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CORPUSCULAR PHYSICSuABSOLUTE MEASUREMENT OF THE a ENERGY OF 253EINSTEINIUM

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CORPUSCULAR PHYSICS--ABSOLUTE MEASUREMENT OF THE \( \alpha \) ENERGY OF \(^{253}\text{Einsteinium} \)

Bertil Grennberg, Albrecht Rytz and Frank Asaro
(presented by Louis de Broglie)

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CORPUSCULAR PHYSICS -- ABSOLUTE MEASUREMENT OF THE $\alpha$ ENERGY OF $^{253}$EINSTENIUM


The energy determinations of the $\alpha$ groups of $^{253}$Es (half-life $\sim$ 20 days) known up to now [(1), (2)] are all relative measurements with a rather moderate accuracy (see Table).

<table>
<thead>
<tr>
<th>Authors and Year</th>
<th>Ref.</th>
<th>Method</th>
<th>Radioactive standard</th>
<th>$\alpha$ Energy (KeV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jones et al.</td>
<td>(1) Grid ionization</td>
<td>$^{226}$Ra $^{218}$Po</td>
<td>Published value</td>
<td>6.636±5</td>
</tr>
<tr>
<td>(1956)</td>
<td>chamber</td>
<td>$^{222}$Rn $^{214}$Po</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hummel (1956)</td>
<td>(2) Magnetic spectrograph</td>
<td>$^{220}$Rn</td>
<td>(absolute)</td>
<td>6.633±5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$^{216}$Po</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present study</td>
<td>--- Magnetic spectrograph</td>
<td>$^{253}$Es</td>
<td></td>
<td>6.632.73</td>
</tr>
</tbody>
</table>

Although it is not a very common $\alpha$-emitter, $^{253}$Es could possibly be used as a radioactive standard in an energy region that does not have very many suitable reference energies.

We measured the energy of $\alpha_0$ with the absolute magnetic spectrograph in the International Bureau of Weights and Measures (3). Some details of this instrument were described in a previous note (4). The stabilization of the magnetic field was the subject of a separate publication (5). A complete description of the spectrograph and of all the results obtained is in preparation.
The $^{253}$Es specimen utilized in our experiments was prepared in the Lawrence Radiation Laboratory, Berkeley, California, by J. Harris and his heavy element separation group. On its arrival at the International Bureau of Weights and Measures, it had an activity of around 2mCi. It was dissolved in 3M $\text{NO}_3\ H$ and the sources were obtained by sublimation under vacuum. Each source was utilized several times. The figure represents the spectrum of $\alpha$ particles observed during one of the exposures. On the high energy of each group, the traces recorded on the photographic plate were counted by bands 10 $\mu$m wide. Therefore, the point corresponding to the highest energy could be determined with an error (typical deviation) quite smaller than this width (see figure).

Although $\alpha_{42}$ may appear well-determined in the figure, an analysis has shown that the background coming from the tail of the main beam is too considerable to make an accurate extrapolation possible.

![Spectrum of $\alpha$ particles](image)

Key: a = number of tracks per 100 X 100 $\mu$m; b = plate; c = extrapolated value.

For the main group, the six photographs analyzed give an average value of

$$E_{\alpha_0} = 6,632.73 \text{ KeV}$$

and a typical deviation of 0.05 KeV from the average. We evaluated the different systematic errors and formed their quadratic sum. In order to take this total systematic error of 0.05 KeV into account in an overall combined error, it must be considered on the same level of reliability as a typical error.
The numerical values of the constants utilized in computing the energy were:

**Faraday constant:**

\[ F = 96,486.70 \text{ C.mol}^{-1} \]

**Gyromagnetic coefficient of the proton:**

\[ \gamma_p' = 2.675127 \times 10^{-8} \text{ s}^{-1} \cdot \text{T}^{-1} \]

**BIBLIOGRAPHY**


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