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n+-MESON PRODUCTION CROSS-SECTION AS A FUNCTION OF ATOMIC NUMBER

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UNIVERSITY OF CALIFORNIA

Radiation Laboratory

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$\pi^+$ -MESON PRODUCTION CROSS-SECTION  
AS A FUNCTION OF ATOMIC NUMBER

D. Hamlin, M. Jakobson, J. Merritt and A. Schulz

August 29, 1951

Berkeley, California

$\pi^+$ -MESON PRODUCTION CROSS-SECTION  
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The relative cross sections for the production of  $53 \pm 4$  Mev mesons at  $0^\circ \pm 7^\circ$  by 340 Mev protons have been measured for C, Al, Fe, Cu, Ag, and Pb. The mesons were produced by the external scattered beam of the 184-inch synchro-cyclotron. In order to separate the mesons from the proton beam, the mesons were turned through approximately  $90^\circ$  by means of a magnetic field<sup>1</sup> (Fig. 1). The mesons were detected by trans-stilbene crystals and electronic circuits already reported.<sup>2</sup> Briefly, a coincidence of the pulses caused by a  $\pi^+$ -meson passing through one crystal and stopping in a second generates a delayed gate which is put in coincidence with the  $\mu^+$  pulse resulting from the decay of the stopped  $\pi^+$ -meson.

Figure 2 shows the measured relative cross sections. The standard deviations indicated include only the statistical deviations arising from counting. A curve is given for  $\sigma/A$  as well as  $\sigma$  per nucleus to indicate the effective cross section per nucleon. The cross section divided by A is a decreasing function of A similar to that measured by Mozeley for production of  $\pi^+$ -mesons by photons.<sup>3</sup> The A dependence observed is in agreement with that obtained by Brueckner, Serber, and Watson in an analysis

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<sup>1</sup> The arrangement was similar to that used by C. Richman, M. Skinner, J. Merritt, B. Youtz, Phys. Rev. 80, 900, (1950)

<sup>2</sup> M. Jakobson, A. Schulz, J. Steinberger, Phys. Rev. 81, 895 (1951)

<sup>3</sup> R. F. Mozeley, Phys. Rev. 80, 493 (1950)

based on the absorption of  $\pi$  mesons in nuclear matter.<sup>4</sup>

Previously the differential production cross sections for 20 Mev mesons at  $150^\circ \pm 15^\circ$  made by 240 Mev protons have been reported.<sup>5</sup> Results are in qualitative agreement and give the same general functional relation for the production cross section as a function of A.

In order to compare counter detection of  $\pi^+$ -with plate techniques, the peak spectrum for the reaction  $p + p \rightarrow D + \pi^+$  was investigated. This spectrum has been investigated previously by plates.<sup>1</sup> Figure 3 shows the spectrum which was obtained with a 2-inch polyethylene target. The peak occurs at the energy expected from the thick production target which was used. The peak obtained by counters is considerably broader than that obtained by plates because of the greater energy width of the crystal detectors.

Thanks are due Prof. C. Richman and co-workers for assistance in all parts of the experiment. We also wish to thank Prof. O. Chamberlain for helpful discussions concerning the experiment.

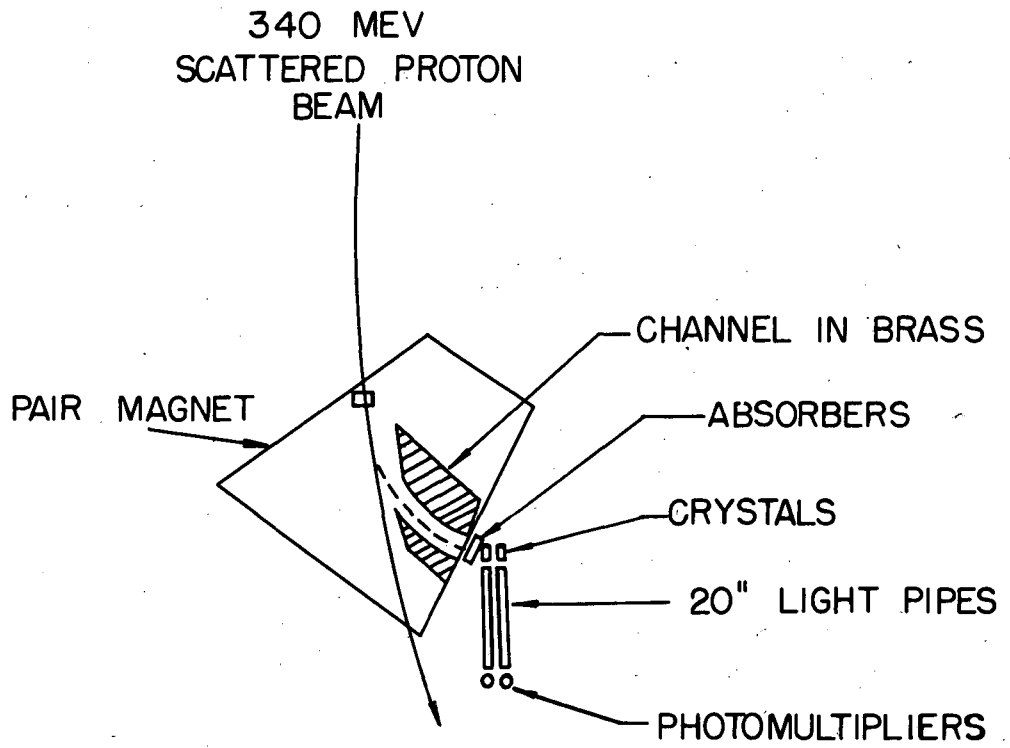
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<sup>4</sup> K. A. Brueckner, R. Serber, and K. M. Watson, UCRL 1358

<sup>5</sup> D. Clark, Phys. Rev. 81, 313 (1951)

FIGURE CAPTIONS

- Fig. 1 Schematic diagram of the experimental arrangement.
- Fig. 2 The relative cross-sections in arbitrary units for the production at  $0^\circ \pm 7^\circ$  of 53 Mev  $\pi^+$  mesons by 340 Mev protons on C, Al, Fe, Cu, Ag, and Pb. The relative cross-sections per nucleus is shown in solid lines and the relative cross-section  $\sigma/A$  is shown in dotted lines.
- Fig. 3 A curve showing the  $\pi^+$  meson energy distribution from a 2 inch polyethylene target bombarded by 340 Mev protons. Measurements were made at  $0^\circ \pm 7^\circ$  to the proton beam direction.



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Fig. 1



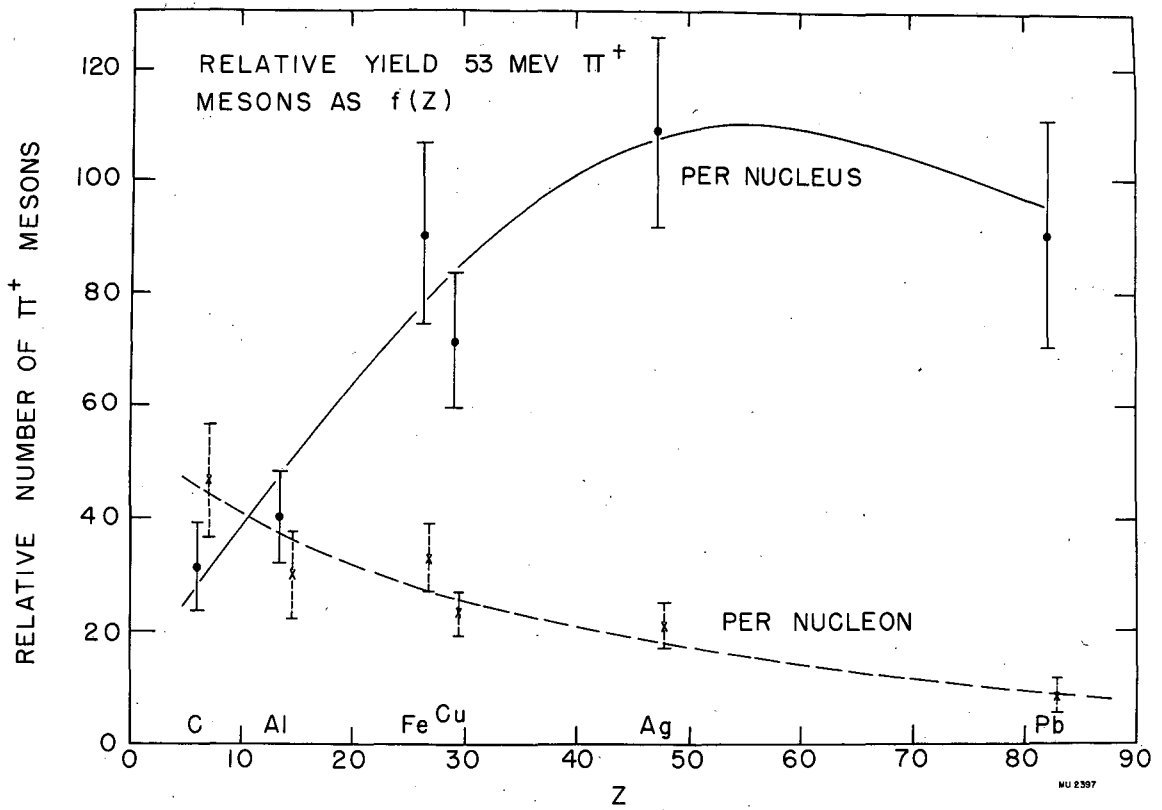


Fig. 2

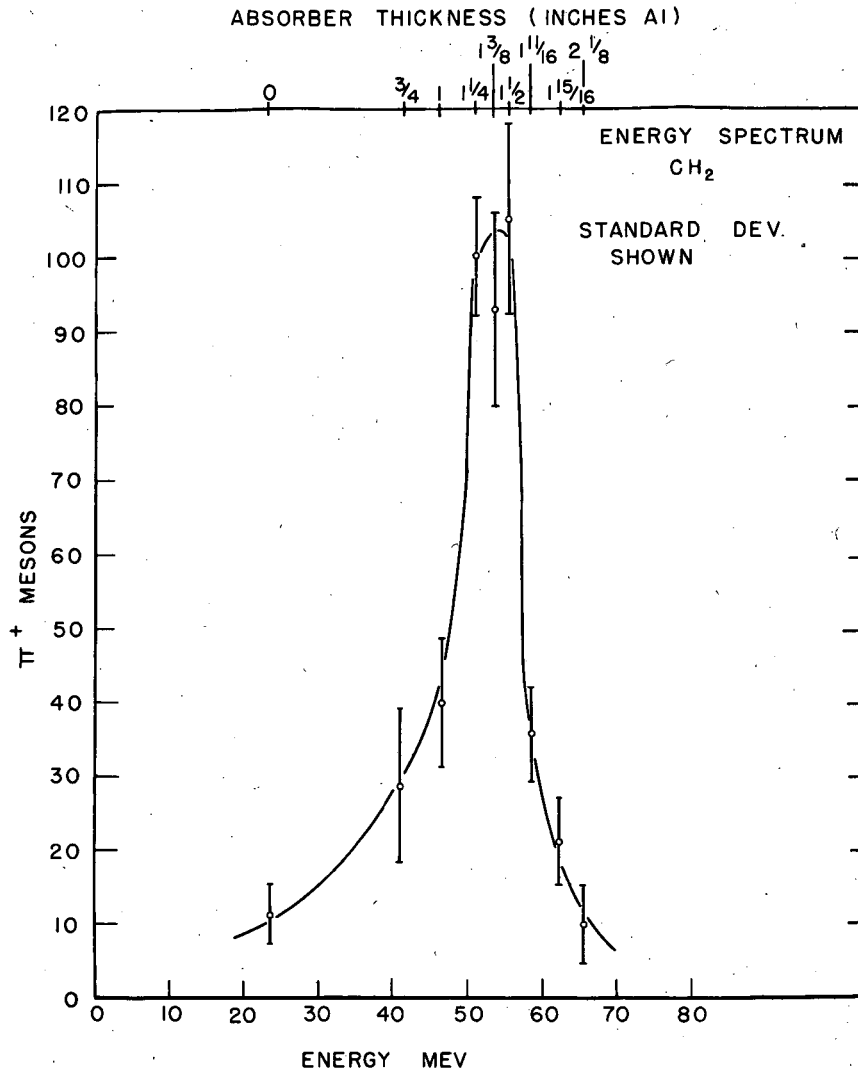


Fig. 3