AbstractID: 9672 Title: Carbon Foam Collimators for Proton Therapy

Purpose: The purpose of this study was to test the effectiveness of a new collimating material made of carbon foam and low-density polyethylene. The hypothesis is that the carbon foam material will produce fewer neutrons and be more affordable to manufacture than conventional materials. The study includes comparison with spallations produced from a tungsten target and a combination between a new material and tungsten, as well as the effect of the products in Tissue Equivalent Plastic, and the energy deposition contribution to the total dose. The study also includes incorporating a new Multi-leaf Collimator concept.

Method and Materials The collimation material developed in this study is based on a space radiation shielding materials NASA project, and it is a low density Polyethylene that was impregnated into Carbon Foam (PELowFOAM). The material has a density of 1.071 g/cm3, a hydrogen atomic composition of 10.5% and a carbon atomic composition of 89.5%. Monte Carlo analyses for neutron and secondary protons production was performed (using HETC-HEDS).

Results: The number of neutrons produced with Tungsten is 65.78 % of the primary proton beam. PELowFoam and PELowFoam with tungsten produce almost 3.5 times fewer neutrons than tungsten alone. Secondary protons produced are not of concern. Almost 45.43 % of the primary beam deposited its energy as a scattering neutron into the Tissue equivalent Plastic. This number is alarming and needs to definitely be taken into consideration.

Conclusion: A novel material was tested that is made of low density polyethylene impregnated in carbon foam to be used for collimating proton beams instead of using high Z materials like tungsten. Out of the three materials, tungsten performed the worst producing 66% of the primary beam in the form of neutrons, while the PELowFoam produced about 16% neutrons, and the PELowFoam combined with tungsten produced about 19% neutrons.