AbstractID: 11310 Title: Validation of an MCNPX Monte Carlo model of a discrete-spot scanning beam nozzle and evaluation of the beamlet lateral envelope of low doses

Purpose: To build and experimentally validate an accurate Monte Carlo (MC) model of a discrete spot scanning beam nozzle and to use this model to assess the dosimetric consequences of the “halo” dose (i.e., that due to scattering from beam line components and nuclear interactions). **Method and Materials:** An accurate model of the scanning nozzle at our institution was implemented using the MC system MCNPX version 2.5.0 according to the blueprints provided by the manufacturer of the proton therapy system (Hitachi Ltd., Tokyo, Japan). The MC model was validated against measurements of percentage depth doses (PDDs), lateral profiles in-air (LPA) and in-water (LPW), field size factors (FSFs), and spread out Bragg peaks. The validated MC model presented in this study was used to generate data for clinical configuration of our treatment planning system (TPS). **Results:** Distance to agreement between measured and simulated ranges, LPAs and LPWs were within 0.16 cm, 0.05 cm and 0.1 cm, respectively. Comparisons between measured FSFs and TPS predictions, which may not model the halo dose properly, reveled differences of up to 9.5%, whereas comparison with MC simulations showed maximum differences of 3.6%. We found that ion chambers with radius as large as 4.2 cm are insufficient to measure the integral energy deposition. **Conclusion:** Because of the halo dose, which broadens lateral sizes of the proton beamlets, care should be taken when measuring integral energy deposition for configuration of the TPSs. Furthermore, the halo dose must be properly modeled in the dose algorithm used by TPS for accurate prediction of scanned proton beam doses.