AbstractID: 5528 Title: Dose per Monitor Unit Determination for Proton Therapy Treatment Portals with and without the Range Compensator

Purpose: To determine whether dose per monitor unit values (*D/MU*) for small-field proton therapy treatment portals can be more reliably measured with or without the field-specific range compensator present.

Methods and Materials: Treatments of 14 geometric models representative of typical neurosurgery patients were simulated using a Monte Carlo model of the M. D. Anderson Proton Therapy Center-Houston double scattering nozzle. Simulations of field-specific *D/MU* calibration measurements were carried out in a water phantom with and without the range compensator present. *D/MU* values from each calibration technique were compared to values from the patient treatment simulation. For each case, *D/MU* values were scored with metrics that characterized the accuracy, uncertainty, the standard deviation of accuracy and uncertainty, worst agreement, and maximum uncertainty. The metrics were combined by defining the following figures of merit (FOM), which ranged in value from 0 to 1 (0 being worst, 1 being best): total FOM (a composite of all metrics), clinical FOM (accuracy and uncertainty metrics), variability FOM (standard deviations of accuracy and uncertainty metrics), and worst-case FOM (worst agreement and maximum uncertainty metrics). The two *D/MU* calibration techniques were compared based on the FOMs.

Results: The total FOM when measuring without the range compensator was 0.85 and 0.49 with the compensator. The clinical, variability, and worst-case FOMs were 0.85, 0.92, and 0.79, respectively, without the range compensator, compared to 0.51 (clinical), 0.48 (variability), and 0.46 (worst-case) with the range compensator. The superiority of calibrating without the compensator was mainly attributable to the fact that the dose distributions were more similar to those in the patients. Additionally, determining *D/MU* values without the compensator is conceptually simpler and more convenient.

Conclusion: For the 14 cases considered in this work, measuring *D/MU* without the range compensator provided more reliable values of *D/MU* than measuring with the range compensator.