AbstractID: 10321 Title: Validation of a grid-based Boltzmann solver for 6 and 18 MV photon beams impinging on a heterogeneous phantom.

Purpose:
To benchmark the accuracy of a grid-based Boltzmann solver, Acuros, against Monte Carlo for 6 and 18MV photon beams in a tissue-bone-lung-tissue slab phantom.

Method and Materials:
Acuros was developed specifically for radiotherapy dose calculations. It solves for both neutral and charged particle transport, and incorporates spatial adaptation to automatically increase spatial resolution in regions of sharp gradients such as beam penumbra and material heterogeneities. Comparisons were made between EGSnrc and Acuros for single field photon beams impinging on a $30\times30\times30cm^3$ slab phantom consisting of: tissue (0-3cm), bone (3-5cm), lung (5-12cm), and tissue (12-30cm). Calculations were performed for square fields of 2.5×2.5, 5.0×5.0, and $10\times10cm^2$ for both 6MV and 18MV energies. Comparisons were made between Acuros and EGSnrc on $2\times2\times2mm^3$ voxels along the beam centerline (0-30cm), and on transverse lines at depths of D_{max}, 10, and 20cm. To minimize the influence of Monte Carlo uncertainties, the EGSnrc calculations were run to a tight statistical uncertainty ($\sigma\approx0.1\%$) and fine resolution, up to 1 mm in the penumbra. Acuros results were output on a $2\times2\times2mm^3$ cubic grid encompassing the $30\times30\times30cm^3$ phantom. All comparisons were made in terms of absolute doses, Gy per incident particle.

Results:
For all 6 cases, maximum voxel-wise differences between EGSnrc and Acuros along the beam centerline were less than 2% of D_{max} or 1mm distance-to-agreement (DTA). Maximum voxel-wise differences along the transverse lines were less than 2% of D_{max} or 2mm DTA. Acuros calculation times were less than 5 minutes on a two processor AMD Opteron workstation.

Conclusion:
The results indicate an excellent agreement between both codes. Since Acuros calculation times are primarily dependent on the volume of the region being solved, and not on the number of beams, it is well suited for arc-therapy modalities.

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