Measurements of Electron Response and Average Energy Required per Scintillation Photon in Plastic Scintillators for Gamma Rays (II)

SOKENDAI[1], KEK[2], Waseda Univ.[3], Ngan N.T. Tran[1], Shinichi Sasaki[1,2], Toshiya Sanami[1,2], Yuji Kishimoto[1,2], Eido Shibamura[3]

E-mail: ngantran@post.kek.jp

Previously, we have introduced preliminary data of the relative scintillation yield per unit energy deposited by electrons (called as "electron response"), which are measured by Compton Coincidence Technique (CCT), and of average energy required per scintillation photon W_s in plastic scintillators (EJ-200, EJ-212, EJ-252). In this study, W_s values in these plastic scintillators are re-evaluated in consideration of photon transport evaluation in a scintillator-photomultiplier tube system. W_s is defined as E / N_{ph}, where E is the deposited energy in the scintillator and N_{ph} is the number of scintillation photons produced. New data of deposited energies E in these plastic scintillators are measured by CCT and N_{ph} is calculated relatively to the N_{ph} in a CsI(Tl) scintillator. The N_{ph} in the CsI(Tl) is determined from the combination of the absolute number of photoelectrons (measured for a 2-inch diameter and 2-inch length crystal coupling to a photomultiplier tube (PMT) operated as a photodiode, the system is irradiated with gamma rays), the calculation of collection efficiency of scintillation photons at the PMT photocathode using Monte Carlo simulations and experimental determination of photon-to-photoelectron conversion efficiency at the PMT photocathode. Employing W_s values, the absolute light yield of plastic scintillators can be evaluated and then compared with light yields of other scintillators.