AbstractID: 5221 Title: ADAPTIVE DIFFERENCING SCHEMES WITH PAPRALLEL COMPUTING FOR DETAILED SN SOLUTIONS OF A Co-60 RADIOTHERAPY UNIT

Purpose: To apply deterministic techniques to provide a numerical solution for the 3-D integro-differential form of the Boltzmann transport equation using the discrete ordinates (S_N) method for a radiotherapy unit.

Method and Materials: Comparisons were made between deterministic and Monte Carlo simulations considering angular quadrature, spatial discretization (also spatial differencing), and cross section library selection. In order to assess these issues, we simulated the ^{60}Co beam from a standard *Eldorado* radiotherapy unit. In addition, we simulated the gantry, air gaps, and a water phantom. A 3-D spatial distribution was generated to yield a 24 'z-level' model of 150,000 fine mesh cells. To accurately compare our deterministic results with Monte Carlo, we considered an equivalent MCNP5 model with ENDF/B-VI cross-section data libraries and volumetric flux (F4) tallies along the central axis of the model.

Results: Overall, deterministic S_N results yielded good agreement with Monte Carlo results within the Monte Carlo stochastic error for the reference case. At the same time, the parallel S_N model provided a full 3D-scalar flux distribution over the entire geometry within an acceptable running time. To accurately represent the radiation transport, a quadrature level of at least S_{24} was required with an added ordinate splitting refinement of 6 directions of interest. These results where obtained when the Directional Theta-Weighted (DTW) differencing scheme was locked for the regions with low density material (air regions), and the adaptive differencing scheme with upgrades up to the Exponential-Directional Weighted (EDW) differencing scheme was prescribed for higher density regions.

Conclusions: The discrete ordinates (S_N) method provides a viable alternative to the Monte Carlo method for solving the Boltzmann transport equation. With the proper discretization, an adaptive differencing scheme, and suitable quadratures with ordinate splitting, the S_N method is a useful tool in determining the resulting radiation transport throughout a radiotherapy unit.