EXPERIMENTAL PLASMA MASER AS A BROADBAND NOISE AMPLIFIER [[1]](#footnote-1)\*)

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Plasma masers are high-power microwave (HPM) sources which operate using the Cherenkov interaction of relativistic electron beam (REB) with travelling slow waves in plasma. Hence, plasma masers differ from a vacuum travelling-wave tube (TWT) by the nature of the slow-wave structure, namely, instead of a spatially periodic (e.g., corrugated) waveguide, plasma is used. This is plasma dispersion characteristics that make plasma maser emission spectrum extremely broad [1, 2] (up to 3 octaves) unlike the spectrum of any vacuum relativistic high-current HPM source as TWT and others.

Experiments were conducted with plasma maser operating in the noise amplification regime. The pulse duration was 50 ns, the feedback absence was provided by microwave absorbers, transition from noise amplification to self-oscillation regime was demonstrated, maximum power of 10 MW with the efficiency of 3% were measured. The frequency band of an emission pulse was in the range of 3 GHz to 15 GHz, the noise spectrum was relatively stable during the pulse.

Figure 1 shows the dependence of the electric field strength of the microwave wave on the interaction length L. Up to a length of 27.5 cm, an exponential increase in the electric field of the amplified wave is observed. From the slope of the straight line, one can estimate the spatial gain δk ≈ 0.25 cm‑1, the value of which agrees well with the calculation results [3]. The length L = 28 cm is a threshold, since at a length of 28.5 cm there is a sharp jump in the electric field due to the transition to the oscillator mode.

Fig. 1 - The dependence of the electric field of the microwave wave on the length L

References

1. M.V. Kuzelev, O.T. Loza, A.A. Rukhadze, P.S. Strelkov, and A.G. Shkvarunets, Plasma Phys. Rep., 27(8), 669 (2001)
2. O.T. Loza, P.S. Strelkov, I.E. Ivanov, IEEE Trans. on plasma science, 26(3), 336 (1998)
3. Bogdankevich I. L., Ivanov I. E., Loza O. T., et al. "Fine Structure of the Emission Spectra of a Relativistic Cherenkov Plasma Maser" // Plasma Physics Reports, Vol. 28, No. 8, 2002, pp. 690–698
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVII/Pt/ru/GH-Buleiko.docx) [↑](#footnote-ref-1)