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STUDY OF THE Y-π, K-π AND π-π INTERACTIONS

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The recent experimental observation of resonances in the Y-π, K-π, π-π systems have aroused great interest in the study and explanation of these phenomena towards a deeper understanding of strong interactions.

Further investigations are however necessary to assign the relevant quantum numbers to the observed resonances and to find out the behaviour of the excitation functions. Also the mass spectra of the mentioned systems are probably still incomplete.

We propose to study all above interactions (and possibly also the Y-K system) in the 80 cm Hydrogen Bubble Chamber exposed to a π^- beam of 2.5 to 3 BeV/c with a resolution of 1 o/o.

The energy is chosen in order to investigate resonant systems of relatively high mass in contrast to result of investigations already published.

For instance, in the reaction

$$\pi^- + p \qquad \text{nucleon} + (n\,\pi)_{\text{bound}} \qquad (1)$$

a 2.7 BeV/c incident pi-minus can produce a multipion bound system with a mass $\leq$ 1500 MeV.

A recent proposal has been made by De Alfare e Vitale [1] according to which a four pion bound state is possible with a mass of 990 MeV. They used the Abashian, Booth and Crowe value for the mass of a scalar three pion system. Using instead the value recently found by the Alvarez Group, the mass is raised to a value of about 1300 MeV.

A study of the mass values of multi-pion systems is being carried on by the Theoretical Group in Pisa, under Prof. Radicati.

The energy chosen also makes it relatively easy to clearly distinguish and completely analyze events in which a π^0 is emitted. This allows study of I=0 multipion systems and determination of branching ratios for decay into different channels.

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The reaction

$$\pi^- + p \quad K + (Y-\pi)_{bound} \qquad (2)$$

can produce, at an incident momentum of 2.7 BeV/c an isobar of mass up to 1944 MeV, thus allowing to check many predictions of the globally symmetric models[2],[3] as well as the various experimental indications of other isobars[4].

An advantage of reaction (2) in studying hyperon isobars is that one has 3 different particles in the final state thus avoiding Bose statistics effects which plague Y-star production from K-mesons.

Final state interactions is still present but at this energy the two main resonant channels K^* and Y^* are quite separable kinematically (as is shown in the Dalitz plot in fig. 1). Detailed computations are being undertaken by the Theoretical Group in Pisa in order to use Adair-like arguments to determine the spin of the hyperon isobars, taking into account final state interaction.

Exposure - 200,000 pictures should yield about 1200 examples of Y_1^*, one tenth of which could be used for an Adair analysis of its spin. About 6000 Y,K associate production events should also be available to investigate the mass spectra of Y-π and K-π resonances.

The number of reactions (1) in which 4 pions are produced is estimated to be of the order of 20,000.

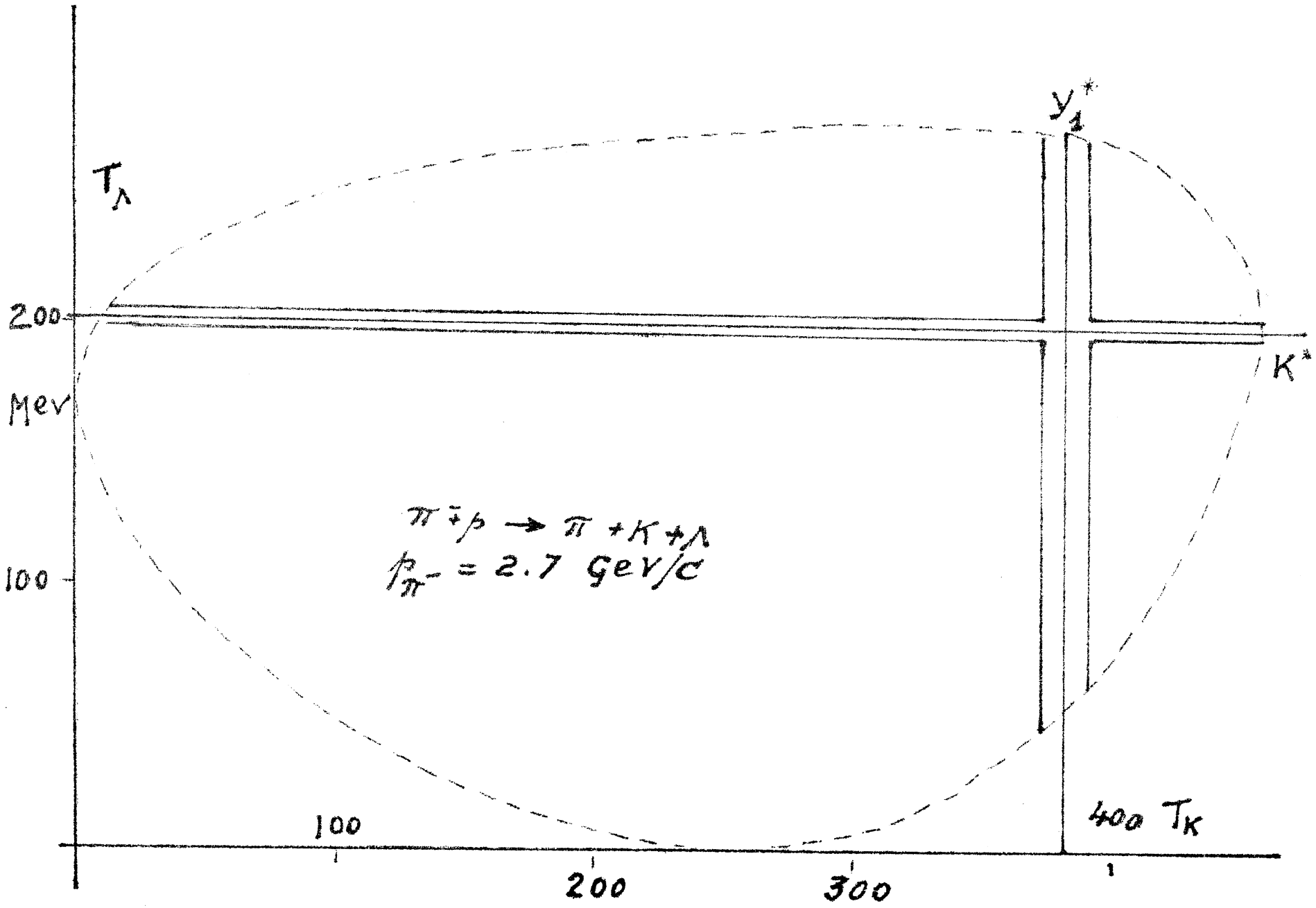
References

1) - V. De Alfare and B. Vitale, P.R.L., 7, 72 (1961)

2) - T.D. Lee and C.N. Yang, Phys.Rev., 122, 1954 (1961)

3) - A. Salam, Aix-en-Provence-Conference

4) - F.T. Solmitz, Aix-en-Provence-Conference


T_Λ
200
Mev
100
y_1^*
K^*
$\pi^- + p \rightarrow \pi + K + \Lambda$
$p_{\pi^-} = 2.7$ Gev/c
100
200
300
400 T_K
1