary collisions *λ* ~ 3*h*. This report also presents the results of experiments with variable plasma rotation speed.

References

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