SIMULATION OF A CAPILLARY DISCHARGE IN THE FREQUENCY MODE [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2023.50.2023.1.1.190

Savenko N., Bagdasarov G., Gasilov V.

Keldysh Institute of Applied Mathematics of the RAS, [savenkonkt@gmail.com](mailto:savenkonkt@gmail.com)

Currently, the frequency modes of operation of electron accelerators based on capillary discharges are being actively studied. The electrons in them are accelerated under the action of femtosecond laser pulses passed through the discharge plasma. This report discusses the results of a three-dimensional magnetohydrodynamic simulation of a capillary discharge cycle, which includes the stages of filling the capillary with a working gas (hydrogen), the formation of a plasma channel, and the restoration of the working medium before the start of the next discharge. The simulated capillary has a circular section with a diameter of up to ~500 µm, connected to the gas supply channels.

The simulation was carried out mainly to obtain such a characteristic, which affects the efficiency of the accelerator as a whole, as the characteristic time required to obtain steady flows at separate stages

operation of the accelerator system:

* the stage of filling the capillary with gas from the supply channels before steady state;
* the stage of electric discharge in the capillary and the output of the parameters to the level of the parameters of the filling stage.

The free parameters in this problem are: the length of the capillary, its diameter, the shape of the cut, the pressure of the gas supplied through the supply channels. It was assumed that the capillary was 2 cm long, 300 µm in diameter, round cut, and the inlet pressure was 125 mbar at a temperature of 293 K. In the main calculation, an attempt was made to ensure, by varying the free parameters, the symmetry of the plasma channel along the axis of the capillary, keeping its profile (with a reduced density on the axis) necessary for focusing the laser beam, if possible. The possibility of symmetrization of the channel through the use of four inlet channels located crosswise is shown. The possibility of using a capillary discharge in the frequency mode is shown.

The calculations were carried out on the K60 and K100 supercomputers of the Center for Collective Use IAM them. M.V. Keldysh RAS.

References

1. G.A. Bagdasarov, K.O. Kruchinin, A.Yu. Molodozhentsev, P.V. Sasorov, S.V. Bulanov, V.A. Gasilov Discharge plasma formation in square capillary with gas supply channels. Physical Review Research 4, 013063 (2022)
2. A.J. Gonsalves, F. Liu, N.A. Bobrova, P.V. Sasorov, C. Pieronek, J. Daniels, S. Antipov, J.E. Butler, S.S. Bulanov, W.L. Waldron, D.E. Mittelberger and W.P. Leemans Demonstration of a high repetition rate capillary discharge waveguide. Journal of Applied Physics 119, 033302 (2016)

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/Pt/ru/HI-Savenko.docx) [↑](#footnote-ref-1)