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July 22, 1953

Berkeley, California

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A preliminary result has been obtained on the variation of the (T_π = 33 Mev) positive pion production cross section with atomic number which results from the interaction of a (T_p = 340 Mev) proton beam with target nuclei. The chief concern is the functional behavior with atomic number of pion production cross sections at different pion energies.

For this experiment the targets consisted of six elements (Be, C, Al, Cu, Ag and Pb). These targets were in tubular form having the following dimensions:

(a) for the light elements (Be, C, Al) 3/4 in. O.D., 1/2 in. I.D. and 1-1/2 in. long
(b) for the heavy elements (Cu, Ag, Pb) 3/4 in. O.D., 1/2 in. I.D. and 1/2 in. long.

A 1/2 in. long tubular carbon target was used to determine the normalization factor necessary for the difference in target geometry between the light and heavy elements.

The targets were mounted on the axis of a 22 in. (pole-diameter) spiral orbit spectrometer. They were bombarded by a (1 in. diameter) collimated proton beam which was electrically deflected out from the 184-inch synchro-cyclotron, integrated by an argon filled ion chamber, and then passed through the (1-1/2 in. I.D.) axial hole of the magnet.

The principle of "the sprial-orbit spectrometer"[1] was used to focus pions of known energy which were emitted at 90° to the incoming proton beam. The pions were detected by means of C-2 Ilford (200 μ) nuclear emulsions which were placed in the region of the "stable orbit" as is shown schematically in

Fig. 1. Since pions of T_π = 9.2 Mev were being focussed at the "stable orbit" a 4 in. O.D. tubular copper degrader of appropriate thickness permitted the selection of the $T_\pi = 33 \pm 3$ Mev pions created in the target.

The same volume of emulsion was scanned for each of the seven exposures. The relative π^+ production cross section per target nucleus was determined and is presented in Fig. 2. The uncertainties indicated in the spectral data are statistical probable errors involved in the counting of pions. Shown also in Fig. 2 are

(a) Z^1 variation normalized at the Ag point

(b) $Z^{2/3}$ variation normalized at the Ag point

(c) $Z^{2/3}$ variation normalized at the Al point.

The experimental results for the six elements indicate clearly a better fit to a $Z^{2/3}$ variation. This is quite similar to the results obtained by one of the authors for T_π = 42 Mev pions.[2] Furthermore the data are in accord with those reported by Hamlin, et al.[3]

Exposures have also been obtained (for T_π = 25 Mev and T_π = 11 Mev) for negative and positive pions. These results will soon be reported.

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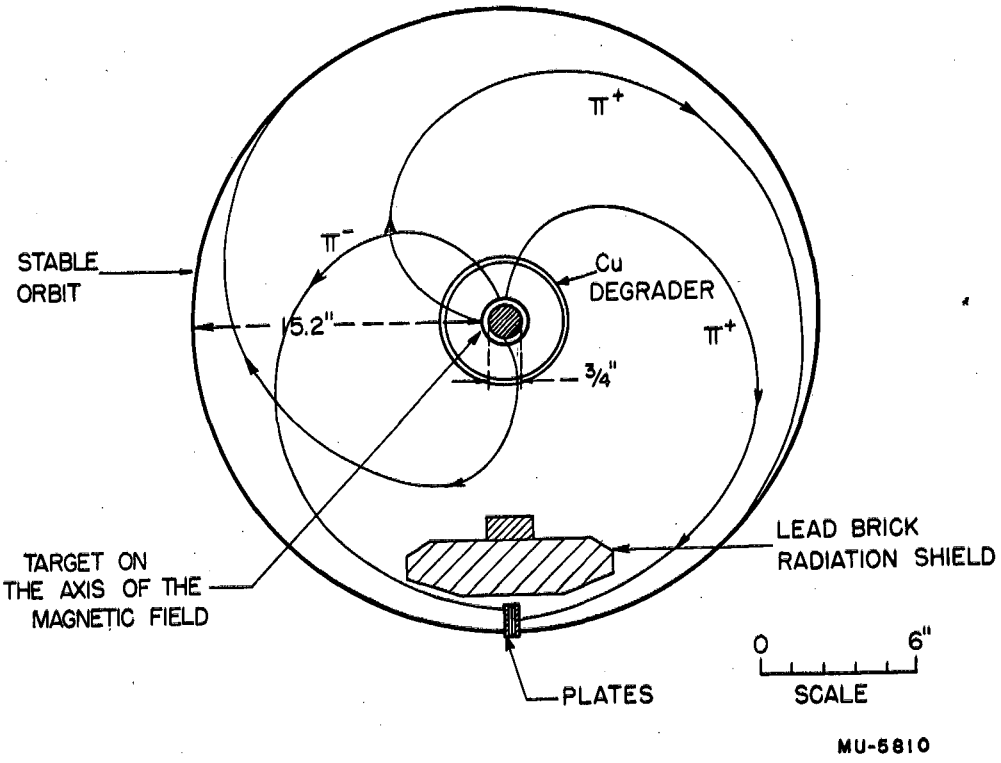

Fig. 1 Schematic diagram of experimental arrangement illustrating the charged pion trajectories in the median plane of the spiral orbit spectrometer.

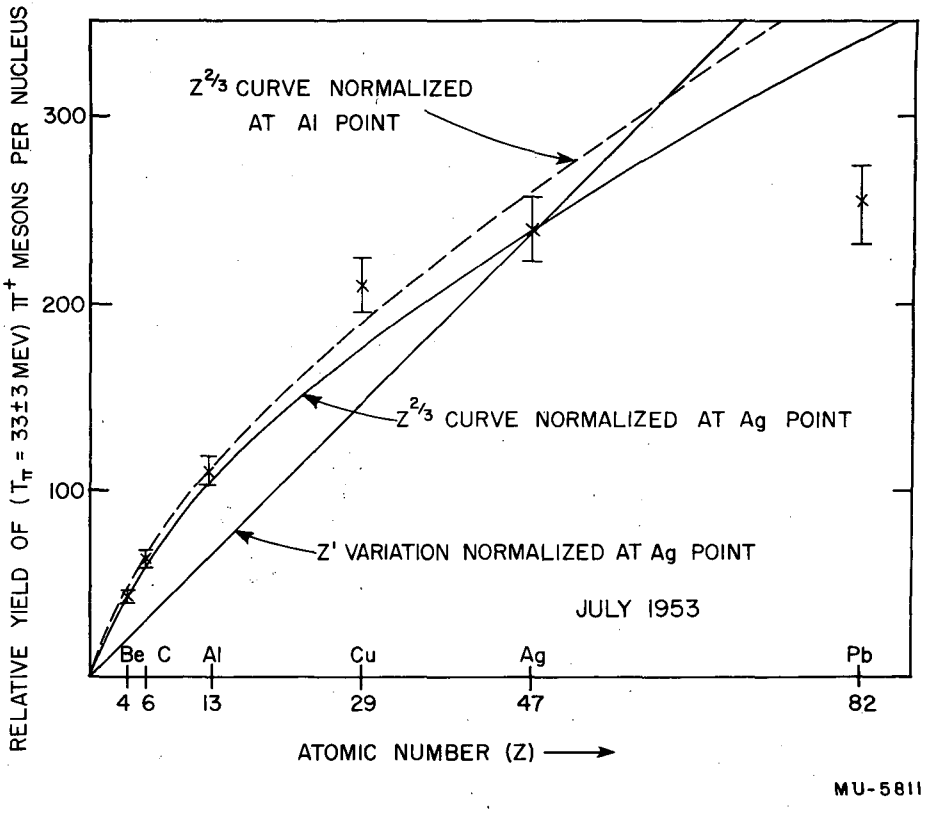

Fig. 2 Relative (T_π = 33 ± 3 Mev) π^+ production cross sections as a function of atomic number illustrating the variation of experimental data from a Z^1 and $Z^{2/3}$ dependence.