

AbstractID: 12306 Title: Normalized Bragg Peak Curves for Various Proton Energies in a Cylindrical Water Phantom: A Simulation with MCNPX and GEANT4 Monte Carlo Codes

Purpose: To simulate proton interaction (energy from 60 to 250 MeV) in water using MCNPX version 2.7B Monte Carlo code to determine accurately proton ranges from Bragg peak.

Method and Materials: A cylindrical water phantom (100cm length, 30cm radius), composed of 1000 packed circular sensitive detector discs (2cm radius, 1 mm thick) was used. A pencil beam source was incident on the surface of the cylinder in z direction. Tabular nuclear data from LA150N and LA150H libraries were used for neutrons and protons with <150 MeV. For >150 MeV, the LAHET physics code was used and the hadronic interactions were handled using the Bertini cascade model. The Vavilov model was used to account for charged-particle straggling. Normal transport was performed for neutron, proton, photon, electron, deuteron, triton, helium-3, alpha, and heavy ions. Light ion recoil was accounted for in the simulations and the cutoff energy for these particles was set to zero to prevent early termination of their transport. A 5cm x 5cm field size beam was also simulated. A total of 80,000 source histories were run for each simulation. Eleven source energies were tested for the pencil beam and three source energies were studied for the 5cm x 5cm field size beam.

Results: Our MCNPX results were compared with GEANT4 results as well as the Continuing Slowing Down Approximation (CSDA) data from the United States National Institute of Standards and Technologies (NIST). The deviation in Bragg peak range was <1% of that calculated with the GEANT4 and <0.6% of the CSDA data. The entrance to peak dose ratios between the different codes were comparable for 150 and 200 MeV though larger difference was noted for 250 MeV beam.

Conclusions: Our proton Bragg peak simulation results using MCNPX are in excellent agreement with GEANT4 as well as NIST data.