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Non-destructive measurement of detailed transverse beam distribution with the use of an ionization monitor

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The constant monitoring of the uniformity of the density distribution of the flux of the accelerated particles is required in various applied fields as such as the studies of biological objects and of radiation resistance of electronic devices. The ionization monitor has been developed at FLNR JINR in order to make the non-destructive detailed high precision measurement of the transverse profile of a wide beam of accelerated particles. The monitor design is aimed at measuring the concentration of residual gas ions arising along on the beam path. The distribution of the ions is proportional to the distribution of the particle flux density. The ions are extracted from the beam region by a constant electric field larger than 0.2 kV/cm and then are accelerated by a sawtooth voltage with a frequency of 2 Hz. During the extraction the ions get the kinetic energy proportional to the distance traveled in a constant field and to the value of the subsequent accelerating voltage. The extracted ions enter two consecutive electrostatic analyzers separated by a plate with 1 mm slit. Ions can enter the second analyzer through this slit only if they were created in a narrow beam region, which position depends on the value of the sawtooth voltage. The monitor sensitivity is increased by MCP (Micro channel plate) placed after the analyzers. The collector divided into 31 strips is located after the MCP. The current from the strips is digitized by several ADC (Analog to digital converter) channels. The first coordinate of the ion formation position is determined by the number of the collector strip. The second coordinated is extracted from the value of the sawtooth voltage measured by another ADC. The number of employed ADCs allows every second measurement of a detailed two-dimensional distribution with 31x31 points on a beam cross section up to 45 mm in diameter. Because the ions of the residual gas are collected from the beam path 90 mm long, the sensitivity of the monitor is almost two orders of magnitude higher than the existing analogs [1, 2]. The monitor can also be used to measure the profile of secondary beams.

The speaker is a student or young scientist

Yes

Section

1. Design and development of charged particle accelerators and ionizing radiation sources

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