Υ production in *pp* and *pA* collisions: from RHIC to the LHC

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with E.G. Ferreiro, F. Fleuret, N.Matagne, A. Rakotozafindrabe

Part I

Υ production in *pp*

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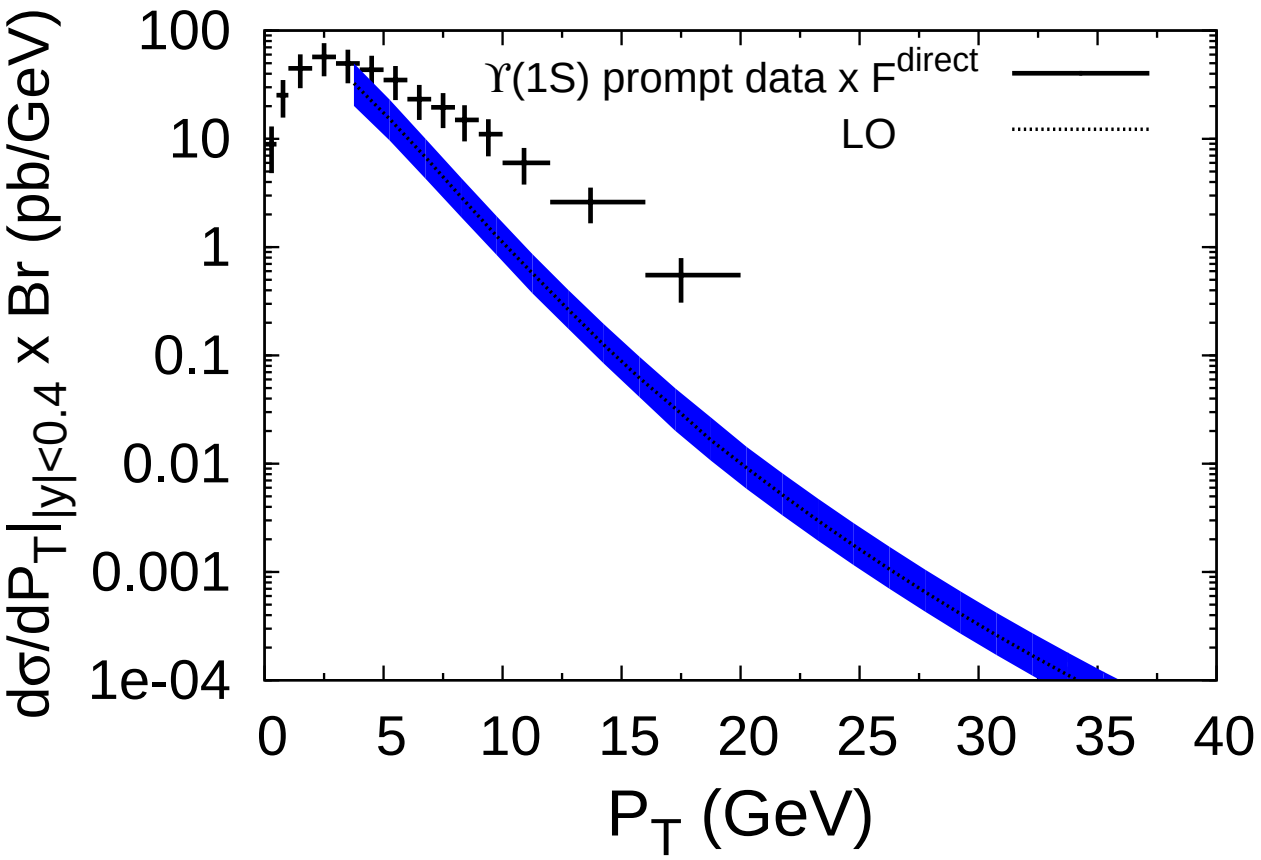

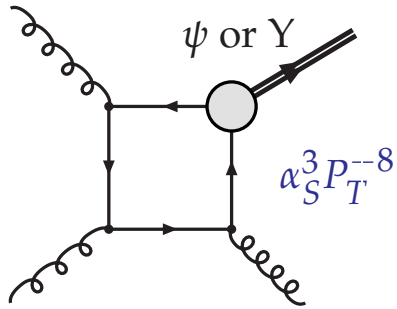

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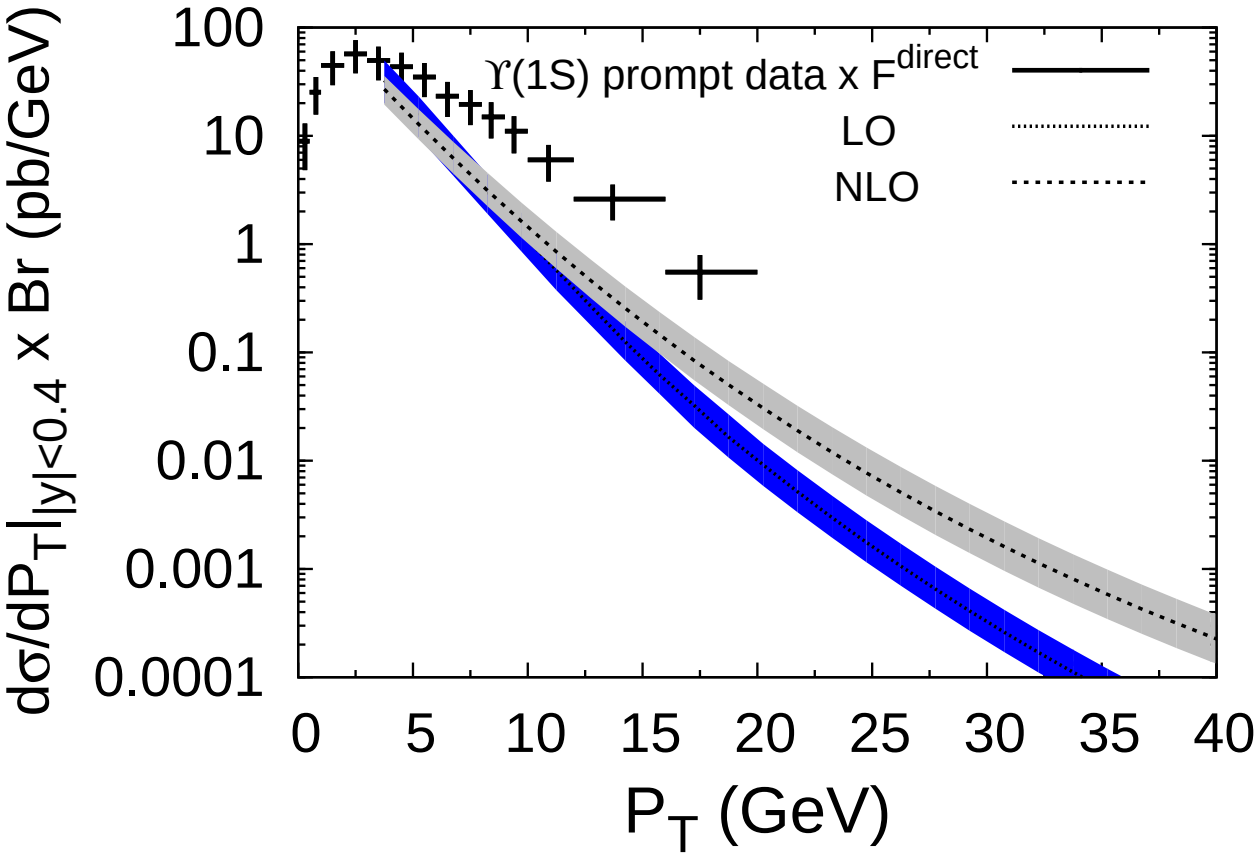

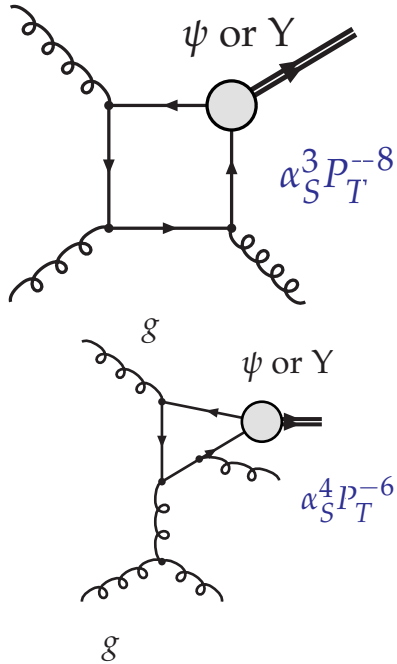

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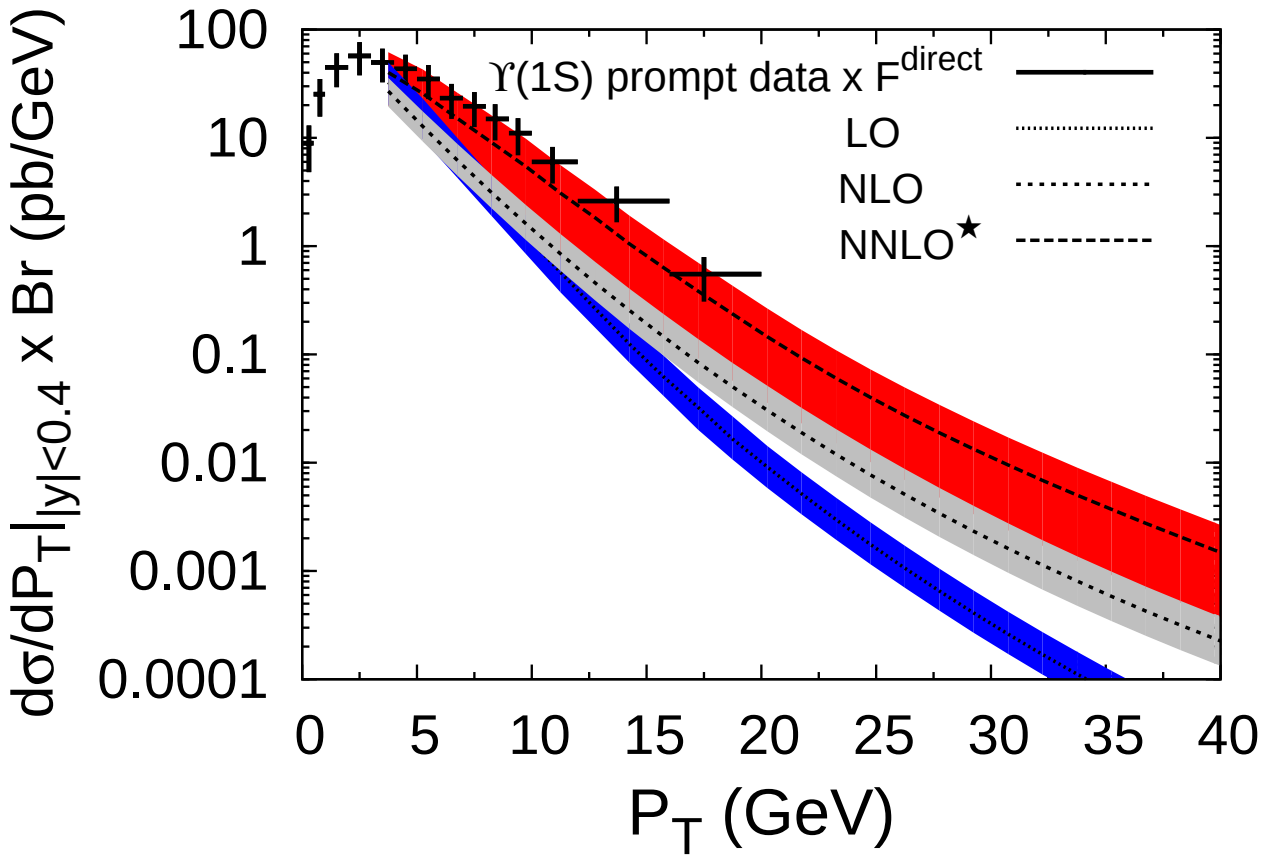

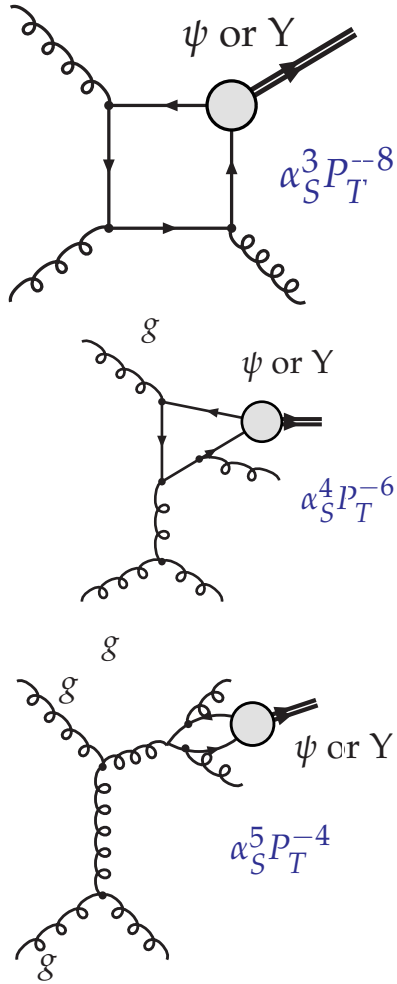

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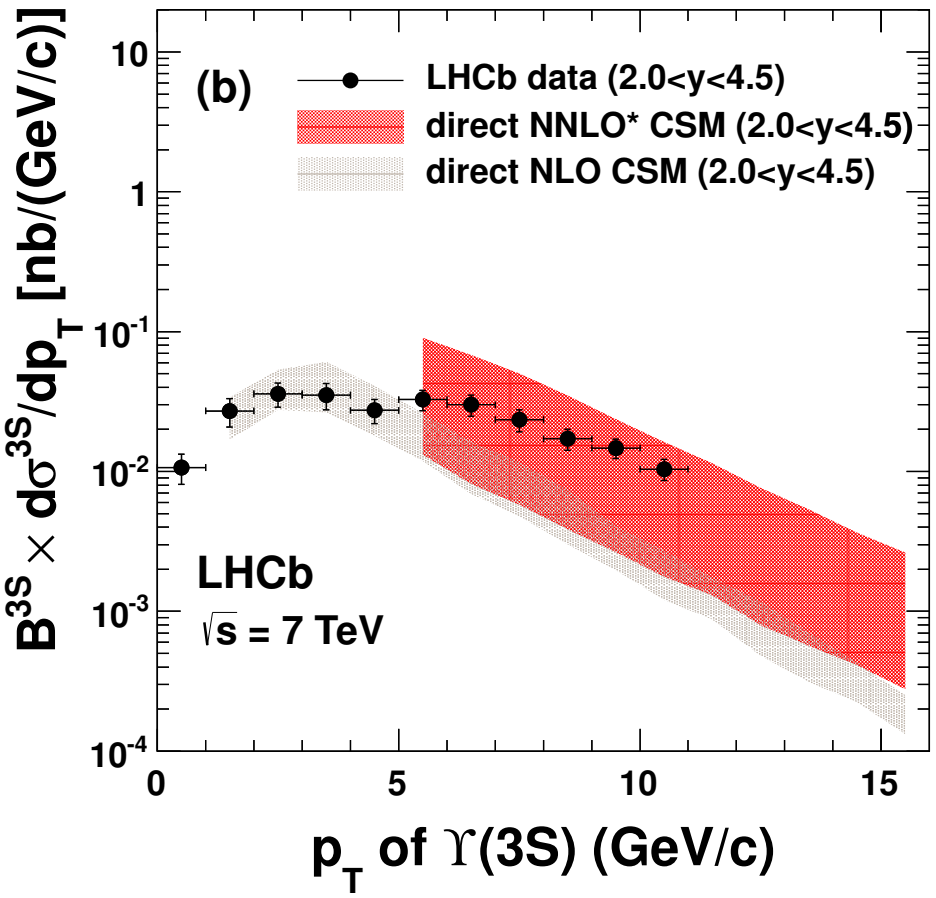

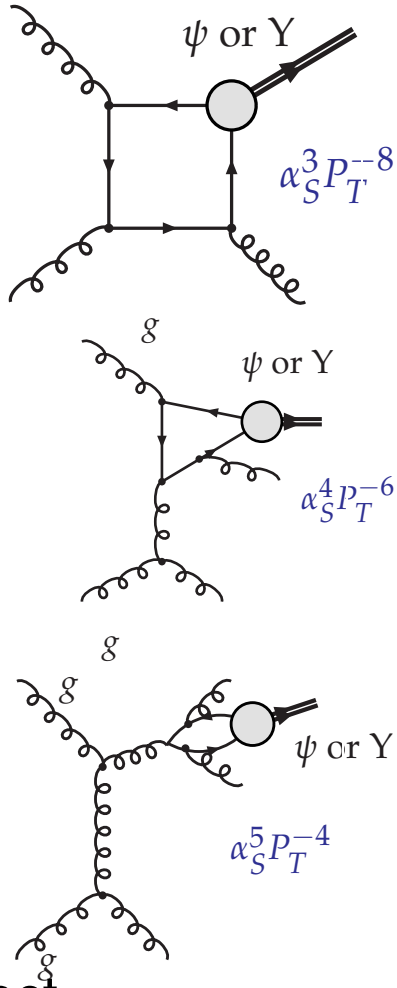

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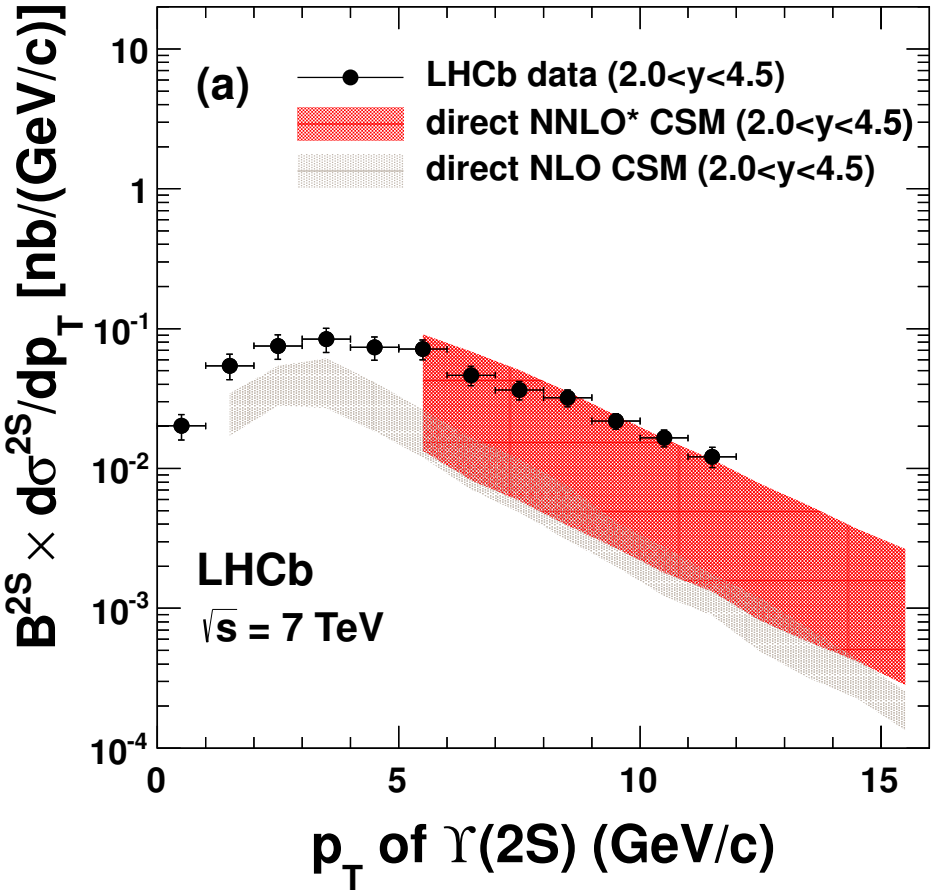

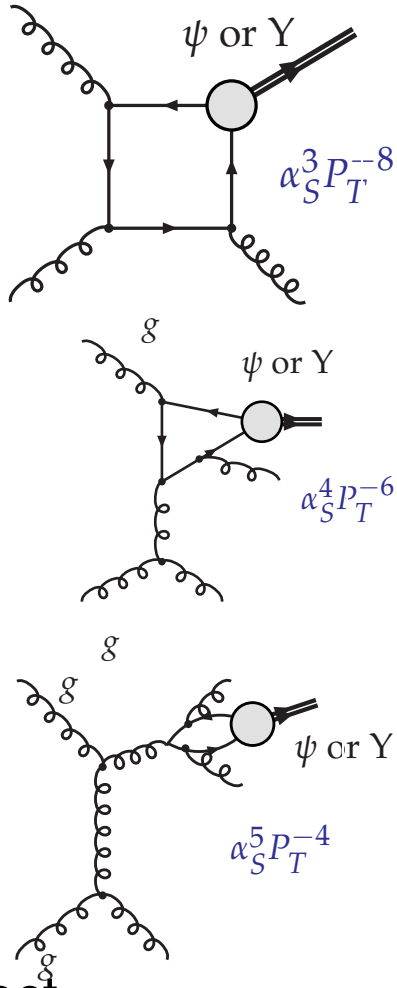

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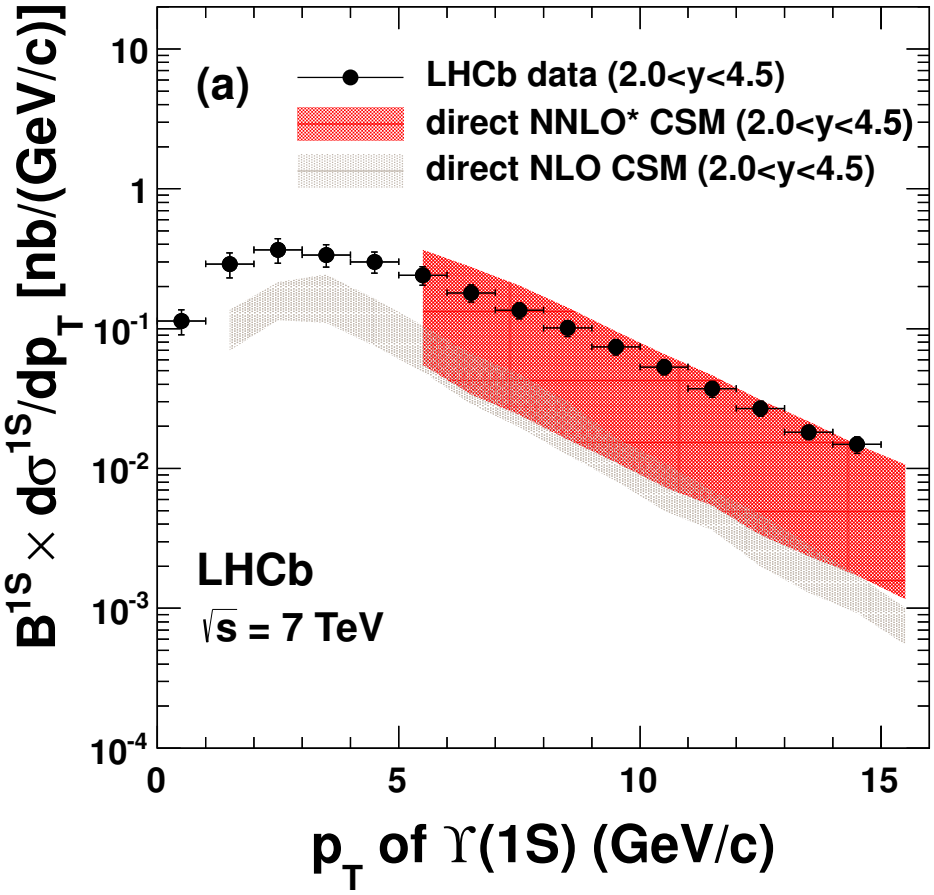

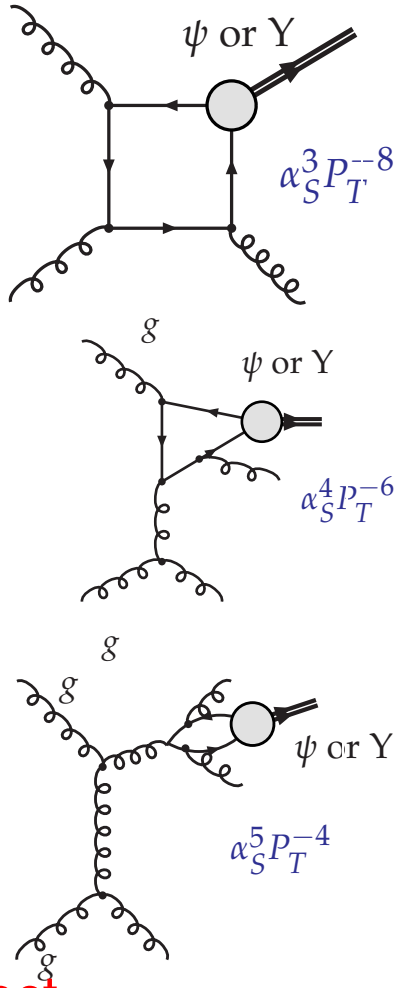

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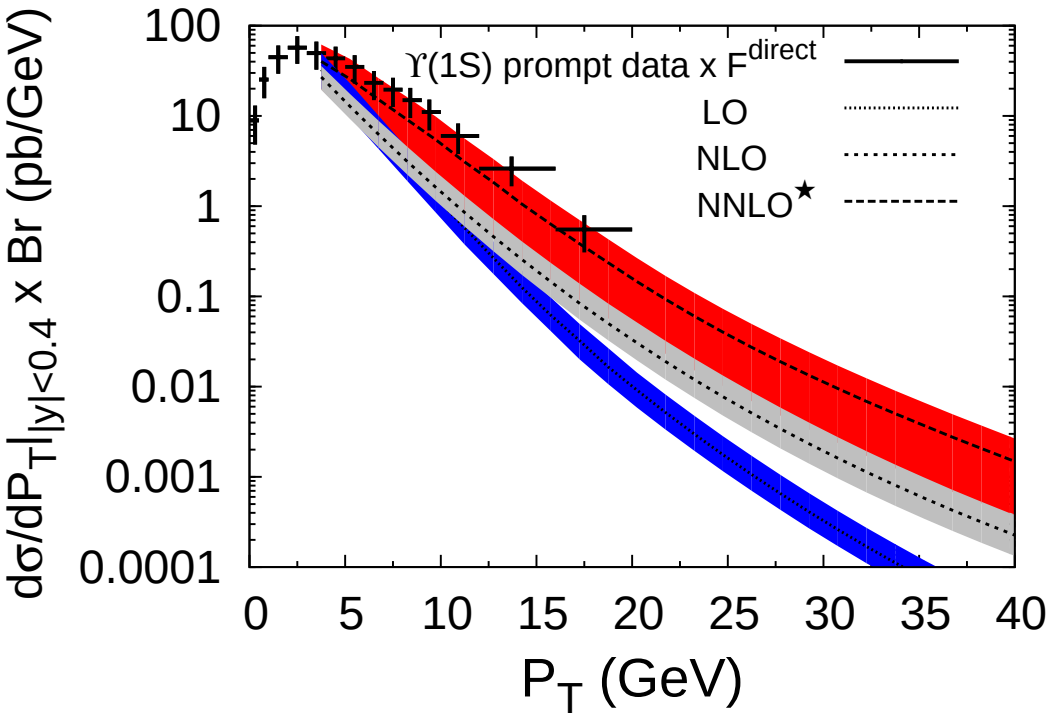
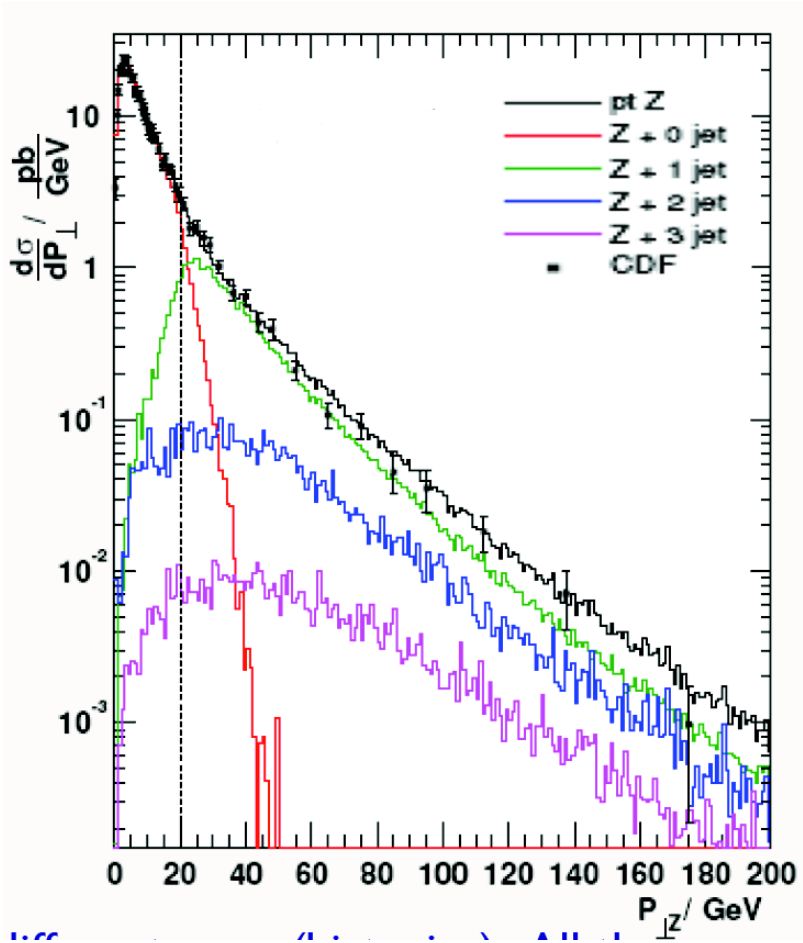
Analogy with the P_T spectrum for the Z^0 boson





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S. J. Brodsky and JPL, PRD 81 051502 (R), 2010; JPL, PoS(ICHEP 2010), 206 (2010)

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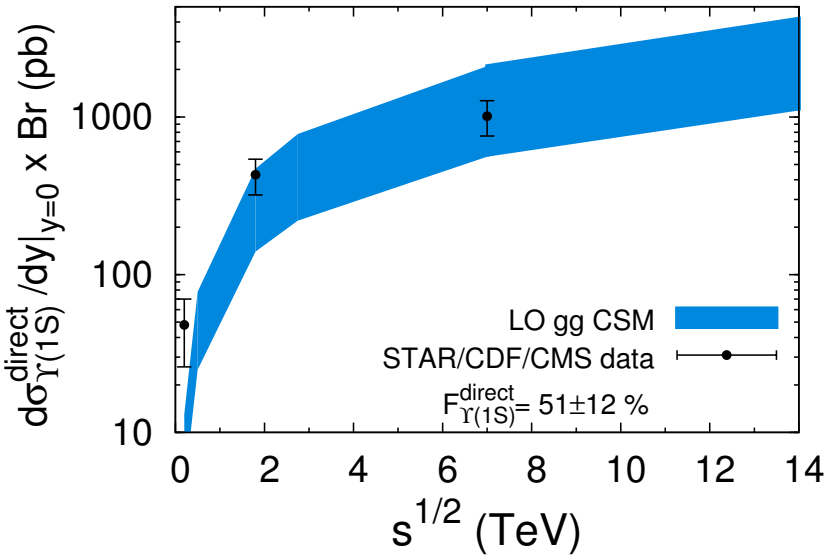

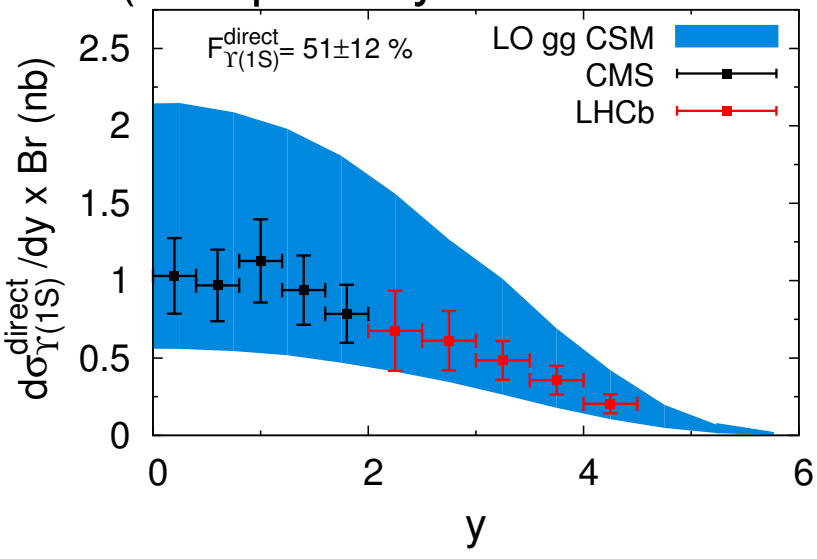

STAR PRD 82 (2010) 012004 ; CDF PRL 88 (2002) 161802; CMS PRD 83 (2011) 112004; LHCb arXiv:1202.6579 [hep-ex]

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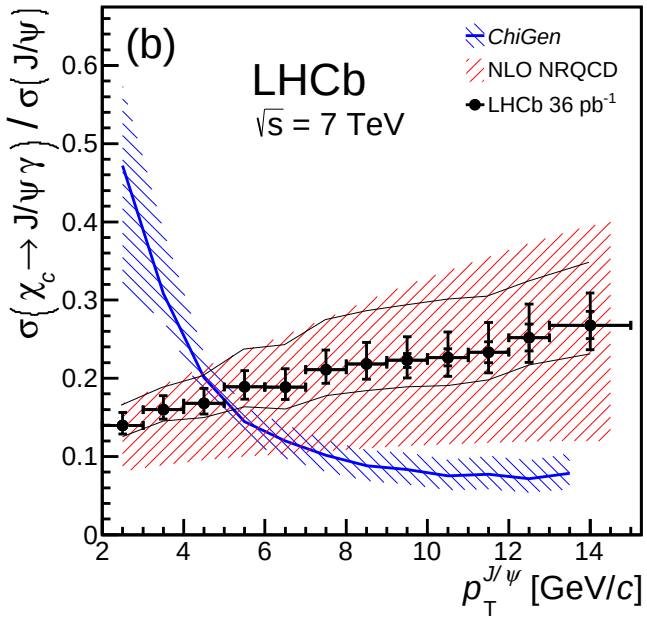
Impact of χ_c's and χ_b's



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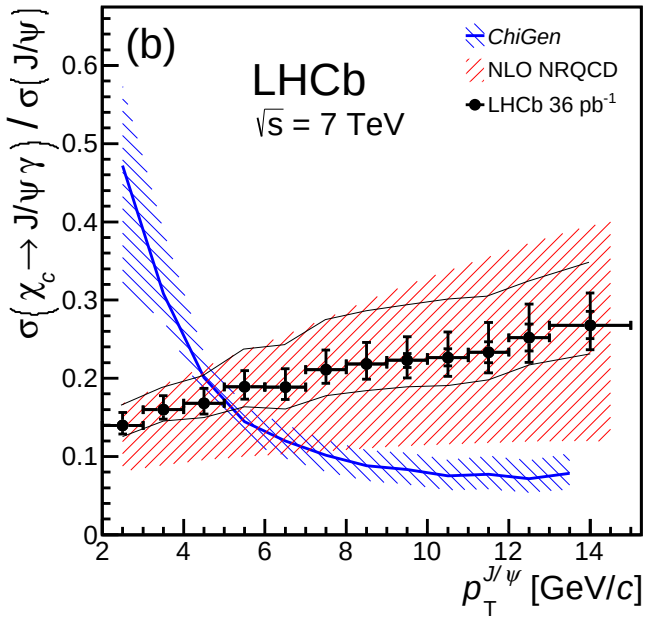

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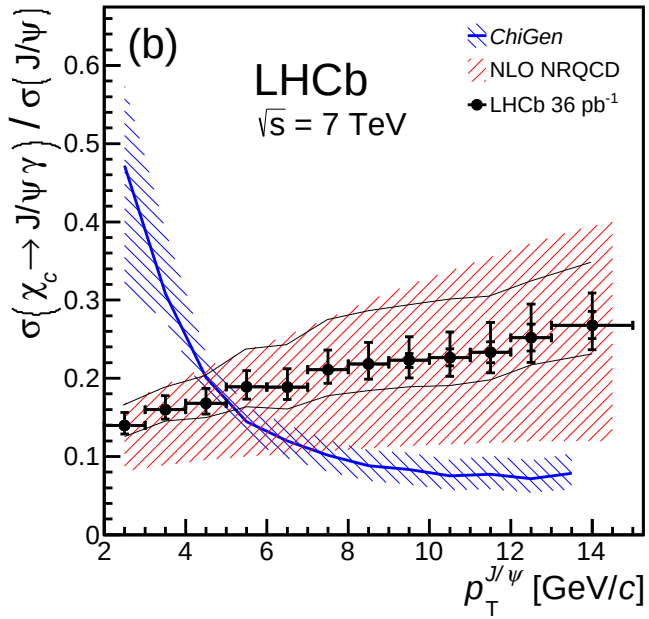

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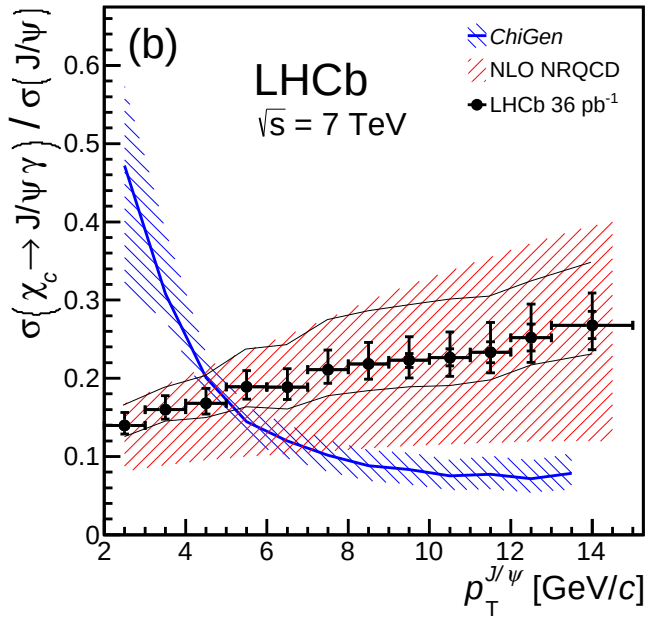

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- No information about the P_T dependence of the χ_b fraction

Part II

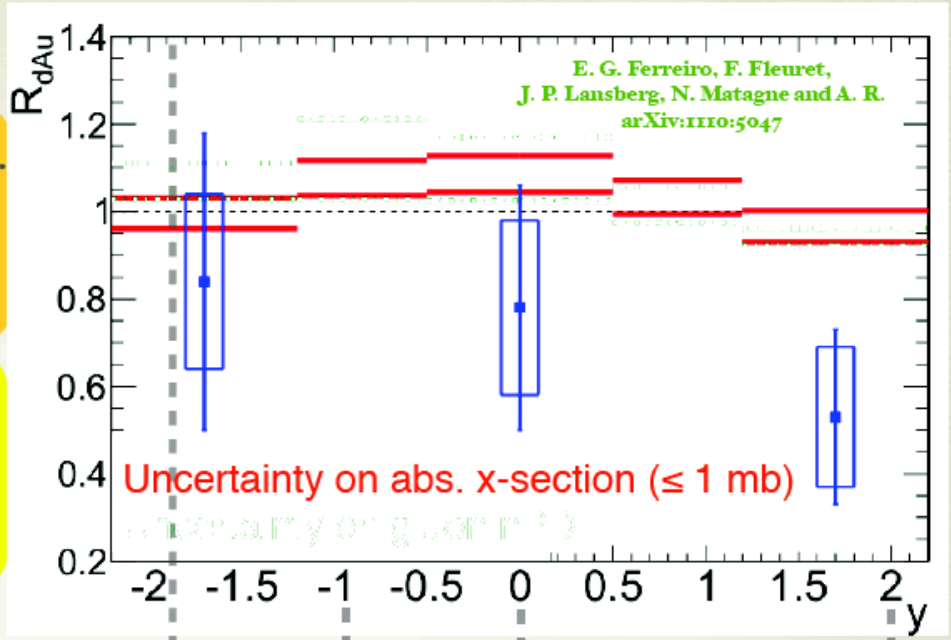
Υ in $p(d)A$ at RHIC, the LHC, now and AFTER ...

Υ in dAu @ RHIC : abs. **effective** x-section

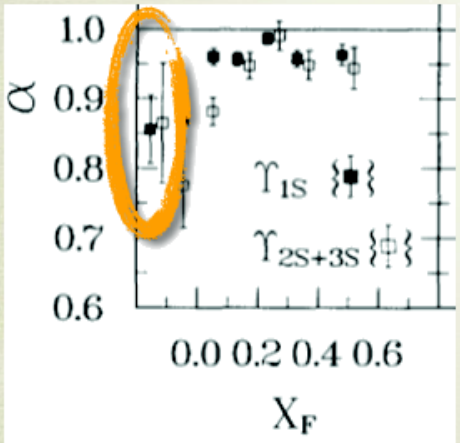
σ_{abs} should be small :

- at bkwd-y, $t_f < r_{Au}$, fully formed Υ. But no diff. exp. seen between Υ(1S) and Υ(2S+3S) σ_{abs}.
- at $y>0$, $t_f > r_{Au}$, same small-size pre-resonance for all Υ states

$$\sigma_\Upsilon \sim 0.1\,\sigma_{J/\psi}\ ?$$



E772 collaboration, PRL 66 (1991) 2285.



increasing t_f in the Au rest frame

propagating in Au :

r_{Au} $\quad 2.r_{Au}$ $\quad 7.r_{Au}$ $\quad 52.r_{Au}$

fully formed Υ

pre-resonant state $\sigma_\Upsilon \sim \left(\frac{m_c}{m_b}\right)^2 \sigma_{J/\psi}$

$x_F = 0$ $\quad x_F \simeq 0.28$

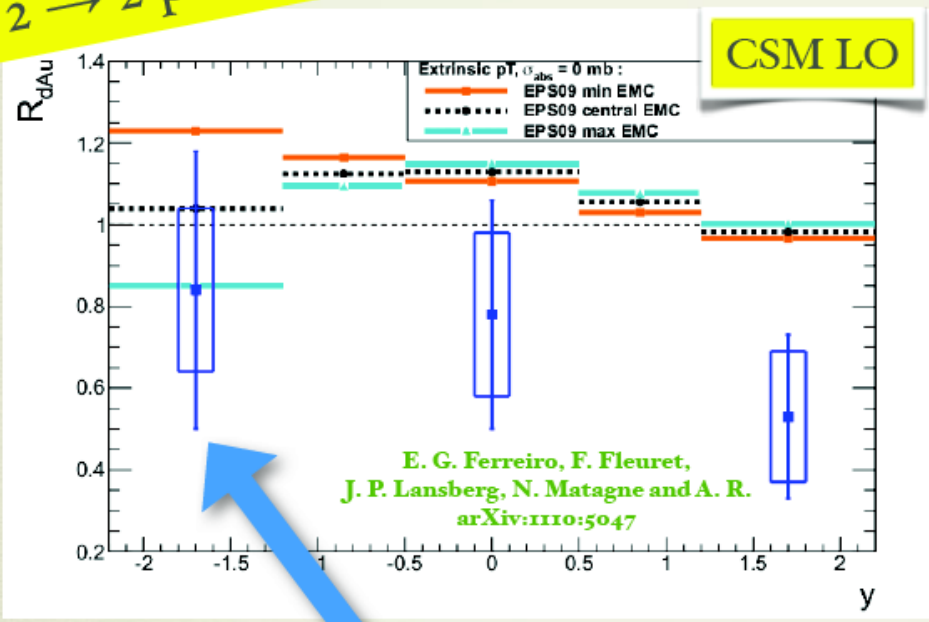
Υ in dAu @ RHIC : gluon EMC effect

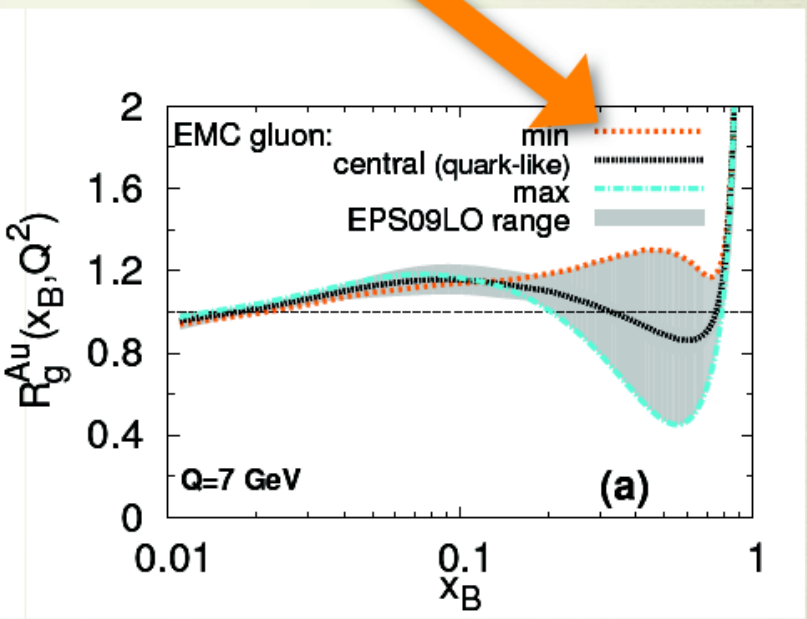
Let us focus in the EMC region and pick the EPS09 sets that are the limiting cases in this region :

$2 \to 2$ process

min. disfavoured

CSM LO





EMC effect stronger for g than for q ?

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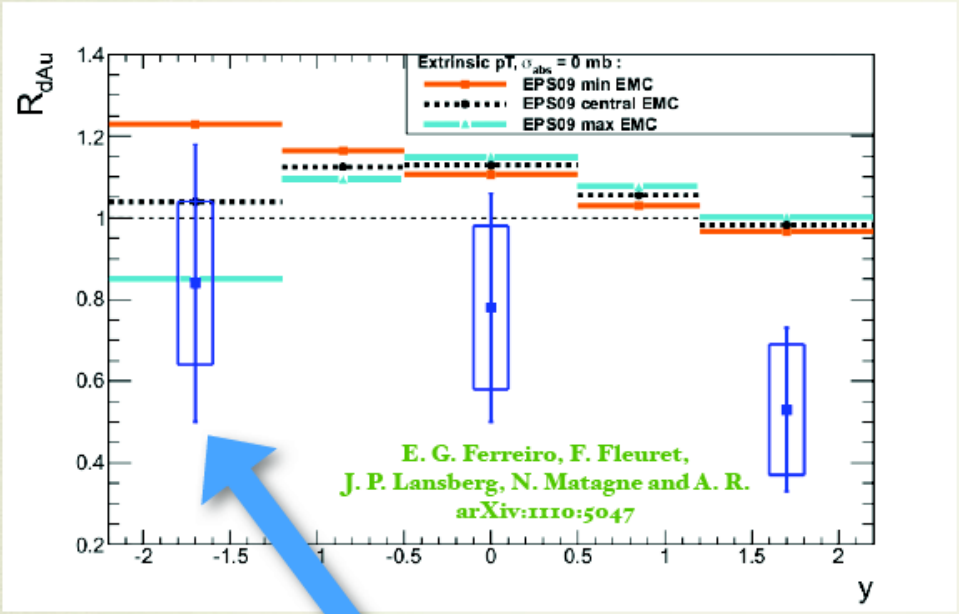

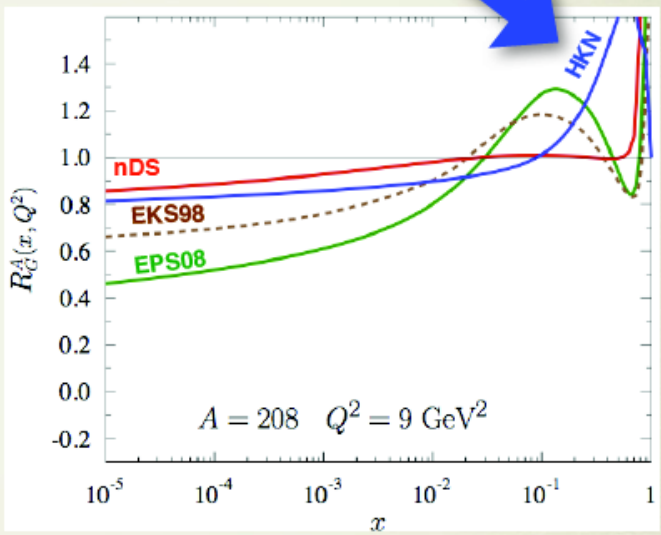

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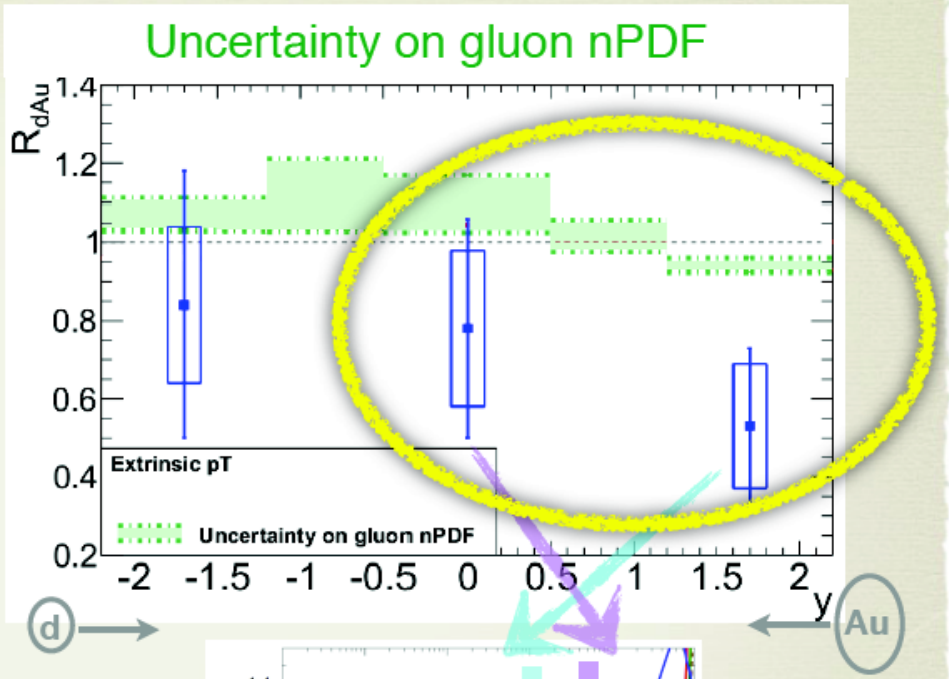
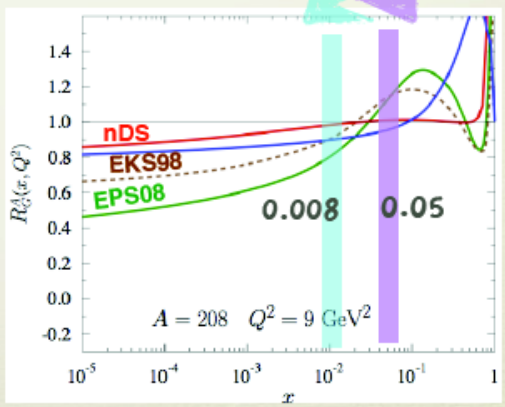
Υ in dAu @ RHIC : shadowing

E. G. Ferreiro, F. Fleuret, J. P. Lansberg, N. Matagne and A. R.
arXiv:1110:5047

Typical gluon nPDF parametrisations induce a **flat rapidity dependence** w.r.t. data





$\langle x_2 \rangle$

shadowing not strong enough
absence of antishadowing ?

Data:
STAR Preliminary, Nucl. Phys. A855 (2011) 440,
PRD 82 (2010) 012004.
PHENIX Preliminary, PoS DIS2010 (2010) 077.

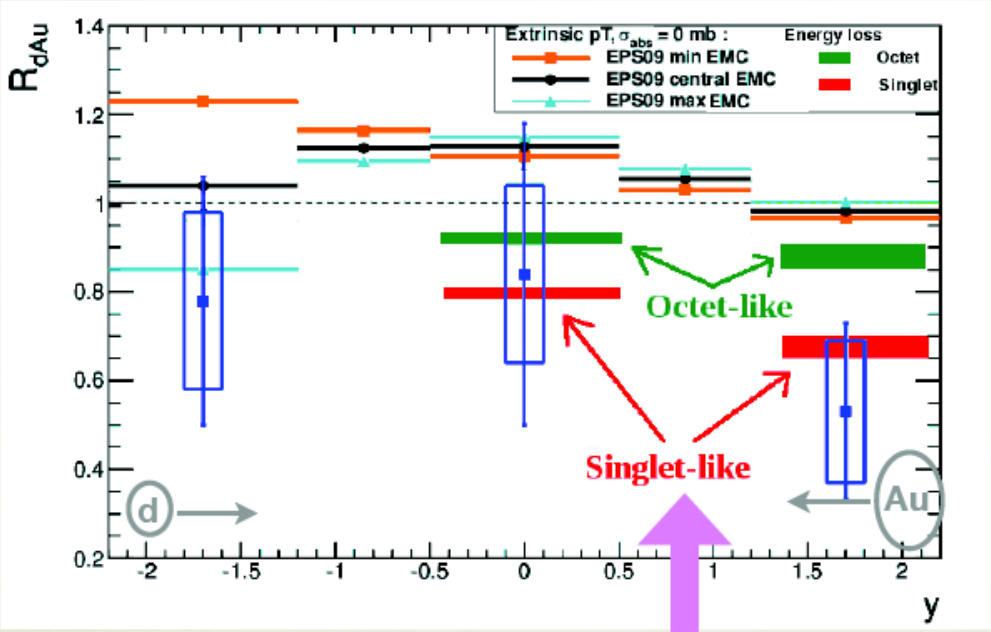
Υ in dAu @ RHIC : energy loss

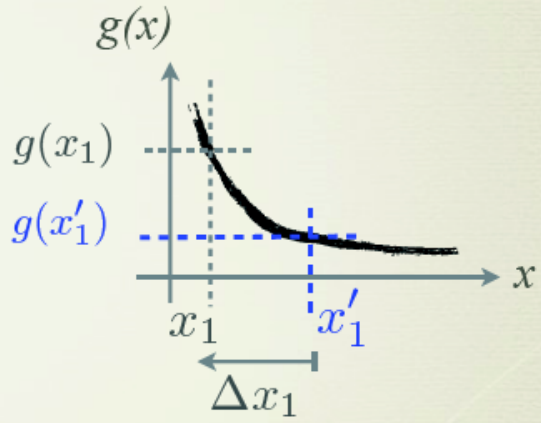
$$t_f^{\text{gluon}} \gg r_{Au} \qquad \Delta E/E = \Delta x_1/x_1 \simeq N_c \alpha_s \sqrt{\Delta \langle p_T^2 \rangle / M_T}$$

[F. Arleo, S. Peigné, T. Sami, PRD 83 (2011) 114036]

radiation off the incoming parton and outgoing colored object is coherent (small scattering angle in the rest frame of the nucleus)

E. G. Ferreiro, F. Fleuret, J. P. Lansberg, N. Matagne and A. R. arXiv:1110:5047





$$R_{\text{loss}}(x_1, Q^2) = \frac{g(x_1', Q^2)}{g(x_1, Q^2)}$$

different E loss for CSM vs COM, **singlet** favoured by the data

J/ψ in dAu @ RHIC : energy loss

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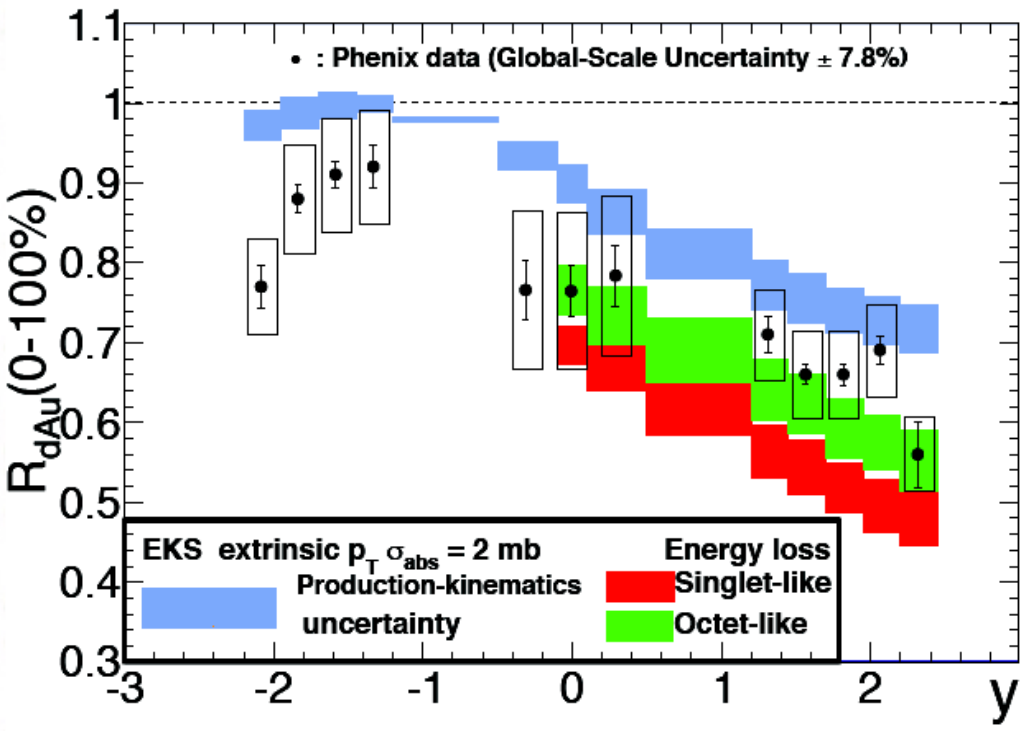

Data:
PHENIX Collaboration, PRL 107 (2011) 142301.

J/ψ picture less clear w.r.t. ϒ :

- rather large uncertainty from the prod. model
- large uncertainty on σ_{abs} (here only one value was chosen)
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Difficult to draw conclusions about the colour state of the produced $c\bar{c}$ pair.

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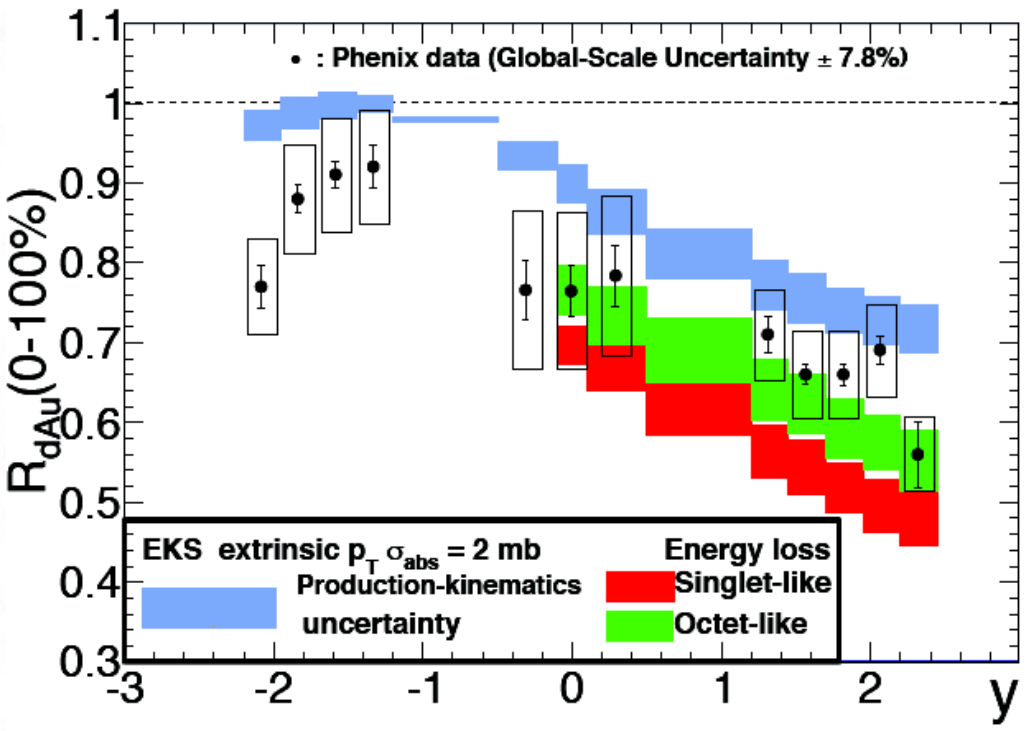

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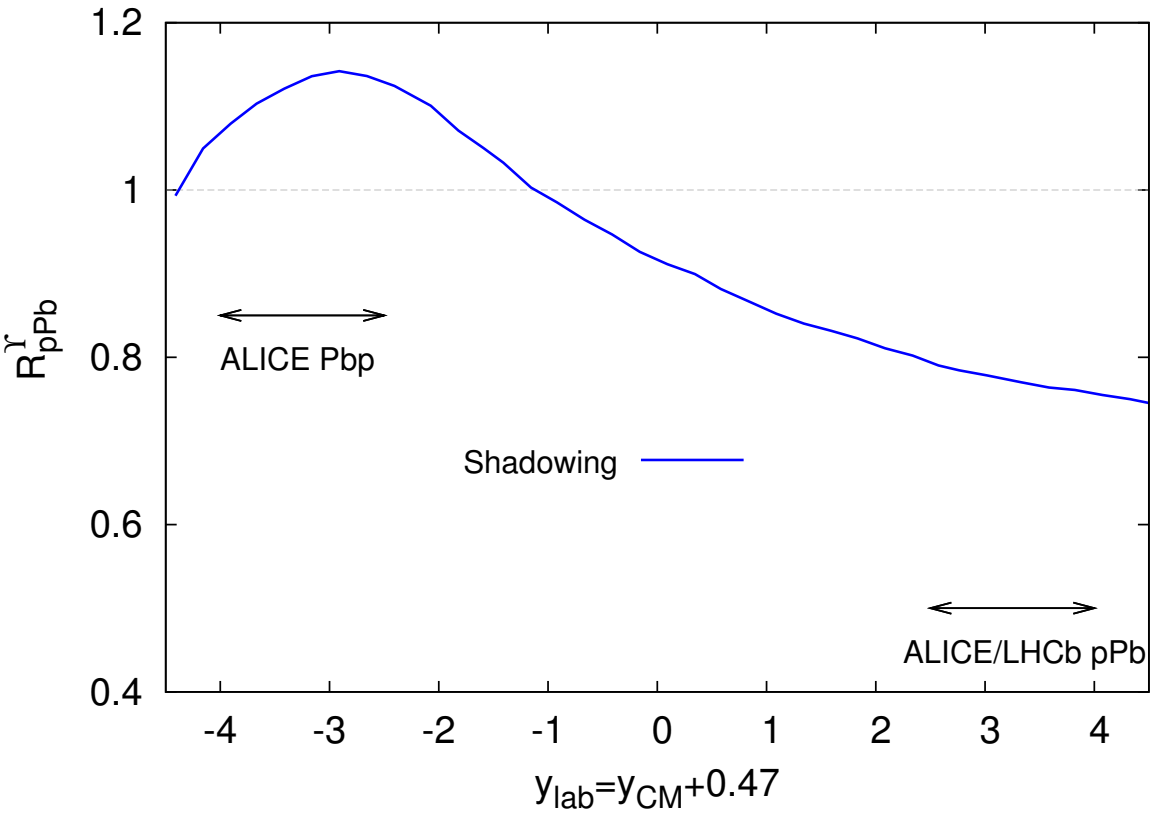
See also F. Arleo's talk (on Monday): our results qualitatively agree

Υ production in *p*Pb at 5 TeV

- Shadowing effect is not small (here EKS98)



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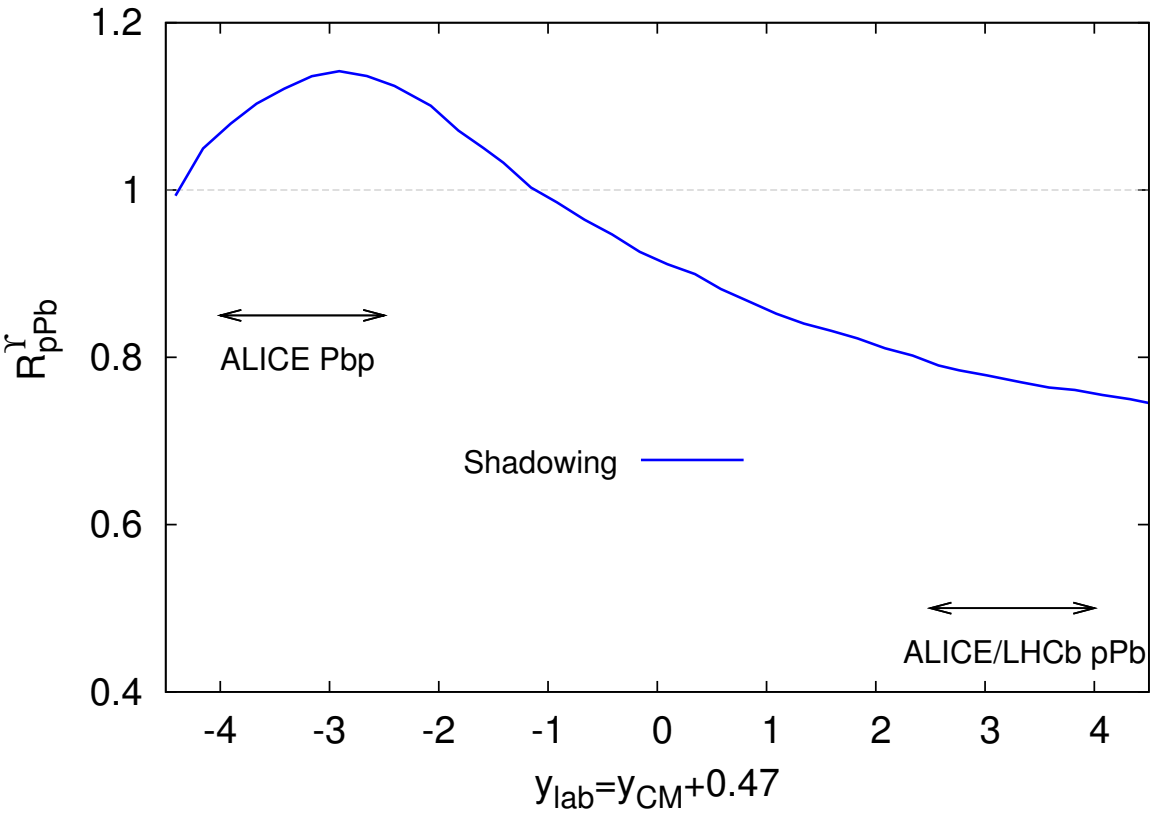

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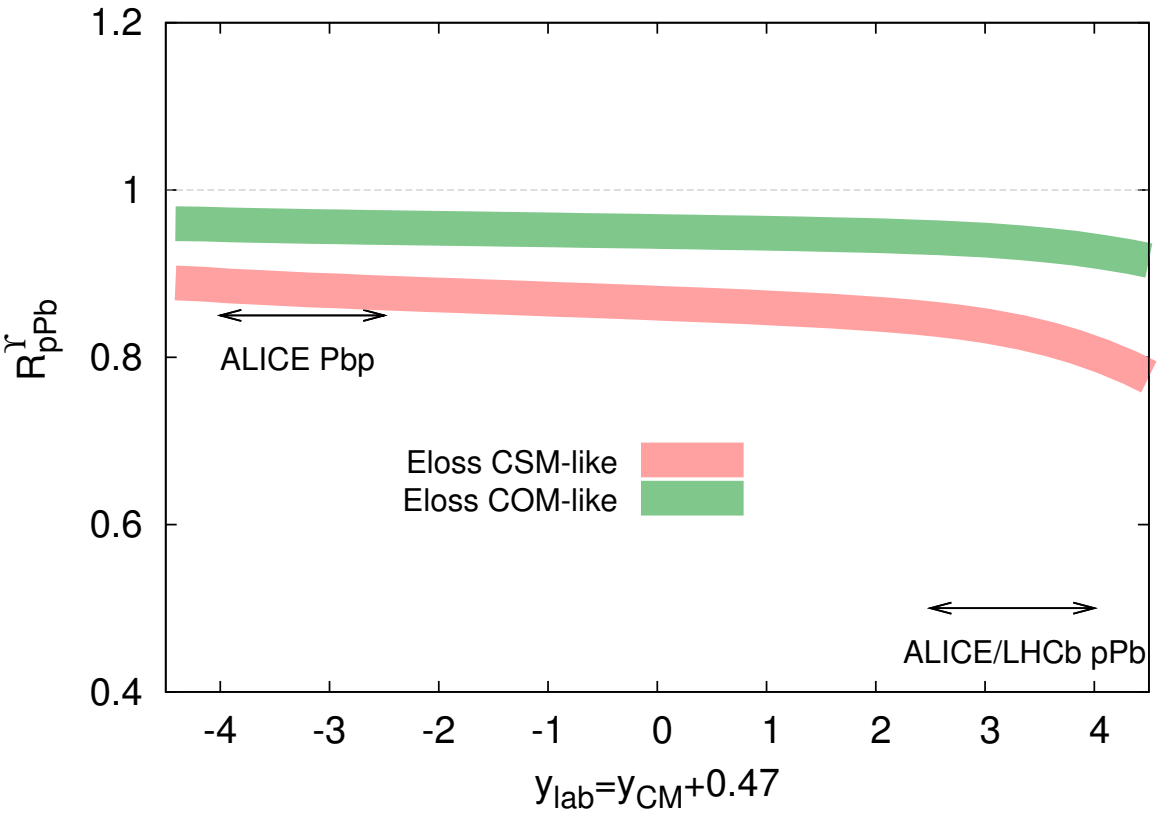

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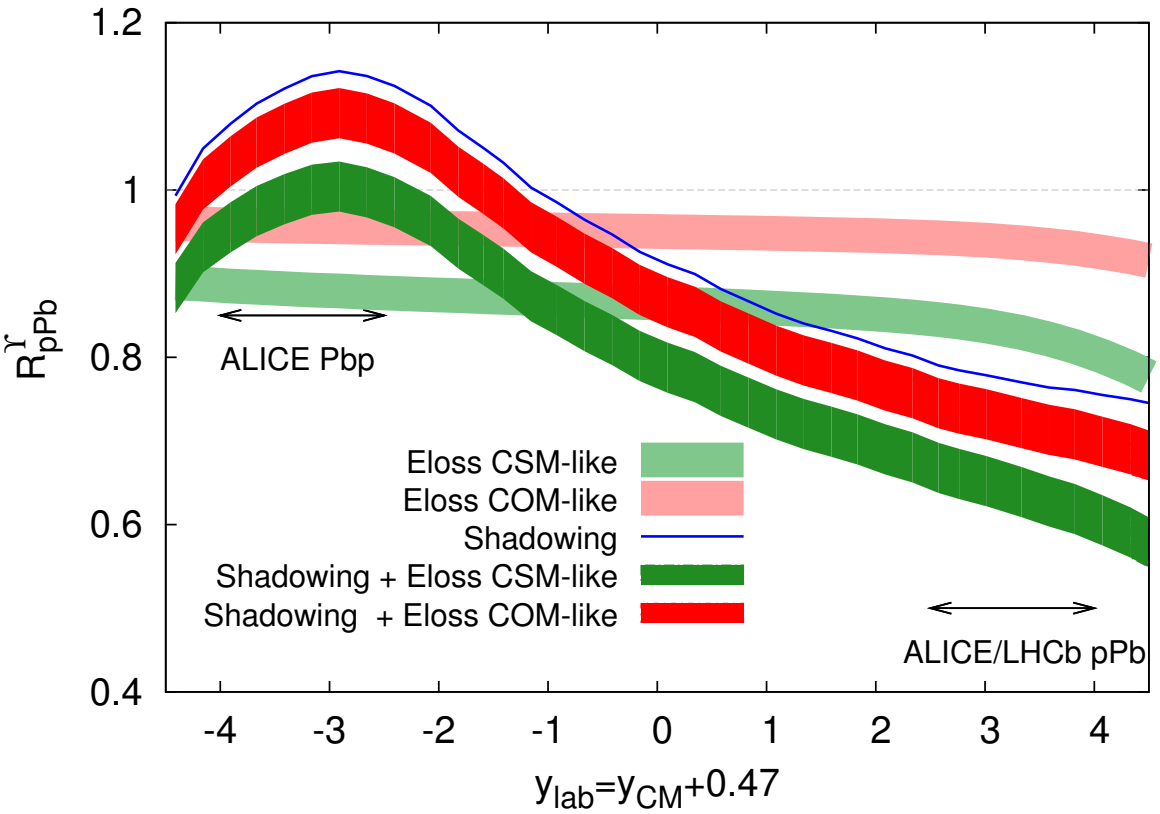

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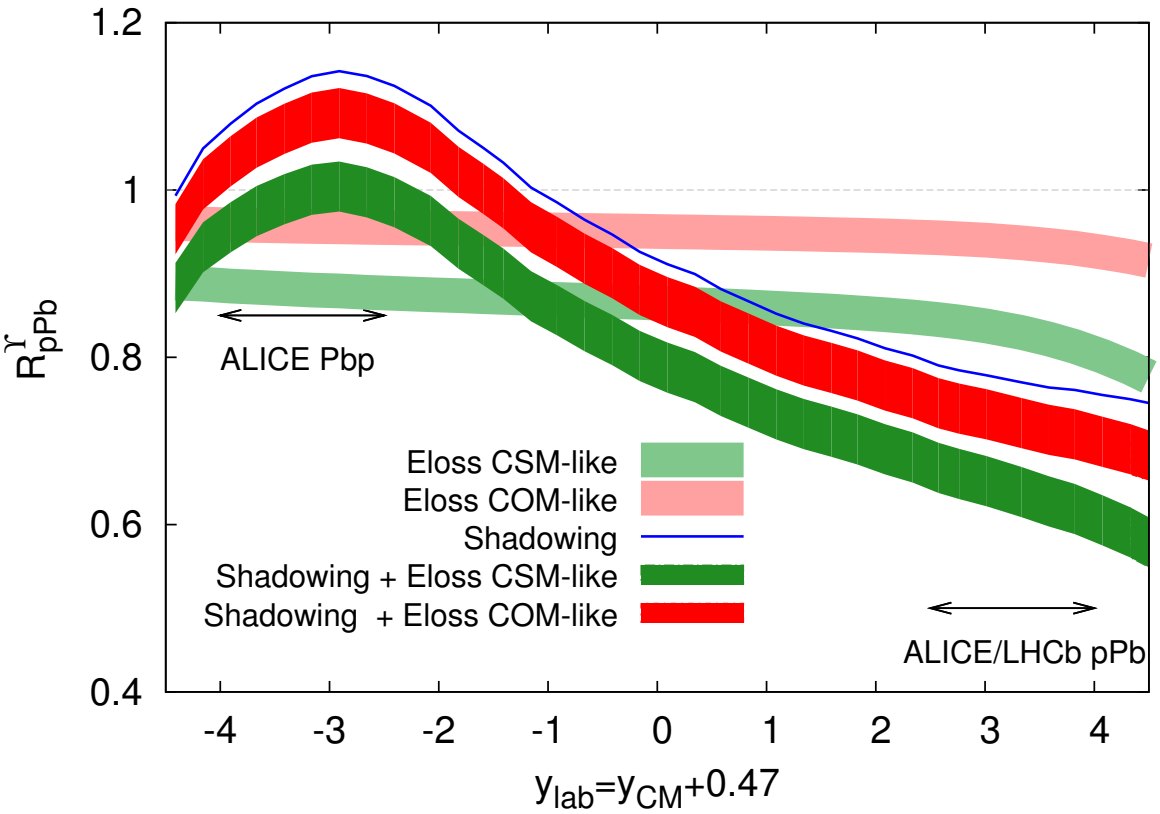

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- Prompt J/ψ and $\psi(2S)$ yield; $\Upsilon(nS)$ yields

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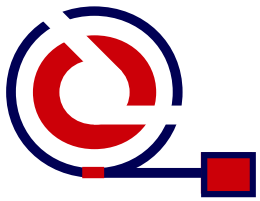

AFTER @ LHC

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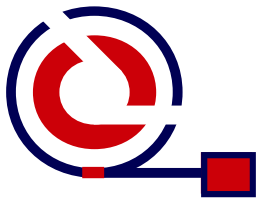
- Stay tuned for talks at ICHEP2012 and Quark Matter2012



AFTER @ LHC

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- The forthcoming pPb run as well as A Fixed Target ExpeRiment at the LHC will/would provide much information
  see **http://after.in2p3.fr**

Part III

Backup

A Fixed Target ExperRiment

Generalities

- pp or pA with a 7 TeV p beam : $\sqrt{s} \simeq 115$ GeV

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P. Ballin *et al.*, **NIMB 267 (2009) 2952**

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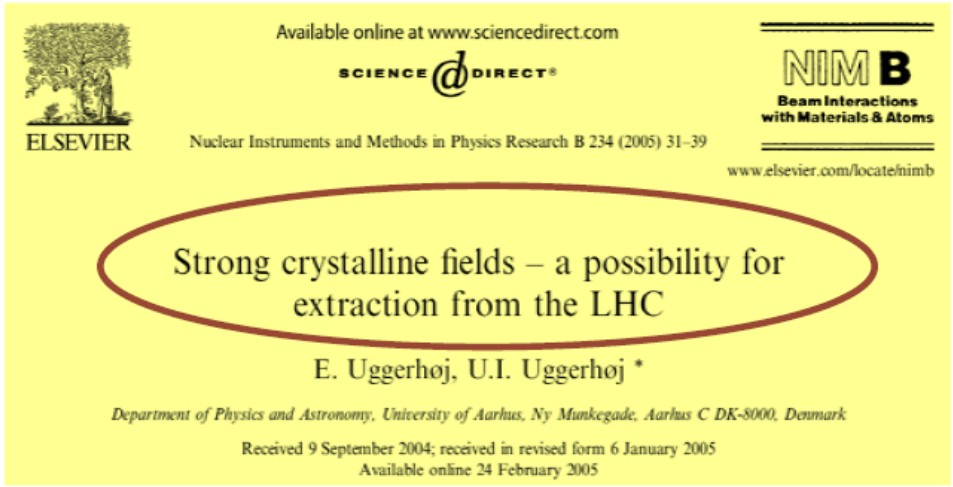
Beam extraction

- **Beam extraction @ LHC**

… there are extremely promising possibilities to extract 7 TeV protons from the circulating beam by means of a bent crystal.

… The idea is to put a bent, single crystal of either Si or Ge (W would perform slightly better but needs substantial improvements in crystal quality) at a distance of $\simeq 7\sigma$ to the beam where it can intercept and deflect part of the beam halo by an angle similar to the one the foreseen dump kicking system will apply to the circulating beam.

… ions with the same momentum per charge as protons are deflected in a crystal with similar efficiencies



If the crystal is positioned at the kicking section, the whole dump system can be used for slow extraction of parts of the beam halo, the particles that are anyway lost subsequently at collimators.

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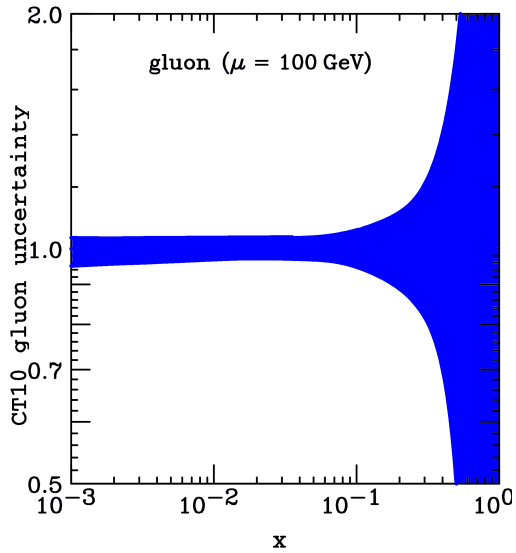

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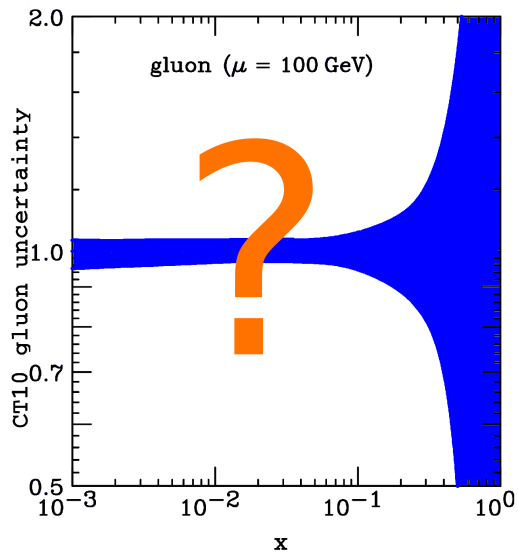

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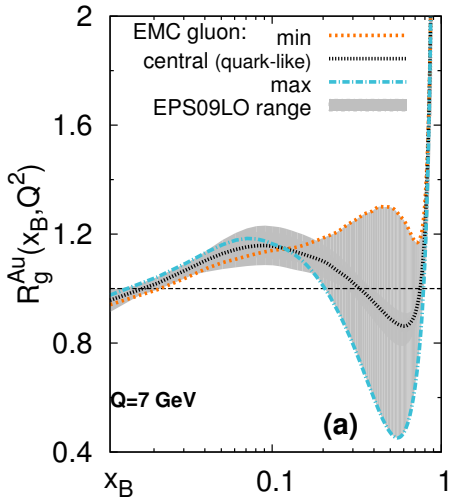

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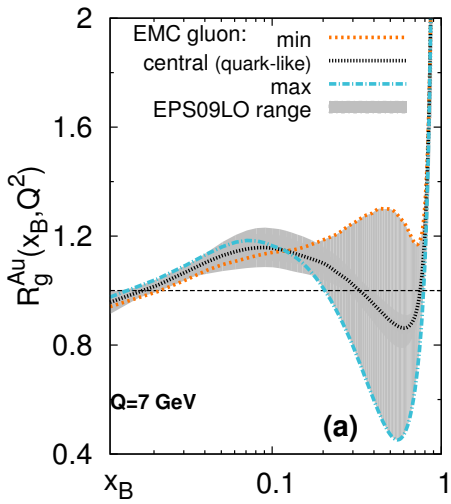

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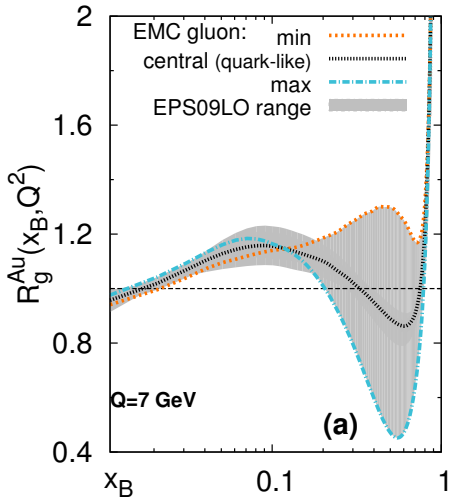

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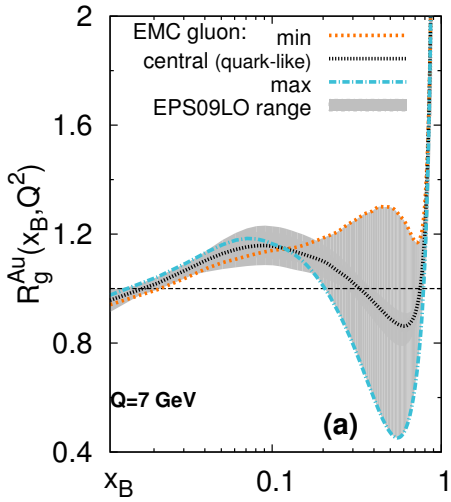

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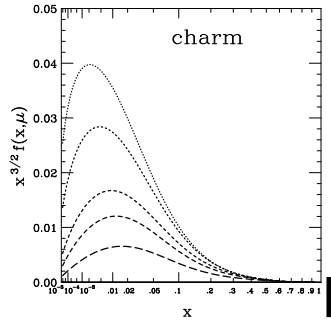

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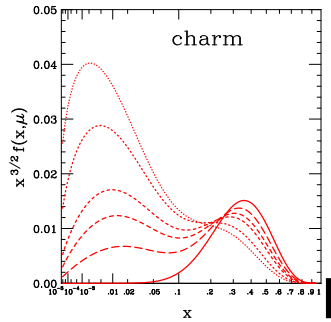

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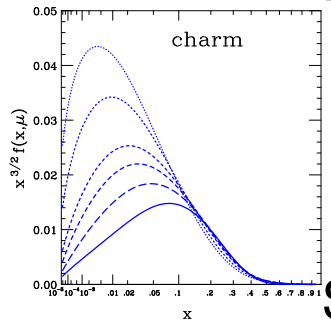

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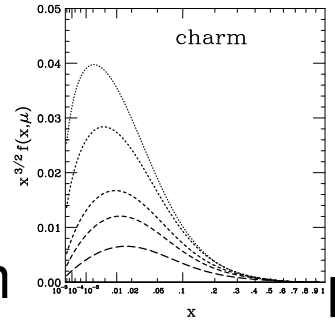

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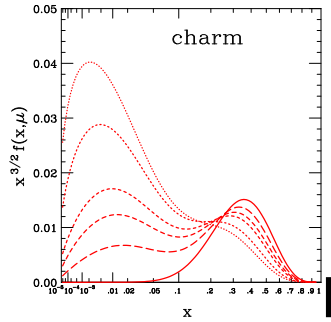

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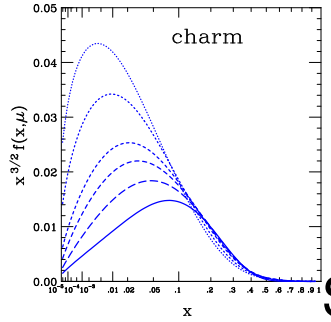

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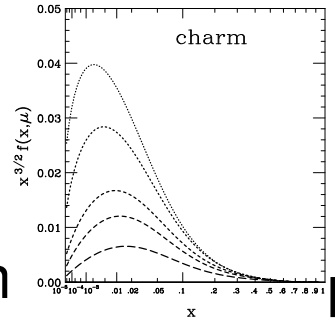

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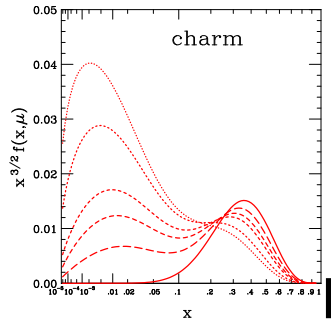

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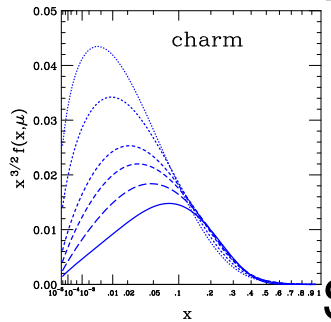

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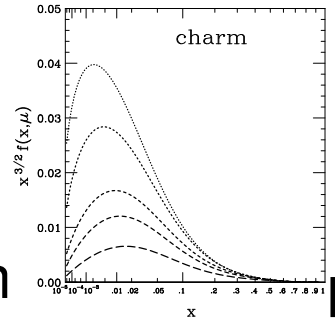

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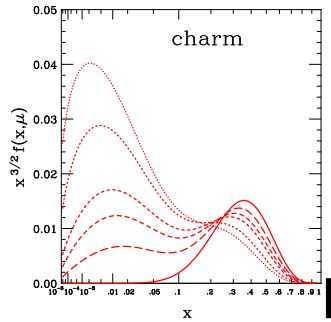

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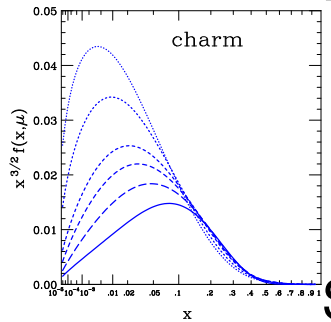

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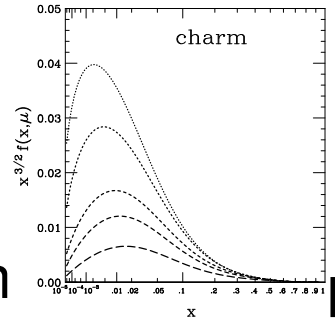

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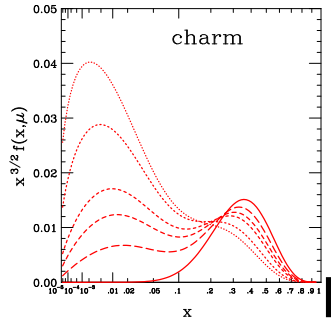

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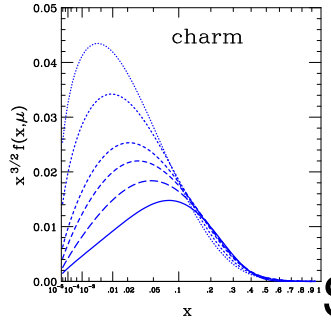

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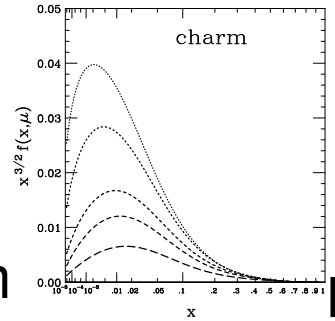

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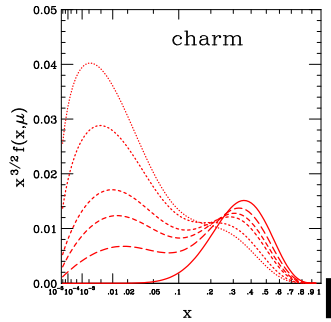

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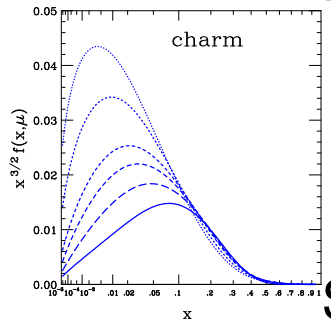

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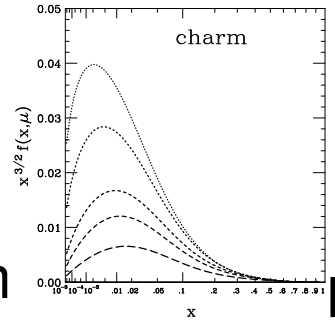

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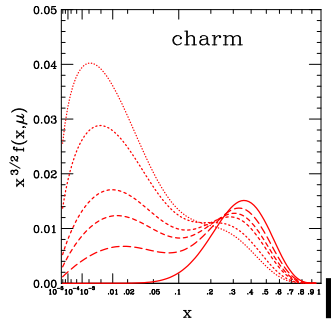

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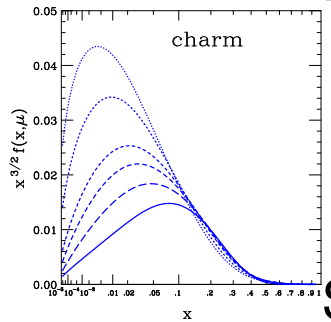

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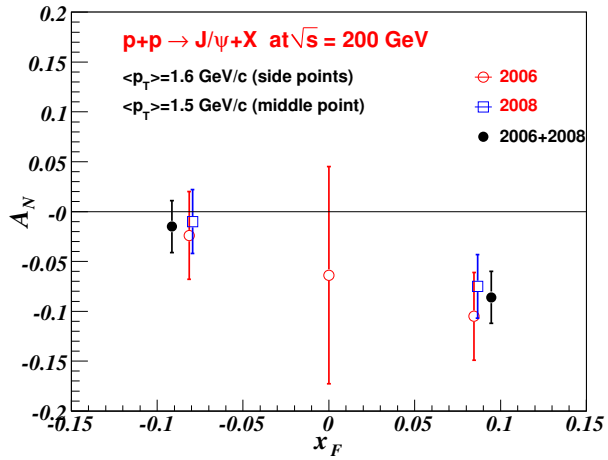

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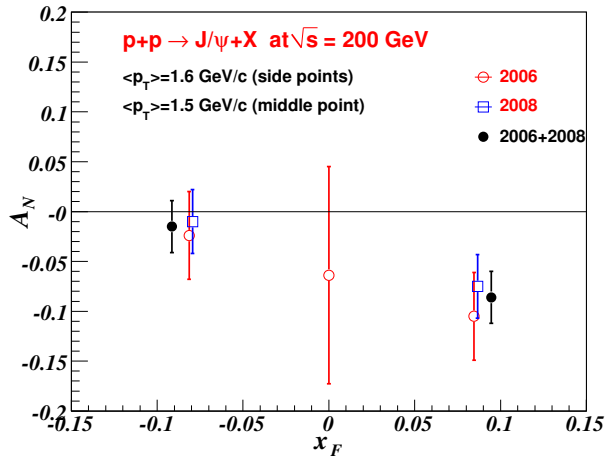

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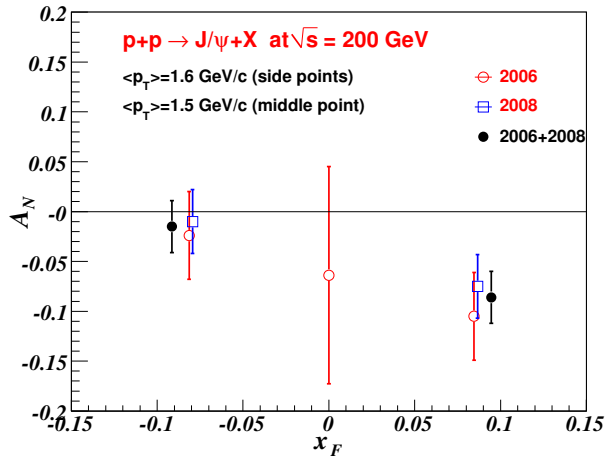

(**A. Bacchetta,** *et al.***Phys. Rev. Lett. 99 (2007) 212002)**

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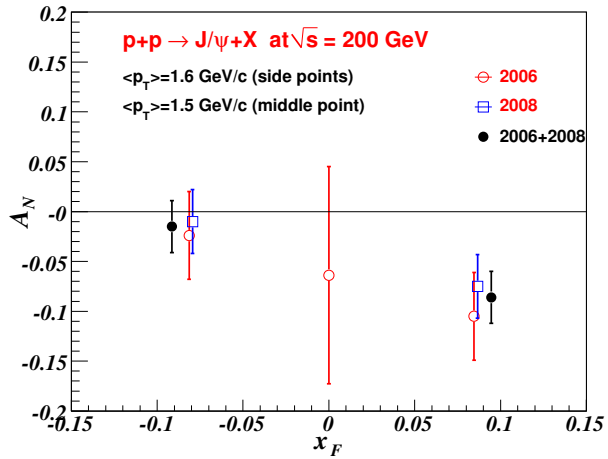

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- Multiply heavy baryons: discovery potential ?
- Very forward (backward) physics:
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  - Ultra-peripheral collisions, etc.