1 Abstract

The purpose of this report is to compare the relative rates for the PhotoElectric, Compton, and Pair Production physics processes with GEANT4 simulations.

2 Methodology

The simulation geometry involves a photon source interacting with the target material, which for this exercise is chlorine gas at standard temperature and pressure. The geometry is completely linear with the target perpendicular to the gamma beam. The target thickness is set to 20 cm. A tally is included in routine SteppingVerbose.cc to distinguish the three processes and extract the position and momentum during the execution [1]. In addition, the tally generates the energy deposited for the photoelectric effect and the energy of the scattered electron for Compton scattering. The GEANT4 physics processes selected for this study include G4LowEnergyPhotoElectric, G4LowEnergyCompton, wG4LowEnergyGammaConversion.

A broad energy range, from 100 eV to 10 GeV, is included in the study. The energy of the gamma beam is sequentially increased and for each energy step 1000000 gammas are tracked. The range is decomposed into a low energy range from 100 eV to 1 Mev and executed in steps 10 KeV, and a high energy range from 1 Mev to 10 Gev and executed in steps of 10 MeV.

3 Results

Figure 1 shows the number of events recorded as a function of energy for the following processes: (1)PhotoElectric, (2)Compton, and (3)Pair Production. Photoelectric dominates the low energy range, Compton predominates in the middle range, and Pair Production takes over in the high energy range.
Figure 1: Energy dependent photon interactions in GEANT4
References