Pion-Pion Interaction from $\pi$ Production in $\pi N$ Collision.

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Summary. — The Chew and Low model for the determination of the $\pi \pi$ cross section is used for the analysis of an experiment of pion production by pions. The one-pion-exchange model and the possible $\pi \pi$ resonances are discussed.

1. Introduction.

Recently many theoreticians (1) have realized that the $\pi \pi$ interaction is fundamental for the construction of a theory of strong interacting particles.

Several attempts were made to find some evidence for this interaction and if possible, its charge and energy behaviour, studying different processes such as nucleon charge structure, $\tau$-decay spectra, pion-nucleon scattering (2), etc.

It was thought that the most suitable process for the study of $\pi \pi$ interaction is the $\pi$ production in pion-nucleon collision. Chew and Low (3) have suggested an unambiguous method to determine the pion-pion scattering cross-section from an extrapolation of the $\pi N \rightarrow \pi \pi N$ final nucleon laboratory kinetic energy distribution.


In this work we shall apply the method to the experiment made in Bologna by ALLES BORELLI et al. (*) at 960 MeV incident pion kinetic energy.

It will clearly result that the method is very delicate in the actual application and that the present statistics are by no means sufficient to give any positive reply.

2. - The Chew and Low extrapolation.

Let us review the Chew and Low method. They consider the contribution to the \( \pi \) production in which the incoming \( \pi \) takes out one pion from the nucleon cloud.

\[
\frac{1}{q^2} \frac{1}{q'^2} \frac{1}{q^3} \frac{1}{q'^3} \frac{1}{q^4} \frac{1}{q'^4} \]

In the physical region for the \( \pi \) production the intermediate \( \pi \) is outside the mass shell with mass

\[
\Delta^2 = (p_2 - p_1)^2,
\]

If one takes the limit for \( \Delta^2 \to -\mu^2 \) the pion becomes real and one has the proper \( \pi\pi \) cross-section for a definite energy in the \( \pi\pi \) center of mass \( \omega^2 = (q_2 + q_3)^2 \), namely

\[
\lim_{\mu^2 \to -\Delta^2} \frac{\partial^2 \sigma}{\partial \Delta^2 \partial \omega^2} \to \frac{f^2}{2\pi q^2_1 \mu^2 (\Delta^2 + \mu^2)^2} \omega^2 \left( \frac{\omega^2}{4} - \mu^2 \sigma_{\pi\pi}(\omega) \right),
\]

for \( \pi^- + p \to \pi^- + \pi^0 + p \) and twice for \( \pi^- + p \to \pi^- + \pi^- + n \). The very crucial point in the method is that at \( \Delta^2 = -\mu^2 \) this term is the only singular one and so it dominates the nearest regions of \( \Delta^2 \). By dividing the available region in various strips of \( \omega \) and using the relation \( \Delta^2 = 2MT_L \), \( (T_L \text{ recoiling nucleon}) \)

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