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Mass Spectrographic Assignment of Rubidium Isotopes

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MASS SPECTROGRAPHIC ASSIGNMENT OF RUBIDIUM ISOTOPES

BY

Frederick L. Reynolds, D. C. Karraker,

and David H. Templeton

September 29, 1948

Berkeley, California

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MASS SPECTROGRAPHIC ASSIGNMENT OF RUBIDIUM ISOTOPES

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and David H. Templeton

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September 29, 1948

We have used a mass spectrograph to investigate rubidium isotopes produced by bombardment of bromine (ammonium bromide) with helium ions in the Berkeley 60-inch and 184-inch cyclotrons. The 60^{o} deflection spectrograph is similar to that of Lewis and Hayden[1] but with larger dimensions and all-metal construction[2].

In each bombardment with 20 to 100 Mev helium ions there was a good yield of rubidium activity with half-life about 6 hours. The rubidium activities were separated from the target material using 20-30 micrograms of inactive rubidium carrier and divided into two portions. One part was further purified and used for decay and absorption measurements. The other major portion was placed on the tungsten filament of the mass spectrograph as the nitrate or chloride. The Rb^{+} ions produced by heating this filament were analyzed by the instrument and caught on a photographic plate. The mass scale was fixed by the lines of stable Rb^{85} and Rb^{87}. Lines at masses 81 and 82 were shown to be radioactive both by the photographic transfer technique (Fig. 1) and by counting with a Geiger counter provided with a narrow slit. With 80 Mev helium ions 5.0 hour Rb^{81} predominated in the mixture, and with 20 Mev helium ions almost pure 6.3-hour Rb^{82} was obtained. Otherwise the similar half-lives would have made characterization of the radiations, which are listed in Table I, very difficult. The

signs of the particles were determined with a crude 180° deflection beta spectrograph. The energies listed in Table I were obtained with this instrument or from absorption measurements with aluminum, beryllium, or lead, as indicated.

The previously reported[3] 6.5-hour rubidium activity assigned to Rb^{84} was presumably Rb^{82} or a mixture of Rb^{82} and Rb^{81}. No description of the radiations was reported.

Attempts to observe a krypton daughter of Rb^{81} have shown no positive results. Experiments are under way to characterize some longer-lived activity produced in these same bombardments due to Rb^{83} and perhaps Rb^{84}. Barber[4] has reported a 40-day positron emitter which he attributed to Rb^{84}.

The cooperation of Mr. J. T. Vale, Mr. B. Rossi, and the crews of the 184-inch and 60-inch cyclotrons is gratefully acknowledged.

This paper is based on work performed under the auspices of the Atomic Energy Commission.

References

[1] L. G. Lewis and R. J. Hayden, U. S. Atomic Energy Commission Report MDDC 1556, "A Mass Spectrograph for Radioactive Isotopes" (1947); R. J. Hayden, Phys. Rev. 74, 650 (1948).

[2] We are greatly indebted to Dr. A. J. Dempster, Dr. M. G. Inghram, and Dr. R. J. Hayden for information and advice concerning their techniques and the design of this instrument.

[3] J. O. Hancock and J. C. Butler, Phys. Rev. 57, 1088 (1940).

[4] W. C. Barber, Phys. Rev. 72, 1156 (1947).

Table I

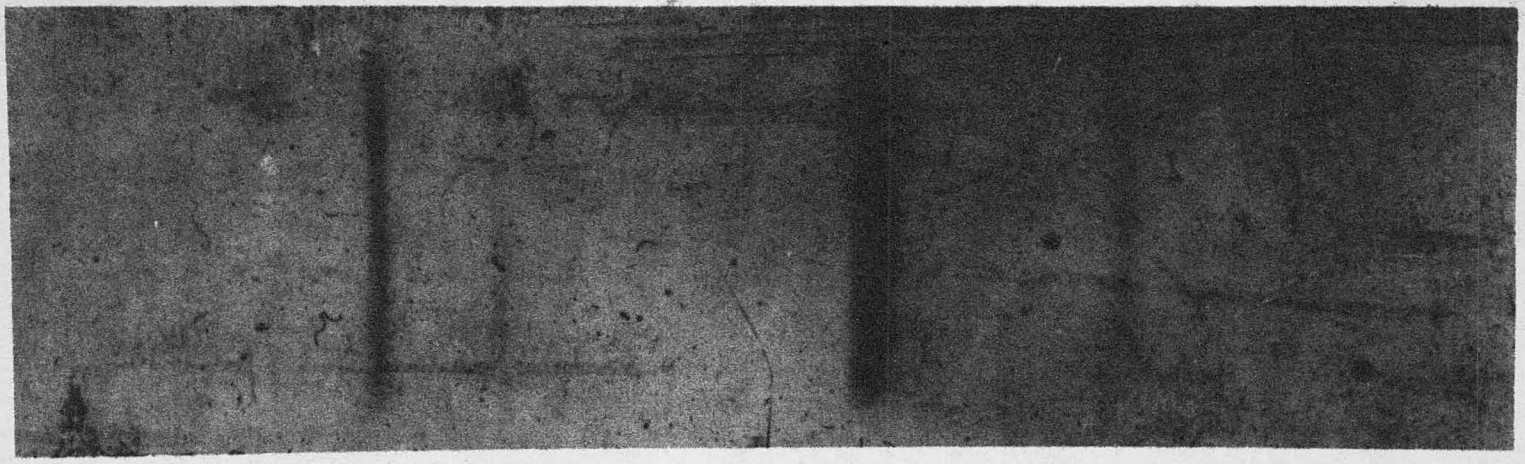
Radiations from Rubidium Isotopes

Isotope	Half-life	Radiations	e^-/β^+ ratio
Rb^{81}	5.0 hours	β^+ 0.7 Mev (abs.Al) e^- 0.2 Mev (spect.) γ 0.8 Mev (abs.Pb) K x-rays (abs.Al,Be)	~1
Rb^{82}	6.3 hours	β^+ 0.6 Mev (abs.Al) γ 1.0 Mev (abs.Pb) K x-rays (abs.Al,Be)	<0.02

Fig. 1

The original plate shows stable Rb^{85} and Rb^{87} and radioactive Rb^{81} and Rb^{82}. The "transfer" plate is placed emulsion-to-emulsion with the original for several hours before either is developed, to locate radioactive material.

a.



b.

81 82 85 87

FIG. 1

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