AbstractID: 12890 Title: Proton SOBP Reconstruction for Low-Density Media and Divergent Beams

Purpose:

To show a realistic analytical model for energy spectrum calculation leading to a flat depth dose distribution for low density media and divergent beams. We put the accent on the divergence of the beam in order to make this model applicable to new proton accelerator technologies such as dielectric wall or laser induced proton beams where the gantry size would be smaller than the conventional gantry size. Although the model is suitable for any density and divergence of the beam, we focus our effort on low density media, in order to investigate lung cancer treatments using such novel systems.

Methods and Materials:

Monte Carlo simulations have been performed using the code Fluka. We first used a uniform phantom to validate the model and then double layer geometry (7 cm tissue ICRP slab followed by 20 cm lung ICRP slab). The lung density has set to 0.2 g/cc. The beam size has been set to 10×10 cm^2, while the divergence of the beam ranged from 80 cm SSD to 1000 cm.

Results:

We showed that for any divergence of the beam, density of the media or proton range, the model gives a flat SOBP in a very fast way. Calculations showed that in double layer geometry, the in-water calculated proton energy spectrum does not give a flat dose distribution anymore, especially for high divergent beam. We showed the limitations of the model over the field size, down to 5×5 cm^2 the lack of equilibrium starts to affect the depth dose distribution.

Conclusion:

The analytical model we developed permits to reconstructed a flat physical dose distribution in a very fast way for any beam parameters and low density material. It can easily be implemented in a treatment planning system to get the appropriate proton energy spectrum for uniform tumor coverage.