PRECISION ENERGY MEASUREMENTS OF HIGH ENERGY GAMMA RAYS OCCURRING IN THE DECAYS OF ^{46}Sc, ^{82}Br, ^{99}Mo AND ^{110}Ag^m *

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Curved-crystal spectrometers have been utilized to determine the energies of 21 gamma rays following the decays of ^{46}Sc($T_{\frac{1}{2}}=83.8$ d), ^{82}Br($T_{\frac{1}{2}}=35.4$ h), ^{99}Mo($T_{\frac{1}{2}}=66.6$ h) and ^{110}Ag^m($T_{\frac{1}{2}}=25.3$ d). Seventeen of these gamma rays have energies in the range between 550 keV and 1121 keV and thus provide a number of calibration standards which supplement the earlier standards published by Raeside and others.

Two previous papers have given exact measurements of gamma ray energies from 45 keV to 592 keV which are suitable for the calibration of Ge(Li) spectra[1,2]. The primary purpose of this paper is to present exact measurements of gamma ray energies from 550 keV to 1121 keV which are suitable for the calibration of Ge(Li) spectra.

The University of Michigan 2 m-quartz (310) curved-crystal spectrometer was used to obtain the 40.5845 keV gamma ray energy measurement in the decay of ^{99}Mo, all other measurements were obtained on the University of Michigan 2m-Ge (0$\bar{2}$2) curved-crystal spectrometer. A description of the design of this spectrometer and the various experimental techniques associated with its use have been given elsewhere[3,4]. For the most frequently used source width the Ge(0$\bar{2}$2) crystal had an energy resolution given by ΔE (fwhm) = (2.3×10^{-5}) (E^2/n), where n is the order of reflection and E is the gamma ray energy in keV. The Q(310) crystal had an energy resolution given by ΔE(fwhm) = (1.2×10^{-5}) (E^2/n) for the ^{99}Mo sources. The Ge(0$\bar{2}$2) crystal was calibrated using the 411.794±0.008 keV gamma ray occurring in the decay of ^{198}Au[5–7]), while the Q(310) crystal was calibrated using the 59.31918± 0.00035 keV K_{α_1} X-ray of tungsten[6–8]).

All samples were produced in the University of Michigan Ford nuclear reactor (thermal neutron flux ≈ 10^{13} neutrons/s cm^2). All of the samples were fabricated using natural sources.

Measurements were taken in the highest order permitted by gamma ray intensity and counting time.

All final energy values are the average of the values obtained in several runs. The results are presented in table 1.

TABLE 1
Curved-crystal spectrometer energy measurements of some of the gamma rays occurring in the decays of ^{46}Sc, ^{82}Br, ^{99}Mo and ^{110}Ag^m.

Isotope	Energy (keV)
^{46}Sc	889.253 ± 0.028
	1120.506 ± 0.046
^{82}Br	554.333 ± 0.015
	619.034 ± 0.046
	698.337 ± 0.037
	776.495 ± 0.026
	827.801 ± 0.081
^{99}Mo	40.5845 ± 0.0016[a]
	140.508 ± 0.004
	181.063 ± 0.008
	366.426 ± 0.032
	739.576 ± 0.062
^{110}Ag^m	657.748 ± 0.027
	677.594 ± 0.036
	687.012 ± 0.043
	706.690 ± 0.033
	744.252 ± 0.059
	763.911 ± 0.032
	818.025 ± 0.036
	884.668 ± 0.028
	937.476 ± 0.042

[a] The Q(310) crystal was used for this measurement, all other measurements utilized Ge(022) crystal.

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