

Comparing Geant4 Simulated and TALYS-1.8 Code Evaluated Cross-Section Data for 4.438 MeV Gamma ray Line of ^{12}C

V. Ramanathan

Department of Radiography & Radiotherapy, Faculty of Allied Health Sciences, General Sir John Kotelawala Defence University, Werahera, Sri Lanka

In present, Monte-Carlo transport code plays a major role in developing detectors, particularly the Geant4 Monte-Carlo code due to its versatility and flexibility for different applications. Although, the Geant4 has been an invaluable tool for the development of devices, the discrepancies in prompt gamma cross-section data for prominent elements of human body has been reported in the range of proton therapy (50 -250 MeV). Even though, the binary cascade model has been suggested in proton therapy range, the problems with prompt gamma production cross-section have been reported. The aim of this study is to compare Geant4 simulated and TALYS evaluated prompt gamma cross-section data of 4.438 MeV photo peak of ^{12}C to identify the inconsistency in the cross-section data. TALYS is a nuclear reaction study software which can be used to simulate nuclear reactions in the energy range of 1 keV to 200 MeV. The Geant4 model of AFRODITE detector system has been modeled to mimic the iThemba LABS AFRODITE detector system. The Geant4 AFRODITE model was validated using three standard gamma emitting sources (^{60}Co , ^{137}Cs , and ^{152}Eu). The absolute detector efficiency of the Geant4 AFRODITE model also was determined. In the cross-section measurement simulation study, 10^{12} proton histories were used to collide the carbon and mylar target in the proton energy range of 66 – 125 MeV. The same procedures were performed experimentally using AFRODITE clover detector system. Further, TALYS 1.8 code was used to simulate the proton interaction with carbon target in the range of 5 to 150 MeV. As with the 4.438 MeV cross-section data comparison, there is a significant inconsistency between Geant4 simulated and TALYS simulation and also with experimental data set. To improve the accuracy of Monte-Carlo simulation study, more experimental cross-section data and the evaluation of proper physics models of Geant4 Monte-Carlo transport code in proton therapy range are future need.

Keywords: Geant4 Monte-Carlo transport code; TALYS; Prompt gamma production; Proton therapy

Corresponding author. Tel.: +94-77-085-7167
E-mail address: vijitha.r@kdu.ac.lk