Low-Energy $K^+$-Nucleon Scattering.

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(ricevuto il 27 Novembre 1961)

Summary. — Using the phase shifts given by Rodberg and Thaler, an analysis of low energy $S$-wave $K^+$-nucleon scattering is carried out under the assumption that the scattering amplitude is dominated by the $\Sigma$ and $\Lambda$ poles and the recently observed $\Lambda\pi$, $\Sigma\pi$ and $\pi\pi$ resonances.

1. — Introduction.

Recently a variety of resonances have been observed in systems involving strongly interacting particles. Thus there is a $\Lambda\pi$ resonance (1) (called the $Y^*_1$) with isotopic spin 1 and a mass of about 1385 MeV, a $\Sigma\pi$ resonance (2) with zero isotopic spin (designated by $Y^*_0$) and a mass of about 1400 MeV, and a $\pi\pi$ resonance (3) with spin 1 and isotopic spin 1 (called the $\rho$-meson). We

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devote this paper to an analysis of low-energy $S$-wave $K^+\Lambda^0$ scattering data, approximating the scattering amplitude by the contributions from these resonances and the $\Lambda$ and $\Sigma$ pole terms (*). Using the analytical form of the amplitude provided by the approximation, we attempt to deduce the unknown parameters by fitting the results of Rodberg and Thaler (4) on the low energy $S$-wave $K^+\Lambda^0$ scattering phase shifts. Such an analysis seems to be of particular interest in view of the success of the resonance and pole approximations in explaining the isovector part of the nucleon electromagnetic form factor (5) and the lifetime of the charged pion (6).

Evidence has appeared recently for a $3\pi$ bound state and a $3\pi$ resonant state (7). We shall tentatively neglect the contributions from these states, essentially to restrict the number of unknowns.

2. - The calculation.

Let $p_1$ and $q_1$ denote the incident four-vector momenta, and $p_2$ and $q_2$ the outgoing four-vector momenta of the nucleon and $K$-meson, respectively. Define the variables

$$
\begin{align*}
  s & = -(p_1 + q_1)^2, \\
  \bar{s} & = -(p_1 - q_2)^2, \\
  t & = -(p_1 - p_2)^2.
\end{align*}
$$

$s$ is the square of the total center-of-mass energy in the process $K^+\Lambda^0 \rightarrow \rightarrow K^+\Lambda^0$ (which we shall call process I) while $\bar{s}$ and $t$ are the momentum transfers for this process. In the center-of-mass system of the reaction $\bar{K}+\Lambda^0 \rightarrow \bar{K}+\Lambda^0$ (the reaction II), $\bar{s}$ is the square of total energy, while in the centre-of-mass system of the reaction $K^+\bar{K} \rightarrow \Lambda^+\bar{\Lambda}$ (the reaction III) $t$ is the corresponding variable. Following Chew, Goldberger, Low and Nambu (8),

(*) See in this connection, B. W. Lee: Phys. Rev., 121, 1550 (1961), who has discussed the $K^-\Lambda^0$ scattering taking into account the $\pi^-\pi$ resonance and the $K^-\Lambda^0$ rescattering corrections. We are grateful to the referee of Nuovo Cimento for drawing our attention to this paper.


