AbstractID: 13822 Title: A joint research investigation comparing MCNPX and Geant4 Monte Carlo codes to reduce the range uncertainties in proton therapy

Purpose: Advanced technology may help control the depth of the dose delivered to anatomical regions in the patient with a accuracy close to 1 mm. Monte Carlo methods are able to precisely model the transport of protons within the patient offering the potential to assist in achieving this level of accuracy. Both MCNPX and Geant4 Monte Carlo codes have been used for proton beam therapy simulations. However, to our knowledge very little has been done to compare the inherent differences in the handling of proton transport between the two codes.
Methods: A detailed comparison of proton dose distributions within a variety of phantoms was performed between MCNPX and Geant4. Simulations were done using a generic water phantom, a complex phantom with bone and lung components, and a patient phantom produced from CT data. A spread-out Bragg peak proton beam with a range of 17.3 cm and a modulation width of 5 cm was considered. A qualitative comparison investigating the differences between dose distributions together with quantitative comparisons using gamma analysis was completed.
Results: The MCNPX and Geant4 dose distributions agreed very well for most cases. For all curves considered the gamma analysis yielded at least 90% of the points within the 2% and 2 mm criteria. There appears to be a slight disagreement in the uniformity of SOBPs in the water and complex phantom.
Conclusion: This study improves our understanding of the differences in the proton dose deposition predicted from MCNPX and Geant4 Monte Carlo codes.