AbstractID: 8696 Title: Monte Carlo Investigation of Collimator Scatter of Proton-Therapy Beams Produced Using the Passive Scattering Method

Purpose: As a proton-therapy beam passes through the field-limiting aperture, some of the protons are scattered off the edges of the collimator. The edge-scattered protons can degrade the dose distribution in a patient or phantom. Objective of this work was to quantify the dosimetric impact of edge-scattered protons for a variety of clinical treatment beams.

Methods and Materials: The dosimetric impact was assessed using Monte Carlo simulations of proton beams from a contemporary treatment facility. The properties of the proton beams were varied, including the penetration range, width of the spread-out Bragg peak, field size, and air-gap, i.e. the distance between the collimator and the phantom.

Results: The simulations revealed that the dosimetric impact of edge-scattered protons increased strongly with increasing range (6% to 20%), decreased strongly with increasing field size (2% to 20%), increased moderately with increasing air gap (2% to 6%), and increased weakly with increasing SOBP width (< 4% change). In all cases examined, the effects were largest at shallow depths.
32 SOBPs and 79 lateral profiles have been compared so far. In three cases, maximum dose differences (in high dose regions) were found to be 3.0 % and one simulated penumbra was found to differ by 2.1 mm when compared to the measurement. Differences for all other cases are below the tolerance level.

Conclusion: We conclude that the dose deposited by edge-scattered protons can distort the dose proximal to the target with varying contributions due to proton range, treatment-field size, collimator position and thickness, and width of the SOBP. Our findings also suggest that accurate predictions of dose per monitor-unit calculations may require taking into account the dose from protons scattered from the edge of the patient-specific collimator, particularly for fields of small lateral size and deep depths.

Conflict of Interest: None.