Energy content and spectral composition of the submm radiation flux generated in the plasma during REB relaxation with a duration of 5 μs [[1]](#footnote-1)\*)

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Experimental studies of the mechanisms of generation of submillimeter radiation (0.1–0.5 THz) during collective relaxation of a relativistic electron beam (REB with parameters 0.6 MeV / 15 kA / 5 µs) are carried out on a specialized facility GOL-PET [1]. The experiments are carried out at a plasma density of (0.5 - 1) 1015 cm-3 in a multi-mirror magnetic field of 4.8/3.6 T at a beam current density of (1–2) kA/cm2. In the course of the research carried out in 2015-2021, the possible mechanisms of the generation of submm radiation in the beam-plasma system were experimentally and theoretically studied [2]. In the experiments described in this report, a magnetized plasma column with the following plasma density distribution was used. Radial density gradients were created to facilitate direct pumping by a beam of EM waves in the plasma [2]. In addition, a region with a low plasma density is formed in the section with a decreasing magnetic field near the graphite collector absorbing the electron beam passed through the plasma. Given feature facilitates the exit of the radiation flux along the axis of the plasma column into vacuum. Experiments in 2019–2020 showed that the power in the radiation flux ejected into the atmosphere through the teflon window, at a given plasma density distribution, reached ~ 10 MW [3], but the pulse duration was limited to 0.5 μs due to the development of high-frequency breakdown at vacuum side of the output window.

Calorimetric measurements showed that with the indicated limitation of the pulse duration, the energy content in the outgoing flux reaches 9 J. In these experiments, the spectral composition of radiation pulses was also measured, and the electron distribution function of the beam passed through the plasma was measured. In order to increase the duration of the pulse of the outgoing radiation in maintaining the power level, the distance along the vacuum tube from 30 to 210 cm between the mirror and the output window was increased. In addition, this teflon window was replaced by a polymethylpentene (TPX) window, which allowed the radiation pulse to be lengthened up to 4 μs. Such pulse duration was provided by the REB obtained with a voltage plateau on the accelerating diode at a level of 0.6 MV with duration up to 5 μs. Thus, great progress has been made in terms of energy in radiation pulses with a wavelength of 1 mm.

References

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