AbstractID: 5904 Title: Modifying the BEAMnrc phase-space to match Monte Carlo and measured dose distributions

Purpose: To present a method for improving agreement between clinically measured and Monte Carlo (MC) calculated dose distributions (profiles and PDDs) in water for the full range of field sizes.

Method and Materials: Linac beam characteristics are modeled using BEAMnrc code that produces particle phase space above the secondary collimators as a new "source" in MC calculations. We assume that the photon energy spectra, represented in the phase space as achieved by the BEAMnrc model and electron beam characteristics, are reasonably accurate. The 3D dose distributions generated from MC and measured data are then used to modify the weights of each particle in the phase-space. The weight modification occurs through a few (typically 3) iterations and new weights are proportional to the ratio of the measures to MC calculated dose at a point where primary photon crosses the dose matrix plane. One-dimensional (assuming radial symmetry), 2D and 3D correction techniques were investigated. De-noising of the modified phase space has also been performed to reduce the "latent" dose uncertainty.

Results: The method has been applied to our 6 MV and 18 MV beam models and allowed to reduce MC/measured beam profile differences from ~3% to less than 1% for 6 MV beam, and from ~5% to ~1% for 18 MV in the central region of the beam. It also reduced the difference between measured and calculated dose from over 15% to less than 3% in the penumbra of the diagonal profile of the 40 x 40 cm^2 field.

Conclusion: The developed technique provides a relatively simple alternative to a very time-consuming process of fine-tuning BEAMnrc parameters. Initial BEAM model has to be "reasonably accurate" (producing results within ~5% agreement to measured data) prior to correction. 2D correction technique showed optimal performance providing required dose agreement and performing fasted than 3D correction.