

AbstractID: 3669 Title: A Method for Computing Energy Spectra for Multiple Orders of Compton-Scattered Photons

Purpose: To compute the energy spectra for the first several orders of scatter for Compton-collided photons and to discuss the results with respect to radiation transport and radiation protection considerations.

Method and Materials: We assume that a population of monoenergetic, isotropically-emitting point sources is uniformly distributed throughout an infinite, homogenous medium, which is characterized by isotropic scattering and no absorption. With these assumptions, the Boltzmann transport equation is written as a function of energy only, and is numerically solved by the Neumann Series method, which treats the transport problem as a coupled set of integral equations – one for each order of collision.

Results: The differential energy spectra (photons / cm²-sec-MeV versus energy) for the first five orders of scatter are shown for a variety of initial photon energies in water, and in lead. These plots share several similar characteristics. First, the collision spectra become increasingly Gaussian-shaped with each increase in order of scatter. Second, the peak for each spectrum shifts to lower energies with each scatter. However, the magnitude of this energy shift decreases with each progressive increase in order of scatter. Finally, the shapes of the collision spectra do not depend on the scattering medium; only their scale changes according to a ratio of electron densities.

Conclusion: A tool has been developed to compute the energy spectra for the first five orders of Compton-collided photons that result after scattering from an arbitrary initial energy in a homogeneous medium of arbitrary material. These spectra illuminate properties of the Klein-Nishina formula for Compton collisions and are useful for radiation transport problems where one needs an estimate of the expected population of scattered photons in the Compton energy regime. Future work will build photoelectric absorption into the model.