

AbstractID: 1685 Title: Benchmark Dose Calculations of MCNP5 and PENELOPE Codes: Accuracy of Low-Energy Photon Cross-Sections in Monte Carlo Dose Calculations

The MCNP5/MCPLIB04 and PENELOPE 2001 Monte Carlo codes use the photon cross-sections from the updated EPDL97 library, and include Doppler broadening in Compton scattering processes. The significance of such improvements for low-energy photon transport, however, has not been reported. We computed radial dose distributions for $r = 0.2\text{--}10$ cm from a point source in a 50 cm-diameter water sphere, using PENELOPE and MCNP5 with MCPLIB04, MCPLIB03, or MCPLIB02 photon cross-section library. Nine discrete energies were chosen in 10–150 keV. The photoelectric cross-sections of MCPLIB03 and MCPLIB02 are based on the old Storm and Israel data, but MCPLIB03 contains the same Doppler broadening profiles as in MCPLIB04 and PENELOPE. We compared our results with published EGS4 data. The results from MCNP5/MCPLIB04 agreed with those of PENELOPE within statistical uncertainties ($\pm 2\%$) over the entire ranges of energies and radial distances investigated. They also agree well with previous EGS4 data within about $\pm 3\%$ (except for doses at $r < 1$ cm for 80–150 keV). MCNP5/MCPLIB02 or MCPLIB03, on the other hand, produced values up to 9% lower in the range of 20–100 keV than the other codes with updated cross-section libraries. The differences became negligible above 100 keV in the region $r < 5$ cm. The dosimetric effect of Doppler broadening for Compton scattered photons was not significant in the energy range investigated. The differences in doses calculated by MCNP5/MCPLIB03 (or 02) and EGS4 vs. MCNP5/MCPLIB04 and PENELOPE stem primarily from the differences in the photoelectric cross-section data used.