AbstractID: 2676 Title: Characterising an electron pencil beam: Monte Carlo vs measurement

Purpose: Electron beams from linear accelerators have widely varying characteristics in terms of spectral properties, mixtures of electrons and photons, spatial and angular characteristics. Characterizing pencil beams for pencil-beam based calculations and for complex electron optimization calculations is thus necessary for individual electron beams. We evaluated an extrapolation method for characterizing an electron pencil beam and compared a Monte Carlo based method with measurement.
Method and Materials: Radiographic film was used to measure narrow 12 MeV electron beams from a Varian 21EX accelerator. A series of circular beams was considered, collimated with LMPA material between diameters of 1.5 and 32 millimeters. Beam profiles were measured at discrete depths, and the presence of photon contamination from the LMPA was accounted for by subtracting measurements for a solid piece of LMPA. From these measurements, an extrapolation was made to estimate the distribution for a 0.1 mm diameter beam. A similar process was carried out using EGSnrc Monte Carlo, with electron beam characteristics determined using BEAM.
Results: A large amount of similarity was found between pencil beam distributions extrapolated from film-measured and Monte Carlo derived data. Given the amount of noise present in the measured and simulated results, the curve-fitting procedure yielded relatively smooth and appropriate pencil beam distributions. It was also found that the parameters from the curve-fitting could be used to extract central axis percentage depth dose distributions which were consistent (past d_{max}) with measured broad beam data.
Conclusion: This study showed that the extrapolation method is appropriate for derivation of dose distributions for very narrow beams. A Monte Carlo simulated narrow beam distribution would normally be sufficient for characterizing such a distribution, though if high resolution is required, the extrapolation method would be useful.