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RL-254

# EXCITATION FUNCTION OF THE REACTION $C^{12}(n,2n)C^{11}$ AT HIGH ENERGIES

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University of California
Berkeley, California

November 3, 1947



The excitation curve for the reaction $C^{12}(n,2n)C^{11}$ has been calculated for energies up to 100 Mev. The calculations were done as described in the preceding letter for the similar reaction of $C^{12}$ under proton bombardment.

The reaction can go in three ways:

(a) $n + C^{12} \longrightarrow C^{*13}$; $C^{*13} \longrightarrow C^{11} + 2n$

(b) $n + C^{12} \longrightarrow C^{*12} + n$; $C^{*12} \longrightarrow C^{11} + n$

(c) $n + C^{12} \longrightarrow C^{11} + 2n$ (knock out)

The results of the calculations for 50% charge exchange are shown in Figure 1. The calculated cross section for the reaction at 90 Mev is:

.011 barns for 100% charge exchange

.013 barns for 50% charge exchange.

The experimental value is 0.025 ± .004 barns.(1)

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(1) E. M. McMillan and H. F. York, Phys. Rev., to be published

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The ratio of the cross section of the reaction $C^{12}(p,pn)C^{11}$ to the cross section of the above reaction at 90 Mev is

5.8 for 100% charge exchange

3.8 for 50% charge exchange.

The experimental ratio is 2.7 at 90 Mev[1].

This difference in cross sections between the two reactions is established by two factors. Firstly, there is the part played by charge exchange in the $C^{12}(p,pn)C^{11}$ reaction which leads to excited $N^{12}$ with the subsequent boiling off of a proton, while a similar exchange process cannot take place for the $C^{12}(n,2n)C^{11}$ reaction. Secondly, there is the difference between the contributions of the knock out process as a result of the difference in the n - p and the n - n cross sections, which favors the $p + C^{12}$ knock out reaction. It will be noted that the parts of the reactions which go through excited $C^{12}$, while practically equal, are so small that they do not greatly affect either reaction.

Although the results of these calculations do not agree too closely with the experimental results, the results are probably as good as are to be expected because of the crudity of the assumed model. The results do, though, seem to give a good qualitative picture of the contributing factors affecting the total reactions. Finally, it would seem that the assumption of 50% charge exchange gives better agreement.

The authors wish to express their appreciation to Professor Robert Serber for his continued assistance throughout the progress of these calculations.

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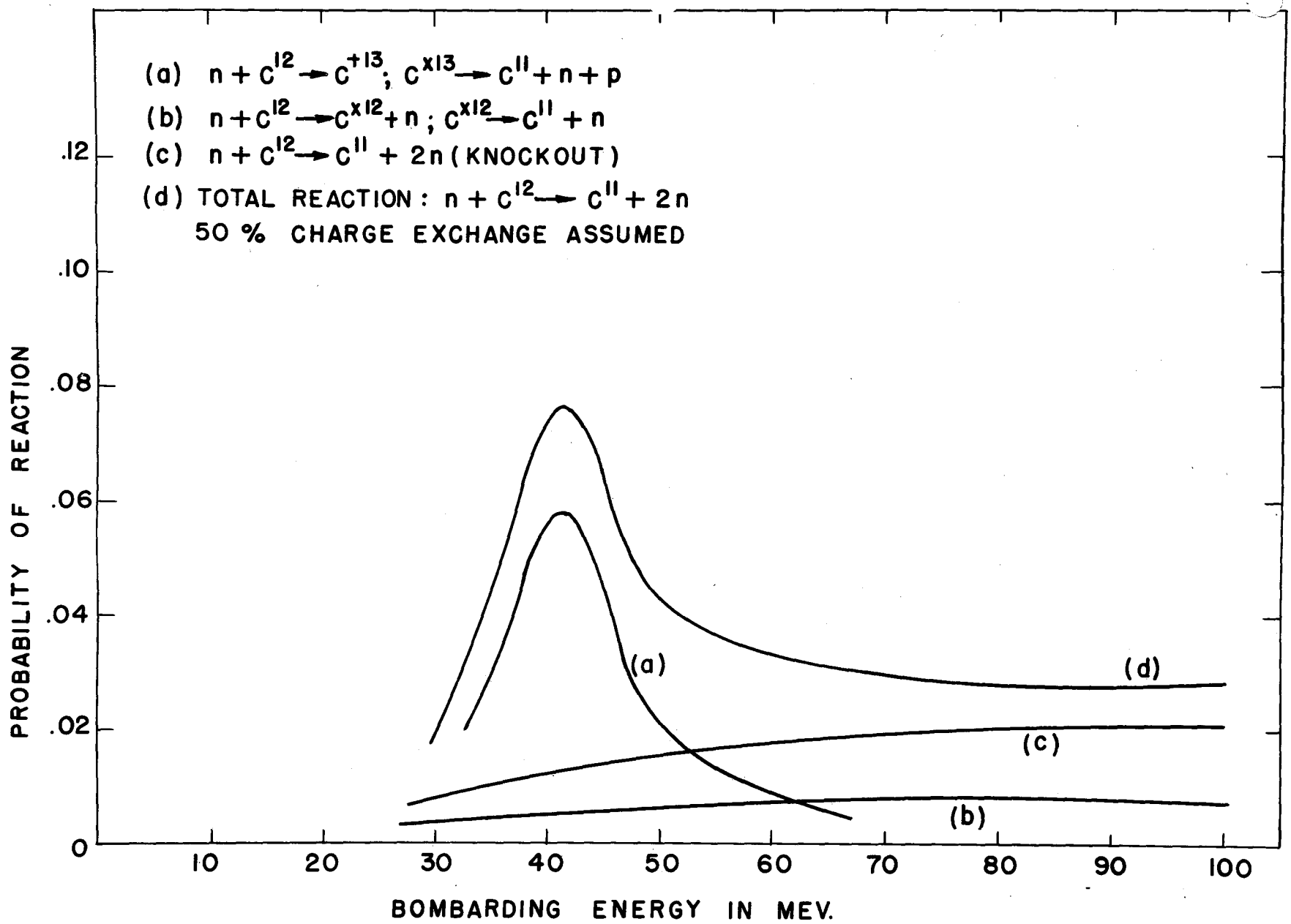
cb -November 4, 1947


(a) $n + C^{12} \rightarrow C^{+13}$; $C^{x13} \rightarrow C^{11} + n + p$
(b) $n + C^{12} \rightarrow C^{x12} + n$ ; $C^{x12} \rightarrow C^{11} + n$
(c) $n + C^{12} \rightarrow C^{11} + 2n$ (KNOCKOUT)
(d) TOTAL REACTION : $n + C^{12} \rightarrow C^{11} + 2n$
50 % CHARGE EXCHANGE ASSUMED
PROBABILITY OF REACTION
.12
.10
.08
.06
.04
.02
0
10
20
30
40
50
60
70
80
90
100
BOMBARDING ENERGY IN MEV.
(a)
(b)
(c)
(d)

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