Numerical simulation of plasma dynamics at plasma focus facilities [[1]](#footnote-1)\*)

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This paper presents an approach to the numerical simulation of the axial plasma flow in plasma focus facilities with a two-dimensional one-fluid MHD model. Previously, the MHD model used has proven itself well in modeling the motion of a current-carrying plasma sheath (CPS) before the formation of a plasma focus [1], including for gases such as deuterium, neon, argon, and deuterium-xenon mixture [2]. In this paper, the same model has been applied to the propagation of a plasma jet. Since, within the framework of the used approximations, it is impossible to reliably simulate the dynamics of a dense pinch, the direct continuation of the simulation of the discharge after the formation of a pinch, within the framework of this model, cannot be realized. In this regard, it is necessary to correctly establish the initial conditions for modeling the propagation of a plasma flow.

In this work, we simulated the dynamics of the plasma flow in the range of initial conditions obtained from modeling the compression of the SST and experimental measurements. Due to the fact that the measurement possibilities near a dense pinch are very limited, the inverse problem of reconstructing the initial flow velocity from experimental observations of its dynamics at a distance of 15-95 cm, published in the literature, was posed and solved. The obtained values ​​were compared with direct measurements in the near-anode region (0.5-1,0⸱107 cm / s) [3] and were used in further modeling.

The proposed approach was applied to simulate plasma flows at the PF-3 and KPF-4 installations. The results obtained demonstrate good agreement with experimental measurements of the flow velocity in the background gas, the magnitude of the trapped magnetic field and its radial distribution in the flow, as well as the shape of the flow head. It was shown that by comparing with experimental data of several different diagnostic systems (for example, optical collimators, magnetic probes, frame rate photographs), it is possible to unambiguously determine all the parameters varied during modeling. Modeling showed a significant effect on the dynamics of the flow of metal diaphragms along its path for the PF-3 installation, and also made it possible to identify two characteristic mechanisms of plasma flow propagation, each of which is dominant at different stages of the plasma jet movement (distance from the place of formation).

References

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