FEATURES OF DISTRIBUTION OF A MAGNETIC FIELD IN A PLASMA FLOW OF A PLASMA FOCUS DISCHARGE

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An important role in various models describing the physics of generation and propagation of astrophysical jets plays the magnitude and the distribution of magnetic fields. In particular, the magnetic field can have a significant effect on the collimation and stability of jets propagating over long distances. One of the advantages of the scheme for laboratory simulation of astrophysical jets using the "plasma focus"-type (PF) facilities is a possibility to measure the distribution of magnetic fields in the plasma flow. Flows generated in the PF are large enough (several cm) compared to flows in similar experiments with fast Z-pinches and powerful lasers that allow one to apply magnetic probe technique.

The presentation summarizes the main results of measurements of magnetic fields on two machines: PF-3 (NRC "Kurchatov Institute") and KPF-4 (SFTI, Sukhum, Abkhazia). Few modifications of the magnetic probes were produced which allow recording of different components of the magnetic field. The studies on the distribution of toroidal magnetic field, both in the flow core and its periphery, were done. It is shown that in the laboratory experiment strong poloidal electric current is generated along the plasma outflow, which determines the predominance of the toroidal magnetic field in the vicinity of the jet.

In this case, as in modern models of astrophysical jets, the longitudinal current is concentrated only in the vicinity of the axis of outflow. Estimates show that the magnitude of this current is sufficient to ensure Bennet balance for the flow core. The magnetic field is attenuated at the flow propagation along the chamber axis, however, when discharge takes place in neon or argon, the flow retains its compactness, which can be explained by the cooling of the plasma due to radiative losses. It is also shown that the magnetic field is concentrated in the region of minimum luminosity of the plasma flow in the so – called "magnetic bubbles".

This technique also allowed a more detailed study of the current distribution on the periphery of the flow, which is important for modeling the behavior of the reverse currents in the region of the cocoon of the astrophysical jet. The structures of the magnetic field associated with the reverse currents were detected. In the experiments on the PF-3 the radius of the reverse current is 5-8 cm for the discharges in neon and more than 8 cm for the discharges in hydrogen. The heterogeneity of the distribution of the magnetic field in the azimuthal direction and the detected opposite sign of the magnetic field correspond to a situation when the reverse current is distributed inhomogeneously on the periphery of the flow, in separate current channels. The results of experiments also indicate a possible helical structure of the current and the magnetic field and the rotation of the plasma flow, which can result in the stabilization of the flow.

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