Abstract ID: 15940 Title: A new, high resolution 2D dose measurement device based on a few scintillating fibers and tomographic reconstruction

Purpose: To develop and validate a novel type of 2D dosimeter based on the tomographic reconstruction of the dose projections obtained using long scintillating fibers.

Methods: 50 parallel scintillating fibers (diameter, 1mm; length, 6 to 20cm) were aligned in a 30cm diameter cylindrical masonite phantom with a 90cm source-to-surface distance and a 100cm source-to-fibers distance. The fibers were disposed so that the effective detection area of the scintillating fibers was a 20cm diameter disk. Both ends of each scintillating fiber were coupled to clear optical fibers to enable light collection by a single CCD camera using an f/2, 50mm focal length lens. 7 IMRT segments and 2 square fields were acquired using 18 projections over a 170 degrees rotation of the device. Dose reconstructions were conducted using a total-variation minimization reconstruction algorithm. 8 monitoring units were programmed for each projection and the reconstructed dose grid pixel resolution was set to 1x1mm².

Results: Using a non-optimized algorithm on a 2GHz CPU, each reconstruction was performed in less than 6 minutes. 3%/3mm gamma tests conducted between the reconstructed IMRT dose distributions and the dose calculated with the treatment planning system Pinnacle³ were on average successful for 99.6% of the dose pixels for the region over 10% of the maximum dose. For both square fields and the whole summed IMRT field, 100% of the dose pixels were successful to the gamma test.

Conclusions: Using tomographic reconstruction on the projections acquired with rotating scintillating fibers, one is able to perform 2D dosimetry of simple and IMRT fields with great accuracy and resolution using only a limited number of scintillating fibers. The underlying concept of tomographic dosimetry and the small number of fibers needed to reconstruct a given 2D dose distribution offer a world of new dosimetric possibility, both applicable to 2D and 3D dosimetry.