Influence of plasma density gradients on the generation of a terahertz radiation flux in a magnetized plasma column during relaxation of a kilo-ampere REB
(GOL-PET experiments, theoretical consideration) [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2020.47.1.157

1,2Arzhannikov A.V., 1,2Annenkov V.V., 1,2Ivanov I.A., 1,2Kalinin P.V., 1,2Kasatov A.A., 1,2Kuznetsov S.A., 1Kuklin K.N., 1Makarov M.A., 1Mekler K.I., 1,2Popov S.S., 1Rovenskikh A.F., 1,2Samtsov D.A., 1,2Sandalov E.S., 1,2Sinitsky S.L., 1,2Stepanov V.D., 1,2Timofeev I.V., and1,2Volchok E.P.

1BINP SB RAS, Novosibirsk, Russia, press@inp.nsk.su
2NSU, Novosibirsk, Russia, press@nsu.ru

Experimental studies of the generation mechanisms of submillimeter waves (0.1 - 0.8 THz) due to collective relaxation of a beam of relativistic electrons (0.8 MeV / 20 kA / 6 μs) in a magnetized plasma were carried out earlier on the GOL-3 and GOL-3T devices [1] and are currently being carried out on a specialized GOL-PET installation [2]. A plasma column 250 cm long and 6 cm in diameter has a variable density in the range (8 1014 -3 1015) cm-3 in a 4.7 T magnetic field. The electron beam has a diameter of 4 cm at a current density of (2-4) kA / cm2. In the described experiments, the local parameters of the beam and plasma were measured. The submillimeter wavelength radiation was also recorded, which exited the plasma column both along the axis of the beam-plasma system and in the perpendicular direction. Given this feature of electromagnetic radiation, we focused experimental studies on measuring the spectral density of the power of radiation extending along the axis of the plasma column.

Experiments have shown that in the case of a strong radial gradient of the plasma density, the main fraction of the power of the submillimeter radiation flux emerging along the axis of the plasma column is concentrated in the frequency range 0.15-0.3 THz, which is located near the frequency of the upper hybrid plasma oscillations [3]. The power spectral density of such a radiation flux under conditions of a strong density gradient is thirty times greater than its value with a uniform distribution of the plasma density over the column cross section. The total power in the indicated frequency range reaches 4 MW with a pulse duration of 3 μs [4]. The report describes the results of the experiments on the generation of a terahertz radiation flux at various plasma density gradients and provides a theoretical analysis of these results.

The research was carried out with the financial support of the Russian Science Foundation in the framework of the project 19-12-00250.

References

1. A.V. Arzhannikov, A.V. Burdakov, V.S. Burmasov, et al., Phys. Plasmas 21, 082106 (2014).
2. A.V. Arzhannikov, V.V. Annenkov, V.S. Burmasov, et al. // EPJ Web of Conferences. – EDP Sciences, 2018, vol. 195, p. 01002.
3. I.V. Timofeev, V.V. Annenkov and A.V. Arzhannikov. Regimes of enhanced electromagnetic emission in beam-plasma interactions // Phys. Plasmas 2015, Vol.22, P.113109.
4. A.V. Arzhannikov, I.A. Ivanov, A.A. Kasatov, et al., “Well-directed flux of megawatt sub-mm radiation generated by a relativistic electron beam in a magnetized plasma with strong density gradients” // Submitted to Plasma Phys. Control. Fusion (2019).
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVII/Pt/ru/GL-Arzhannikov.docx) [↑](#footnote-ref-1)