AbstractID: 8321 Title: Experimental proof and feasibility of a 3D real-time detector system for therapeutic proton beams

Purpose: Fast and accurate quality assurance of complex proton treatments is challenging, but could be achieved with a real-time three-dimensional detector system. The purpose of this work is to study the feasibility and to provide experimental proof of principle that a liquid scintillator (LS) dosimetry system can measure three-dimensional dose distributions of proton beams in real-time.

Method and Materials: A plastic tank of $7\times7\times16$ cm^3 filled with BC-531 liquid scintillator was irradiated with a proton pristine Bragg peak. Scintillation light produced during the irradiation was measured with a cooled CCD camera. Acquisition rates of 20 or 10 frames per seconds (fps) were used to image consecutive frame sequences. These measurements were then compared to ion chamber measurements and Monte Carlo simulations.

Results: We have shown that real-time image acquisition was possible with our current dosimetry system design. A field of view of 12×9 cm^2 was measured with the CCD camera. Dose measured from the images acquired at rates of 20 fps and 10 fps have a standard deviation of 1.1% and 0.7% respectively in the plateau region of the Bragg peak. Differences were seen between the raw LS signal and the ion chamber due to quenching effects of the LS. We have shown that this effect can be accounted for and corrected by Monte Carlo simulations. Once corrected, dose distributions measured with the LS were in good agreement with ion chamber measurements.

Conclusion: We have shown the feasibility of using real-time image acquisition to measure proton dose distributions in LS. Like many other detectors, LS response depends on the energy of the proton beam, but we have shown that Monte Carlo can be used to correct LS measurements. Such system would be extremely useful for fast and accurate quality assurance of proton treatments.

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