AbstractID: 3473 Title: Validation of a Monte Carlo Algorithm for Simulation of Dispersion due to Scattering of a Monoenergetic Proton Beam

Purpose: A multi-leaf collimator is being designed as part of a collaborative effort to build a regional protontherapy facility. The Monte Carlo framework GEANT4 has been chosen to assist in this design by simulating the effects of changing the width of the leaves as well as the distance to the patient. The present work focuses on the validation of the current algorithm by comparing the range of the proton beam and lateral penumbra it produces with published data.

Method and Materials: Several experimental setups have been simulated according to the data currently available for comparison. All configurations include a monoenergetic beam and a right-angled water parallelepiped where the deposited energy is sampled. We report here the specific results obtained from a variety of independent setups including a pencil beam and a 5 cm by 5 cm square beam. The proton ranges obtained for different energies are compared to tabulated ICRU values. Parameters associated with the multiple scattering dispersion of the beam are compared to published experimental data. In addition to that we compare lateral penumbra results obtained in a more realistic beam line configuration to experimental data published by the Orsay Center for Protontherapy.

Results: The proton ranges produced agree with the ICRU values for all simulated energies. The level of reproducibility of multiple scattering effects for all the different beam profiles is adequate when compared to reference values published by Szymaowski et al. [5] The lateral penumbra produced by our beam line simulation satisfactorily corresponds to the behavior described by Oozeer et al. [4]

Conclusions: GEANT4 is a promising tool for assisting in the design of the MLC. Our implementations reproduce to the extent presently needed, not only proton ranges but also multiple scattering and lateral penumbra effects.