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CORPUSCULAR PHYSICS--ABSOLUTE MEASUREMENT OF THE α ENERGY OF ^{253}EINSTEINIUM

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(presented by Louis de Broglie)

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CORPUSCULAR PHYSICS -- ABSOLUTE MEASUREMENT OF THE α ENERGY OF ^{253}EINSTEINIUM

[Note by Bertil Grennberg, Albrecht Rytz and Frank Asaro, of the International Bureau of Weights and Measures and the Lawrence Radiation Laboratory, submitted by Louis de Broglie, in the 4 January 1971 meeting of the French Academy of Sciences; Paris, Comptes Rendus de l'Academie des Sciences, French, Series B, Vol 272, pp 283-285]

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

TABLE

Energy Measurements of the Main α-Beam of ^{253}Es

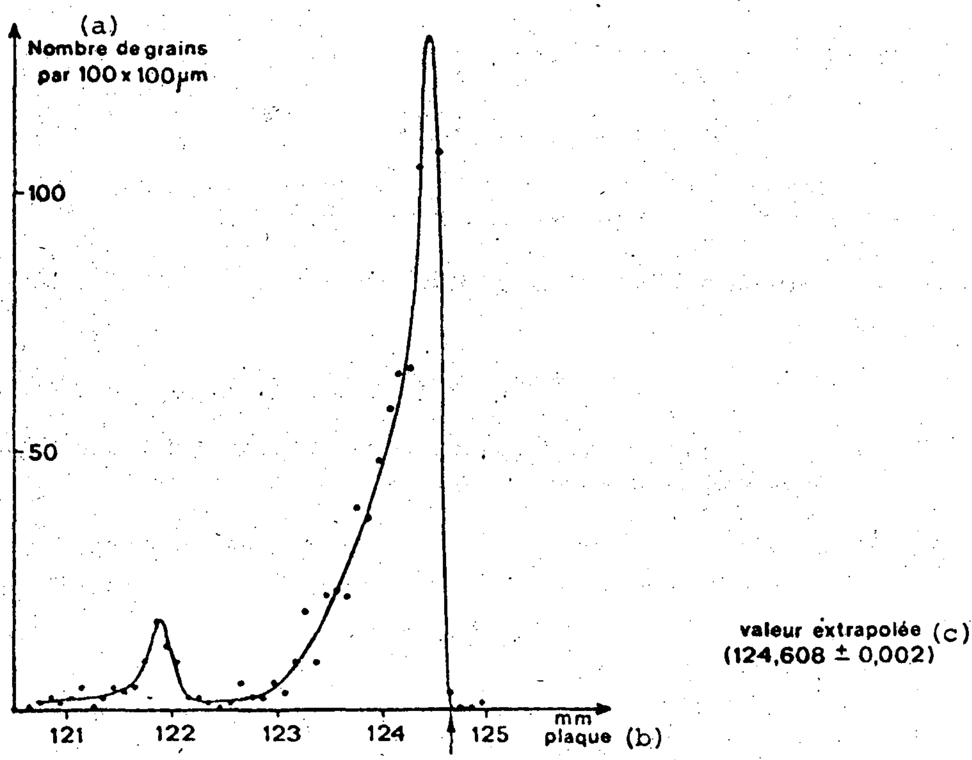
Authors and Year	Ref.	Method	Radioactive standard	α Energy (KeV) Published value	α Energy (KeV) Recalibrated value
Jones et al. (1956)	(1)	Grid ionization chamber	^{226}Ra ^{218}Po, ^{222}Rn ^{214}Po	6,636±5	6,641
Hummel (1956)	(2)	Magnetic spectrograph, 60°	^{220}Rn, ^{216}Po	6,633±5	6,638
Present study	---	Magnetic spectrograph, 180°	(absolute)	--	6,632.73

Although it is not a very common α-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 α_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 NO_3 H and the sources were obtained by sublimation under vacuum. Each source was utilized several times. The figure represents the spectrum of α 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 μm 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 α_{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.



Key: a = number of tracks per 100 X 100 μm;
b = plate; c = extrapolated value.

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

$$E_{\alpha o} = 6,632.73 \text{ KeV}$$

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:

$$F = 96,486.70 \ C.mol^{-1}$$

Gyromagnetic coefficient of the proton:

$$\gamma'_p = 2.675127 \times 10^{-8} s^{-1}.T^{-1}.$$

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