AbstractID: 7125 Title: Therapeutic Uniform Scanning Proton Beam Development and Characterization: Longitudinal Results

Purpose: To utilize a new depth-dose detector and to construct, develop, characterize and quantify longitudinal beam profiles with an active uniform scanning proton beam delivery system.

Method and Materials: The active uniform scanning beam delivery system is composed of two primary devices—wobbler magnet and binary range modulator. Through transverse scanning a large proton beam spot at about 10-15Hz, the wobbler magnet creates a flat integral transverse field. The binary range modulator constructs spread out Bragg peaks (SOBP) by incrementally stepping a pristine Bragg peak by 3mm or 6mm in depth. A depth-dose detector was constructed to acquire all the longitudinal beam data. This detector, the Multi Ion Chamber Detector (MLIC), is composed of 122 parallel-plate ion chambers in a 1D array.

Results: Upon proper calibration and commissioning, the MLIC detector performed well for the acquisition of longitudinal beam data, providing adequate discrete data with 1.8mm spatial resolution. The full width half maximum of various energy pristine Bragg peaks was measured. This data necessitated changing the range modulator step size from 6mm to 3mm for all SOBPs below a certain proton energy (i.e. equivalent to 12.0cm range in water). The pristine peak and SOBP exhibit a range deficit that decreases as proton energy decreases. This effect is also correlated to the FWHM of the pristine peak. A library of various SOBP extents, from 14.5cm to 2.2cm, was constructed and shown to pass clinical specification. For a given SOBP, the skewness, defined as the slope of the 100% isodose or SOBP “flattop”, was correlated to proton range in water.

Conclusion: The MLIC proved useful, efficient and satisfactory in measuring depth-dose profiles for active scanning proton beams. The active scanning beam delivery system delivered therapeutically useable fields with increased modularity and flexibility compared to passive scattering techniques.