A search non−$q\bar{q}$ mesons

in the WA102 experiment

at the CERN Omega Spectrometer

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Outline

1) An introduction to non−$q\bar{q}$ mesons

2) The WA102 experiment

3) A possible Glueball−$q\bar{q}$ filter

4) New results on $\pi^+\pi^-\pi^+\pi^-$ and $K\bar{K}\pi$

5) Summary

Reggeon (Quark–like) Vs Pomeron (Gluon–like) Exchange

$$\sigma(RR) \propto s^{-1}$$

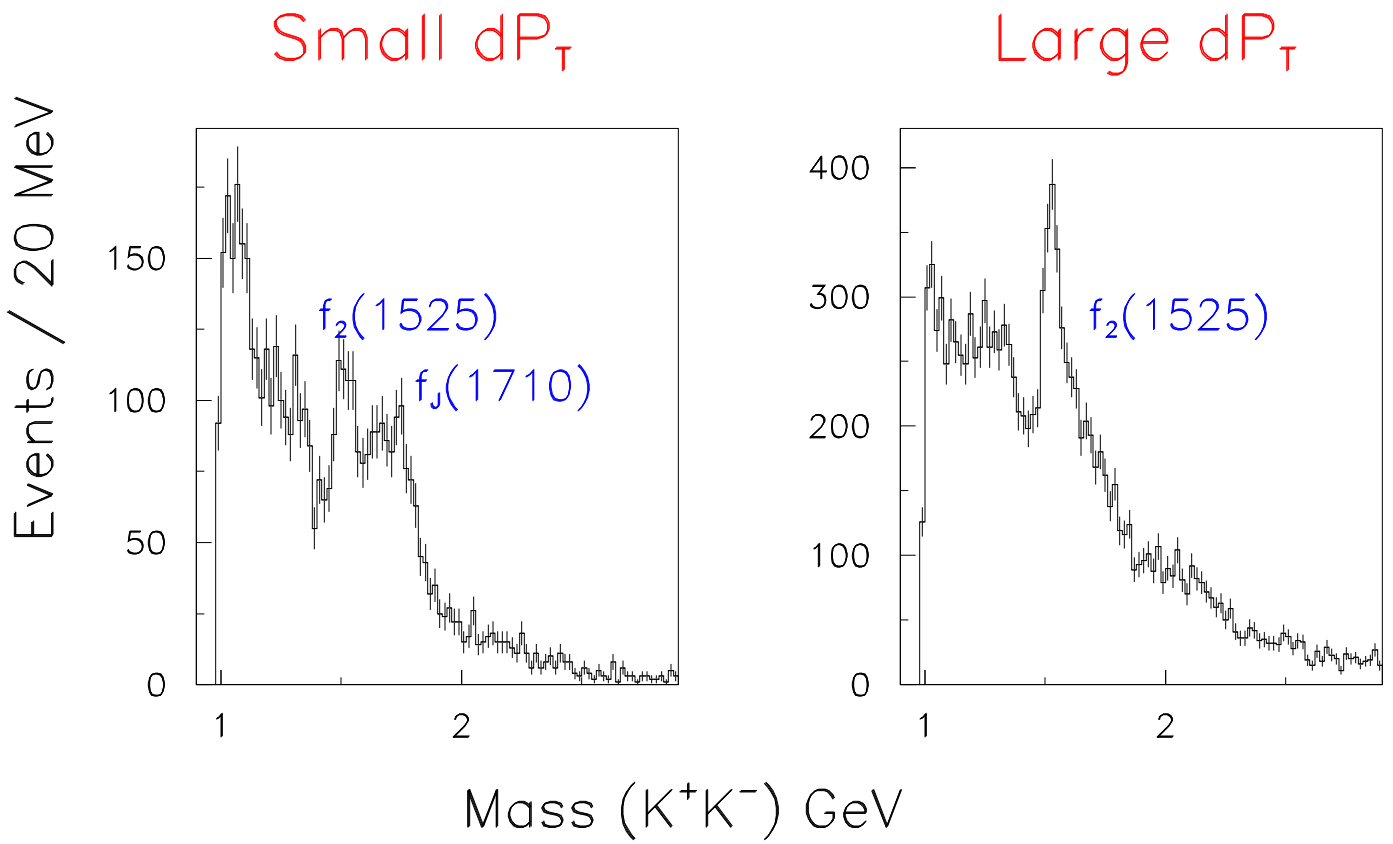
$$\sigma(R\mathbb{P}) \propto s^{-0.5}$$

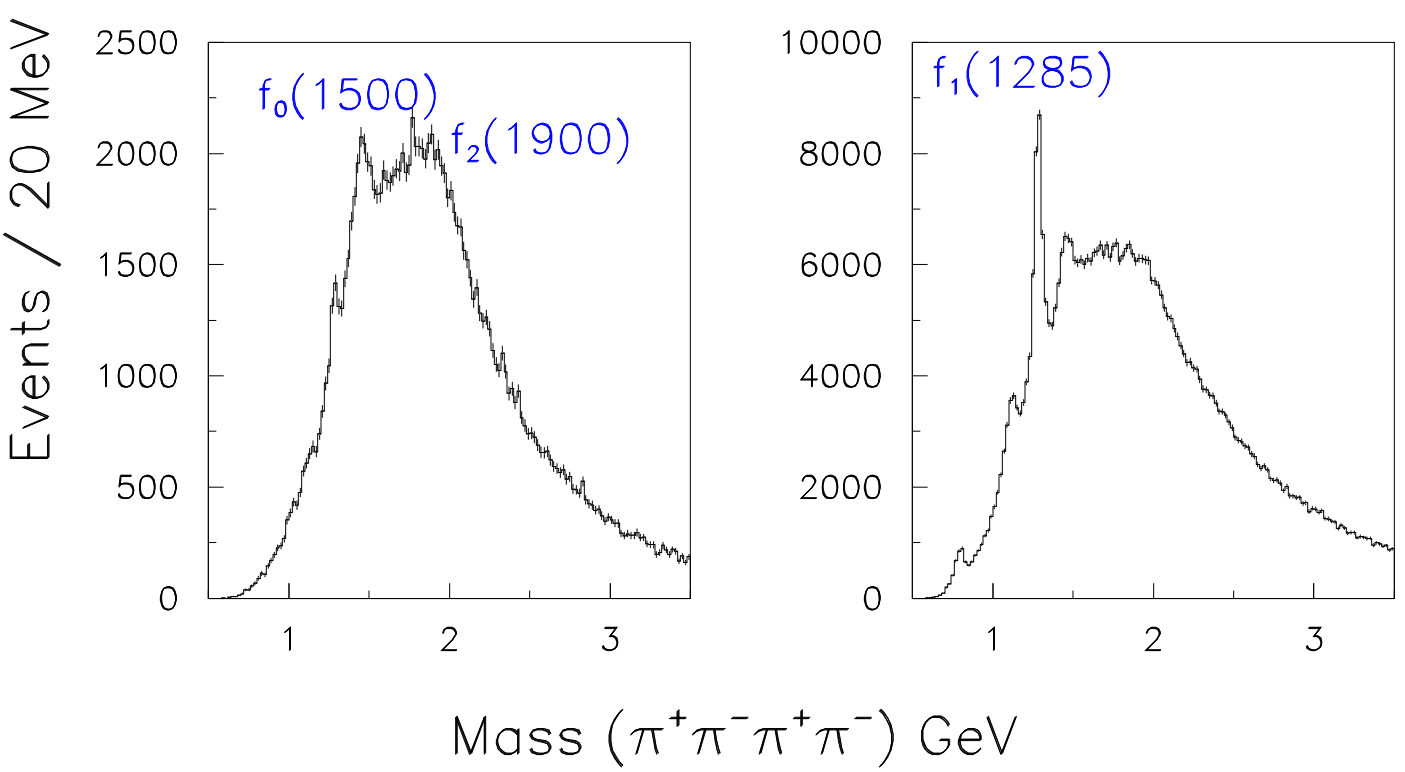
$$\sigma(\mathbb{P}\mathbb{P}) \propto \text{constant}$$

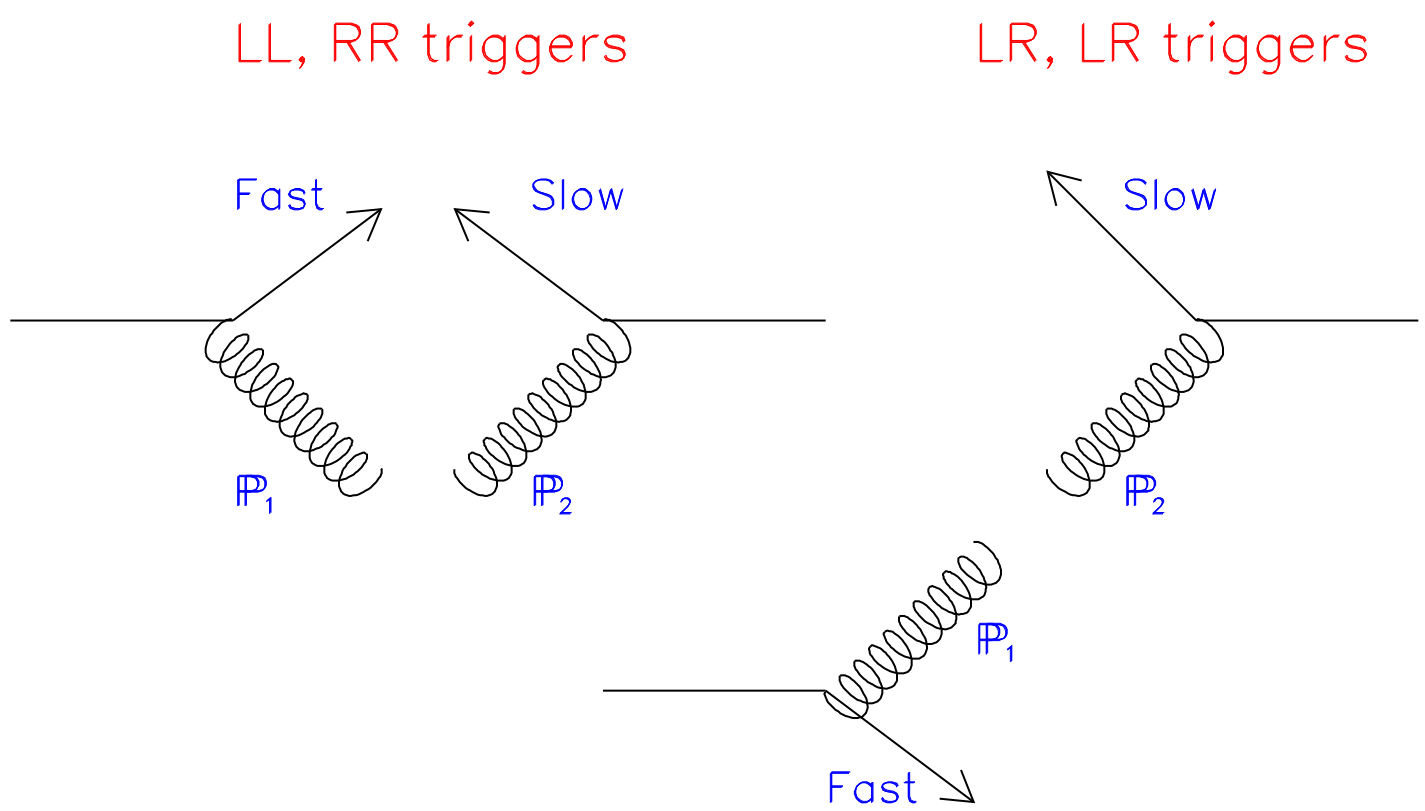
Hence Double Pomeron Exchange becomes increasingly more important as the centre of mass energy is increased

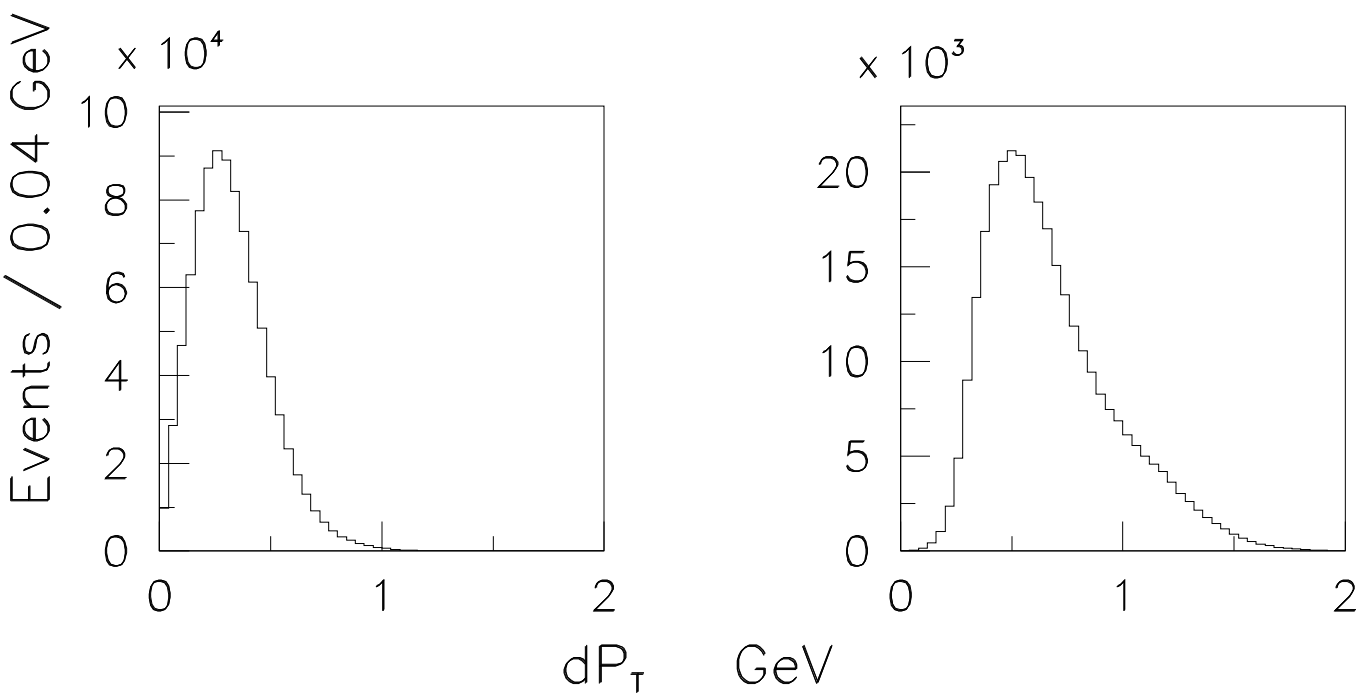
The decrease in the relative strength of Reggeon exchange can be measured by observing the $\rho(770)$ which can only be produced when a Reggeon is exchanged

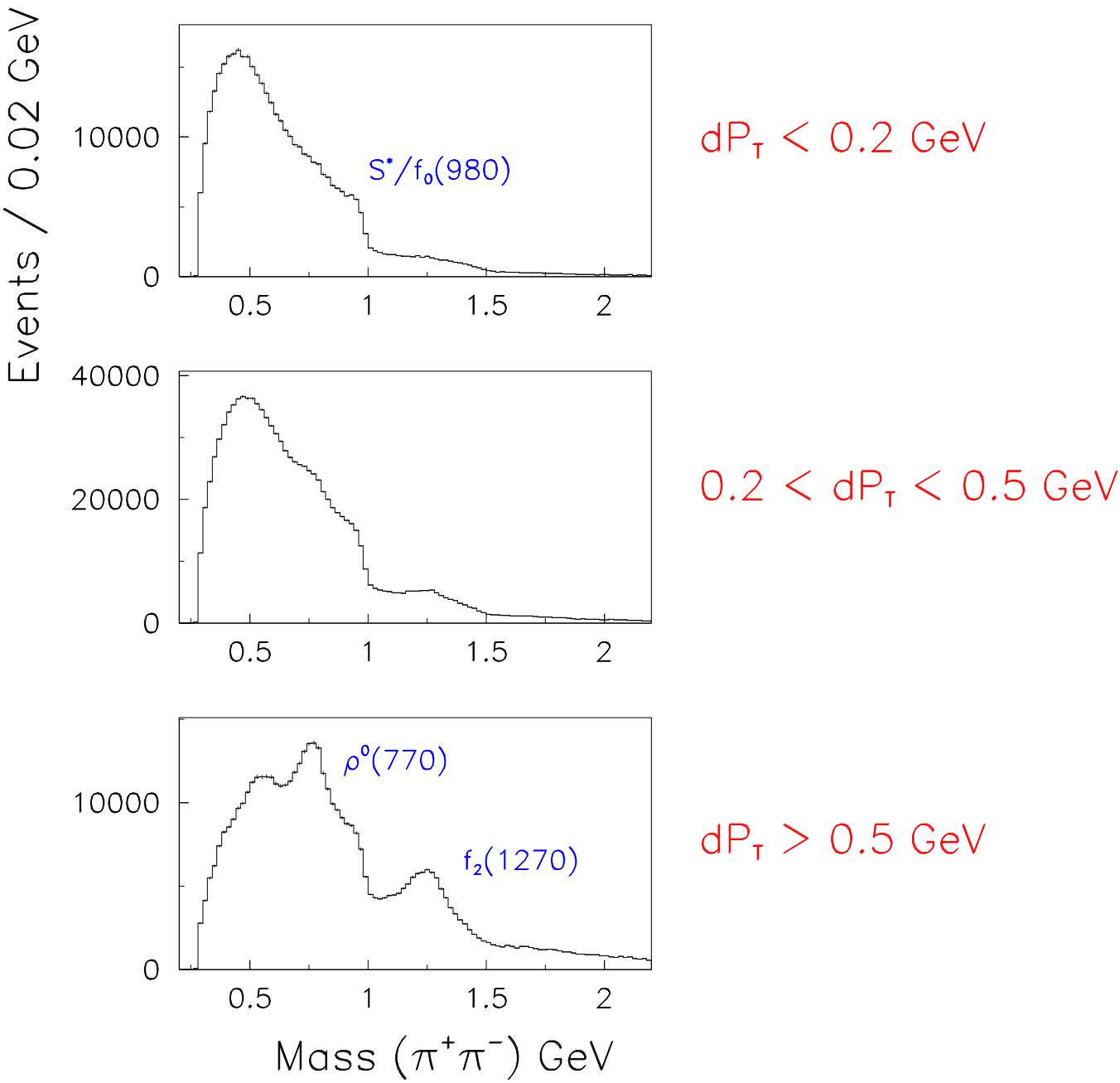
Data at $\sqrt{s} = 12.7, 23.8$ and 29 GeV allows a study to be performed


Small dP_T
Large dP_T
Events / 20 MeV
$f_2(1525)$
$f_J(1710)$
$f_2(1525)$
Mass (K^+K^-) GeV

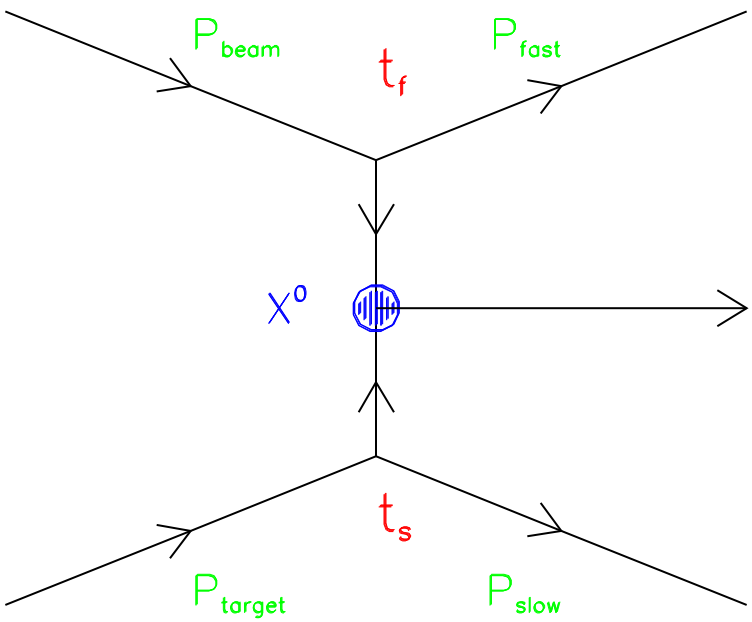

$dP_T < 0.2$ GeV
$dP_T > 0.5$ GeV
Events / 20 MeV
$f_0(1500)$
$f_2(1900)$
$f_1(1285)$
Mass $(\pi^+\pi^-\pi^+\pi^-)$ GeV


LL, RR triggers
LR, LR triggers
Fast
Slow
Slow
$\mathbb{P}_1$
$\mathbb{P}_2$
$\mathbb{P}_2$
$\mathbb{P}_1$
Fast

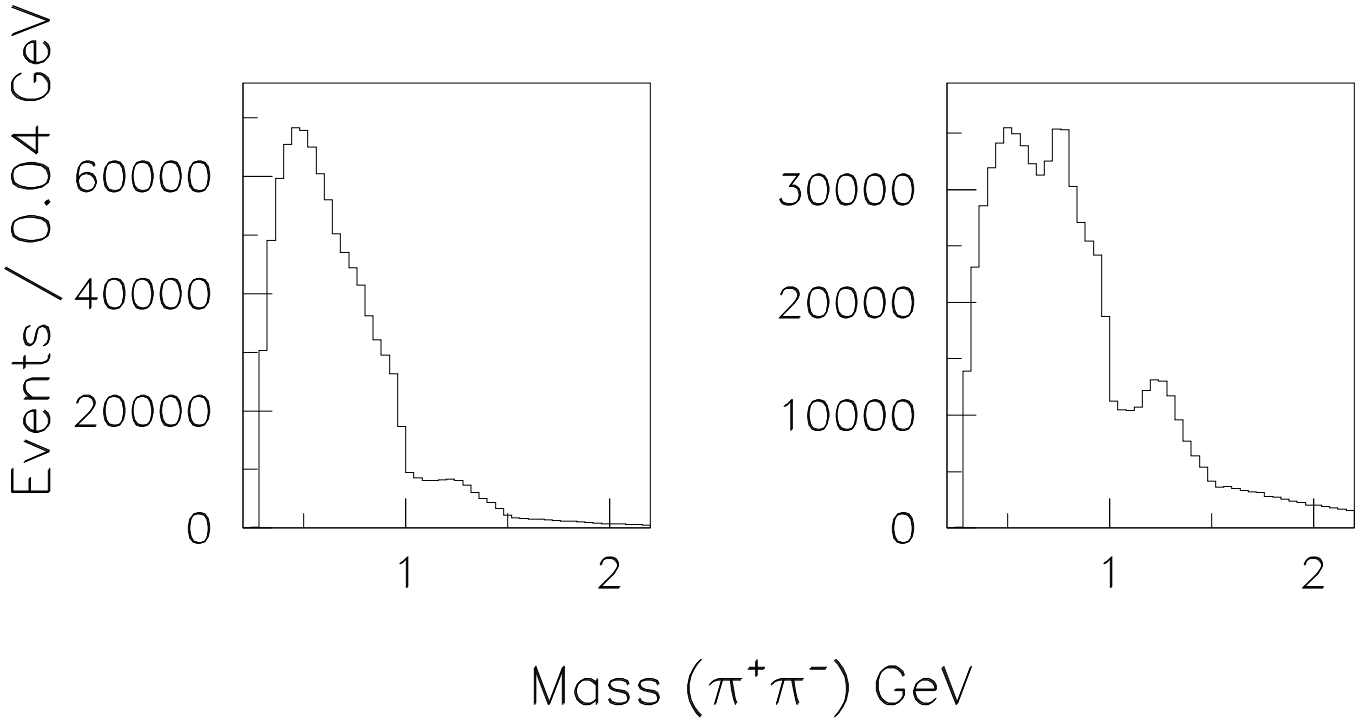

Events / 0.04 GeV
x 10^4
10
8
6
4
2
0
0
1
2
x 10^3
20
15
10
5
0
0
1
2
dP_T GeV


Events / 0.02 GeV
10000
0
S*/f₀(980)
0.5
1
1.5
2
40000
20000
0
10000
0
ρ⁰(770)
f₂(1270)
Mass (π⁺π⁻) GeV
dP_T < 0.2 GeV
0.2 < dP_T < 0.5 GeV
dP_T > 0.5 GeV

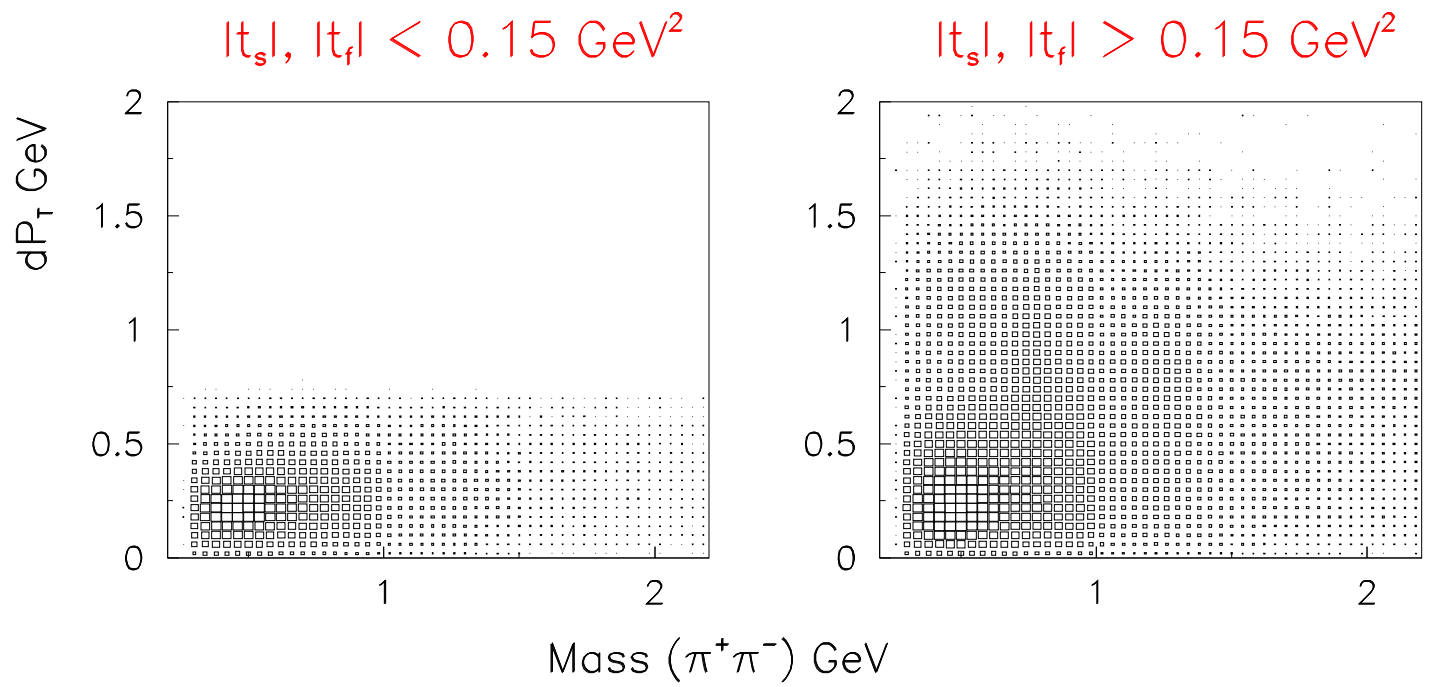
Momentum transfer at the proton vertices



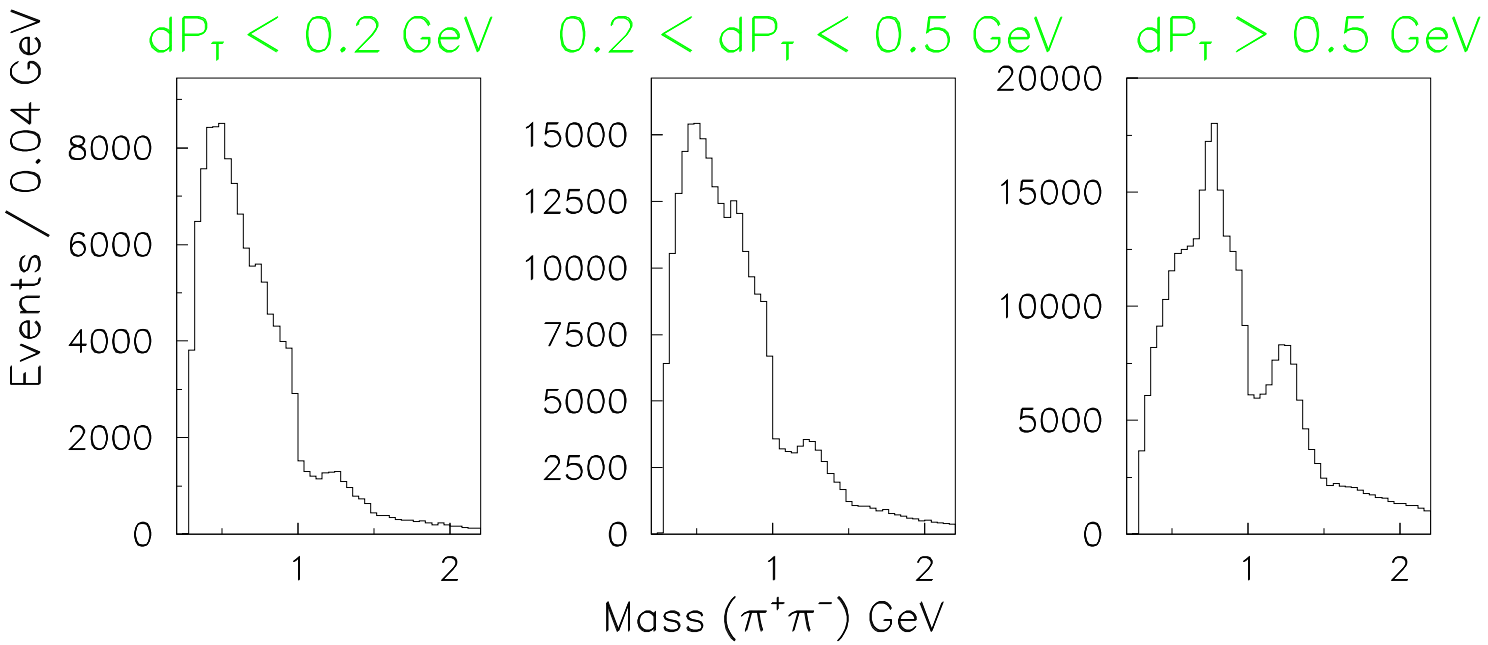
$|t_s|, |t_f| < 0.15\ GeV^2$ $|t_s|, |t_f| > 0.15\ GeV^2$



dP_T effect or t effect

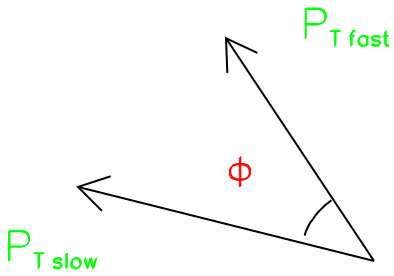


Require $|t_s|, |t_f| > 0.15$ GeV^2

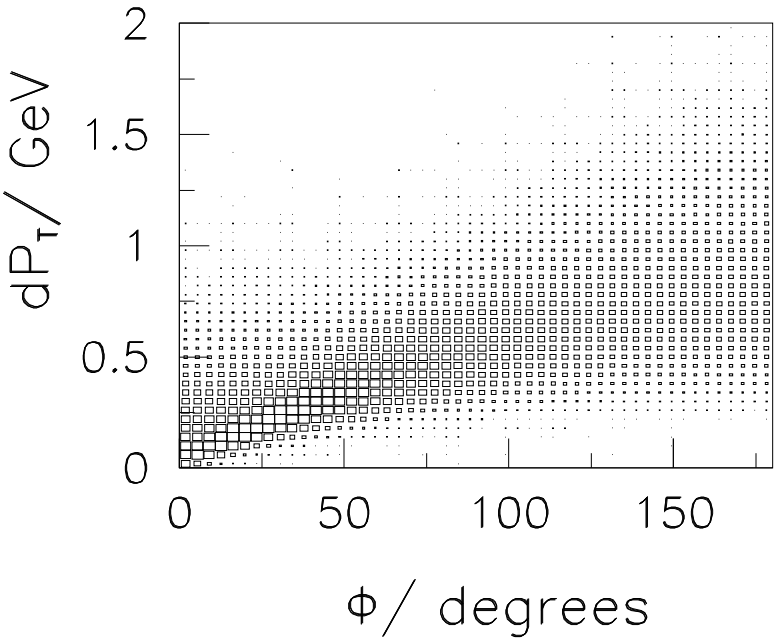


dP_T is more important than t

what about angle between the protons



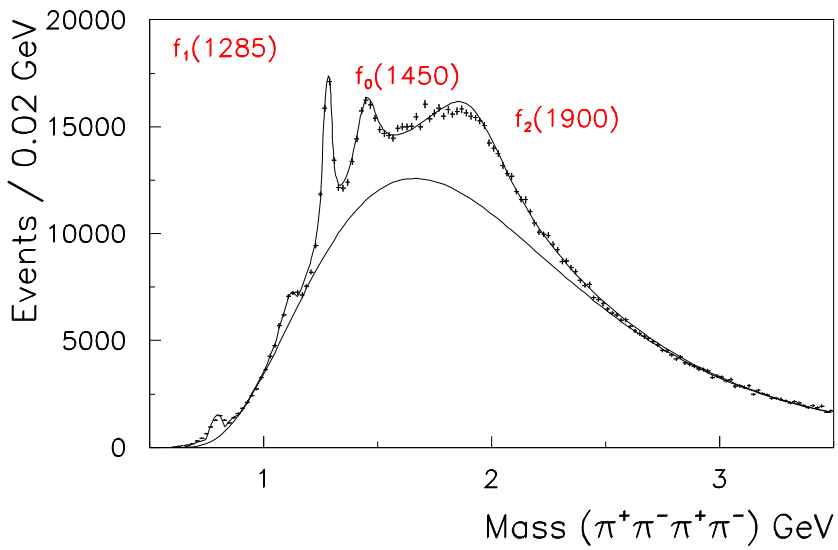
$$\cos\Phi = \frac{dP_T^2 - P_T^2}{4t_s t_f}$$



There is a correlation between Φ and dP_T

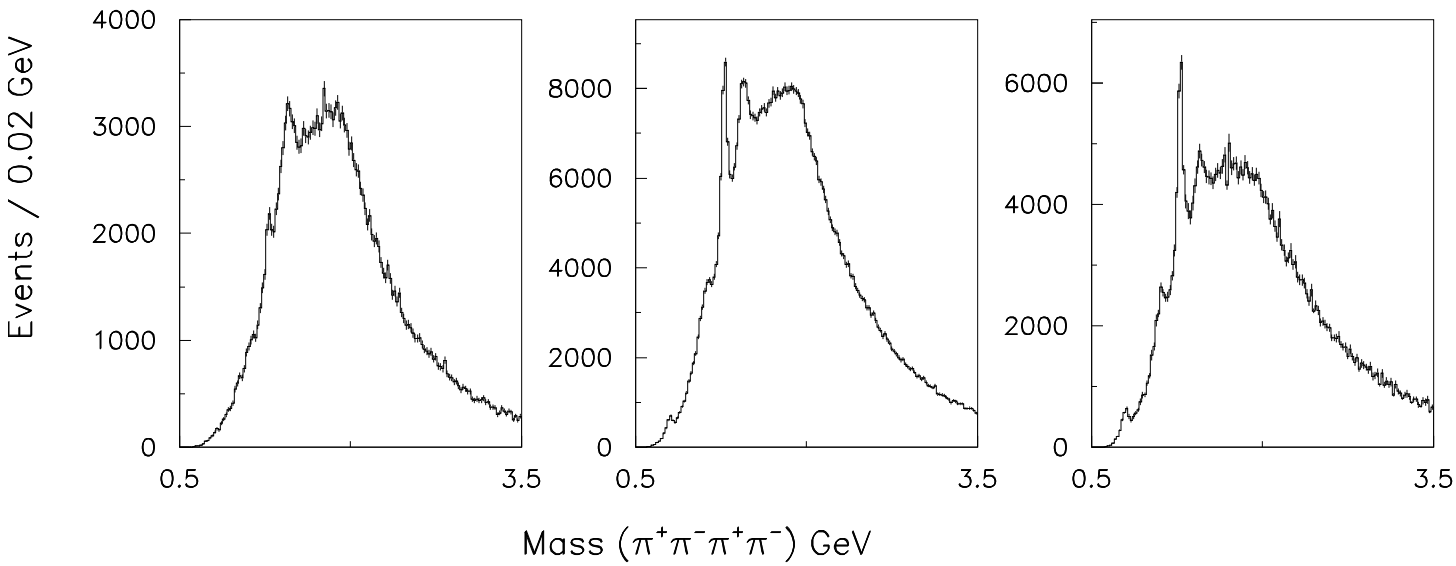
Cuts in Φ are not as effective as cuts in dP_T

$pp \rightarrow p_f(\pi^+\pi^-\pi^+\pi^-)p_s$

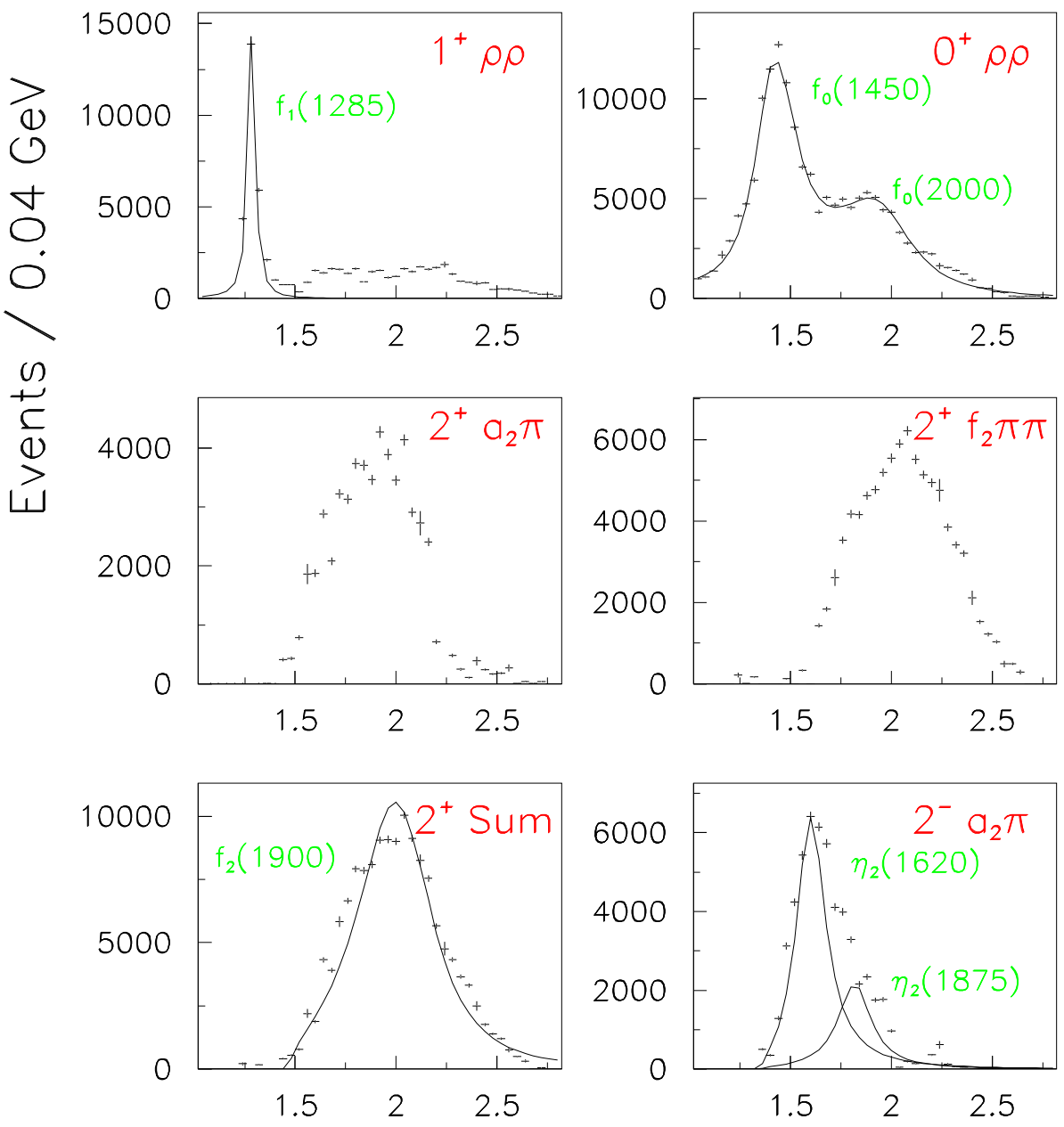


$f_0(1450)$ can be due to interference between $f_0(1300)$ and $f_0(1500)$

$dP_T < 0.2$ $\quad 0.2 < dP_T < 0.5$ $\quad dP_T > 0.5$

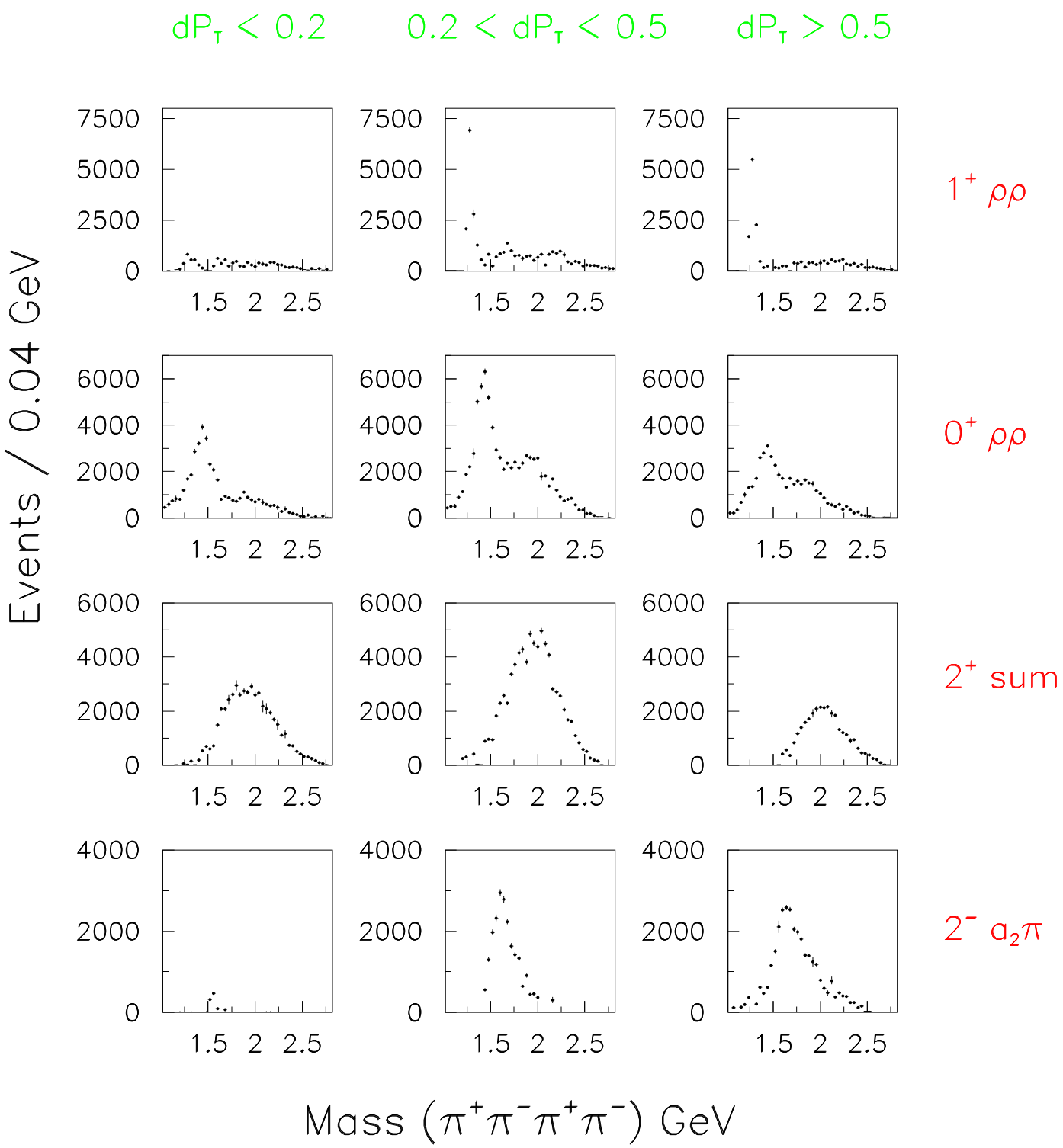


Results of the spin analysis



$f_0(1450)$
or
Interference of
$f_0(1300)$ and
$f_0(1500)$

Spin analysis and dP_T



A summary of the $\pi^+\pi^-\pi^+\pi^-$ channel

The $f_1(1285)$ is observed in the 1^{++} $\rho\rho$ wave

The 1.45 GeV peak is observed in the 0^{++} $\rho\rho$ wave
Either a single resonance or interference between the $f_0(1300)$ and $f_0(1500)$

Evidence also for a peak at 2.0 GeV in 0^{++} $\rho\rho$

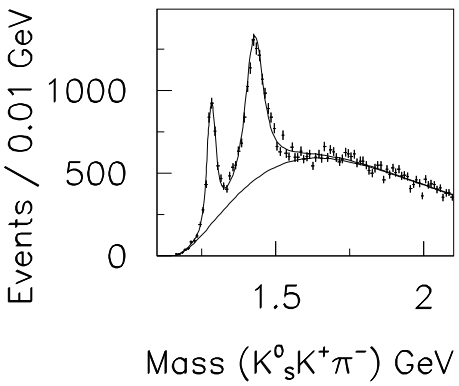
The $f_2(1900)$ decays to $a_2\pi$ and $f_2(1270)\pi\pi$

The $\eta_2(1620)$ and $\eta_2(1875) \rightarrow a_2\pi$ are observed

The $f_1(1285)$, $\eta_2(1620)$, $\eta_2(1875)$ and $f_0(2000)$ are all suppressed at small dP_T consistent with other $q\bar{q}$ states

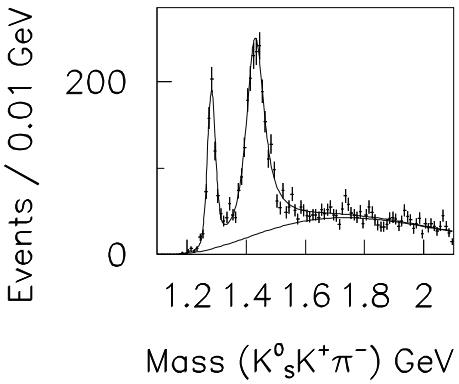
In contrast, the $f_0(1450)$ and $f_2(1900)$ are not suppressed at small dP_T

$$pp \rightarrow p_f(K\bar{K}\pi)p_s$$

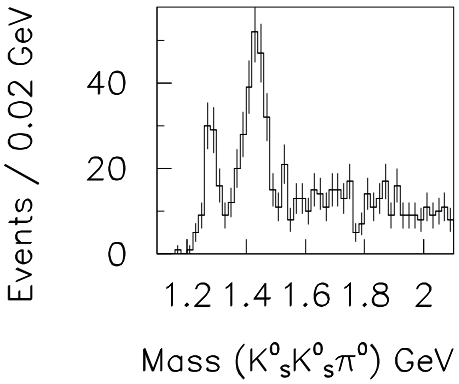


K Identified
by energy balance

J^{PG}
from spin analysis



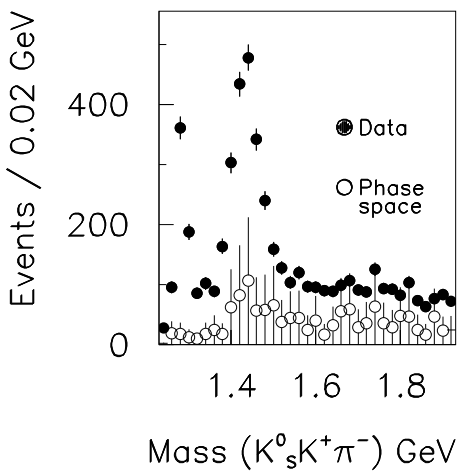
K Identified
by Cerenkov



C Parity Positive Only

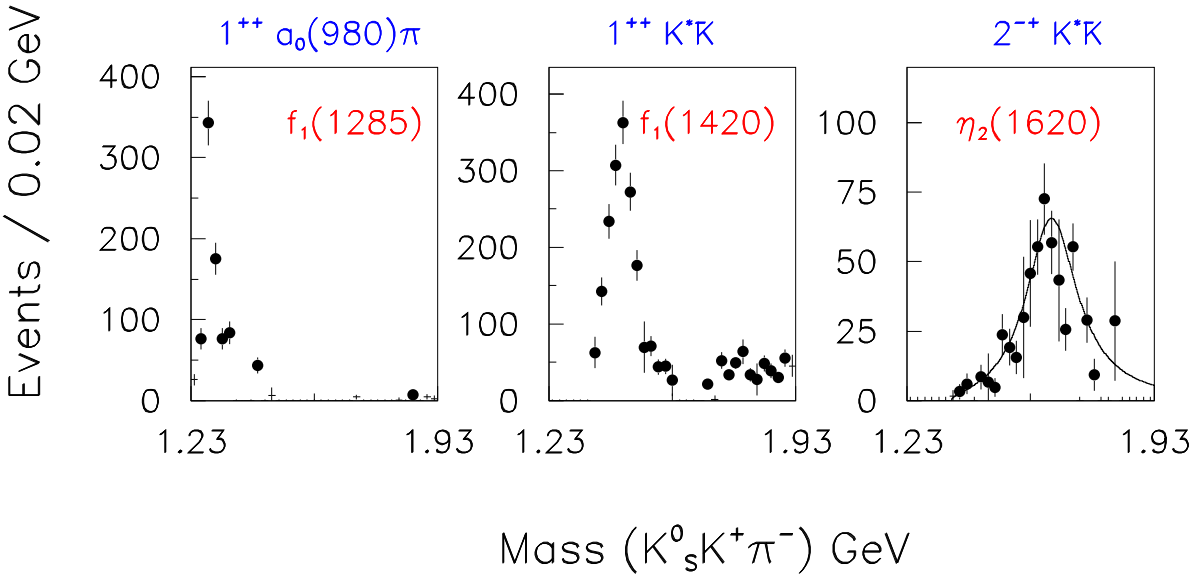
$\rightarrow I^GJ^{PC}$

Results from the spin analysis

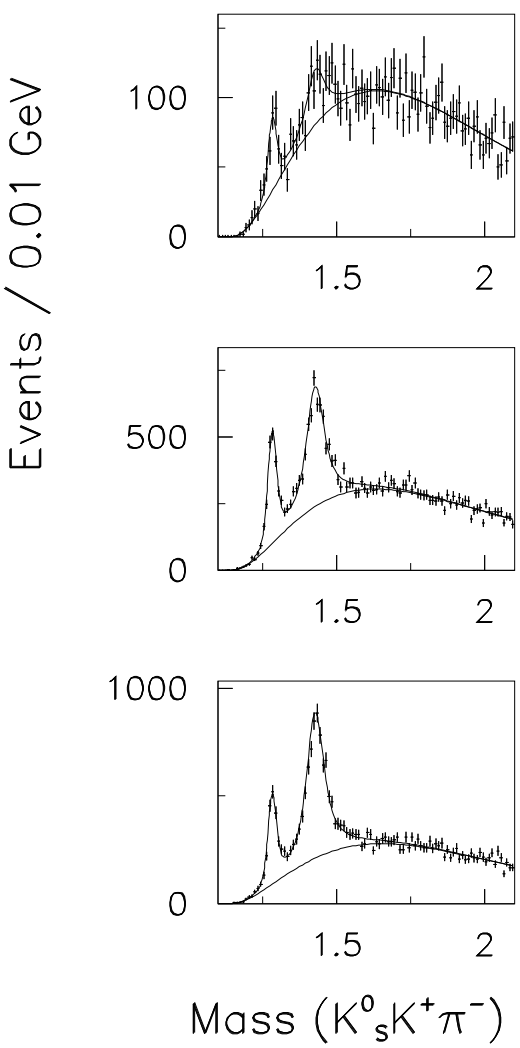


No 0^{-+} required in the fit

No evidence for $f_1(1510)$



dP_T effect



$dP_T < 0.2$ GeV

$0.2 < dP_T < 0.5$ GeV

$dP_T > 0.5$ GeV

A summary of the $K\bar{K}\pi$ channel

The $f_1(1285)$ is observed decaying to $a_0(980)\pi$ only

$M = 1281 \pm 1$ MeV $\quad \Gamma = 20 \pm 2$ MeV

BR $f_1(1285) \rightarrow (K\bar{K}\pi)/(4\pi) = 0.265 \pm 0.01 \pm 0.01$

The $f_1(1420)$ is observed decaying to $K^*\bar{K}$ only

$M = 1426 \pm 1$ MeV $\quad \Gamma = 58 \pm 4$ MeV

Evidence for $\eta_2(1620) \rightarrow K^*\bar{K}$

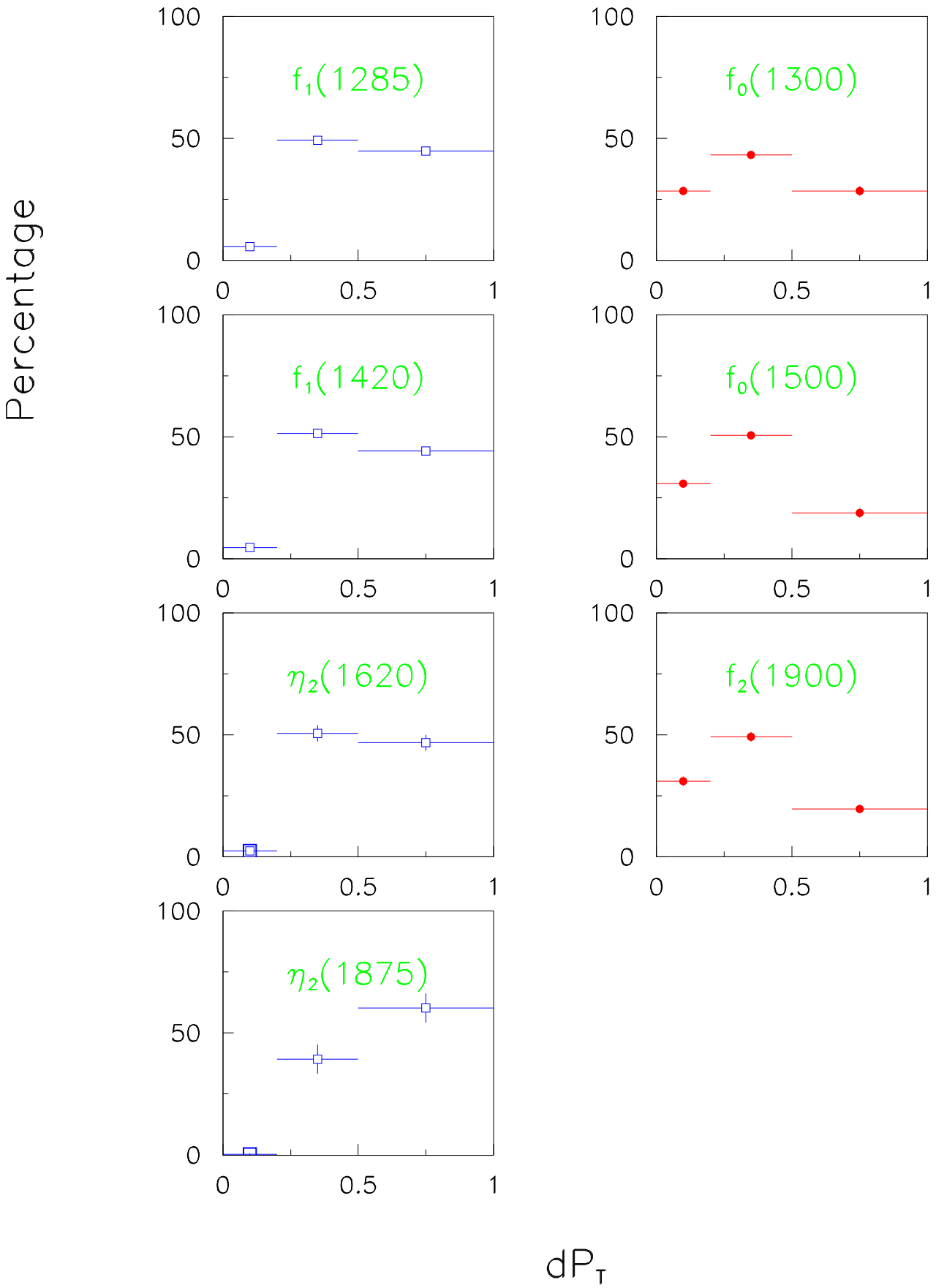
BR $\eta_2(1620) \rightarrow (K\bar{K}\pi)/(a_2\pi) = 0.07 \pm 0.02 \pm 0.02$

No Evidence for the $f_1(1510)$

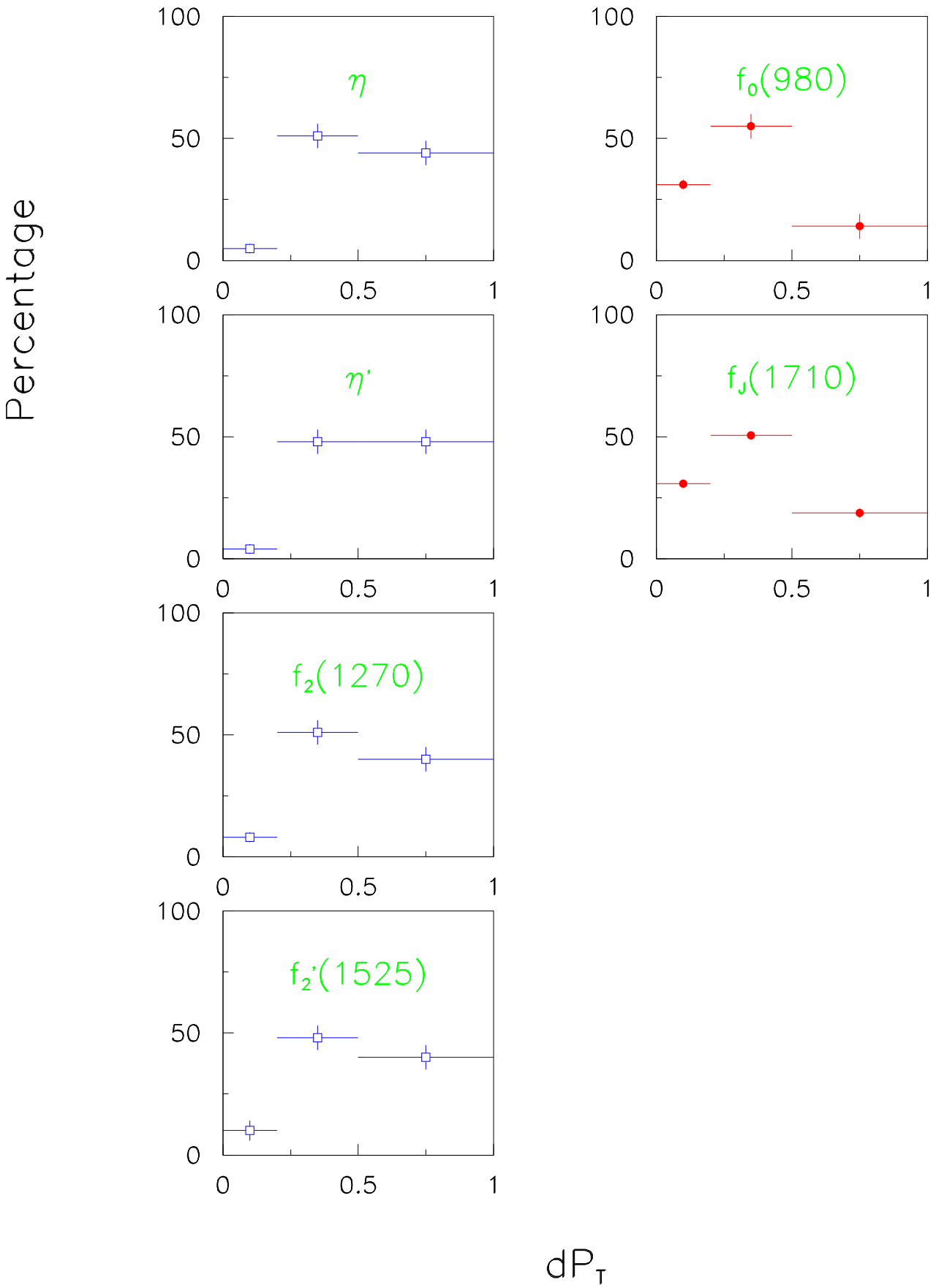
No Evidence for any 0^{-+} states which appear to be suppressed in central production

The $f_1(1285)$ and $f_1(1420)$ have the same behaviour as a function of dP_T consistent with both being $q\bar{q}$ states

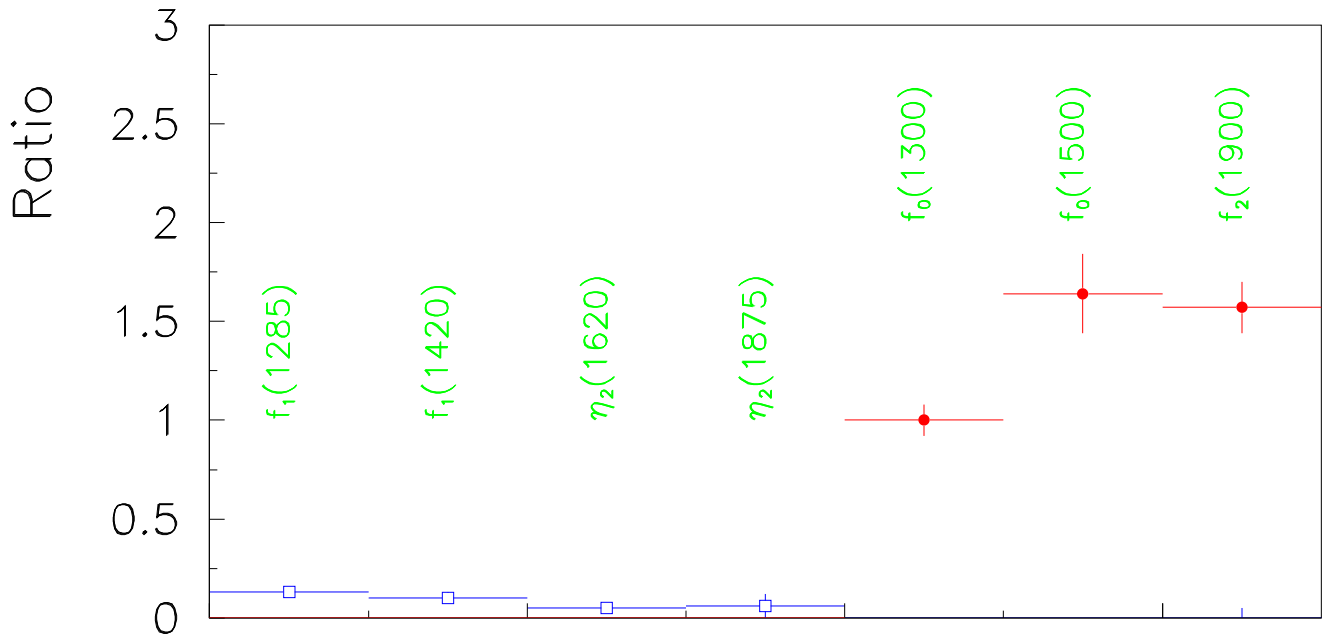
Resonance production as a function of dP_T

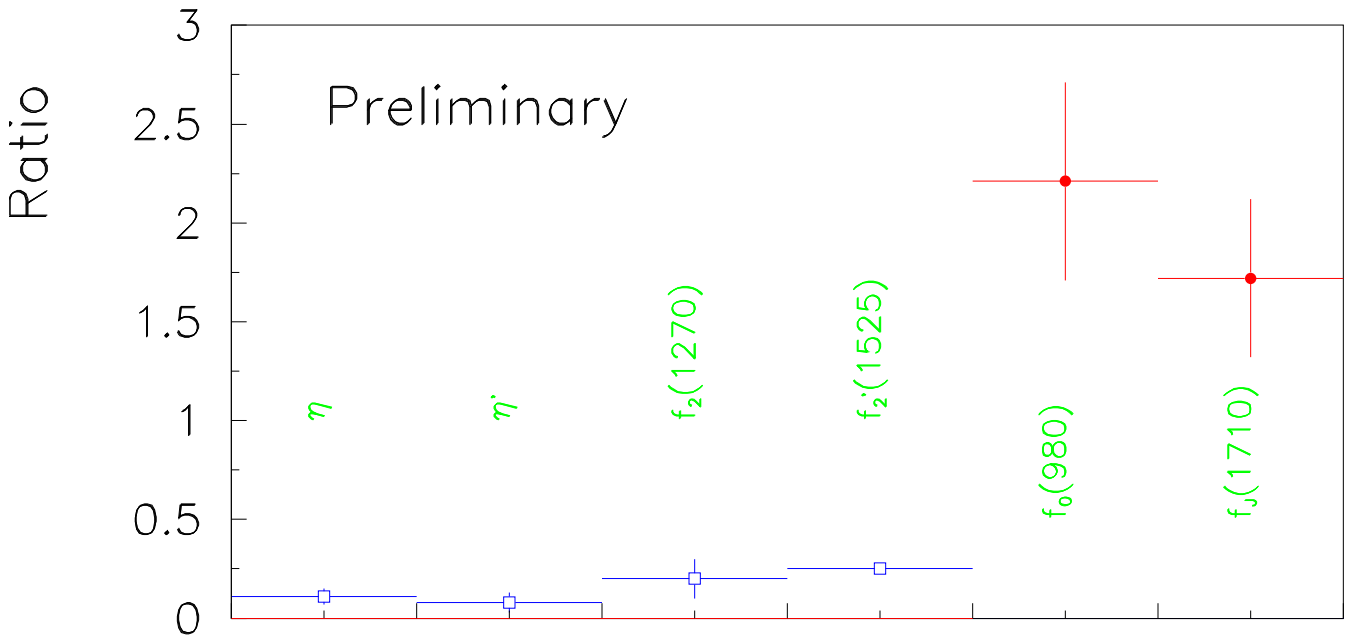


Preliminary results from other channels



Ratio of events at small dP_T to large dP_T





Summary

New results from central production show that there is a kinematical filter which can select out glueball candidates from known $q\bar{q}$ states

An analysis of the $K\bar{K}\pi$ final state shows that the $f_1(1285)$ and $f_1(1420)$ behave like other $q\bar{q}$ states and that 0^{-+} states are suppressed in central production

An analysis of the $\pi^+\pi^-\pi^+\pi^-$ final state shows evidence for the $f_1(1285)$, $\eta_2(1620)$ and $\eta_2(1875)$ which behave like $q\bar{q}$ states

In contrast, the peak at 1.45 GeV and the $f_2(1900)$ are not consistent with other $q\bar{q}$ states

Preliminary results from other channels show that the $\vartheta/f_J(1710)$ and $f_0(980)$ have a similar dependence

We have a large increase of statistics in other interesting channels like $\eta\eta$, $\eta'\eta'$ $\omega\omega$ etc which are in progress