Studies of the propagation of plasma flows in PF DISCHARGE using visible light collimators

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The laboratory simulation of the astrophysical processes is one of the actively developed applications of the plasma flows generated in the Z-pinch systems [1]. It allows, subject the certain scaling laws, to carry out experiments that are difficult or inaccessible at all at the real conditions. In particular, that refers to one of the brightest phenomena in the Universe - astrophysical jets. Recently the series of studies aimed on simulation this phenomenon has been launched in NRC "Kurchatov Institute" on the plasma focus type facilities [2]. In the case of non-relativistic jets emitted by young stellar objects (YSO), a significant role in the jets collimation may play their interaction with the surrounding plasma. In this regard, the study of interaction plasma flows with the background plasma in the PF discharge has considerable interest.

The experiments were performed on two facilities, representing various modifications of the plasma focus with the Filippov type (PF-3, NRC "Kurchatov Institute") and the Mather type (KPF-4, Sukhum, SFTI) discharge systems. A light probes were used as the main diagnostic tool to study the processes of the plasma flows propagation. The light probe is a collimator collecting the light radiation along the diameter of the chamber, which then transferred with the optical lightguide to the PM photocathode.

The collimators of various designs were used: a single one that allows to determine the average velocity of the jet at it propagation from the anode to the observation point, and a double collimator, representing two parallel channels separated on 1.6 cm each from other and allowing measure the instantaneous velocity in the area of observation. The studies were performed using various gases (neon, argon, hydrogen, and deuterium) at different distances from the facility anode (up to 95 cm).

Based on the obtained data, the conclusion about the dynamics of jet motion in the ambient gas has been done – the brake force is proportional to the square of the jet velocity. The instantaneous velocity of the jet is determined as , where *V0* is the initial jet velocity and *X0* is the distance at which the jet velocity is reduced in *e* times.

It was shown that the initial velocity of the plasma jet under the optimum initial pressure is almost independent of the nature of the gas.

The technique also allows determining the length and structure of the plasmoids in some cases.

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References

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