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The Uranium Isotope U236

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THE URANIUM ISOTOPE  $U^{236}$

A. Ghiorso, J. W. Brittain, W. M. Manning, and  
G. T. Seaborg

December 20, 1950

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THE URANIUM ISOTOPE U<sup>236</sup>

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December 20, 1950

Following the early observation<sup>1</sup> that U<sup>235</sup> captures slow neutrons to an appreciable extent in competition with the fission reaction, an attempt was made to detect the expected alpha particles from the resultant U<sup>236</sup> and the negative result led to the placement of a lower limit of  $3 \times 10^5$  years for this half-life.<sup>2</sup> A little later the isotope U<sup>236</sup> was detected with the mass spectrograph<sup>3</sup> in a sample of enriched U<sup>235</sup> which had been irradiated with slow neutrons in the uranium chain reacting pile.

In the summer of 1945 a sample of enriched U<sup>235</sup> which had been strongly irradiated with slow neutrons became available for measurements of the alpha radiation. It was estimated from the (n,γ) cross section for U<sup>235</sup> and the amount of the neutron irradiation that the ratio of U<sup>236</sup> to U<sup>235</sup> in the sample should amount to approximately 1.7 percent. Measurements with the alpha pulse analyzer apparatus<sup>4</sup> on the chemically purified uranium indicated alpha particle activity of energy about 4.5 Mev (i.e., slightly greater than that of the main group of U<sup>235</sup> alpha particles) with intensity about half as great as that of

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†Work performed under auspices of Manhattan District (Contract No. W-7401-eng-37) in 1945 at the then Metallurgical Laboratory (now Argonne National Laboratory).

the  $U^{235}$ . This corresponded to an alpha half-life for  $U^{236}$  of about  $2 \times 10^7$  years. Measurements a little later on another sample similarly prepared containing approximately  $U^{236}$  by weight, led to the same result.

This alpha particle energy corresponds very well with that expected for  $U^{236}$  from the alpha systematics.<sup>5</sup> The half-life is just that expected for a nucleus of atomic number 92 of the even-even type, in which case the decay is not prohibited. The isotope  $U^{236}$  is, of course, expected to be beta stable.

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<sup>1</sup>Wilson, Williams, Segrè, and co-workers, unpublished work at the Los Alamos Scientific Laboratory (1943).

<sup>2</sup>H. Anderson and D. Nagle, Manhattan Project Metallurgical Laboratory report CP-1389, p. 10 (February, 1944).

<sup>3</sup>D. Williams and P. Yuster, Los Alamos Scientific Laboratory report LAMS-195 (January, 1945).

<sup>4</sup>Ghiorso, Jaffey, Robinson, and Weissbourd, National Nuclear Energy Series, Plutonium Project Record, Vol. 14B, "The Transuranium Elements: Research Papers," Paper No. 16.8 (McGraw-Hill Book Co., Inc., New York, New York, 1949).

<sup>5</sup>Perlman, Ghiorso, and Seaborg, Phys. Rev. 77, 26 (1950).



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