Calculations of an HPGe Detector Peak Efficiency Curve up to 11 MeV with EGS4 and GEANT4

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A precise efficiency curve up to 11 MeV is needed for the precise determination of γ-ray intensities. The major method of the determination of a peak efficiency curve of an HPGe detector is by fitting measured data sets. This method has a maximum deviation of 2 % in this energy range [1]. In this work, we attempted to construct an efficiency curve up to 11 MeV with 0.5 % accuracy with the aid of the Monte Carlo cords EGS4 and GEANT4.

The peak efficiencies of a 22 % coaxial HPGe detector were measured by using decay γ-rays from ^{24}Na, ^{56}Co, ^{88}Y, ^{133}Ba and ^{152}Eu sources in the energy range of 0.3- 3 MeV, and prompt γ-rays from ^{14}N(n,γ)^{15}N reaction in the energy range up to 11 MeV. The measured efficiencies were compared with EGS4 and GEANT4 (Fig. 1). The detector specifications used in calculations were adjusted so that the calculated values agree with the measured efficiencies in the energy range of 0.3 - 2 MeV because the measured efficiencies in this energy region have high reliability. The EGS4 values were becoming smaller systematically to measured efficiencies in the energy range of 2 - 11 MeV. On the other hand, GEANT4 values were becoming larger systematically in the same energy range. Differences between the calculation and measured values were within 0.5% (Fig. 2). The calculation is corrected for the deviation from EGS4.

We can determine an efficiency curve up to 11 MeV with 0.5 % accuracy by using of the calculations.

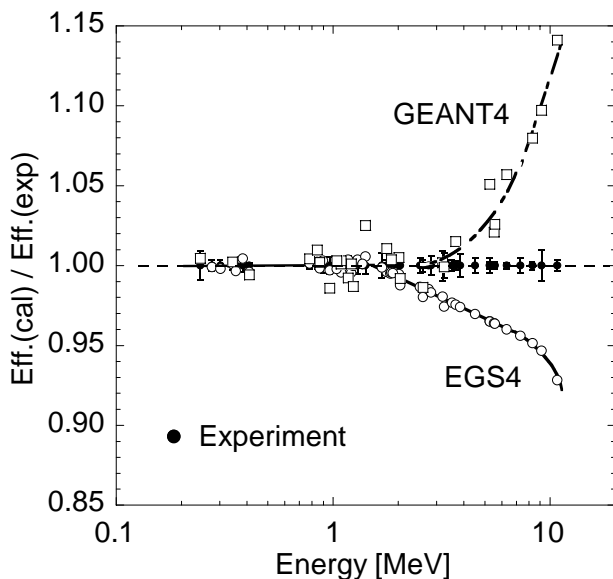[1] S. Raman *et al.*, Nucl. Instr. Meth. A 454 (2000) 389-402

Fig. 1 The ratio of EGS4 and GEANT4 values to measured efficiencies. The lines are eye guides.
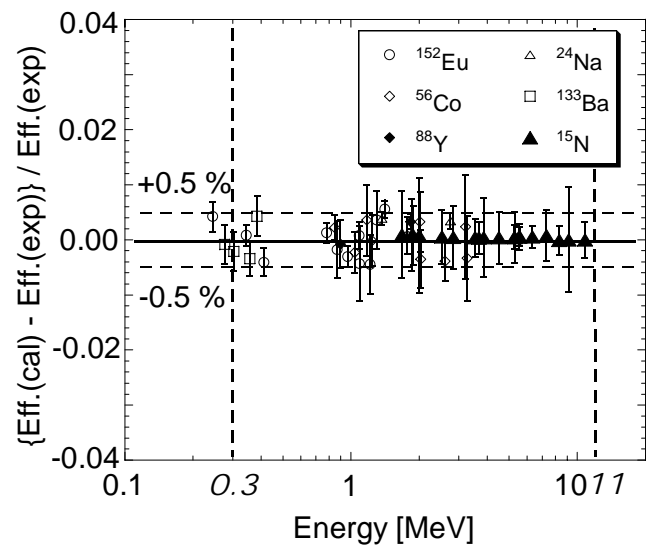

Fig. 2 Differences between the ratios of calculation to measured efficiencies. The calculation is corrected for the deviation from EGS4.