in terms of the Caltech crystal spectrometer scale, but

$$E_{\text{thres}}[\text{Li}^7(p,n)\text{Be}^7] = 1879.7 \pm 1.1 \text{ kev}$$

in terms of Lindstrom's proton-moment calibrated scale.

Graphical comparison of various independent determinations of this threshold are shown in Fig. 5.

A weighted mean of these independent measurements of the $\text{Li}^7(p,n)\text{Be}^7$ threshold is 1881.1 ± 0.5 kev.

CONCLUSIONS

No appreciable systematic differences between the gamma-ray scales and current nuclear-reaction energy scales are indicated by the present work. There is, however, some suggestion of a systematic difference between two current gamma-ray scales. Somewhat better consistency with nuclear reaction data is found for the gamma-ray scale based upon the curved-crystal spectrometer measurements.

PHYSICAL REVIEW VOLUME 94, NUMBER 4 MAY 15, 1954

The Half-Life of U^{232}

P. A. SELLERS, C. M. STEVENS, and M. H. STUDIER
Chemistry Division, Special Materials Division, Argonne National Laboratory, Lemont, Illinois

(Received February 5, 1954)

The half-life of U^{232} has been determined to be 73.6 ± 1.0 years by a method involving isotopic dilution, mass spectrometric analysis, and the determination of the specific activity of the diluted sample by conventional weighing and counting techniques.

THE half-life of U^{232} has been reported as 30 years[1] and 70 years.[2] The 30-year value was estimated from the growth of U^{232} alpha activity from its beta-emitting parent Pa^{232} and the 70-year value from the growth of U^{232} from its alpha-emitting parent Pu^{236}. No limits of error have been given for either value, but the 70-year value was based on a later measurement and considered to be more accurate than the 30-year value.

The half-life of U^{232} is sufficiently long that the direct measurement of its decay is difficult. On the other hand, the direct determination of the specific activity is difficult because of the small quantities which are available and is hazardous because of the high specific activity of U^{232}. However, isotopic dilution with a large excess of relatively inactive U^{238} enables one to determine the specific activity of the diluted sample by conventional weighing and counting techniques. A mass spectrometric determination of the ratio U^{238}/U^{232} then permits one to calculate the specific activity of U^{232}.

An aliquot (0.09905 g) of U_3O_8 from a Bureau of Standards sample of natural uranium was accurately weighed and transferred to a preweighed polyethylene bottle containing nitric acid and approximately 100 micrograms of U^{232}. After the oxide was dissolved, the solution was diluted with water to 102.61 g, from which was taken 1.0459 g which in turn was diluted to 101.54 g. From this final solution, about 100-milligram aliquots were weighed, evaporated on platinum plates, and counted in an argon-carbon dioxide counter with a geometry of 50.6 percent and τ of 4×10^{-8} minute. An average of three determinations gave a value of 56 530 disintegrations per minute per 100 mg of solution, with a probable error of 120 disintegrations per minute based on the deviations from the mean, which is a measure of the precision of weighing and counting the samples. This corresponds to a specific activity of the diluted sample of 6.61×10^{10} disintegrations per minute per gram of U^{238}. From the mass spectrometric analysis of the sample [$U^{232}/U^{238} = (1.436 \times 10^{-3}) \pm 1.0$ percent, and $U^{233}/U^{238} = (4.75 \times 10^{-2}) \pm 2.2$ percent, mole ratios] the specific activity of U^{232} was calculated to be 4.65×10^7 disintegrations per minute per microgram. (A mass spectrometric analysis of the original U^{232} sample showed that its U^{238} content was negligible.) This corresponds to a half-life of 73.6 years. The U^{233} was the only isotope other than U^{232} which contributed appreciably (1.5 percent of the total alpha activity) to the activity of the uranium sample, and a correction was applied. A correction was also made for the growth of the daughters of U^{232} by comparing the counting rates of the final samples with that of a sample taken immediately after purification of the U^{232} from its daughters. A consideration of the various errors leads to a probable error of about one year in the half-life.

The authors are grateful to Miss Lillie Mae Porter and Miss Marjorie M. Petheram for their help with the counting.

[1] J. W. Gofman and G. T. Seaborg, *The Transuranium Elements: Research Papers* (McGraw-Hill Book Company, Inc., New York, 1949), Paper No. 19.14, National Nuclear Energy Series, Plutonium Project Record, Vol. 14B, Div. IV, p. 1427.

[2] James, Florin, Hopkins, Jr., and Ghiorso, *The Transuranium Elements: Research Papers* (McGraw-Hill Book Company, Inc., New York, 1949), Paper No. 22.8, National Nuclear Energy Series, Plutonium Project Record, Vol. 14B, Div. IV, p. 1604.