

Purpose:

To create a comprehensive data library of lateral dose profiles to characterize proton pencil beam spots (PPBS) with wide range of energies available for clinical use.

Methods:

To improve accuracy of dose modeling by the treatment planning system, a comprehensive data library of measured PPBS profiles has been created. At our institution, there are 94 energies available for spot scanned proton beams. For each energy, lateral dose profiles of PPBS in water have been measured at several depths. A pinpoint chamber with an active volume of 0.015 cm³ was used to collect relative dose profiles in water tank using a fixed SSD setup. Both in-line and cross-line relative dose profiles of PPBS have been measured and analyzed. A PTW Bragg peak chamber (BPC) was used to obtain the absolute planar integral spot dose (PISD) of these PPBS at the respective depths of measurements. A structured query language based data repository has been created for query and retrieval of the details of dosimetry data of these PPBS.

Results:

PPBS characteristics, such as full width half maximum, the PISD (Gy-cm²/MU) and integral spread of the PISD along the central axis have been tabulated for all available beam energies. The availability of this database allows the study of the spot size distribution as a function of energy and depth. Additionally, the measured data also provides the critical long tail dose correction factors (LTDCF) for the BPC measured PISD as a function of energy and depth.

Conclusions:

The lateral profiles measured for 94 different energies, has provided useful information about the effect of multiple Coulomb scattering and nuclear halo effect on the propagation of PPBS in water, and spot sizes as a function of energy and depths. The database provides a comprehensive library of lateral profiles of PPBS for clinical and research uses.

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