AbstractID: 6612 Title: Variations in Scanned Beam Proton Therapy Doses due to Random Magnetic Beam Steering Errors

Purpose: To study perturbations to delivered dose due to steering uncertainties of magnetically scanned proton beams. Understanding the effect of these perturbations on the delivered dose will help in determination of appropriate treatment structure volume (TS) expansions to ensure adequate coverage.

Method and Materials: Monte Carlo simulations were performed using a model of a clinical scanned-beam treatment nozzle to calculate the delivered dose spots from magnetically scanned proton pencil beams. Using a simple dose calculation program, the simulated dose spots were used to create a treatment plan to deliver a uniform 75 Gy dose to a TS within a water phantom.

To determine effects of steering uncertainties, small random magnetic field perturbations ($\Delta B \leq \pm 0.1\%$) were added to the steering parameters used to deliver a uniform TS dose. Variations in the dose delivered to the TS and an adjacent critical structure (CS) due to magnetic steering uncertainties were determined. This included determination of dose hot and cold spots in the TS, and changes to the dose volume histogram (DVH) of the TS and CS.

Results: The TS volume receiving 95% of the prescribed dose decreased by as much as 7% and the maximum TS dose increased by as much as 13% due to random magnetic steering uncertainties. For the CS, very little change was observed in the DVH with the maximum dose increasing by up to 10%. The maximum possible dose hot and cold spots created by deliberately moving adjacent spots in the TS were calculated to be 187% and 52% of the prescription dose, respectively.

Conclusion: For the expected range of ΔB values within the beam-scanning steering magnets, significant variations in the dose delivered were observed. We conclude that magnetic steering uncertainties should be considered when determining appropriate expansions during treatment planning.