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Status of Charmonium Analyses:

$J/\Psi\ \pi^+\ \pi^-$, $J/\Psi\ \gamma$

March 3-7, 2008 –

Panda Collaboration Meeting - GSI

Outline:

- Overlook
- Y(4260)->J/Ψ π^+ π^- selection and reconstruction
  - ✓ New angular distribution model
  - ✓ Background studies
  - ✓ Study of J/Ψ π^+ π^- at different energies
- J/Ψ γ selection and reconstruction
- Summary and Outlook

$J/\Psi\ \pi^+\ \pi^-$ selection

- Release 0.15.2
- Detectors: MVD, STT, EMC, DIRC, DCH, MUO, GEM
- List π: PionCombinedLHVeryLoose
- List J/Ψ: JPsiToEEPID.
- List for Electrons: ElectronLHCombinedVeryLoose
- E_{CMS}=3.526, 3.686, 3.872, 4.260, 4.600, 5.000 GeV
- fittingAlgorithm: TreeFitter
- Kinematic fit: vertex/mass constraint
- J/Ψ Mass window [2.5;3.5] GeV
- CL>0.1%

Y(4260)->J/Ψ π^+ π^- selection

Y(4260) was observed for the first time by BaBar in ISR events. (Ref. Phys. Rev. Lett. 95, 142001)

The quantum numbers of this state are $J^{PC} = 1^{--}$.

One possible interpretation of this state is a hybrid.

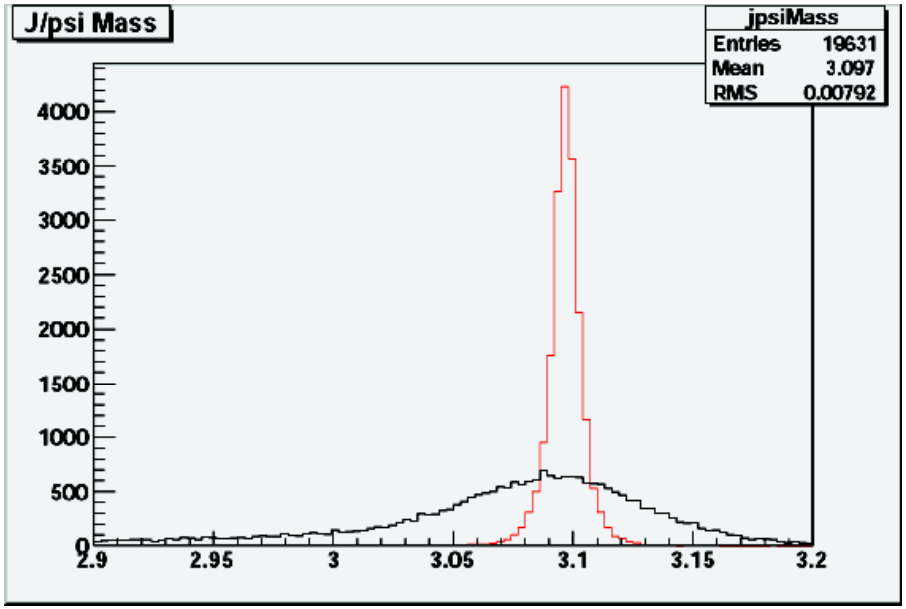
The idea is to study this state through its decay in

J/ψ $\pi^+\pi^-$

50K events $\bar{p}p$->Y(4260)->J/Ψ π^+ π^-

No phase space decay model used

Y(4260)->J/Ψ π^+ π^- selection



Without 4C fit:

Mean 3.037 GeV

$\sigma = 0.127$ GeV

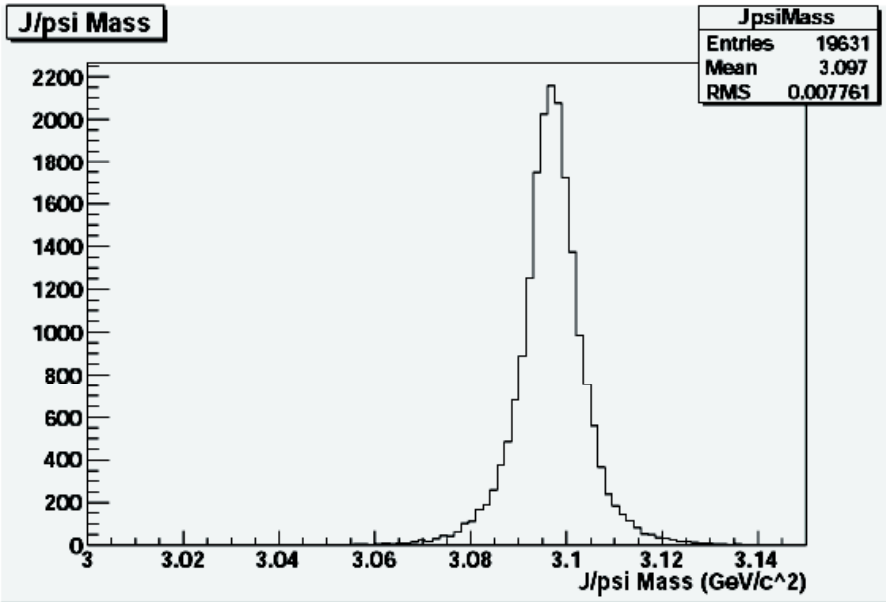
Efficiency= 54%

With 4C fit:

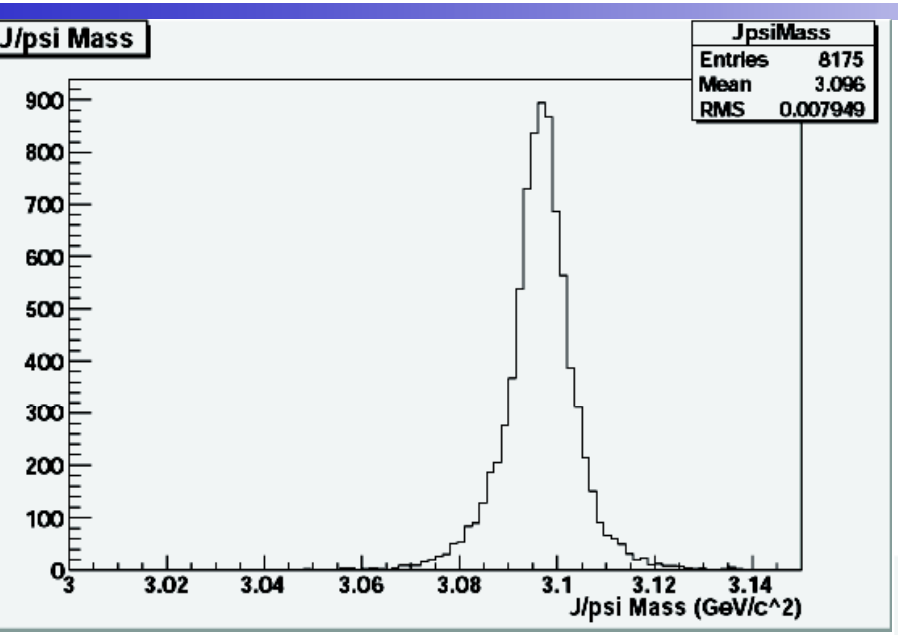
Mean 3.097 GeV

$\sigma = 0.008$ GeV

Efficiency= 39%



Y(4260)->J/Ψ π^+ π^- selection with 4C fit



Electron channel:

Mean 3.096 GeV

$\sigma = 0.008$ GeV

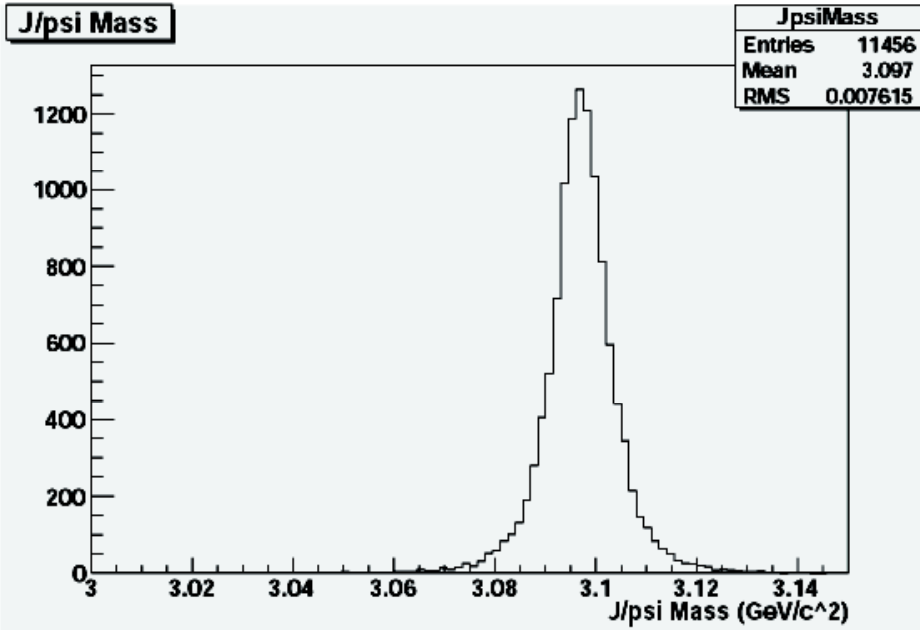
Efficiency: 32.7%

Muon channel:

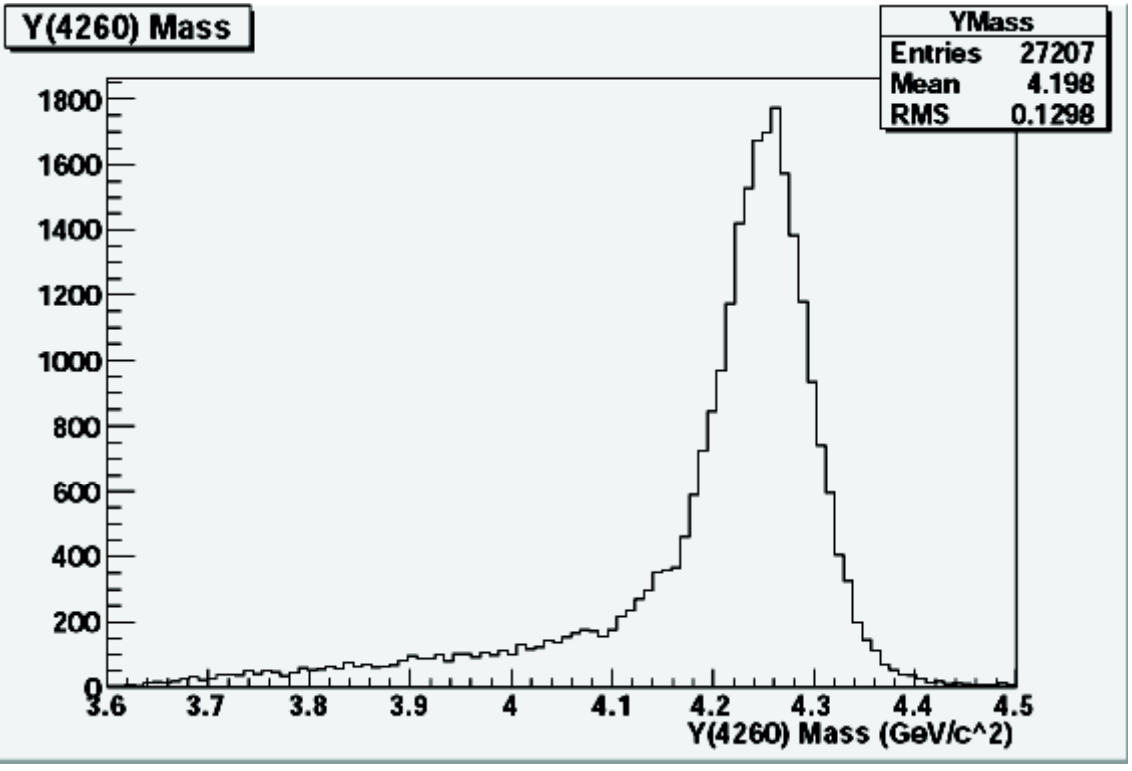
Mean 3.097 GeV

$\sigma = 0.008$ GeV

Efficiency: 45.8%



Y(4260)->J/Ψ π^+ π^- selection



Mean 4.198 GeV

σ= 0.130 GeV

Efficiency: 54.4%

$J/\Psi\ \pi^+\ \pi^-$ dipion invariant mass

The choice is motivated by observations from $\psi(2S)\rightarrow J/\psi\pi^+\pi^-$

Parametrization of the dipion mass in the decay

$$Y(4260)\text{->}J/\Psi\ \pi^+\pi^-$$

$$d\Gamma/dm_{\pi\pi} \propto PHSP\cdot(m^2_{\pi\pi}-\lambda m^2_{\pi})^2$$

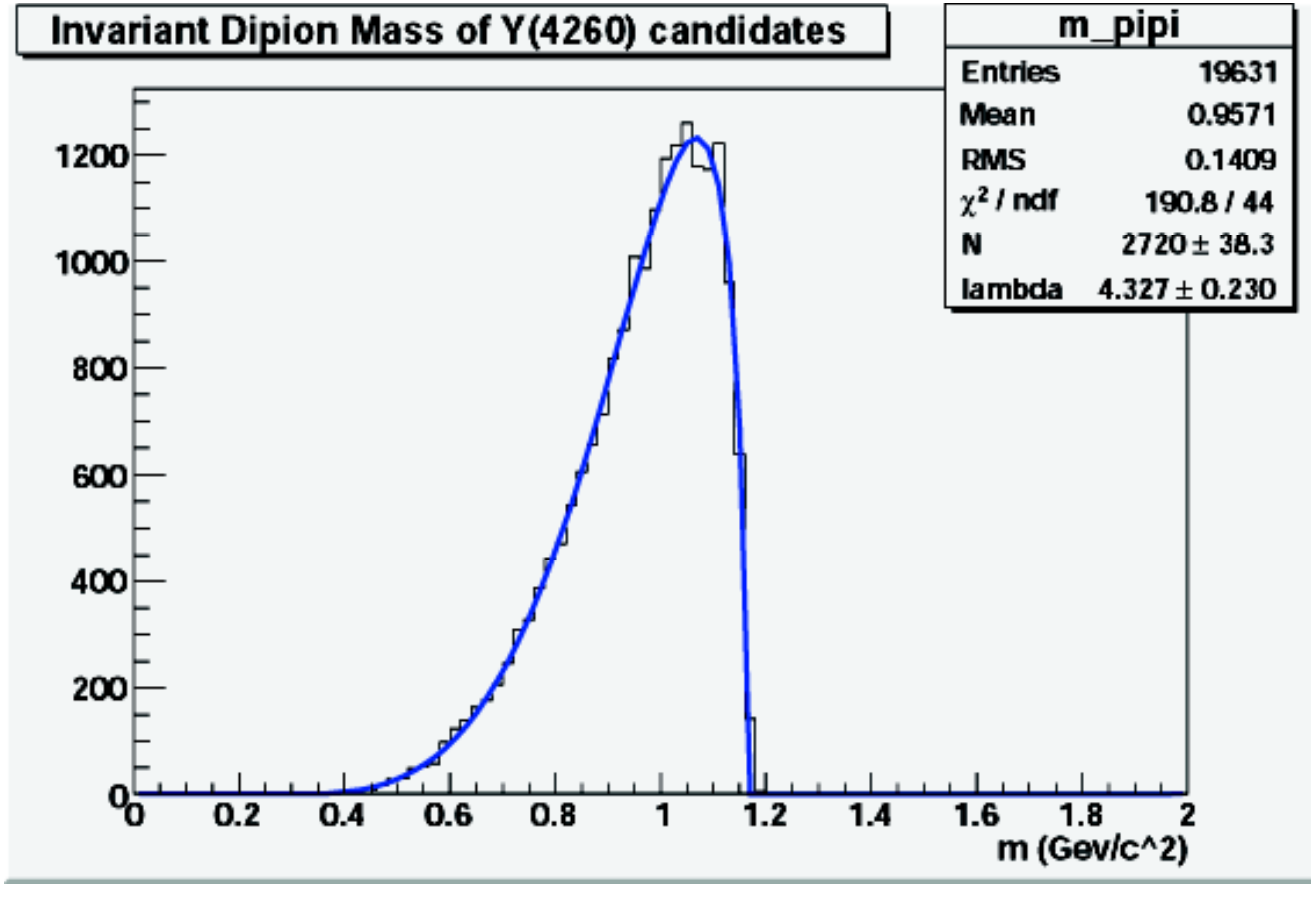
$$PHSP=\sqrt{\frac{(m^2_{\pi\pi}-4m^2_{\pi\pi})[M^4_{\Psi}+M^4_{\Psi'}+m^4_{\pi\pi}-2(M^2_{\Psi'}m^2_{\pi\pi}+M^2_{\Psi'}m^2_{\pi\pi}++M^2_{\Psi}+M^2_{\Psi'})]}{4M^2_{\Psi'}}}$$

Ref. T.N.Pham, B.Pire and T.N. Truong, Phys. Lett. B61 (1976) 183

$J/\Psi\ \pi^+\ \pi^-$ dipion invariant mass

Simulation: $\lambda=4.0$

Fit result: $\lambda=4.3 \pm 0.2$



Y(4260)->J/Ψ π^+ π^- background studies

The major background to this channel come from

$\bar{p}p$->$\pi^+\pi^-\pi^+\pi^-$ events (two pions may be mis-identified like electrons which can reconstruct one J/Ψ)

(500.000 background events generated)

Apply same selection of signal events to background events

The Result is: 18 J/Ψ "bad reconstructed"

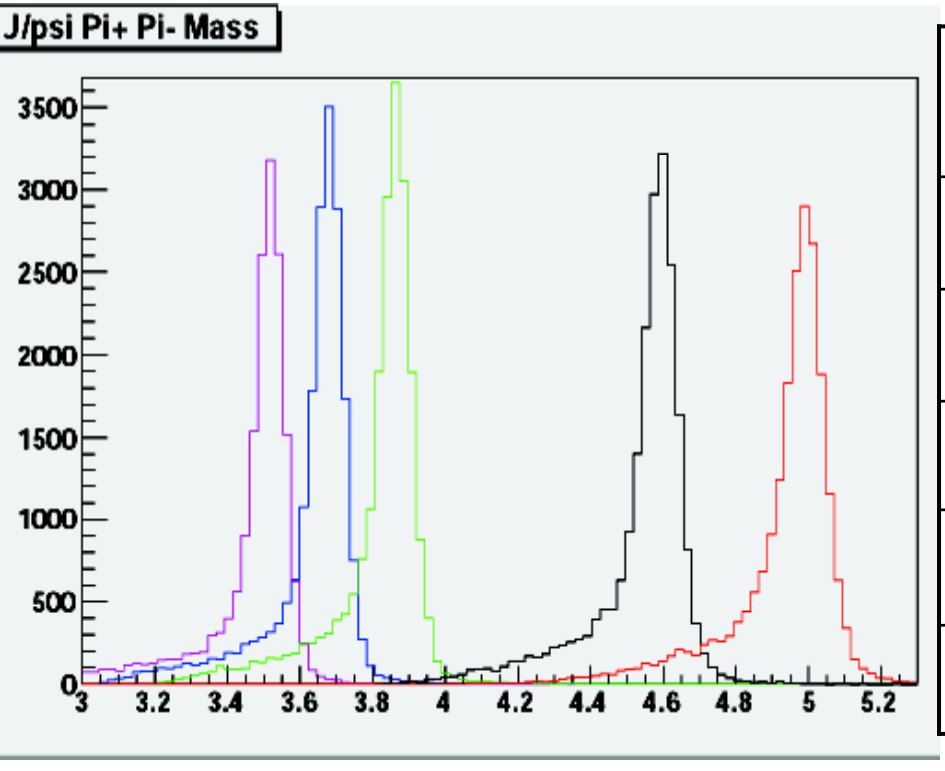
The Ratio Signal/Background = 6

$\sigma(\bar{p}p->\Psi')\approx$10 nb (from E835)

$\sigma(\bar{p}p->\pi^+\pi^-\pi^+\pi^-)\approx$0.046 mb

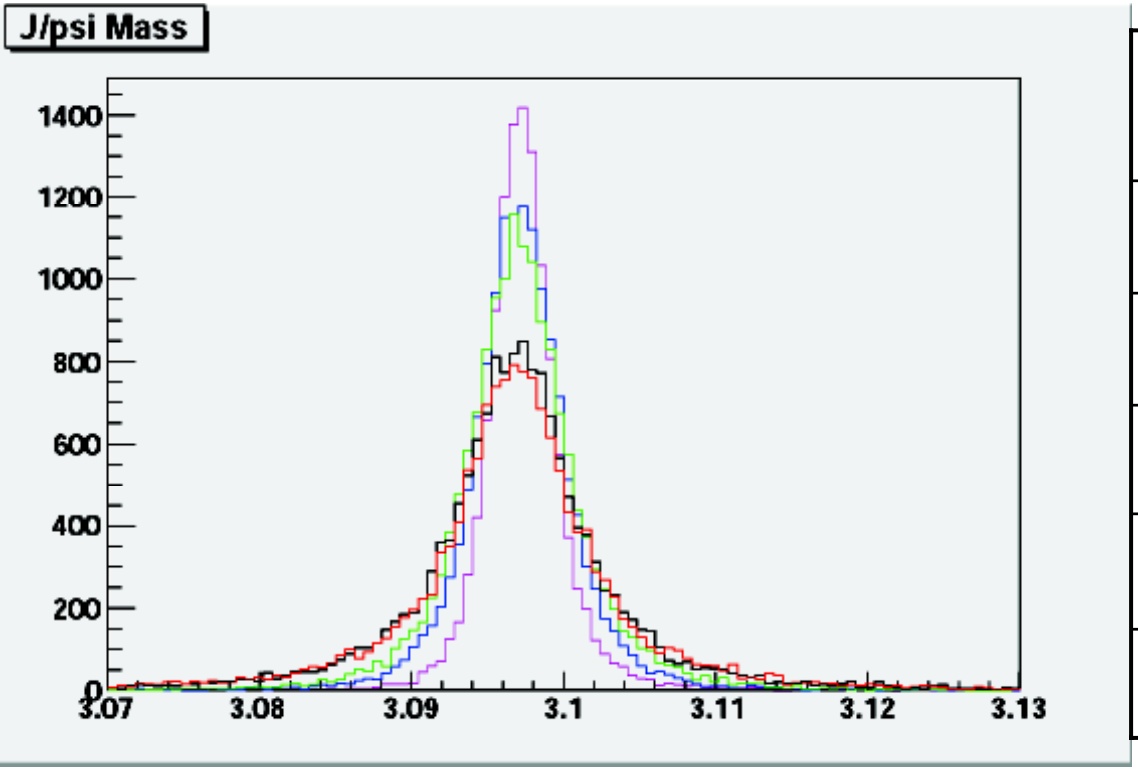
Muon channel under investigation

J/Ψ π^+ π^- other energies



	E_{CMS} (GeV)	Mean (GeV)	σ (MeV)	Eff (%)
	3.526	3.472	113	43
	3.686	3.628	122	49
	3.872	3.812	127	52
	4.600	4.540	129	53
	5.000	4.934	139	53

J/Ψ π^+ π^- other energies



	E_{CMS} (GeV)	Eff (%)	σ (MeV)
	3.526	30	2
	3.686	35	3
	3.872	38	4
	4.600	38	6
	5.000	37	7

Mean Value=3.097 GeV

$J/\Psi\,\gamma$ selection

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- List J/Ψ: JPsiToEEPID.
- List for Electrons: ElectronLHCombinedVeryLoose
- List for Gamma: CalorNeutral
- E_{CMS}=3.510, 3.556, 3.872 GeV
- fittingAlgorithm: TreeFitter
- Kinematic fit: vertex/mass constraint
- J/Ψ Mass window [2.5;3.5] GeV
- CL>0.1%

J/Ψ γ selection

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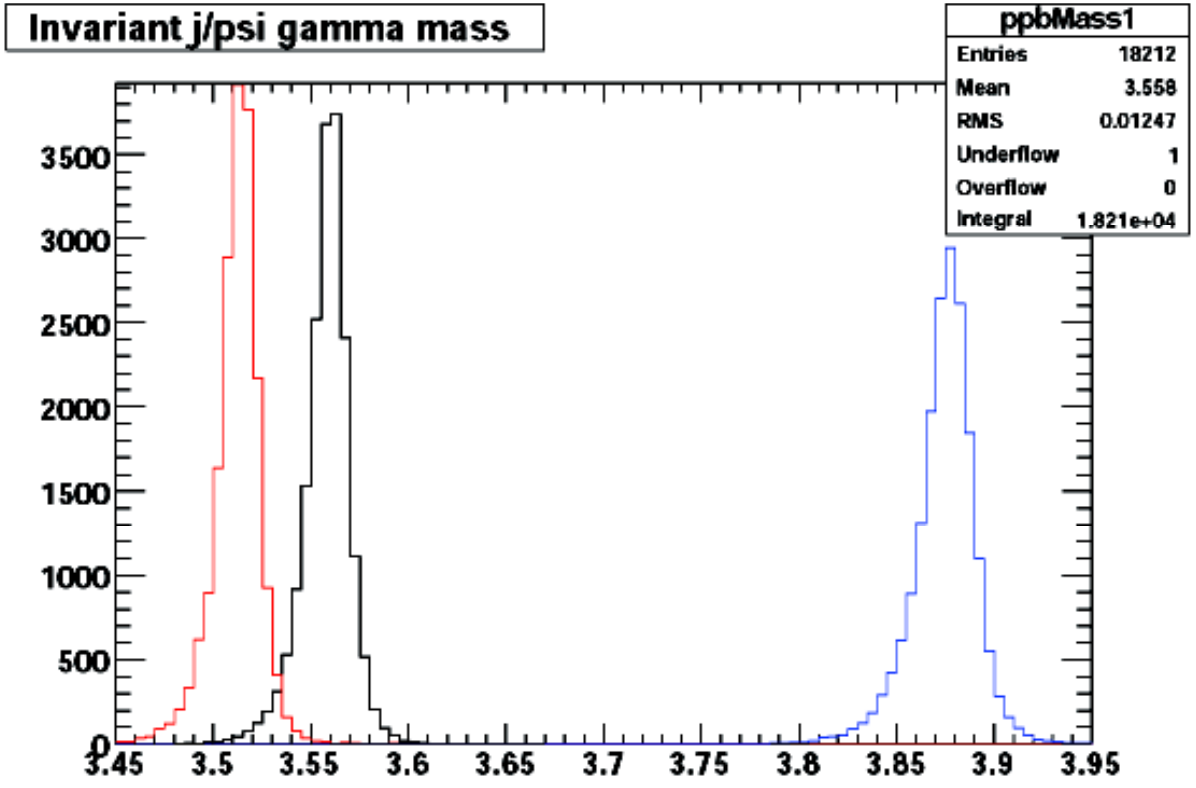

	E_{CMS} (GeV)	Eff (%)
	3.510	46
	3.556	46
	3.872	46

J/Ψ γ selection

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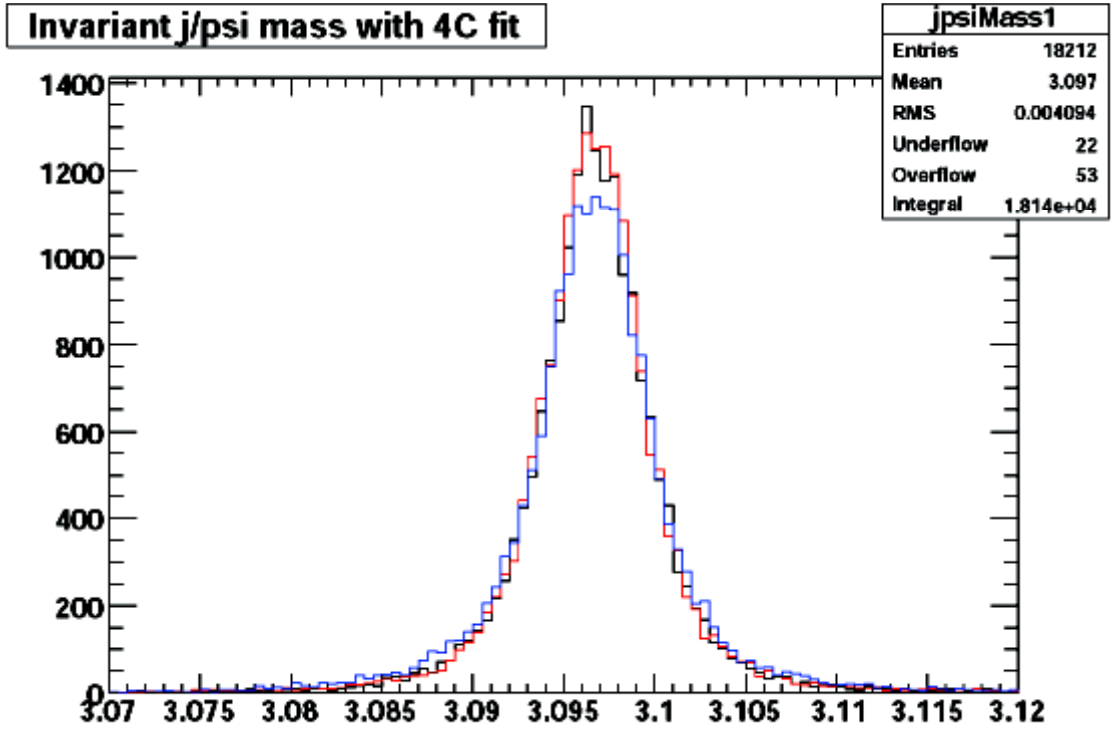

	E_{CMS} (GeV)	Eff (%)
	3.510	46
	3.556	46
	3.872	46

Summary and Outlook $J/\Psi\ \pi^+\pi^-$

- In the release 0.15.2 this channel is well simulated: the efficiency and the resolution are improved.
- The resolution of Y(4260) is good. (0.130 GeV)
- The fit of dipion invariant mass is consistent with the input data.
- The study of the background demonstrates that the signal channel could be well identified.
- To do: study of the muon channel for the background.

Summary and Outlook $J/\Psi\,\gamma$

- We are at a preliminary study, but the results are good.
- To do: Implementation of the right angular distribution.
- To do: Study of the background.

Thanks for the attention!