AbstractID: 6913 Title: Neutron Dose from Thin, Thick Targets and Passive Proton Beam Delivery Systems

Purpose: Due to possible radiobiological implications that neutrons might have during proton therapy this work focuses on the determination of which components of a proton therapy treatment nozzle contribute the most to neutron production for passive systems.

Method and Materials: The LANL Code MCNPX is used to simulate a proton beam interacting with components of a passive treatment nozzle. Several treatment nozzle geometries are simulated. During the first simulations, a 200 MeV proton beam interacts with targets of 10 MeV, 20 MeV thickness and stopping (thick) targets. Several materials were used as targets: lead, aluminum, graphite, water, and polyethylene. The neutron flux was scored in a water phantom 1 m away from the point of maximum neutron production in the target and used to determine the neutron dose as function of neutron emission angle. The second set of simulations is for a double scatter passive system. A 200 MeV proton beam interacts with a high-Z to low-Z (lead-lucite) rotational modulation wheel, a low-Z to high-Z (lucite-lead) scatterers and a collimation system. The resultant neutron dose for 100 mm spread-out Bragg Peak (SOBP) is investigated.

Results: The neutron dose was higher for thick targets than for thin targets. This behavior was consistent among all target's materials. The neutron production was forward-peaked with a maximum at around 15°. For low-Z and high-Z materials, there was a large neutron flux contribution for energies below 20 MeV. For thin and thick targets the high-Z materials produced the greatest amount of neutrons, although the thin targets produced the most energetic ones.

Conclusion: We noted that the high-Z material components are producing the highest amount of neutrons while decreasing the energy of the beam by 10% produces an increment of approximately 30% increase in neutron production.