AbstractID: 9354 Title: Antiproton Therapy: Monte Carlo Simulations of Normal Tissue Equivalent Dose from Annihilation Neutrons

Purpose: Recent *in vitro* experiments at CERN have demonstrated a superior biological effectiveness for antiprotons relative to protons. A continued concern is the normal tissue dose resulting from annihilation neutrons. Using Monte Carlo simulations of a CT-based anthropomorphic human phantom, we quantify the physical dose from annihilation byproducts and present the first organ specific calculations of normal tissue equivalent dose from neutrons in antiproton therapy. **Method and Materials:** MCNPX and FLUKA were utilized to model antiproton irradiation of the segmented whole-body phantom of a 38 year old male representing the ICRP reference man. The fluence was tallied as a function of energy and organ type for a 75 MeV antiproton pencil beam with a Bragg peak located in the frontal lobe of the phantom's brain. Physical dose was calculated for each organ as a function of energy using fluence to kerma conversion coefficients (ICRU-63). Finally, using energy dependent radiation weighting factors (ICRP-60), the equivalent dose from neutrons was estimated for each organ. **Results:** The results indicate a neutron fluence on the order of 10^{-5} cm^{-2} per incident antiproton for the bladder and colon, and a neutron fluence on the order of 10^{-4} cm^{-2} per incident antiproton for the thyroid and esophagus. As anticipated, the physical and equivalent doses are dependent on the irradiation geometry and the proximity of the organs to the Bragg peak; of the organs tallied, bone and thyroid received the highest physical and equivalent dose for the given irradiation protocol. The estimates of organ physical and equivalent dose and their uncertainties are discussed. **Conclusion:** We have developed an anthropomorphic Monte Carlo model for antiproton therapy. The model provides a method for more sophisticated biological modeling of treatment response such as cost basis analysis of TCP and NTCP relative to other treatment modalities.