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

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The light output is one of the most concerned parameters in scintillators. For plastic scintillators, however, the scintillation yield such as an average energy required to produce one scintillation photon, W_s, is not known accurately at present. The departure from proportionality of their scintillation response with the deposited energy of electrons is mainly pronounced at low energies but has not been examined in detail. In the present study, in order to investigate the relative scintillation response per unit energy deposited by electrons (called as "electron response") and to further determine W_s in plastic scintillators, deposited energies in plastic scintillators of EJ-200 and EJ-212 are carefully measured using the Compton Coincidence Technique (CCT). The CCT employs the combination of two separated detectors (one plastic scintillator and one NaI(Tl) scintillator) which are operated in coincidence. By selecting only the coincidence events between two detectors, specifically deposited energy in the scintillators can be measured by incident gamma rays which are scattered at a specific angle. The experiments are conducted at several scattering angles for evaluating the electron response, and for determining the Compton edge the results obtained from experiments at a scattering angle of 180° are used. The pulse height distribution spectrum of ^{137}Cs measured with a plastic scintillator (Pilot-U) using CCT at the scattering angle of 180° is shown in Fig.1. The Compton edge obtained in the CCT experiment is at 311 channel, while the edge obtained from a fitting method is at 324 channel. The discrepancy between two methods is approximately 4%. The experimental method and results will be presented in detail at our presentation.

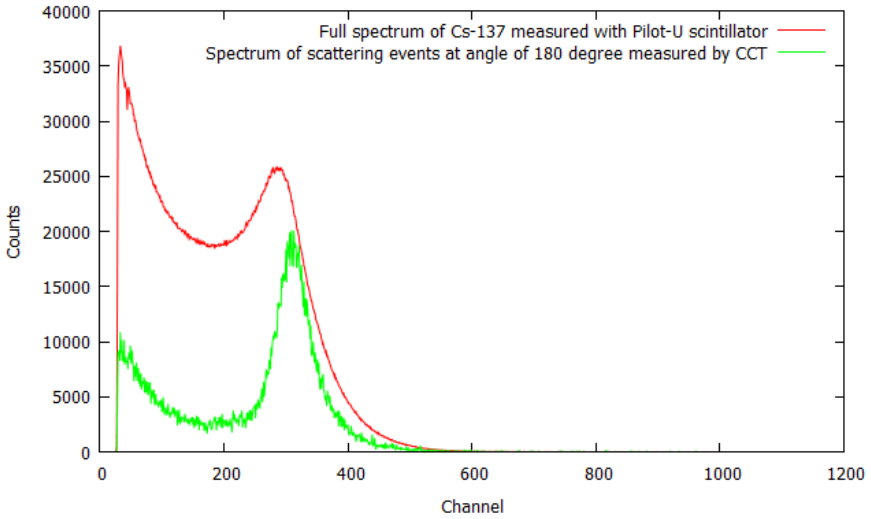

Fig.1. Pulse height distribution spectra of ^{137}Cs measured with Pilot-U scintillator