AbstractID: 13409 Title: Improving reference dosimetry of nonstandard beams

Purpose: First to characterize the factors responsible for non-unity corrections in nonstandard beam dosimetry, and provide conceptual solutions to minimize corrections. Second to provide methods to estimate uncertainties accurately in nonstandard beam dosimetry, and achievable levels in clinical situations.
Materials: Ionization chamber response to static and dynamic IMRT deliveries is simulated using Monte Carlo and chamber perturbation factors are calculated. An exhaustive characterization and uncertainty analysis method applied to radiochromic film dosimetry is performed. Experimental criteria for achieving required levels of uncertainties are predicted using the method. An implementation of a Monte Carlo based setup positioning-induced dose uncertainty (PIDU) is performed in egs_chamber to evaluate uncertainties during ionization chamber measurements. An Exradin A12 chamber and a PTW 60012 diode models are used to numerically evaluate PIDU in nonstandard beams.
Results: Results show that the factor responsible for large corrections factors in nonstandard beams is the gradient effect. Reporting dose to the sensitive volume of the chamber filled with water reduces the correction factor by half under high gradients. A theoretical expression of correction factors is obtained for ideal nonstandard reference fields. Levels of uncertainty of the order of 0.3% are achieved with strict procedures of radiochromic film dosimetry and show great potential for non-standard beam measurements. Realistic uncertainties up to 4% on IMRT k_Q factor measurements are reported using the Exradin A12 in modulated fields. Realistic uncertainties up to 3% using a PTW 60012 diode are reported for small beam output factor measurements.
Conclusions: Reporting dose to the volume of the chamber instead of a point of measurement could reduce the correction factors. Depending on outcomes of future developments, corrections could be eliminated. Uncertainties in non-standard beams are an important issue during QA routine and reference dosimetry, and could be a limiting factor in the new protocol generation.