Half-Life of Zr^{88}†

EARL K. HYDE
Radiation Laboratory, University of California, Berkeley, California
(Received July 29, 1953)

The half-life of Zr^{88} has been determined to be 85 days by following the growth and decay of its 105-day Y^{88} daughter.

IN an earlier report[1] concerning some neutron deficient isotopes of zirconium, brief mention was made of Zr^{88}. This was reported to be a long-lived activity emitting only x-radiation, 406-kev gamma radiation and conversion electrons. The determination of the half-life posed some difficulty, as it could not be determined directly by following the decay of the x- and gamma radiation because of the interference of of similar radiation from the 105-day daughter Y^{88}. The method selected as most suitable was the determination of the growth and decay of the 1.85-Mev gamma radiation of Y^{88} counted through sufficient absorber to eliminate the 406-kev gamma radiation of Zr^{88}. Because of the length of the parent and daughter half-lives, this method requires that the sample be followed for over two years. At the time of the above report, an estimate based on the determination of only the initial portion of the growth and decay curve gave 150 days as an approximate value of the Zr^{88} half-life. Sufficient time has now elapsed to permit completion of the growth and decay curve (see Fig. 1), and an accurate value of 85 days has been determined.

The zirconium sample used to obtain the experimental data of Fig. 1 was isolated from a niobium target which had been bombarded with 100-Mev protons in the 184-inch cyclotron on August 4, 1950. The zirconium was isolated 95 days after the bombardment, at which time the Zr^{86}, Zr^{87}, and Zr^{89} had decayed completely, by the chemical methods outlined before.[1] No zirconium activity other than that of Zr^{88} was present. The sample, mounted on platinum foil, was counted through 16.1 grams/cm^2 lead absorber placed immediately below a chlorine filled Geiger tube (Amperex). This tube was chosen because of its long-term stability. Each time the sample was counted, a UX_2 standard was counted immediately afterward. The 16.1 g/cm^2 of absorber reduced the gamma radiation of Zr^{88} to 3 percent or less of its original amount. The decay of Y^{88} is almost 100 percent by electron capture, and each electron capture event is followed by a 908-kev gamma ray and a 1.85-Mev gamma ray. The 16.1 g/cm^2 of lead is one half-thickness for this latter gamma. Hence the observed activity can be considered as due almost solely to Y^{88}.

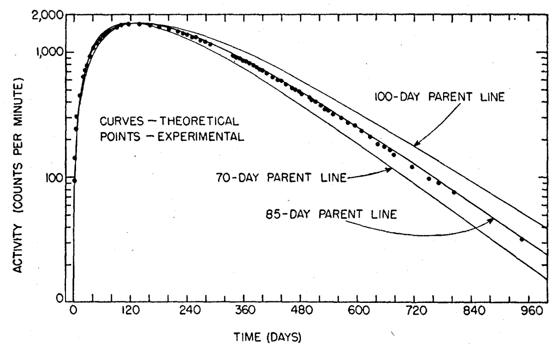

FIG. 1. Half-life determination of Zr^{88}. Experimental points represent growth and decay of energetic gamma radiation of 105-day Y^{88}. Sample was pure Zr^{88} initially. Curves are theoretical curves calculated for 3 values of parent half-life.

The experimental points are plotted against the time from the final purification of the zirconium fraction. Theoretical growth and decay curves were calculated for a 105-day daughter produced by a parent of various half-lives. Three of these curves normalized to the maximum of the experimental points are shown, including that for a parent half-life of 85 days which seems to fit the data best.

† This work was carried out under the auspices of the U. S. Atomic Energy Commission.
[1] E. K. Hyde and G. D. O'Kelley, Phys. Rev. 82, 944 (1951).