AbstractID: 9138 Title: Benchmark of Geant4 and MCNPX for proton radiation therapy (E<70 MeV): total dose and secondary particle production

Purpose: The validity of the Monte Carlo (MC) for proton dose calculation has been proved by the fact that the simulation matches measurement. The secondary particles generated by hadronic interactions, e.g. neutron, alpha, can give high effective dose even if the production rate is low. This will potentially spoil the gain of using proton radiotherapy. Challenged by the measurement, attempts have been made to use MC to predict the secondary particle dose. Different code using different physics models or cross section data may lead to quite different spectrum. The comparison should be made among those MC codes to document the difference.

Method and Materials: The ocular-beamline from the Harvard Cyclotron Laboratory (Cambridge, USA) as well as measured data was used. Two MC codes, Geant4 (4.9.1) and MCNPX, were compared. Since the physics process can be customized in Geant4, different physics module combinations were generated. Proton nozzle, scoring region, material, and lateral spread out of the initial beam were kept same in all the simulations. In the first step, different simulations were tuned differently by changing the energy spread of the initial beam and the thickness of the range shifter to match the measurement. Then, the neutron flux as well as the dose from different particles within the phantom was compared between the simulations.

Results: All the simulations match the proton beam ion chamber measurements providing different energy spreads and range shifter thickness. The neutron flux and specific particle dose within the phantom varies between different simulations in the preliminary result, which likely represents differences between physics module.

Conclusion: Both Geant4 and MCNPX are good for proton dose calculation. However, for the secondary particle dose, the preliminary result shows that quantitative evaluation is suspect.

Conflict of Interest (only if applicable): Thomas Mackie has a commercial relationship with proton radiotherapy.