Measuring the Transverse Intensity Distribution of a High-Energy Electron Beam with a Multichannel Ionization Chamber System

Angelina Bulavskaya[1], **Sergei Alexeev**[2], **Elizaveta Bushmina**[2,1], **Irina Miloichikova**[1,3], **Daria Polomoshnova** [1], **Konstantin Timoshenko**[2,1], **Sergei Stuchebrov**[1] OR

[1] Tomsk Polytechnic University, Tomsk, Russia
[2] Joint Institute for Nuclear Research, Dubna, Russia
[3] Cancer Research Institute of Tomsk National Research Medical Center; Russian Academy of Sciences, Tomsk, Russia

Electron beams produced by various accelerators have a broad spectrum of applications across multiple fields, including industry, medicine, agriculture, and scientific research. Precise monitoring of the transverse distribution of the electron beams is essential for modern accelerator technologies.

Existing methods for measuring spatial beam properties utilize a variety of detectors, yet many of these techniques face limitations due to the rapid degradation of materials, which can compromise the accuracy and reliability of the measurements. Profilometers serve as effective tools for determining the position and spatial distribution of particle beams, as they are designed to measure the radiation incident on the detector in the transverse plane.

The research proposes a multiangle scanning technique aimed at capturing transverse intensity distributions, which involves rotating the profilometer at various angles around the beam's central axis. This study introduces a cylindrical ionization chamber designed as a detector. A multichannel profilometer equipped with several ionization chambers was designed and tested. The detection system integrates linear motion of the detector with rotational adjustments concerning the beam axis. The dataset generated reflects variations in the beam profile corresponding to different scanning angles. By employing reconstruction algorithms such as the inverse Radon transform, it becomes possible to reconstruct a two-dimensional intensity map of the beam.

The results obtained for the 7 MeV electron beam of the Microtron MT-25 facility (Dubna, Russian Federation) demonstrate the potential of ionization chambers as effective detectors for determining the transverse distribution of the high-energy electron beam intensity.

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References

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