CALCULATIONS OF THE DENSITY PROFILE FOR PULSE INJECTION OF WORKING GAS INTO THE PF CHAMBER AND EXPERIMENTAL RESULTS [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2022.49.1.089

1Galanin M.P., 2Grabovsky E.V., 2Efremov N.M., 2Krylov M.K., 2Lauhin Ya.N., 2Lototsky A.P., 1Lukin V.V., 2Nikolashin A.A., 2Seryakov A.G., 2Sulimin Yu.N., 2Panfilov D.G.

1Keldysh Institute of Applied Mathematics, Russian Academy of Sciences,Moscow, Russia,
 lukin@keldysh.ru
2AO SRC RF TRINITY, Moscow, Russia, lototsky@triniti.ru

In the Plasma Focus electric discharge system, the profiled distribution of the density of the gas filling the chamber makes it possible to optimize the conditions for the formation of an axisymmetric current plasma sheath with the conditions for the accumulation of a dense pinch at the maximum current. The primary breakdown along the surface of the insulator between electrodes occurs at the limited (1–5 Torr) filling pressures, while the increase in the current proportionally to the square of its magnitude, the mass of the current plasma sheath should increase. Density profiling over the chamber space by means of external pulsed gas injection was repeatedly used earlier, for example [1]; however, the optimization of the operating modes of such a system requires complete information about the forming gas flows, the geometry of the flows, reflections from the walls, etc. Of great importance in this case is the nature of the gas outflow from the working volume of the valve when the flow area changes after the control pulse is applied. Calculations of the filling of the chamber of the PF-MOL installation [2] with a discharge current of up to 750 kA when using a pulse valve with an electrodynamic drive, which are triggered within 300 μs at pressures of 5‑40 bar, have been carried out. The second aspect of the problem that is being solved is the calculation of the interaction of the injected deuterium with an inert gas stationary filling the chamber. It was assumed that the axisymmetric current plasma sheath is organized on a low-density gas, which can compress deuterium in a pinch like a heavy liner. It is shown that, upon rapid injection, deuterium can completely displace xenon (or any other gas) from the local pinch zone. In this case, the boundary of the mixing of gases remains relatively thin, preventing the mixing of gases before the arrival of current plasma sheath. Such a computational regime was experimentally simulated in the chamber of the PF-MOL setup using helium (instead of xenon). At a current of 550 kA, a neutron yield of 2\*109 per pulse was obtained. When gases were reversed (injection of helium into deuterium), the neutron yield was close to the background value, which confirms the conclusions of the calculations. And that also gives hope for the implementation of the PF installation with currents exceeding 2.5–3.0 MA and a neutron yield of more than 1012 in the D–D version.

References

1. Voitenko D.A., Ananiev S.S., Astapenko G.I., et al. // Plasma Physics Reports, 2017, V. 43, N. 12, p. 967–982.
2. Grabovskiy E.V., Gribov A.N., Krylov M.K., et al. Dynamics of the current sheath in a self-compressing plasma discharge with additional gas injection // VANT (in press).
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLIX/It/ru/DM-Lototskiy.docx) [↑](#footnote-ref-1)