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Noise amplification by a relativistic electron beam in a double coaxial plasma-metal waveguide

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Effective noise amplification has been experimentally demonstrated during the interaction of a relativistic electron beam (electron energy 250 keV, current 1.5 kA, pulse duration 2 ns) with slow plasma waves in a plasma maser, in which a double coaxial waveguide is used as the generator section. The outer and inner electrodes of the section are metal, and the role of the middle electrode is played by tubular plasma. The optimum length of the generator section was determined to create conditions that maximize noise amplification.
As it was shown in [1], the use of such a plasma maser system "makes it possible to increase the electron beam current transported through the system, at which the instability increment and the efficiency of the conversion of the energy of directed motion of electrons also increase". In the process of analyzing experimental data, the dependence of the emission amplitude on the length L of the generator section of the plasma maser was obtained. The measurements were performed at a fixed plasma concentration n = 2·1013 cm3. The emission amplitude grows while changing the length L of the generator section of the plasma maser from 10 to 40 cm, reaches its maximum at L = 40 cm and then decreases, which is typical for microwave devices. The emission frequency of the plasma maser is in the range from 3 to 8 GHz.
Fig. 1. Dependence of the output emission amplitude of a plasma maser with a double coaxial plasma-metal waveguide on the length of the generator section.
As a result of the research, it can be concluded that the presence of the inner electrode not only does not harm the emission of the plasma maser, but also opens the way for promising research on increasing the plasma maser power in a coaxial configuration.

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References

[1]. I. N. Kartashov and M. V. Kuzelev. The Use of a Coaxial Electrodynamic System for Amplification of Microwave Range Waves During the Development of Beam–Plasma Instability // Plasma Physics Reports, 2021, Vol. 47, No. 6, pp. 548–556.

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