INFLUENCE OF A LONGITUDINAL MICROWAVE ELECTRIC FIELD ON THE PARAMETERS OF THE PLASMA FLOW OF AN ELECTRODE-FREE INJECTOR [[1]](#footnote-1)\*)

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Kalashnikov A., Shevtsov E.

Peoples Friendship University of Russia, [nich@rad.pfu.edu.ru](mailto:nich@rad.pfu.edu.ru)

The paper presents the results obtained on an experimental stand [1], created to study the possibility of accelerating charged particles in a longitudinal microwave electric field. The stand consists of two consecutively arranged cylindrical resonators and solenoids providing a longitudinal, axially symmetric magnetic field. A dielectric plasma duct (quartz glass, diameter — 6 cm, length — 200 cm) passes both resonators through their end walls. One of the resonators, with a TE111 oscillation mode, acts as a plasma-forming injector. The other, with an E011 mode, provides within itself and, subsequently, inside the plasma duct, a microwave field with a mainly longitudinal electric component; its effect on the parameters of the produced plasma is the subject of research. Plasma flow is carried from the injector to the E011 resonator by the axial magnetic field gradient created between the resonators. For this study, two magnetron generators with stabilized power supply (М-105-1, ω0 = 2πf0 = 1.5 × 1010 rad s-1) were used. The TE111 is excited by two whip antennas located in azimuth at an angle of 90 degrees. Both symmetrical antennas are powered from one magnetron with a modernized anode cooling system. Design features of the microwave path provide the phase difference of the microwave field between one antenna and the other, all of which, combined with their azimuthal arrangement in the resonator, leads to the formation of a radially rotating microwave electric field. The E011 resonator is excited by a microwave coupling loop from a second magnetron generator. Vacuum pumping is carried out by a TMN-1500 turbopump with a pumping speed of 700 l/s. The working gas supply (Ar, Xe) is regulated by a CHA-1 piezoelectric inlet system. The magnetic field profile was determined by setting both the distances between the solenoids and the nominal current strength in each of them. Plasma flow parameters were measured with a five-grid electrostatic analyzer and a disk-shaped electrode.

Through the experimental stand, the optimal operating conditions necessary to achieve effective production of plasma in the injector and its further transportation to the E011 resonator have been established. The possibility of producing plasma with a concentration exceeding the critical value (cutoff density) for the used microwave frequency is shown. Changes in energy flow of the ionic and electronic components of plasma were recorded as an effect of the longitudinal electric microwave field.

The results indicate the need for additional equipment of the experimental stand, with diagnostic and monitoring tools for further research.

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Reference

1. Balmashnov A.A., Dutko N.B., Kalashnikov A.V., Stepin V.P., Stepina S.P., Umnov A.M. “Multifunctional experimental stand. Acceleration of plasma particles by a field formed by a longitudinal microwave electric field. " XLVII International Zvenigorod Conference on Plasma Physics and Controlled Fusion. Zvenigorod, 2020, p. 183.

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