Title
SUMMARY OF THE RESEARCH PROGRESS MEETING OF FEB. 6, 1950

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H. P. Kramer

February 27, 1950

Berkeley, California

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Delayed α-Emitters. L. Alvarez.

The title of this talk is ambiguous insofar as it might lead one to expect a discussion of a process wherein the emission of α-particles from an excited nucleus occurs after a lapse of time. The present investigation, however, is concerned with the emission of α-particles from a daughter of a primary excited nucleus in such a manner that the decay time of the intermediate stage is extremely short. The first instance of such a process that has been studied is the emission of two α-particles in the decay of Li^8 according to the scheme:

$$Li^8 \longrightarrow Be^{8*} + e^-$$
$$Be^{8*} \searrow 2\alpha + K.E.$$

The observed half-life in this process is 0.89 sec. of which all but a negligibly small portion is attributable to the passage from Li^8 to Be^8. The spread in energy of the α-particles is about 3 Mev which points according to the uncertainty principle to a half-life for the decay of Be^8 into two α-particles of about 10^{-27} sec.

The active interest of the speaker in the subject was aroused by the analogy between the manner of decay by delayed α-emission and that by the delayed emission of a neutron which had occupied him previously:

$$N^{17} \longrightarrow O^{17} + e^-$$
$$O^{17} \searrow O^{16} + n$$

Equivalent to this observed decay but escaping experimental verification is :

$$Ne^{17} \longrightarrow F^{17} + e^{+}$$
$$F^{17} \longrightarrow O^{16} + p$$

Similar to the above instances of equivalent decays and delayed emission are:

$$C^{9} \longrightarrow B^{*4} + e^{+} \qquad B^{8} \longrightarrow Be^{*8} + e^{+}$$
$$B^{*4} \longrightarrow Be^{8} + p \qquad Be^{*8} \longrightarrow 2\alpha + K.E.$$

The speaker set himself the task of establishing the existence of C^{9} and B^{9} and to determine their manner of decay.

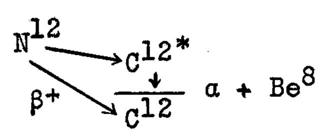
For this purpose it was possible to design a rather elegant experiment whose mechanics are indicated in the sketch of Fig. 1. The proton beam of the linear accelerator is controlled energetically by means of a wheel equipped with a number of absorber windows of different thicknesses before it passed through an ionization chamber filled with boron trifluoride. A wire extending along the axis of the chamber received ionization pulses which are amplified and observed on an oscilloscope screen. The oscilloscope screen accommodated a visual time record of the voltage on the wire for a period extending for about 1/15 sec. after the initial burst of ionization from the proton beam. The beam pulse is removed from the screen by an electronic gate. Any pulse that appears after this instant can be correlated with a delayed emission and the time elapsed between cause and event can be read on the screen. The circuits are designed so that only pulses initiated by heavy particles are observed. Such pulses were observed and the half-time of decay determined on the basis of the measured delays is 0.65 sec.

Since chemical methods of identification were clearly impossible reliance had to be placed on other means. The possibility that the pulses were due to delayed particles from Li^8 was ruled out by the fact that the absorber wheel was designed to degrade the energy of protons to a value below the threshold for Li^8 production.

Two checks showed that the activity was due to B^8. Be^9 was bombarded with protons and an attempt was made to detect delayed α-emission. Any such activity would have to be due to Li^8 or B^8 since it is impossible to obtain C^9 from Be^9 by proton bombardment. At first, any B^8 which might have been produced from Be^9 was masked by the strong Li^8 activity. It was only after a magnetic field was applied and the positron from B^8 separated from the electron from Li^8 that the identification could be made by measuring the β-energy in triple coincidence and finding it to be 13.5 Mev. The β-energy to be expected from the decay of C^9 was calculated not to exceed 6.5 Mev.

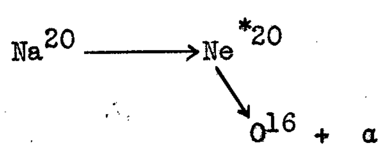
The threshold proton energy for the production of B^8 from B^{10} was found to be about 23 Mev. By setting up an energy and mass balance one finds that the reaction ought not be represented by $B^{10}(p,p2n)B^8$ since this results in a larger mass for Be^8 than for B^8 but should instead be regarded as the emission of a triton, $B^{10}(p,H^3)B^8$.

Two additional delayed α-emitters were found by filling the chamber with CH_4 one time and with Ne another. From CH_4, N^{12} was produced and identified by its 17 Mev positron. Its decay is represented by the following scheme.



$\tau_{1/2}$ = .012 sec.

Ne^{20} yielded Na^{20} by a (p,n) reaction. The decay of Na^{20} proceeded according to the following pattern.



$\tau_{1/2}$ = 0.25 sec.

The three delayed α-emitters which have been found are members of the second order mirror nuclei series:

	He^6	Li^8	Be^{10}	B^{12}	C^{14}	N^{16}		
		Be^{8*}	B^{10*}			O^{16}		
Li^4	Be^6	B^8	C^{10}	N^{12}	O^{14}	F^{16}	N^{18}	Na^{20}

An unsuccessful attempt has been made to verify the existence of Be^6 and F^{16}.

New Technique of Growing Stilbene Crystals. R. Leininger.

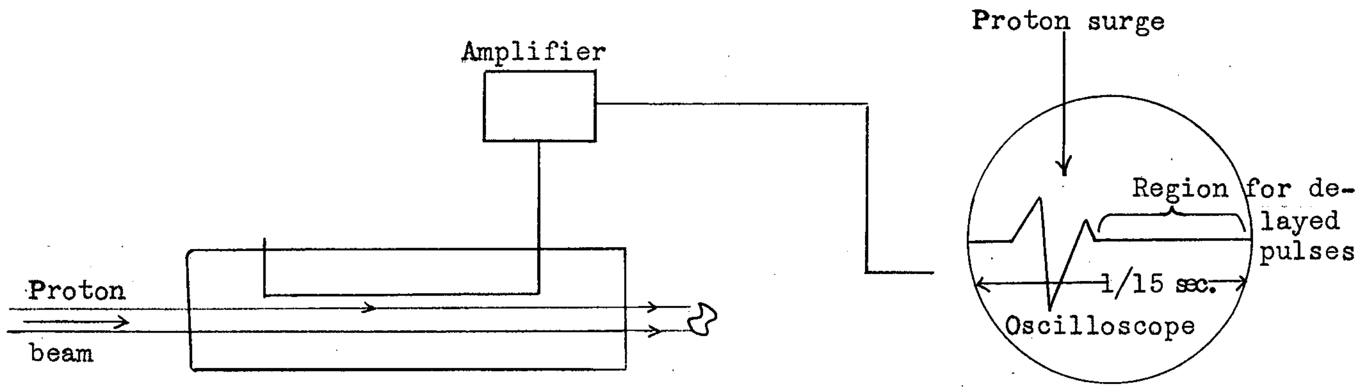
At the present time the art of crystal growing is still in the trial and error stage. By following this procedure in the course of growing a large number of crystals for experimental use by the group directed by E. Segrè the technique has been improved with the result that larger and more perfect crystals are now produced.

Formerly, the ampules that contained the solution were lowered through a large temperature gradient, 10°C per centimeter, with the result that cleavage occurred. Now the ampules are lowered more slowly through a temperature gradient of 1/2°C/cm at the rate of 1.75 in. per day. The oven in which the closely controlled temperature gradient is maintained is sketched in Fig. 2. One week is required to grow very large and flawless crystals.

Neutron Deficient Isotopes of Strontium. S. Castner.

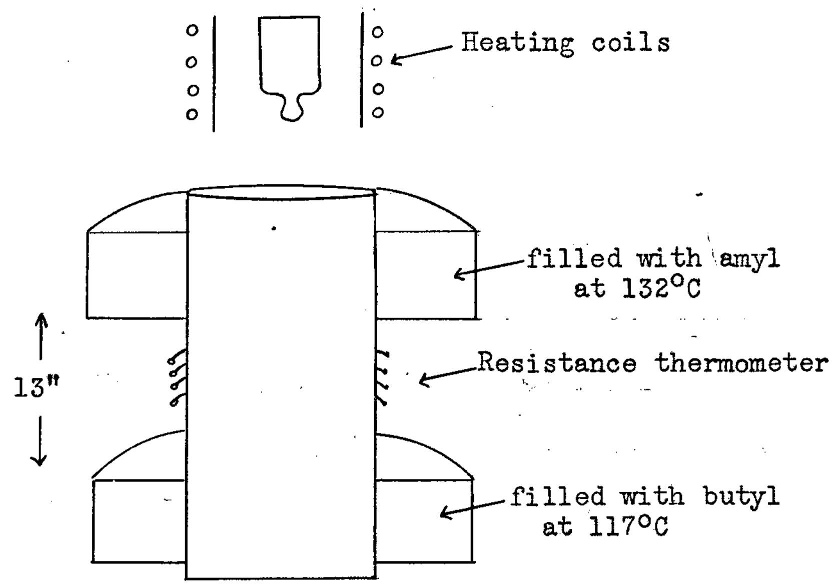
By bombarding rubidium with deuterons, three new isotopes of strontium have been found:

Z \ Mass no.	81	82	83
Sr	4 hr. Energy (Mev) K β^+ 0.09 e^- 0.05 γ 0.042	~30 d. Energy (Mev) K - e^- γ 0.3	30 hr. Energy (Mev) K β^+ 2.3 e^- 0.4 γ 0.5



Mechanism for Verifying Delayed α-Emitters

Fig. 1



Apparatus for Growing Stilbene Crystals

Fig. 2