AbstractID: 3877 Title: A higher accuracy electron beam model based on large field measurements

Purpose: To commission the beam model for electron treatment planning with Monte Carlo using measurements made with the jaws wide open (with no applicator) along with state-of-the-art Monte Carlo simulation.

Method and Materials: Central axis depth dose curves and dose profiles of 6-21 MeV Primus electron beams were measured for the 40x40 cm field. Monte Carlo treatment head and water phantom simulations were done with the EGSnrc system using the BEAM and DOSXYZNRC user codes, respectively. The measured data was used to estimate source and geometry parameters, some previously inaccessible in treatment head simulation, including incident beam direction, scattering foil thickness, offset of the secondary scattering foil and monitor chamber from the beam axis, and the distance separating the monitor chamber from the primary scattering foil. Parameter estimation relied on a published, comprehensive analysis of the sensitivity of the measured quantities to source and geometry parameters.

Results: Dose distributions calculated with this large-field commissioning approach generally compared to 2%/2 mm with diode measurement. Larger discrepancies, as large as 5 mm present at a couple beam energies, were limited to the beam edge, well outside the region collimated with an applicator. The match to dose in the bremsstrahlung region was considerably better than previously published results for EGS4.

Conclusion: This method gives more accurate estimates of source and geometry parameters than simulation of fields defined with an applicator. EGSnrc provides a better match than EGS4. This approach simplifies the commissioning procedure, relying on a single beam model, with parameters derived from a relatively small data set, to model all applicators. In addition, the beam has few energy-degraded, scattered electrons, relative to fields collimated with an applicator. A clean beam is much easier to model, opening up the possibility of achieving high accuracy in fluence estimation with a simple, experimentally-based beam model.