COMMISSIONING OF SPOT SCANNING PROTON GANTRY AT CCB IFJ PAN

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The commissioning of spot scanning proton therapy Gantry 1 in Cyclotron Center Bronowice IFJ PAN in Kraków has just been completed.

Pencil beam spot scanning system in CCB IFJ PAN consist of a delivery system (IBA Proteus C-235), an oncology information system (ARIA®), and a treatment planning system (TPS) (Eclipse V 13.5). Discrete proton pencil beams (spots) are used to deposit dose spot by spot and layer by layer for the proton distal ranges from 4.0 to 32.0 g/cm^2 and over a maximum scan area at the isocenter of 30x40 cm^2.

The input data required by the TPS included in-air transverse profiles, integral depth doses (IDDs), calibration of monitor units MUs and preparation of CT calibration curve [1].

Spot positions and spot sizes in air for proton beams with various energies were measured using scintillator-based sensors, radiochromic films and TL detectors at 5 different distances (±20 cm, ±10 cm, 0 cm) from isocenter. The fluence of individual spots was initially modeled as a single Gaussian (SG) function and later as a double Gaussian (DG) function. The DG fluence model was introduced to account for the spot fluence due to contributions of large angle scattering from the devices within the beam delivery system.

Integral depth doses (IDDs) curves were obtained in water phantom for proton beams with energies from 70 MeV to 225 MeV with the largest commercially available parallel-plate ionization chamber (8 cm diam.). The sensitive area of the chamber was insufficient to fully cover the entire lateral dose deposited at depth by a pencil beam. To correct for the detector size integral depth doses were determined using MC simulations (FLUKA ver. 2011.2) for virtual chamber of 20 cm diameter.

As reference calibration condition to define the monitor units (MUs) monoenergetic layers with flat dose distribution were chosen. Calibration was performed with parallel-plate Markus-type ionization chamber for proton beams of energies ranging between 70 MeV and 225 MeV.

The stoichiometric calibration method was applied for preparation of the calibration curve [2]. HUs of 9 tissue equivalent plugs from phantom (Model 062M, CIRS Inc.) using CT scanner (Somatom AS Definition, Siemens AG) were measured with different scanning parameters.

To validate the dose models, we compared calculations and measurements, including doses at the center of spread out Bragg peaks (SOBPs) as a function of nominal field size, range, and SOBP width.

The gantry is ready for patient treatment.

REFERENCES

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