AbstractID: 2819 Title: MCPI, An Accelerated Monte Carlo Dose-Calculation Engine for Real-Time Prostate Implant Dosimetry.

Purpose: To present a new accelerated Monte Carlo code (MCPI: Monte Carlo for Prostate Implant) intended for use as a dose calculation engine for planning clinical prostate implants. MCPI simulates physically a set of radioactive seeds with arbitrary positions and orientations, merged in a 3D CT-based heterogeneous phantom representing the prostate and surrounding tissue.

Material and Methods: MCPI uses a phase space data source-model to account for seed self-absorption and seed anisotropy. A "hybrid geometry" model (full 3D seed geometry merged in a 3D mesh of voxels) is developed for rigorous treatment of the interseed attenuation effect. MCPI is based upon the GEPTS general-purpose Monte Carlo code. Compton scattering, coherent scattering, and photoelectric effect (with emission of fluorescence X-rays) are modeled in detail, using the XCOM/EPDL97/NIST95 cross-section data. MCPI is benchmarked against the MCNP5 code for the case of an idealized prostate implant, consisting of 83 ^{103}Pd (or ^{125}I) seeds.

Results: MCNP5 and MCPI are in excellent agreement. The average difference between the dose distributions from the two codes is less than 0.5% for both seed models. **For a 2×2×2-mm^3 voxel mesh, MCPI calculates the ^{103}Pd and ^{125}I prostate dose distributions with 2% average statistical uncertainty in 2.1 to 2.2 minutes using a single Pentium 4 PC. More than 3 hours calculation time is required for MCNP5 to achieve the same statistical precision. MCPI is about 90 and 700 times faster than MCNP5 for 2 and 1-mm^3 voxels, respectively.**

Conclusion: The use of multiprocessor parallel calculation can further increase the speed of MCPI and makes sub-minute dose calculations for prostate implant planning a reality.