

⁶⁶Ga: A Standard for High-Energy Calibration of Ge Detectors

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The response of Ge detectors varies with the energy of γ rays because the photoelectric, Compton, and pair production cross-sections depend on this quantity. Thus, there is a need for calibrating the efficiency of such detectors throughout the energy range of interest. There are several commercially available radioactive sources that are commonly used for calibrating Ge detectors, such as ²²Na, ⁵⁴Mn, ⁵⁶Co, ⁵⁷Co, ⁶⁰Co, ⁸⁸Y, ¹³³Ba, ¹³⁷Cs, ¹⁵²Eu, ¹⁵⁴Eu, ²⁰³Hg, ²⁰⁷Pb, ²²⁸Th, and ²⁴¹Am, for which γ -ray emission probabilities are known with a precision of 1-3% [1]. However, although these radionuclides emit γ rays strong enough to be of practical use as standards, their energies cover a limited range of 14-3500 keV.

⁶⁶Ga is a suitable radionuclide for calibration in that, despite its relatively short half-life of 9.5 h, it can be produced readily through the ⁶⁶Zn(p,n) and ⁶³Cu(α ,n) reactions, and then used as a secondary standard to extend the calibration energy range to 4806 keV. Also, the γ -ray multiplicity of ⁶⁶Ga is low; consequently, any correction for coincidence summing will be small (provided that low-energy X-rays from the electron-capture process do not reach the detector). To use ⁶⁶Ga as a standard, however, its γ -ray emission probabilities must be known accurately. It is here that a serious problem exists, because the measurements of Camp et al. [2] did not provide accurate emission probabilities for γ rays in the 3000-5000 keV range. To remedy this situation, new independent emission probability measurements were undertaken at Lawrence National Berkeley Laboratory, and at Budapest. Table 1 shows the results of these measurements, as well as those of Camp et al. [2].

Footnotes and References

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[1] IAEA-TECDOC-619, *International Atomic Energy Agency, Vienna, 1991.*

[2] D.C. Camp and G.L. Meredith, Nucl. Phys. **A166**, 349 (1971).

E_γ (keV)	I_γ (rel.) Camp <i>et al.</i> [2]	I_γ (rel.) Berkeley	I_γ (rel.) Budapest
833	15.92 (17)	15.93 (14)	15.92 (6)
1039	100.0	100.0 (9)	100.0 (3)
1333	3.25 (4)	3.20 (3)	3.171 (13)
1419	1.70 (3)	1.641 (23)	1.659 (8)
1508	1.520 (24)	1.503 (23)	1.496 (7)
1899	1.09 (4)	1.063 (23)	1.050 (8)
1918	5.63 (8)	5.44 (6)	5.360 (23)
2190	15.06 (18)	14.50 (15)	14.39 (6)
2422	5.16 (5)	5.15 (6)	5.072 (24)
2752	61.2 (6)	61.5 (6)	61.34 (26)
3229	3.96 (4)	4.07 (4)	4.087 (22)
3381	3.78 (4)	3.99 (4)	3.950 (23)
3422	2.18 (4)	2.29 (3)	2.321 (16)
3791	2.68 (3)	2.95 (4)	2.929 (24)
4086	3.07 (4)	3.42 (4)	3.455 (20)
4295	9.17 (11)	10.51 (15)	10.25 (7)
4461	1.875 (22)	2.20 (4)	2.275 (23)
4806	3.82 (4)	4.99 (6)	5.04 (3)

Table 1. Measured Relative γ -Ray Emission Probabilities for ⁶⁶Ga