Title
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We are in the process of studying the interaction of K^+ mesons on hydrogen at 1.96 Bev/c. The experiment was carried out in the 20-inch BNL hydrogen bubble chamber in the separated beam tuned to K^+ mesons. The momentum spread of the beam was about ±1%.

From our preliminary analysis we find a total cross section of

$$\sigma_{K^+H} = 18 \pm 3 \text{ mb.}$$

Of the interactions which are observed, we have concentrated on the reactions

$$K^+ + P \to K^+ + P + \pi^+ + \pi^- \qquad (a)$$

$$\to K^0 + P + \pi^+ + \pi^0 \qquad (b)$$

$$\to K^0 + N + \pi^+ + \pi^+ \qquad (c)$$

$$\to K^0 + P + \pi^+ \quad . \qquad (d)$$

The observed ratios for these, based on 151 measured and fitted events of type (a) and ~ 200 events of types (b), (c), and (d) combined, are

$$a:b:c:d: \; = \; 10:7:1:20$$

where we took account of the undetectable decay modes of the K^o. The partial cross section for processes (a), (b), (c), and (d) is

$$\sigma = 7 \pm 2 \text{ mb} .$$

If we ascribe the events occurring between $M_{K\pi} = 860 - 920$ to K^* production and $M_{P\pi} = 1180 - 1290$ to N_{33}^* production, then we find that out of 151 identified events

25 are in the "non-resonant" region
78 are in the K^* region
106 are in the N_{33}^* region,

and finally 62 of the above events are in the common K^* and N_{33}^* region. Thus about half or more of the interaction appears to go through the double resonant state.

In Fig. 1 we plot $M_{P\pi^+}$ ($T = 3/2$) against $M_{K^+\pi^-}$ ($T = 3/2, 1/2$), while in Fig. 2 we plot $M_{P\pi^-}$ ($T = 3/2, 1/2$) against $M_{K^+\pi^+}$ ($T = 3/2$), all from reaction (a). The projections on the various effective mass axes are also shown. The difference between these is very striking and demonstrates clearly that the K^* is a $T = 1/2$ resonance.

In Fig. 3 we plot $M_{P\pi^+}$ against $M_{K^0\pi^0}$, and in Fig. 4 $M_{P\pi^0}$ against $M_{K^0\pi^+}$ from reaction (b). This differs from reaction (a) in that the K^* can be formed with either pion. It is remarkable that the K^* seems to have disappeared—within the limited statistic—perhaps due to interference effects. In Fig. 5 we present the C.M. angular distribution of the K^* from reaction (a) with the incoming K^+, where the events were selected to correspond to the double resonance as discussed above. The K^* distribution is strongly forward peaked and consequently (C.M.) the N^*_{33} is backward peaked, suggestive of production in a peripheral collision.

In Figures 6 and 7 we plot the final two mass combinations M_{KP} against $M_{\pi\pi}$ for reactions (a) and (b). These do not appear to show any particular structure.

Figures 8 and 9 give two Dalitz plots for the 3-particle reaction (d). Here again the presence of both the K^* and the N^*_{33} are clearly observed, but here the π^+ is shared between them, giving rise to constructive interference effects. Figures 10, 11, and 12 give the corresponding mass plots for $M_{P\pi^+}$, $M_{K^0\pi^+}$, and M_{PK^0} .

We wish to take this opportunity to thank the many members of the staff of the Brookhaven National Laboratory for their very helpful attitude in making this experiment possible. In particular we would like to express our appreciation to Dr. H. Blewett, Dr. R. Shutt, Dr. J. Sanford, and Mr. Spiro and the AGS crew.

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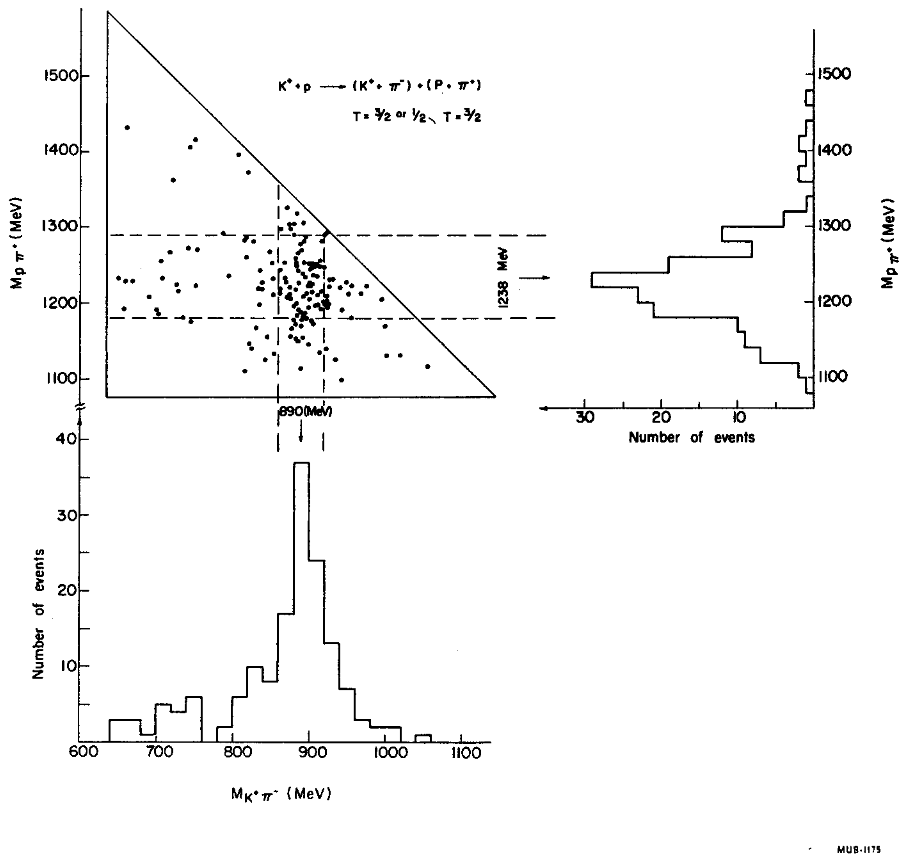
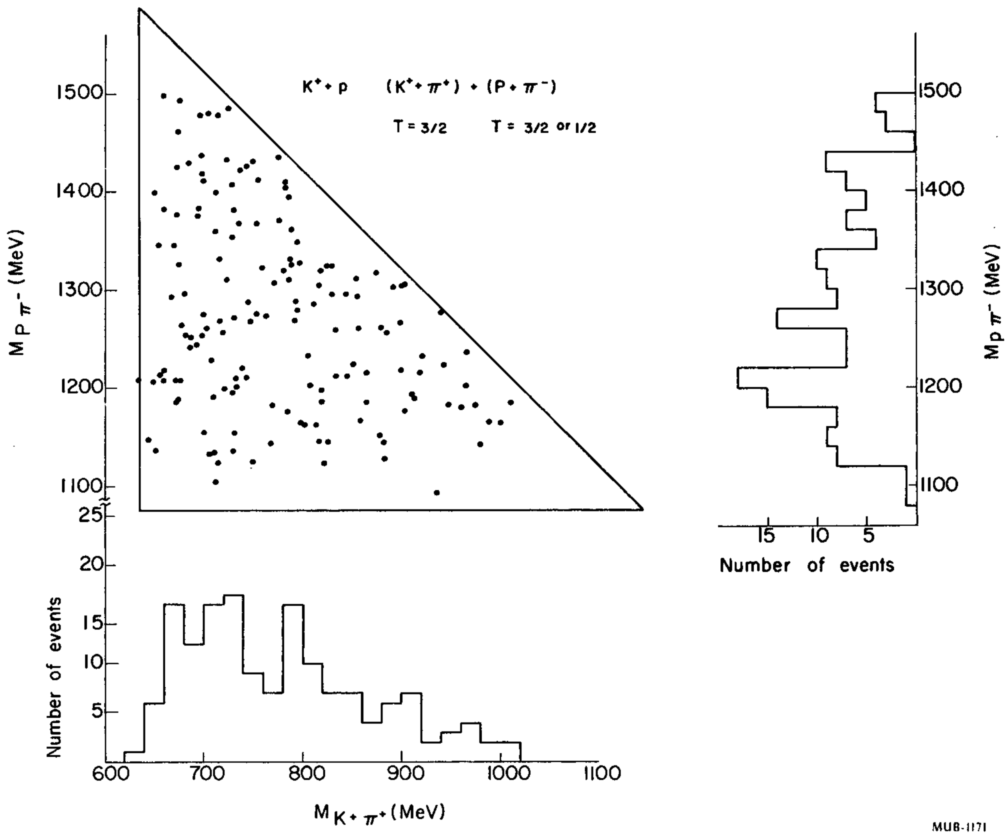
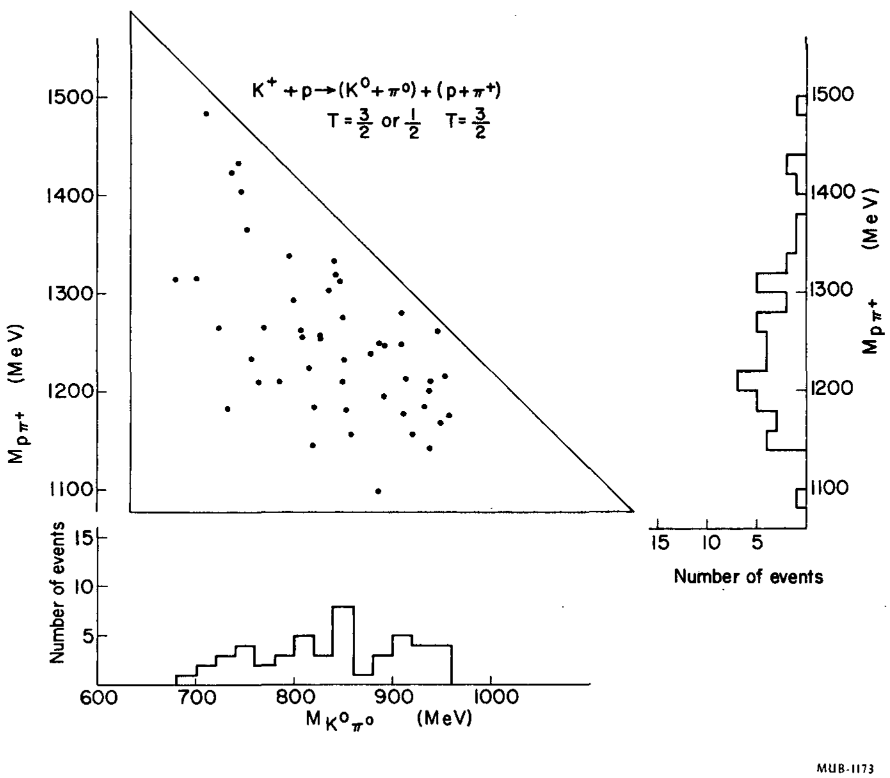

K⁺ + p ⟶ (K⁺ + π⁻) + (P + π⁺)
T = 3/2 or 1/2 T = 3/2
Mp π⁺ (MeV)
1500
1400
1300
1200
1100
1238 MeV
890(MeV)
40
30
20
10
Number of events
600
700
800
900
1000
1100
MK⁺ π⁻ (MeV)
30
20
10
Number of events
MUB-1175

Fig. 1



K⁺+ p (K⁺+ π⁺) + (P + π⁻)
T = 3/2 T = 3/2 or 1/2
1500
1400
1300
1200
1100
$M_{p\pi^-}$ (MeV)
25
20
15
10
5
Number of events
600
700
800
900
1000
1100
$M_{K^+\pi^+}$ (MeV)
15
10
5
Number of events
MUB-1171

Fig. 2



K+ + p→(K0+π0) + (p+π+)
T = 3/2 or 1/2 T = 3/2
1500
1400
1300
1200
1100
Mpπ+ (MeV)
Number of events
15
10
5
600
700
800
900
1000
MK0π0 (MeV)
MUB-1173

Fig. 3

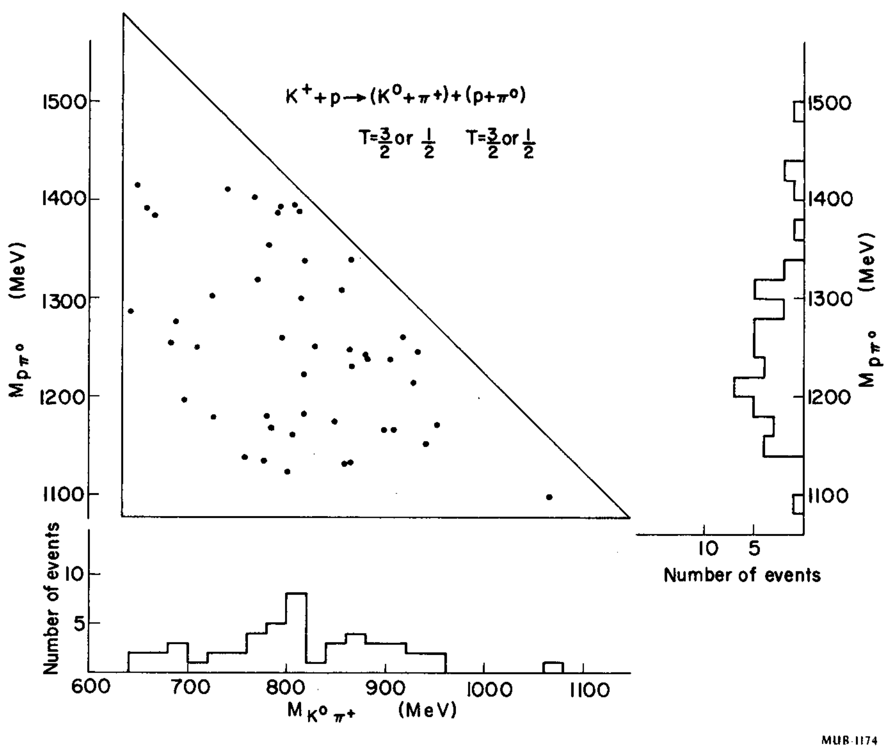
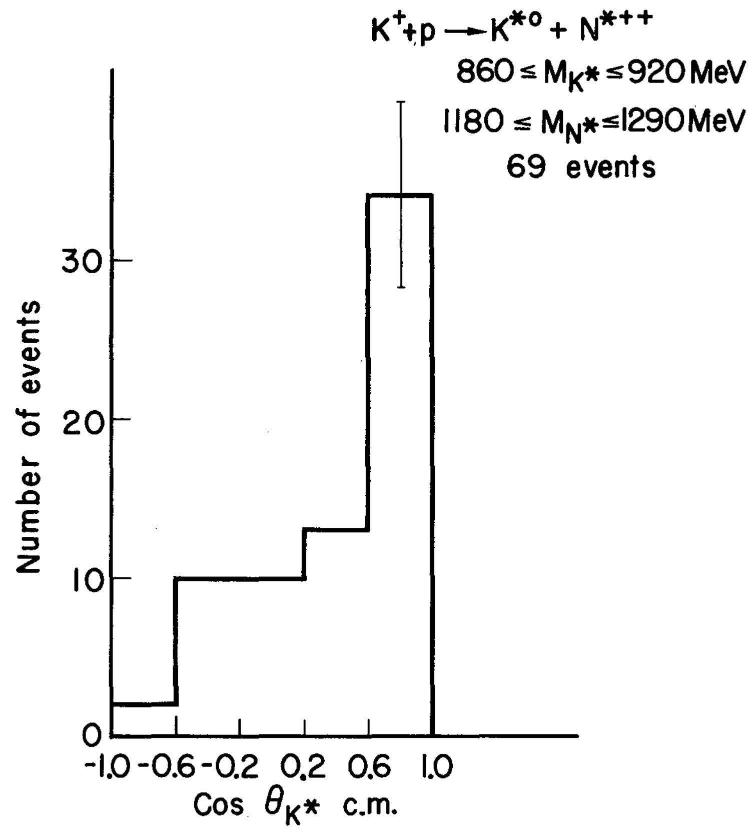
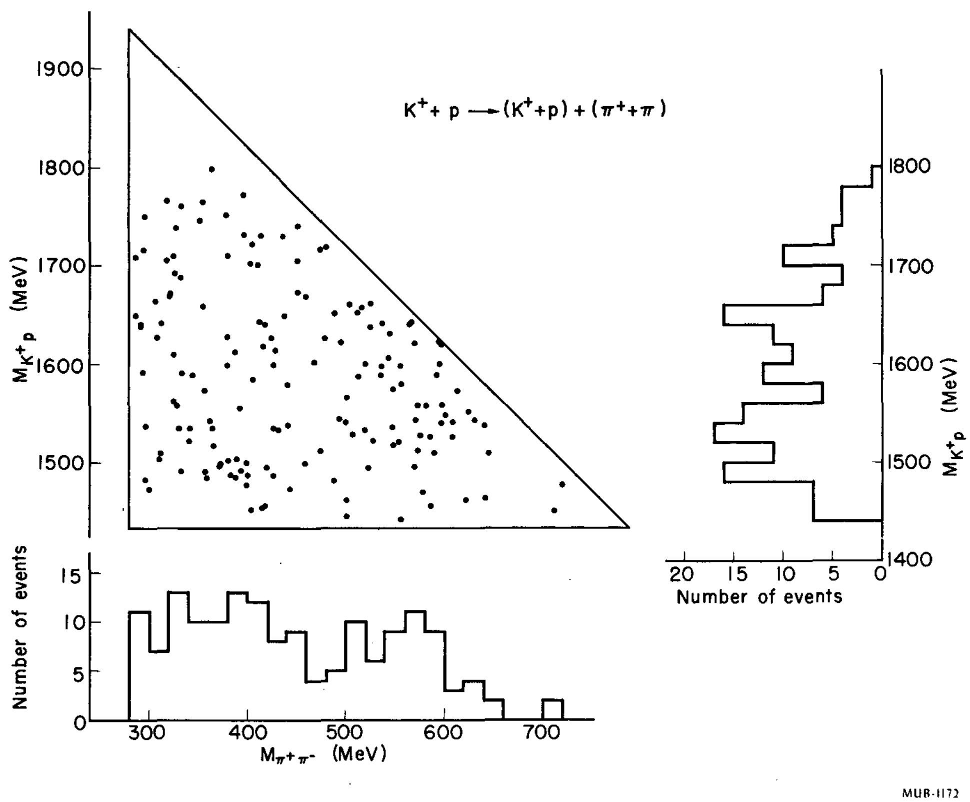

$K^+ + p \rightarrow (K^0 + \pi^+) + (p + \pi^0)$
$T=\frac{3}{2}$ or $\frac{1}{2}$ $T=\frac{3}{2}$ or $\frac{1}{2}$
$M_{p\pi^0}$ (MeV)
1500
1400
1300
1200
1100
Number of events
10
5
600
700
800
900
1000
1100
$M_{K^0\pi^+}$ (MeV)
MUB-1174

Fig. 4



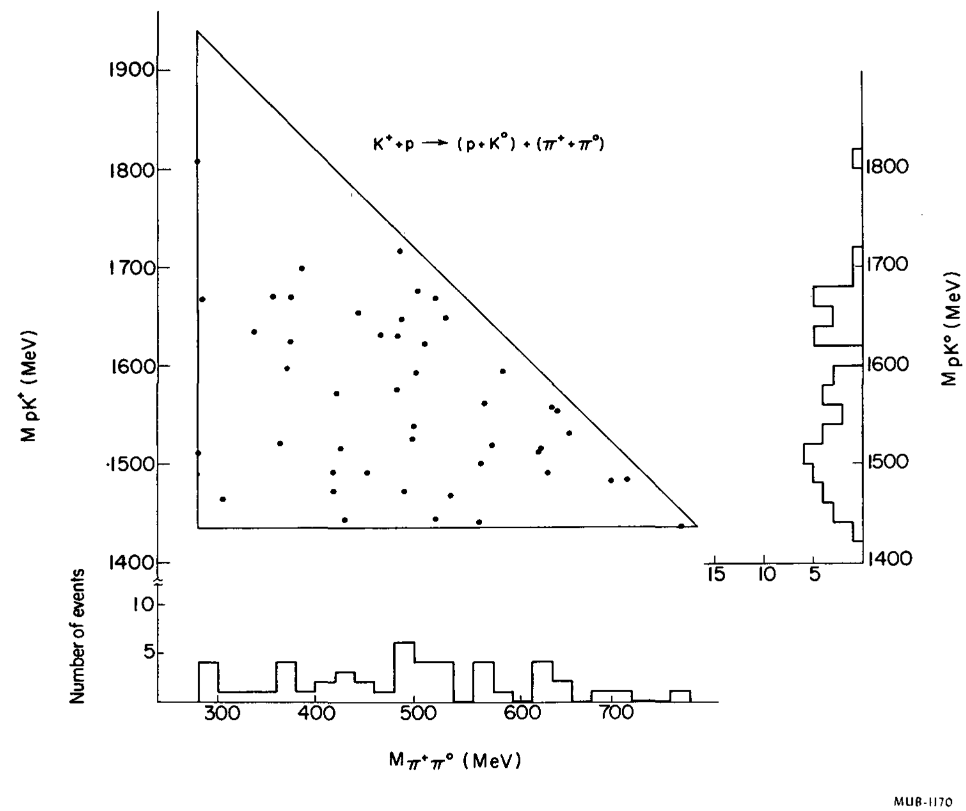
MU-27187

Fig. 5



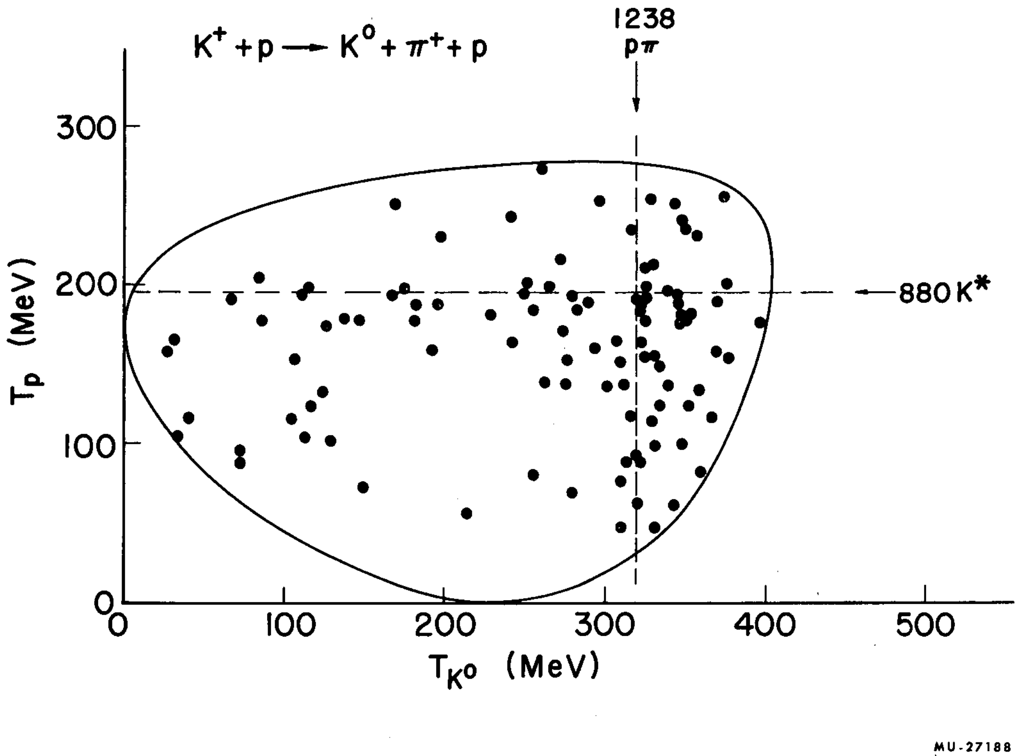
K⁺+ p ⟶ (K⁺+p) + (π⁺+π⁻)
1900
1800
1700
1600
1500
M_{K^+p} (MeV)
Number of events
15
10
5
0
300
400
500
600
700
$M_{\pi^+\pi^-}$ (MeV)
1800
1700
1600
1500
1400
M_{K^+p} (MeV)
20
15
10
5
0
Number of events
MUB-1172

Fig. 6.



K⁺+p → (p+K°) + (π⁺+π°)
M pK⁺ (MeV)
1900
1800
1700
1600
1500
1400
Number of events
10
5
300
400
500
600
700
M π⁺π° (MeV)
M pK° (MeV)
1800
1700
1600
1500
1400
15
10
5
MUB-1170

Fig. 7



K⁺ + p ⟶ K⁰ + π⁺ + p
1238
pπ
880 K*
300
200
100
0
T_p (MeV)
0
100
200
300
400
500
T_{K^o} (MeV)
MU-27188

Fig. 8

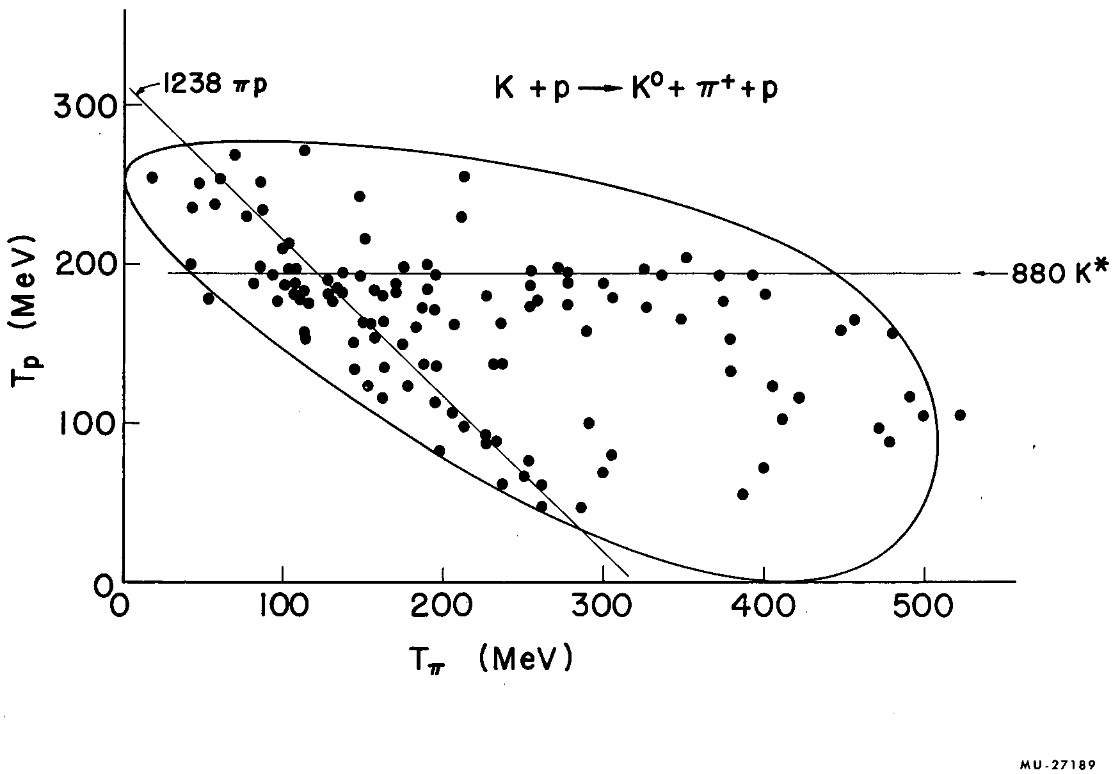
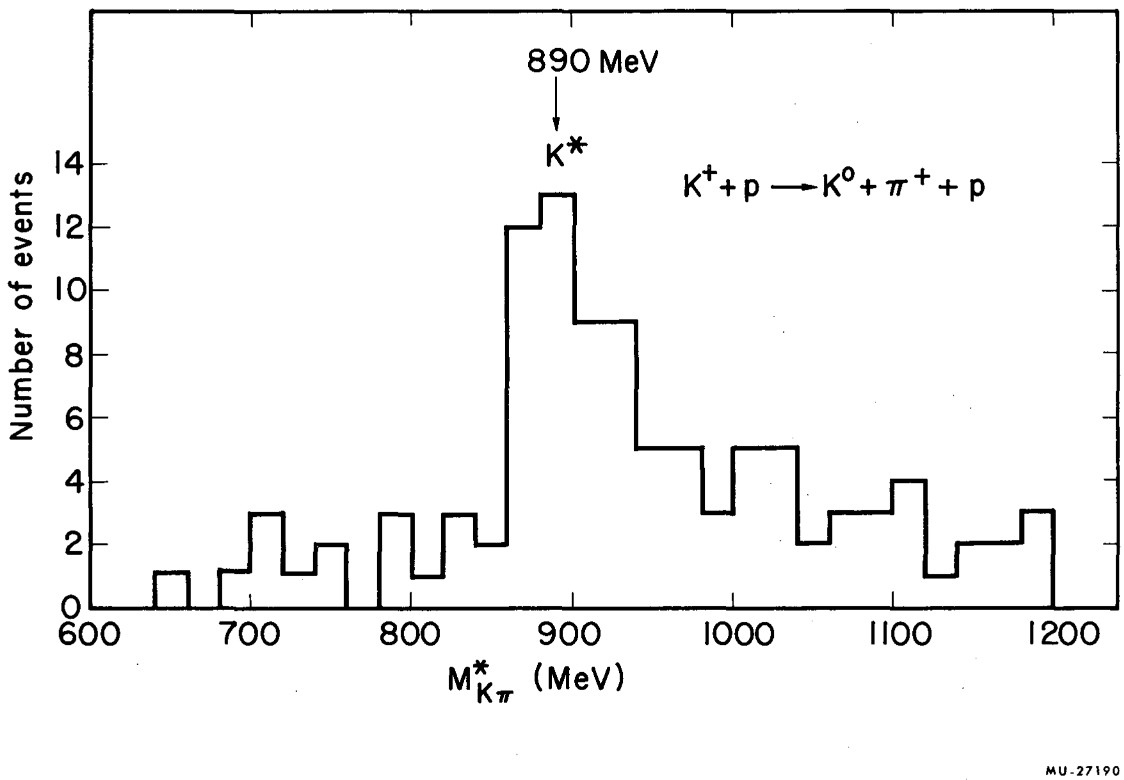
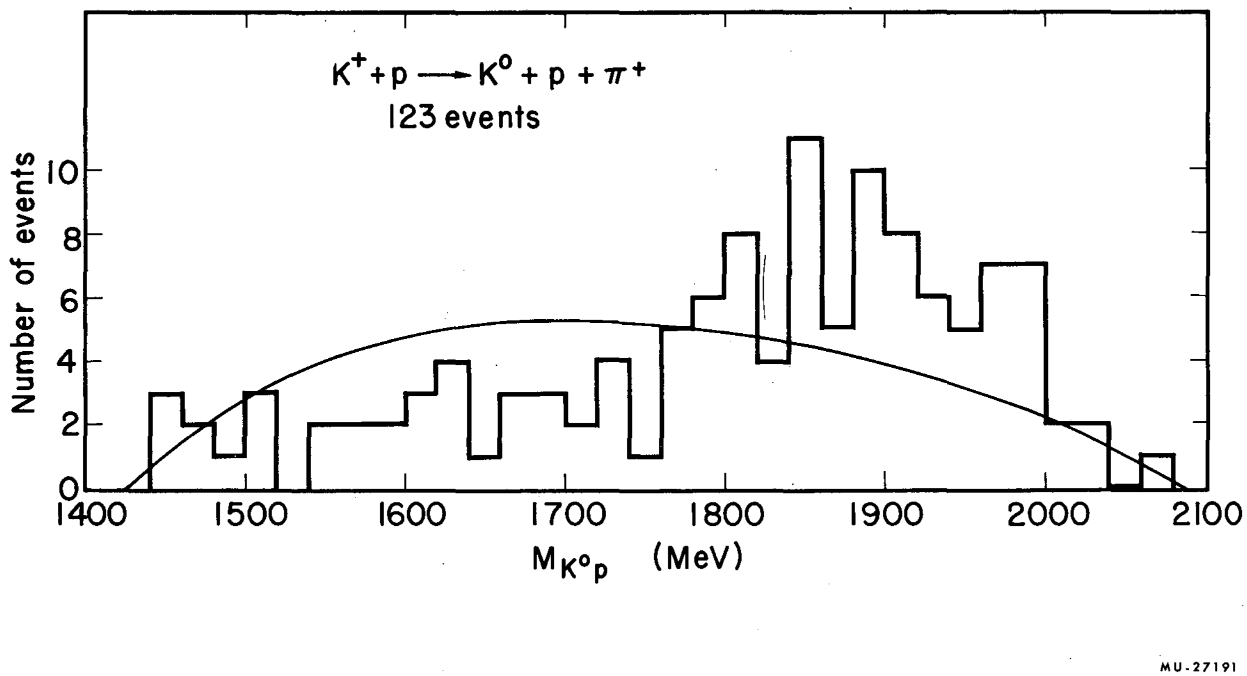

K + p → K⁰ + π⁺ + p
1238 πp
880 K*
T_p (MeV)
T_π (MeV)
300
200
100
0
0
100
200
300
400
500
MU-27189

Fig. 9



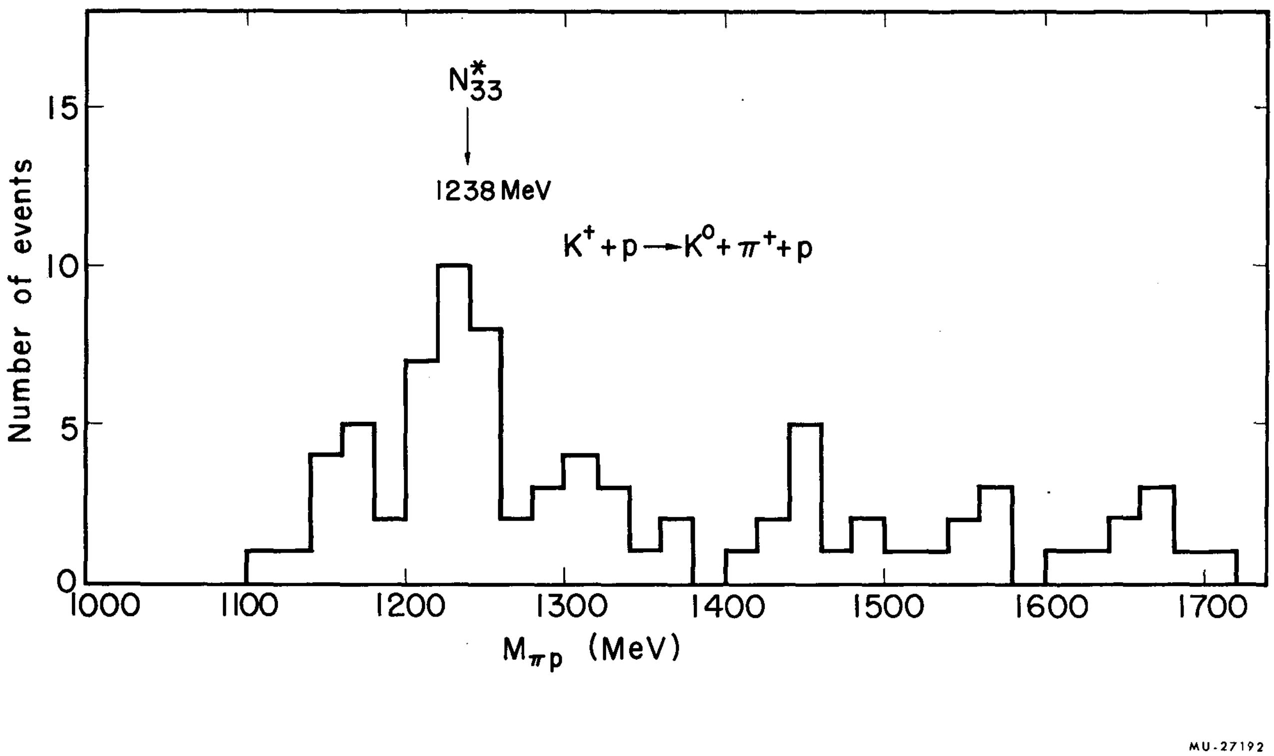
890 MeV
K*
K⁺+p ⟶ K⁰+π⁺+p
Number of events
0
2
4
6
8
10
12
14
600
700
800
900
1000
1100
1200
$M^*_{K\pi}$ (MeV)
MU-27190

Fig. 10



K⁺+p ⟶ K⁰ + p + π⁺
123 events
Number of events
0
2
4
6
8
10
1400
1500
1600
1700
1800
1900
2000
2100
M_K⁰p (MeV)
MU-27191

Fig. 11



15
10
5
0
Number of events
N^*_{33}
1238 MeV
$K^+ + p \rightarrow K^0 + \pi^+ + p$
1000
1100
1200
1300
1400
1500
1600
1700
$M_{\pi p}$ (MeV)
MU-27192

Fig. 12