AbstractID: 8683 Title: Central Axis Neutron Production Determination for a Double Scatterer Passive System

Purpose: The purpose of this work was to determine which components along the central axis of a passive beam delivery system for proton therapy contributes the most to the production of secondary neutrons.

Method and Materials: In this work a passive beam delivery system was modeled based on the MD Anderson Cancer Center treatment nozzle. We performed Monte Carlo simulations with Los Alamos code MCNPX. In these simulations a 200 MeV proton beam is shaped by a rotational modulator wheel (RMW), a secondary scatterer and by a collimating system including a variable snout. Cylindrical volumes were placed along the beam central axis to determine the radial distribution of the neutrons produced. The volumes were made of concentric cylinders with radius ranging from 50 mm to 20 mm. The volumes were placed after the RMW, the secondary scatterer, before and after the snout. The neutron flux and energy spectra were determined for each volume radii and for three treatment volumes.

Results: After the RMW the neutron flux was higher for all treatment volumes diminishing as the distance along the central axis increased. The flux increased slightly just before the final snout for the smaller field sizes indicating a backscatter contribution as the proton beam is finally collimated. At the end of the nozzle the flux was lower than after the RMW. The larger neutron flux with energies ranging from 130 MeV to almost 200 MeV was found at smaller radii. As the radial distance increased the flux of energetic neutrons diminished.

Conclusion: We found that the RMW was the major source of neutrons in the treatment nozzle. The flux diminished as the distance increased indicating a $1/r^2$ dependency. The other shaping components contribute to the neutron production but it is difficult to differentiate between contributors after the RMW.