AbstractID: 3610 Title: Monte Carlo treatment planning: The influence of "variance reduction" techniques (ECUT, PCUT, ESTEP) on the accuracy and speed of dose calculations

Purpose: To investigate the influence of low energy electron cutoff values and electron step size on accuracy and speed of dose calculations in MC treatment planning over a range of anatomical sites. Because low energy cutoffs and electron step size are not true variance reduction techniques, they are likely (if not used judiciously) to systematically bias the results. Consequently, tradeoffs between accuracy and speed associated with the use of these parameters must be carefully examined over the range of sites encountered in MC clinical planning.

Methods: MC planning (using RT_DPM) was performed for several anatomical sites including the head/neck, lung and prostate. Plans generally consisted of complex, multiple segment fields using 6 and/or 15 MV photons. Multiple calculations were performed for each treatment plan in which each of the parameters, ECUT, PCUT, and ESTEP were independently varied. ECUT ranged from 10 to 500 keV for two values of PCUT, 10 and 50 keV – typical values encountered in clinical MC planning. ESTEP ranged from 2 to 5 mm. Additionally, the scoring voxel size was reduced from 5 to 2.5 mm^3 in some cases. All calculations were performed with sufficient histories for average uncertainties (1σ) of less than 1% within the PTV's.

Results: Evaluation a variety of dose metrics showed in some instances significant differences amongst plans using different cutoff and step values. We demonstrate that for treatment sites, such as the lung and head/neck, where low density structures are prevalent, even the use of conservative cutoffs (ECUT=50 keV) introduce significant systematic errors. In contrast, for homogeneous (water-like) sites, such as the prostate, the time savings associated with use of higher energy cutoffs may be taken advantage of without affecting the dose accuracy.

Conclusions: Further studies of energy cutoffs and step sizes are warranted before MC is used for routine clinical planning.