Q_β MEASUREMENT USING A TOTAL ABSORPTION DETECTOR WITH SIMULATED RESPONSE FUNCTIONS BY EGS4

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We are developing a high-efficient HPGe detector, what we call a total absorption detector, to measure Q_β-values far from the β stability without knowledge of the decay scheme (Fig.1) [1]. Owing to an actually geometrical condition, the measured β-spectra are distorted. We tested the detector performance by analyzing Q_β-values of nine nuclides produced with the (n,γ) reaction, whose Q_β are well evaluated. We analyzed the β-spectra by means of the folding method with simulated response functions for monoenergetic electrons and photons.

The response function for a monoenergetic electron is shown in Fig.2. We divided response functions into three components. The folded β-spectra by the original response functions agreed with experimental spectra in 500 keV below Q_β. In order to obtain the spectra agreed in the much wider energy region, we modified the response functions as shown in Fig.2 (bold line): the intensity of A was decreased, while the B and C were increased. As the result, folded β-ray spectra agreed with experimental ones in 2 MeV below Q_β. A systematic uncertainty is evaluated to be 10 keV by differences from evaluated values [2] for nine nuclides (Fig.3).

We found that experimental spectra were well reproduced using modified response functions. We are going forward with research on Q_β determination for the nuclides far from the β stability.

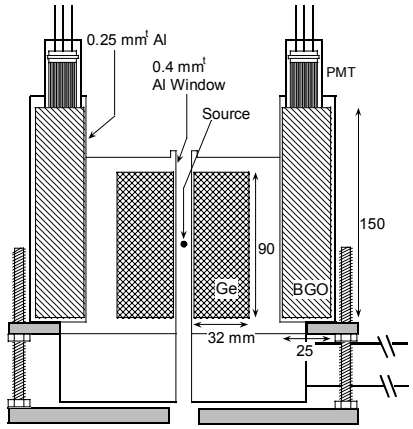

Fig.1 Schematic view of the total absorption detector, which is composed of the true coaxial HPGe detector, and the BGO scintillator for Compton suppression.

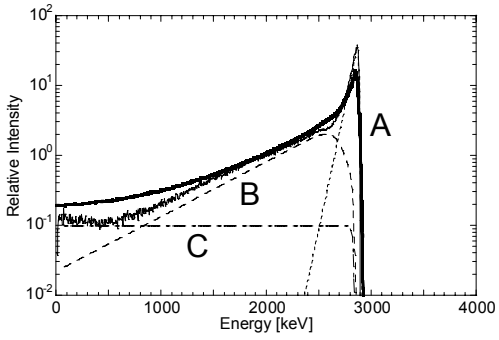

Fig.2 An electron response function for incident energy of 3 MeV. It is constructed of 3 parts; (A) full energy peak, (B) multi-scattering and photon escapes, (C) side scattering. A bold line shows modified response function.

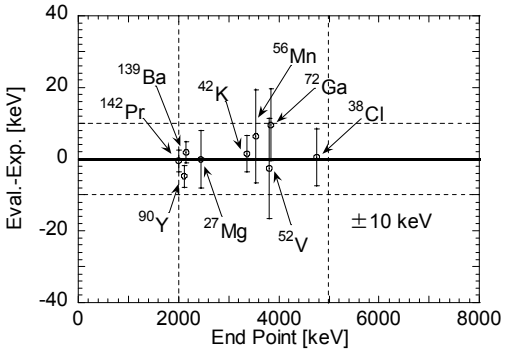

Fig.3 A comparison between experimental values and evaluated values [2]. Each data is deviated within 10 keV.

[1] H. Hayashi *et al.* "Q_β measurement using a well-type HPGe detector", Symposium on Nuclear Data, Japan Atomic Energy Research Institute, Nov.27 2003.
[2] G. Audi *et al.*, Nucl. Phys. A729 p.337-676 (2003).