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ABSTRACT

A new spontaneous-fission activity has been observed in a fermium fraction separated from 120 mg of mixed curium isotopes which had been subjected to an integrated flux of 2.4×10^{22} neutrons per square centimeter at the Materials Testing Reactor, Idaho Falls, Idaho (MTR). A least-squares analysis of the spontaneous-fission decay data yielded a half life of 10.8 days with a standard deviation of about $\begin{pmatrix} +2.2 \\ -1.8 \end{pmatrix}$ days. An estimated half life of $\begin{pmatrix} 11^{+10} \\ -6 \end{pmatrix}$ days is reported here. The mass assignment is uncertain, but limited to $A = 258$ or 257.

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INTRODUCTION

Irradiation of curium isotopes in the high-flux MTR has produced transcurium isotopes as heavy as Fm^{256} (1). In recent years the amounts of transcurium isotopes have increased significantly. A study of decay systematics suggested that Fm^{257} might have a half life of the order of days or longer. It seemed interesting therefore to search for this isotope.

CHEMICAL PROCEDURES

The irradiated curium target material was purified by standard chemical procedures (2). The fermium fraction separations and purification were completed about 12 days after the curium irradiation in the MTR. A separation factor of $\sim 10^9$ was obtained between fermium and einsteinium. The fermium sample used for the activity measurements contained ~ 100 alpha decays per min of E^{253} . This source was prepared by electroplating on a platinum disc, and its alpha and spontaneous-fission activity were studied for a period of several weeks.

ACTIVITY MEASUREMENTS

Results of the decay of the 11-day spontaneous-fission activity in the Fm fraction are presented in Fig. 1. Decay of the spontaneous-fission activity in the fermium fraction was followed with two independent counting

systems. The first system involved a windowless proportional counter. These results are denoted by A in Fig. 1. In the second system, spontaneous-fission events were detected by a 1-in.-diam phosphorous-diffused solid-state detector and a multichannel pulse-height analyzer. These results are denoted by B in Fig. 1.

Because of the presence of 100 alpha decays per min of E^{253} in the Fm fraction, it was impossible to observe Fm alpha particles which might have had energies less than 6.7 MeV.

DISCUSSION

The assignment of the proton number $Z = 100$ to the 11-day fission activity is based on the following considerations. It was observed only in the fermium fraction. (The einsteinium fraction did not contain this activity-- in any case, spontaneous-fission half-life systematics also indicate that an 11-day half life is much too short for an einsteinium isotope). The chemical separation of the mendelevium and fermium fractions, which was repeated, also rules out the possibility that the 11-day activity is a mendelevium isotope. It is not possible that the 11-day activity is the mendelevium daughter of a beta-unstable fermium parent, because the last fermium-mendelevium chemical separation was completed 12 days after the end of the MTR bombardment. If the half life of the beta-unstable fermium parent is less than 2 days, it would have decayed by this date. If the postulated half life of the beta-unstable fermium parent is longer than 2 days, we would have observed the growth of the 11-day daughter. This consideration is also supported by an examination of cross sections necessary for the formation of a fermium isotope of mass number 259, which is also predicted to be the first beta-unstable fermium isotope. It seems unlikely that the 11-day fission activity would be an isomer of a known Fm isotope Fm^{254} , Fm^{255} , or Fm^{256} .

Therefore, the mass assignment is most likely to be $A = 257$ or 258 .

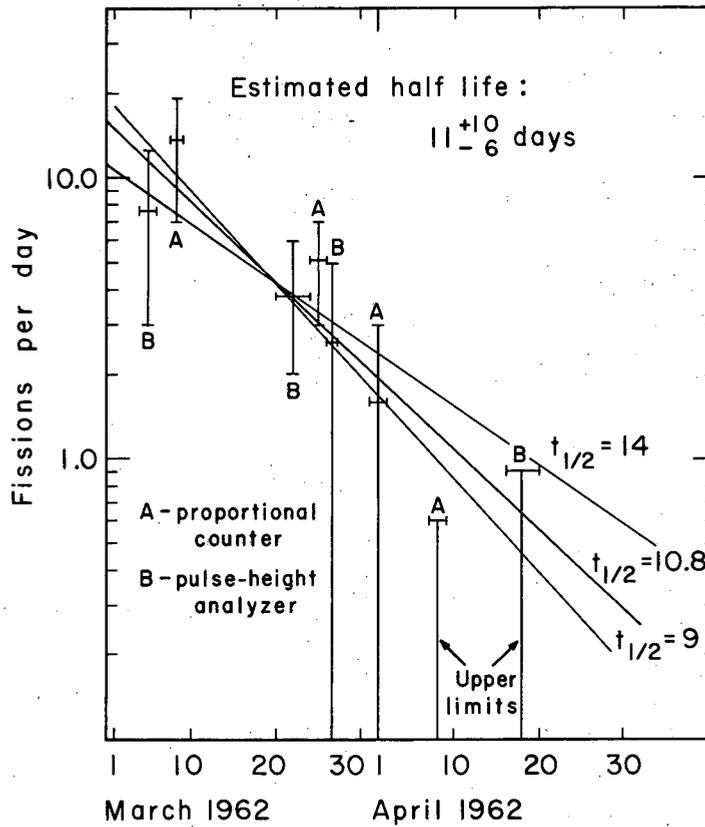
We wish to thank Dr. S. Fried, as well as F. McCarthy, J. Haley, L. Gibson, J. Rees, L. White, and A. Fregulia for their help in the experimental procedures. We are grateful to Drs. S.A.E. Johansson, W. J. Swiatecki, and F. Asaro for helpful discussion.

FOOTNOTES AND REFERENCES

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2. S. Fried and H. Schumacher, in Chemistry Division Annual Report, UCRL-10023, January 1962.



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Fig. 1. Decay of the new Fm isotope. Approximately 50 events have been directly observed. The activity is calculated from the observed events and the geometry factor. Two different sets of counters were used. The background is subtracted.

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