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Ion-chamber system with low threshold energy for proton therapy monitoring

A system of three ion-chambers with low threshold energy, giving new possibilities in proton beam monitoring and analyzing, is considered. The system includes a new double-gap chamber with the gap of 1 mm, with polyimide films of 3 μm thickness and with the sensitive area 113 cm^2 and two double-gap ionchambers, each with the gap of 2 mm. Ionization losses in each of six sensitive air gaps, as well as losses for 64 strips, are measured in coincidence for every accelerator spill. Total amount of non-sensitive material crossed by the beam is only 3.9 mg/cm^2 . Protons at Bragg-peak energy and below are capable to penetrate the anode which separates two neighbour gaps and peculiar behavior of loss correlations can be observed. This behavior can be explained by alternative trends of energy-loss dependence below and above Bragg peak. Recombination contribution is estimated as only few percents at 1 nA/cm^2 . An essential contribution to the dose from protons at about 1 MeV and below was demonstrated both by calculations and experimental data. Selected contributions of fast and slow protons and δ -electrons to the energy loss can be extracted from the data. The system demonstrated a stable operation after a proton irradiation of 5 Mrad.

Primary author: POTASHEV, Stanislav (Inst. of Nucl. Research, Moscow)

Presenter: POTASHEV, Stanislav (Inst. of Nucl. Research, Moscow)