DOI: 10.34854/ICPAF.51.2024.1.1.164

DYNAMICS OF THZ RADIATION FLUX IN CORRELATION WITH THE EVOLUTION OF PLASMA DENSITY IN EXPERIMENTS ON THE INTERACTION OF REB WITH PLASMA AT THE GOL-PET INSTALLATION *)

[1,2]Arzhannikov A.V., [1,2]Sinitsky S.L., [1]Samtsov D.A., [1,2]Kalinin P.V., [1,2]Popov S.S., [1]Atlukhanov M.G., [1,2]Sandalov E.S., [1,2]Stepanov V.D., [1]Kuklin K.N., [1]Makarov M.A.

[1]*Budker Institute of Nuclear Physics, Siberina Branch, Russian Academy of Sciences, Novosibirsk, Russia, press@inp.nsk.su*

[2]*Novosibirsk State University, Novosibirsk, Russia, press@nsu.ru*

Research into the process of generating terahertz radiation during relaxation of a relativistic electron beam (REB) in a plasma is currently being carried out on a specialized GOL-PET installation [1]. In these experiments, a beam of electrons with an energy of 0.5 MeV, a current density of 1–2 kA/cm^2 (total beam current up to 20 kA) and a pulse duration of 5 μs is injected into a plasma column with a density of (4–8)·10^{14} cm^{-3}, held magnetic field 4 T (see [1]). When carrying out these experiments, the generation of a radiation flux was realized, directionally propagating in the atmosphere, with a pulse duration approaching the pulse duration of the injected beam, with an energy content on a scale of 10 J in the frequency range 0.2–0.3 THz (see [1–3]).

Further development of these studies is aimed at establishing the correlations between the dynamics of the parameters of the radiation flux generated during beam injection and changes in the plasma density in the section of the plasma column where the high-current REB propagates. Along with obtaining fundamental knowledge in the field of plasma physics in the direction of beam-plasma interaction, the result of these studies becomes significant in the development of the method of generating terahertz radiation implemented by us in relation to its practical use. We associate this development of the method of generating THz radiation with the transition in the experiments described in this report to the use of kiloampere REB generated in a linear induction accelerator for injection into plasma [4]. These changes in experimental conditions open up the possibility of obtaining megawatt radiation fluxes near a frequency of 1 THz in a pulse-periodic mode of operation of the radiation generator.

References

[1]. A.V. Arzhannikov, S.L. Sinitsky, S.S. Popov et al. “Energy Content and Spectral Composition of a Submillimeter Radiation Flux Generated by a High-Current Electron Beam in a Plasma Column with Density Gradients” // IEEE Transactions on Plasma Science, 50 (8), p. 2348-2363, 2022. https://doi.org/10.1109/TPS.2022.3183629.

[2]. Samtsov D.A., Arzhannikov A.V., Sinitsky S.L., et al. Frequency Spectrum of the Radiation Flow in the Frequency Range 0.1–0.6 THZ Generated at the GOL–PET Facility Under Various Conditions. // Radiophysics and Quantum Electronics, 65 (5–6), 313-322, 2022.

[3]. A.V. Arzhannikov, S.L. Sinitsky, D.A. Samtsov, et al. Frequency spectrum and energy content in a pulsed flux of THz radiation generated by REB in a plasma column with various density distributions. (In Russian) // Manuscript is applied for publishing in Plasma Physics Reports. Manuscript ID: FizPlaz2360145Arzhannikov.

[4]. A.V.Arzhannikov, S.L.Sinitsky, D.F. Starostenko, et al. Beam-Plasma Generator of the THz Radiation Based on an Induction Accelerator (LIA-PET Project) // Siberian Journal of Physics. 2023; 18(1): 28-42. (In Russ.) https://doi.org/10.25205/2541-9447-2023-18-1-28-42.

*) abstracts of this report in Russian