LETTERS TO THE EDITOR

CONVERSION COEFFICIENT OF THE 754 keV TRANSITION IN ^{139}Ce

RAMAN *et al.*[1], for the first time, showed evidence for sizeable discrepancies between the theoretical and experimental values of internal conversion of high multipole transitions. As a part of the continuing programme of searching for such discrepancies in this Laboratory, α_K of the 754 keV transition in ^{139}Ce is determined in the present study.

The conversion coefficient of 754 keV transition in ^{139}Ce was determined by Ketelle *et al.*[2], by X/γ method and a value of 0·08 ± 0·02 was obtained for α_K. The value obtained[3] from the relative conversion electron and gamma intensities, however, was 0·063 ± 0·013. A careful experimental study is therefore undertaken to determine the value of α_K accurately by X/γ method. The source ^{139m}Ce ($T_{1/2}$: 55 sec.) is produced conveniently using $(n, 2n)$ reaction on natural Ce with the 14 MeV neutrons available at the accelerator in the Laboratories for Nuclear Research. Considering the relative abundances of different isotopes in natural Ce, the half lives of the resultant activities and the respective cross-sections, it can be seen that only ^{139m}Ce could be preferentially produced by restricting irradiation time to about 3 mts. In view of the fact that decay scheme of ^{139m}Ce is well established and proceeds through a single gamma ray, a NaI (Tl) detector ($1\frac{3}{4}''$ dia × 2″ height, attached to RCA 8575 photomultiplier) is employed in this study. The isotope is produced using Ce_2O_3 samples of different thicknesses (50 mg to 500 mg) with different irradiation times in the range 1 to 5 mts. All gamma ray spectra showed peaks corresponding to K–X–ray and the 754 keV gamma ray. The relative intensities A_x and A_γ under the peaks corrected for self absorption effect and relative photopeak efficiencies E_x and E_γ in the usual manner, are employed to evaluate α_K by the relation

$$\alpha_K = \frac{A_x}{A_\gamma} \cdot \frac{\epsilon_\gamma}{\epsilon_x} \cdot \frac{1}{\omega_K}$$

where ω_K is the K-shell fluorescent yield, which is obtained as 0·911 ± 0·026 from the data of Bambynek *et al.*[4]

The final value of the K-conversion coefficient is obtained as *0·078 ± 0·004*. This value agrees with that of Dinrklage and Schmidt, Ott[5] obtained recently as 0·0732 ± 0·0023. They used a Ge(Li)–Si (Li) system and obtained the result on the basis of their measurement of internal conversion and gamma photon relative intensities. The error mentioned in their result appears to be an under-estimate in view of the fact that errors of the order of 3% are involved even in efficiency calibrations.

The 754 keV isomeric state of ^{139}Ce is of an established $11/2^-$ character, which may correspond to a $h_{11/2}$ neutron configuration. The ground state has a measured character of $3/2^+$, corresponding to a $d_{3/2}$ neutron configuration. The transition is therefore an M4 and the theoretical value of the K-conversion coefficient obtained from a computer programme of Hager and Seltzer[6] is 0·073. The present experimental value is about 6·8% higher than the theoretical value, but the error is about 6%. It is therefore hard to establish the discrepancy between theory and experiment.

The transition probability is estimated from the half life, the present experimental value of α_K and the reported value of K/L, as 1·13 (8) × 10^{-2}. The transition shows an enhancement of about 13 over the Weisskopf single particle estimate. It is unusual for an odd neutron high multipole transition to show an enhancement over the single particle estimate and a closer look on internal conversion will be of importance.

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