Measurement of the plasma density distribution during relaxation of a kiloampere REB in a magnetized plasma columnat various initial conditions [[1]](#footnote-1)\*)

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Experimental study on the generation of megawatt pulses of terahertz (0.1 - 0.8 THz) radiation arising from the collective relaxation of relativistic electron beam (0.6 MeV / 20 kA / 6 μs) in an inhomogeneous plasma with density ~ 1014 - 1015 cm-3is carried out at the GOL-PET facility(BINP, Novosibirsk) [1].To perform experiments on this facility, a column of preliminary plasma with a diameter of 6 cm and a length of 250 cm in an axial magnetic field of 4.7 T is created.The required initial distribution of the preliminary plasma density along the column axis is created by the distributed injection of hydrogen into the vacuum chamber, which is ionized using a Penning discharge with a current of ~ 20 kA [2]. The transverse inhomogeneity of the current distribution in the discharge is determined by the shape of the discharge electrodes and the polarity of the pulsed power supply connected to them. During the injection of a high-power relativistic beam, the plasma electrons are heated, which leads to a change in the distribution of electron density over the cross section and length of the column. These changes in density can lead to changes in the generated radiation flux, which makes it necessary to register the temporal dynamics of these characteristics.

Plasma density at different moments of time is recorded using interferometry and Thomson scattering. Interferometric measurements (λ = 10.6 µm) make it possible to record the plasma density averaged along the chord during a pulse. Using laser radiation scattering (E ~ 5 J, λ = 1.06 μm), local measurements of the plasma density are recorded at the selected time.

The report presents the results of measurements of the plasma density behavior in time for various initial experimental conditions. The factors that determine the changes in the density with time are discussed, and how significantly these changes affect the characteristics of the terahertz radiation flux generated in the plasma column.

References

1. Arzhannikov A.V., Ivanov I.A., Kasatov A.A., Kuznetsov S.A., Makarov M.A., Mekler K.I., Polosatkin S.V., Popov S.S., Rovenskikh A.F., Samtsov D.A., Sinitsky S.L., Stepanov V.D., Annenkov V.V., Timofeev I.V. “Well-directed flux of megawatt sub-mm radiation generated by a relativistic electron beam in a magnetized plasma with strong density gradients” //Plasma Physics and Controlled Fusion. 2020. Т. 62. № 4. С. 045002. doi: doi.org/10.1088/1361-6587/ab72e3.
2. A.V. Arzhannikov, I.A. Ivanov, P.V. Kalinin, A.A. Kasatov, M.A. Makarov, K.I. Mekler, A.F. Rovenskikh, D.A. Samtsov, E.S. Sandalov and S.L. Sinitsky. “Creation of plasma column with different density gradients to generate terahertz radiation during beam-plasma interaction” //Journal of Physics: Conference Series 1647 (2020) 012011. IOP Publishing doi:10.1088/1742-6596/1647/1/012011.
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVIII/Pt/ru/GL-Sandalov.docx) [↑](#footnote-ref-1)