AbstractID: 7759 Title: Optimization of the beam width in a universal proton therapy nozzle

Introduction:
In Intensity Modulated Proton Therapy (IMPT), the position and quantity of the dose deposited by monoenergetic pencil beams are simultaneously controlled. We are developing the ability to treat patients with IMPT and double scattering in a single nozzle mounted on a gantry, which is called a universal proton therapy nozzle. The beam width in IMPT, which is useful in achieving dose conformality, is dependent upon the materials in the nozzle. Optimization of these materials is necessary to allow both IMPT and scattering techniques.

Methods:
A GEANT Monte Carlo simulation was used to determine the pencil beam width obtainable for different materials in the beam path. Consideration was given to beam instrumentation, vacuum windows, the distribution of air, vacuum or helium in the nozzle, and the beam optics. The results of these simulations were compared to calculations based on the multiple-scattering theory of Moliere.

Results:
The advantages and disadvantages of various configurations will be discussed together with estimates of the beam width. Furthermore, some of these estimates were compared with measurements made with some of the components in the universal nozzle. Monte Carlo simulations should provide a good prediction of the expected beam width, however, the initial beam conditions are a little harder to establish in order to get full agreement.

Conclusions:
The optimum beam width in IMPT should, on the one hand be as small as possible to reduce the dose delivered to healthy tissue, or on the other hand be large enough to allow a practical beam delivery capability and time frame while maintaining high standards of patient safety. Modifications designed to improve the beam width must also have acceptable impact on double-scattering treatments [See abstract 7586]. A system that obtains a reasonable optimization of both solutions has been developed.