PLasma flows in a solenoid with helical field corrugation

1,2Beklemishev A.D.

1Budker Institute of Nuclear Physics, Russian Academy of Sciences, Novosibirsk, Russia
2Novosibirsk State University, Novosibirsk, Russia, bekl@bk.ru

Sections with helical field corrugation are proposed as additional plugs that serve to decrease axial losses from gas-dynamic traps [1]. Similar systems with the varying corrugation period can serve as plasma accelerators in plasma thrusters of megawatt class [2]. The idea is that plasma rotation in a system with helical corrugation of the axial magnetic field and a distributed radial electric field leads to generation of the mean force along the system due to friction between drifting trapped and passing populations. The work of acceleration is produced by the radial electric field that can be either naturally occurring (ambipolar), or be maintained by external sources. If there are axial and radial gradients of plasma parameters then the sections with helical corrugation can produce very diverse effects. In the absence of external current sources the plasma outflow can be either accelerated or decelerated, depending on the helical symmetry, but in both cases the radial drift will cause radial expansion of the discharge that corresponds to neoclassical transport. This situation will be conserved in presence of a source (though with different flux values) if the direction of plasma rotation stays the same as in the ambipolar case. However, if the power and polarity of the source is sufficient to change the direction of plasma rotation, acceleration or deceleration of the plasma flow will be accompanied by radial contraction of the discharge, i.e., by the pinch effect. This regime is obviously the most interesting one. In open traps the external source of rotation can be realized via biasing the end-plates and limiters, by injecting charge with electron beams, or by injecting momentum by off-axis neutral beams. This work considers correlation between axial and radial gradients and plasma fluxes if the plasma rotates in a radially distributed electric potential in a long solenoid with helical corrugation from the theoretical viewpoint.

References

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2. A.D. Beklemishev, Physics of Plasmas, 2015, **22**, 103506.