AbstractID: 1301 Title: A Deterministic Dose Calculation Method Applied to the Dosimetry of Shielded Intracavitary Brachytherapy Applicators

The performance of a novel deterministic dose calculation method, incorporating variably sized tetrahedral elements, was investigated to calculate the dose distribution in water around the Fletcher-Suit-Delclos (FSD) gynecologic applicator, containing four Selectron LDR ^{137}Cs pellets. The approach is based on the Attila radiation transport solver*, which solves the differential form of the linear Boltzmann transport equation for neutral and charged particles. The Attila geometry was created using a 3-D computer-aided-design program with all relevant applicator components modeled, including the rectal and bladder tungsten shields. Attila calculation parameters included 9 photon energy groups (CEPXS cross sections), P_2 scattering order, S_{18} angular quadrature and 35,000 tetrahedra (7×7×8 cm^3 domain). Analytic ray-tracing was performed to calculate the first collided source. Attila results were compared with MCNPX Monte Carlo simulations on a 7.5×7.5 cm^2 scoring plane located 1.25cm inferior to the ovoid central axis. Both Attila scalar flux and MCNPX track length estimator are modified by an energy-dependent heating function to obtain the average photon energy deposition, a good approximation of the collision kerma. The RMS difference between the two solvers over the scoring plane (1mm grid resolution) was 1.95%. Within 5 cm from the sources, differences were generally less than 2.5%. For this case, the MCNPX calculation time was 990 minutes (200 million particles, maximum dose estimate uncertainty <3%, 1.8 GHz Intel P4, scoring grid of 1×1×0.5 mm^3). The Attila calculation time on an equivalent processor, including ray tracing, was 19 minutes.

* Wareing TA *et. al*, Nucl. Sci. Engr., vol 138(2), 2001.