AbstractID: 11031 Title: Configuration and validation of a single Gaussian dose model for scanning proton beams

Purpose: The scanning proton beam (SPB) dose algorithm used by the Eclipse version 8.1 treatment planning system (TPS) assumes that the in-air proton fluence is a single Gaussian. In this work we configure and validate the TPS for the SPBs at the Proton Therapy Center, Houston (PTCH).

Methods: There are a total of 94 energies available for SPB at the PTCH. The input data required by the TPS includes in-air profiles and integrated depth doses (IDDs) for all 94 energies. All in-air profiles and IDDs were generated by a validated Monte Carlo (MC) model of the beamline used in this work. Doses at the depth of 2 cm were measured using a Bragg Peak chamber (BPC) to scale MC generated IDDs to units of Gy/MUmm^2. Because of the halo dose, low dose envelop extending far away from the beam axis, the size of the BPC was found to be insufficient to measure IDDs, especially for low energy beams. Based on MC data, correction factors for IDDs as a function of energy were established. The pencil beam dose model was then validated against a set of measurements in water phantoms.

Results: The calculated depth doses for rectangular target volumes agree well with measured results. The calculated lateral profiles also agree reasonably well with measurements, except up to several percent differences near the edge of the field and outside of the field. However, the measured dose dependence on field size cannot be predicted by the TPS. This discrepancy is attributed to the fact that a single Gaussian is inadequate to model in-air lateral profiles of our scanning nozzle. In addition, the halo dose may not be modeled correctly.

Conclusions: The limitation of the current model is identified for SPB. An improvement using double-Gaussian function for the lateral profiles is suggested.