AbstractID: 9322 Title: Validation study of the GEANT 4 Monte-Carlo simulation of the proton dose distribution from passively scattered proton beam nozzles at the Proton Therapy Center at Houston

Purpose: To validate the accuracy of the representation of the hardware components and the process of Monte-Carlo simulation of the dose distributions from the passively scattered proton beam nozzles of the Hitachi ProBeat system at the Proton Therapy Center at Houston (PTCH) using the GEANT4 software package.

Method and Materials: GEANT4 is a widely used software package for Monte-Carlo simulation (MCS) of ionizing radiation transport, which we plan to use extensively, (a) to check the accuracy of both the measured beam data of our proton therapy beams and the patient dose distributions calculated by the treatment planning system, (b) to obtain the dose distribution in many situations where accurate measurement would not be possible and (c) to compare the results with other MCS packages used at our institution. As the first step, we have carried out simulations of the passively scattered nozzles for selected energies by properly including the material and geometry of the first and second scatterer, range modulating wheels, dose and beam profile monitors, and calculated the dose distribution in a water phantom. The depth dose curves for the pristine Bragg peaks (PBP), spread out Bragg peaks (SOBP) and profiles at selected depths are compared with those obtained from ion chamber measurements.

Results: The ranges obtained from the GEANT4 MCS agreed within 0.5 mm both for the PBP and SOBP. The overall agreement of the depth dose curves is within 2%. The profiles agree within 3% in most of the regions, with some points differing by as much as 5%. The disagreement for profiles is expected to be reduced by increasing the number simulation histories.

Conclusion: We have accurately implemented the passively scattered proton beam nozzle at PTCH for MCS of proton dose distributions using the GEANT4 software package.