AbstractID: 8686 Title: Validation of a Monte Carlo model of the PET component of the Gemini GXL PET/CT

Purpose: To validate a Monte Carlo model of the PET component of the Gemini GXL PET/CT scanner (Philips Medical Systems) developed using the GATE simulation toolkit.

Method and Materials: The precise PET geometry was reproduced with the GATE toolkit, including the 17 864 GSO(Zr) crystals with dimensions of 4 mm x 6 mm x 30 mm. A series of standard tests from the NEMA NU 2-2001 protocol were simulated with the Monte Carlo model and compared to experimental data: sensitivity, spatial resolution, scatter fraction, and noise equivalent count rate. The sensitivity is evaluated through an extrapolation technique both in the middle and at a 10 cm radial offset of a uniform line source surrounded by known absorbers. The spatial resolution is given by the full width at half-maximum amplitude of the point spread function in the transverse and axial directions for compact radioactive sources in a glass capillary. The scatter fraction and noise equivalent count (NEC) rate are evaluated in a cylindrical phantom with variable radioactivity in a line source.

Results: For the sensitivity test, the simulations for both central and offset positions overestimate the measured sensitivity values by 4%. For the resolution test, the difference between experimental and simulated data is between 0.4 mm (radial resolution at 10 cm radius) and 1.3 mm (transverse resolution at 1 cm radius). For the scatter fraction, the simulated results are within 0.5% of the experimental data. For the count rate tests, the peak NEC rate is at (62.8+/-0.5) kcps in the simulation, which is 4% lower than the measurements. Globally, the agreement for the count rate is always better than 5% for all activities less than 17 kBq/cc.

Conclusion: The PET Monte Carlo model reproduces experimental validation data within acceptable limits. It is suitable for PET testing without experimental use of FDG.