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PLASMA LONGITUDINAL VELOCITIES IN MULTIPLE AND HELICAL MAGNETIC FIELDS IN THE OPEN MAGNETIC MIRROR TPAR SMOLA ^{*)}

Inzhevatkina A.A., Sudnikov A.V., Tolkachev M.S., Ustyuzhanin V.O.

Budker Institute of Nuclear Physics, Novosibirsk, Russia, a.a.inzhevatkina@inp.nsk.su

The physics of plasma improved confined at open magnetic mirror trap SMOLA is successfully studied at the BINP [1]. The plasma is rotated by $E \times B$ drift. In the rotating reference frame, the magnetic mirrors velocity is comparable to the longitudinal flow velocity. The magnetic variations velocity is directed along the plasma density gradient in confinement situation. Some of the parameters responsible for the quality of plasma confinement are angular [2] and longitudinal velocities. The flow velocity in the transport section is measured by plane Mach probes [3] installed at several points along the device length.

In the helical field, the important effect is the increase in the local ion density moving from side of end-plate over the local ions density moving from side of plasma gun. The reverse flow of trapped particles was observed at the distance of 15 – 20 mm from the plasma center and $V_{||}$ is $\sim 10^5$ cm/s. The average longitudinal velocity on the plasma periphery are $\sim 6 \cdot 10^5$ cm/s and $\sim 3 \cdot 10^5$ cm/s for straight and helical fields respectively. The longitudinal velocity decreases in the helical field. These effects are consistent with the radial transport model of particles in a helical magnetic field [3]. With the existing plasma parameters, the reverse flow are observed at the cross-section average mirror ratio $R_{\text{mean}} = 1,02$, corresponding to a plasma radius of 0.8 cm.

Experimental series were carried out aimed at comparing the plasma flow in straight and helical magnetic field, as well as with axisymmetric corrugation with mirror ratio $R = 1,15 \div 1,4$ and a combined magnetic field, including axisymmetric and helical corrugations. The average cross-sectional average mirror ratio in helical field varied in the range of 1,15-1,52. Reverse flow of trapped particles was observed only in the combination or helical fields. Thus, the improved confinement is not the multiple-mirror field effect, but the helical configuration.

The report also presents the comparison of longitudinal flow velocities under conditions of axisymmetric and helical corrugation in plasma acceleration regime.

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References

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^{*)} [abstracts of this report in Russian](#)