The Contribution of One-Baryon Exchange to the Reaction $p^+ B \rightarrow V + B$.

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Summary. — The reactions in which a pseudoscalar meson interacts with a baryon to yield a vector meson and another baryon are studied in terms of peripheral model. Baryon exchange as well as meson exchange are considered. Comparison with experimental result on $\pi^+ + p \rightarrow \Sigma^+ + K^*$ at 2.77 GeV/c is made and it is found that in order to fit the angular distribution of the $K^*$ and to obtain cross-sections compatible with experiments, form factors of the exponential type have to be used.

1. - Introduction.

It has been shown experimentally that in the GeV energy region, a great proportion of the $\pi^0$ and $K^0$ inelastic scatterings are via the quasi-two-body production of a vector meson, such as the $\rho$, $\omega$, $\phi$ or $K^*$. The fact that these vector mesons are mostly produced in the forward direction in the overall centre of mass system suggests that the interactions are mainly peripheral and that a one meson exchange process dominates (1). However, in some experiments (2) the vector meson seems to be produced in both forward and backward directions. As the production in the backward direction corresponds

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to large momentum transfer, the one meson exchange model is not expected to be valid. In this paper we consider the one baryon exchange model and apply the results to the reaction $\pi^+ + p \rightarrow K^+ + \Sigma^+$ at 2.77 GeV/c \textsuperscript{(2)}. In the calculation we also take into account the one-meson exchange process in order to explain the more pronounced forward peak. We find that in order to give the right order of cross section and the correct angular distribution, drastic form factors similar to those introduced by Jackson and Pilkuhn \textsuperscript{(3)} have to be used in both baryon and meson exchanges. The coupling constants we employ are estimated from the unitary symmetry model \textsuperscript{(4)}.

In Sect. 2 we shall derive the necessary formulae and shall use them in Sect. 3 to calculate the cross section and the angular distribution for the reaction $\pi^+ + p \rightarrow K^+ + \Sigma^+$.

2. – The various one-particle exchange mechanisms.

We wish to calculate the contribution of pseudoscalar meson exchange, vector meson exchange and baryon exchange to a production process in which a pseudoscalar particle interacts with a baryon to yield a vector meson and another baryon. As this is common to many production processes such as $\pi^+ + p \rightarrow \rho + N', K + p \rightarrow K^* + N'$ etc., we therefore prefer to write down in this section the general expressions for various kinds of exchange mechanisms and then come to a particular example in the following section.

We shall treat the vector mesons as stable particle in calculating their production. This is justifiable because up to now all the vector particles found in nature such as $\rho$, $\omega$, $\varphi$ and $K^*$ have small widths in comparison with their masses.

In what follows we shall adopt the same notations as those used in ref. (3). The four-momenta of the incoming meson, the incoming baryon, the outgoing vector meson, the outgoing baryon and the exchange particle are denoted by $a$, $b$, $c$, $d$, and $e$, and the corresponding masses by $m_a$, $m_b$, $m_c$, $m_d$, and $m_e$ respectively. We shall also use the Mandelstam variables.

\begin{align*}
    s &= (a + b)^2, \\
    t &= -(a - c)^2, \\
    u &= -(a - d)^2 = m_a^2 + m_b^2 + m_c^2 + m_d^2 - s - t.
\end{align*}
