ELECTRON CAPTURE HALF-LIFE OF \(^{243}\text{Am}\)

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ELECTRON CAPTURE HALF LIFE OF Cm$^{243}$

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Calculations of closed decay-energy cycles$^1$ predict equal masses for Am$^{243}$ and Cm$^{243}$, leaving unresolved the direction of beta-decay emission between these neighboring isobars. A previous attempt to milk Am$^{243}$ from a sample of Cm$^{243}$ produced negative results and a lower limit of 50,000 years was set for the electron-capture half-life of Cm$^{243}$.$^2$ However, that experiment was performed in the presence of relatively large amounts of Am$^{241}$ and with cruder chemical separation techniques than are presently available. For the present investigation, a sample of curium was used that had been prepared by successive neutron capture in Am$^{244}$ using the NRU reactor. The curium was purified initially in March 1954, and this plus later purifications ensured complete removal of all americium isotopes from the curium.

Following a growth period of almost ten months after the last purification, the curium was milked for Am$^{243}$. Isotopically pure Am$^{241}$ was added as a chemical-yield tracer prior to the separations. Three successive elutions from Dowex-50 cation resin using ammonium alpha-hydroxyisobutyrate as eluant$^3$ were necessary for removal of all the parent curium. The americium fraction was then electroplated by a previously described method$^4$ to obtain a thin sample for pulse-height analysis. The ratio of Am$^{243}$ to Am$^{241}$ was determined in a 50-channel differential pulse-height analyzer and the total amount of Am$^{243}$ calculated from the initial amount of Am$^{241}$ activity added.

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Table I gives the relative activity intensities of the curium isotopes obtained from an alpha-particle spectrograph and the relative weights obtained from a mass spectrometer.

Table I

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Relative activity</th>
<th>Relative weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cm$^{242}$</td>
<td>1.00</td>
<td>----</td>
</tr>
<tr>
<td>Cm$^{243}$</td>
<td>3.01</td>
<td>2.43</td>
</tr>
<tr>
<td>Cm$^{244}$</td>
<td>1.95</td>
<td>1.00</td>
</tr>
</tbody>
</table>

These data can be used with the best value for the half-life of Cm$^{244}$ (18.4 ± 0.5 years) to obtain an alpha half-life for Cm$^{243}$ of 29.0 ± 0.8 years.

In a similar manner the electron-capture half-life of Cm$^{243}$ can be calculated from the expression

$$t_{1/2,63} = 0.693 \Delta t \frac{N_{63}}{N_{53}},$$

where $\Delta t$ represents the time of Am$^{243}$ growth (0.821 years), 63 refers to Cm$^{243}$ and 53 refers to Am$^{243}$. $N_{63}$ was obtained by use of the 29.0-year value given above and $N_{53}$ by use of a value of 7951 ± 48' years for the Am$^{243}$ half-life. From $2.2 \times 10^7$ d/m of Cm$^{243}$, 4.10 d/m of Am$^{243}$ was milked. The half-life calculated for electron capture in Cm$^{243}$ was 1.1 ± 0.1 x 10$^4$ years. The errors reported are based upon the estimated half-life errors in Cm$^{244}$ and Am$^{243}$ and the errors in counting and assaying.

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REFERENCES


5. F. Asaro, private communication, UCRL, (1957).

