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SUMMARY OF THE RESEARCH PROGRESS MEETING OF JULY 31, 1952

Sergey Shewchuck

September 18, 1952

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Berkeley, California

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I. Further Considerations on Spontaneous Fission. Gary Higgins.

The talk essentially reviewed the experiment as given in report UCRL-1772, entitled "Spontaneous Fission of U^{234}, Pu^{236}, Cm^{240}, and Cm^{244}", by A. Ghiorso, G. H. Higgins, A. E. Larsch, G. T. Seaborg and S. G. Thompson, dated April 21, 1952.

However, a recalculation on the basis of more experimental data has resulted in different values for the spontaneous fission rate of the nuclide Cm^{240}. Whereas the initial values given in report UCRL-1772 were $1.0 \pm 0.2 \times 10^{11}$ fissions/gm-hr and $1.9 \pm 0.4 \times 10^{6}$ "half-life" years, the new values are $4.0 \pm 0.2 \times 10^{12}$ fissions/gm-hr and $7.9 \pm 0.4 \times 10^{5}$ years. Thus, it can be observed that on the plot of spontaneous fission rates vs. Z^2/A for even-even nuclides Cm^{240} falls more closely in line with the other nuclides rather than being possibly another exception in addition to U^{234} or Cm^{244}.

II. Neutron Time of Flight Instrumentation. W. Linlor.

This is in the nature of a preliminary report on work being done by Ragent and Linlor with time of flight measurements on particles with velocities approaching that of light. In the past cyclotron modulation was used by Alvarez in 1939. The present scheme involves cyclotron modulation plus fast electronics. The schematics of the experimental set up are shown in Fig. 1 as follows:

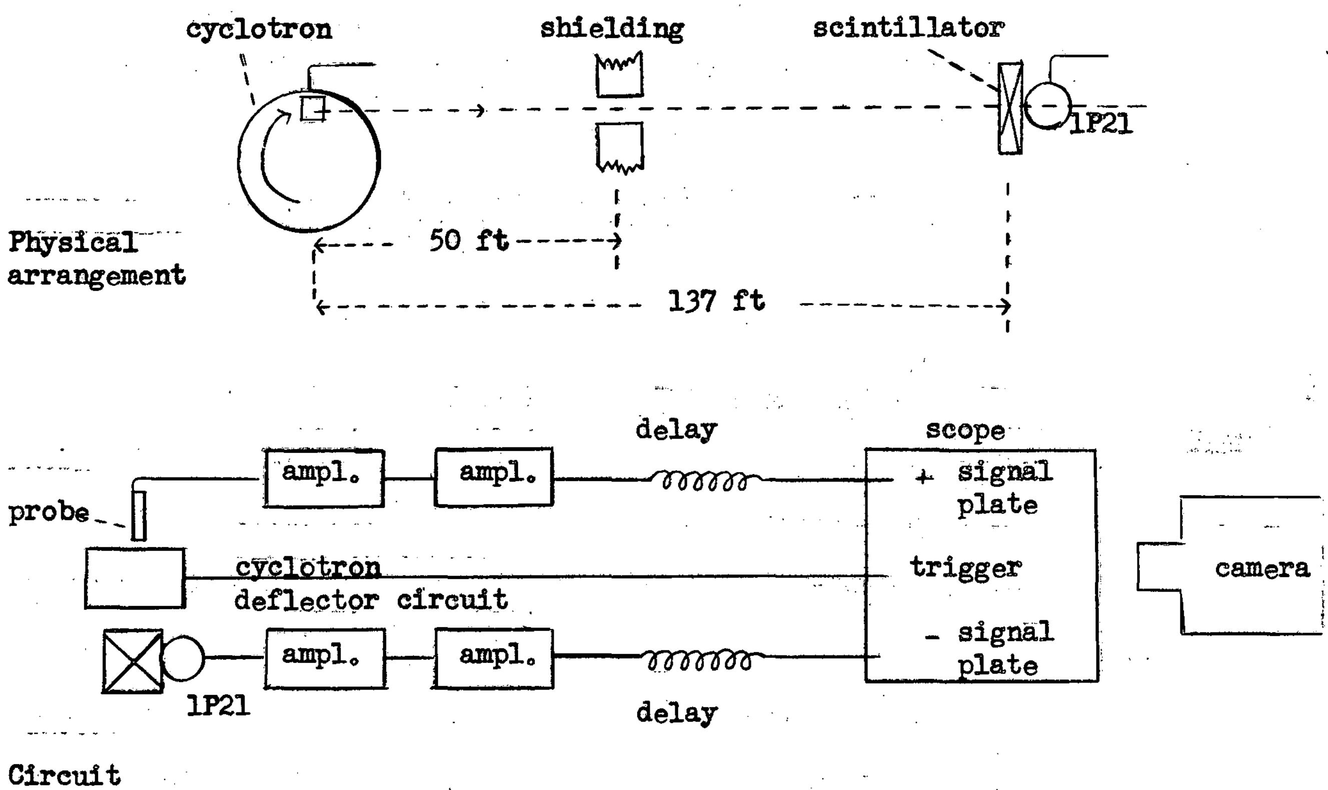

Fig. 1

A one inch Cu or four inch Be probe is used. The deuterons strike the probe in the 184-inch cyclotron. The neutrons go through the collimator; the stripped protons provide the pulse which is amplified. The rf phase signal to the cyclotron deflector circuit is obtained with the aid of the synchronizer unit of Paxon's. It was discovered coincidentally that gamma ray pulses appeared on the traces, thus providing a very effective means of calibrating the lead delays. Their appearance was in the ratio approximately of one gamma to 20 neutrons for the beam from deuterons. Since the gammas travel at the velocity of light, then the formula for the measurement resolves to

$$T_n = T_\gamma + Ax$$

where T_n is the time of flight of neutrons,

T_γ is the time of flight of gammas,

A represents "shakes" (or 10^{-8} sec.) per unit distance on the scope-screen,

x is the scope-screen distance from the gammas to the point of rise of the neutron pulse.

It has been noticed from the traces obtained that only in about three or four sweeps does a measurable event, or pulse, take place. The width of the probe pulse is about three shakes at the base.

Table I below gives the calculated energy resolution at various energies from 1 to 350 Mev.

Table I

Mev	β	Shakes for 100 ft.	Energy resolution in Mev per shake per 100 ft.
1	0.046	221.3	0.009
10	0.145	70.2	0.286
20	0.203	50.0	0.826
40	0.283	35.9	2.32
80	0.388	26.2	6.92
90	0.409	24.8	8.32
100	0.428	23.7	9.82
150	0.506	20.1	18.7
200	0.566	18.0	29.9
250	0.613	16.6	43.3
270	0.630	16.1	49.3
300	0.652	15.6	58.9
350	0.685	14.8	76.8

By plotting the counts of events vs. Mev an energy spectrum of the neutrons is obtained. From the results of such counts of energy groups within ± 5 Mev for the range 50 Mev to 150 Mev it was observed that a high peak occurs at ~90 Mev. The width of the spectrum agrees well with the Serber stripping theory whether with transparent or other nuclear models. The position of the mode is expected to be lower than 90 Mev, so work is in progress to determine why the 90 Mev value had been obtained.

In behavior the cyclotron is changeable and exact reproducibility has not been obtained. One can, however, get a single pulse of neutrons. The critical factors are the rf phase and probe radius. In this connection Paxon's deflector triggering circuit stabilizes the deuteron beam in such a way that the pulses are made to strike the deflector at a certain phase position in the rf cycle.

The background is not too serious since the chance is rather samll of the noise getting on during the 50 shakes of scope sweep. Some of the monitoring problems are being worked out.

Some types of experiments that may be done by this method are:

1. Differential n,p cross section measurements at small angles.
2. Total n,p cross section to within 1 or 2 percent.
3. n,p - n,d difference; or, n - d scattering.
4. Rechecking former work on total cross sections as function of scatterer and energy to obtain better accuracy.
5. Production of charged particles by neutrons.
6. Neutron spectra from various probe materials.
7. Meson experiments.

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