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RADIATION LABORATORY

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Radiation Laboratory

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U^{235} ALPHA FINE STRUCTURE

A. Ghiorso

February 8, 1951

Berkeley, California

U^{235} ALPHA FINE STRUCTURE

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February 8, 1951

It has been possible to resolve the alpha particle radiation emitted by U^{235} into at least three groups by use of our alpha pulse analyzer. The material used for this work had been highly enriched relative to U^{234} as well as U^{238} so that the alpha radiation from U^{234} was only about 35 percent of the total activity.

The sample used for pulse analysis consisted of approximately 100 μg of uranium electrodeposited onto an area 15 mm in diameter on a thin platinum plate. A collimator consisting of a brass ring 3 mm high and 27 mm in diameter was placed around the sample so that the sample area was centered. The purpose of the collimator is to eliminate from detection those alpha particles which emerge from the sample at a small angle relative to the plane of the sample mounting; these are the particles which contribute most to the low energy straggling observed at 2π geometry because of sample self-absorption and back-scattering. This type of collimator enables one to obtain 35 percent geometry with an almost negligible low energy straggling; for a thin sample the low energy "tail" is down to ca 0.1 percent at a point approximately 150 kev lower than the peak.

A typical pulse analysis obtained with our 48-channel differential alpha pulse analyzer is shown in Fig. 1. By comparison with a pulse analysis of radioactively pure samples of U^{234} and U^{238}, it can be shown by a process of elimination that the isotope U^{235} is responsible for the peaks at 4.58, 4.40, and 4.20 mev. The 4.58 mev peak had previously been suspected because of a 180 kev gamma ray which has been observed[1-4] in high abundance associated with

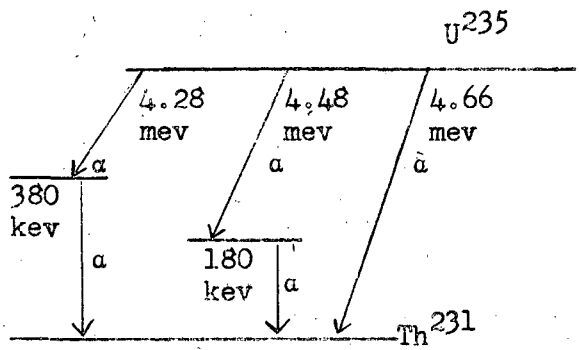
U^{235}. The 4.20 mev peak is a new group and the low abundance 380 kev gamma ray which would be associated with it has not been reported by any workers in this field. The possibility of a fourth alpha particle group at 4.47 mev is suggested by the shape of the main U^{235} peak when it is compared with the U^{234} peak.

The abundances of the various groups and their consequent partial alpha half-lives are as follows:

U_0^{235}	4.58 mev	10.2 percent	6.99×10^9 years
U_I^{235}	4.40 mev	85.6 percent	8.33×10^8 years
U_{II}^{235}	4.20 mev	4.2 percent	1.70×10^{10} years

These are calculated on the basis of Nier's value for the total half-life of U^{235} of 7.13×10^8 years.[5]

The decay sequence of U^{235} is presumably the following:



The author is indebted to Dr. C. E. Larson and the Y-12 Plant of Carbide and Carbon Chemicals Division of the Oak Ridge National Laboratory for making available the sample of highly enriched U^{235}, and wishes to thank Mr. Robert C. Lilly for the careful preparation of the U^{235} sample. This work was performed under the auspices of the U. S. Atomic Energy Commission.

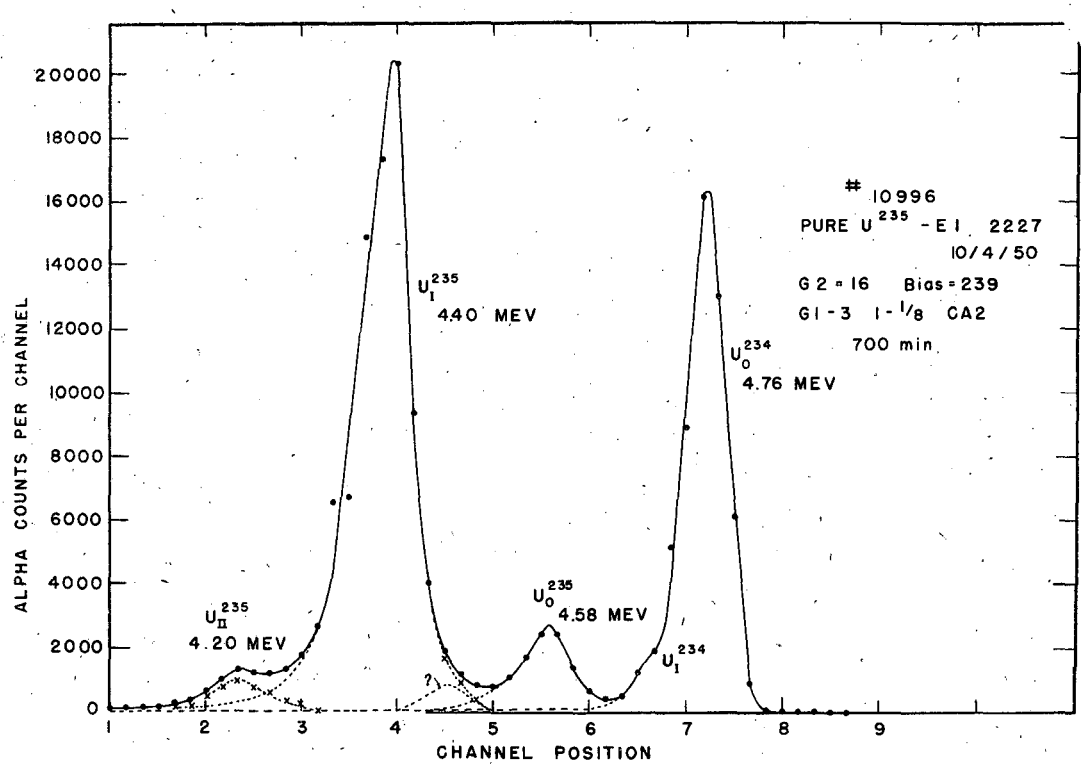
[1] M. H. Studier, reported in Metallurgical Laboratory Report CC-3056 (July, 1945).

[2] R. L. Macklin and W. S. Miller, Uranium Project Report A-3640 (April, 1946).

[3] B. F. Scott, Argonne National Laboratory Report CC-3715 (January, 1947).

[4] R. L. Macklin, Phys. Rev. 76, 595 (1949).

[5] A. O. Nier, Phys. Rev. 55, 150 and 153 (1939).



PULSE ANALYSIS OF U^{235} ALPHA PARTICLES

MU 1031