AbstractID: 8977 Title: Distribution of Secondary Particles In Carbon Ion Therapy

Purpose: The purposes of this work was to study the spallation product generation from a 355.91 MeV/nucleon carbon beam impinged onto a cylinder of Tissue Equivalent Plastic, and analyze its spectra as a function of energy distribution and distance using a three-dimensional Monte Carlo particle transport code.

Method and Materials: Simulations were performed using a 350 MeV/nucleon carbon ion beam incident on a test phantom. The geometry for the test phantom was a cylinder with 20 cm height and 10 cm radius comprised of Tissue Equivalent Plastic. An energy of 350 MeV/nucleon was selected because it is in the range frequently used in carbon ion therapy. Monte Carlo analyses for spallation production were done using HETC-HEDS.

Results: A total of 23.74 % of the original beam was fragmented into charged particles between charges 1 and 5. Almost all charged fragments deposit their energies locally within the cylinder, and nothing escapes from the system.. Compared to neutrons and protons, charged particle fragment production is much lower as the percentages were 473.28 % and 295 % for neutrons and protons, respectively. For protons, most particles will exit the target following the direction of the primary beam. For the neutrons case, however, the 473.28 % exit the target in all directions make it very difficult to conclude that their direction is random.

Conclusion:
Secondary particle production is alarming especially for neutrons produced. Those secondary particles have a wide range of energy and are certainly able to cause secondary tumors. For the charged particles heavier than protons, almost 24% of the primary beam is produced as particles that range from charges 1 through 5. For the neutrons and the protons, the fluences were 473% and 293%. Those particles have high quality factors and could travel enough distance to cause DNA damage in healthy tissue.