Prompt and nonprompt J/ψ modification in pPb collisions at 5.02 TeV with CMS

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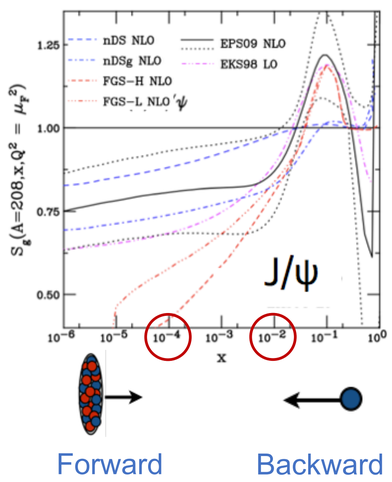
1) Introduction

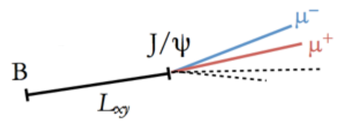
- **pPb collisions**
  - Probes the cold nuclear matter (CNM) effects[2]: modification of nPDFs, energy loss, etc.
  - A baseline for QGP study in PbPb collisions
- **Prompt J/ψ**
  - Sensitive to the gluon PDFs
- **Nonprompt J/ψ**
  (from the decay of B meson)
  - Information on b quark production
- **First J/ψ R_{pPb} results using exclusively pp (2015) and pPb (2013) data at the same $\sqrt{s_{NN}}$ = 5.02 TeV**



2) Analysis Method

- **Prompt vs. nonprompt J/ψ**
  - Signal: a Crystal Ball + a Gaussian
  - Background: an exponential
  - 2D fit to dimuon mass and decay length

$$l_{J/\psi} = L_{xy}\frac{m_{J/\psi}}{p_{\mathrm{T}}}$$

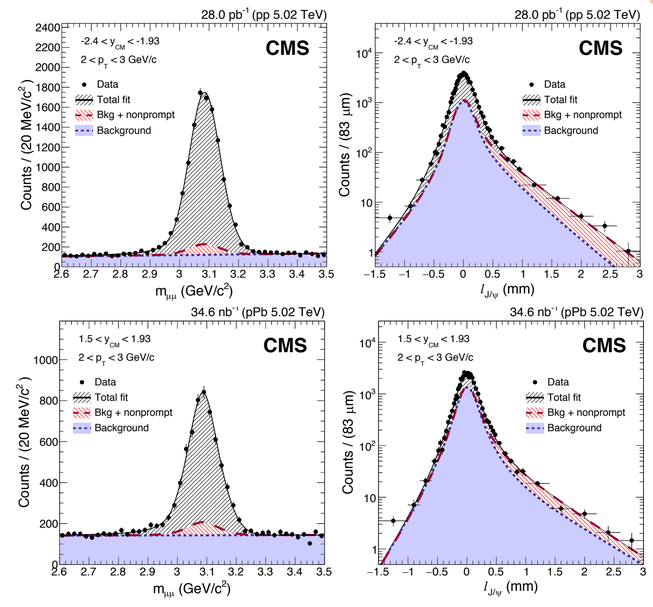


- Long lifetime of B meson (~500 μm/c)

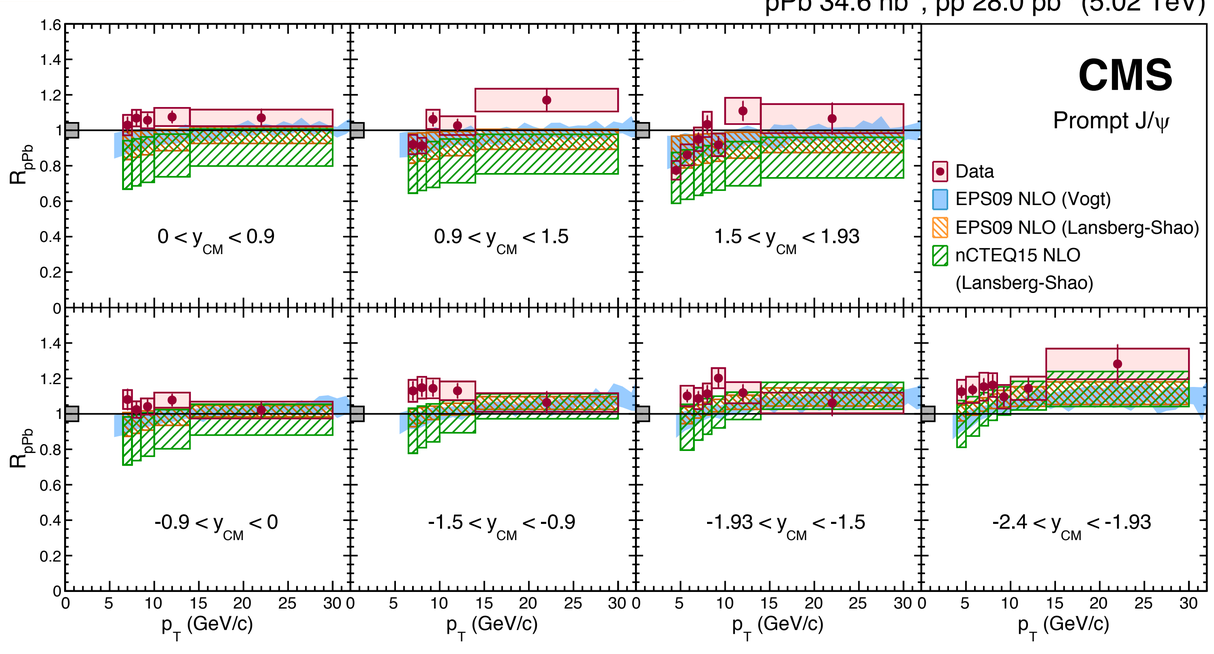
- **Nuclear modification factor**

$$R_{\mathrm{pPb}}(p_{\mathrm{T}}, y_{\mathrm{CM}}) = \frac{(\mathrm{d}^2\sigma/\mathrm{d}p_{\mathrm{T}}\mathrm{d}y_{\mathrm{CM}})_{\mathrm{pPb}}}{\mathrm{A}(\mathrm{d}^2\sigma/\mathrm{d}p_{\mathrm{T}}\mathrm{d}y_{\mathrm{CM}})_{\mathrm{pp}}}$$

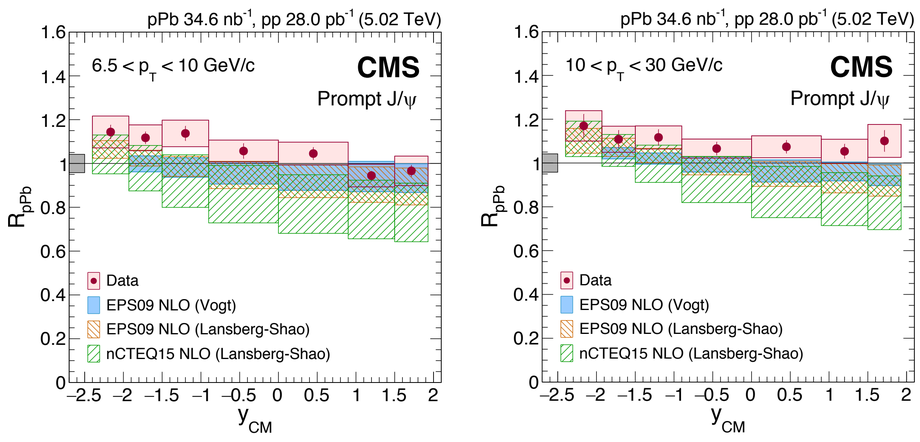
- Cross sections ratio in pPb over pp scaled by the number of nucleons in the pPb nucleus (A = 208)
  ($4 < p_T < 30$ GeV/c, $-2.4 < y_{CM} < 1.93$)



3) Prompt J/ψ R_{pPb}

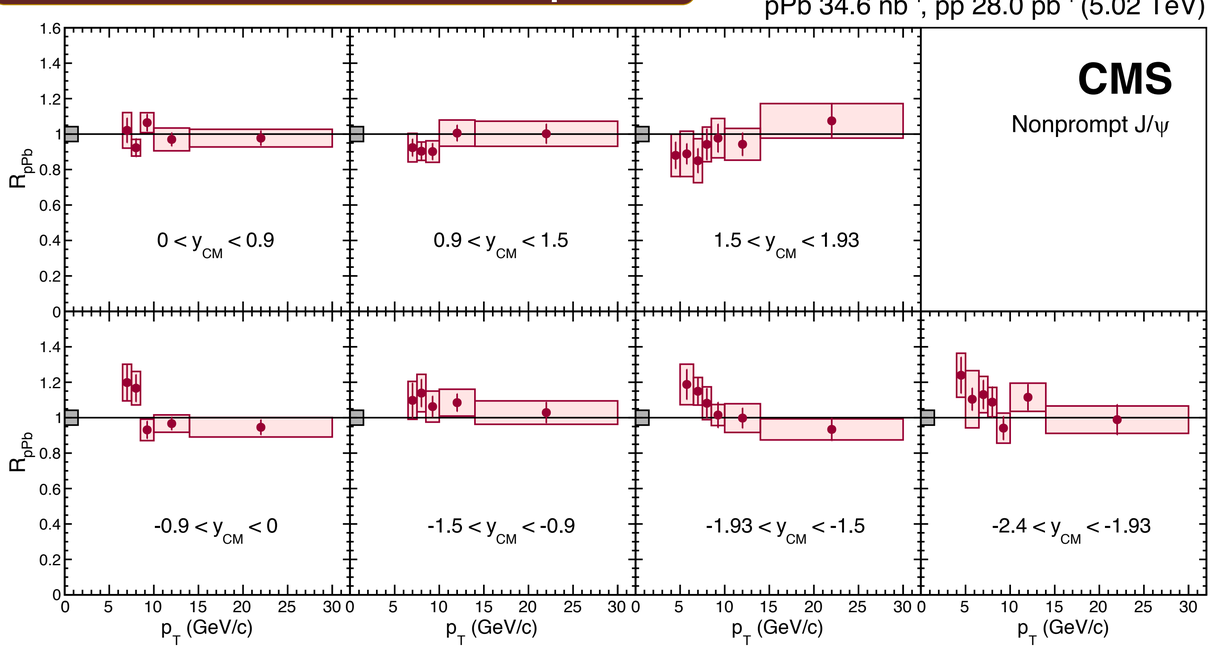


- $R_{pPb} \gtrsim 1$ in mid- and backward y_{CM}
- Suppression at forward and low p_T is suggested
- Three nPDF models[3-6]: marginally lower than data

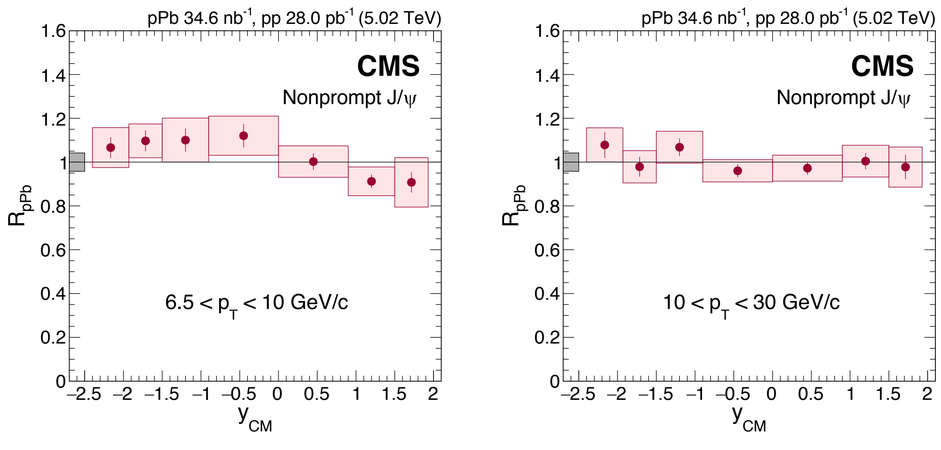


- High p_T: $R_{pPb} > 1$
- Low p_T: possible decrease of R_{pPb} for increasing y_{CM}

4) Nonprompt J/ψ R_{pPb}



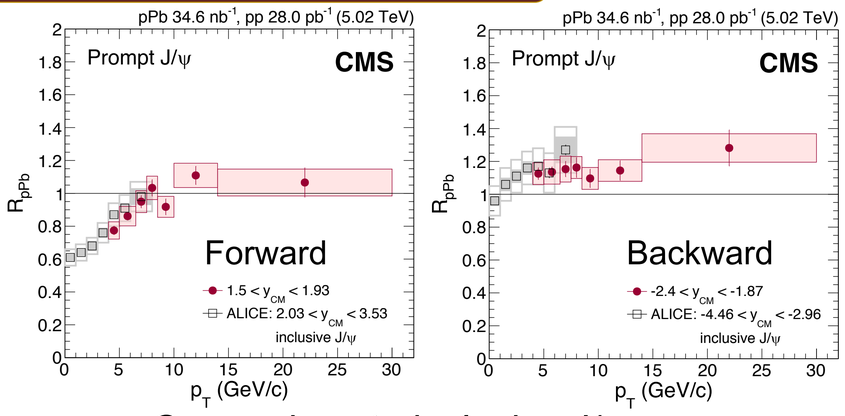
- $R_{pPb} \sim 1$ in all y_{CM} bins analyzed
- Possible enhancement at backward and low p_T



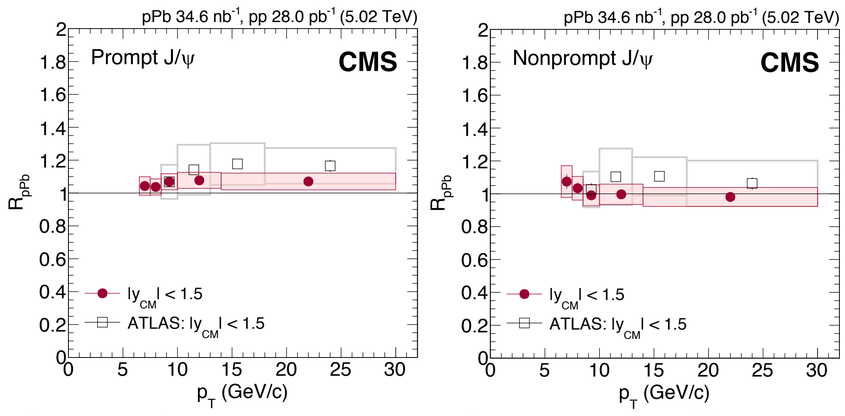
- High p_T: $R_{pPb} \sim 1$
- Low p_T: possible decrease of R_{pPb} for increasing y_{CM}

5) Comparison

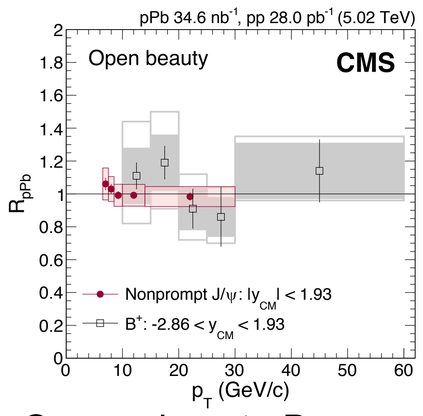
- **Precise measurements of charmonia and open beauty, extending previous measurements**



- Comparison to inclusive J/ψ meson from the ALICE collaboration[7]



- Comparison to prompt and nonprompt J/ψ mesons from the ATLAS collaboration[8]



- Comparison to B+ meson (the CMS collaboration[9])

6) Summary

- Production of prompt and nonprompt J/ψ is separately studied in pPb collisions
- Prompt J/ψ R_{pPb} is above unity at mid- and backward rapidities, with a possible depletion in the most forward bin and low p_T ($\lesssim$ 7.5 GeV/c)
- Nonprompt J/ψ R_{pPb} is compatible with unity
- These measurements, covering a wide kinematic range and using only pp data at 5.02 TeV, provide new insight on nuclear matter effects on charmonium and open beauty production

References

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[7] ALICE Collaboration, JHEP **06** (2015) 055
[8] ATLAS Collaboration, arXiv:1509.06797
[9] CMS Collaboration, Phys. Rev. Lett. 116 (2016) 032301