5 - 15 Study on Energy Resolution of EJ301 Organic Liquid Scintillator

Zhang Suyalatu, Chen Zhiqiang, Han Rui, Liu Xingquan, Lin Weiping
Jin Zengxue, Liu Jianli and Shi Fudong

The γ source geometry, the position of the source, the size of the detector and the detector walls, and the resolution function of the detector system is strongly affected the shape of the light output distribution of the detector. The resolution function of detector can be described by well-known formula[1-4].

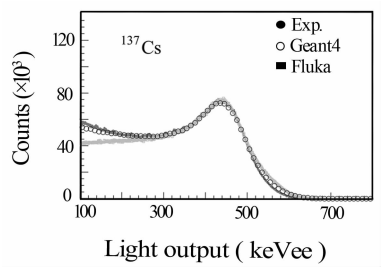

Fig. 1 Comparison of the experimental light output with simulation results.

$$\frac{\Delta L}{L} = \sqrt{\alpha^2 + \frac{\beta^2}{L} + \frac{\gamma}{L^2}}$$

This formula describes light output resolution of the detector due to various effects. The first term α describes the locus dependent light transmission from the scintillator to the photocathode; the statistical variation of the conversion of light to photoelectrons was described by second term β; the third term γ due to the noise contributions from the dynode chain. The resolution parameters for any particular detector set-up must be determined either experimentally by means of mono-energetic photon and neutron sources or theoretical estimates.

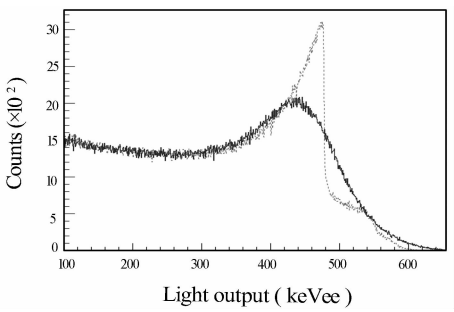

Fig. 2 Simulated Compton electron spectrum from a ^{137}Cs source and the same spectrum folded with resolutions 5.03%.

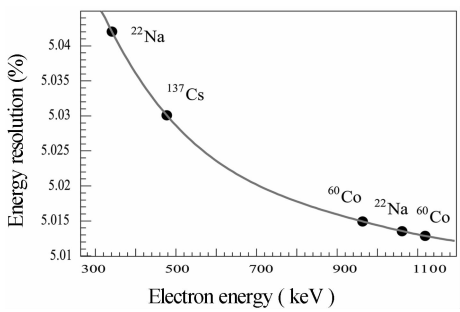

Fig. 3 Energy resolution of 5 cm diameter×20 cm thick EJ301 scintillator detector as a function of the electron energy.

In this work, the values of the parameters α, β, γ have been obtained by comparing the simulated spectrum of gamma sources with the respective experimental data, as shown in Fig. 1. α=0.05, β=0.12, γ=0.002 are best for standard ^{22}Na, ^{60}Co, ^{137}Cs gamma sources. Fig. 2 shows a Geant4 simulated Compton electron spectrum with ^{137}Cs gamma source and the same spectrum folded with the energy resolution of 5.03%. It's indicated that simulated spectrum has to be folded with energy resolution of the detector for comparison with experimental data. In Fig. 3, relations for the energy resolution of the detector as a function of the electron energy are given.

References

[1] J. X. Chen, Z. M. Shi, G. Y. Tang, Nuclear Electronics and Detection Technology, 14(1994)140.
[2] Yan Jie, et al., Chinese Physics, C34(2010)993.
[3] G. Dietze, IEEE Trans. NuclSci., NS26(1979)398.
[4] G. Dietze, H. Klein, Nucl. Instr. and Meth., B193(1982)549.