AbstractID: 2960 Title: Energy Distributions of Proton Interactions in MCNPX and GEANT4 Codes Using a Slab Target

Purpose: Nuclear interactions for proton radiation therapy can be simulated by different Monet Carlo codes. In this study, the energy distributions of secondary particles generated from proton nuclear interactions by GEANT4 and MCNPX are compared.

Method and Materials: Proton ranges were first calculated for proton energies from 70 to 250 MeV using these two codes respectively. A 1-cm thick water (or brass) slab was placed in the vacuum as a target of nuclear interaction. A point-like proton source was emitted in a single direction perpendicularly to the slab. The detector on the other side of the slab recorded the energy distributions of particles generated in nuclear interactions including neutrons, protons, alpha particles. The simulations were repeated for both slab materials at different energies between 100 MeV and 250 MeV.

Results and Discussions: We first compared the calculated ranges with the proton CSDA data from NIST. GEANT4 always gives shorter ranges than the CSDA, while MCNPX only does so for energies higher than 100 MeV. We next studied the energy distribution of the particles generated in nuclear interactions. The proton distributions are quite similar for 150 MeV incident energy case. MCNPX predicts neutrons with, on average, higher energies that GEANT4. As for alphas, the statistical uncertainties are too high (~30%) and the results are qualitative rather than quantitative.

Conclusion: The results suggest that these two codes are in good agreement for proton distribution, although discrepancies in the average neutron energies are observed due to the different physical models