

Disintegration Constant of Thorium and Branching Ratio of Thorium C

Up to the present there has been an uncertainty in the value of the disintegration constant of thorium, a discrepancy of thirty percent existing between the Geiger-Rutherford value and the Kirsch value.

Using a mechanical counter to determine the rate of emission of α -particles from a thin specimen of thorium (ThO_2) and its products covered by a film of celluloid to impound the thorium emanation, we find for the disintegration constant of thorium, $\lambda = 5.17 (10)^{-11}$ yr.⁻¹, the corresponding half-value period being $T = 1.34 (10)^{10}$ yr. This is a preliminary value given by about a million "counts" from four specimens derived from the same source, a thorite, as that used by Geiger and Rutherford originally. Correction for the small amount of ionium in the mineral has been made. Counting on specimens derived from other sources is still in progress.

During the course of the work a certain number of counts were taken with aluminum foils of sufficient thickness placed over the specimens to absorb all α -particles except those due to thorium C'. This allows a determination of the branching ratio of thorium C to be made. The value obtained is 0.660, which checks closely the accepted value given by Meitner and Freitag.

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The Spectra Be III and Be IV

Wave-lengths of the $1s^2 1S_0 - 1s \cdot np \ 1P_1$ series of Be III which have been reported in these columns from two different laboratories^{1, 2} show considerable disagreement among the higher series members in spite of the fact that both authors measured them partially in the second order against known standards. It has been possible to supplement these measurements on a new 5 meter 4° grazing incidence vacuum spectrograph designed by Professor Siegbahn and built in the workshops of this institute. The measurements of the first two lines have been supplemented by higher order determinations on a 1 meter 5.4° grazing incidence spectrograph. The results are listed in Table I.

The line at 100A checks exactly with the previous measurements; the line at 88A has been measured in three orders on five different plates. The line at 84A has been measured in two orders on three plates and the others in the first order only on three plates. Each plate has been measured twice against known oxygen standards where possible or against the lower Be series members and strong

TABLE I. The $1s^2 1S_0 - 1s \cdot np \ 1P_1$ series of Be III ($\nu_{S_0} = 1,241,225 \text{ cm}^{-1}$).

n	$\lambda(\text{A})$	$\nu(\text{cm}^{-1})$	$1s \cdot np \ 1P_1$	n^*
2	100.254	997,466	243,759	2.0128
3	88.314	1,132,323	108,902	3.0114
4	84.758	1,179,830	61,395	4.0107
5	83.202	1,201,894	39,331	5.0109
6	82.377	1,213,931	27,294	6.0107
7	81.891	1,221,135	20,090	7.0113

TABLE II. $1s^2 S - np \ 2P$ series of Be IV.

n	$\lambda(\text{A})$	n	$\lambda(\text{A})$
2	75.9251	5	59.3179
3	64.0629	6	58.5723
4	60.7414	7	58.1316

phosphorus lines measured in from two to ten orders during the present investigation.

Table II lists the lines of Be IV which have been observed. The listed wave-lengths have been calculated from the Penney³ formula. These lines have also been used as standards in this region.

The Be III series herein listed together with new determinations of the He I-like series from Li II to N VI show surprisingly good agreement with values calculated by means of the Hylleraas⁴ formula when the mass and relativity corrections are applied. The subject is being discussed in detail elsewhere.

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¹ P. G. Kruger and F. S. Cooper, Phys. Rev. **44**, 418 (1933).

² B. Edlén, Phys. Rev. **44**, 778 (1933).

³ W. G. Penney, Phil. Mag. **9**, 661 (1930).

⁴ For a complete account see H. Bethe, *Handbuch der Physik*, Vol. 24/1 (1933), pp. 324 *et seq.* Several of Bethe's numerical calculations are incorrect.

Some Lattice Sums Involved in the Calculation of Elastic Constants

In recent calculations the theoretical values for the elastic constants of crystals of the CsCl type were needed. The electrostatic part of the elastic constant C_{11} , usually called $A^{(e)}$,¹ could not be found in the literature. We calculated it with the method of Ewald as used by Heckmann² for the elastic constants of ZnS and CaF₂. Most of the Fourier and D'Alembert series needed for the calculation were already tabulated by Heckmann. A check on the accuracy is obtained in the usual manner by making the calculation for two different values of the arbitrary separation constant E . Here $E = \pi$ and $E = 2$ were chosen. The results were

$$A^{(e)} = (e^2/\delta^4) \times 2 \cdot 1253$$

and $A^{(e)} = (e^2/\delta^4) \times 2 \cdot 1252$ respectively,

where e is the charge of the ions, δ the side of the cubic cell ($\delta^3 = \text{volume per molecule}$).

The electrostatic part of the elastic constant C_{12} , called $B^{(e)}$ by Born, can then be found from the equation connecting it with $A^{(e)}$ and the Madelung constant

$$B^{(e)} = -(e^2/\delta^4) \times 1.5715.$$

The signs of these constants are opposite to those for the NaCl type lattices.

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¹ M. Born, *Atom theorie des festen Zustandes* (Berlin, 1923), p. 571.

² G. Heckmann, *Zeits. f. Physik* **23**, 47 (1924); *Zeits f. Kristallographie* **61**, 287 (1924).