STUDies of The structure and dynamics of plasma flows generated in the plasma focus discharge

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A plasma focus (PF) is one of the most successful species of the Z-pinch systems. Research of the plasma focus began in the mid 50 years of XX century. For a long time the interest in studying of the plasma focus was concentrated on stage of the plasma-current-sheath (PCS) movement and the pinch stage. However, due to the increased interest in plasma flows it is necessary to study the processes taking place in the later stages of the PF discharge, in particular the formation and dynamics of the plasma jets generated in the axial direction.

The experiments on using the plasma flows to simulate astrophysical jets are conducted in NRC "Kurchatov Institute" on the Filippov-type plasma focus facility PF-3 [1, 2]. One of the main goals is to investigate the propagation of plasma flows over long distances. For this purpose a wide range of diagnostic tools is used: light collimators for determining the instant and average flow velocity, magnetic probes for studying the magnetic configuration generated by the magnetic fields captured in the plasma flux, diagnostic set for the registration of the plasma radiation in the visible range and others.

This paper presents the results of the study plasma flows generation in PF, their structure and dynamics at the propagation in the background gas with the help of the high-speed cameras operating both in the streak and frame modes.

The process of the plasma flow formation at the PCS compression at the axis is investigated. The formation of the plasma flows at the stage of the pinch destruction is observed. The structure of plasma flows at different distances from the place of generation (35 and 65 cm) is studied by the high-speed photographing in mutually perpendicular directions. A significant difference in the flow structure is obtained at the various gases: the H2 and D2 streams are more homogenous, the flow structures and its multicomponent are clearly seen in the discharge in Ne. The Xe admixture to the light gases is significantly affect on the plasma flow structure. The flow velocity in the axial direction is higher than in the radial direction that allows keeping the structure of the flow during its motion along the axis. The assumption of the existence of the azimuthal component of the plasma flow velocity has been done on the base of the results of the experiments.

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References

1. N.V.Filippov, T.I.Filippova, V.P.Vinogradov, Nuclear Fusion: Supplement, 1962, Part 2, 577-587.
2. V.I. Krauz, V.V. Myalton, V.P. Vinogradov et al., XLII Int. (Zvenigorod) conf. on plasma physics and CNF. Abstracts. // "PLASMAIOFAN". Moscow, 2015, p. 145. http://www.fpl.gpi.ru/Zvenigorod/XLII/I.html#U1, IU-2-6.