AbstractID: 9484 Title: Quality Control in the fabrication of scintillating fiber probes for radiotherapy applications

Purpose: Miniature plastic scintillation detectors (PSDs) and plastic scintillation detector arrays are highly useful in many radiotherapy applications. However, PSDs can show large detector variability between apparently identical detectors. Such variability may impact on the performance of a PSD array. The purpose of this work is to develop a quality control procedure to increase the uniformity of PSDs.

Methods and Materials: A uniform procedure for fabricating PSDs was established. A quality control bench was then designed, which comprised a precise positioning mechanism, an ultraviolet LED for stimulating the scintillation light in plastic scintillators and a spectrometer to characterize the relative emission spectra of the PSDs as well as their total light output. The reproducibility of the bench itself was evaluated by measurements of a single detector through numerous mounting, un-mounting cycles. A batch of 15 PSDs was then built and tested for quality.

Results: The quality control bench could be used with an average reproducibility of 0.7%. Stimulation of the plastic scintillators by ultraviolet light produced the same emission spectrum as one obtained from ionizing radiation. Quality control measurements for the 15 PSDs showed no major discrepancies in the relative emission spectrum. However, large variations in total light output were observed. The standard deviation of the total light output was 16%, with a maximum variation of 28%. Of all detectors, 13% had a total light output of 0.85 or less relative to the mean.

Conclusion: The precision of a plastic scintillation detector will suffer if its total light output is too low. In this work, we have developed a tight quality control procedure for PSDs that could improve the performances of PSDs and PSD arrays. This procedure can be used to prevent detectors with poor light output from being used.