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The low-energy gamma-ray spectrum of ^{75}Se

J L Campbell

Department of Physics, University of Guelph, Guelph, Ontario, Canada

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Absstract. The gamma-ray spectrum of ^{75}Se below 30 keV has been recorded with a guard-ring Si(Li) spectrometer. No evidence was found to support a recent observation of a 14·9 keV gamma ray; the upper limit for its intensity was 0·0017 relative to I_γ (264·6 keV) = 100.

Thomas and Thomas (1973) recently reported a Ge(Li) x-ray detector study of low-energy gamma rays emitted during radioactive decay of ^{75}Se. Their results are compared with other work in table 1. Their intensity for γ24·4 is about twice that found by other workers, and they found evidence for a new gamma ray of energy $14{\cdot}9 \pm 0{\cdot}5$ keV with intensity about half that of γ24·4. The peak intensity was near the borderline of the statistical significance test used, but this gamma ray would fit between the levels at 264·6 and 279·5 keV, with a hindrance of 45 ± 23 relative to the M1 single-particle rate.

Table 1. Relative intensities of low-energy gamma rays in the decay ^{75}Se → ^{75}As.

Energy (keV)	Intensity				
	Rao *et al* (1966)	Pratt (1970)	Paradellis and Hontzeas (1970)	Thomas and Thomas (1973)	This work
K x-rays	$94{\cdot}0 \pm 2{\cdot}4$		$90{\cdot}3 \pm 2{\cdot}6$		91 ± 5
14·9				$0{\cdot}034 \pm 0{\cdot}006$	$<0{\cdot}0017$
24·4	$<0{\cdot}001$	$0{\cdot}032 \pm 0{\cdot}010$	$0{\cdot}044 \pm 0{\cdot}006$	$0{\cdot}063 \pm 0{\cdot}008$	$0{\cdot}036 \pm 0{\cdot}004$
265	100	100	100	100	100

We have attempted to observe this new gamma ray but are unable to corroborate the above result.

Low-energy photon spectra from a droplet-evaporated ^{75}Se source were accumulated with a Kevex guard-ring type Si(Li) detector of energy resolution 185 eV at 5·9 keV. Although counting rates were deliberately held to less than 200 counts/s, a pile-up rejector was incorporated. For the purpose at hand, this detector has two significant advantages relative to Ge(Li). First its considerably smaller efficiency for radiation above 50 keV reduces markedly the Compton electron background due to high-energy events that underlies the low-energy region of the spectrum; efficiency over the 5–20 keV region is similar to Ge(Li) however. In addition, the guard-ring confers excellent charge collection characteristics on the central detector, reducing the degradation tail from

high-energy events by a factor of about 10 relative to a conventional Si(Li) detector. These two aspects of the Si(Li) spectrometer enhance its ability to detect low-energy transitions such as the one of interest here. The measured absolute efficiency curve of the detector (Campbell and McNelles 1972) is shown in figure 1.

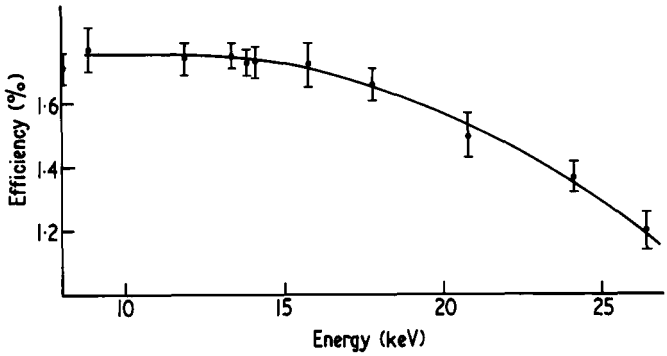

Figure 1. The absolute efficiency of the Si(Li) x-ray spectrometer.

The total number of As K x-rays recorded in the experiment was 5×10^7. Regions of interest of one of our several spectra are displayed in figure 2. The spectra exhibited the 24·4 keV gamma ray, well resolved from the As K x-ray pile-up complex, but revealed no structure in the region of 15 keV.

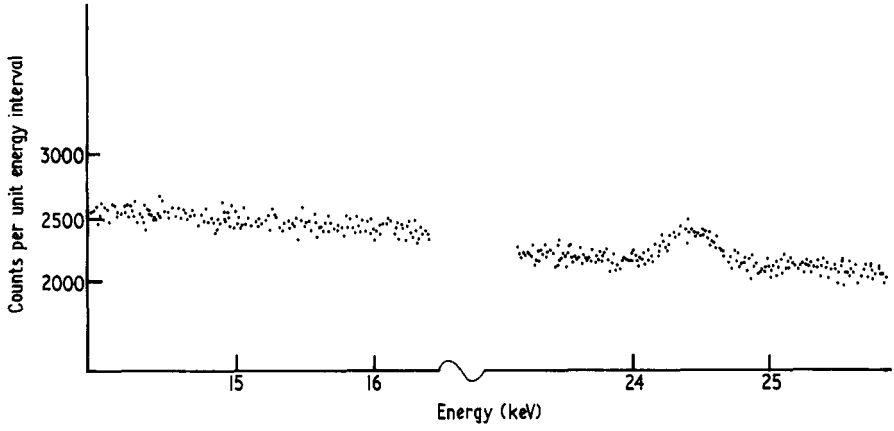

Figure 2. Regions of interest of the ^{75}As photon spectrum recorded with the Si(Li) spectrometer.

Gamma-ray intensities in ^{75}Se decay are generally expressed in units such that the intensity of γ264·6 is 100. Accordingly the absolute intensity of γ264·6 was measured with a coaxial Ge(Li) spectrometer, whose absolute efficiency curve was determined with IAEA and LPMRI gamma standards (McNelles and Campbell 1973).

The final results of these measurements are given in table 1. The 24·4 keV gamma ray intensity agrees well with results of other recent studies. This agreement strengthens the

credibility of the non-observation of a 14·9 keV gamma ray. By defining suitable background regions on either side of the spectral region that a 14·9 keV peak would occupy, we find an upper limit of 0·0017 units for the intensity with statistical confidence level 95%. This upper limit is a factor of about 20 less than the intensity reported by Thomas and Thomas (1972)

We conclude that present evidence does not warrant the inclusion of a 14·9 keV gamma-ray transition between the 279·5 keV and 264·6 keV levels in ^{75}As.

Acknowledgments

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References

Campbell J L and McNelles L A 1972 *Nucl. Instrum. Meth.* **98** 433–44
McNelles L A and Campbell J L 1973 *Nucl. Instrum. Meth.* **109** 241–51
Paradellis Th and Hontzeas S 1970 *Can. J. Phys.* **48** 2254–64
Pratt W W 1970 *Nucl. Phys.* A **147** 601–5
Rao P V, McDaniels D K and Crasemann B 1966 *Nucl. Phys.* **81** 296
Thomas R N and Thomas R V 1973 *J. Phys.* A: *Math., Nucl. Gen.* **6** 1037–40