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Summary of the Research Progress Meeting

July 1, 1948

Margaret Foss Folden

Special Review of Declassified Reports
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Physics-General

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University of California
Radiation Laboratory
Berkeley, California

Summary of the Research Progress Meeting

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Margaret Foss Folden

Excitation Curves on Carbon $C^{12}(p,pn)C^{11}$ at 32 Mev. R. Phillips.

Studies have been made to investigate the reaction $C^{12}(p,pn)C^{11}$ at the highest resolution possible with the linear accelerator near the excitation threshold. This reaction is one whose high energy behavior cannot be explained by a compound nucleus process.

The excitation curve is obtained by stacking uniformly molded polystyrene foils, bombarding them on the proton beam and counting with a Geiger counter in standard geometry. The resulting curve is shown in Figure 1, which shows the sharp threshold

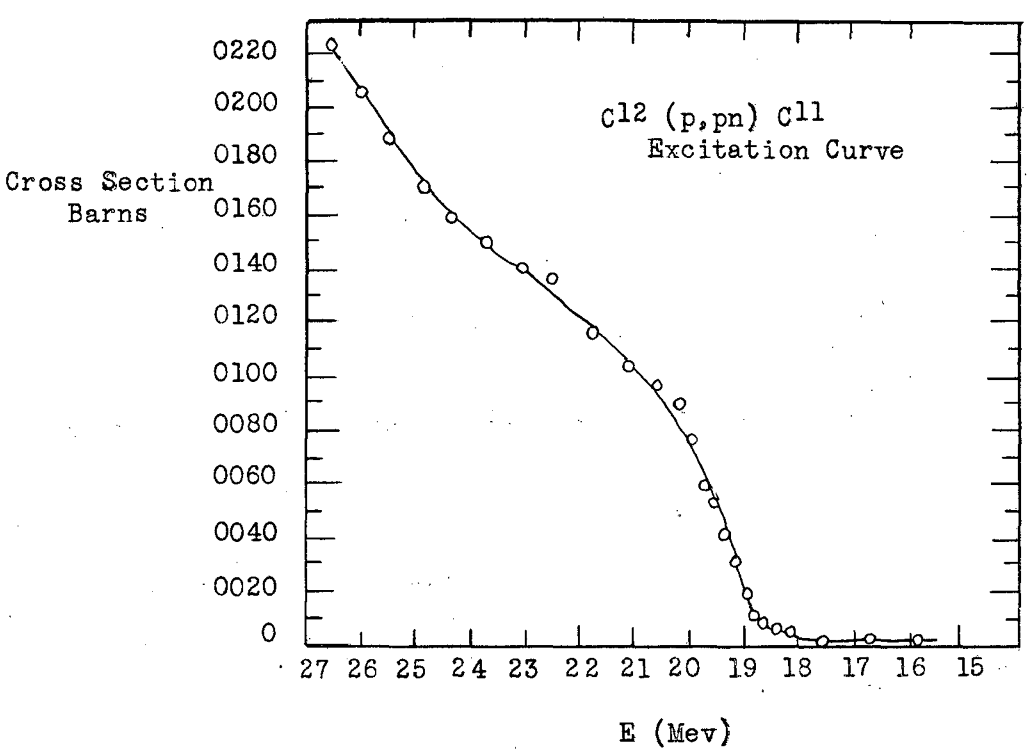

Figure 1

of the reaction. The second curve, shown in Figure 2, of the excitation shows an RMS width of 270 kv, the theoretical straggling width due to the foils of 170 killivolts,

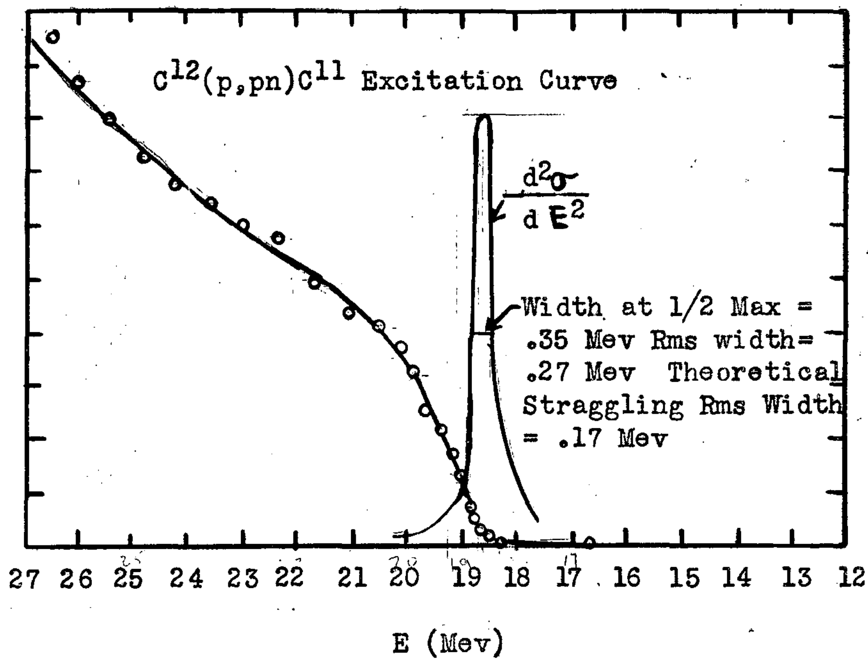

Figure 2

and the remaining width in accordance with the energy spread of approximately ± 100 kv half width of the linear accelerator. These data are compatible with a sharp threshold for this reaction.

The reaction can proceed by the various mechanisms as indicated below:

Mechanisms for the Reaction $C^{12}(p,pn)C^{11}$

Mechanism		Threshold, Mev Laboratory System
1. Compound Nucleus Mechanisms		
$C^{12} + p = N^{13*} \rightarrow N^{12*} + n$; $N^{12*} \rightarrow C^{11} + p$	I	20.4
$N^{13*} \rightarrow C^{12*} + p$; $C^{12*} \rightarrow C^{11} + n$	II	20.4
$C^{12*} \rightarrow 3\,He^4$		
$N^{13*} \rightarrow C^{11} + d$	III	18.1
2. Knock Out Mechanisms		
$C^{12} + p \rightarrow N^{12*} + n$; $N^{12*} \rightarrow C^{11} + p$	IV	~20.4
$C^{12} + p \rightarrow C^{12*} + p$ (Inelastic Scattering); $C^{12*} \rightarrow C^{11} + n$	V	20.4
$C^{12*} \rightarrow 3\,He^4$		
$C^{12} + p \rightarrow C^{11} + d$ (Proton Capture)	VI	18.1

It is believed from the observed excitation behavior that the most probable reactions are (a) deuteron emission from the compound nucleus N^{13} or (b) intranuclear n-p scattering in the carbon nucleus leading to proton unstable N^{12}.

Neutron Observation Cross Section for Lead. C. Leith.

In order to check the neutron scattering cross section measurements made with carbon detectors an experiment was done to determine the absorption cross section also using carbon detectors. The experimental apparatus is shown in Figure 3.

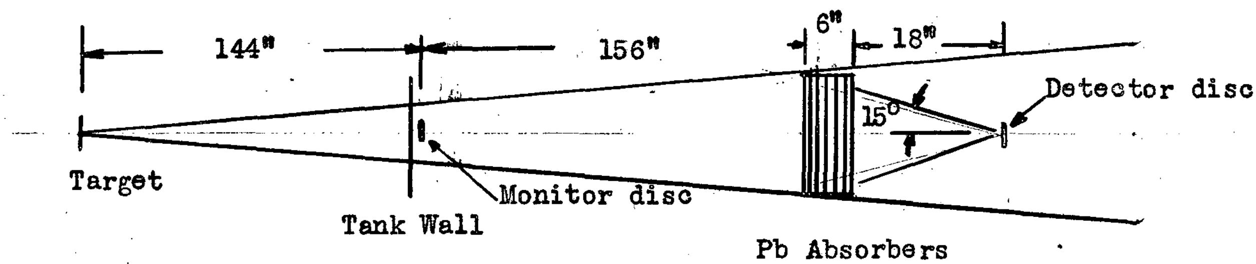

Figure 3

The monitor and detector discs are 3.4 cm. in diameter and 0.6 cm. thick. The absorbers are discs of lead 12 inches in diameter and 1 inch thick.

The cross section measured by this geometry is the absorption cross section plus a correction for scattering cross section greater than 15°, minus a correction for production of scattered neutrons within the 15° cone which can be detected.

The measured value for lead was

$$\sigma_{ab} + \sigma_{sc>15^\circ} - \sigma_{prod<15^\circ} = 1.95 \pm 0.07 \text{ barns}$$

By numerical integration of the angular distribution of scattered neutrons from lead measured previously it is found that

$$\sigma_{scat} - \sigma_{sc>15^\circ} + \sigma_{prod<15^\circ} = 2.60 \pm 0.11 \text{ barns}$$

The sum of these is

$$\sigma_{abs} + \sigma_{scat} = 4.55 \pm 0.13 \text{ barns}$$

The total cross section of lead measured by Cook, McMillan, Sewell and

Peterson using carbon detectors was

$$\sigma_t = 4.53 \pm 0.09 \text{ barns}$$

This result is in excellent agreement.

To determine the absorption and scattering cross sections it is necessary to evaluate the correction terms mentioned above. Tentatively this has been done and indications are that

$$\sigma_{abs} \text{ is } \simeq 1.8 \text{ barns}$$

$$\sigma_{sc} \text{ is } \simeq 2.8 \text{ barns.}$$

It seems positive that the scattering cross section is greater than the absorption cross section, indicating that the lead nucleus is not opaque for neutrons of 78 Mev energy.

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