

AbstractID: 3433 Title: PSF and S/P in mammography: A validation of simulations using the GEANT4 code

Purpose: To study GEANT4 predictions for low-energy (10-40 keV) photon transmission and scattering through tissue-like thick matter, specifically to compare the predicted scatter to primary ratio (S/P) and line and point spread functions (LSF and PSF) against published and new measurements.

Method and materials: Using the GEANT4 code we have performed Monte Carlo simulations of the 1978 Barnes and Brezovich beam stop measurements of S/P, and the 2000 Cooper et al. edge detection experiments to evaluate S/P and LSF. Also, we have measured the PSF with a tungsten 1 mm diameter collimator on 3 – 6 cm thick lucite phantoms, using a Senographe 2000D unit operated at 26-28 kVp. In the simulations we have reproduced the exact experimental geometrical conditions, as well as the rest of parameters, according to the information contained in the original reports.

Results: The S/P simulation and data agree within 3-10% accuracy, depending on the data set. The largest difference is with respect to Cooper et al., probably partially related to an inaccurate simulation of the original experimental conditions. For the LSF, the agreement between simulation and data is better than 15%, and for our PSF, better than 12 % at distances smaller than 5 mm. This last value should be taken as an upper limit, because of the lack of complete information on the features of the clinical unit.

Conclusions: The analysis of these comparisons confirms that the GEANT4 predictions for low energy photon scattering are described with an accuracy better than 12%, at least up to 8 cm tissue thickness.