AbstractID: 13778 Title: Neutron production in novel heavy ion accelerators

Purpose: The use of heavy ions in radiation therapy represents a major step forward in terms of dose conformity and better tumor control. Novel acceleration techniques involving high power lasers have the potential of reducing the footprint and cost of the accelerator and bring the whole system into the treatment vault. Therefore, knowledge of the amount of neutrons produced in the beam line and the patient is crucial.

Method and Materials: Two Monte Carlo codes are used in this study: FLUKA2008 and Geant4. A collimated (2x2cm^2) monoenergetic (450MeV/nucleon) carbon beam is incident on two types of targets: iron beam block (as a part of the particle selection system) and water phantom simulating patient being treated. The double differential yield (for energy and polar angle) is studied from FLUKA, while Geant4 is used for detailed studies of the angular distribution of neutrons.

Results: Quantitative study of the spectral yield (neutrons/MeV/primary) reveals that neutrons with energies in excess of 50MeV are generated in abundance inside the patient with probability 2.5 times greater than that in beam modifiers. Lower energy and thermal neutrons originating from the beam blocks are found to have an order of magnitude higher yield than those generated inside the patient. We studied the angular distribution of energy density and found that a maximum of the distribution at ~20^o from the beam axis for iron beam modifiers and ~10^o for the patient phantom. This information is valuable for organ dose calculation from secondary neutrons as well as beam-line design.

Conclusion: Monte Carlo simulations of neutron production in compact carbon accelerators are presented. Various parameters are studied that allow for accurate calculation of the organ dose from secondary neutrons to be carried out. Shielding calculations for the vault and gantry can also be performed using the data from our study.