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SPONTANEOUS FISSION RATE OF Cf^{246}

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In order to obtain further data which may be useful in a study of the spontaneous fission process as, for example, in confirmation of the exponential dependence of the spontaneous fission rate upon Z^2/A of even-even nuclides,[1, 2] the spontaneous fission half-life of Cf^{246} has been measured. An extrapolation of previously available data[1, 3] indicated that Cf^{246}, for which Z^2/A equals 39.04, should have a spontaneous fission "half-life" of approximately 2000 years. Our measured value is 2100 $\pm$ 300 years, which is in excellent agreement with that predicted.

The californium isotope was produced by helium ion bombardment of curium containing all the isotopes ranging from Cm^{242} to Cm^{245}, inclusive.[4] The target technique employed in this work has been previously described.[5] The curium used in this experiment had been produced by a neutron irradiation of long duration of Am^{241} at a position of high flux in the Chalk River pile.[6] After bombarding the curium with 35 Mev helium ions, the californium was separated from other elements, using previously described combinations of precipitation and ion exchange chemical methods.[7] By alpha pulse analysis at the beginning of the experiment, the californium fraction was observed to contain essentially pure Cf^{246} radioactivity except for a small fraction of Pu^{238} alpha radioactivity incompletely separated. The amount of Pu^{238} present was insufficient to produce any

spontaneous fission events in view of its long half-life for this process.[1]

The fission rate was determined by placing a known quantity of Cf^{246} in a thin deposit on one electrode of a parallel plate ionization chamber filled with a mixture of argon and carbon dioxide. A stylus recorder maintained a record of each fission event and time of occurrence until essentially all of the Cf^{246} had decayed. The fission rate decreased with the same 35 hour half-life as that observed for the alpha decay of Cf^{246},[4] thus proving that the fissions recorded originated from this isotope. The experimental data are best summarized in Fig. 1. The ratio of the alpha disintegration rate to the spontaneous fission rate is 5.2×10^5 giving by simple computation the spontaneous fission half-life of 2100 years. In view of its close agreement with the predicted value, this result might then be considered as evidence that a subshell of 148 neutrons does not exist since, on the basis of the considerations by Seaborg,[1] an abnormally small nuclear radius due to a closed subshell might be expected to result in an increased rate of spontaneous fission.

We are especially indebted to Professor Glenn T. Seaborg for his continued advice and encouragement during the course of this work. We also wish to express our appreciation to Professor J. G. Hamilton, G. B. Rossi, and the operating crew of the 60-inch cyclotron of the Crocker Laboratory for the intensive bombardment of curium, and to Nelson Garden and the Health Chemistry group for providing the excellent protective equipment used in handling the high level alpha radioactivity. Likewise, the cooperative

effort of the Canadian Chalk River Laboratory in handling some difficult problems connected with irradiating and shipping the sample is greatly appreciated. This work was performed under the auspices of the AEC.

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[1]G. T. Seaborg, Phys. Rev. 85, 157 (1952).

[2]W. J. Whitehouse and W. Galbraith, Nature 169, 494 (1952).

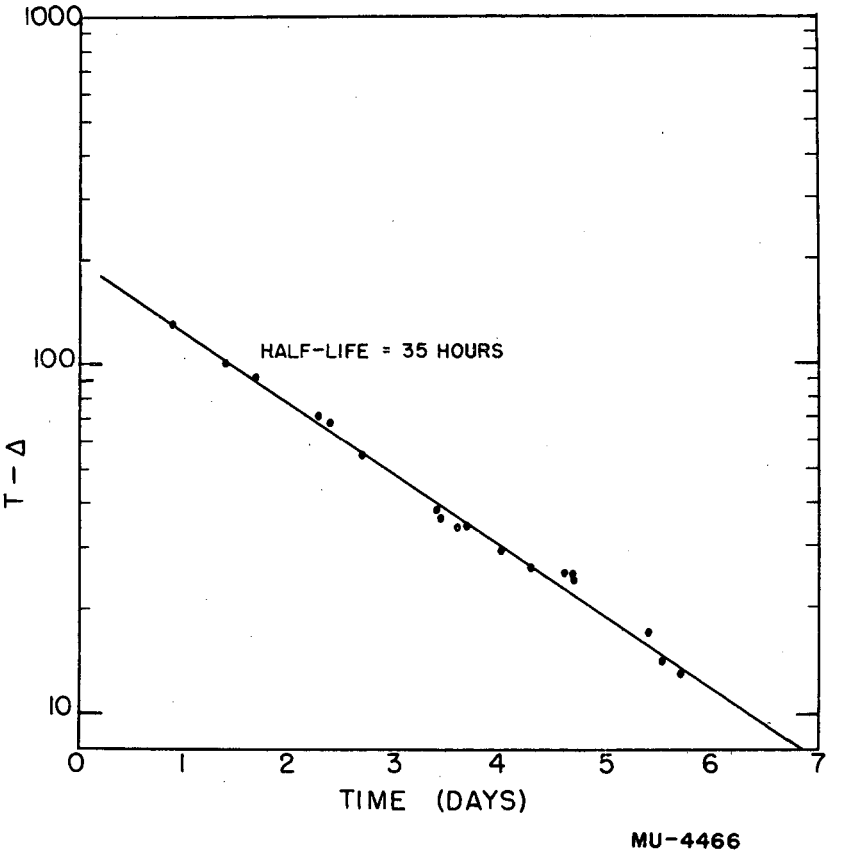
[3]Ghiorso, Higgins, Larsh, Seaborg, and Thompson, Phys. Rev. 87, 163 (1952).

[4]Hulet, Thompson, Ghiorso, and Street, Phys. Rev. 84, 366 (1951).

[5]Thompson, Ghiorso, and Seaborg, Phys. Rev. 80, 783 (1950).

[6]Reynolds, Hulet, and Street, Phys. Rev. 80, 467 (1950).

[7]Thompson, Street, Ghiorso, and Seaborg, Phys. Rev. 80, 790 (1950).



T = total number of fissions observed and

Δ = number of fissions observed to the time t.