AbstractID: 13176 Title: A 3D Liquid Scintillator Detector System for Intensity Modulated Proton Therapy: Online measurements of proton spots intensity

Purpose: The purpose of this work is to use a 3D liquid scintillator (LS) system to monitor proton spots delivered through intensity modulated proton therapy in real-time. **Methods and Materials:** The LS detector system is comprised of a 20x20x23 cc volume of LS in a light tight enclosure rigidly coupled to a CCD camera. Image acquisitions are triggered by a signal from synchrotron starting 140 ms prior to the first proton spot. Irradiations were conducted at M.D. Anderson Cancer Center, Proton Therapy Center on the scanning beam line. Repeated irradiations of proton spots were performed with the minimum (0.005 MU) and maximum (0.04 MU) dose per spot to assess the sensitivity and the precision of the LS system. Irradiations of proton spots were made throughout the LS volume to evaluate the system's response as a function of proton spots position. **Results:** Single spots of 0.04 MU were measured with a precision of 0.5% (one standard deviation) and with a signal-to-noise ratio of 195. Single spots of 0.005 MU were measured with a precision of 3% and with a signal-to-noise ratio of 31. The system showed a uniform response (less than 0.4% variations) for spots delivered within a 5cm by 5cm region. Outside this region, spots intensity decreased as a function of lateral position. Proton spot intensity underestimations up to 7.5% were measured close to the edge of the LS tank. This was caused by a truncation of the tails of the spot profile. The peak intensity of proton spots was more uniform. The maximum underestimation in the peak intensity was 2%. **Conclusions:** The LS system has been shown capable of precise online measurements of proton spots delivered in a 3D volume. This system could be used for quality assurance of IMPT.

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