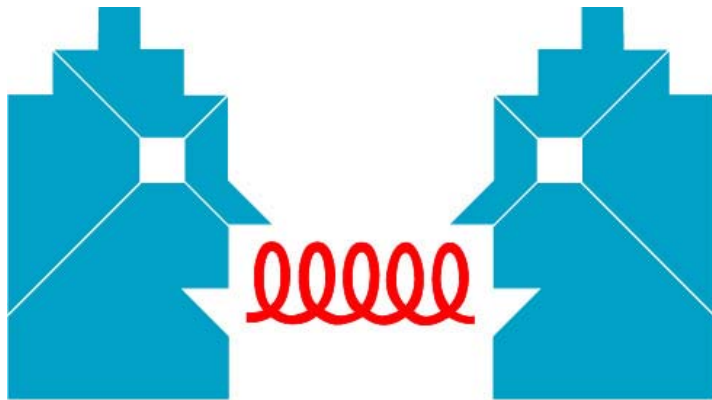


Possible Hints and Search for Glueball Production in Charmless Rare B Decays

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July 25, 2002
ICHEP 2002, Amsterdam



31st INTERNATIONAL CONFERENCE ON
HIGH ENERGY PHYSICS AMSTERDAM

臺灣大學

National Taiwan University



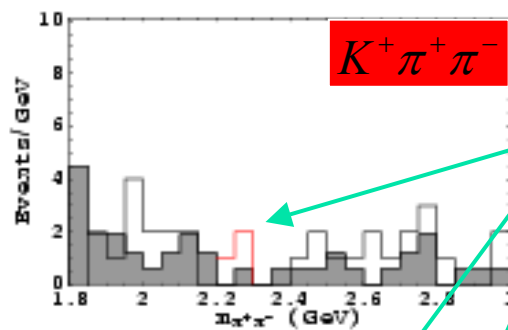
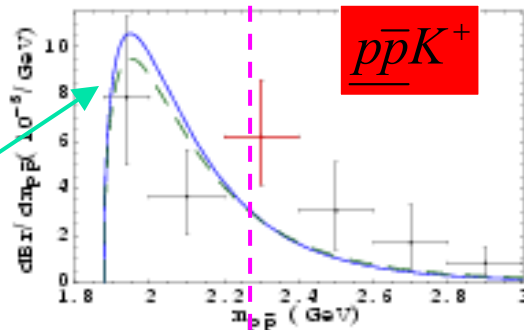
Based on C.K. Chua, WSH and S.Y. Tsai, hep-ph/0204186

I. $K^{(0)} h^+ h^-$ Hint ?

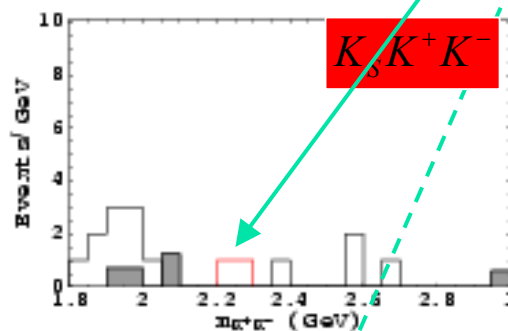
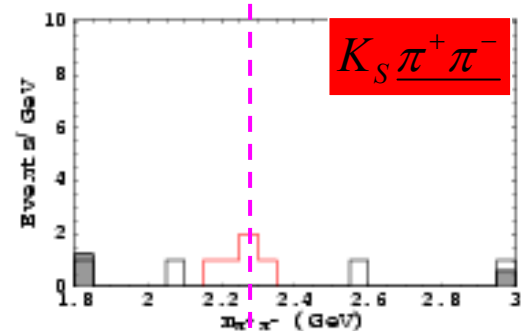
(30 fb⁻¹, Belle)

Underlying Curve (II.)

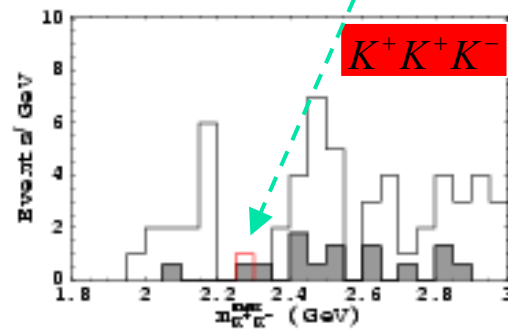
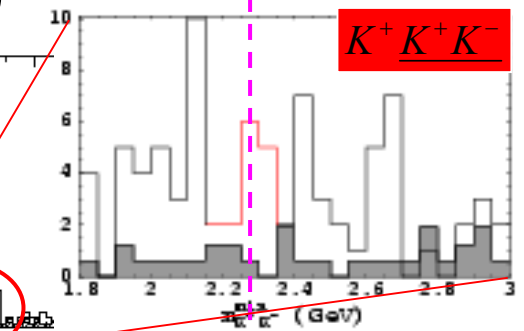
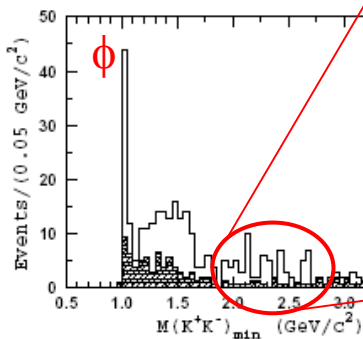
Glueball Bump? (III.)



No Evidence?



Elsewhere? (IV.)

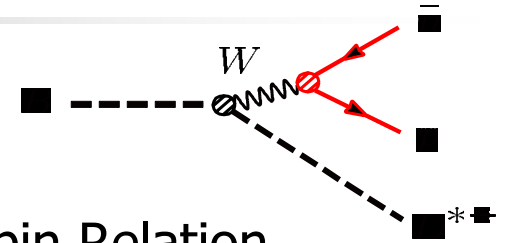


$pp\bar{p}K, K_S\pi^+\pi^-, K^+K^+K^-$ line-up @ 2.2–2.3 GeV

ξ ?

II. Possible Dynamics of Underlying 3-body

- CLEO'01: $\bar{B} \rightarrow D^* p \bar{n}$



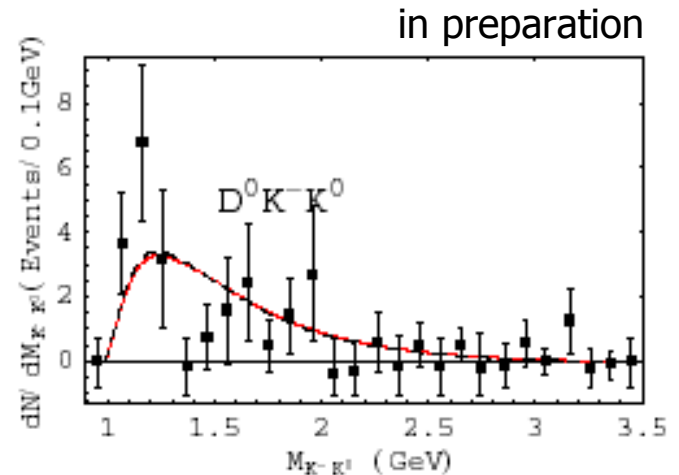
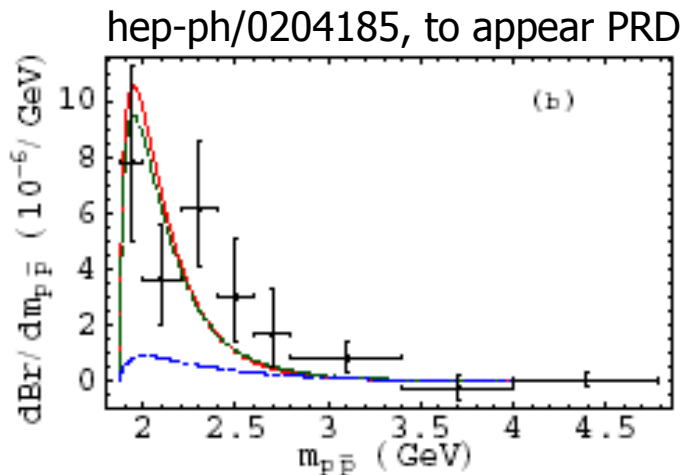
Factorized Currents/Current Produced $p \bar{n}$ / Isospin Relation

Chua, WSH, Tsai, PRD'02

⇒ Vector Current gives 60% & *Threshold Enhancement*
 ∴ Form Factor

- Belle'02: $B \rightarrow p \bar{p} K$ and $\bar{B} \rightarrow D^{(*)} K^- K^{0(*)}$

Extend Idea ... *Seems to Work*



III. Charmless B Decays & Glueball Search

Why Interesting ?

- Glueballs Massive → Accessible (Probably) in B Only

- Curious: Gluonic Penguin

Why

$$b \rightarrow sg^* \rightarrow sq\bar{q} \text{ Only ?}$$

No Glue Counterpart ?

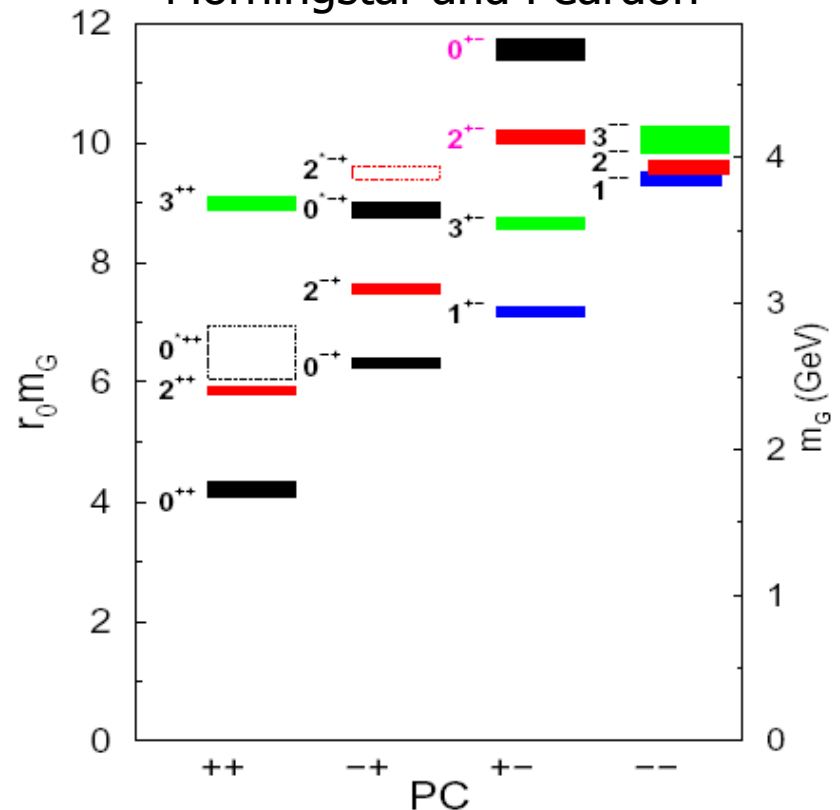
Absence of $b \rightarrow sgg$!

But ...

$$B \rightarrow \eta' K, \eta' X_s \text{ LARGE}$$

Glue Rich !

Morningstar and Peardon

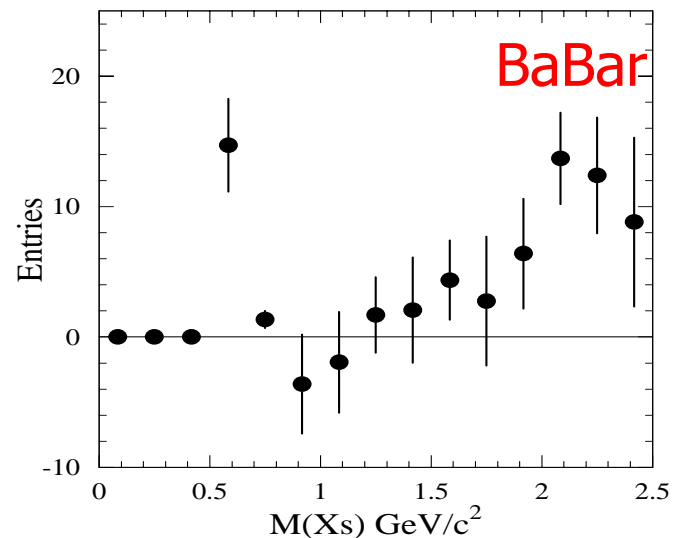
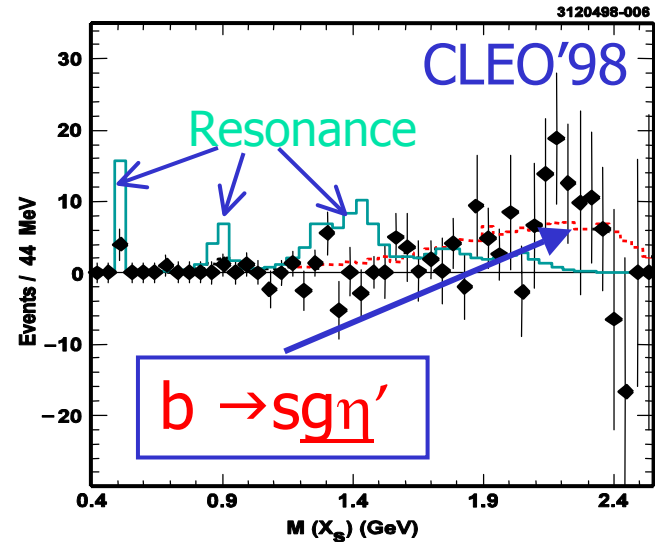
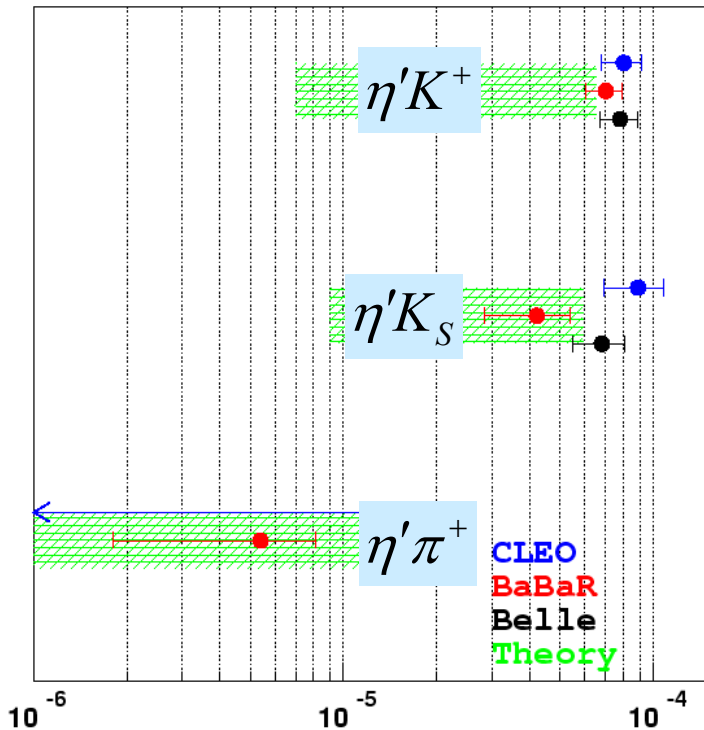


$B \rightarrow \eta' K, \eta' X_s$ LARGE

$\approx 10^{-4}, \approx 10^{-3}$

Not Understood!

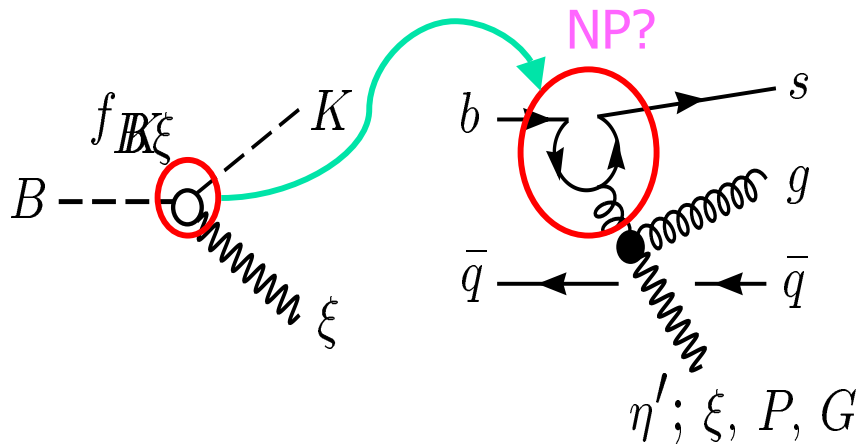
Data *Above* (Pre)Predictions



$g^* \rightarrow g \eta'$? QCD Anomaly.
 Caution (A. Kagan): $Y(1S)$ data
 indicate form factor small

Possible Picture in B Decay:

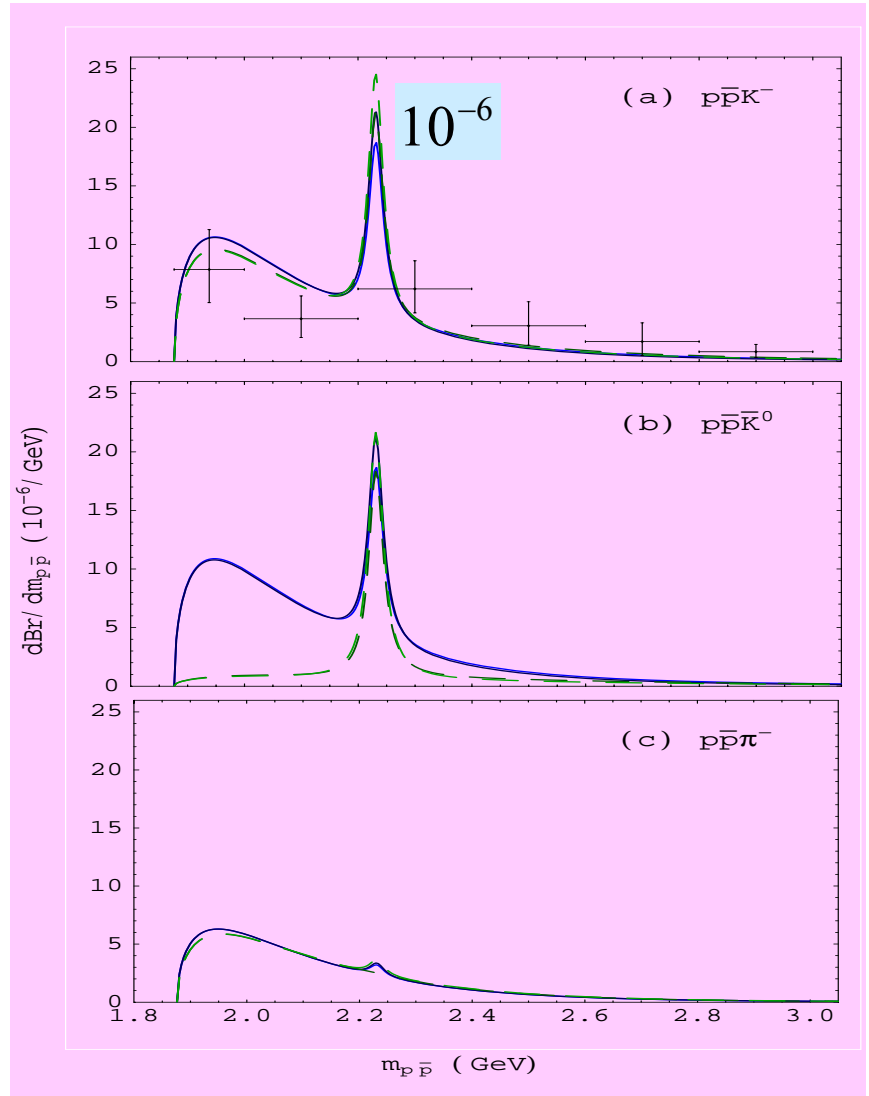
$$B \rightarrow \xi K \approx 10^{-4}$$



[Replace $g^* \rightarrow g\xi$ by $(c\bar{c})_8 \rightarrow g\xi$ if desired]

Exciting if True !!
Glueball from Charmless B

Combine Modes
 in Analysis !



IV. Other ξ Evidences and *Possible Competition*

ξ is Very Controversial

“Opponent” Largely $p\bar{p}$ or pp

However,

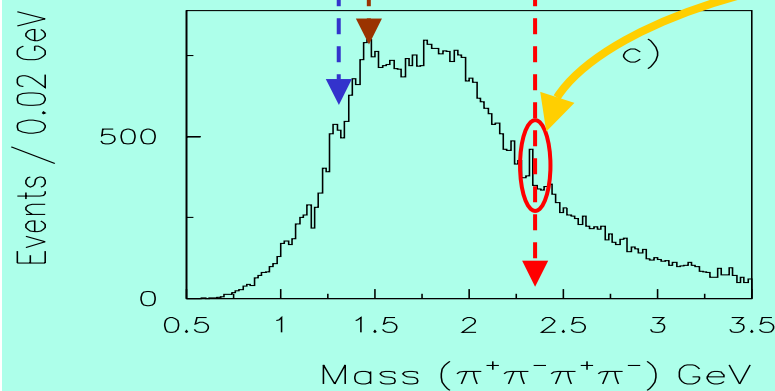
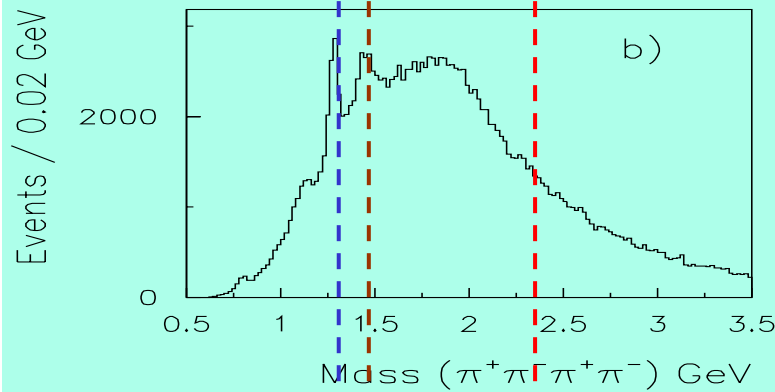
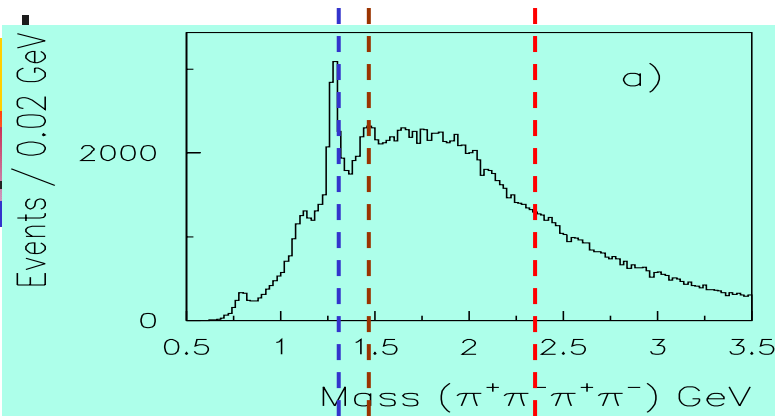
- Close’s Glueball Filter: $pp \rightarrow p_f (\pi^+ \pi^- \pi^+ \pi^-) p_s$
- $p\bar{p} \rightarrow \phi\phi?$
- CLEO’s $Y \rightarrow \gamma p\bar{p}$

Seem to Give Hints, Too

- But, BES ...

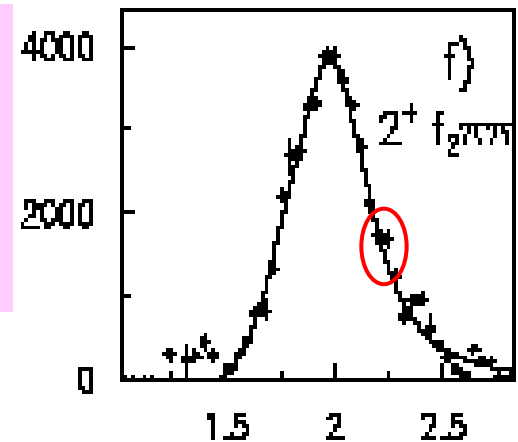
Close's Glueball Filter

★ $pp \rightarrow p\pi^+\pi^-\pi^+\pi^-p$ "Central" production
 w/ " dP_T " Glueball Filter. [Close and Kirk, PLB'97]
 w/ WA102 450 GeV p



a) $dP_T > 0.5$ GeV; b) $0.2 < dP_T < 0.5$ GeV
 c) $dP_T > 0.2$ GeV \Rightarrow $f_1(1285)$ Disappears
 $f_0(1500)$ Retained
5.5 σ Spike at 2340!
 Bump at ~ 2400

Similar Peak in
 WA102 PLB'00
 at a bit lower
 Mass (22XX)
 (calibration)



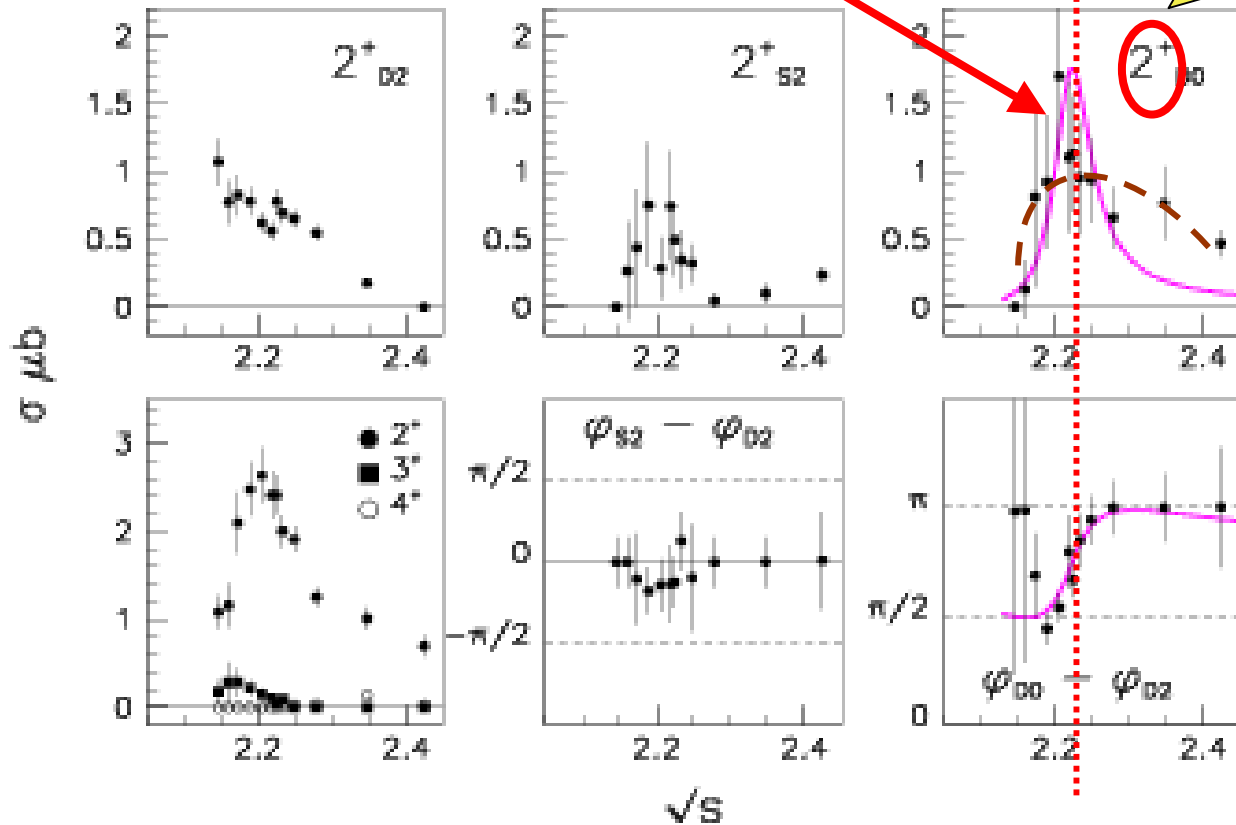
Nonobservation in (LEAR) $p\bar{p} \rightarrow K_S K_S, \underline{\phi\phi}, \pi^0 \pi^0, \eta\eta$

BUT [Palano, Frascati '99]

★ $p\bar{p} \rightarrow \phi\phi$ PWA \Rightarrow

Too broad ?
70 MeV state

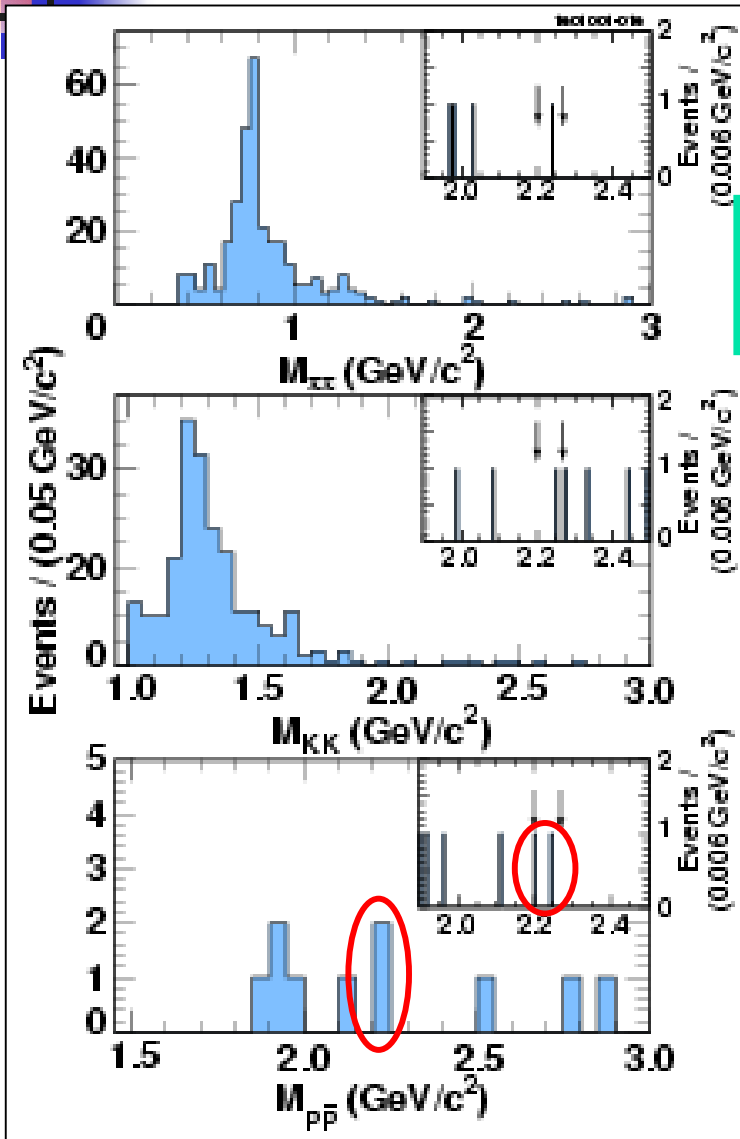
**Narrower If B-W
+ Underlying**



Maybe There
Afterall !

$\Gamma \approx 30$ MeV
(My Guess)

CLEO $Y \rightarrow \gamma p\bar{p}$ (61.3 pb⁻¹) [1.3 fb⁻¹ Just Taken!]



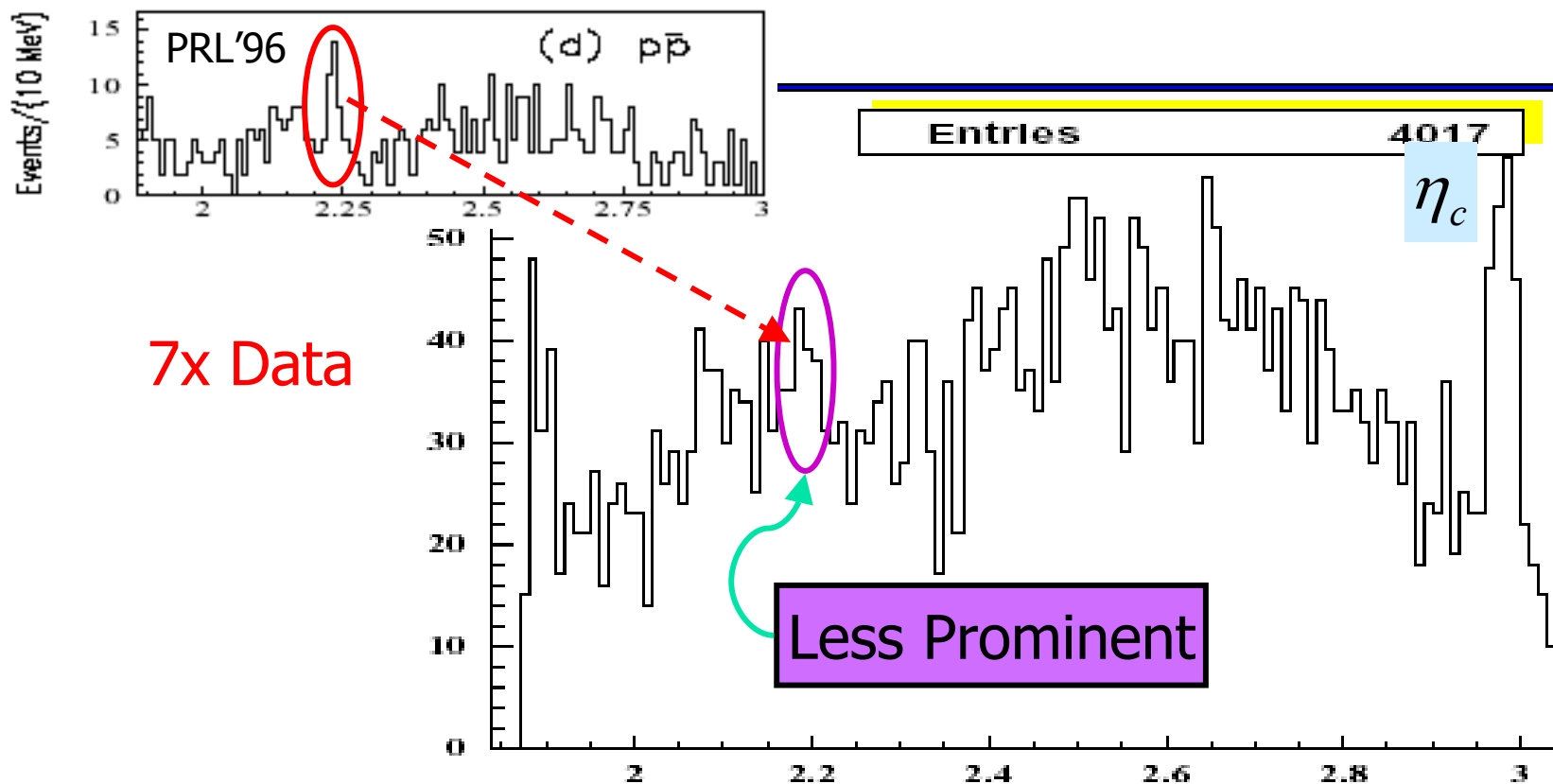
★ 1, 1, 2 evts in $\pi^+\pi^-$, K^+K^- , $p\bar{p}$ w/
0.12, 0.21, 0.28 BG

**Expect 10-40 Evt/Mode
by End of 2002**
[Scale up from BES]

**Cute if ξ Emerges
From CLEO**

But, BES ... (at PIC'02)

Near threshold structure in $J/\psi \rightarrow \gamma p \bar{p}$



7x Data

Conclusion

- Charmless B Decays: *Possible Glueball Search Ground?*
 - Heavy Enough to Produce Glueballs
 - Penguins are Gluon Induced
 - The η' Enigma: Rates Too Large and Not Understood!
Glue Rich Indication.
 - “Possible” Hint in 3-body Charmless ...
 - Lot's of **Data/Growing Fast!**
- CLEO $Y(1S)$, $p\bar{p}$ Annihilation or pp Central Production
 - All Have Tantalizing Hints and Search Potential

Glueballs May (or May Not) Emerge
in a Year, in these channels