AbstractID: 2908 Title: Small field dosimetry using a series of customized Exradin T11 prototype ion chambers: Under-response due to electron fluence perturbations

Purpose: To investigate the suitability of custom-made small volume plane-parallel ion chambers for accurate dosimetry of small photon fields.

Methods and Materials: A series of four plane-parallel chambers, based upon the Exradin T11 chamber, with varying active volume diameters (2,4,10 and 20mm) and constant air cavity dimensions (2mm electrode separation and 30mm diameter) were used to measure relative dose factors at central axis for circular (0.5 to 4cm diameter) and square (5 and 10cm) 6MV X-ray fields. Other detectors (MOSFET, radiographic and radiochromic film, pin-point ion chamber) were used for intercomparison purposes. Experimental conditions were modeled using BEAMnrc to analyze the ion chamber air cavity's influence on the dose scored in the air cavity as compared to water.

Results: A large discrepancy was observed between all detector types in the 0.5mm field, where the smallest plane-parallel chamber yielded a signal 40% lower than radiochromic film. BEAM results confirmed that an under-response is expected in this chamber. Scoring planes within the air cavity indicate a decreased secondary electron fluence near central axis in air (compared to water), which corresponds to the area occupied by the collecting electrode. There were no significant differences in electron/photon energy spectra or angular distribution due to introduction of the air cavity into the medium. Correction factors for the experimental measurements were calculated based on differences between dose scored in air and in water. The 2mm diameter chamber requires correction factors of 1.29, 1.36 and 1.75 for 5,10 and 15mm fields respectively. These correction factors were also found to increase linearly with increasing cavity thickness.

Conclusions: In order to achieve accurate dosimetric measurements in small fields, correction factors must be applied to the measurements of plane-parallel ion chambers. These large correction factors make small-volume plane-parallel chambers with large guard rings unsuitable for small field central axis measurements.