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SUMMARY OF THE RESEARCH PROGRESS MEETING OF AUGUST 16, 1951

Sergey Shewchuck

September 15, 1951

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Berkeley, California

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Bevatron Status. W. Brobeck

The building was completed a year ago but progress on the bevatron has been slowed somewhat due to other work. At present the magnet steel is all erected. The coil winding is half done and expected to be completed by the end of the year. It was started in March.

The pole pieces and vacuum tank are not on order yet, though the magnet pole design has been complete for some time and the vacuum tank design is 75 percent complete. The vacuum chamber is to be of stainless steel. One section of the vacuum tank 10 feet long, built as a sample, has been tested to find the amount of outgassing from the pole tips which form a part of the vacuum vessel, as may be seen from Fig. 1. Actual tests showed little outgassing. Gasket joints were also tested and improvements made in their design. There is no scheduling of work yet on pole tips or tank parts.

The magnet power supply, motor generator sets and rectifiers, has been installed. The peak power is 100,000 kva. Rectifiers rectify during the increasing part of cycle and invert during the reverse part. The machines have been run but not under load. Testing under load will not be done until the winding of all four coils is completed and the four quadrants can be energized simultaneously to avoid unbalanced mechanical forces. The magnet should be ready for such tests about the first part of next year. Small improvement and adjustment work is being done on the magnet power system. Blowers and cooling equipment are being installed.

The noise problem from the motor generator sets is going to require solution. Consultants on acoustics from UCLA measured a noise level of 110 decibels inside the building and of 70 decibels at the nearest house. Recommendations for sound absorption have been made by these acoustic experts. One suggestion was the use of fiberglass mats. No insulation has been attempted.

It has been suggested that plans be made to install the high field pole tips at once if the Brookhaven cosmotron works successfully. This would give about 6 Bev by using a 1 ft. x 4 ft. aperture between pole tips. Present plans are based on using a 2 ft. x 6 ft. aperture to give about $3\frac{1}{2}$ Bev. Drawings have been made and they indicate the same amount of steel is required in both cases. Hence, the steel and the two sets of dies could be ordered now and the decision made later as to which set of dies to use.

The accelerating electrode design is complete and the work on the electronic frequency control system is progressing satisfactorily. The vacuum tank for the injector linear accelerator has been received and the drift tubes have been completed but not yet installed. A limited amount of work is being done on the vacuum system as well as on the control room. The machine should be completed sometime in 1953 if work continues at the present rate.

μ Meson Decay Spectrum. Harmon Hubbard

The external proton beam of the cyclotron is used to bombard a polyethylene target. The meson beam is brought out of the shielding and it enters a cloud chamber. The beam is pulsed at the rate of one pulse per minute. The π mesons penetrate a thin carbon plate in the chamber and decay in it. The μ decay electron track and π meson track coincidence is used to identify the π-μ decay.

$1\frac{1}{2}$ to 2 Mev energy is lost in traversing the carbon plate. 75 cloud chamber tracks have been studied showing that variations in energy loss have been small. An average correction has been applied except at higher energy level where corrections are applied individually. A curve has been plotted, Fig. 2, based on 435 measured tracks of μ mesons. The average energy appears to be 33 Mev while the maximum energy is $53\frac{1}{2} \pm 2\frac{1}{2}$ Mev.

It is hoped that from this work it may be possible to discover whether a μ meson decay is of the same type as β decay.

Complex Alpha Structure in Heavy Elements. F. Asaro

Magnetic deflection is the only method permitting the separation of energies within a few Kev. Early experiments on alpha energy measurements by Rutherford, by Briggs, and by Rosenbloom in France were described. No work has been done previously by the magnetic deflection method of separation of complex alpha groups of the transuranium elements except for Pu^{239} by Rosenbloom.

The present work was done with a Nier type mass spectrograph converted into an alpha spectrograph. Fig. 3 shows the alpha ray spectrograph. The magnetic field is for 14 Mev alpha particles. Radius of curvature is 75 cm. The plates used are Eastman 000 NTA nuclear plates. The efficiency is 1 alpha particle at the plate per 20,000 disintegrations at the source. The dispersion on the plate represents 4 Kev per mm for a 6 Mev alpha particle. The locations of the spectral lines are determined by the alpha particle track count made with the use of a microscope when the lines are not distinctly visible otherwise.

A 48-hour exposure of an Eastman 30 plate to the alpha groups of Cm^{242} is shown in Fig. 4. Here the lines for two alpha groups of Cm^{242} are clearly

visible. The main energy group is at 6.08 Mev.

Fig. 5 shows a plot of alpha tracks for Cm^{242}, while the decay scheme is given in Fig. 6. The abundance distribution of the alpha groups of Cm^{242} is shown to be 73 percent and 27 percent with a difference in energy level of 44 Kev.

The α spectrum of Pu^{239} is shown in Fig. 7 and exhibits three alpha groups with distributions of 69 percent, 21 percent, and 10 percent. The decay scheme of Pu^{239} to U^{235} is shown in Fig. 8. The gamma ray has not been found.

Fig. 9 exhibits the gross complex structure on Am^{241} showing mainly two groups of 42.6 Kev apart. Greater resolution of complex structure curve on Am^{241} as shown in Fig. 10 reveals five groups with three of them found in the low abundance groups. A still greater resolution (Fig. 11) in the low abundance high energy groups reveals another split for Am^{241}, making a total of six groups altogether. The alpha particle decay scheme of Am^{241} to Np^{237} is given in Fig. 12.

It is felt that the data on alpha tracks is real and indicative of alpha structure. The deviations in the curves are due to complex alpha structure and not to variations in magnetic current, sample thickness, chemical impurity in the sample, etc. The energy differences remain constant, and the relative abundances for each group together with the slopes of the peak are the same for all groups. Hence, the structure is believed to be true for the heavy elements.

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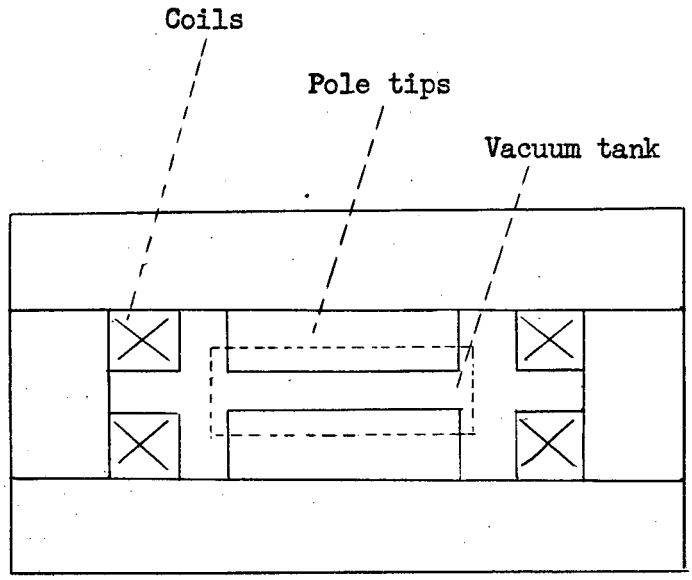

Coils
Pole tips
Vacuum tank

Fig. 1

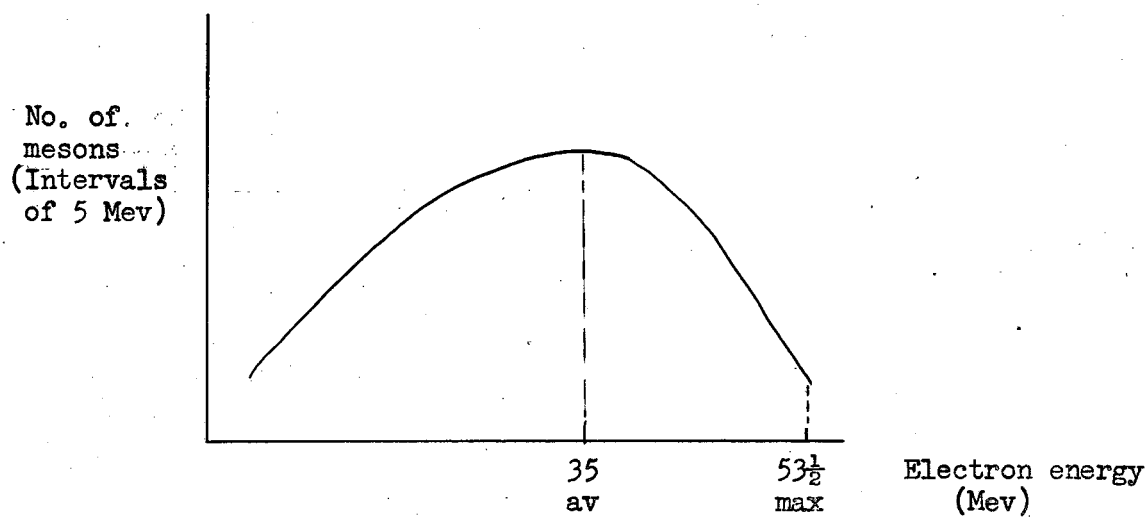

No. of mesons (Intervals of 5 Mev)
35
av
53½
max
Electron energy (Mev)

Fig. 2

ALPHA RAY SPECTROGRAPH

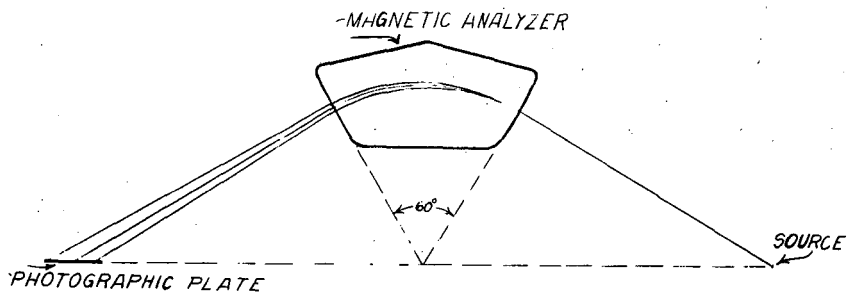
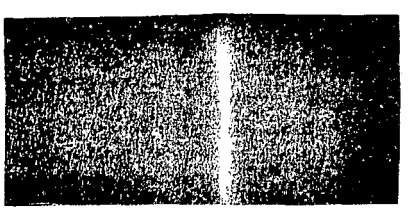


Fig. 3

Cm^{242} α-PARTICLE SPECTRA



6.08
MEV

FORTY EIGHT HOUR EXPOSURE OF ALPHAS FROM Cm^{242} SHOWING THE MAIN ENERGY GROUP AT 6.08 MEV AND A FINE STRUCTURE GROUP APPROXIMATELY 44 KEV LOWER IN ENERGY.

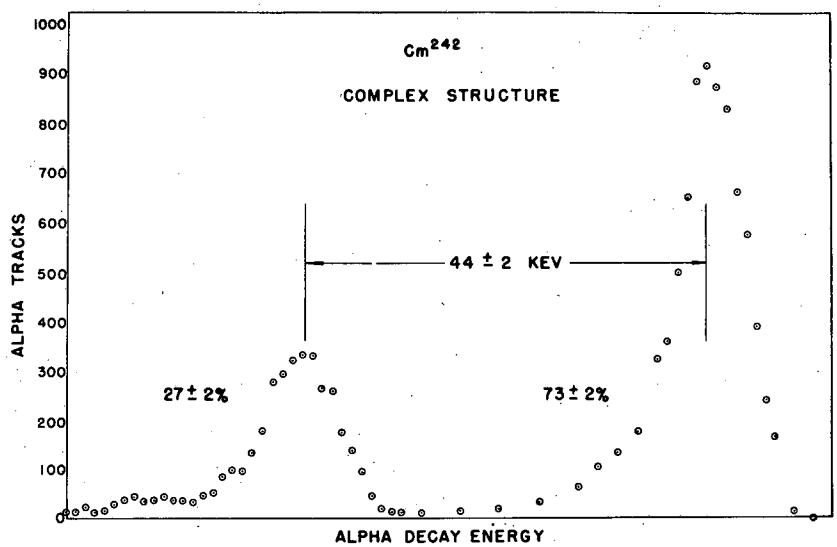

Cm242
COMPLEX STRUCTURE
44 ± 2 KEV
27 ± 2%
73 ± 2%
ALPHA TRACKS
ALPHA DECAY ENERGY
1000
900
800
700
600
500
400
300
200
100
0

Fig. 5

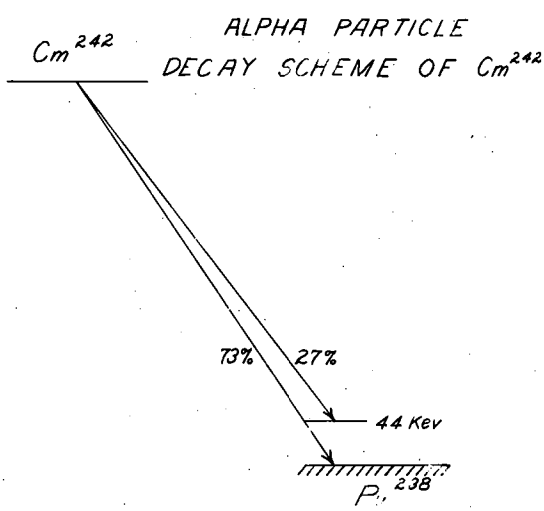

ALPHA PARTICLE
DECAY SCHEME OF Cm242
Cm242
73%
27%
44 Kev
P.238

Fig. 6

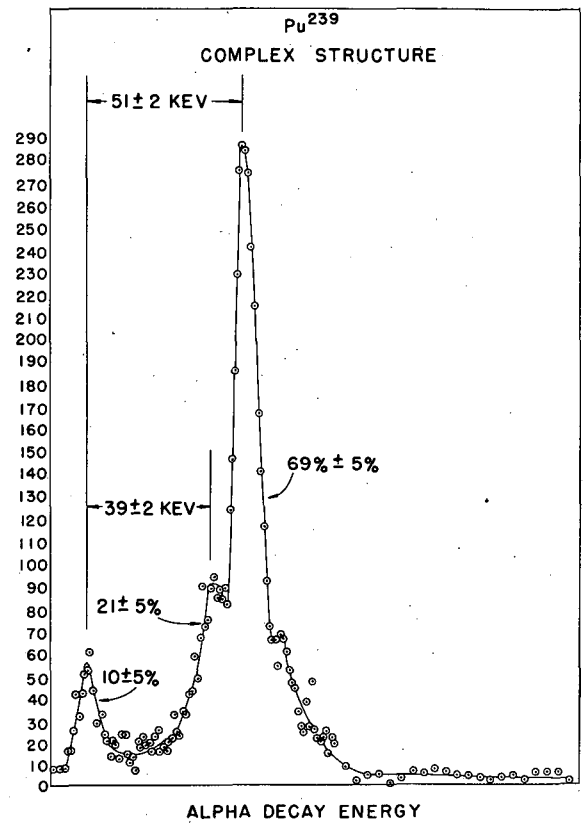

Pu239
COMPLEX STRUCTURE
51 ± 2 KEV
39±2 KEV
69% ± 5%
21± 5%
10±5%
290
280
270
260
250
240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ALPHA DECAY ENERGY

Fig. 7

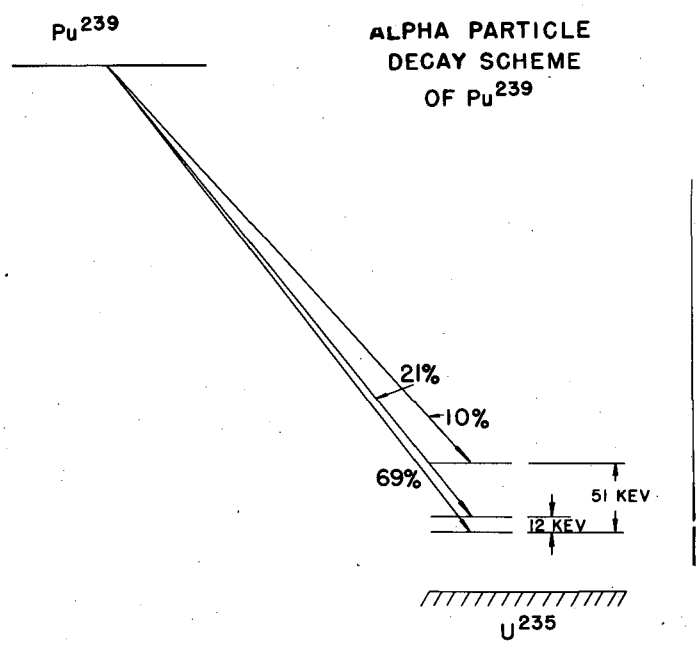

Pu239
ALPHA PARTICLE
DECAY SCHEME
OF Pu239
21%
10%
69%
51 KEV
12 KEV
U235

Fig. 8

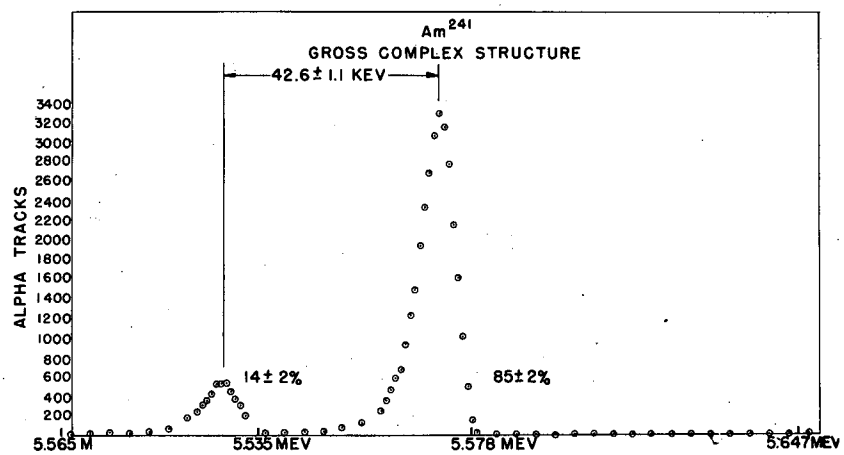

Am241
GROSS COMPLEX STRUCTURE
42.6± 1.1 KEV
ALPHA TRACKS
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
14± 2%
85± 2%
5.565 M
5.535 MEV
5.578 MEV
5.647 MEV

Fig. 9

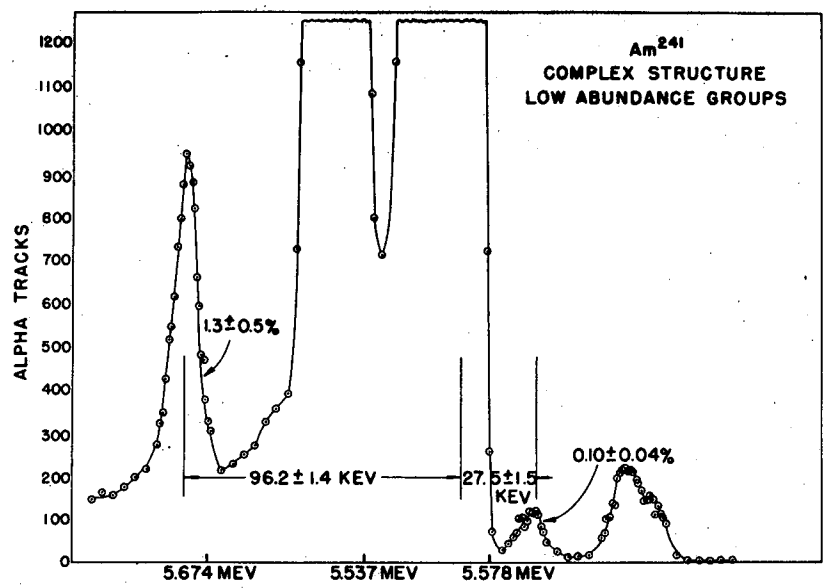

Am241
COMPLEX STRUCTURE
LOW ABUNDANCE GROUPS
ALPHA TRACKS
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
1.3±0.5%
96.2± 1.4 KEV
27.5±1.5 KEV
0.10±0.04%
5.674 MEV
5.537 MEV
5.578 MEV

Fig. 10

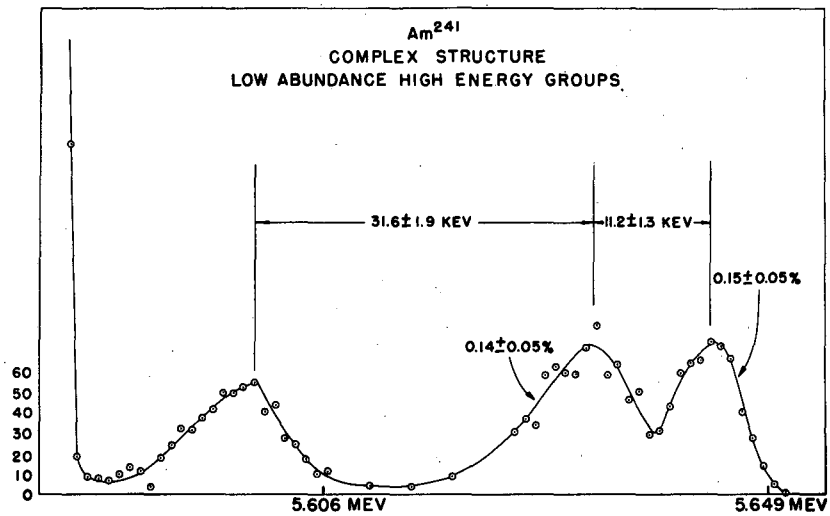

Am241
COMPLEX STRUCTURE
LOW ABUNDANCE HIGH ENERGY GROUPS
31.6±1.9 KEV
11.2±1.3 KEV
0.15±0.05%
0.14±0.05%
60
50
40
30
20
10
0
5.606 MEV
5.649 MEV

Fig. 11

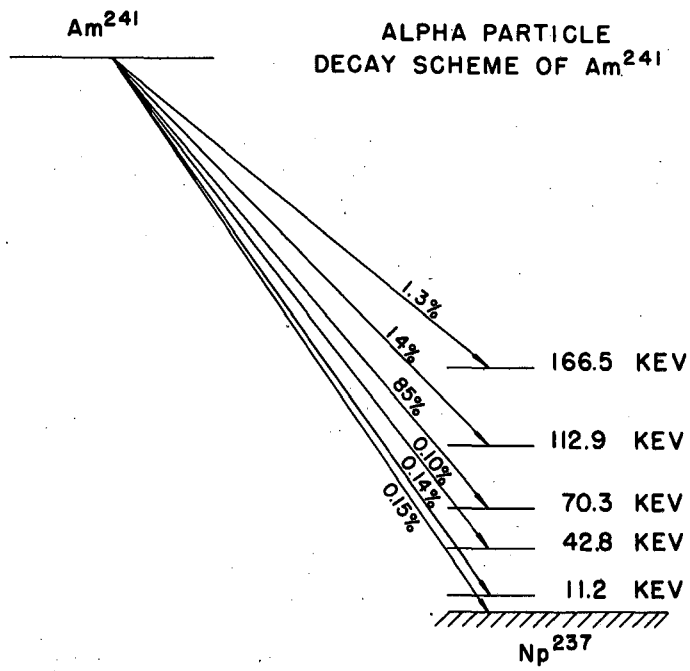

Am241
ALPHA PARTICLE
DECAY SCHEME OF Am241
1.3%
14%
85%
0.10%
0.14%
0.15%
166.5 KEV
112.9 KEV
70.3 KEV
42.8 KEV
11.2 KEV
Np237

Fig. 12