# Excitation Function of $O^{16}(t,n)F^{18}$†

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(Received December 9, 1954)

The excitation function of the reaction $O^{16}(t,n)F^{18}$ has been measured for triton bombarding energies of 0.680 to 2.130 Mev. The half-life of the $F^{18}$ beta decay has been measured to be $111\pm1$ min.

## INTRODUCTION

INTEREST has been growing in this and other laboratories[1] in the use of mass-3 nuclides as bombarding projectiles in nuclear reactions. Use of these particles, tritons and $He^3$ nuclei, has a number of advantages: The large mass defect is of advantage in producing high excitations; new positions on the isotope chart can be reached; and the known energy levels of nuclei can be reached by new routes and with new isobaric spin configurations. Of course, the systematics of reactions with projectiles made up of three nucleons should be studied for its own sake. In line with these thoughts, it was decided to measure the excitation function of $O^{16}(t,n)F^{18}$ for bombarding energies of 0.680 Mev to 2.130 Mev.

## EXPERIMENTAL PROCEDURE

Thin mica targets were irradiated by various energy triton beams from one of the 2.5-Mev Los Alamos electrostatic generators. Both $HT^+$ and $T^+$ beams were used. The resulting $F^{18}$ was identified by following the well known 111-min decay with a $4\pi$ scintillation counter. The target holder acted as a Faraday cup for beam current measurements and a 300-volt "barrier" was used to isolate the Faraday cup from electron currents due to secondary electron emission. The $HT^+$ beam was used also to avoid uncertainty due to the $H_3^+$ in the mass-3 beam. The integrator was calibrated with a precision current source. The energy spread of the beam was held automatically to about 2 kev. Individual irradiations lasted not longer than 4 min.

The $O^{16}$ targets used for the different runs were cut out of a single sheet of 0.70 mg/cm² muscovite mica. No crystal plane edges were visible on close inspection, and the targets were assumed to be of uniform thickness. The beam level had to be kept to less than $\frac{1}{10}$ microampere through a $\frac{1}{8}$-in. aperture in order to prevent the targets from disintegrating. Kahn's values of $dE/dx$ for mica were used.[2] The decay was followed in each case for at least eight half-lives and usually more.

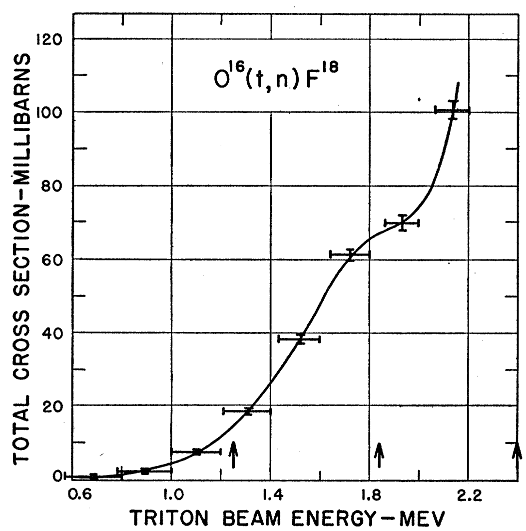


FIG. 1. Excitation function for $O^{16}(t,n)F^{18}$. See text (Results) for discussions of errors. Arrows indicate positions of energy levels of compound nucleus (reference 3). Note suppressed zero. Horizontal bars are not errors but indicate energy spread due to target thickness.

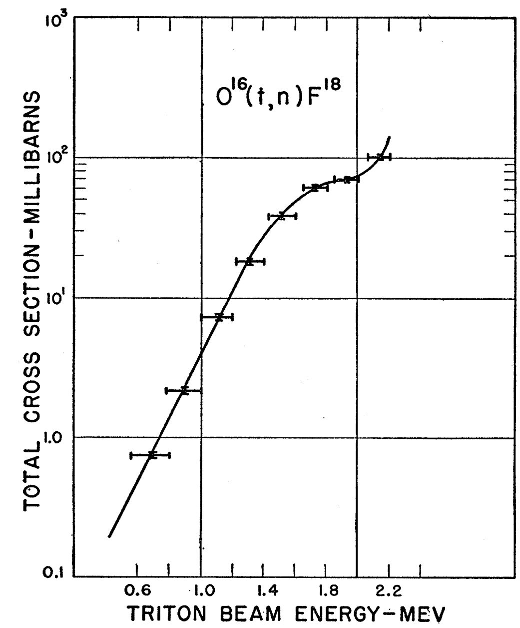


FIG. 2. Excitation function for $O^{16}(t,n)F^{18}$ on a semilog scale. See caption of Fig. 1 for discussion.

† Work performed under the auspices of the U. S. Atomic Energy Commission.

[1] M. L. Pool and D. N. Kundu, Phys. Rev. **82**, 305 (1951); Moak, Kunz, Good, and Kundu, Phys. Rev. **91**, 462 (1953); Almqvist, Allen, Dewan, and Pepper, Phys. Rev. **91**, 1022 (1953); Symposium on $H^3$ and $He^3$ Reactions, Phys. Rev. **91**, 488 (1953); C. D. Moak, Phys. Rev. **92**, 383(T) (1953).

[2] D. Kahn, Phys. Rev. **90**, 503 (1953).

## RESULTS

The results are shown graphically in Figs. 1 and 2. The relative error between points (indicated by the vertical bars) is about 2 or 3 percent. The horizontal bars on the figures are not errors but indicate the energy spread due to target thickness. The values of the absolute cross section are only good to about 20 percent due to the difficulty of obtaining a reliable absolute measurement. Because of this difficulty the vertical scale should be considered only as a rough indication of the absolute value.

The knee in the curve at about 1.8 Mev was verified by a second run and is consistent with data on the known levels of $F^{19}$, the intermediate nucleus involved.[3] (See Fig. 1.) The lower energy levels are probably overwhelmed by the effect of barrier penetration. The roughly exponential form of barrier penetration at low bombarding energies is apparent in Fig. 2, where the curve is approximately a straight line up to about 1.2 Mev.

Data from this experiment gave a half-life for the $F^{18}$ beta decay of $111\pm1$ min, in good agreement with published values.[4]

## ACKNOWLEDGMENTS

I wish to thank L. H. Treiman for the excellent samples of mica and H. C. Martin for his advice and details of his preliminary work on this reaction. I also wish to acknowledge the help of H. R. Lewis in checking calculations.

[3] Blaser, Boehm, Marmier, and Sherrer, Helv. Phys. Acta **24**, 465 (1951).

[4] Blaser, Boehm, and Marmier, Phys. Rev. **75**, 1953 (1949).

PHYSICAL REVIEW VOLUME 98, NUMBER 1 APRIL 1, 1955

# Half-Life of $Rb^{86}$†

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(Received November 19, 1954)

A number of very pure samples of $Rb^{86}$ obtained by a new radiochemical procedure were found to have a half-life of $18.64\pm0.04$ days.

THE accepted value[1] of 19.5 days for the half-life of $Rb^{86}$ was determined by Helmholz *et al.*,[2] on a somewhat impure sample. It has been possible to redetermine the half-life of this nuclide in connection with the separation of a number of very pure samples of $Rb^{86}$ from an intense source of fission-product radioactivities by an improved radiochemical procedure.

The chemical procedure used was based primarily on alternate $Fe(OH)_3$ scavengings from $NH_4OH$ and $NaOH$-$Na_2CO_3$ solutions, an $Sb_2S_3$ scavenging from $0.2N$ HCl solution, and several precipitations of the alkali metal perchlorates from ethyl acetate solution. The Rb was separated from Cs by elution with $0.3N$ HCl from the cation exchange resin, Duolite C-3. A column $0.85\ cm^2\times6$ cm of 200–325 mesh resin operated at room temperature gave a very satisfactory separation.

The activities of eight samples of $Rb^{86}$ were followed for from 7 to 9 half-lives by counting through an absorber (110.7 $mg/cm^2$ of Al) which removed the natural activity of $Rb^{87}$. The apparent half-life of each sample was constant with time, and the final counts, with no absorber, indicated that only the natural $Rb^{87}$ activity remained. The lack of residual activity indicates a decontamination factor for Cs of at least $5\times10^4$, based on the $Cs^{137}$ content of cesium fractions isolated from the same samples.

The data obtained by counting through the absorber were analyzed for $\lambda$ by a least-squares technique. The statistical reliability of counts taken during the last few half-lives was lower because of uncertainty with regard to the background counts. Rejection of all counts with a probable error greater than 1.4 percent left 20 to 24 counts (obtained over 6 or 7 half-lives) for each sample. The following values for the half-life (in days) were obtained: 18.700, 18.565, 18.628, 18.690, 18.547, 18.660, 18.639, and 18.682.

This leads to a mean value for the half-life of $Rb^{86}$ of 18.64 days with a probable error of $\pm0.04$ day.

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

[1] Hollander, Perlman, and Seaborg, Revs. Modern Phys. **25**, 513 (1953).

[2] Helmholz, Pecher, and Stout, Phys. Rev. **59**, 902 (1941).