presumed to be the cause of the increase of the resistivity as the sodium content is increased above $x=0.70$.

We wish to express our thanks to Professor J. J. Dropkin for numerous stimulating discussions.

* Supported by the Signal Corps.
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Capture and Scattering of π^+ Mesons*

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(Received September 17, 1951)

TO obtain a more complete survey on the nuclear interactions induced by pions in complex nuclei, plates (Ilford G5) were exposed to the π^+ beams of the Nevis Cyclotron as was previously done in the symmetric π^- beams.[1]

The spreads in energy values of the π^+ beams are, respectively, 35–50 and 70–80 Mev. The relative occurrences of the two competing processes (stars and scatterings) in a total of 150 interactions found scanning "along the track" are indicated in Table I. We did not find any "stops in flight."[1,2] In Table I, $\Sigma l'$ are total lengths of tracks and λ the evaluated mean free paths.[1] The first are corrected for the estimated electron and μ meson impurities.[1] The scatterings include some probable, but doubtful cases due to very steep tracks.

TABLE I. Relative occurrence of stars and scattering.

Energy (in Mev)	$\Sigma l'$ (in cm)	Stars	Elastic scattering $>40°$	Inelastic scattering	λ (in cm)
35–50	3120 ± 180	55	25	2	$38\ \pm4.5$
70–80	2250 ± 100	63	16	9	25.5 ± 3

As in the π^- case the capture process predominates over the scatterings at both energies, but now the energy dependence of catastrophic processes (stars and inelastic scatterings) is more evident since the cross sections for star production by π^+ are respectively 0.38 and 0.67 barn, and the corresponding figures for π^- are 0.62 and 0.76. The origin of this difference between π^+ and π^- is not clear, but taking into account the energy dependence of the capture cross section a difference between $\lambda\pi^+$ and $\lambda\pi^-$ is expected as a result of the coulomb barrier. Some evaluations are in progress to estimate this effect.

The coulomb field could also explain the lack of strongly inelastic scatterings (frequently found with π^- of 70–100 Mev[1]) in which the scattered π^+ meson has a very low energy ($E\lesssim10$ Mev).

In Table II the frequencies of stars *versus* number of prongs are indicated. Because the features of these stars do not change appreciably between 50 and 100 Mev both energy ranges have been included in the table. The first figure enclosed by the parentheses are of those stars having one fast proton ($E\gtrsim30$ Mev), the second figure, those having two fast protons. In a total of $\sim$350 stars (including 150 stars found in "scanning per area") all induced by π^- mesons, only one star with 2 fast proton prongs was observed. On the contrary, stars with 2 fast proton prongs represent more than 10 percent of $\sim$250 (155 found "scanning per area") π^+ captures. Table II also gives a simple explanation of the "stops in flight." They are captures associated with the emission of neutrons only. Therefore, as was pointed out,[3] they do not require the existence of a $\pi\rightarrow\pi^0$ scattering.

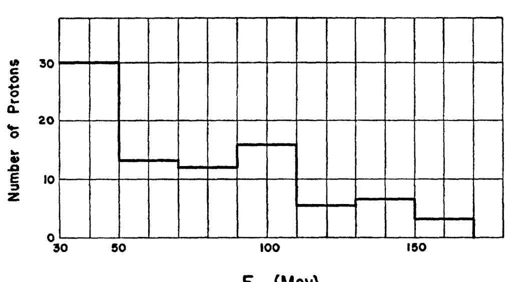

FIG. 1.

TABLE II. Frequencies of stars *vs* prongs.

No. prongs	0	1	2	3	4	5	6	7	Total
π^+	0	11(6)	32(20;6)	31(19;5)	18(11;2)	15(8;2)	6(3;2)	2(1;0)	115(68;17)
π^-	12	38(8)	27(8;0)	21(8;0)	4(0;0)	2(0;0)	0	0	104(24;0)

Considering the π^- capture as the mirror-image of the π^+ capture it is also possible to conclude that the charge-exchange scattering competes, if at all, only in a few percent in all π interactions. An energy-momentum balance of the π^+ stars allows as an upper limit for the $\pi\rightarrow\pi^0$ scattering a cross section not larger than $\frac{1}{10}$ of the total scattering cross section and $\simeq0.02\sigma$ geom. Wilson and Perry[4] in a direct search for the scattered π^0 reach a similar conclusion in the light nuclei.

The frequencies of one and two fast proton stars give some support to the two-nucleon model recently discussed.[5] With this model the probability of a π capture in nuclear matter can be written

$$W_c(\pi)=\Gamma\sigma(\pi^++d\rightarrow2p).$$

Using the known value of σ,[6] Γ turns out to be of the order of 10. A more definite estimate of Γ would involve a quite questionable definition of the mean free path of pions in nuclear matter (we find, for π^+ of $\sim$50 Mev, $\lambda\simeq3r_0$).

In some cases the two-nucleon absorption was evident because the two fast proton prongs show almost all the energy and momentum of the incoming π^+. Two of these cases could be easily interpreted with the reaction scheme

$$\pi^++{}_7N^{14}\rightarrow3\alpha+2p.$$

The energy and angular distribution of fast protons emitted in π captures are given in Fig. 1 and Table III. They are preliminary results but they could possibly be of some use in the discussion of further meson experiments.

TABLE III. Angular distribution of fast protons in π-captures.

($\theta\pi p$) in degrees	0–30	30–60	60–90	90–120	120–150	150–180
No. of fast protons	7	23	23	15	11	3

We are indebted to Messrs. J. Spiro, H. Edwards, and G. Rosenbaum for their assistance in the cyclotron operation and to Mesdames N. Bernardini and D. Lee for their invaluable help in scanning and measuring the nuclear events.

We owe very much to Dr. L. Lederman for his important contributions to this work, and Professor J. Steinberger for many interesting discussions.

* This work jointly sponsored by the ONR and AEC.
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