

Lawrence Berkeley National Laboratory

Recent Work

Title

THE NUCLIDE 99254

Permalink

<https://escholarship.org/uc/item/7rn4c4pm>

Authors

Harvey, B.G.
Thompson, S.G.
Choppin, G.E.
et al.

Publication Date

1955-04-11

UCRL _____
UNCLASSIFIED

UNIVERSITY OF
CALIFORNIA

*Radiation
Laboratory*

BERKELEY, CALIFORNIA

DISCLAIMER

This document was prepared as an account of work sponsored by the United States Government. While this document is believed to contain correct information, neither the United States Government nor any agency thereof, nor the Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or the Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof or the Regents of the University of California.

UCRL-2952

UNCLASSIFIED

UNIVERSITY OF CALIFORNIA

Radiation Laboratory
Berkeley, California

Contract No. W-7405-eng-48

THE NUCLIDE 99^{254}

B. G. Harvey, S. G. Thompson, G. R. Choppin, and A. Ghiorso

April 11, 1955

Printed for the U. S. Atomic Energy Commission

The Nuclide 99^{254}

B. G. Harvey, S. G. Thompson, G. R. Choppin, and A. Ghiorso

Radiation Laboratory
University of California, Berkeley, California

April 11, 1955

The nuclide 99^{254} has previously been reported^{1, 2} and found to decay^{2, 3} with a half-life of 36 hours by emission of β^- particles.

Further investigation has revealed the existence of another isomer of 99^{254} which decays almost entirely by emission of alpha particles.

The 36-hour isomer has been found to exhibit electron-capture branching to produce Cf^{254} .

1. The long-lived isomer -- Samples of the 20-day 6.6-Mev alpha emitting 99^{253} subjected to neutron bombardment were shown by alpha pulse analysis to contain a nuclide emitting 6.44 ± 0.01 Mev alpha particles. This new alpha radioactivity showed no decrease in intensity during 3 months, so that the nuclide responsible for it must have a half-life longer than about 2 years.

Chemical purification of the 99^{253} by the method of ion-exchange elution, using Dowex-50 cation resin and ammonium α -hydroxy-isobutyrate as eluant⁴ showed that the 6.44-Mev alpha emitter could not be separated from element 99.

Its assignment, based on the systematics of alpha radioactivity,^{5, 6} was most logically to mass 254. This assignment was confirmed by collecting recoil nuclei from a very thin sample of the new alpha emitter. These daughter nuclei were shown to decay, by emission of

β^- particles, with a half-life of approximately 3 hours. This radiation is characteristic of Bk^{250} .⁷

The absence of any 7.2-Mev alpha particles of 100^{254} 1, 2, 3, 8 in equilibrium with this long-lived isomer of 99^{254} shows that the partial half-lives of the latter species for both β^- decay and isomeric transition to the 36-hour isomer are more than 100 times longer than the alpha half-life. It is perhaps more likely that the 36-hour isomer is the metastable state, and it will be convenient provisionally to refer to it as 99^{254m} .

2. Electron capture in 99^{254m} . --Preliminary experiments⁹ showed that a californium isotope decaying by spontaneous fission, with no detectable emission of alpha particles, grew into very carefully purified samples containing 99^{253} , 99^{254} , 99^{254m} , and 99^{255} . The californium exhibited a half-life of 85 ± 15 days. This observation has since been repeated and confirmed with much larger amounts of activity.

The californium isotope responsible for such a short-lived spontaneous fission decay is most likely of even mass, and is therefore probably Cf^{254} , since Cf^{250} and Cf^{252} are already known.^{7, 10, 11} Some Cf^{256} might have been formed by electron capture decay of the (unknown) nuclide 99^{256} , which might have been present in the sample. However, 99^{256} is expected to be short-lived,¹² and any Cf^{246} produced by its electron-capture decay would have been removed in the initial purification of the 99 sample. Samples containing only 99^{253} and 99^{254} exhibit only a very small spontaneous fission activity. The Cf^{254} must therefore grow from the 36-hour 99^{254m} , by the electron-capture process, and not from the 99^{254} . The amount of Cf^{254} produced by a known amount of 99^{254m} gave a value of 1000 for the ratio of β^- decay to electron capture.

This work was performed under the auspices of the U.S. Atomic Energy Commission.

1. B. G. Harvey, S. G. Thompson, A. Ghiorso, and G. R. Choppin, *Phys. Rev.* 93, 1129 (1954).
2. P. R. Fields, M. H. Studier, J. F. Mech, H. Diamond, A. M. Friedman, L. B. Magnusson, and J. R. Huizenga, *Phys. Rev.* 94, 209 (1954).
3. G. R. Choppin, S. G. Thompson, A. Ghiorso, and B. G. Harvey, *Phys. Rev.* 94, 1080 (1954).
4. G. R. Choppin, B. G. Harvey, and S. G. Thompson, unpublished work.
5. I. Perlman, A. Ghiorso, and G. T. Seaborg, *Phys. Rev.* 77, 26 (1950).
6. A. Ghiorso, S. G. Thompson, G. H. Higgins, and B. G. Harvey, *Phys. Rev.* 95, 293 (1954).
7. A. Ghiorso, S. G. Thompson, G. R. Choppin, and B. G. Harvey, *Phys. Rev.* 94, 1081 (1954).
8. M. H. Studier, P. R. Fields, H. Diamond, J. F. Mech, A. M. Friedman, P. A. Sellers, G. Pyle, C. M. Stevens, L. B. Magnusson, and J. R. Huizenga, *Phys. Rev.* 93, 1428 (1954).
9. A. Ghiorso, B. G. Harvey, G. R. Choppin, and S. T. Thompson, unpublished work.
10. H. Diamond, L. B. Magnusson, J. F. Mech, C. M. Stevens, A. M. Friedman, M. H. Studier, P. R. Fields, and J. R. Huizenga, *Phys. Rev.* 94, 1083 (1954).
11. S. G. Thompson, A. Ghiorso, B. G. Harvey, and G. R. Choppin, *Phys. Rev.* 93, 908 (1954).
12. R. A. Glass, S. G. Thompson, and G. T. Seaborg, *J. Inorg. and Nuclear Chem.* 1, 3 (1955).