Interactions of 1.15 GeV/c $K^-$ Mesons in Emulsion - III.

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Summary. In the previous two parts of this work we have found some results about the emission of charged $\Sigma$ hyperons from $K^-$ interactions. Here we consider the experimental energy distribution of these $\Sigma$, and we try to explain it taking into account the processes inside the nucleus.

1. In previous works (1,2) we studied the emission of charged $\Sigma$-hyperons in the interaction of $K^-$-mesons of 1.15 GeV/c with emulsion nuclei. We found that, after taking into account scanning loss corrections, the percentage of emitted charged $\Sigma$-hyperons is 16.4%. The energy distribution of the charged hyperons in the laboratory system is given in Fig. 1, where the dashed line represents the observed spectrum and the full line the spectrum obtained taking into account the corrections.

This energy spectrum is very different from the curve one expects if the hyperons were produced in the reaction

$$K^- + \Lambda \rightarrow \Sigma + \pi$$


with an isotropic angular distribution in the centre of mass system (curve a of Fig. 1). In the present paper we make a rough analysis of the possible processes arising from K⁻ interactions with emulsion nuclei in order to see if this discrepancy can be explained.

2. - First of all we must take into account that at 1.15 GeV/c the cross-section for the reaction:

\[ K^- + N \rightarrow \Sigma + \pi + \pi \]

is not negligible. This is shown both from the results of Alvarez (3) and Good (4) and from observations in nuclear emulsion made in our own laboratory (1,2). In fact, analysing the stars in which two pions are emitted, we concluded that reaction (2) occurs in about 30% of the cases. Recent experiments (4) gave evidence for an isobar \( Y^* \) that decays in the mode \( Y^* \rightarrow \Lambda^0 + \pi \) but nothing has been said yet on the decay mode \( Y^* \rightarrow \Sigma + \pi \) (5). If this mode of decay occurred frequently, one would observe a peak in the \( Q \) value distribution calculated for the stars from which both \( \Sigma \) and \( \pi \) emerge. Such an effect was not observed in our 74 stars. This result, however, is not very significant owing to secondary processes in nuclear matter. For this reason we simply calculated the energy distribution of the \( \Sigma \) produced in reaction (2) with phase space considerations, neglecting the contribution via the isobar production. The results are indicated in Fig. 2 (curve b). As one can see, the disagreement between calculated and experimental spectra is still important.


(5) Note added in proof. - More recent results give an estimate \(< 4\% \) for the percentage of the decay mode \( Y^* \rightarrow \Sigma + \pi \) (M. H. Alston and M. Ferro-Luzzi: Rev. Mod. Phys., 3, 416 (1961) and UCRL 9587).