K internal-conversion coefficient of the $M4$ 65-keV transition in ^{119}Sn†

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The α_K coefficient of the 65-keV $M4$ transition in ^{119}Sn was measured. The result is $\alpha_K = 1610 \pm 82$ which shows a 3% deviation from the theoretical value of Hager and Seltzer. This deviation agrees with the systematic behavior of $E3$ and $M4$ conversion coefficients.

[RADIOACTIVITY ^{119}Sn^m; measured I_x and I_γ. ^{119}Sn deduced α_K.]

In a recent paper Raman *et al.*[1] have summarized all the measurements of $E3$ and $M4$ conversion coefficients which have an accuracy better than 5%. From their work there appears to be a small discrepancy between the experimental values and the theoretical results of Hager and Seltzer.[2,3] The number of precise measurements was insufficient to decide whether or not the above mentioned discrepancy was a function of Z or of the energy of the transition. All experimental results tended to be (2–3)% less than the theoretical results. These conclusions led us to examine the K shell conversion coefficient of the $M4$ transition in ^{119}Sn. Drost, Weiss, and Weyer[4] have previously measured this K conversion coefficient. However, their result ($\alpha_K = 1860 \pm 150$) is significantly larger than the Hager and Seltzer theoretical value ($\alpha_K = 1660$) computed using the best available value for the transition energy[5] ($E_\gamma = 65.66 \pm 0.01$ keV).

In the present work a high resolution (190 eV at 5.9 keV) planar Si(Li) detector with an active area of 80 mm^2 was used. The detector efficiency was measured using the method described in Ref. 6. The calibration was made over the energy range 10–80 keV using a set of sources (^{57}Co, ^{88}Y, ^{133}Ba, ^{137}Cs, ^{241}Am, ^{203}Hg) prepared by the Radiochemical Centre of Amersham (code QCR.1). With these sources, calibration points at 11.90, 13.90, 14.15, 14.36, 15.80, 17.80, 20.80, 26.40, 30.86, 32.06, 35.10, 36.50, 59.5, 70.83, 72.87, and 80.5 keV were available. A semiempirical function similar to expression 2 of Ref. 6 was fitted to the data. In the present energy range we have taken into account the number of Compton events contributing to the full energy peak. At the energies that concerned us in this work the efficiency ratios were:

$$\frac{\epsilon(25.3)}{\epsilon(65.7)} = 7.73 \pm 0.24, \quad \frac{\epsilon(28.5)}{\epsilon(65.7)} = 6.82 \pm 0.21 .$$

A ^{119}Sn^m source was used and a partial γ and x-ray spectrum is shown in Fig. 1. The α_K value can be obtained from direct spectrum according to the relation

$$\alpha_K = (I_{K\alpha} + I_{K\beta}) / (\omega_K I_{\gamma,65}) ,$$

where $I_{K\alpha}$, $I_{K\beta}$, and $I_{\gamma,65}$ are the $X_{K\alpha}$, $X_{K\beta}$, and γ intensities, respectively, and ω_K is the K fluorescence yield. The adopted value $\omega_K = 0.868 \pm 0.028$ was the mean of several experimental and

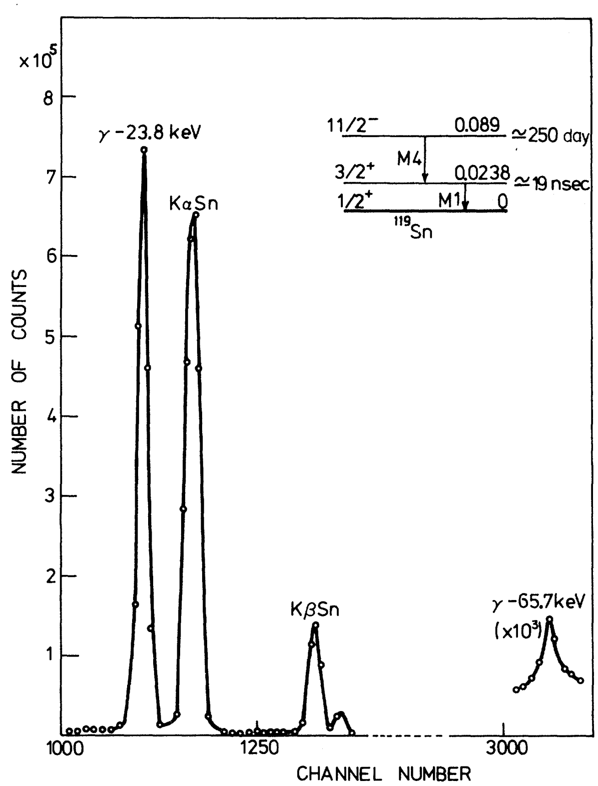

FIG. 1. A partial γ and x-ray spectrum from the ^{119}Sn^m source.

theoretical values.[7-9]

Our result is $\alpha_K = 1610 \pm 82$ which shows the "predicted" deviation (3%) from the theoretical results. The reported uncertainty includes not only statistical effects but also the uncertainties in efficiency calibration and in the K fluorescence yield.

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[1]S. Raman, T. A. Walkiewicz, R. Gunnink, and B. Martin, Phys. Rev. C 7, 2531 (1973).
[2]R. S. Hager and E. C. Seltzer, Nucl. Data A4, 74 (1968).
[3]R. S. Hager and E. C. Seltzer, Nucl. Data A9, 119 (1971).
[4]H. Drost, W. Weiss, and G. Weyer, Z. Naturforsch. 26a, 1092 (1971).
[5]J. P. Bocquet, Y. Y. Chu, G. T. Emery, and M. L. Perlman, Phys. Rev. 167, 1117 (1968).
[6]M. C. Abreu, A. Maio, and M. J. Temes d' Oliveira, Nucl. Instrum. Methods 123, 295 (1975).
[7]E. J. McGuire, Phys. Rev. A 2, 273 (1970).
[8]V. O. Kostroum, M. H. Chen, and B. Crasemann, Phys. Rev. A 3, 533 (1971).
[9]W. Bambynek, B. Crasemann, R. W. Fink, H. U. Freund, H. Mark, C. D. Swift, R. E. Price, and P. Venugopala Rao, Rev. Mod. Phys. 44, 716 (1972).