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MEASUREMENT OF THE ω^0 AND η^0 BRANCHING RATIOS AND A STUDY OF THE REACTION $K^- + p \longrightarrow \bar{K}^0 + n$

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I. Introduction

We have studied the interactions of 1.455 GeV/c K^- mesons with protons in the CERN 30 cm hydrogen bubble chamber. The beam has been described previously [(1)]. The events have been processed by the CERN THRESH-GRIND system followed by the system of library programs CULL-CSORT-UPDATE-SUMX.

II. The ω^o and η^o branching ratios

Among the interactions giving a Λ^o together with two charged particles 709 fit the hypothesis $K^- p \rightarrow \Lambda^o \pi^+\pi^-\pi^o$. The effective mass plot in Fig. 1 shows that 51 o/o of these pass via the reaction $K^- + p \rightarrow \Lambda^o + \omega$. A small number of events fall in the region of the η mass. The Dalitz plot of the ω decay shows the well established decrease in population towards the boundary. The η plot shows a concentration of events towards low π^o KE as has also been found by other workers [(2)].

465 zero prong events with associated Λ^o have been found and Fig. 2 shows the missing mass plot for these events. The peaks at the ω^o and η^o masses are clearly visible. These correspond, of course, to decays into neutral particles. The direct way to determine the branching ratio, as has been used by other authors [(3,4)], is to compare these two plots. This is liable to lead to systematic errors since the resolution in the effective mass is necessarily better than in the missing mass, and because the zero prong events, which need only a decay fit are more likely to pass the kinematics programmes than the two prong events where a decay and interaction fit are required. We therefore treated both 0-prong and 2-prong events in the same way by demanding only a Λ^o decay fit and plotting their c.m.s. KE (which is equivalent to the missing mass in this case). This was done by modifying the CULL program to choose best decay fits automatically. Experience has shown this to be reliable. These two plots are shown in Fig. 3. Zero prong events were measured in less pictures than two prong events. The ratio of the beam tracks in the two groups of pictures is $1.40 \pm .05$ and the results must be multiplied by this factor.

Λ^o with very low or very high momenta are more difficult to fit than others, and those which have very low energy pi mesons have reduced scanning efficiency.

These effects depend on the laboratory kinetic energy and so are identical in the two cases (0-prong and 2-prong).

Since the kinematics of the $\Lambda^0 + \omega\ (\eta)$ is the same whether it is produced in a 2-prong or 0-prong event, the biases are the same and no correction is necessary to the ratio.

Using this method the 2-prong events give the combined $\pi^+\pi^-\pi^0$ and $\pi^+\pi^-\gamma$ decay modes. The results are given in Table I.

Table I

	η	ω
0-prong	37	20
2-prong	20	254
Corrected ratio $\frac{\longrightarrow \text{neutrals}}{\pi^+\pi^-\pi^0 + \pi^+\pi^-\gamma}$	2.6 ± 0.9	$0.11 \pm .02$

We compare our results with other experiments (summarised in ref. (5)). To find the ratio $\frac{\eta \longrightarrow \text{neutrals}}{\eta \longrightarrow \pi^+\pi^-\pi^0}$ we correct our ratio using the measured value $\frac{\eta \longrightarrow \pi^+\pi^-\gamma}{\eta \longrightarrow \pi^+\pi^-\pi^0} = 0.26$ and the result becomes $\frac{\eta \longrightarrow \text{neutrals}}{\eta \longrightarrow \pi^+\pi^-\pi^0} = 3.3$ which is slightly higher than found by other groups.

Our experimental results are insufficient to see the mode $\omega \rightarrow \pi^+\pi^-$ in the events of the type $K^-p \rightarrow \Lambda^0\pi^+\pi^-$ but we can give an upper limit $\omega \rightarrow \pi^+\pi^- < 0.09\ \omega \rightarrow \pi^+\pi^-\pi^0$.

<u>K^- charge exchange process</u>

Among the zero prong events with associated V^0, 367 are found to be $K^- + p \longrightarrow \bar{K}^0$ + neutrals. Fig. 4 shows the distribution of neutral mass and a well defined peak at the neutron mass is seen. It is therefore possible to make a clean separation of the charge exchange reactions $K^- + p \rightarrow \bar{K}^0 + n$. There are in fact 161 events with $0.75 < MM^2 < 1.1$ GeV^2. The charge exchange cross section is 1.95 ± 0.20 mb. Fig. 5 shows the production angular distribution.

Fig. 6 is a scatter diagram of events on a P_t P_L^* plot. The events in the charge exchange peak are shown as dots and fall clearly on a semicircle defined by the kinematics. Events outside the circle must be wrong identifications. The uniform distribution of inelastic events (represented by crosses) inside the circle implies that high angular momentum states are not important in the inelastic processes.

Acknowledgements

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Figure Captions

Fig. 1 The effective mass distribution for the 3π combination in 709 events $K^-p \rightarrow \Lambda^o\pi^+\pi^-\pi^o$ (2-prong + V^o).

Fig. 2 The (missing mass)^2 distribution in the reaction $K^-p \rightarrow \Lambda^o$ + neutrals (0-prong + V^o).

Fig. 3 The Λ^o kinetic energy distribution in the reactions $K^-p \rightarrow \Lambda^o$ + 2 charged tracks (+ neutrals) and $K^-p \rightarrow \Lambda^o$ + neutrals.

Fig. 4 The (missing mass)^2 distribution in the reaction $K^-p \rightarrow \bar{K}^o$ + neutrals (0-prong + V^o).

Fig. 5 The center of mass production angular distribution for the reaction $K^-p \rightarrow \bar{K}^o n$. Events are defined as those in the elastic peak in Fig. 4.

Fig. 6 $P_\perp$ P_L plot of all events $K^-p \rightarrow \bar{K}^o$ + neutrals. Events defined as $\bar{K}^o n$ are shown as dots, other events as crosses.

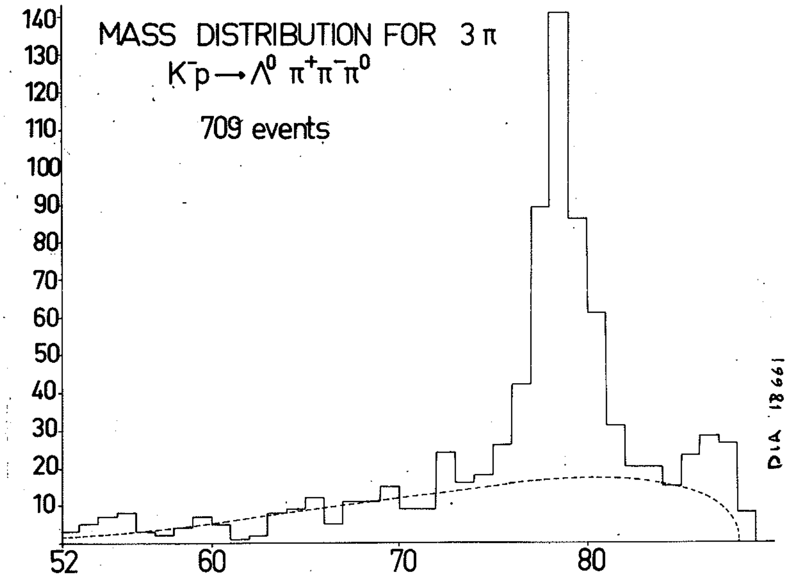

Fig.1

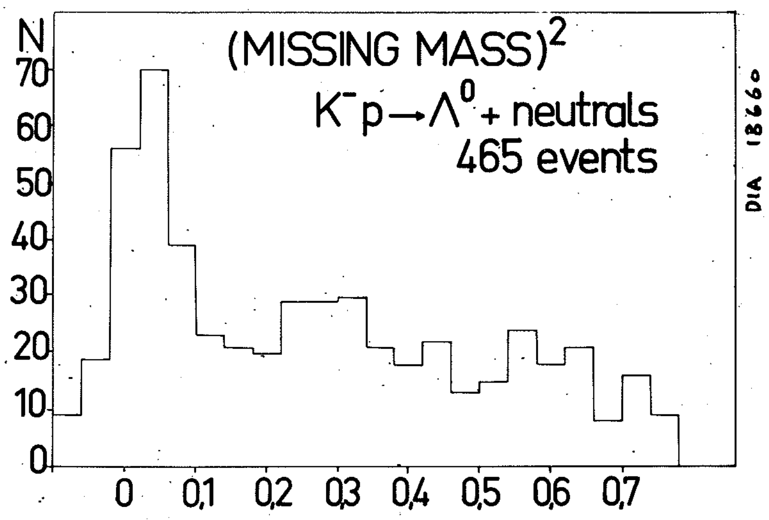

Fig.2

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Fig 1

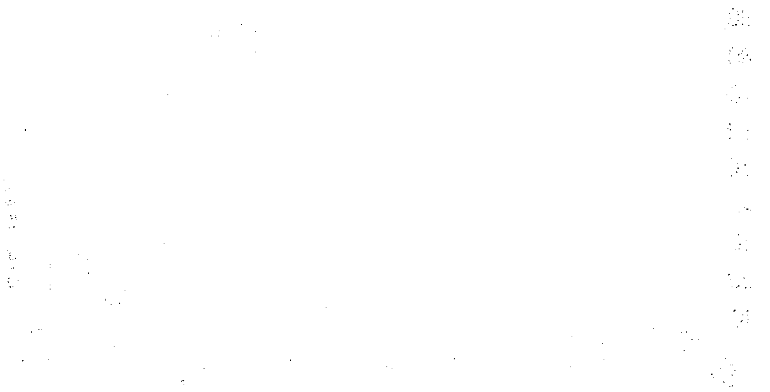
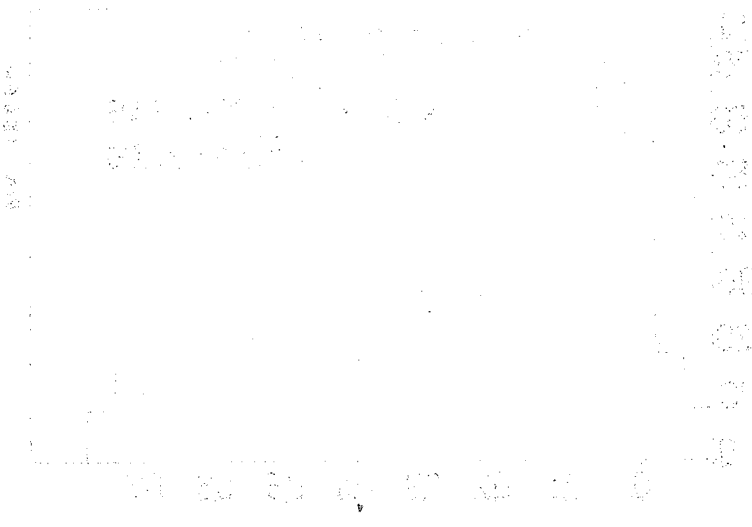


Fig 2



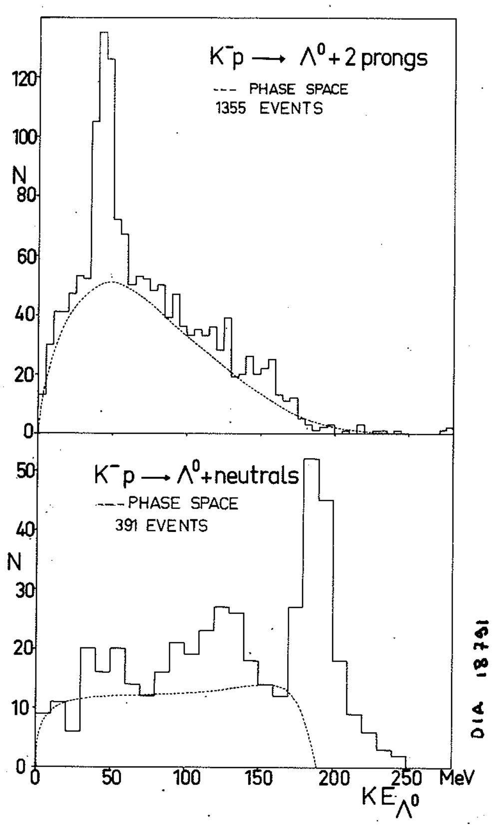

K⁻p ⟶ Λ⁰+2 prongs
--- PHASE SPACE
1355 EVENTS
K⁻p ⟶ Λ⁰+neutrals
--- PHASE SPACE
391 EVENTS
N
0
20
40
60
80
100
120
10
30
50
0
50
100
150
200
250
MeV
KE Λ⁰
DIA 18781

Fig.3

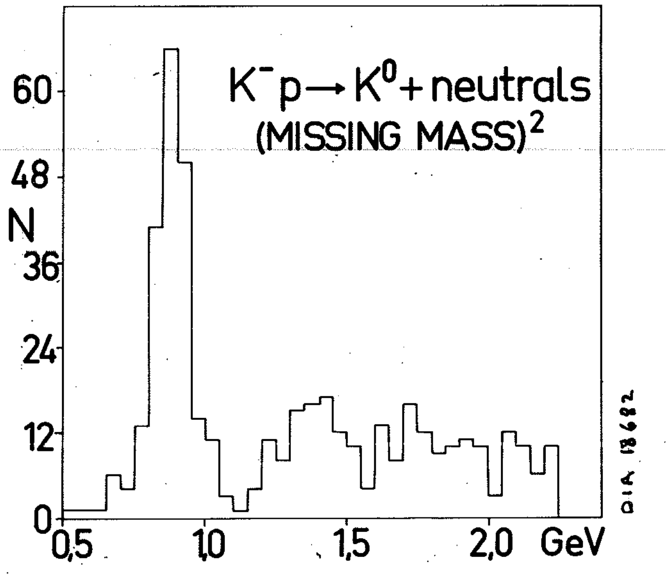


Fig.4

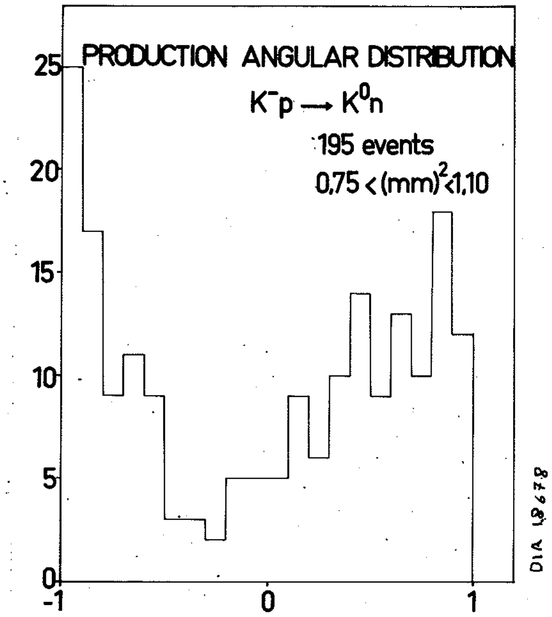


Fig.5

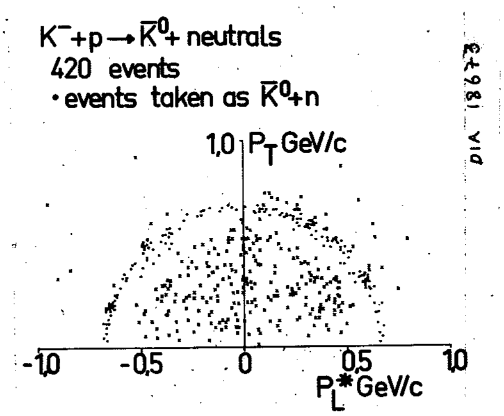


Fig.6

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