AbstractID: 12950 Title: Secondary Neutron Production by a Scanning Proton Beam

Purpose: A scanning proton beam is a highly desired option in new proton facilities. However, the patient specific brass aperture used to shape the beam is one of the major sources of secondary neutrons, which contribute to whole body dose. Thus, minimizing neutron yield from the aperture is a critical criteria for optimization of scanning parameters. In this study we investigated this neutron yield, and the concurrent generation of the neutrons inside the patient, in a uniform scanning proton beam using Monte Carlo simulation.

Materials and Methods: The general purpose Monte Carlo code FLUKA was used to simulate the interaction of a 204.8 MeV uniform scanning beam with brass apertures between 2 and 10 cm in diameter using a 10 cm shout. A water phantom 5 cm from the aperture surface was used to simulate a homogeneous absorbing medium. The neutron fluence, spectrum and dose equivalent in the phantom was acquired for various scanning patterns.

Results: Neutrons generated in the brass aperture affect the ambient dose equivalent H*(10) near the surface of the phantom. However, neutrons generated inside the phantom have a dominant contribution to the ambient dose equivalent H*(10) close to isocenter. Their contribution ranges from 50% to 90% to the total neutron H*(10), corresponding to a dose equivalent of 2.5 to 5.5 mSv/Gy for the different apertures used in this study. The H*(10) values 30 cm from the beam axes are one order of magnitude less than at the isocenter.

Conclusions: The neutrons produced in the aperture are the major contributor to secondary dose only in the superficial region. However, neutrons generated inside the patient are the most important factor contributing to the total body dose in proton therapy.