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Measurement of the electron beam profile by the multi-angle scanning method

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In the context of modern accelerator technology, it is essential to guarantee the specified characteristics of the extracted electron beam. In addition to the information regarding the energy and intensity of the beam, it is crucial to ascertain its spatial and angular distribution [1].
The position of the particle beam in space and its transverse intensity distribution can be determined by means of profilometry. The detectors of profilometers are of various types, dependent on the method employed for the acquisition of the profile. One such method is wire scanning. In order to implement the wire scanning method, it is proposed that a cylindrical ionization chamber can be used as the detecting element, with the detecting device moving linearly in a plane perpendicular to the beam propagation axis. This approach has been put forth due to the notable advantages of ionization chambers, including high radiation resistance, sensitivity to low-intensity radiation, ease of use, and the capacity to collect data in real time.
In order to obtain transverse distributions of the electron beam intensity, it was proposed that the multi-angle scanning method be used [2]. This method entails the rotational movement of the profilometer at different angles relative to the central axis of the beam. The data set obtained in this way represents the dependence of the beam profile on the scanning angle. Through the use of mathematical reconstruction methods, including the inverse Radon transform, the two-dimensional intensity distribution of the beam can be reconstructed.
As part of the study, a wire-scan profilometer utilizing an ionization chamber was developed and evaluated. In order to obtain transverse distributions of the electron beam intensity, a multi-angle scanning device was developed and tested. This included the profilometer described above, which provides linear movement of the detector, as well as a rotation system relative to the central axis of the beam. The prototype of the profilometer and the multi-angle scanning device were tested at the Microtron MT-25 facility (Dubna, Russian Federation) at an electron energy of 7 MeV.
The experimental studies conducted on the electron beam revealed that the ionization chamber is an effective tool for determining the position and measuring the size of the electron beam with high resolution (no worse than 1 mm). Transverse distributions of the electron beam intensity were obtained at varying distances from the microtron output window. The study demonstrated the efficacy of utilizing the ionization chamber in the capacity of a detector for both the profilometer and a multi-angle scanning device.
References:
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