

# Bits of Onia in Alice

Andry Rakotozafindrabe  
CEA-Saclay

HLPW08 - Belgium

# Framework & running strategy

## □ LHC ion capabilities:

- ✓ Pb-Pb @ 5.5 TeV
- ✓ heavy ion running ~ 4 weeks/year ( $10^6$  s effective)
- ✓ luminosity  $10^{27}$  cm $^{-2}$  s $^{-1}$  (Pb) to  $>10^{30}$  (light ion)
- ✓ integrated luminosity 0.5 nb $^{-1}$ /year

## □ Initial ALICE program [Phys. Perf. Rep. vol1]:

- ✓ regular pp @ 14 TeV
- ✓ Pb-Pb physics pilot run (1/20<sup>th</sup> luminosity design)
- ✓ 1-2 years Pb-Pb (medium  $\rightarrow$  design luminosity)
- ✓ 1 year of p-Pb like collisions
- ✓ 1-2 years of Ar-Ar

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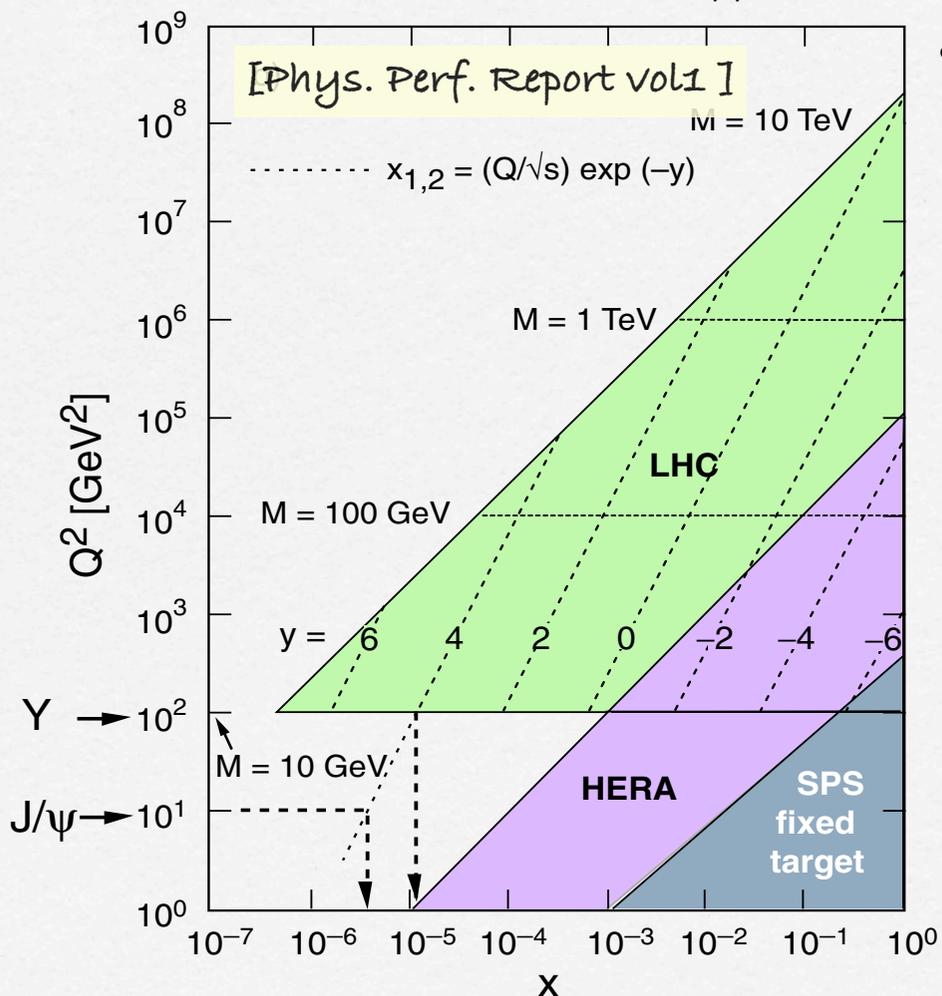
✓ 1 year of p-Pb like collisions

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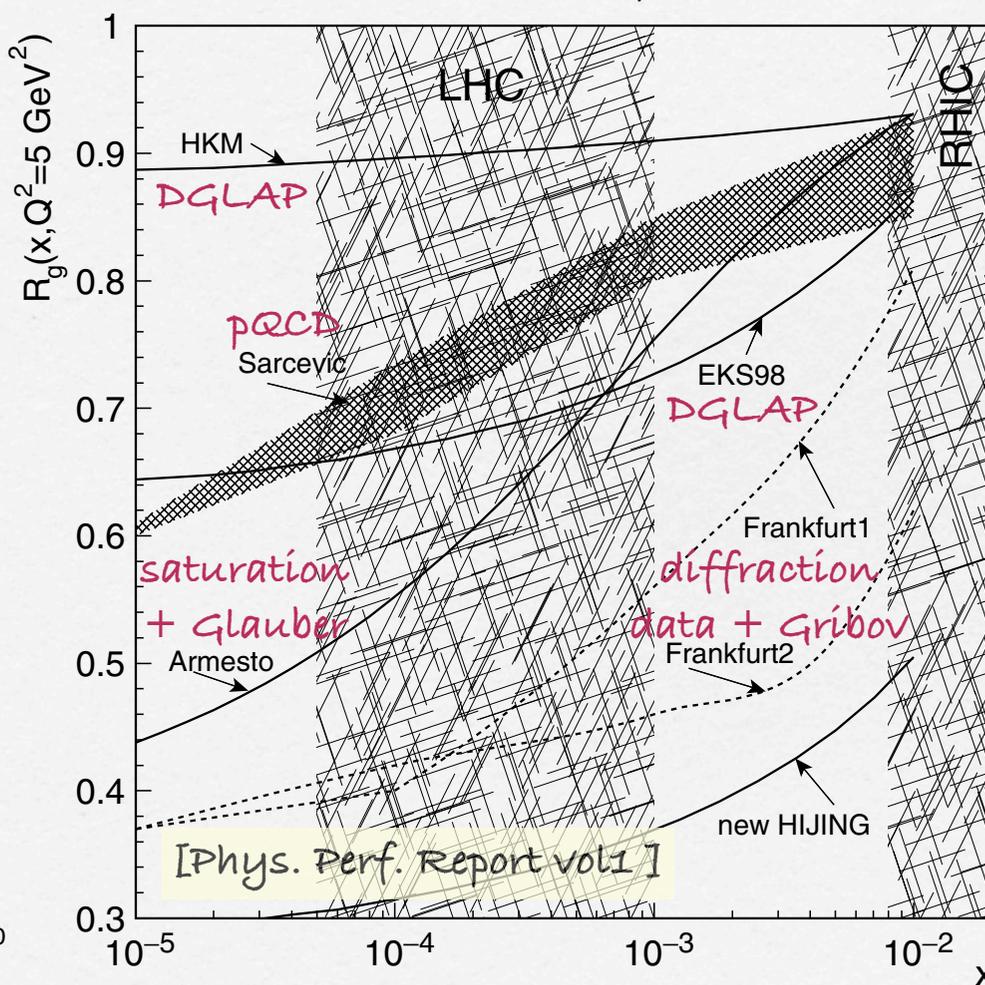
pp benchmark @ 5.5 TeV ?

# Partons sketch

Parton kinematic domain in pp @ 14 TeV

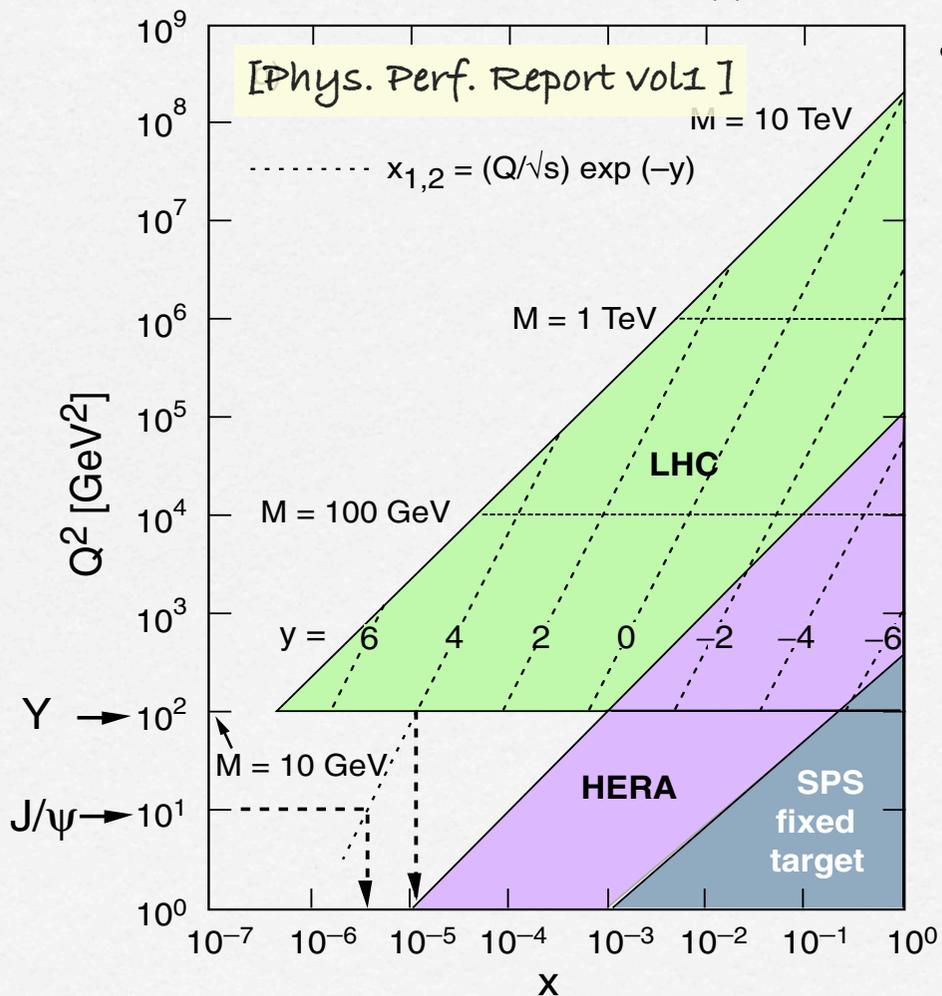


gluon densities ratio Pb/p at  $Q^2 = 5$  GeV<sup>2</sup>

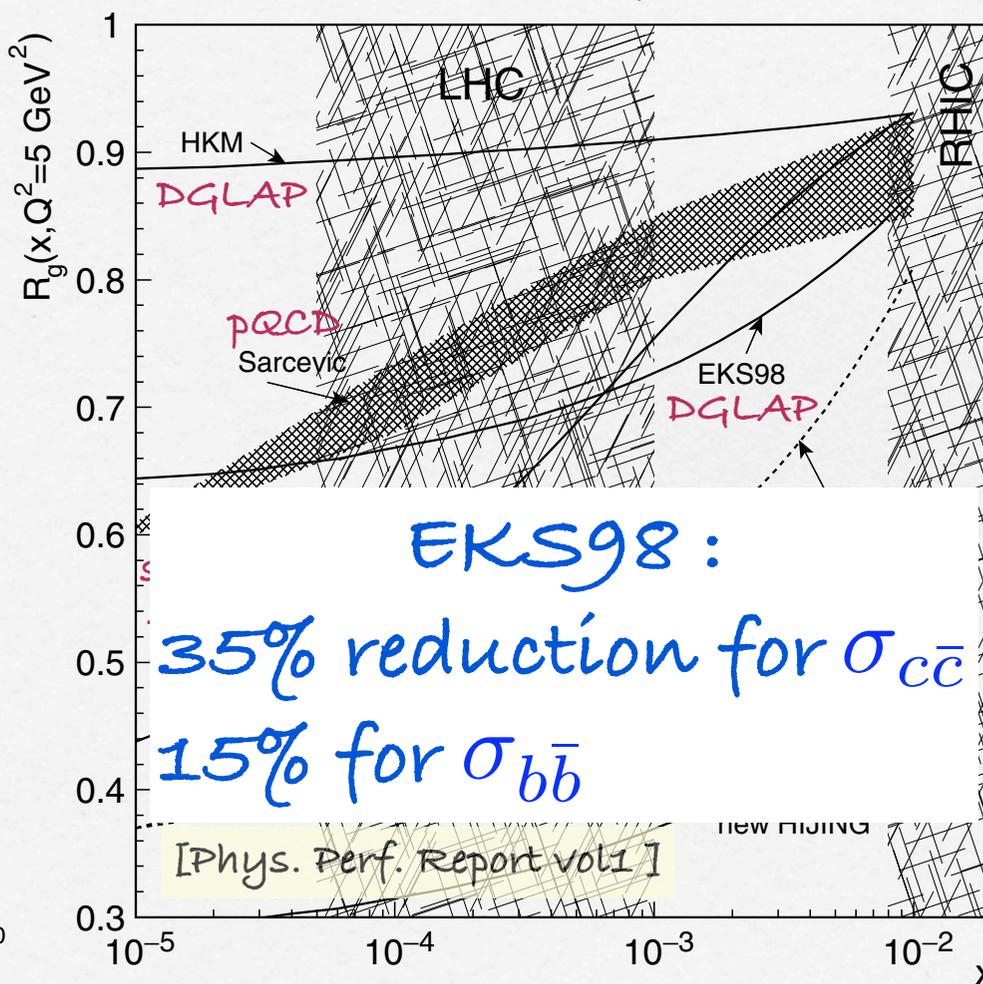


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gluon densities ratio Pb/p at  $Q^2 = 5 \text{ GeV}^2$



## ALICE's Heavy Quark Shopping List

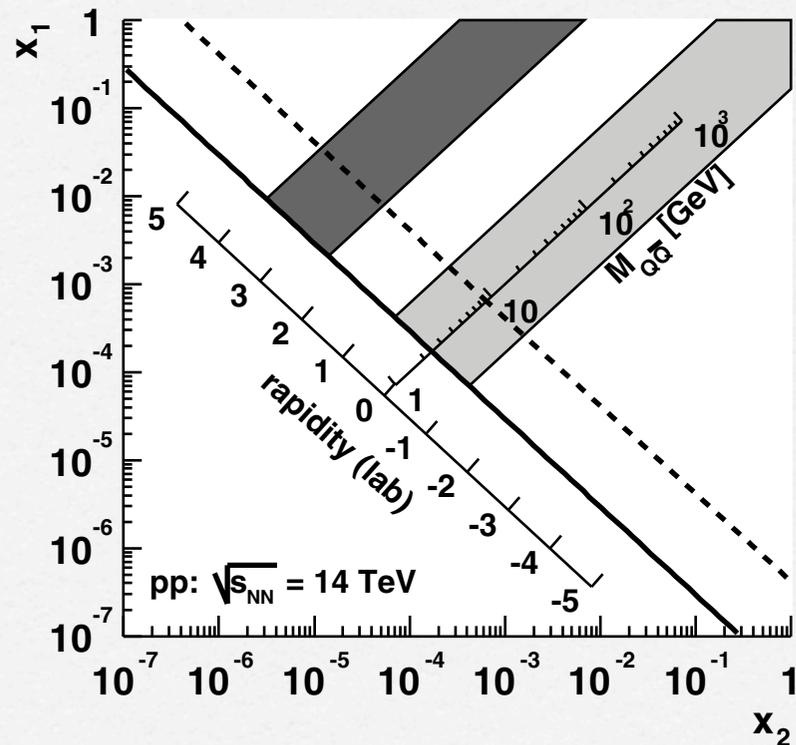
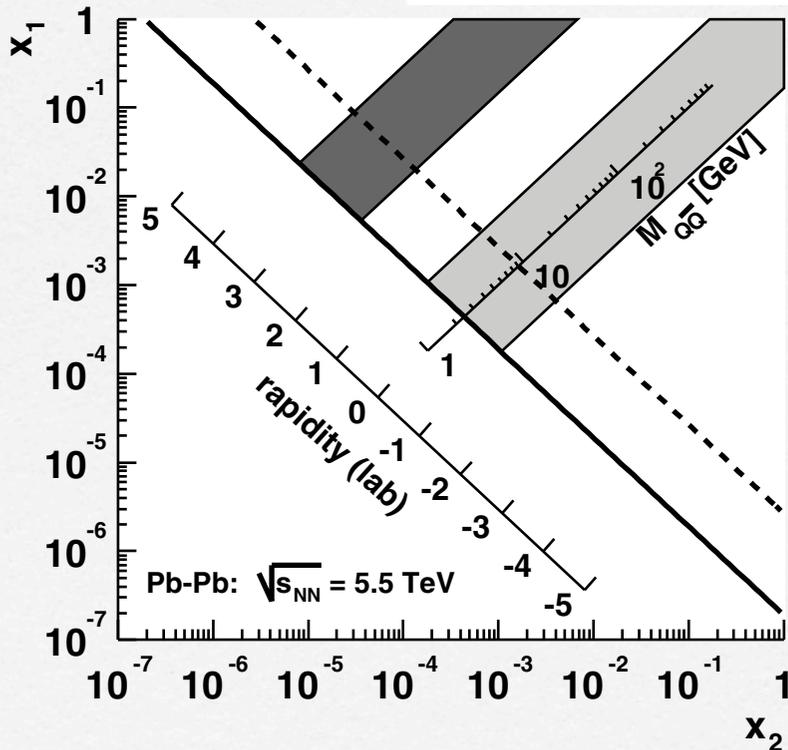
probe	channel	acceptance
$J/\psi, \psi', \Upsilon, \Upsilon', \Upsilon''$	$e^+e^-$	$ \eta  < 0.9$
$J/\psi, \psi', \Upsilon, \Upsilon', \Upsilon''$	$\mu^+\mu^-$	$2.5 < \eta < 4$
$c\bar{c} \text{ \& \ } b\bar{b}$	$e^+e^-$	$ \eta  < 0.9$
$c\bar{c} \text{ \& \ } b\bar{b}$	$\mu^+\mu^-$	$2.5 < \eta < 4$
D mesons	$\pi, K$	$ \eta  < 0.9$
B mesons	$B \rightarrow J/\psi \rightarrow e^+e^-$	$ \eta  < 0.9$
D & B mesons	single $e^\pm$	$ \eta  < 0.9$
$c\bar{c} \text{ \& \ } b\bar{b}$	$e^\pm\mu^\mp$	$1 < y < 3$

# ALICE acceptance (I)

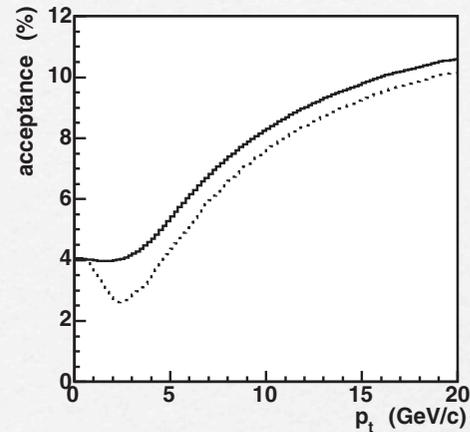
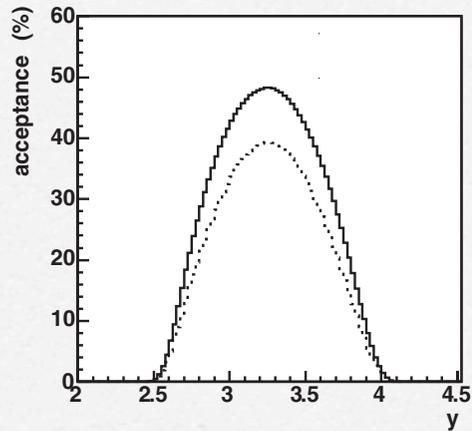
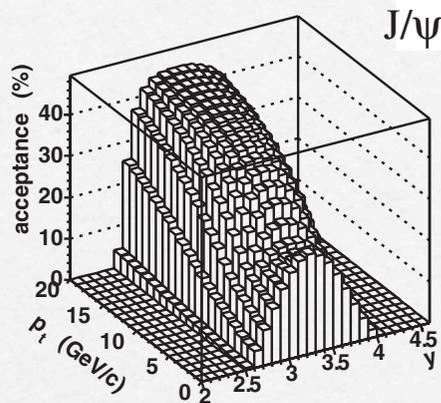
ALICE acceptance in  $(x_1, x_2)$  plane for heavy flavors in Pb-Pb and p-p  
 [Phys. Perf. Report vol2]

—  $M_{Q\bar{Q}}^{\min} = 2.4 \text{ GeV}$ : charm  
 - - -  $M_{Q\bar{Q}}^{\min} = 9 \text{ GeV}$ : beauty

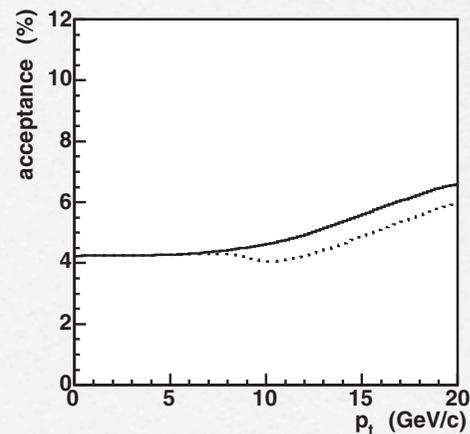
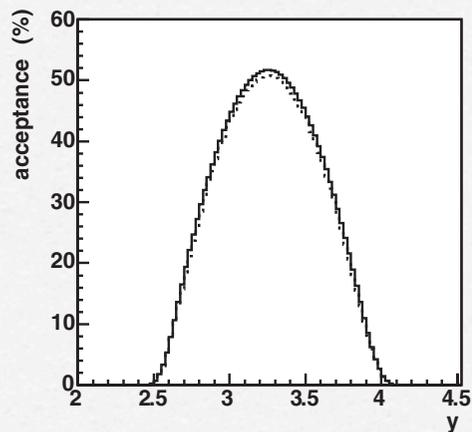
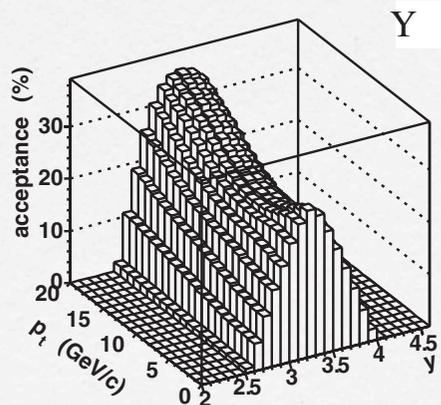
□ Central barrel:  $|\eta| < 0.9$   
 ■ Muon arm:  $2.5 < \eta < 4$



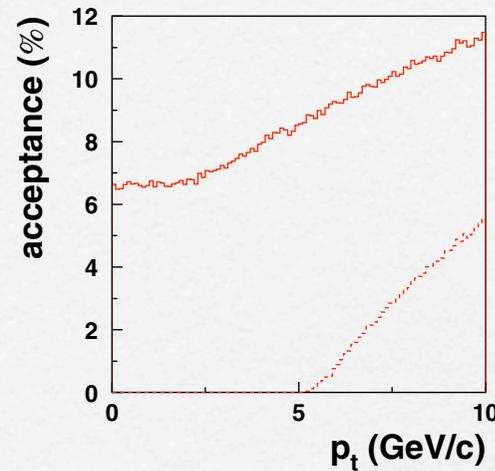
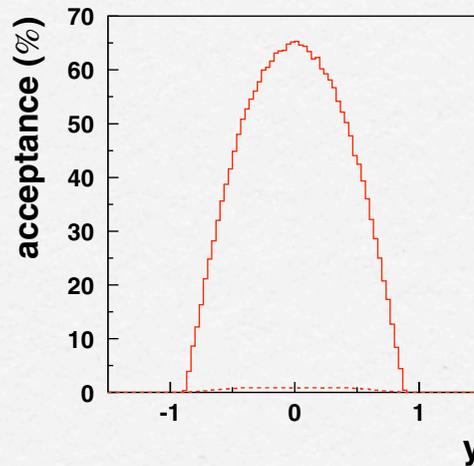
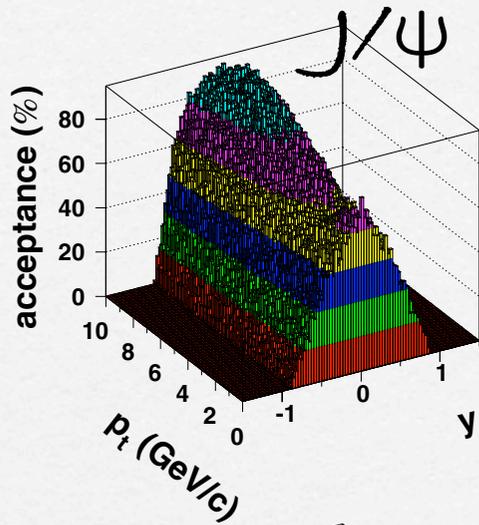
# ALICE acceptance (II) - muon arm



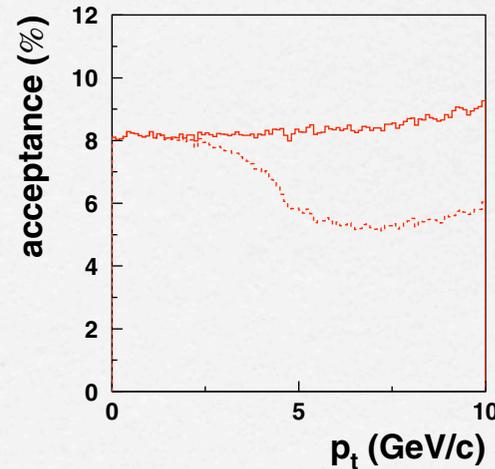
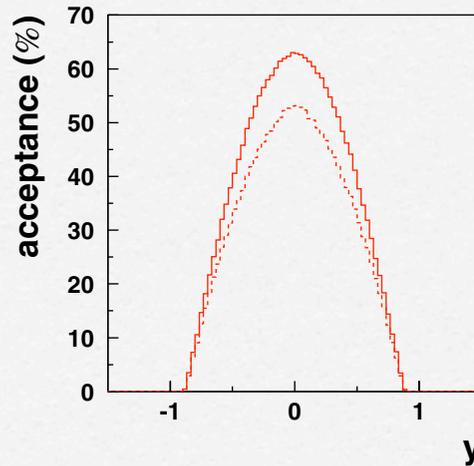
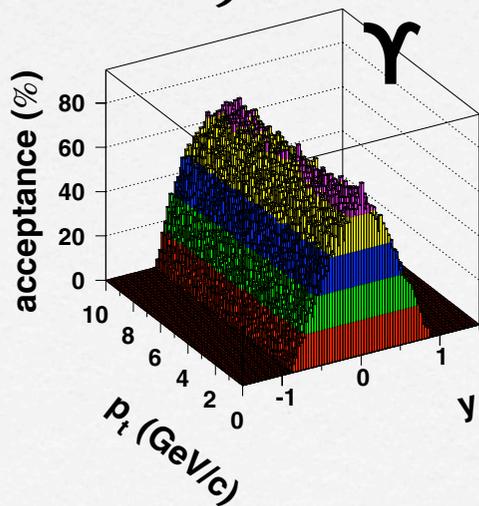
..... trigger effect :  
 cut on single  $\mu$   
 from  $J/\psi$   $p_T > 1$  GeV/c  
 from  $\Upsilon$   $p_T > 2$  GeV/c



# ALICE acceptance (III) - central barrel

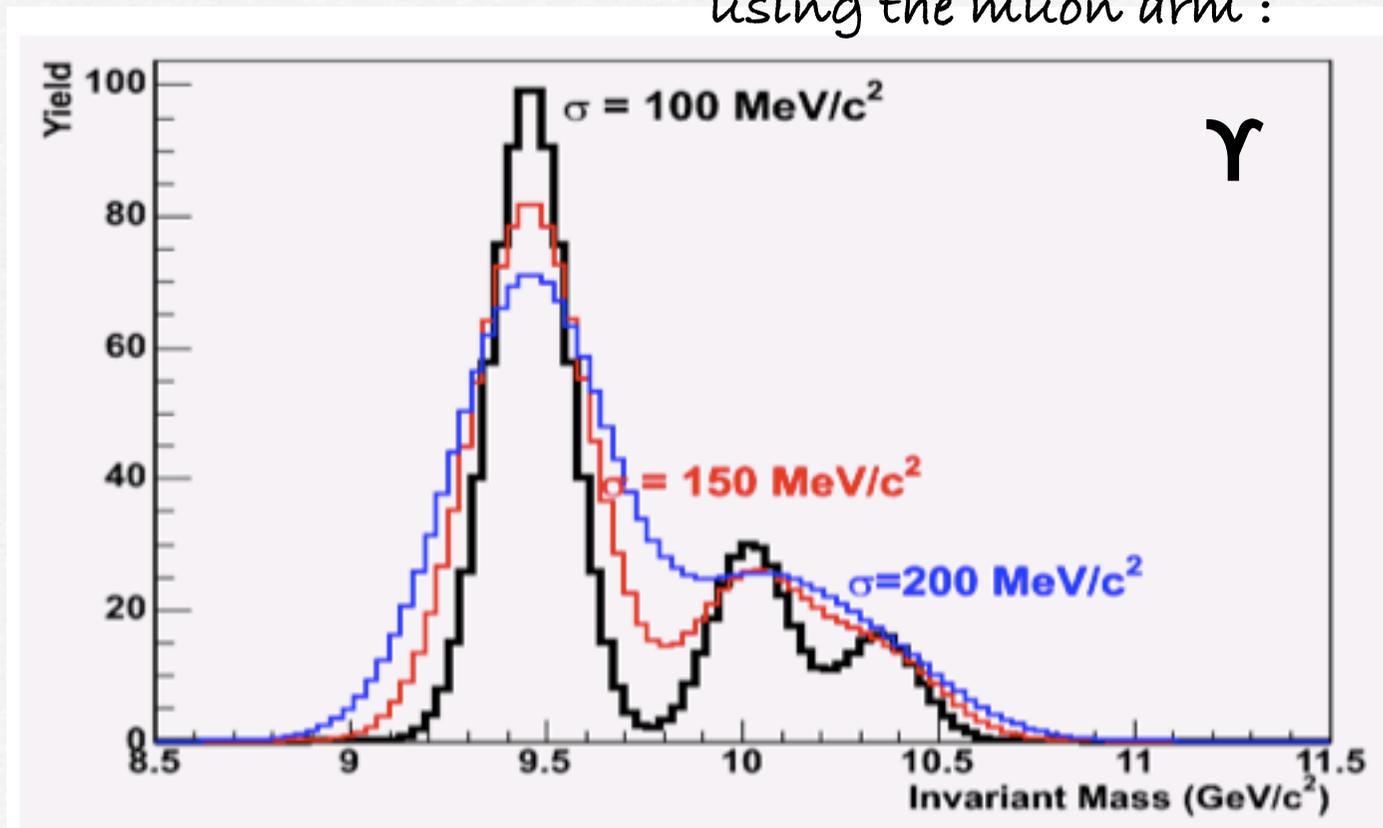


..... trigger effect :  
cut on single e  
 $p_T > 3$  GeV/c

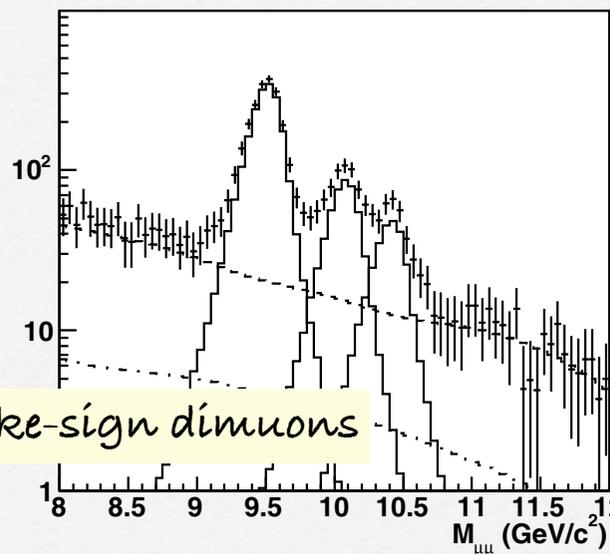
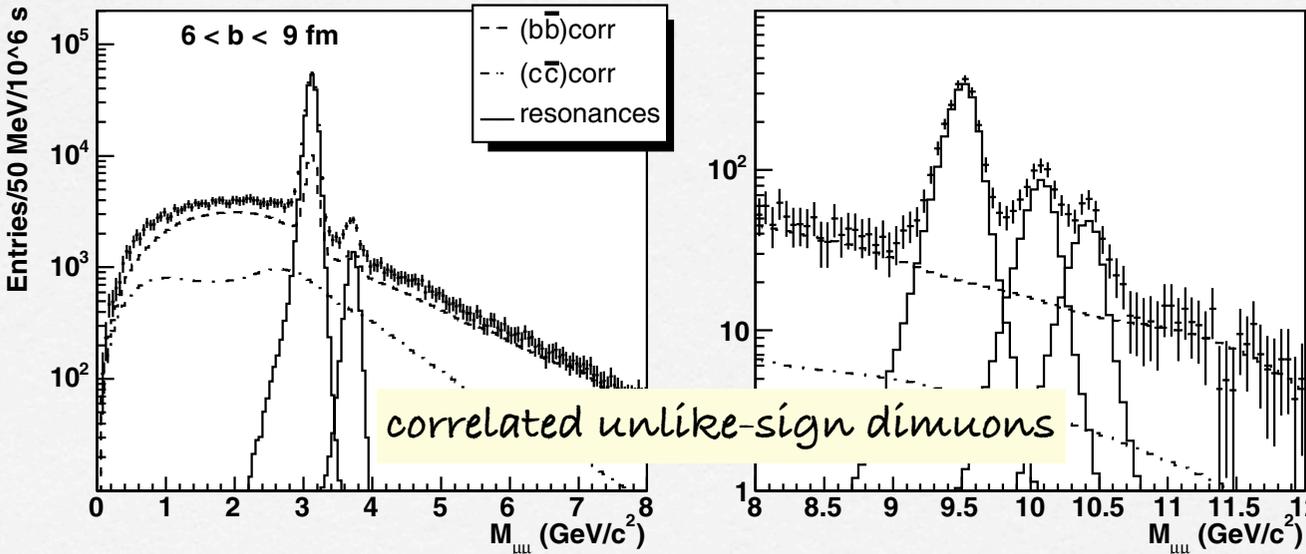
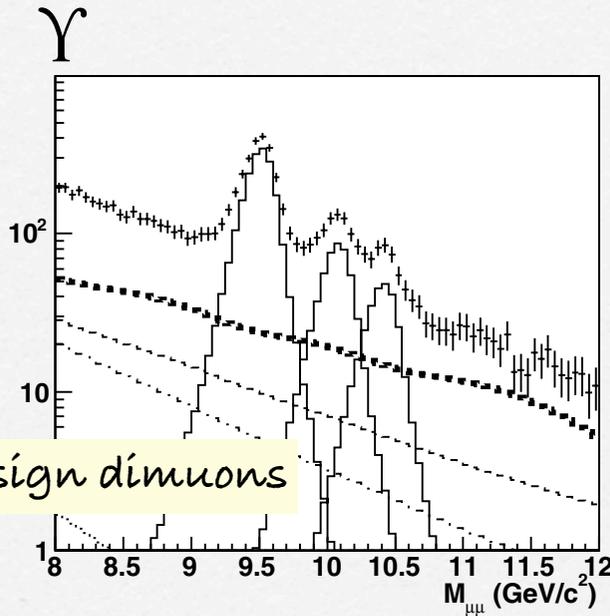
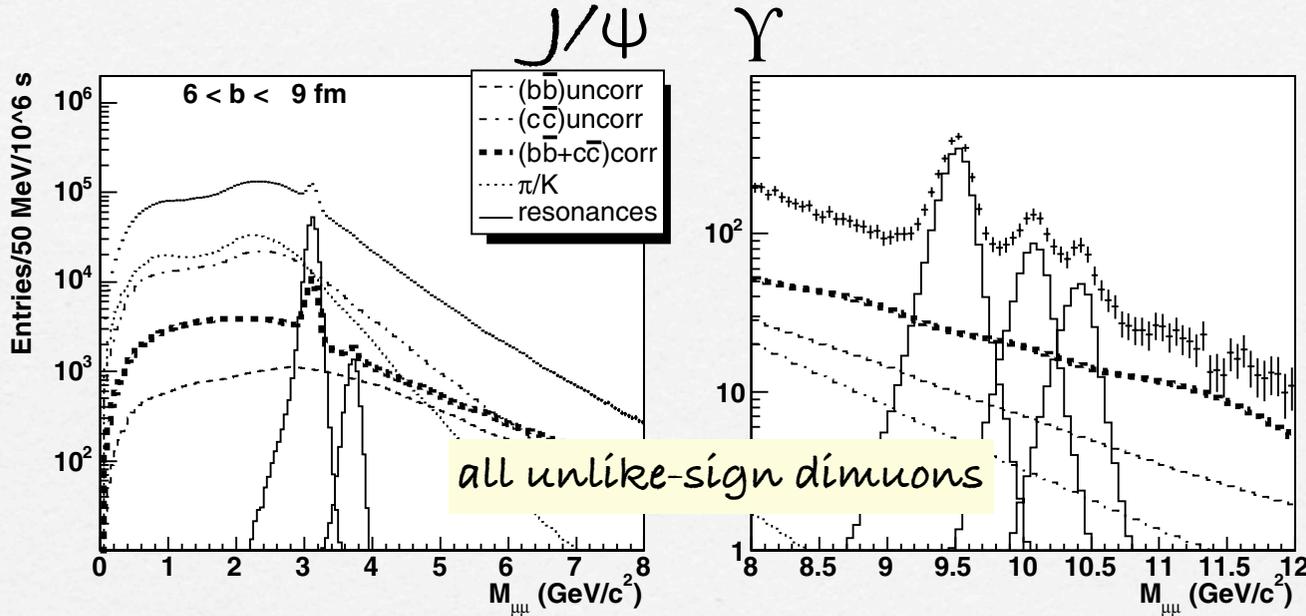


# Resonance separation ?

using the muon arm :

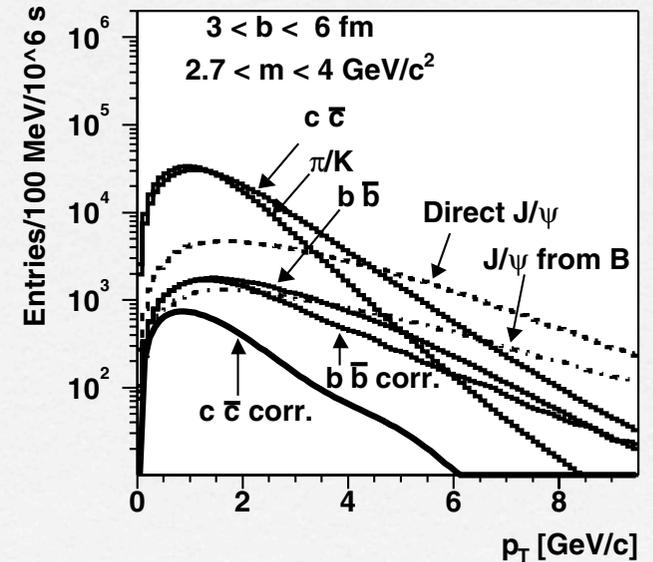


# Quarkonia $\rightarrow \mu\mu$ in Pb-Pb



Statistics for 0.5 nb<sup>-1</sup>

- J/ψ: excellent (>5x10<sup>5</sup>)
- ψ': marginal (S/B)
- Υ: good (7000)
- Υ': ok (2000)
- Υ'': low (1000)

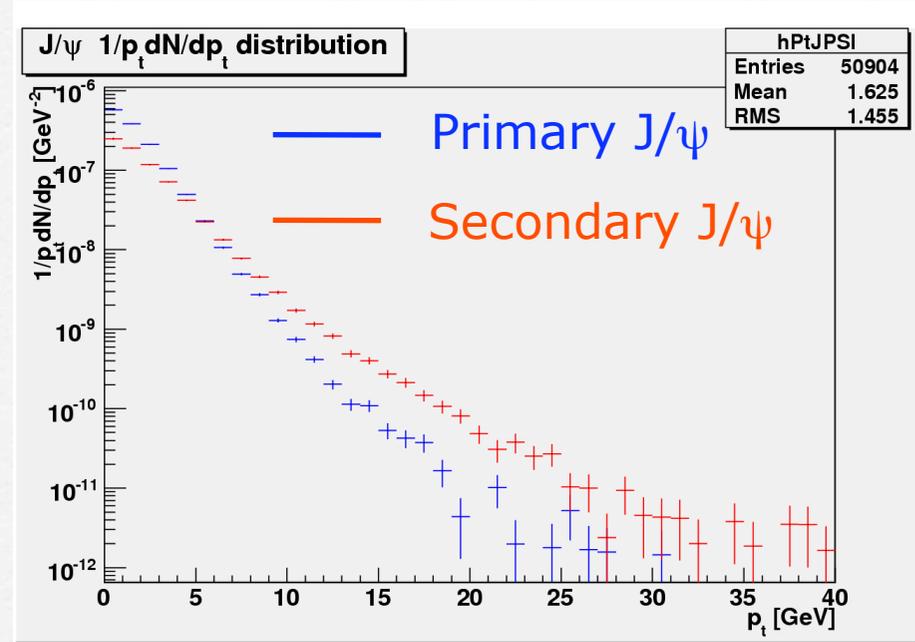
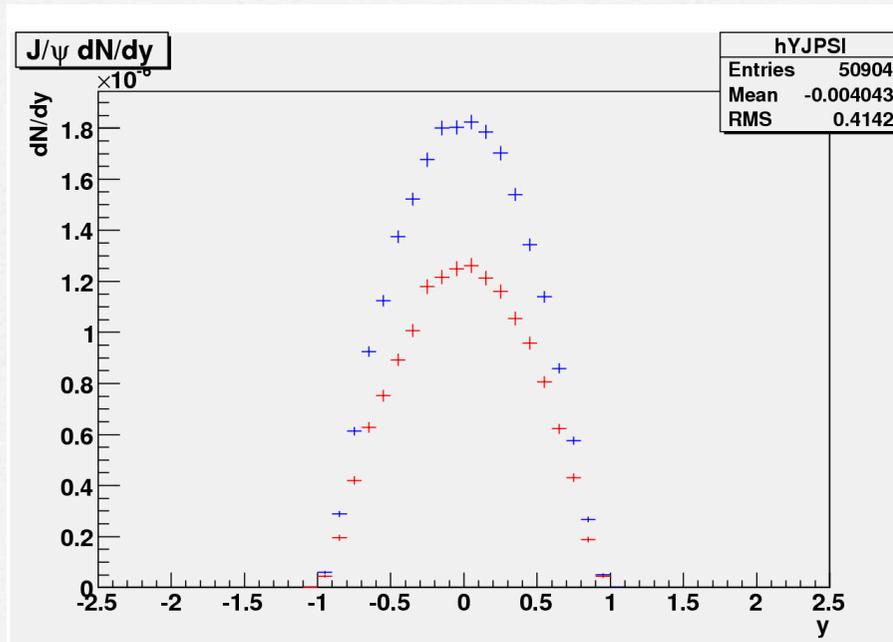


# $J/\psi$ polarisation in muon arm

- in pp, simu + reco ok
- in Pb-Pb, it is feasible to study the polarisation vs centrality [R. Arnaldi, E. Scapparín, Alice-Physics-Week, Münster (2007)]
  - predicted increasing polarisation in a QGP [B. L. Ioffe and D. E. Kharzeev, PRC 68 (2003)061902]
- but sys. err. to be evaluated

# $B \rightarrow J/\psi + X$ decay

- 40%  $J/\psi$  from  $B$  !
- in the central barrel acceptance



[G. Bruno, Alice-Physics-Week, Prague (2008)]

# $B \rightarrow J/\psi + X$ decay

□ Performance plot wrt CDF :

— tot

— tot  $J/\psi$

—  $J/\psi$  from  $B$

— bkgd

CDF

ALICE

[G. Bruno, Alice-Physics-Week, Pragues (2008)]

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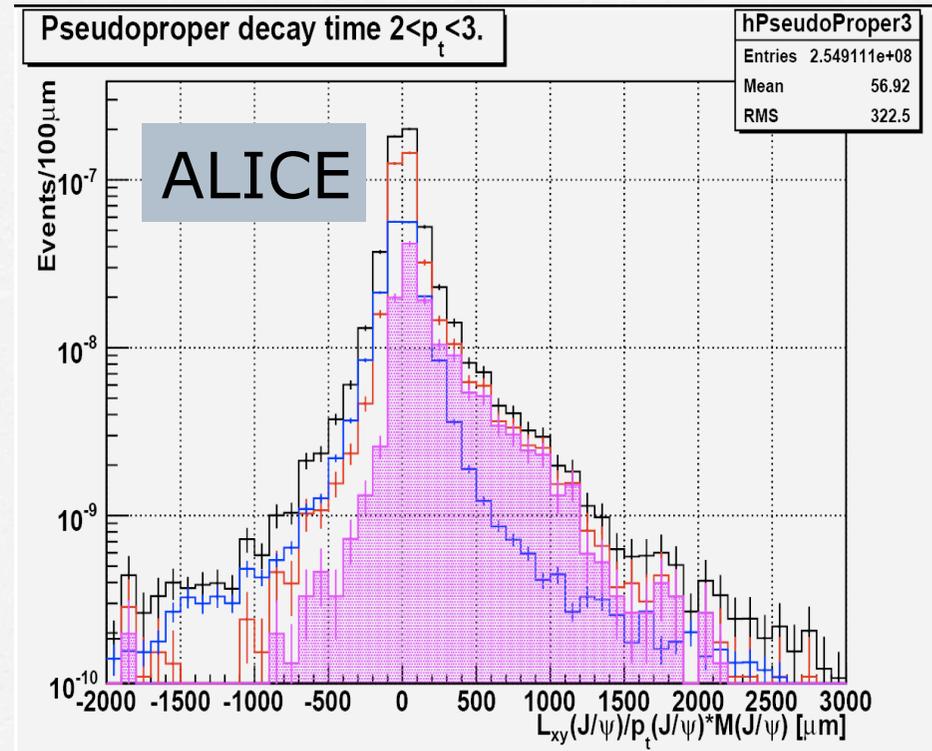
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— tot  $J/\psi$

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— bkgd

CDF

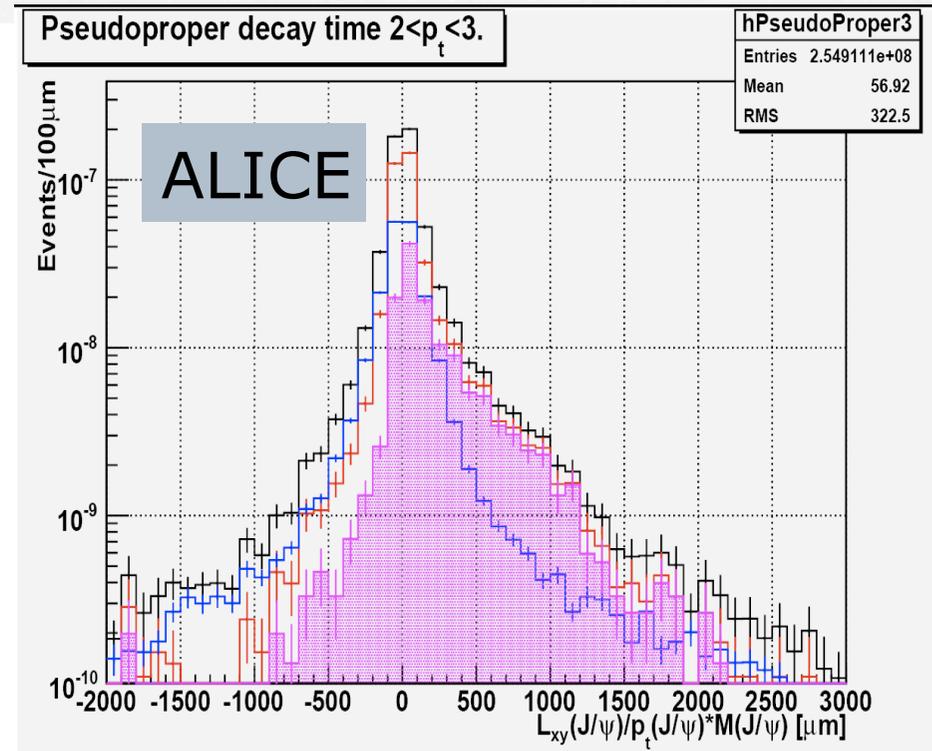
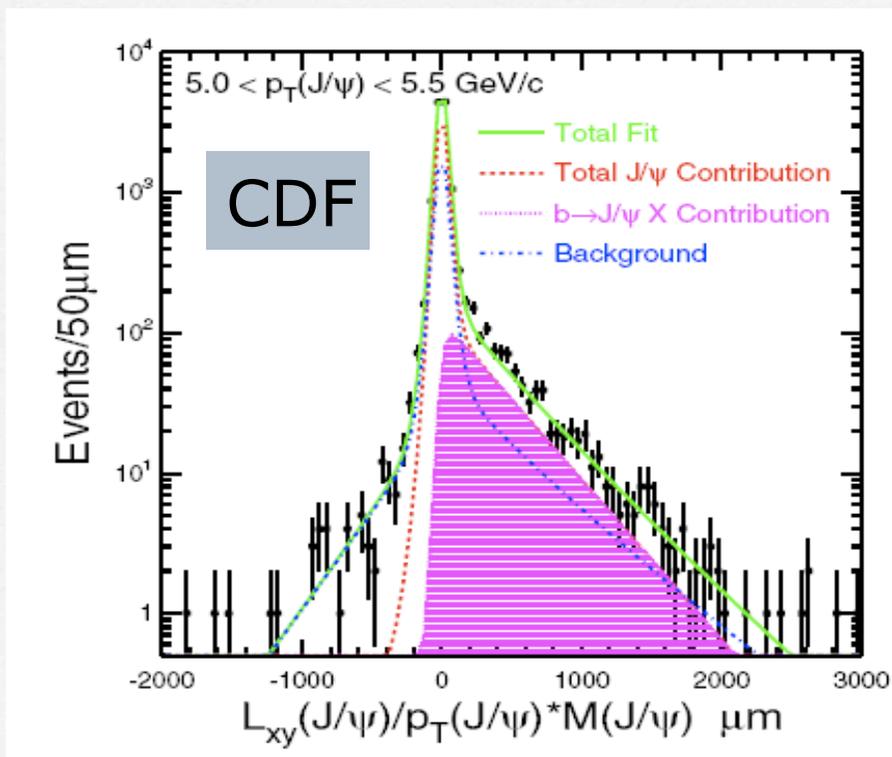


[G. Bruno, Alice-Physics-Week, Prague (2008)]

# B $\rightarrow$ J/ $\psi$ + X decay

□ Performance plot wrt CDF :

— tot   
 — tot J/ $\psi$    
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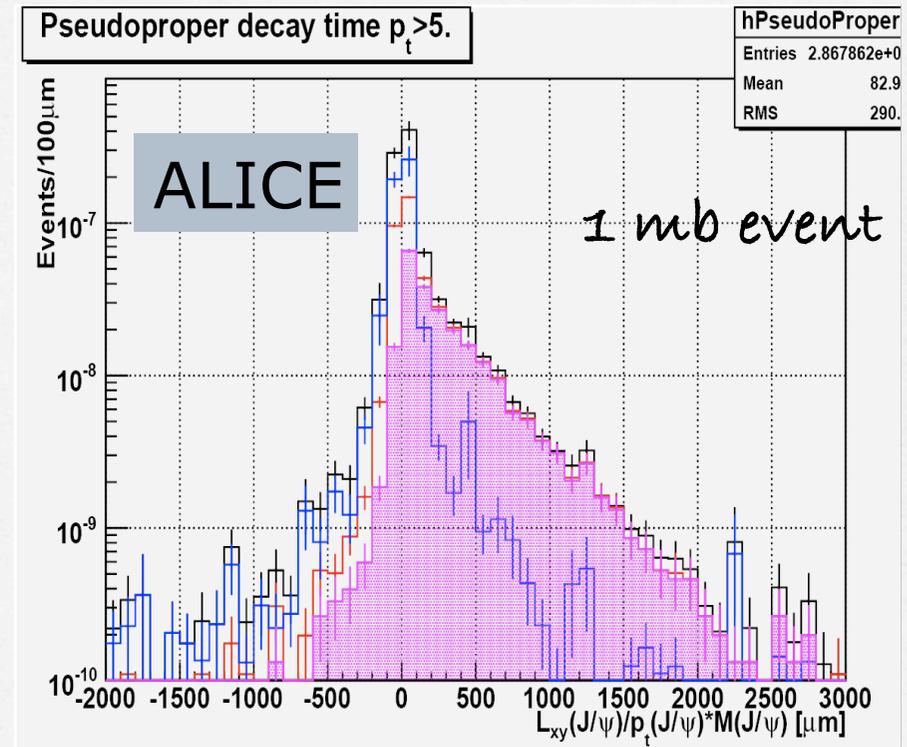
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CDF

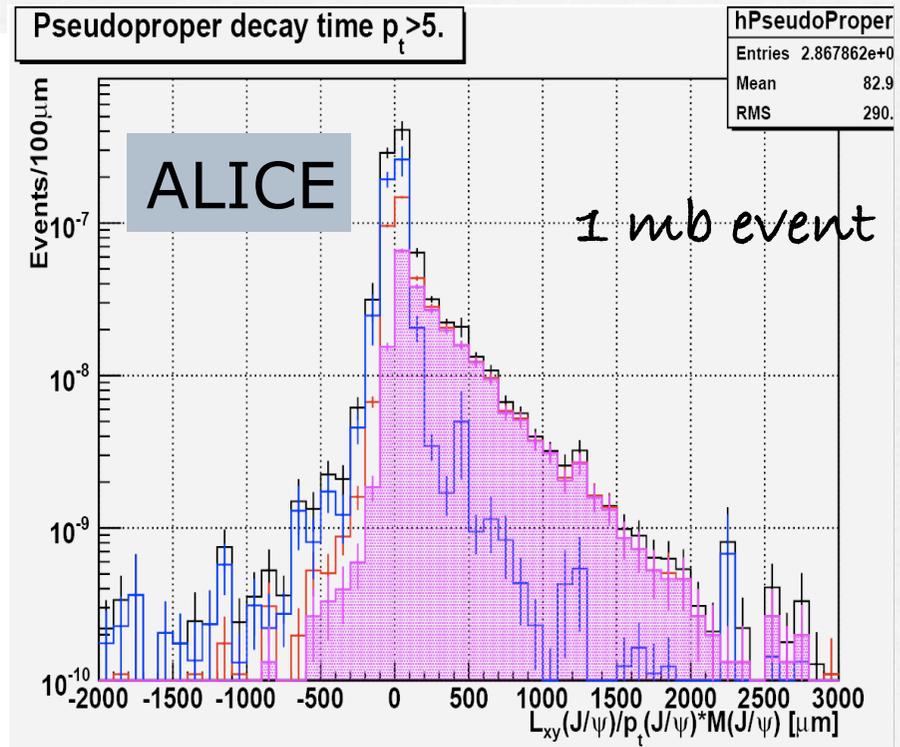
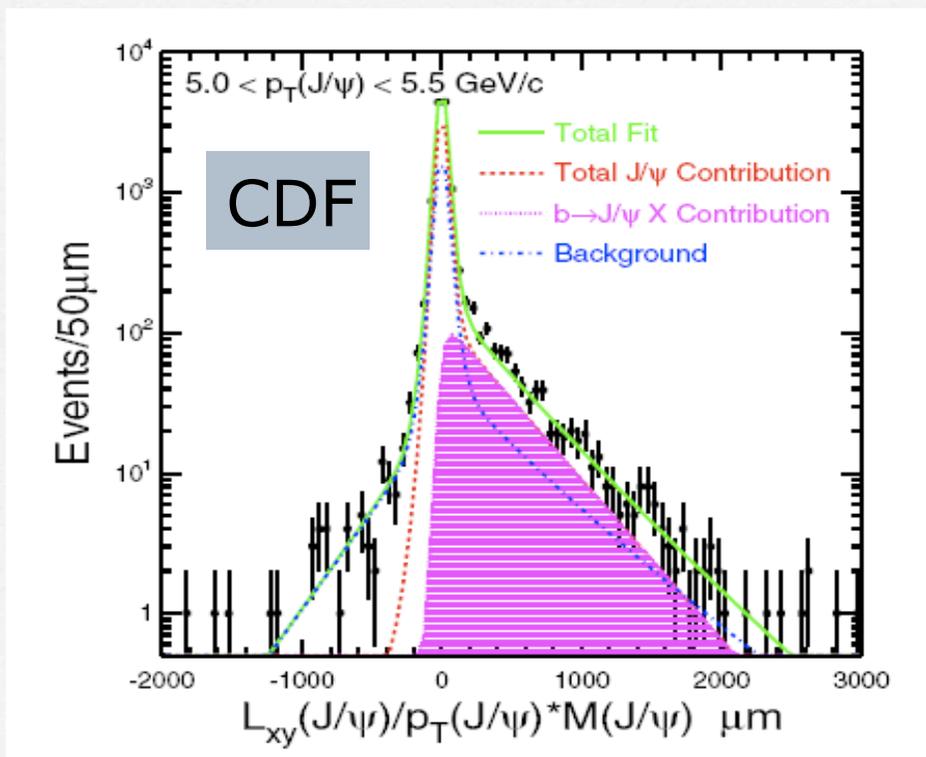


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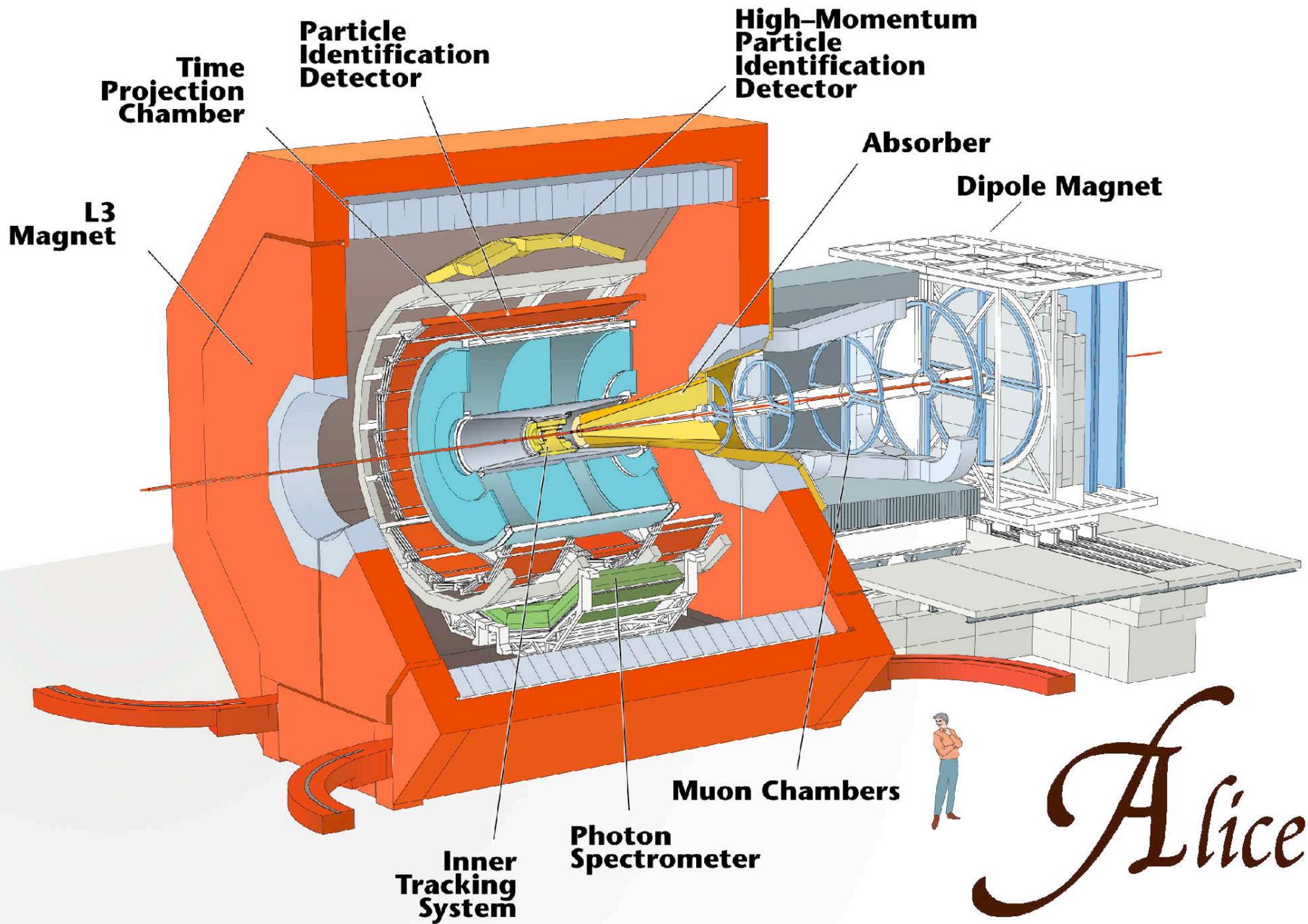
— tot   
 — tot J/  $\psi$    
 — J/  $\psi$  from B   
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[G. Bruno, Alice-Physics-Week, Pragues (2008)]

□ possibilités :

- ☑ séparer les contributions  $J/\psi$  direct ou par feed-down du  $b$ , mesure de  $\chi_c \rightarrow J/\psi + \gamma$ ,  $\psi' \rightarrow J/\psi$
- ☑ physique de l'upsilon (section eff de production, shadowing, color screening...)



*Alice*