

Understanding the $Y(4260)$

Some Comments

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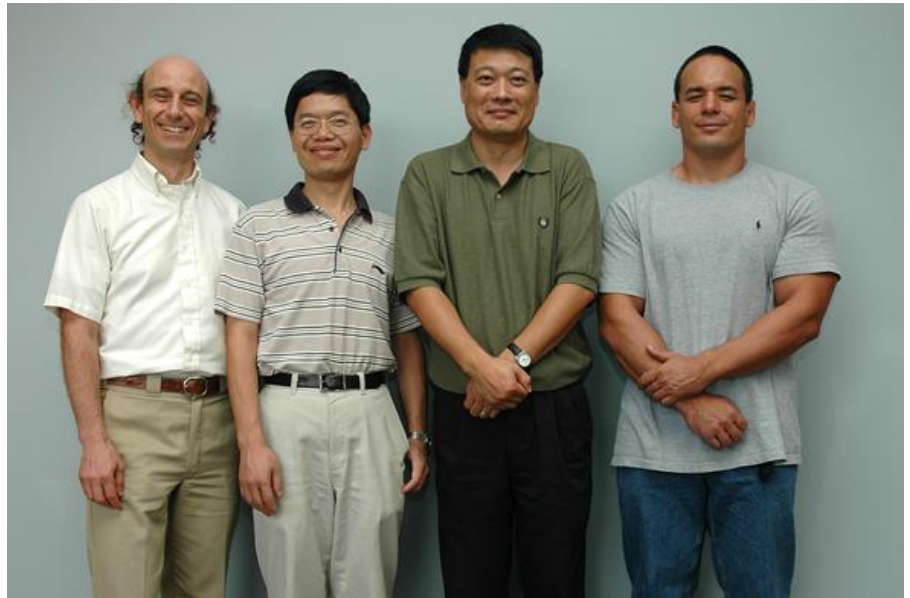
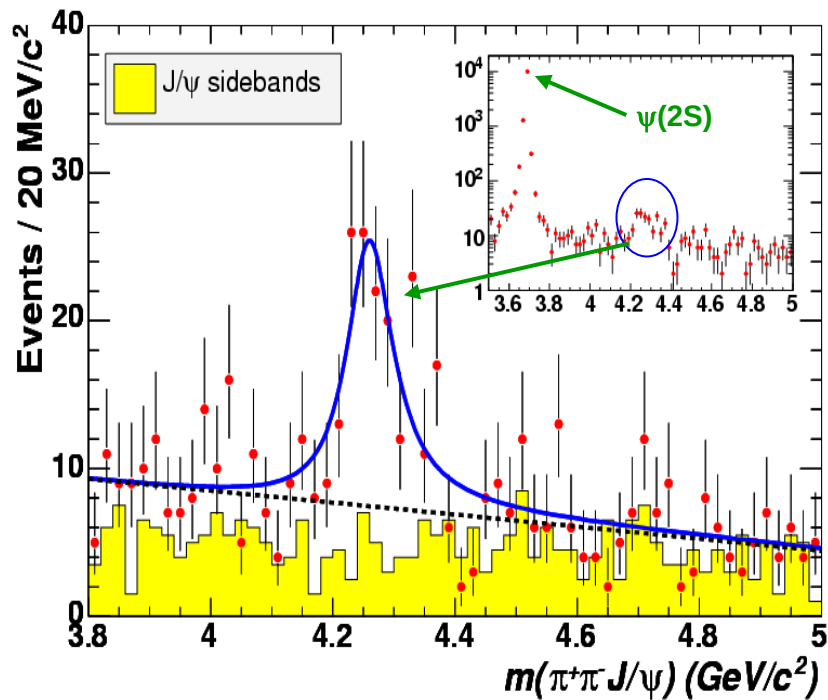
Outline

The $Y(4260)$

- Some recast
- What we have learnt experimentally
- What can we do at BESIII-BEPCII to nail the nature of the $Y(4260)$?



Some Recast



The single-resonance fit-probability(χ^2) is about 2.6%

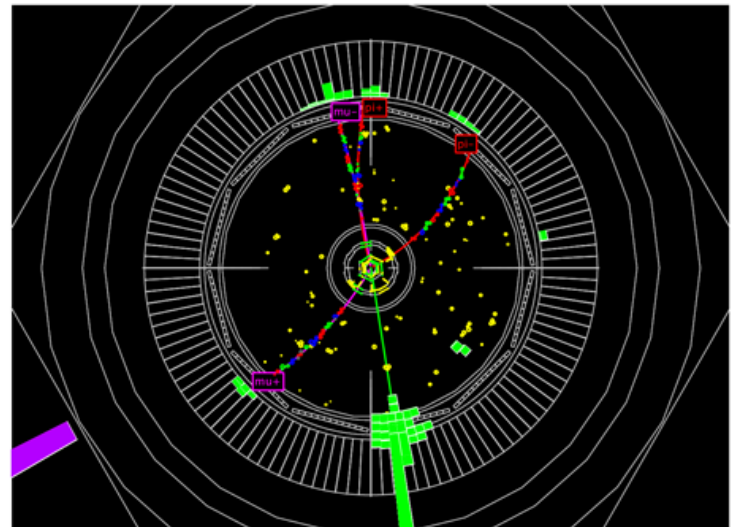
Two-resonance fit yields:

$$M_1 = 4251 \pm 6 \text{ MeV/c}^2, \quad \Gamma_1 = 58 \pm 18 \text{ MeV/c}^2$$

$$M_2 = 4334 \pm 1 \text{ MeV/c}^2, \text{ consistent with the resolution}$$

Fit-prob(χ^2) is about 9.4% (not a significant improvement)

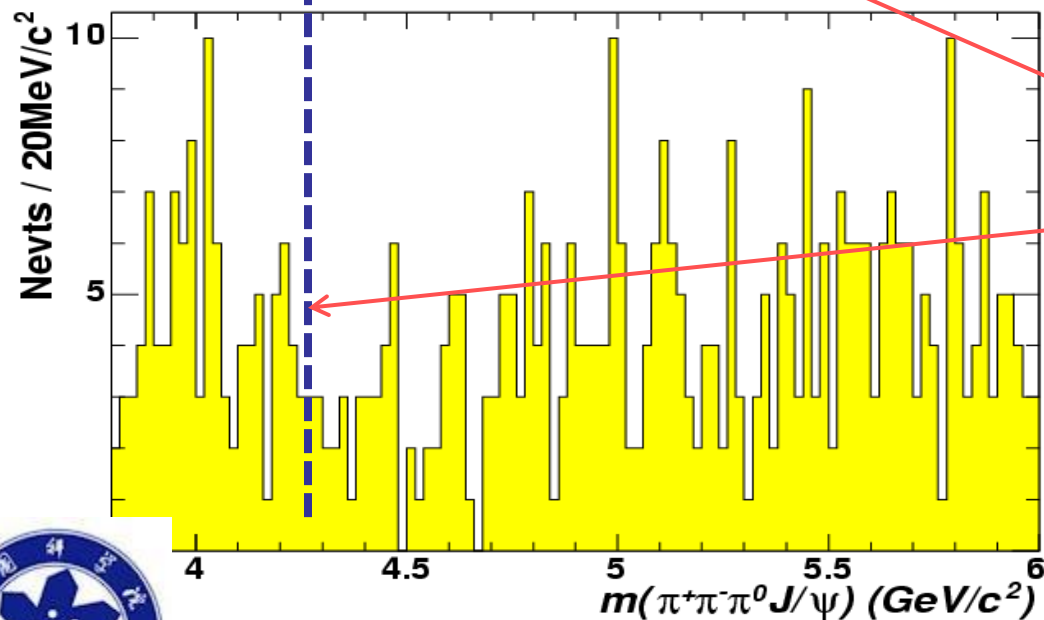
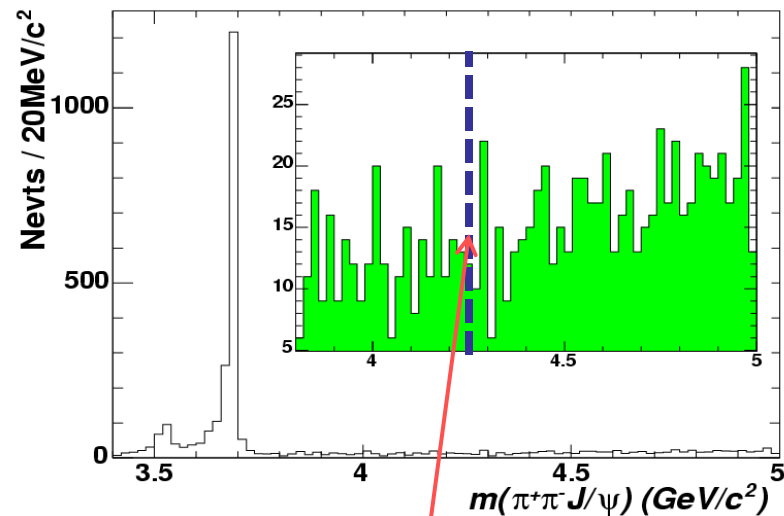
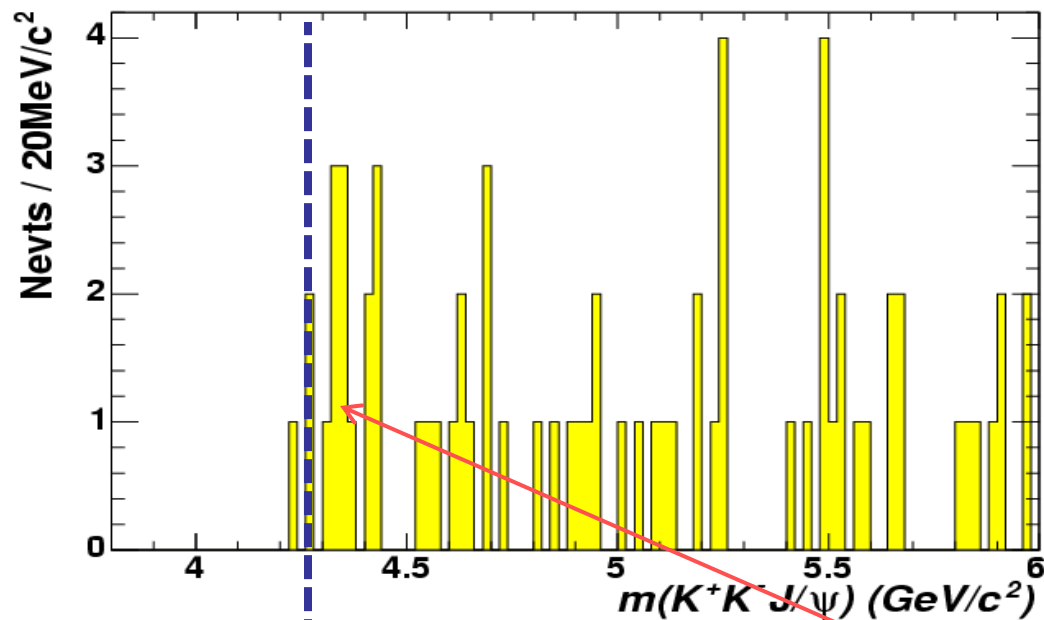
“We cannot exclude or establish a multi-resonance hypothesis”



$$Y(4260) \rightarrow J/\psi \pi^+ \pi^-$$

Issues & questions	knowledge then	knowledge now
Is it real?		confirmed
$J^{CP}?$	1^{--}	1^{--}
Other decay modes	None seen	others reported (but are they real?)
Large Γ ($J/\psi \pi \pi$)	>1 MeV	
hard to interpret as a conventional charmonium	YES	YES
Molecule of ($D_s^{*+} D_s^{*-}$)?	Probably not (not seeing $J/\psi KK$)	Probably not (possible evidence for $J/\psi KK$)
Molecule of (D^0 anti- $D^{*0}(2420)$)?	No (Min. mass > 4287 MeV)	No (Min. mass > 4287 MeV)
What is it?	Don't know	Probably still don't know





no signals from

- $J/\psi K^+K^-$
- $J/\psi \pi^+\pi^-\pi^0$
- $J/\psi \pi^+\pi^-$ in two-photon production

S. W. Ye, SLAC Seminar
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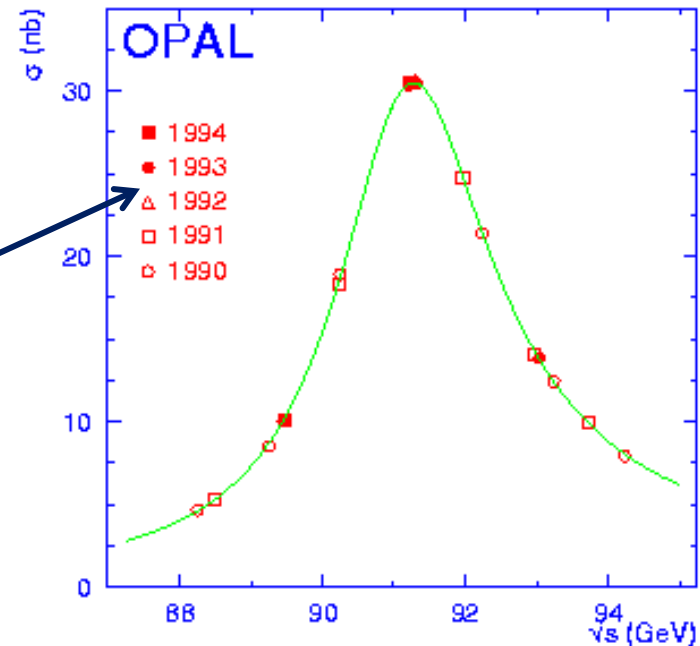


Z Lineshape

$$\Gamma_{tot} = \Gamma_1 + \Gamma_2 + \Gamma_3 + \dots = \sum_i \Gamma_i$$

$$BR_i = \Gamma_i / \Gamma_{tot} \text{ or } \Gamma_i = BR_i \times \Gamma_{tot}$$

valid at all energy or mass values for a resonance



For a perfect detector and short of any interferences:

line-shape of “total count” (all modes) $\equiv$ the line-shape of individual mode

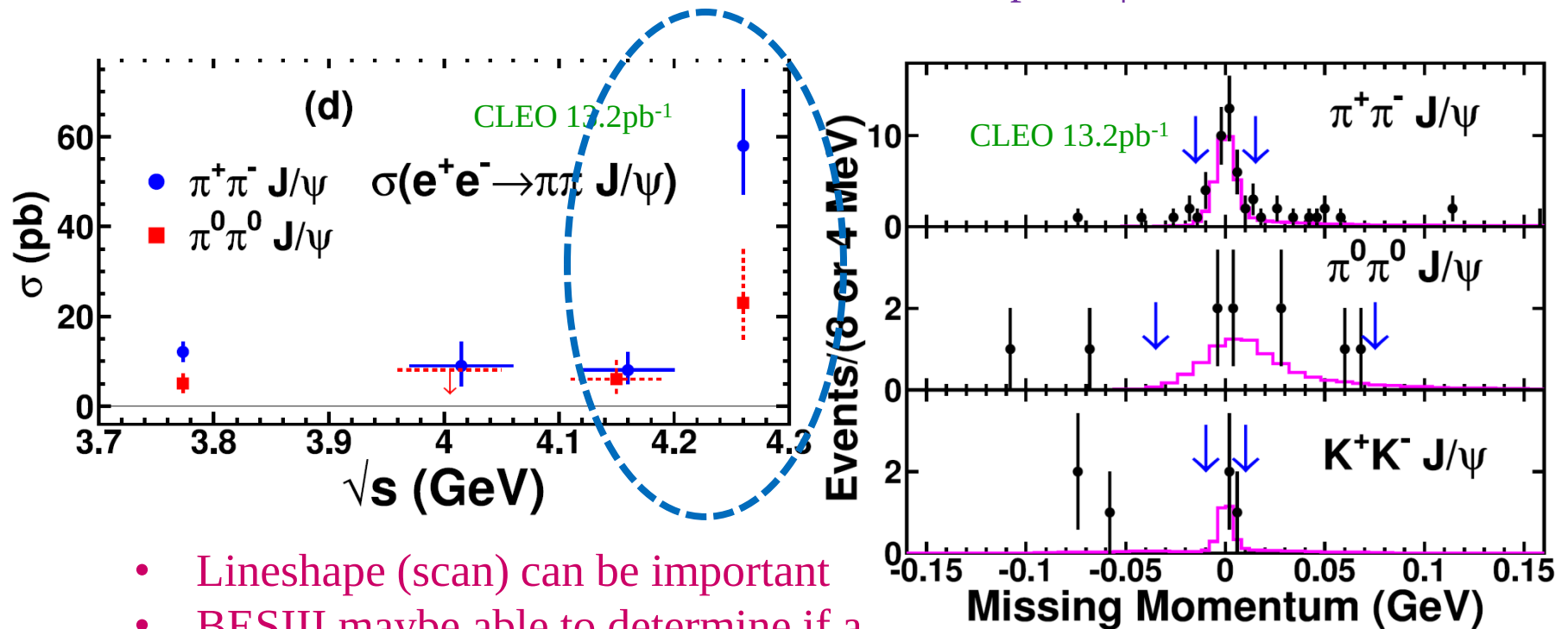
Use **lineshape $\oplus$ enhancement** to isolate the Y(4260)



$Y(4260) \rightarrow J/\psi \pi^+ \pi^-$

- $J/\psi \pi^+ \pi^-$ seen by Babar, Belle and CLEO
- $J/\psi \pi^0 \pi^0$, possible $J/\psi K^+ K^-$, reported by CLEO

inferred from the ratio, not lineshape; $J/\psi KK$ small statistics

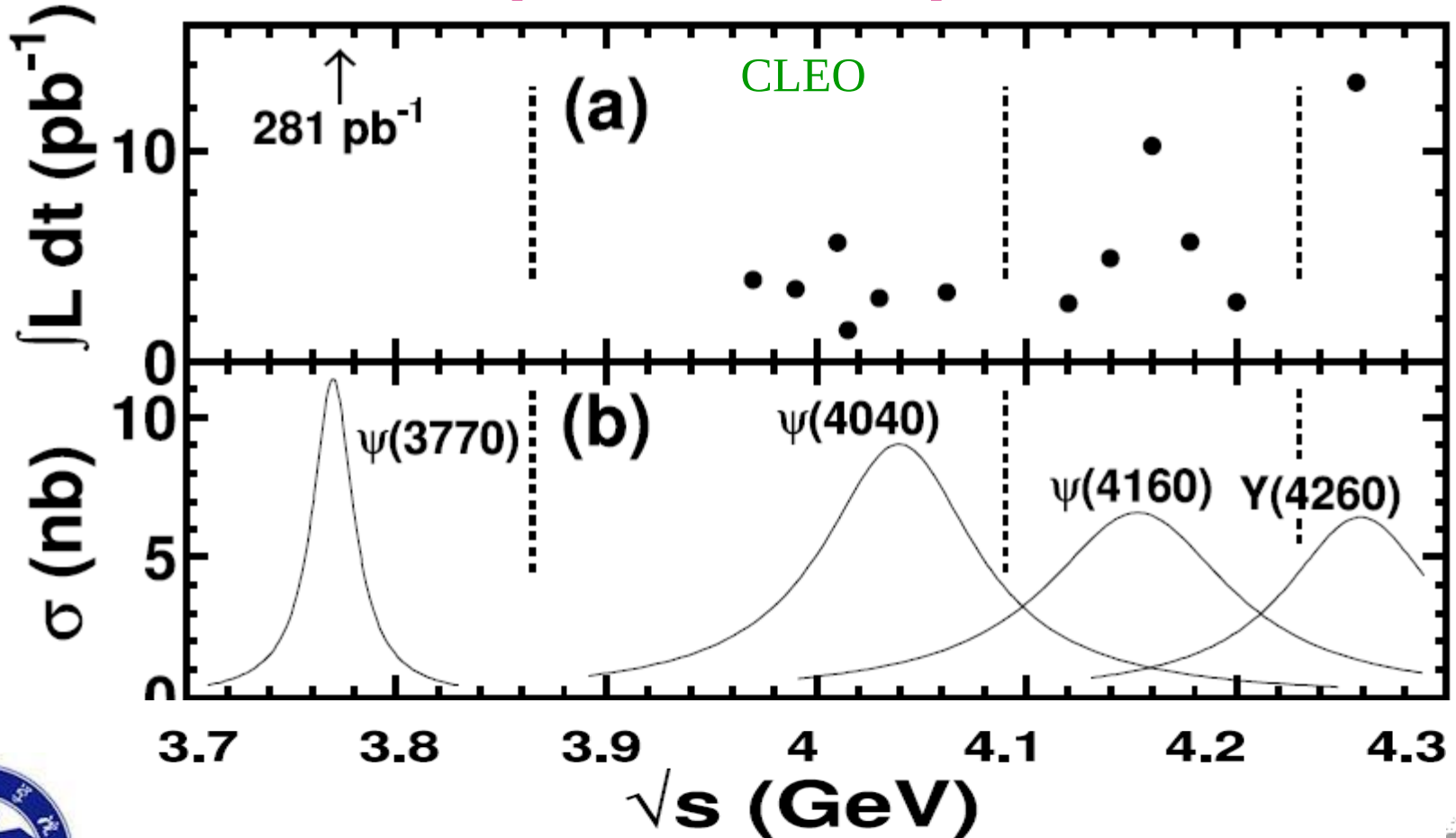


- Lineshape (scan) can be important
- BESIII maybe able to determine if a final state is from $Y(4260)$ or not



$$Y(4260) \xleftrightarrow{\text{?}} J/\psi \pi^+ \pi^-$$

- Lineshape (scan) can be important;
- Scan around immediate $Y(4260)$ adds useful info
- Scan optimization would be prudent



BESIII data at or immediately around 4260 would be valuable,
especially if optimized

Theorists can use the BESIII results to interpret the $Y(4260)$

What can we do to really understand the $Y(4260)$ in 3-5 years?

