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Nuclear Properties of 100^{256}

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The nuclide 100^{256} has been made by neutron irradiation of 99^{255} in the Materials Testing Reactor. One purpose of this experiment was to determine the most probable mass assignment of the isotope of element 101 which has been produced recently.[1]

Since the irradiated sample had been made earlier from Pu^{239} by successive neutron captures,[2] it was principally 99^{253}. A short bombardment and fast chemical separation of the 100 fraction from the 99 fraction was used to minimize the amount of 100^{254} which would grow in from its 36-hour 99^{254} parent. The rapid chemical isolation was achieved by the use of precipitation and ion-exchange procedures.[3] Even then 17,000 disintegrations of 7.2-Mev alpha particles of 100^{254} and several hundred of 7.1-Mev 100^{255} (from the β^- decay of 99^{255}) were observed with a gridded alpha ionization chamber and a 50-channel differential pulse-height analyzer. This prevented observation of the alpha particles of 100^{256} (predicted to be of the order of 6.9-Mev energy) which would be in much lower abundance. However, a total of 33 spontaneous fission events occurred in the 100 fraction which was well outside the probability of the number of such events (10.8 ± 3) expected from 100^{254} based on the measured alpha-to-spontaneous fission ratio of 1550 for this nuclide.[4] The additional events are attributed to the nuclide 100^{256}. The spontaneous fission half-life was found to be approximately 3 to 4 hours (Fig. 1). The reaction sequence was:

$$99^{255}(n, \gamma)99^{256} \xrightarrow{\beta^-} 100^{256} \xrightarrow{S.F.} .$$

The predicted value[5] of the alpha half-life indicates that the alpha-to-spontaneous fission ratio of 100^{256} must be on the order of 0.04. As the initial amount of 99^{255} was known from the measured amount of 100^{255} in equilibrium with it just prior to bombardment, the pile neutron capture cross section of 99^{255} could be calculated to be about 40 barns. A similar experiment performed several months ago gave results which agreed with those reported here.

An irradiation of a small amount of 100^{255} in an attempt to produce 100^{256} gave one spontaneous fission probably attributable to this nuclide. This experiment set an upper limit of 100 barns on the capture cross section of 100^{255}.

Acknowledgment is due to the personnel of the Materials Testing Reactor for their valuable cooperation. We wish to express our appreciation of the continued interest of Dr. G. T. Seaborg.

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1. A. Ghiorso, B. G. Harvey, G. R. Choppin, S. G. Thompson, and G. T. Seaborg, Phys. Rev. (this issue).

2. G. R. Choppin, S. G. Thompson, A. Ghiorso, and B. G. Harvey, Phys. Rev. 94, 1080 (1954).

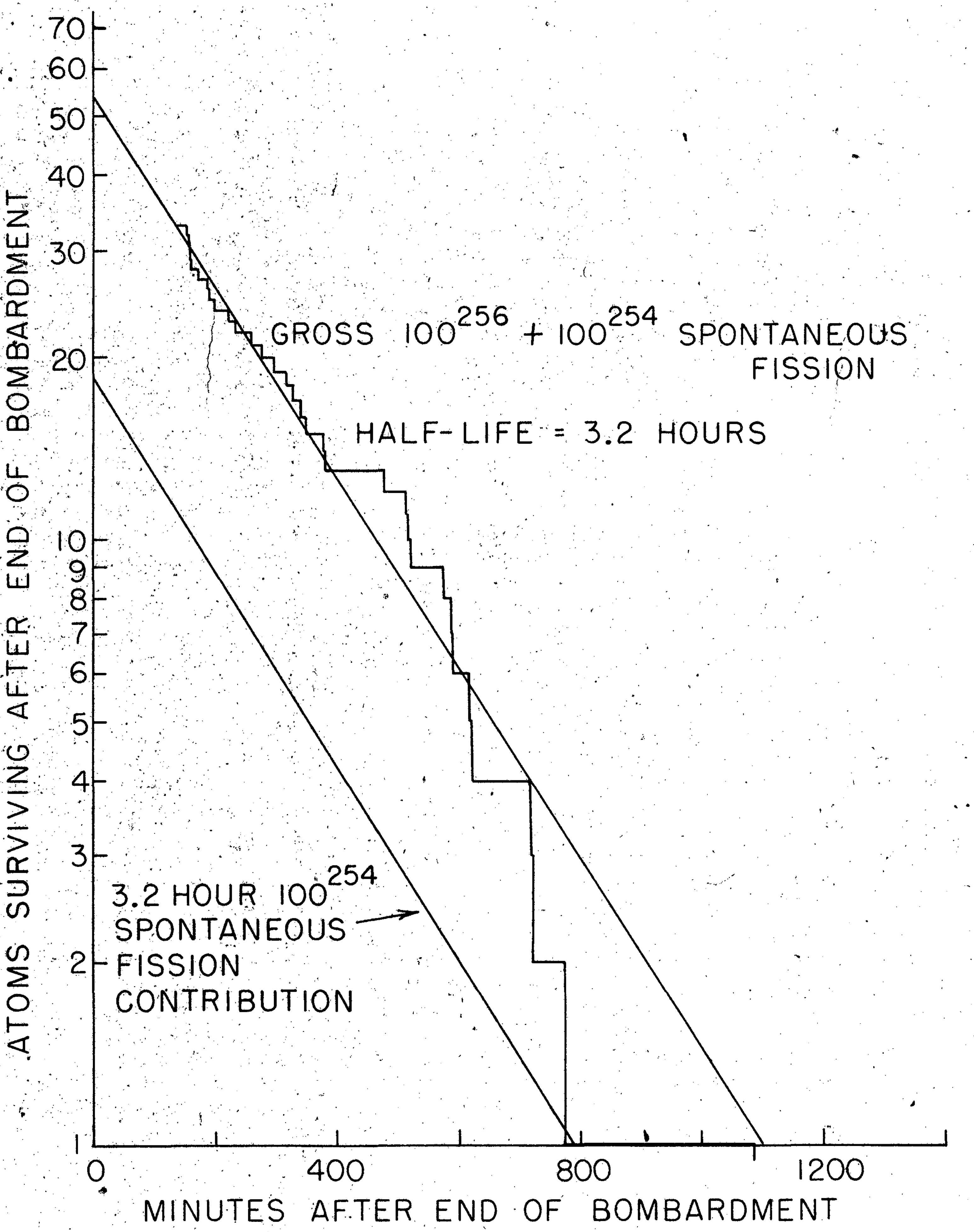
3. S. G. Thompson, B. G. Harvey, G. R. Choppin, and G. T. Seaborg, J. Am. Chem. Soc. 76, 6229 (1954).

4. Unpublished data from this laboratory.

5. R. A. Glass, S. G. Thompson, and G. T. Seaborg, J. of Inorganic and Nuclear Chemistry, in press.

FIGURE CAPTION

Fig. 1. Spontaneous fission decay of 100^{256}.


ATOMS SURVIVING AFTER END OF BOMBARDMENT
70
60
50
40
30
20
10
9
8
7
6
5
4
3
2
1
GROSS 100^256 + 100^254 SPONTANEOUS FISSION
HALF-LIFE = 3.2 HOURS
3.2 HOUR 100^254 SPONTANEOUS FISSION CONTRIBUTION
0
400
800
1200
MINUTES AFTER END OF BOMBARDMENT