

AbstractID: 13832 Title: Theoretical design and performance of a scintillating fiber detector for real-time quality control of MLC-driven radiotherapy treatment

Purpose: To present the design and theoretical performance of a fluence monitoring detector based on the optical attenuation of scintillating fibers for the on-line verification of radiotherapy treatments. **Method and Materials:** A theoretical model was constructed to predict the intensity of light collected on each side of a long (app. 30cm) scintillating fiber placed under a field of radiation of varying size, intensity and position. It can be shown that one can measure independently both the central position of the interaction (x_c) and the integral fluence passing through the detector (Φ_{int}). The performance of this approach in term of detection capacity was quantified by the evaluation of the standard deviation (SD) on x_c and Φ_{int} as a function of the irradiated length of the field and incident dose. **Results:** Examination of the SD of x_c and Φ_{int} shows good agreement with Poisson statistics. SD below 1mm on x_c is achieved for any field longer than 2cm (down to 1cGy). This precision is improved greatly as the dose to the fiber increases: for a dose greater than 5cGy any field longer than 2mm will result in a SD of less than 1 mm. Moreover, it can be seen that the SD on Φ_{int} does not exceed 0.5% for any field longer than 2mm (down to 1cGy). **Conclusion:** This work clearly demonstrates the potential of on-line fluence monitoring by a detector based on optical attenuation of scintillating fibers. This detector could be used in the accessory mount of a linac during a radiotherapy treatment, in order to compare (using statistical tests) the characteristics of the incident radiation field with those predicted by the treatment planning software. The sensitivity and specificity performances of the system would enable real-time quality control of the incident fluence.