AbstractID: 10663 Title: Monte Carlo dose distributions from photon beams obtained with the Bethe-Heitler and NIST bremsstrahlung cross-sections

Purpose: Reports on Monte Carlo-based clinical dose calculations have identified a paucity of information on the influence of cross-sections on such calculations. A recent investigation on BEAMnrc-based linac phase space (PHSP) calculations showed systematic differences (up to 3%) between fluence distributions computed using the Bethe-Heitler (BH) and NIST bremsstrahlung cross-sections. To understand the impact of these differences, we performed a study involving dose calculations in simulated water and heterogeneous phantoms.

Method and Materials: DOSXYZnrc was used to calculate the dose distributions from a 6 MV (Siemens, Primus) photon beam. BEAMnrc was used to generate PHSP files, using the BH and NIST bremsstrahlung cross-sections, for field sizes ranging from 5×5 to 40×40 cm^2. Dose was computed in phantoms composed of water and heterogeneous media, including air, lung, bone and aluminum slabs, following the ICCR benchmark. The voxel dimensions were set to 5×5×2 mm^3 (*x, y, depth* dimensions).

Results: MC-calculated dose distributions using the NIST and BH bremsstrahlung cross-sections agreed within 2% for all geometric configurations and field sizes considered, including at interfaces in the ICCR benchmark phantom. Larger differences (up to 4%) were noted for the 40×40 cm^2 field size, due to statistical fluctuations resulting primarily from the higher latent variance in the PHSP file for this large field size.

Conclusions: Despite relatively large, systematic differences observed in the fluence distributions generated with the NIST and BH bremsstrahlung cross-sections, calculated dose distributions in water and heterogeneous phantoms agreed within 1-2% on average. On the other hand, the insensitivity of dose distributions in phantom illustrates the importance of studying fluence distributions in MC-based dose calculations, particularly when generating beam models from PHSP. Though we have shown that the differences in the fluence distributions have no impact in dose calculations, further investigation is needed on the cause of this discrepancy.

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