Title
ON THE RELATIVE PRODUCTION OF pi + AND pi- MESONS BY NEUTRONS

Authors
Bradner, Hugh
O'Connell, D.J.
Rankin, B.

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May 1, 1950

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ON THE RELATIVE PRODUCTION OF π^+ AND π^- MESONS BY NEUTRONS

Hugh Bradner, D. J. O'Connell and B. Rankin

May 1, 1950

We have made an experiment to determine the relative yields of high energy π^+ and π^- mesons produced by 270 Mev neutron beam[1] striking a carbon target. The general arrangement used for the investigation is shown in Fig. 1. A close-up view of the target and plate holder is shown in Fig. 2. The target was 1/2 inch thick graphite, inclined to the neutron beam so that it could be considered thin for the mesons observed. Mesons with 50-65 Mev energy leaving the target at roughly 90° to the incident neutron beam could be recorded in nuclear emulsions after passing through 1/2 inch copper absorber. This energy and angle were chosen to permit comparison with the results from proton beam experiments.[2] A total of 34 π-μ decays and 307 σ (star forming) mesons were observed to stop in the emulsions. Assuming that all π^+ mesons undergo π-μ decay, and that 73 percent of π^- mesons produce stars, this represents a π^+/π^- ratio of $\frac{1}{12.6} \pm 12$ percent. Four events classed as π-μ decays could not be distinguished with certainty from single prong stars with a high energy prong leaving the emulsion. It is not unreasonable that this number of cases should be found in the 307 σ events observed,[3] and therefore the true π^+/π^- ratio may be approximately 1/14. This is far different from the reciprocal of the 4.8/1 yield found when carbon was bombarded

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(1) E. Kelley, C. Leith, C. Weigand, Phys. Rev., to be published

(2) H. Bradner and S. B. Jones, Phys. Rev. 78, 90 (1950) E10
C. Richman and H. Wilcox, Phys. Rev. 78, 85 (1950) C11

(3) F. Adelman, Phys. Rev. 78, 86 (1950) D3

by 345 Mev protons. However, the phase space arguments which Chew[4] employed in discussing the π^+/π^- ratio from protons on carbon can be used to give qualitative agreement with the observed 1/14 ratio. His model would consider the 5 nucleons which are close together when a neutron enters an α-particle nucleus. If a π^- is created, the remaining particles (3p,2n) must find room in phase space and at least one proton must be energetic; if a π^+ is created, at least 2 neutrons of the remaining particles (1p,4n) must be energetic. The production of π^+ would therefore be inhibited. The magnitude of the effect depends on the energy available to the nucleons, and Chew's arguments would predict a ratio of the order of 1/10 to 1/20 for 50-60 Mev mesons.

This work was done under the auspices of the Atomic Energy Commission.

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(4) G. Chew and J. L. Steinberger, Phys. Rev., May 15, 1950

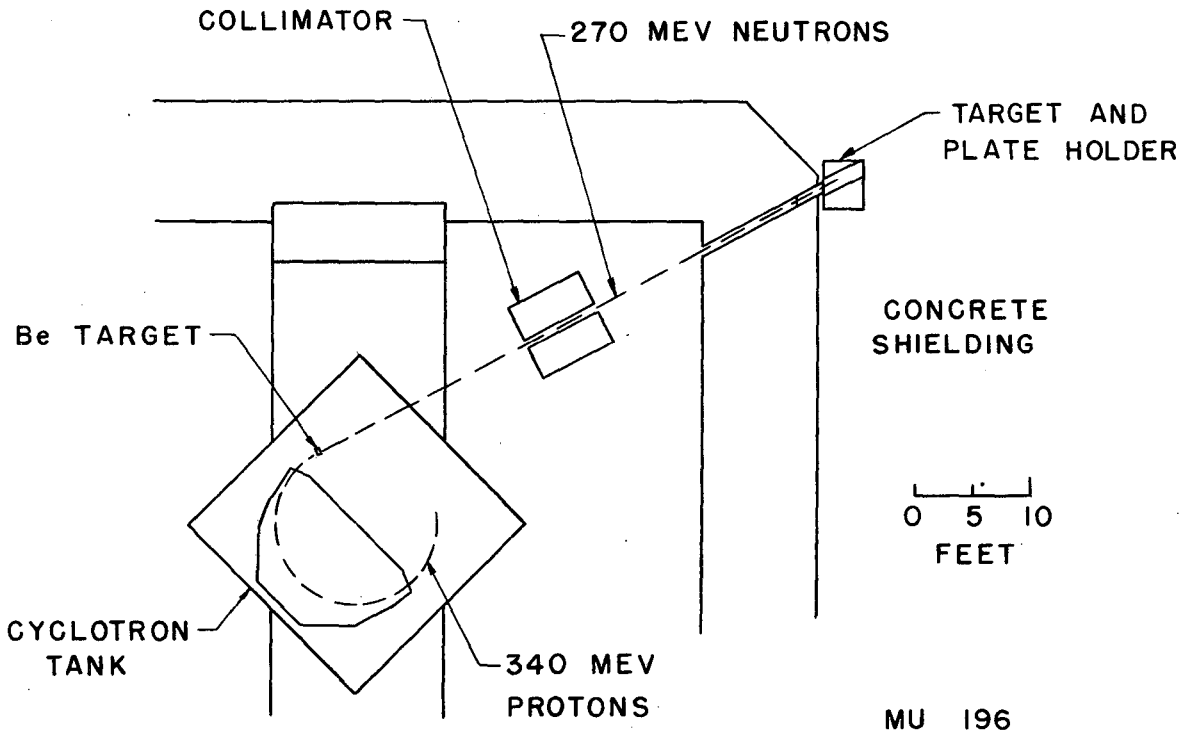
COLLIMATOR
270 MEV NEUTRONS
TARGET AND
PLATE HOLDER
Be TARGET
CONCRETE
SHIELDING
0 5 10
FEET
CYCLOTRON
TANK
340 MEV
PROTONS
MU 196

FIG. 1

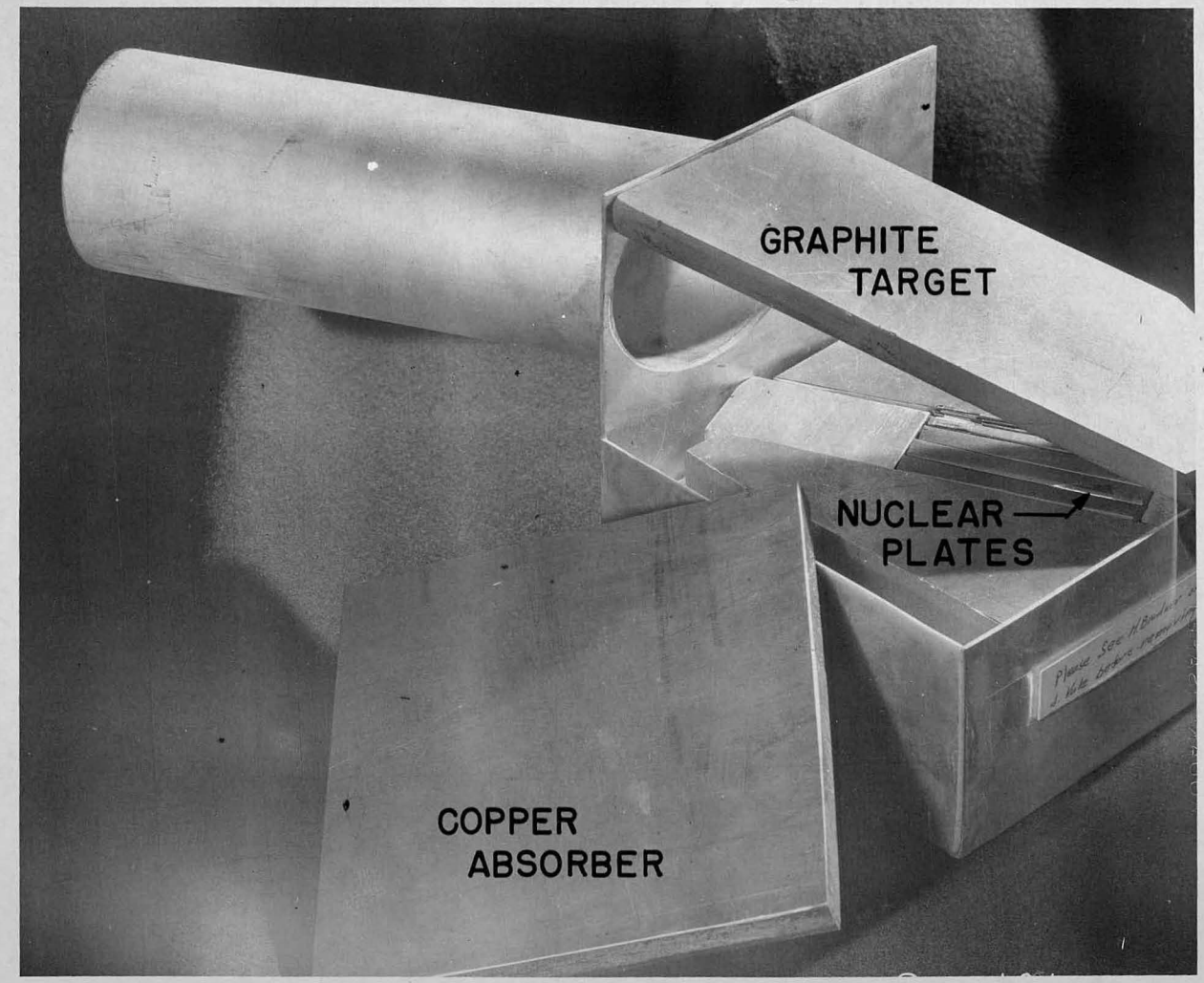

FIG. 2