AbstractID: 13881 Title: Experimental validation of a scintillating fiber detector for real-time quality control of MLC-driven radiotherapy treatment

Purpose: To validate a novel type of fluence monitoring detector based on the optical attenuation of scintillating fibers to be used for on-line quality control of radiotherapy treatments. **Method and Materials:** 20 long scintillating fibers were aligned along the direction of motion of each of the 20 central pairs of leaves on a Varian Clinac iX MLC and coupled on both ends to a clear optical fiber to enable light collection. Following the theoretical model of scintillation collection based on optical attenuation previously developed, the central position (x_c) and integral fluence (Φ_{int}) of various radiation fields were calculated and compared to the expected values as deduced from a radiographic film and a planar dose (PD) calculated from the treatment software. **Results:** The difference between the measured and calculated x_c was within 2mm for more than 92% of the fields with a mean around 0.8mm. Of all these deviations, 93% can be explained by statistical variations (Poisson statistics). For Φ_{int}, the difference was less than 2% in 89% of the fields, with a mean around 0.9%. Although most of these discrepancies cannot be explained by statistical variations alone, they can be imputed on a small miss-alignment of the fiber with the collimator leaves and small systematic errors with film processing and planar dose calculation. Nevertheless, any absolute displacement of MLC leaf pair of more than 3mm or any fluence variation over 3% can be detected by our system. **Conclusion:** This work validates the principle that a detector based on the optical attenuation of scintillating fibers can achieve real-time quality control of a radiotherapy treatment with good precision. At the moment, the detection threshold for Φ_{int} is limited by the robustness of the fiber positioning system. This threshold is expected to fall below 2% with a more robust design.