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EXPERIMENTAL AND CALCULATED PHOTOPEAK EFFICIENCIES FOR A COAXIAL Ge(Li) DETECTOR*

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Experimental and calculated photopeak efficiencies have been obtained for a 32 cm³ true coaxial Ge(Li) detector at four distances: 2 cm, 5 cm, 10 cm and 20 cm. A comparison of these results is presented.

During the past few years several papers discussing the experimental efficiency calibration of Ge(Li) detectors have appeared[1–7]). Recently a paper by Aubin et al.[8]) describing a Monte Carlo computer program to calculate the efficiency of planar and true coaxial Ge(Li) detectors has been published. The present investigation was undertaken to provide a comprehensive comparison between the calculated results obtained with this program and experimental results obtained with the pair-point method[1–4]). Ten sources were used to obtain the data for the experimental officiency curves of fig. 1: ^{22}Na, ^{60}Co, ^{46}Sc, ^{108m}Ag, ^{88}Y, ^{24}Na, ^{180m}Hf, ^{137}Cs, ^{139}Ce and ^{160}Tb. The program of Aubin et al.[8]) was run on the PDP-10 computer of the University of Michigan physics department. Several hours of running time were required to obtain the data for each source-to-detector distance. Photon cross sections used in the calculations were taken from the work of Storm and Israel[9]); detector dimensions were

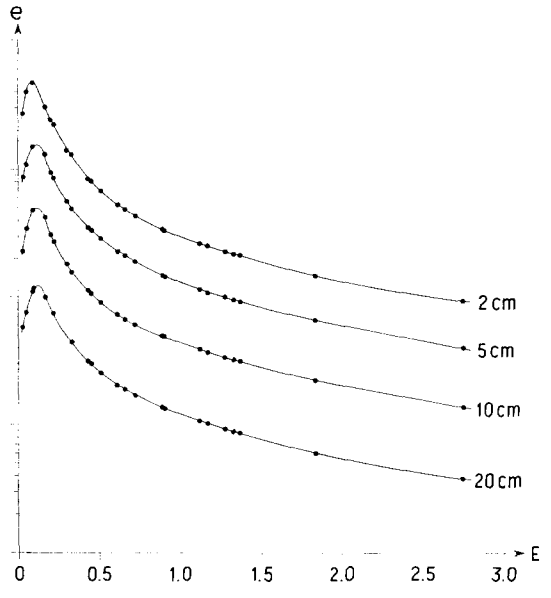

Fig. 1. The photopeak efficiency (e) of a 32 cm³ true coaxial Ge(Li) detector (diameter 35.8 mm; length 39.2 mm; drift depth 11.8 mm; diffusion depth 0.9 mm) for a point source on the symmetry axis of the detector at distances 2, 5, 10 and 20 cm from the face of the detector. The scale of the ordinate is logarithmic; the scale of the abscissa is linear and the units are MeV. The absolute efficiencies at 2, 5, 10 and 20 cm are 2.15×10^{-3}, 9.40×10^{-4}, 3.17×10^{-4}, and 8.81×10^{-5}, respectively, for the 1333 keV gamma ray of ^{60}Co. Here we understand absolute efficiency to mean the probability of the emission of a photon into an appropriate solid angle and its subsequent detection as a photoelectric event.

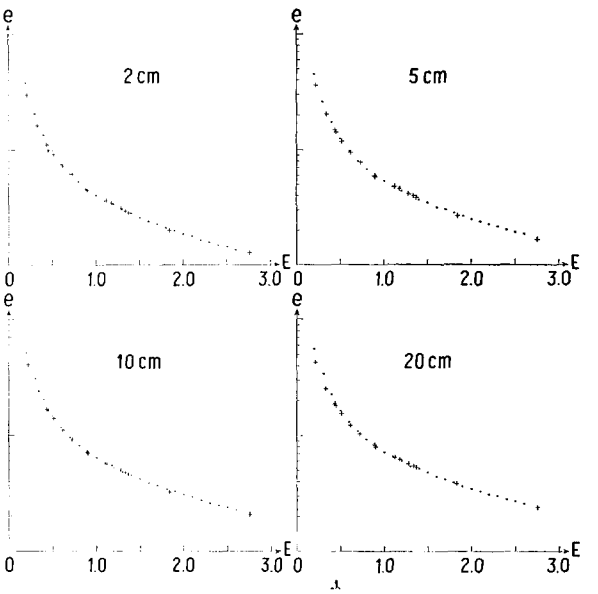

Fig. 2. A comparison of experimental and calculated photopeak efficiencies (e) for a 32 cm³ true coaxial Ge(Li) detector. The experimental values were overlapped with the calculated values visually to obtain the best fit. The scale of the ordinate is logarithmic; the scale of the abscissa is linear and the units are MeV. The dots represent calculated values and the crosses represent experimental values.

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taken from the specifications of the manufacturer (Ortec). A comparison between experimental and calculated values is shown in fig. 2. Because of the fact that the computer program can not reproduce the hump [produced by attenuation in the surroundings of the Ge(Li) crystal] at the low-energy end of each of the curves shown in fig. 1, the data of fig. 2 start at an energy well beyond this hump (0.2 MeV). As fig. 2 shows, the agreement between experimental values and calculated values is excellent.

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