To date, no public domain Monte Carlo code has been validated for accurate simulation of both shape and intensity of diagnostic x-ray spectra. Given that Monte Carlo is the most powerful method available for simulating radiation transport processes, such a validated code would be of great use to the diagnostic radiological physics community. Our preliminary evaluations of MCNP4b indicate that it benchmarks well for general purpose x-ray spectra and that it needs improvement for mammographic spectra.

A major improvement in version 4b of the MCNP code, released in 1997, is an enhanced electron physics package. The new electron physics in the code produce electron backscatter factors for various target materials that agree within ~5% of measured data for incident electron energies down to about 10 keV. These tough benchmarking tests prove the viability of multiple scattering electron transport theories in the diagnostic energy range.

MCNP4b spectra matched within ~5% the absolute outputs (mR/mAs) and demonstrated similar shapes to semi-empirical spectra[1] at 70, 100, and 140 kVp. For mammography, the bremsstrahlung produced by MCNP4b at 30 kVp for a Mo-target was within ~10% of measured values. However, the characteristic K x-ray peak was more than twice that of the measured data. The poor result is entirely from inaccurate impact ionization cross sections in the code. Until these cross sections are updated, MCNP4b is not recommended for spectra production from mammography targets.

[1] IPEM # 78, Catalogue of Diagnostic X-ray Spectra and Other Data, Institute of Physics and Engineering in Medicine, 1997.