

2.6. Polarimetric efficiency of a planar Ge(Li) detector

B. MOLAK, K. ILAKOVAC and J. NOSIL, *Institute »Ruder Bošković«, Zagreb*

Application of a single Ge(Li) planar detector^{1,2)} to measurements of the degree of linear polarization of gamma rays has some advantages over the coincidence spectrometers: it is simple and reliable and the detection efficiency is relatively high. The main disadvantage is a lower polarimetric efficiency.

An Ortec Ge(Li) planar detector of $\phi 18 \times 3$ mm was used for measurements of linear polarization. Since the detector could not be rotated, a system was built by means of which the plane of polarization was rotated, other conditions being unchanged (see Fig.). To determine the polarimetric efficiency of the system for different gamma-ray energies, Compton scattering of 662 keV, 1173 and 1332 keV gamma rays was used. The degree of polarization of secondary Compton photons (P_C) obtained by scattering in graphite at a number of angles, was calculated. From the measured asymmetry of the counting rates $A = (N_1 - N_2)/(N_1 + N_2)$ the polarimetric efficiency $\varepsilon = A/P_C$ was calculated. N_1 and N_2 are the counting rates when the plane of polarization is parallel and perpendicular to the plane of the detector, respectively.

An approximate formula for the polarimetric efficiency has been derived

$$\varepsilon \approx F \cdot \frac{d\sigma_C(E, \Theta)}{d\Omega} \cdot P_C(E, \Theta) / \sigma_{tot}, \quad (1)$$

where $d\sigma_C/d\Omega$ and P_C are the differential cross section and the degree of linear polarization of photons of incident energy E when scattered by the Compton effect at an angle Θ , for which the product is maximum, σ_{tot} is the total cross section for the absorption of gamma rays and F a normalizing factor. A comparison of the results of measurements and of the calculated values of ε_{th} is given in the Table on the p. 16.

References

- 1) J. Honzátko and J. Kajfosz, ČS Akad. Véd Report 2113-F (1968); Czech. J. Phys. **B19** (1969) 1218;
- 2) G. T. Ewan, G. I. Anderson, G. A. Bartholomew and A. E. Litherland, Physics Letters **29B** (1969) 352.-

2.7. Tests and calibration of a 3D system

K. ILAKOVAC, M. JURČEVIĆ and B. MOLAK, *Institute »Ruder Bošković«, Zagreb*

Multiparametric analysis of events has become a widely applied technique in complex experimental methods of investigation in nuclear physics. A three-dimensional (3D) system of $256 \times 256 \times 256$ channels (24 bit) with the provision for extension up to 36-bit recording of data has been built in the Department of Electronics in the Institute. It is used in connection to a double- or triple-input fast-slow electronic system. Coincident data are analyzed in three ADC-s and the channel numbers recorded on punched paper tape. The total number of channels

TABLE
Polarimetric efficiency of planar Ge(Li) detectors.

E0(MeV)	0.233	0.288	0.382	0.475	0.570	0.660	0.847	1.368	1.779	4.43
$\epsilon^{(a)}(\%)$	3.98 ± 0.12	5.06 ± 0.10	5.61 ± 0.09	6.5 ± 1.2	5.5 ± 0.7	7.2 ± 1.0				
$\epsilon^{(b)}(\%)$	—	—	—	5.68 ± 0.17	—	—	7.85 ± 0.5	5.20 ± 0.75	6.3 ± 0.8	3.2 ± 0.5
$\epsilon^{(c)}(\%)$	4.37	4.95	5.65	6.03	6.21	6.26	6.26	5.82	5.27	2.53

a) our result with an $\varnothing 18 \times 3$ mm detector, increased by an estimated factor of 1.1 for comparison. with results (b);
 b) results of Ewan et al.²⁾, divided by a factor of 2 to have the same definition of asymmetry A;
 c) values for $\Theta = 40^\circ$ calculated from formula (1).

is extremely large and presents difficulties in the analysis of data. A programme for the analysis of double decay processes in the decay of nuclear levels has been written in the Real Time Fortran language for the off-line analysis of data in a CAE 9040 computer.

The system was electronically tested for linearity, time resolution, stability etc. For the measurements of a double gamma decay in which two coaxial Ge(Li) detectors were applied, a calibration of the system was made by Compton scattering of gamma rays from one detector into another. The time difference between the pulses from the two detectors was recorded in one channel and the amplitudes of the pulses in the other two channels. The calibration measurements yielded a straight line in the amplitude 1 — amplitude 2 diagram, since a continuous distribution of energy deposited in each detector was obtained (due to the variation of the scattering angle), with the condition of a constant sum. The same applied in the case of double decay. A detailed investigation of the time spectra (time dimension) along the constant sum line was made. When one amplitude increases the other decreases, and this causes shifts (of about 30 ns) of the time distributions. A considerable improvement of the time resolution was obtained when corrections for these shifts were introduced in the analysis of data, depending on the channel numbers of amplitude 1 and amplitude 2.

2.8. Automatic analysis of the gamma radiation spectra

I. SLAVIĆ, *Institute »Boris Kidrič«, Beograd*

2.9. The short dead time of halogen parallel plate counters

V. HENČ-BARTOLIĆ, *Faculty of Electrical Engineering, Zagreb*

Introduction. The investigation of properties of halogen (Ne-Br₂) parallel plate counters of the Srdoč type¹⁾ revealed the possibility of constructing counters with a dead time shorter by an order of magnitude than that of cylindrical GM counters.

In general, the decrease of the impedance connected to the counter causes the reduction of the dead time. The dead time of parallel plate counters with low impedance (300 k Ω) and the pressure ratio $P_{Br_2} : P_{Ne} = 100$ is short, less than 10 μ s. In particular cases, if P_{Br_2} is 1.2 torr and the distance between the electrodes 3 mm, the dead time is 6 μ s.

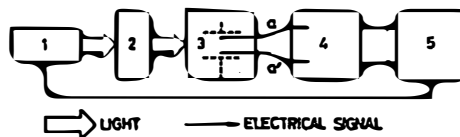


Fig. 1.

To explain this phenomenon, the discharge in the counter caused by gamma or beta particles was measured using the experimental setup described below.