Attivita’ di analisi a Roma1

Roberta Santacesaria

LHCb-Italia, LNF, 14 ottobre 2015

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** Apporto fondamentale di Augusto che e’ ora al CERN con contratto Cincinnati University ma ancora collabora con noi*

Stati esotici di charmonio

Analisi pubblicata:

- $B^0 \rightarrow K\ \psi(2S)\pi$ per conferma $Z(4430) \rightarrow \psi(2S)\pi$ con analisi model-independent. http://arxiv.org/abs/1510.01951 , sottomesso a PRD

Analisi in corso:

Con approccio analogo alla Z(4430):

1- $B^0 \rightarrow K\ J/\psi\ \pi$ per ricerca esotici in $J/\psi\ \pi$

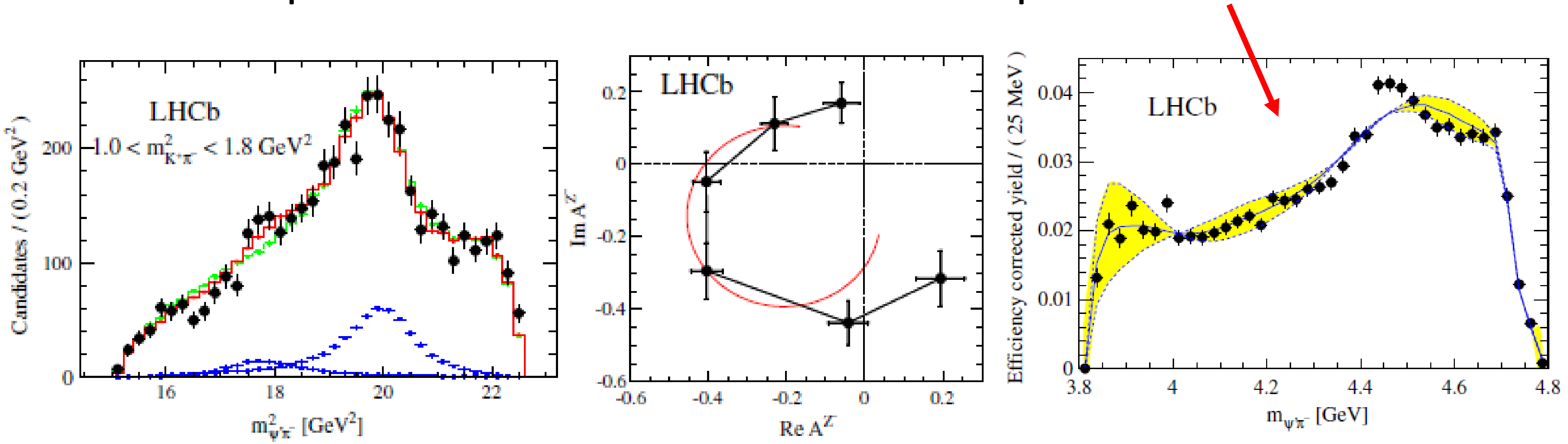
2- $B^0 \rightarrow K\ \chi_{c1}\ \pi$ per ricerca esotici in $\chi_{c1}\ \pi$. Z(4250) e Z(4050) osservate da Belle ma non confermate da BaBar

X(3872):

3- $B^+ \rightarrow K^+\ J/\psi\ \omega$ per confermare $X(3872) \rightarrow J/\psi\ \omega$ visto da BaBar ma non da Belle

Z(4430)→ψ(2S)π

- 2014 : pubblicata analisi di ampiezza con evidenza a 18σ. Analisi model-independent inclusa come conferma “qualitativa”

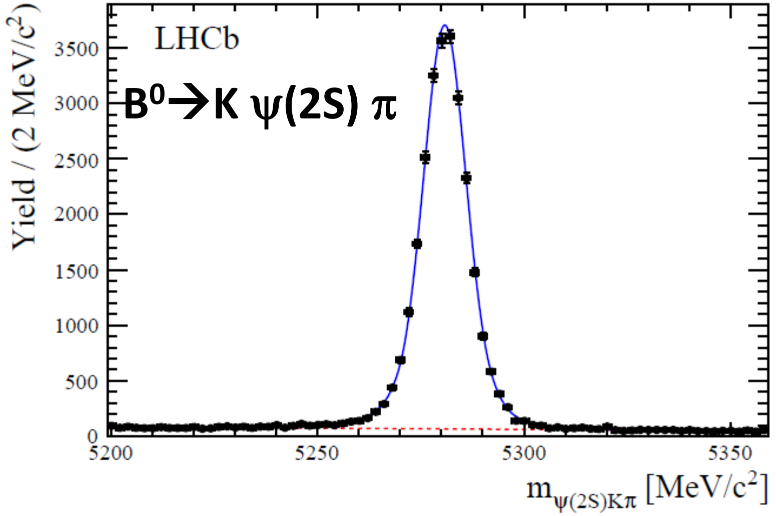


“Observation of the resonant character of the Z(4430)$^-$ state”

Phys. Rev. Lett. 112 (2014) 222002

Z(4430)→ψ(2S)π model-independent

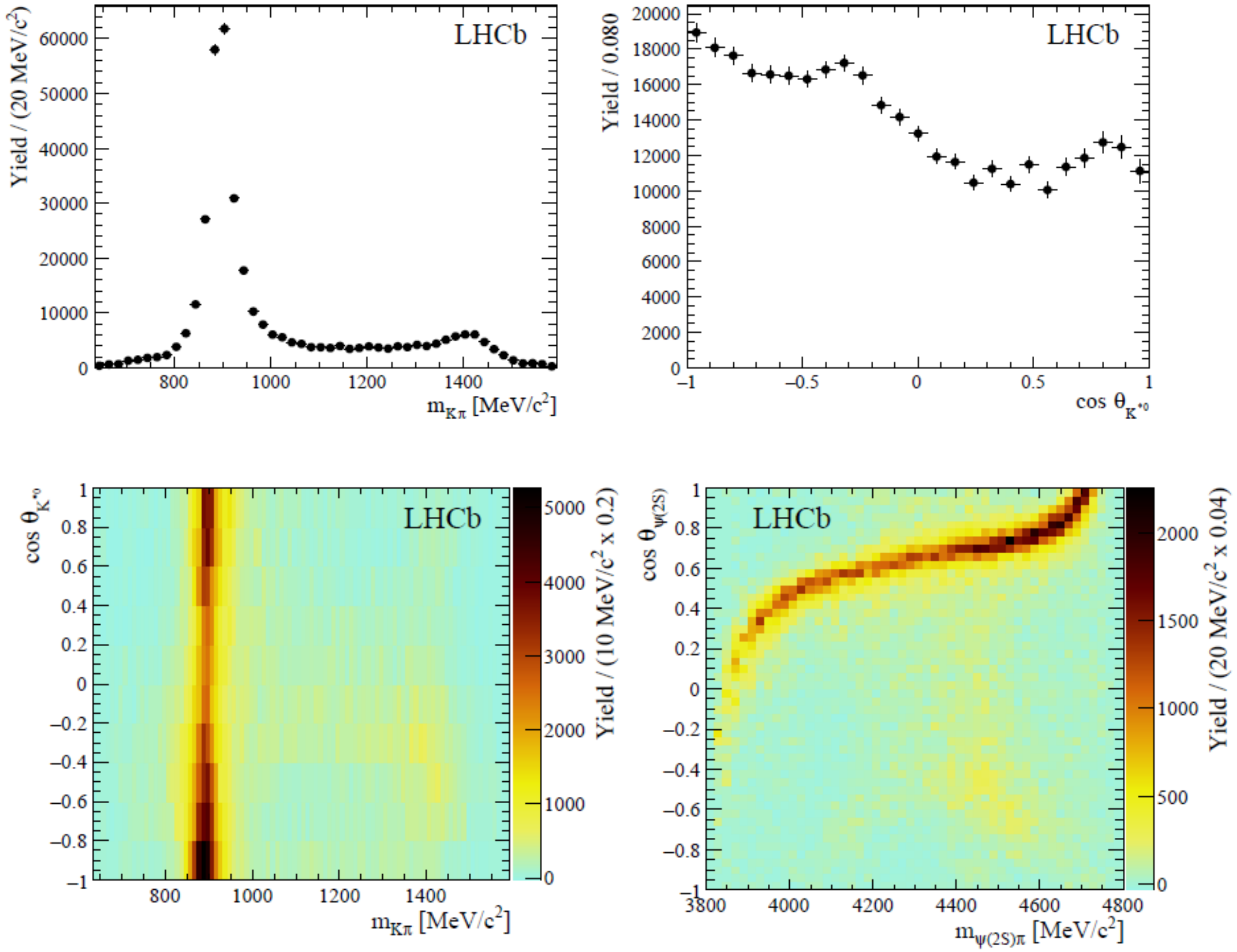
(A.A.,G.M.,R.S.)



Variable	Fit results
M_{B^0}	5280.83±0.04 MeV/c^2
σ_{B^0}	5.77±0.05 MeV/c^2
Signal yield	23,801±158
Background yield	757±14

- No assunzioni sulla forma delle risonanze $K\pi$ e loro interferenze
- le distribuzioni di $m_{k\pi}$ e $\cos\theta_{K*0}$ estratte dai dati vengono usate per predire lo spettro $\psi(2S)\pi$ attraverso un toy MC
- Dal confronto delle predizioni coi dati si testa l'ipotesi che il solo sistema $K\pi$ sia sufficiente per spiegare la struttura dello spettro $\psi(2S)\pi$
- L'ipotesi e' esclusa a 15σ

Risultati:sistema Kπ



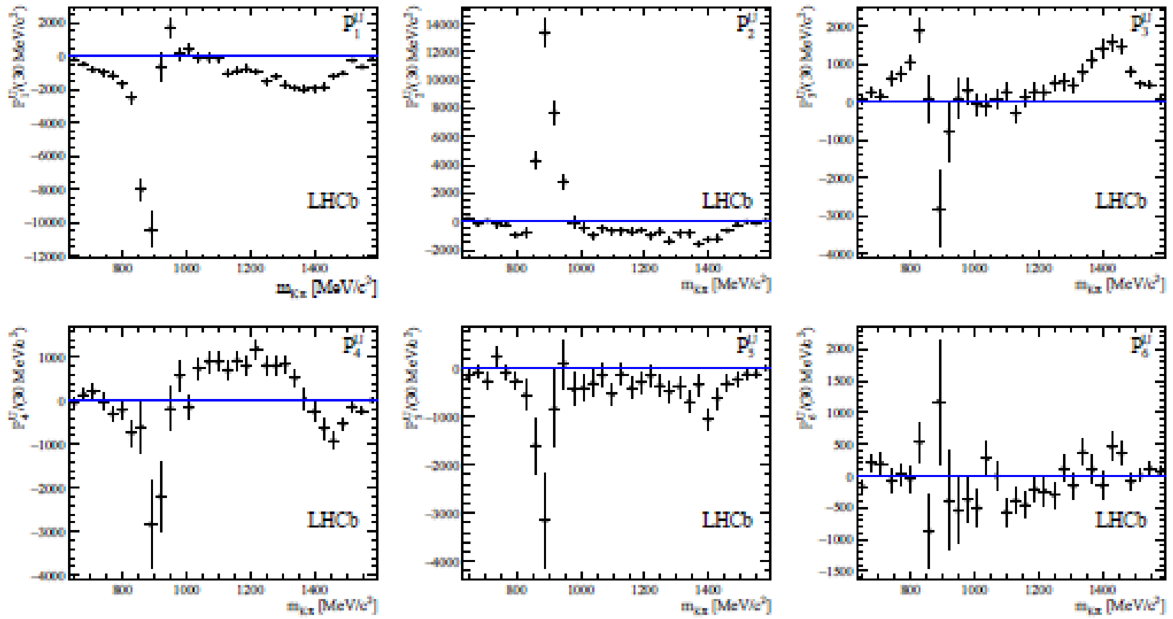
Resonance	Mass (MeV/c^2)	Γ (MeV/c^2)	J^P
$K^*(892)^0$	895.81 ± 0.19	47.4 ± 0.6	1^-
$K^*(1410)^0$	1414 ± 15	232 ± 21	1^-
$K_0^*(1430)^0$	1425 ± 50	270 ± 80	0^+
$K_2^*(1430)^0$	1432.4 ± 1.3	109 ± 5	2^+
$K^*(1680)^0$	1717 ± 27	322 ± 110	1^-
$K_3^*(1780)^0$	1776 ± 7	159 ± 21	3^-

Soglia cinematica = 1593 MeV/c^2

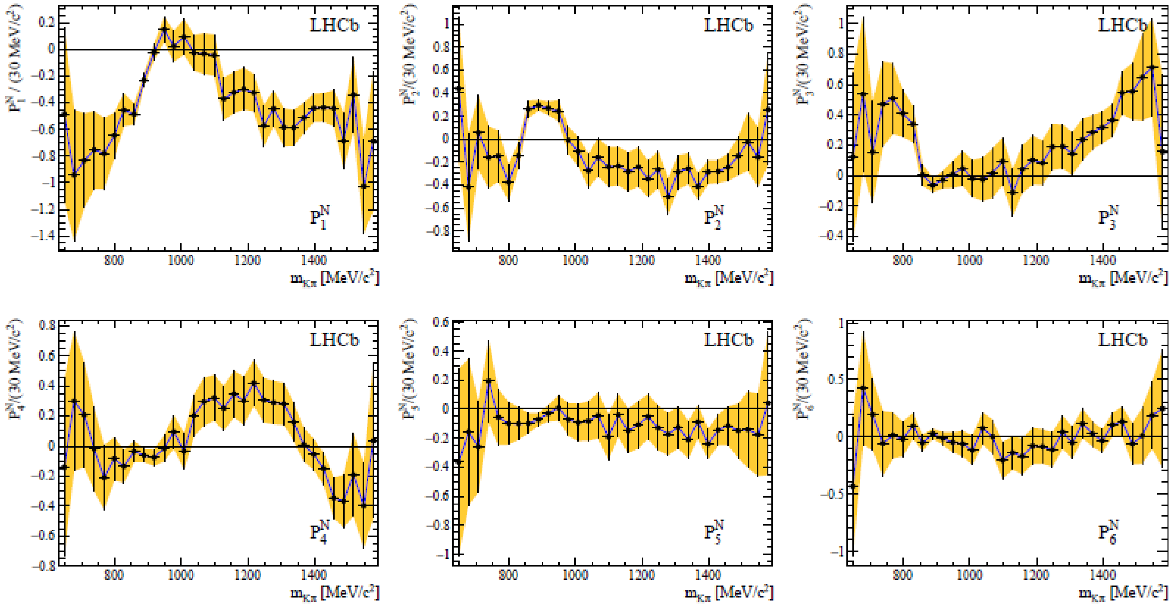
Momenti del sistema Kπ estratti dai dati

$$\frac{dN}{d\cos\theta_{K^{*0}}} = \sum_{j=0}^{l_{max}} \langle P_j^U \rangle P_j(\cos\theta_{K^{*0}}),$$

- $\cos\theta_{K*0}$ angolo di elicita’ del K^{*0}
- $P_j(\cos\theta_{K*0})$ polinomi di Legendre
- J = s contribuisce fino a l_{max}=2s

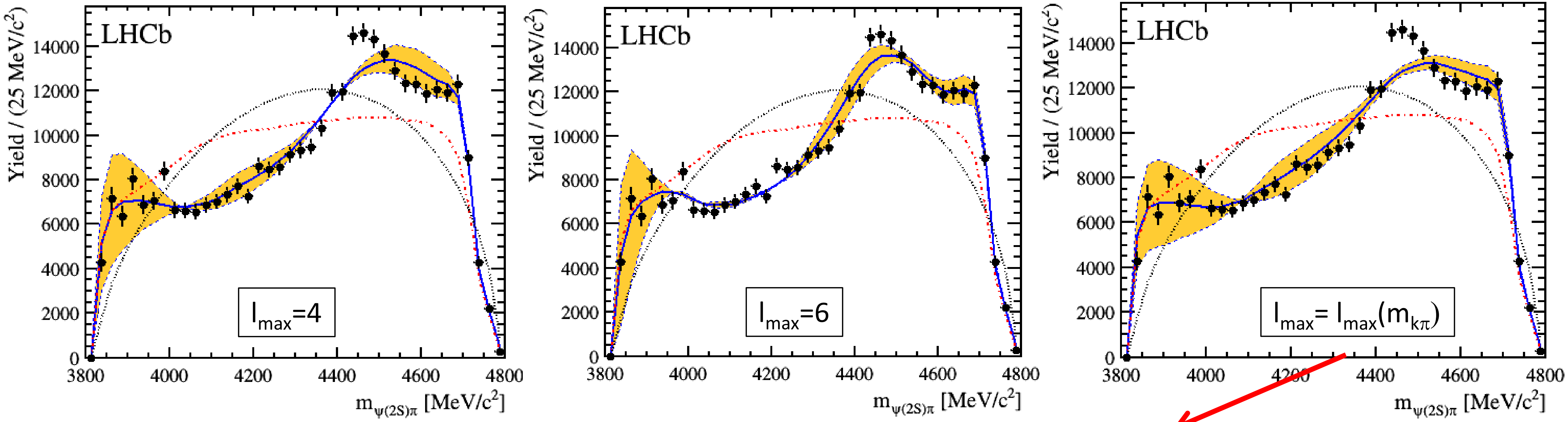


Momenti normalizzati $\langle P_j^N \rangle = 2\langle P_j^U \rangle / N$



Risultati : spettro $\psi(2S)\pi$

Predizioni con toy MC del decadimento $B^0 \rightarrow K\,\psi(2S)\pi$:
phase space ………………… , $m(k\pi)$ – · – · – · , $m(k\pi)+\cos\theta_{K*0}$ ———

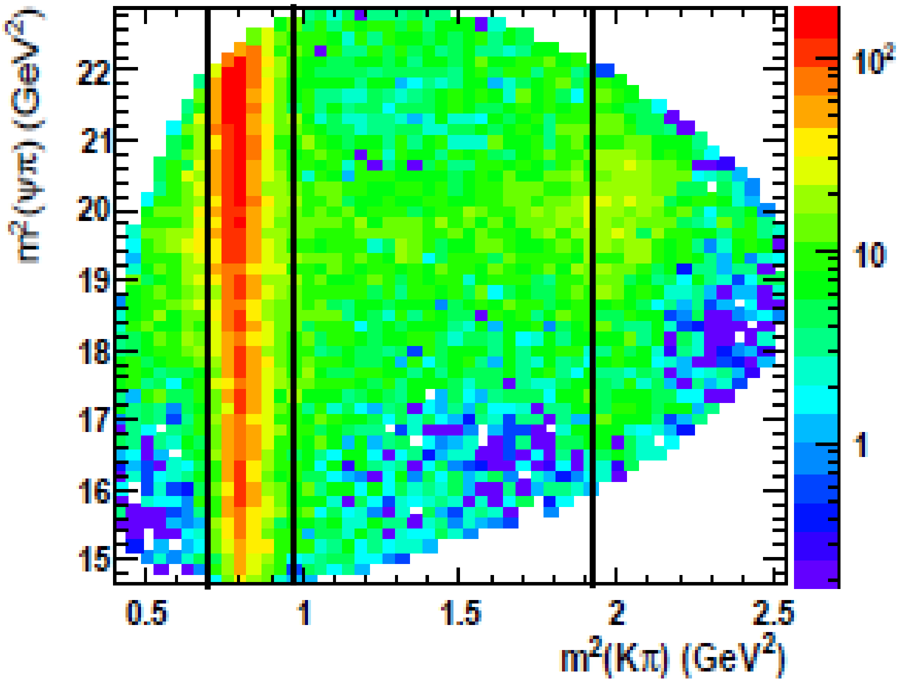


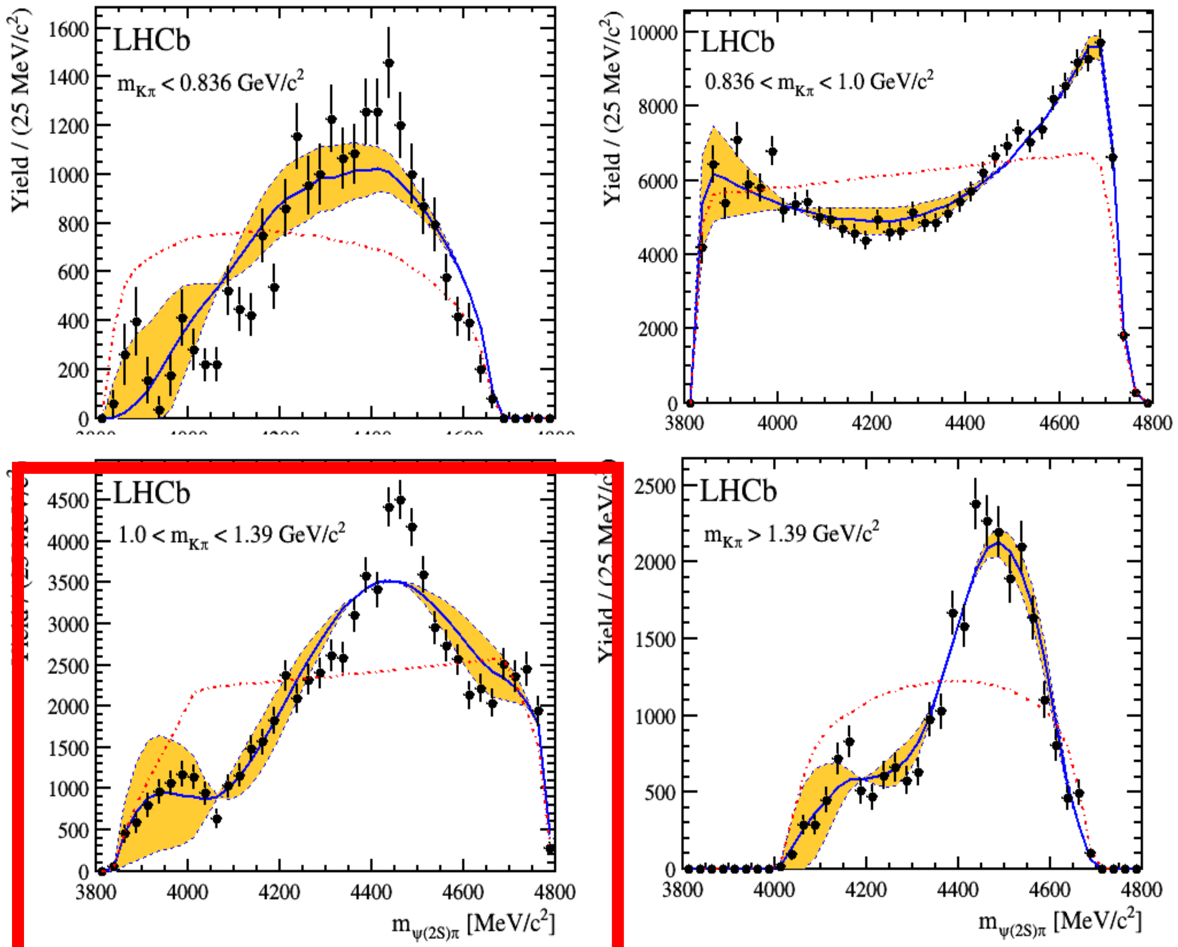
Unica assunzione e' massimo spin del sistema $K\pi$

$$l_{max} = \begin{cases} 2 & m_{K\pi} < 836\ \mathrm{MeV}/c^2 \\ 3 & 836\ \mathrm{MeV}/c^2 < m_{K\pi} < 1000\ \mathrm{MeV}/c^2 \\ 4 & m_{K\pi} > 1000\ \mathrm{MeV}/c^2. \end{cases}$$

Risultati:spettro $\psi(2S)\pi$

- Selezionando diverse zone di $m_{k\pi}$



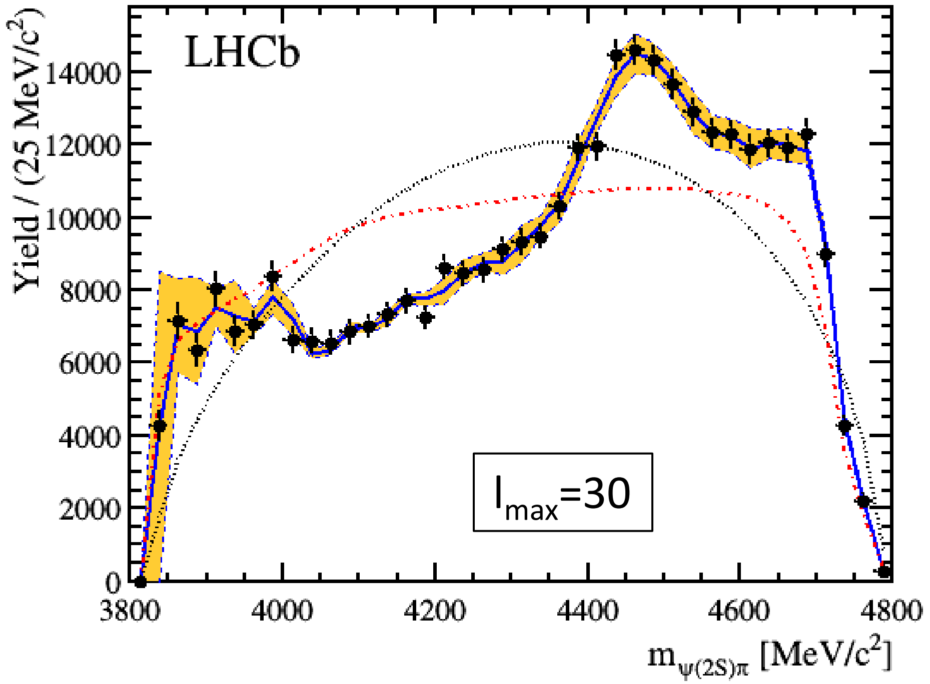


Test d'ipotesi: puo' lo spettro $\psi(2S)\pi$ essere spiegato con il sistema $K\pi$?

Generazione di pseudoesperimenti con momenti fino a l_{max}=4, l_{max}=6, l_{max}= $l_{max}(m_{k\pi})$

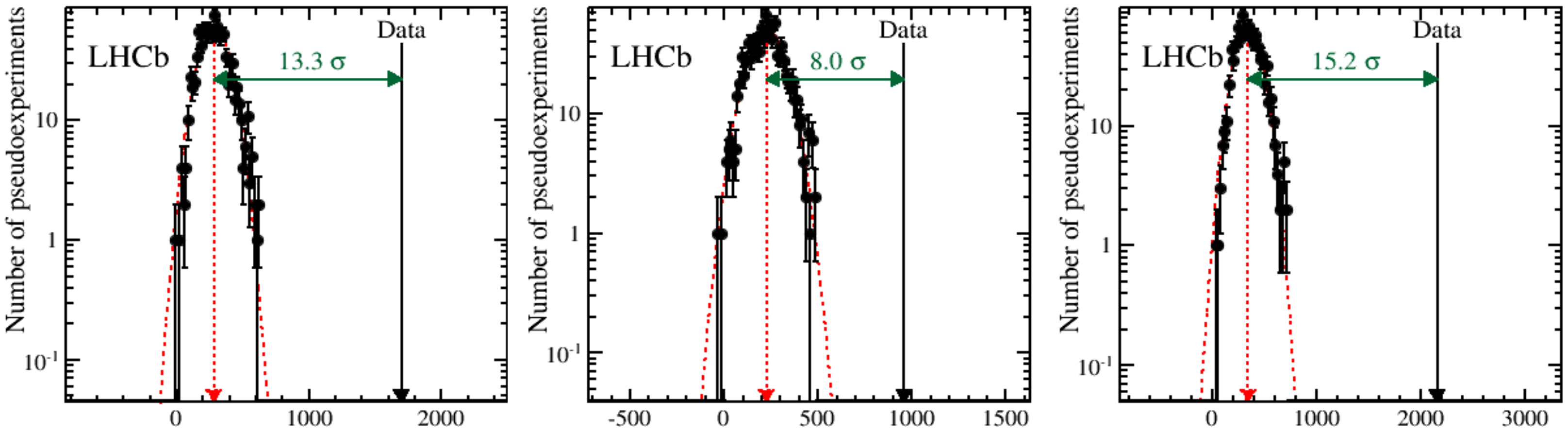
$$-2\Delta\mathrm{NLL}_{l_{\max}} = -2\log\frac{\mathcal{L}_{l_{\max}}}{\mathcal{L}_{30}} = -2\log\frac{\prod_i \mathcal{F}_{l_{\max}}(m^i_{\psi(2S)\pi})}{\prod_i \mathcal{F}_{30}(m^i_{\psi(2S)\pi})}$$

$\mathcal{F}_{lmax}$ e' la predizione di $m_{\psi(2S)\pi}$ basata su $m_{k\pi}$ e $\cos\theta_{K*0}$:
Si misura il rapporto della likelihood con $\mathcal{F}_{lmax}$ limitando l_{max} e ponendo l_{max} =30
→valore non fisico che descrive "esattamente" lo spettro sperimentale

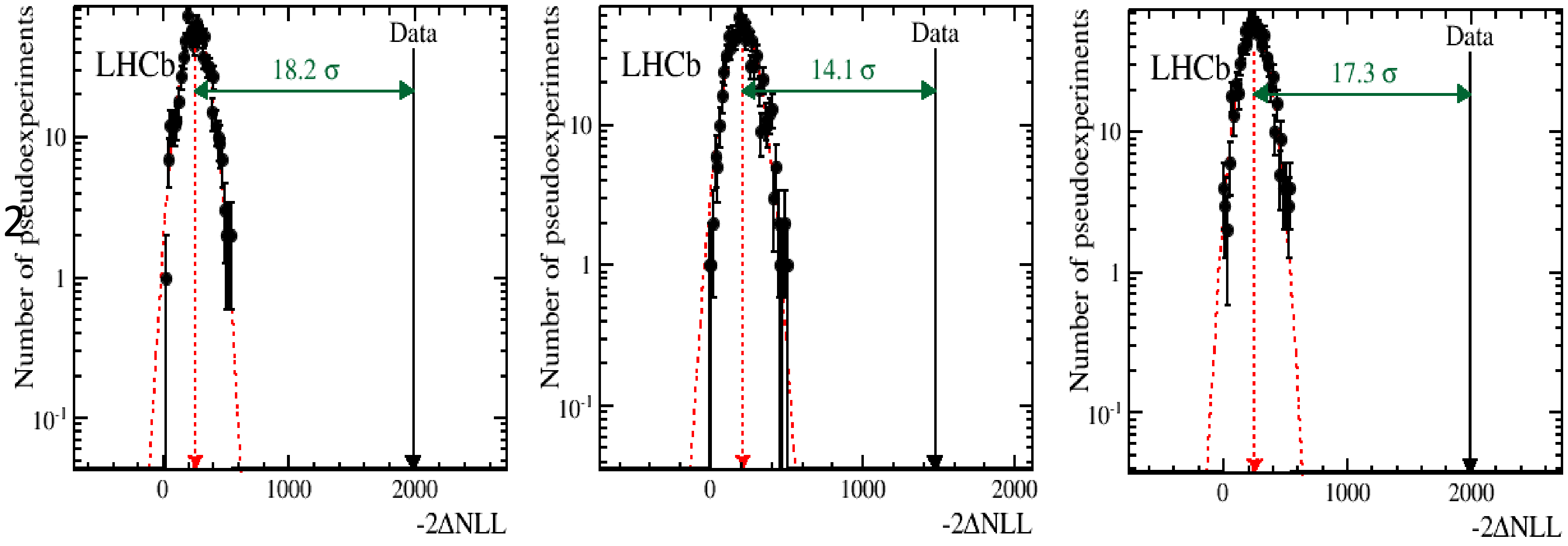


Ipotesi esclusa : significativita statistica

Intero spettro $m_{k\pi}$



$0.836<m_{k\pi}<1.0 GeV/c^2$

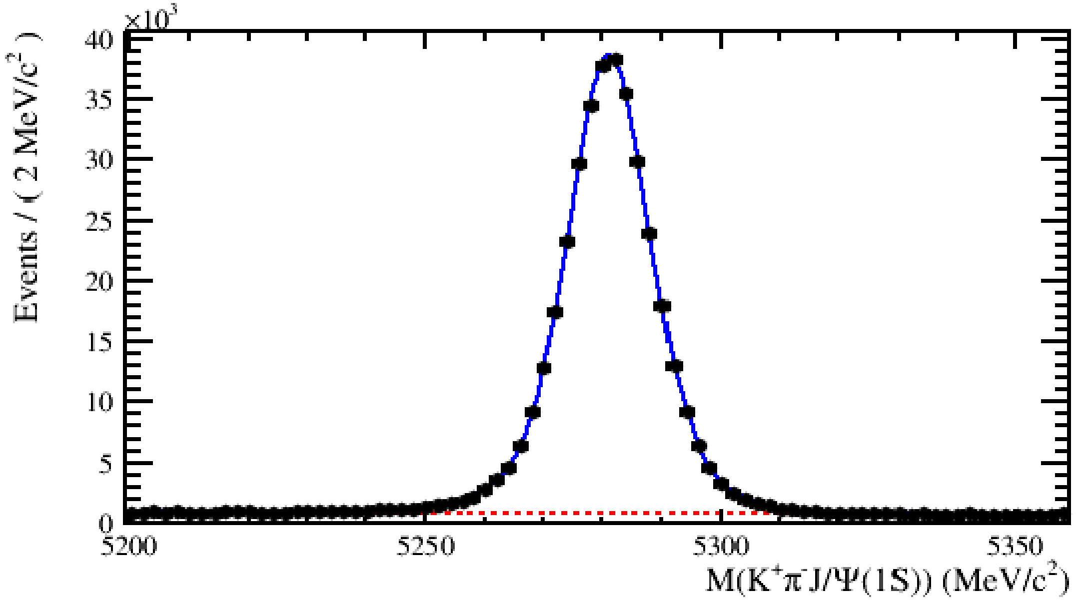


Ipotesi esclusa : significativita statistica

	S, whole $m_{K\pi}$ spectrum	S, $1.0 < m_{K\pi} < 1.39\,\mathrm{GeV}/c^2$
$l_{\max} = 4$	13.3σ	18.2σ
$l_{\max} = 6$	8.0σ	14.1σ
$l_{\max}(m_{K\pi})$	15.2σ	17.3σ

$B^0 \rightarrow K\ J/\psi\ \pi$

(A.A.,R.S.)

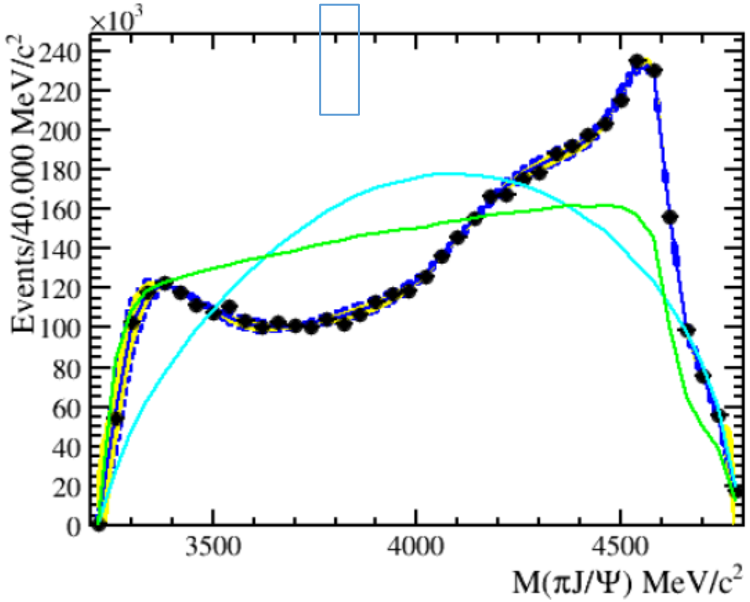


$M_{\mathrm{B^0}}$	$5281.215 \pm 0.015\,\mathrm{MeV}/c^2$
$\sigma_{\mathrm{B^0}}$	$7.862 \pm 0.053\,\mathrm{MeV}/c^2$
S/B	24.248 ± 0.021
N_s^{total}	360651.489 ± 632.494
$N_s^{2\sigma}$	331579.375 ± 251.767
χ^2	1.479

Resonance	**Mass** (MeV/c^2)	Γ (MeV/c^2)		**BR**$(\mathrm{K}^{*0^0} \to \mathrm{K}\pi)$
$\mathrm{K}^*(892)$	895.81 ± 0.19	47.4 ± 0.6	1^-	$\sim 100\%$
$\mathrm{K}^*(1410)$	1414 ± 15	232 ± 21	1^-	$(6.6 \pm 1.3)\%$
$\mathrm{K}_0^*(1430)$	1425 ± 50	270 ± 80	0^+	$(93 \pm 10)\%$
$\mathrm{K}_2^*(1430)$	1432.4 ± 1.3	109 ± 5	2^+	$(49.9 \pm 1.2)\%$
$\mathrm{B}^0 \to \mathrm{K}^+\pi^-\psi(2S)$ phase space limit	1593			
$\mathrm{K}^*(1680)$	1717 ± 27	322 ± 110	1^-	$(38.7 \pm 2.5)\%$
$\mathrm{K}_3^*(1780)$	1776 ± 7	159 ± 21	3^-	$(18.8 \pm 1.0)\%$
$\mathrm{K}_4^*(2045)$	2045 ± 9	198 ± 30	4^+	$(9.9 \pm 1.2)\%$
$\mathrm{B}^0 \to \mathrm{K}^+\pi^-\mathrm{J}/\psi$ phase space limit	2183			

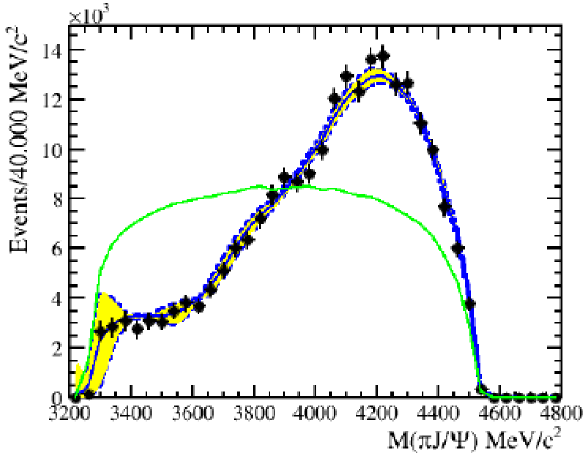
Risonanze a spin piu' alto possono contribuire

Dati vs predizioni da Kπ, l_{max}=8

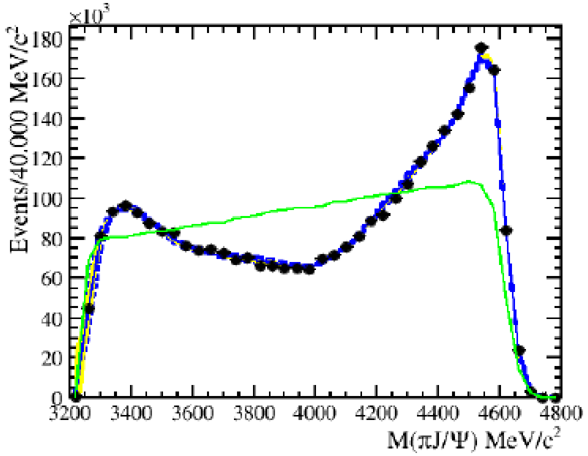


Buon accordo

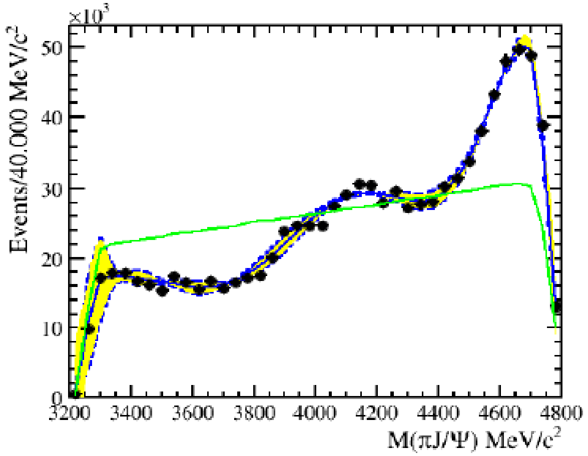
$m_{K\pi} < 836$ MeV/c^2



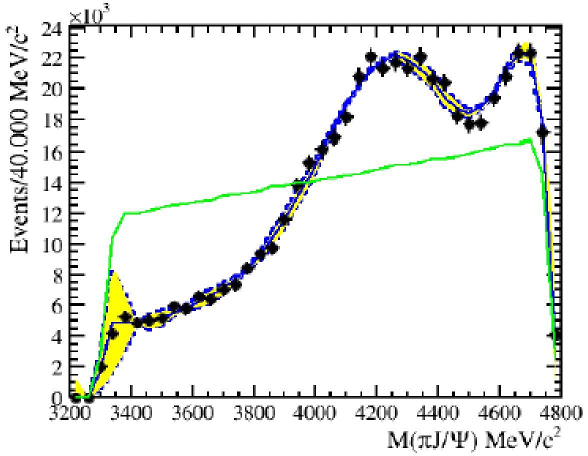
$836 < m_{K\pi} < 1000$ MeV/c^2



$1000 < m_{K\pi} < 1390$ MeV/c^2

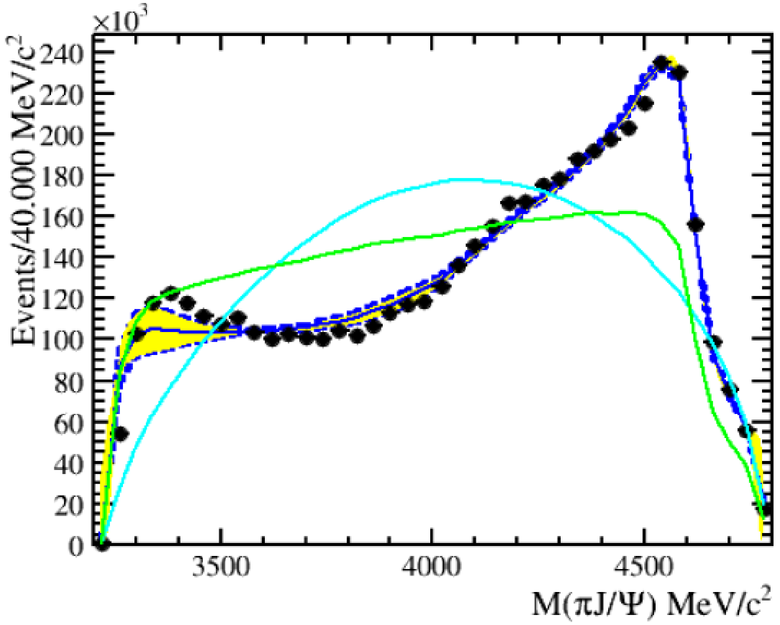


$m_{K\pi} > 1390$ MeV/c^2

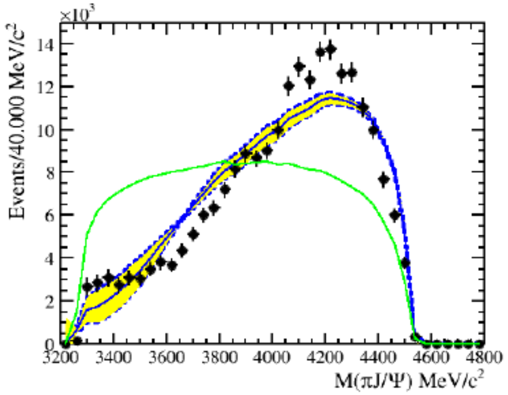


Dati vs predizioni da $K\pi$, $l_{max}=l_{max}(m_{k\pi})$

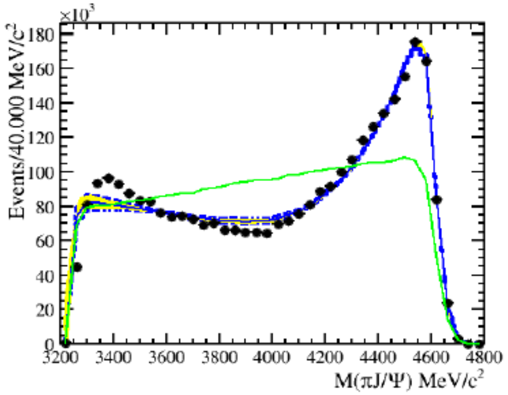
$$L_{\max}(\mathrm{m}_{K\pi}) = \begin{cases} 2 & \text{if } \mathrm{m}_{K\pi} < 0.836\,\mathrm{GeV}/c^2 \\ 3 & \text{if } 0.836 < \mathrm{m}_{K\pi} < 1.0\,\mathrm{GeV}/c^2 \\ 4 & \text{if } 1.0 < \mathrm{m}_{K\pi} < 1.39\,\mathrm{GeV}/c^2 \\ 8 & \text{if } \mathrm{m}_{K\pi} > 1.39\,\mathrm{GeV}/c^2 \end{cases}$$



$\mathrm{m}_{K\pi} < 836\ \mathrm{MeV}/c^2$



$836 < \mathrm{m}_{K\pi} < 1000\ \mathrm{MeV}/c^2$



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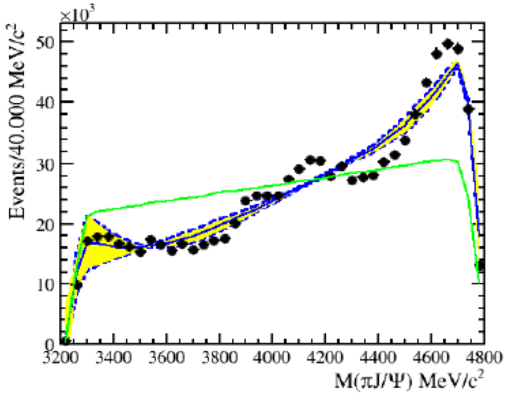
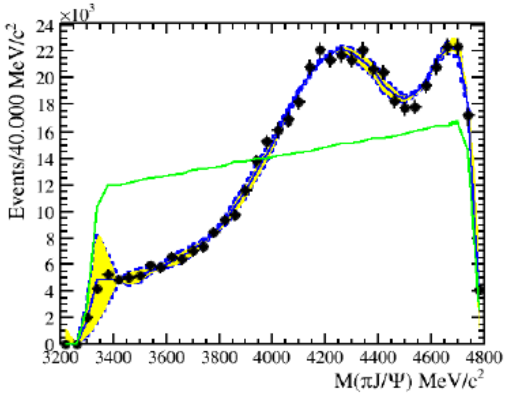


$\mathrm{m}_{K\pi} > 1390\ \mathrm{MeV}/c^2$



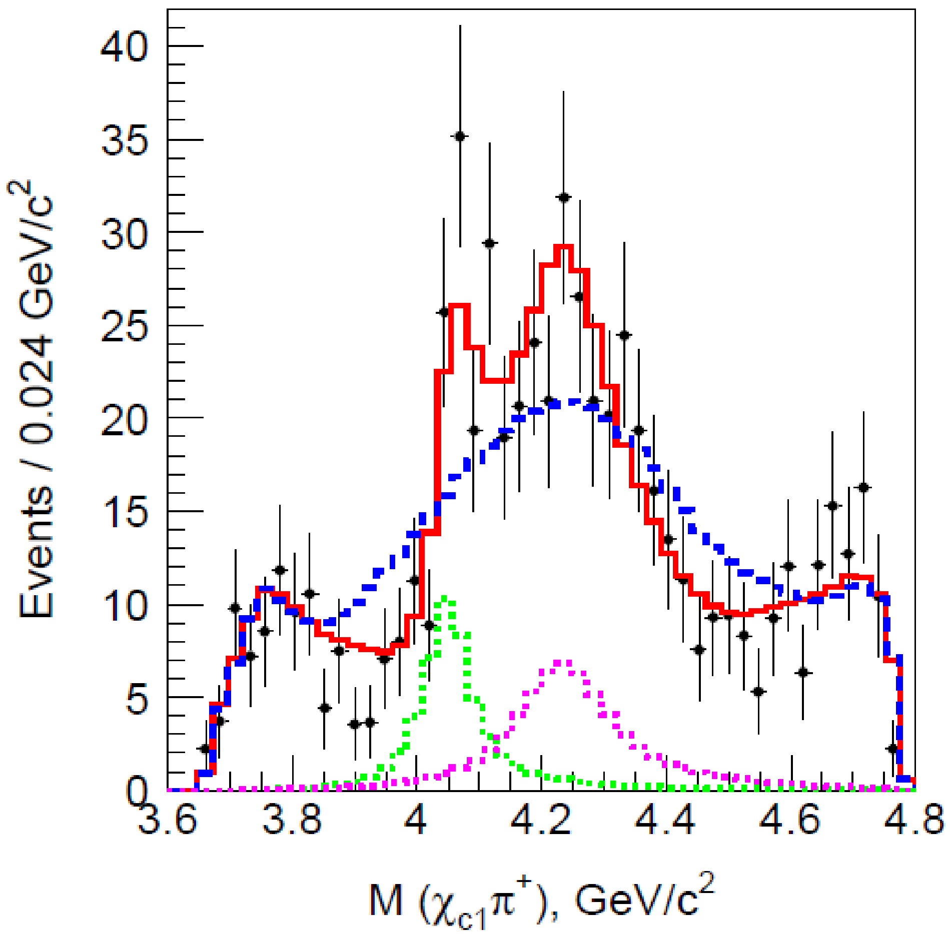
Accordo non soddisfacente: nuove risonanze? Test di ipotesi in corso

(analisi di ampiezza procede in parallelo, idea di pubblicare insieme)

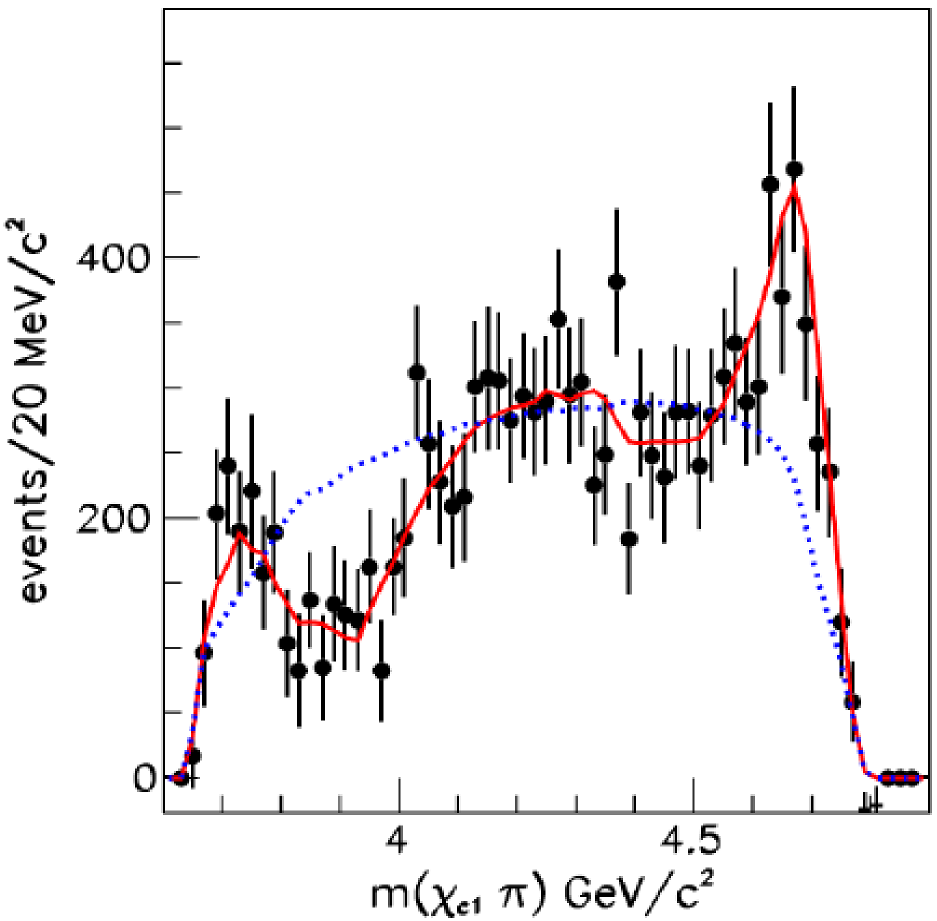
$B^0 \rightarrow K\, \chi_{c1}\, \pi$

- Belle osserva Z1(4050) e Z2(4250)

No evidenza in BaBar



Phys.Rev. D78 (2008) 072004



Phys. Rev. D 85(2012), 052003

LHCb: $B^0 \to K\,\chi_{c1}\,\pi$, $\chi_{c1} \to J/\psi\,\gamma$

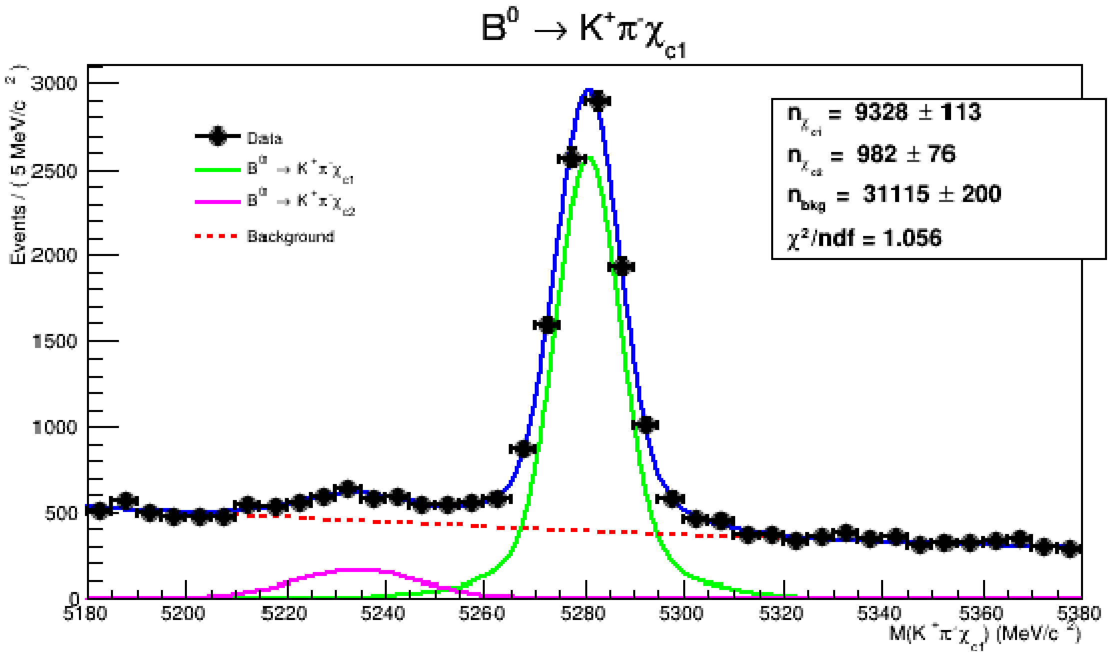
(A.A.,R.S.)

$$S/B = 3.61 \pm 0.036 \ @ \ 2\sigma$$

$$M^{B}_{\chi_{c1}} = 5280.9 \pm 0.10$$

$$M^{B}_{\chi_{c2}} = 5234.6 \pm 1.62$$

Shift di $M^{B}_{\chi c2}$ di -46 MeV/c^2
dovuto al refit del decay fissando la massa del χ_{c1}



$$\boxed{9328 \pm 133 \ \text{signal} \ B^0 \to K^+\pi^-\chi_{c1} \ \text{events !}}$$

L'analisi e' in fase di ri-ottimizzazione

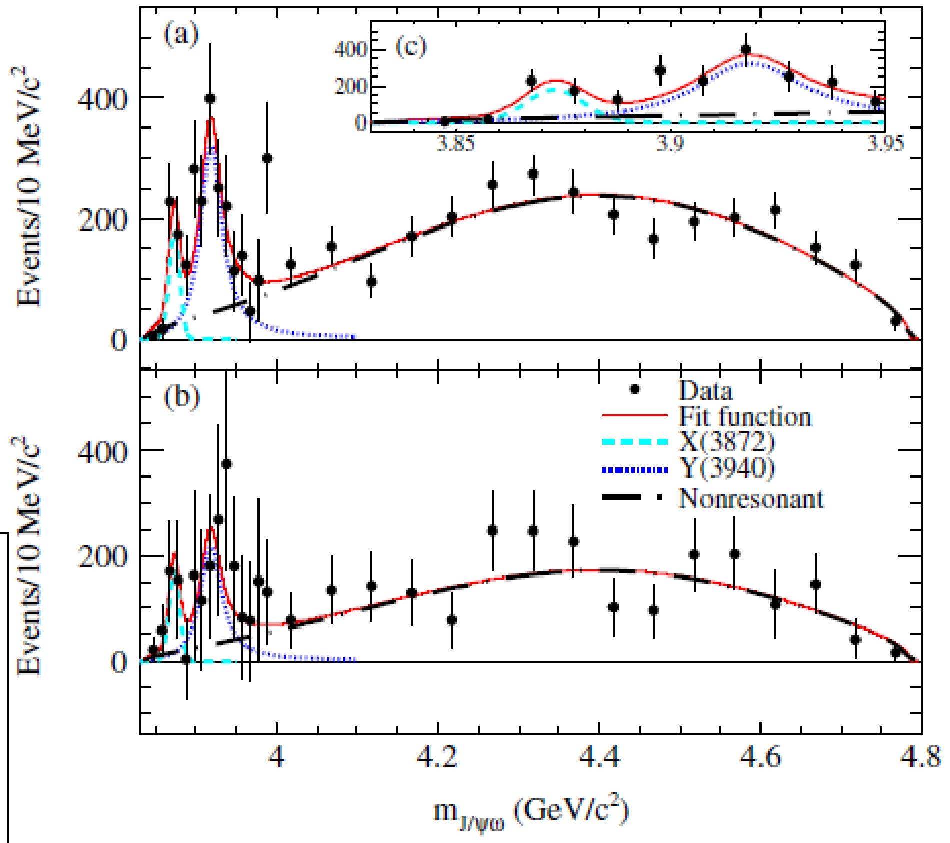
X(3872)→ J/ψ ω
(A.A.,R.S.)

BaBar misura:
BR(B^+→X(3872)K^+) x BR(X(3872)→J/ ψ ω)=
$[0.6 \pm 0.2(stat) \pm 0.1(syst)]$x10 $^{-5}$

Mai confermata da Belle

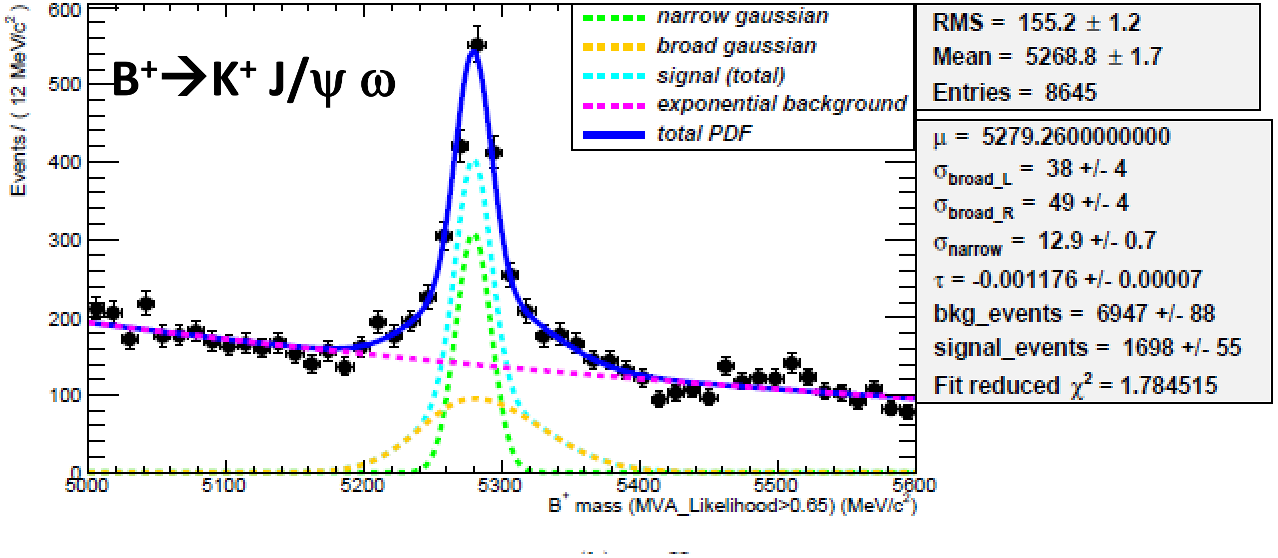
J/ψ ω →I=0, J/ψ ρ→ I=1
Se confermato implica che X(3872) decade, con BR simili, in stati con differenti isospin: due particelle distinte? Massima violazione?

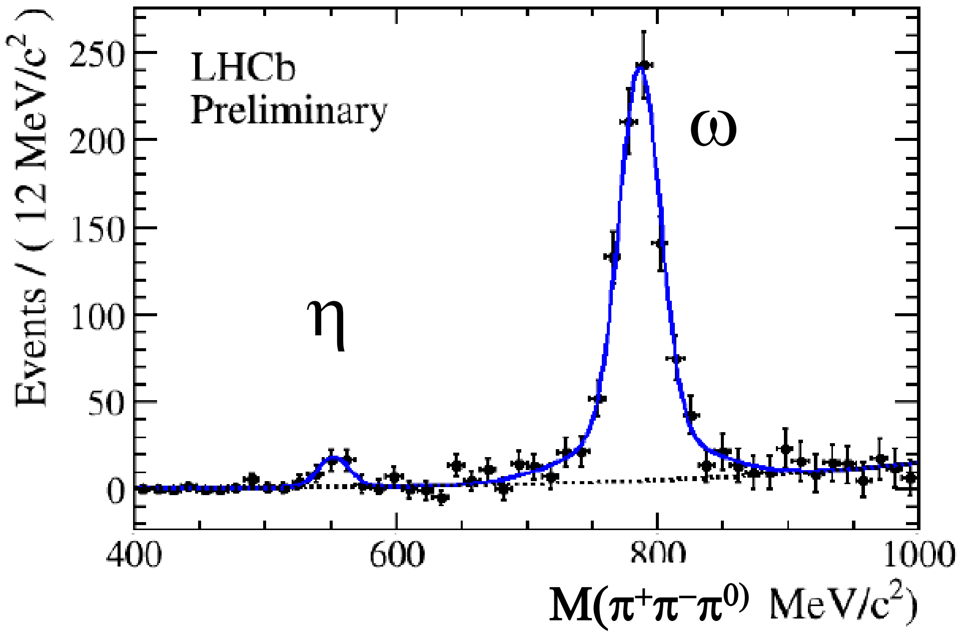
PHYSICAL REVIEW D 82, 011101(R) (2010)



Decadimento sottosoglia
M(J/ψ)+M(ω)>M(3872)

X(3872)→ J/ψ ω





Tesi magistrale di Lorenzo Capriotti→ http://cds.cern.ch/record/1988462?ln=en
Tesi magistrale di Guido Andreassi→ http://cds.cern.ch/record/1986460?ln=en

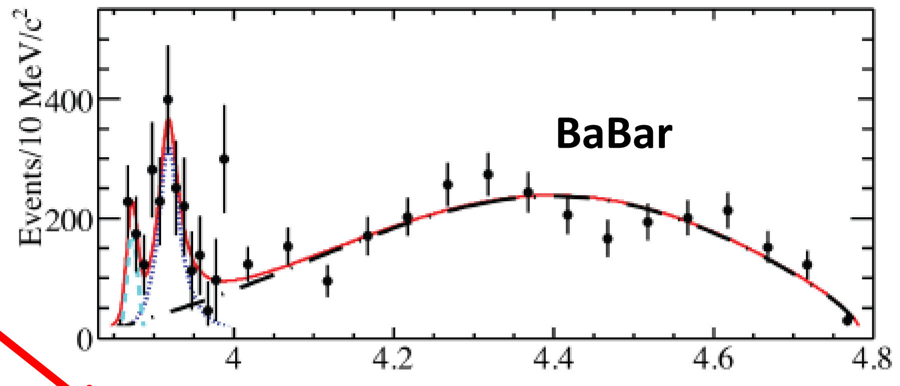
X(3872)→ J/ψ ω

Il risultato sembra promettente ma…

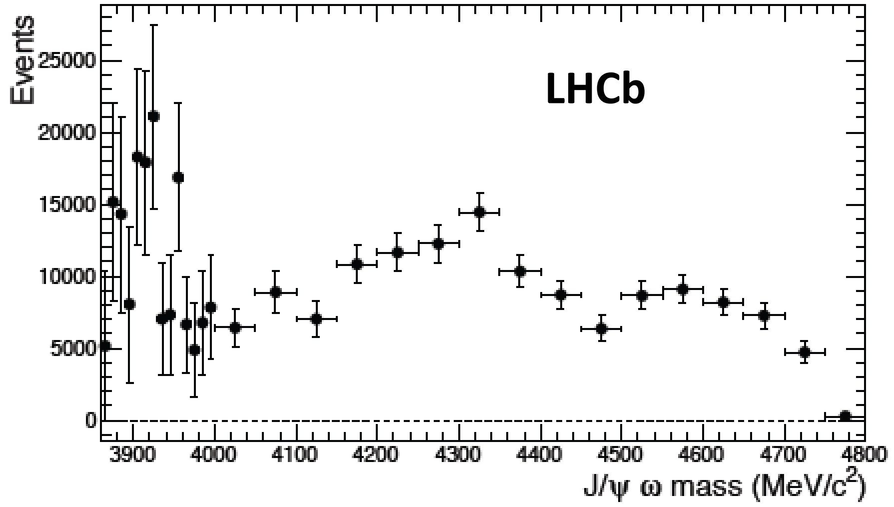
Problemi principali:

- Comprensione dello spettro di massa della B: origine della componente larga e asimmetrica sotto il picco della B
- probabilmente dovuta a problemi di ricostruzione del π^0 ma non riproducibile dal MC
- Struttura dello spettro J/ψω, non sembra phase-space come assume BaBar

- **Gruppo allargato recentemente a Celeste, Alessia, Stefania Ricciardi**



(a) BaBar's results.



Measurement of inclusive jets and dijets cross section in pp collisions at √s= 7 TeV (G. Auriemma, C. Satriano)

- inclusive jet cross section measured in p-p collisions $2<y<5$ and $p_T > 20$ GeV/c
- Dijets with M>30 GeV/c^2
- Jets clustering code FastJet v2.5 - algorithm anti-kT with R=0.4 (0.5 and 0.6)
- Data 2011 (~1 fb) Stripping 17 Stream HLT1L0Any
- Acceptance, Jet Energy Corrections, etc, from MC10 ….
- Trigger efficiency from data (Streamer Nobias)
- Results compatible (where overlapping) with CMS and ATLAS
- Data 2012 under analysis.