Investigation of the dynamics of the azimuthal structure of axial plasma Outflow at the PF-3 Facility [[1]](#footnote-1)\*)

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The paper presents the results of experiments on studying the features of the dynamics of the internal structure of an axial plasma outflow at the PF-3 facility. Measurements of the azimuthal distribution of the toroidal magnetic field *B*() were carried out using 8 magnetic probes located at the same radius and at several points in azimuth. This made it possible to determine the position of the region of the central current of the axial plasma outflow and its displacement relative to the axis of the facility flight chamber. Probe measurements carried out at various radii showed that the periphery of the plasma flow, through which reverse fault currents flow, in experiments with neon is in the range of radii of 6-8 cm.

In some discharges the signals from the magnetic probes located along the azimuth are not symmetrical, which is apparently due to the presence of several autonomous bunches with their own trapped magnetic field. Such modes are characteristic of neon discharges, in which clearly expressed structures are observed in frame camera pictures. An analysis of the azimuthal distributions *B*() shows that the position of regions with an increased level of the *B*-field changes both in time and in space. Two types of motion may be observed simultaneously: the azimuthal rotation of separate parts of the plasma flow and the displacement of the axis of the central current relative to the axis of the facility flight chamber. The estimation of the angular velocity of rotation gives values of ~ (1.5-2.5)106 rad/s, rotation is observed mainly counterclockwise.

Magnetic probe measurements are supplemented with registration using optical high-speed cameras. With the help of K-008 and SFER-6 streak cameras, time sweeps of the plasma flow were obtained at different distances from the region of its generation. Analysis of these sweeps allows us to assume the presence of rotational motion of the plasma, and the estimate of the rotation speed gives a value of ~ 3106 rad/s, which is close to the data of measurements using magnetic probes.

To proof this hypothesis, a scheme has been developed for registering the plasma flow from the end face of the flight chamber by means of two frame cameras, launched with a delay of several microseconds relative to each other. In these experiments, it was also possible to detect individual structures with azimuthal dynamics. It is impossible to determine the direction of rotation from two frames, but if we assume the presence of counterclockwise rotation, then the obtained values of the angular velocity (1-2)106 rad/s is correspond well to the measurements with magnetic probes.

Thus, the presence of rotation of the plasma flow has been shown by three independent methods, and the obtained values of the rotation rate  106 rad / s are in good agreement with the MHD theory of jet ejections from young stars.

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1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVIII/It/ru/DS-Kharasov.docx) [↑](#footnote-ref-1)