X-RAY EMISSION OF ELECTRON BEAMS IN THE 82.6 GHz GYROTRON OF THE T-15MD TOKAMAK [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2023.50.2023.1.1.088

Savrukhin P.V., Shestakov E.A., Lisovoy P.D., Tepikin V.I., Khramenkov A.V., Roy I.N., Pimenov I.S.

NRC "Kurchatov Institute", 123182, Moscow, Russian Federation

Measurement of the x-ray radiation during the operation of microwave radiation generators (gyrotrons) is of interest for reconstructing the energy distributions of electron beams, calculating high-energy electron trajectories, and optimizing energy recuperation and deceleration of electron beams in a collector (see, for example, [1]). An important task is also the development of shielding systems to reduce x-ray fluxes during operational maintenance of gyrotrons.

Gyrotron with electron beam energy recuperation is installed on the T-15MD tokamak. Main parameters: power 1 MW, pulse duration 30 s, microwave frequency 82.6 GHz, accelerating voltage 71 kV (cathode voltage - 46.5 kV, anode voltage + 24.5 kV), cathode current 37 A. Gyrotron equipment set and transmission lines were developed and manufactured by the Institute of Applied Physics of the Russian Academy of Sciences together with ZAO NPP GIKOM (Nizhny Novgorod).

Preliminary measurements of x-ray radiation were carried out during operation of the gyrotron in the test mode with short pulse duration of up to 1 ms. Two LaBr3 scintillation detectors (Ø38.1 × 38.1 mm) were used for x-ray registration, located in a sealed housing with a PMT and a 2007P preamplifier. The data acquisition system is based on NI PXIe-5105 ADC. The LaBr3 detectors were calibrated using an Eclipse-IV Amptek Inc x-ray tube (anode current Ia ~ 2.0–49.9 μA at cathode voltage up to 45 kV).

Measurements of the x-ray intensity showed a non-uniform distribution of the radiation along the gyrotron axis. The maximum radiation intensity is observed near the output window of the microwave path. With distance from the gyrotron, a significant decrease in the x-ray intensity is observed in accordance with the inverse square dependence.

To reduce the possible dose of personnel exposure to T-15MD gyrotrons, it is planned to install protective lead screens near the electron beam collectors. Lead screens provide attenuation of the x-ray intensity up to 8-9 times with full coverage of the entire gyrotron from the side of the detector.

To determine absolute values of the x-ray fluxes, it is planned to carry out additional measurements using CdTe detectors in the flux mode and using LaBr3 detectors in the spectrometric mode, as well as to calibrate the detectors on a certified x-ray stand.

References

1. A. Arkhipov et al, Reconstruction of Energy Distributions in Electron Beams on the Basis of Bremsstrahlung X-Ray Spectra, IEEE TRANSACTIONS ON PLASMA SCIENCE, VOL. 41, NO. 10, 2013, p 2786.

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/Mu/ru/DZ-Savrukhin.docx) [↑](#footnote-ref-1)