AbstractID: 6641 Title: Whole Body and Distal Organ-Specific Dosimetry Using Parallel S_N Methods

Purpose: To create a new methodology for dose computations applicable to general medical physics applications, based upon a direct deterministic solution of the (3-D) Boltzmann transport equation (BTE).

Method and Materials: Using the multigroup discrete ordinates (S_N) deterministic method in the PENTRAN-MP (Parallel Environment Neutral-particle TRANsport-Medical Physics) code system, fluxes and corresponding doses were determined for a clinical test case using a UF Series B whole-body voxelized pediatric patient phantom. With a 90 keV planar x-ray source, we performed two sets of transport calculations based on the same phantom model, employing both the Monte Carlo (MC) and S_N methods. S_N calculations were performed using PENTRAN, and the MCNP5 code was used for MC calculations. Post processing in the PENTRAN-MP code system includes seamless parallel data extraction using the PENDATA code, followed by application of the 3D-DOSE code to compute dose in each phantom voxel, with dose-volume histograms for critical organs of interest.

Results: We demonstrate that the deterministic S_N and MC solutions are, in the vicinity of the source region, completely in agreement; the largest statistical error of the MC simulation was <5%, typically averaging <2%. Moreover, the deterministic S_N method also provided *globally converged results* in each voxel at sites distal to the source (in ~3 hrs on 16 processors), where the MC results on the same computing platform had significant out of field error, and would require a significantly longer running time (estimated at >2000 hrs) to produce meaningful results with an acceptable stochastic error to enable comparison with the well-converged S_N results.

Conclusions: A new methodology for 3D dose calculations has been developed based on a parallel discrete ordinates (S_N) solution of the BTE. With the proper discretization applied, the S_N method presents an accurate, fast solution yielding a complete 3-D dose distribution without stochastic error.