AbstractID: 7620 Title: Dose Accuracy Gains by Use of Monte Carlo in Routine IMRT Treatment Optimization

Purpose: To establish Monte Carlo (MC) as the primary dose engine for IMRT treatment plan optimization and quantify the benefits in routine use.

Methods: A virtual particle source model (VSM) was developed for and commissioned to standard and mini MLC geometries for photon beams of 6 and 15 MV. The model uses three particle sources with variable energy spectra and a simplified particle transport through the MLC. The VSM was used together with the patient model MC code XVMC inside the MLC segment shape optimization loop of an IMRT TPS. The performance of the VSM was gauged by extensive film and ionization chamber measurements of clinical treatment plans.

Results: The parameters of the VSM can be determined reliably from a set of large-field measurements in air and water, amended by small field cross-profile measurements for stereotactic applications (fields < 2 cm). An acceptance criterion of 2%/2mm can be met in almost all points. For stereotactic IMRT with a mini-MLC, an acceptance criterion of 3%/1mm could be met. The VSM, combined with XVMC, is efficient enough for routine use with computation times in the order of 15-60 min.
As a consequence of the reliability of dose computation, complicated MLC segment shapes need not be suppressed. Non-standard applications like IMRT for brain metastases can be implemented easily.

Conclusion: The accuracy of clinically used MC depends crucially on a properly commissioned accelerator head model. A dedicated VSM can be tuned to meet the highest clinically relevant accuracy criteria. Approximately 400 patients per year are treated with MC dose computation/IMRT at our hospital on three linacs. Indivdual patient QA measurements are performed only in exceptional cases.