

AbstractID: 1430 Title: Calibration of a Proton Beam Energy Monitor

Delivery of therapeutic proton beams requires an absolute energy accuracy of about 0.5 MeV for patch fields and a relative energy accuracy of about 0.1 to 0.3 MeV for energy stacking. Achromatic switchyard tunes, which lead to better stability of the beam transported to the patient, unfortunately limit the ability of switchyard magnet field monitors to verify the correct energy. A new monitor to measure the proton energy before transport through the switchyard has been installed into a proton synchrotron. This monitor, that consists of two frequency and eight beam position detectors, has been calibrated by measuring the range of the beam through water and interpolating within a published range-energy table. A relationship between depth dose curves and range-energy tables was determined using Monte Carlo simulations (MCNPX) of particle transport and energy deposition. To reduce the many uncertainties associated with typical scanning water phantoms, a new technique was devised in which the energy was scanned while a fixed thickness water tank was sandwiched between two fixed parallel plate ionization chambers. The frequency when the distal edge of the Bragg peak occurred within the distal ionization chamber was used for calculating the nominal accelerator orbit radius. This procedure was repeated for several tank sizes. The average of the derived radii is subsequently used during treatment by the monitor to calculate the energy. Studies were also performed to determine the spill-to-spill stability of the delivered energy. The accuracy of the new energy monitor appears to be sufficient for the energy stacking technique.