AbstractID: 10727 Title: Output Factor Measurements and Aperture Size Dependence of Dose Distributions for Scanned Proton Beams at MPRI

Purpose: Prior to a patient's proton beam treatment at MPRI, the Quality Assurance program entails measurement of the specific output factor for each field with its associated hardware in place. As a basis for comparison to patient specific measurements, and to characterize our dose delivery and monitoring system, we have measured a standard set of output factors (10 cm diameter aperture without compensator) over the energy range of clinical interest for all spread-out Bragg peaks (SOBPs) commissioned for delivery. We have also made detailed measurements of on-axis depth-dose distributions as a function of aperture diameter from 10 cm to 2 cm for representative scanned-beam fields to further characterize our system.

Method and Materials: Single point output factor measurements were made in a water phantom using a Markus ionization chamber. Additionally, depth-dose distributions were acquired with a multi-layer ionization chamber (MLIC) array, which provides 122 depth channels spaced approximately every 0.18 cm. Lastly, beam profiles were measured with a commercial array of ionization chambers (MatriXX, IBA).

Results: The results show the systematic decrease in dose along the SOBP plateau, and the increase of the SOBP entrance dose relative to the plateau dose, as a function of aperture size and treatment range. The need to carefully plan and deliver fields less than 5 cm diameter is obvious. Additionally, the application of the standard output factor measurements to predicting patient specific output factors for prostate patients has been verified with ±0.8% accuracy.

Conclusions: Given the similarity of prostate fields and our ability to model the output factors within ±0.8%, we no longer measure patient specific output factors for prostate patients treated with opposed laterals. But, we do make these output factor measurements for other treatment fields while utilizing the MLIC to characterize depth-dose distributions for fields smaller than 5 cm diameter.