Comparison of Compton Scattering Energy Differential Cross-section simulated in GEANT4 to the Klein-Nishina Formula Using Silicon as Target

1 Abstract

Implementation of the compton scattering process in GEANT4 using 25 keV photons incident on silicon (Si) target is evaluated and compared to the theoretical prediction calculated by Klein-Nishina formula.

2 Discussion

The compton scattering differential energy cross-section of 25 keV photons interacting with target as a function of energy is calculated using Klein-Nishina formula. 30 cm thick Si target is constructed in GEANT4. 25 keV incident photon interacts with the Si target exclusively through “G4ComptonScattering” process defined in the physics list. 1000000 events are simulated and the differential cross-section is deduced. The results of the theoretical calculations are compared to GEANT4 simulation results and presented in Figure 1.

Figure 1: Comparison of compton scattering energy differential cross-section calculated by Klein-Nishina formula to GEANT4 simulation using “G4ComptonScattering” process.

The total area under the curve is 35 percent higher for the theoretical model than the GEANT4 simulation.
Implementation of “G4LowEnergyCompton” process in GEANT4 was also evaluated. 25 keV incident photon interacts with the Si target exclusively through “G4LowEnergyCompton” process defined in the physics list. 1000000 events are simulated and the differential cross-section is deduced. The results are compared to the theoretical prediction by Klein-Nishina formula and are presented in Figure 2.

![Comparison of compton scattering spectra for 25 keV photons incident on 30 cm silicon target](image)

Figure 2: Comparison of compton scattering energy differential cross-section calculated by Klein-Nishina formula to GEANT4 simulation using “G4LowEnergyCompton” process.

The total area under the curve is 33 percent higher for the theoretical model than the GEANT4 simulation.
References

[1] Class notes