Study of the intense pulsed electron beam energy spectrum from BIPPAB-450

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Intense pulsed particle beams have been widely used and studied as an effective method for material surface modification in the past several decades. Beihang Intense Pulsed PArticle Beams 450 accelerator (BIPPAB-450) can produce Intense Pulsed Ion Beams (IPIB) and Electron Beams (IPEB) in two modes with different Magnetically Insulated Diodes (MID). For IPEB, the pulse duration, accelerating voltage, total beam current are 100ns, up to 450keV and 3kA, respectively. In order to get a clear view of IPEB, and further broaden its application, the energy spectrum of IPEB was studied in this work with two approaches. With Child-Langmuir Law, the accelerating voltage of IPEB can be transformed into electron current density. After accumulating the current over the pulse time for separate voltages, an energy spectrum of IPEB before passing through the Titanium foil cathode can be obtained. Monte-Carlo simulation with Fluka and EGSnrc was applied to calculate the final IPEB energy spectrum after Titanium cathode. To verify the accuracy of the above algorithm, a magnetic spectrometer with an Imaging Plate (IP) was designed to test the IPEB energy spectrum. The IP was placed perpendicular to the electrons' incident direction to record the intensity of electrons with specific radius of curvature in a constant magnetic field. Afterwards, the locations on the IP can be transformed into corresponding electron energies with the theory of relativity. According to the comparison of the above energy spectra, the energy distribution of the IPEB can be basically determined.