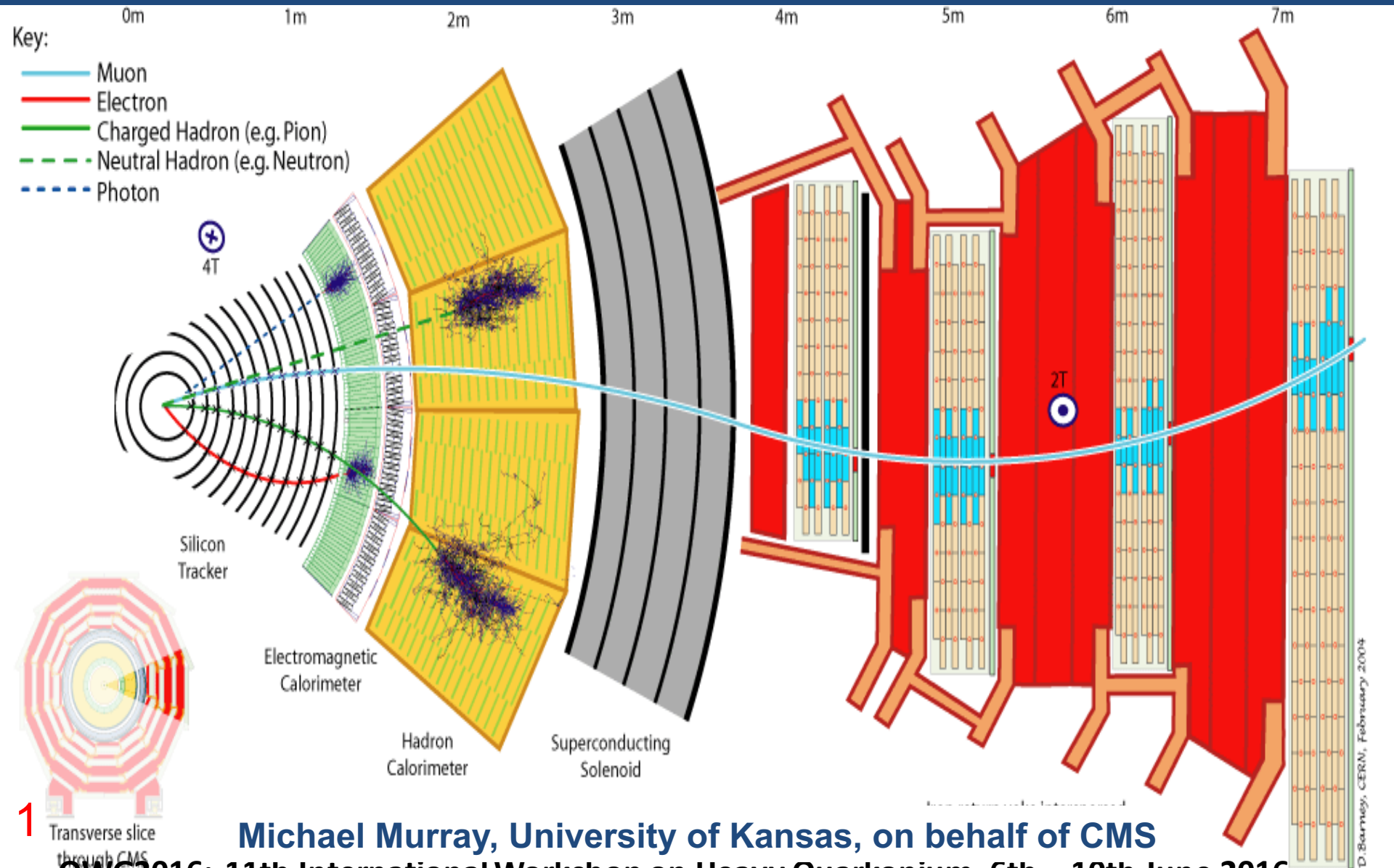
Bottomonium production in p-Pb and Pb-Pb



Michael Murray, University of Kansas, on behalf of CMS

Outline

Hot Effects

- Study nuclear suppression vs p_T & y
- Compare suppression of Y(1S),Y(2S),Y(3S)
- Do this as a function of E_T and N_{Tracks} in event
- Y(nS)/Y(1S) decreases with E_T and N_{Tracks}

Cold Effects

- Quarkonia production in exclusive γ+p and γ+Pb
- Look for effects of gluon saturation.

P_T spectra: pp, PbPb $\sqrt{s_{NN}}$ = 2.76 TeV

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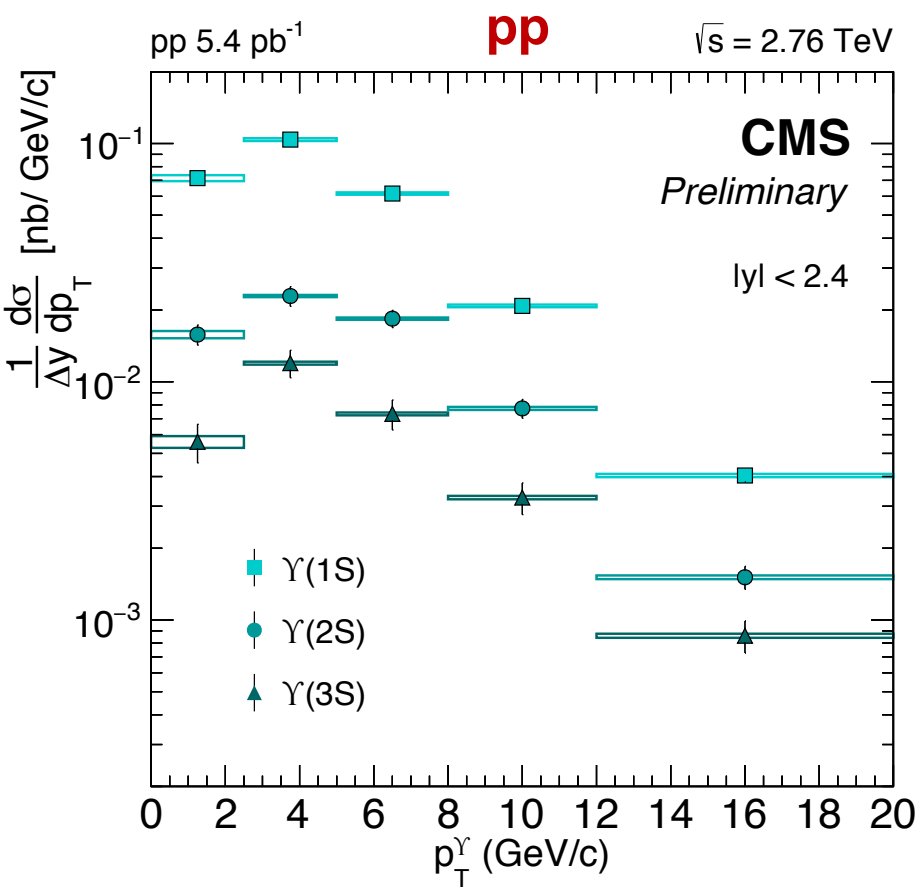

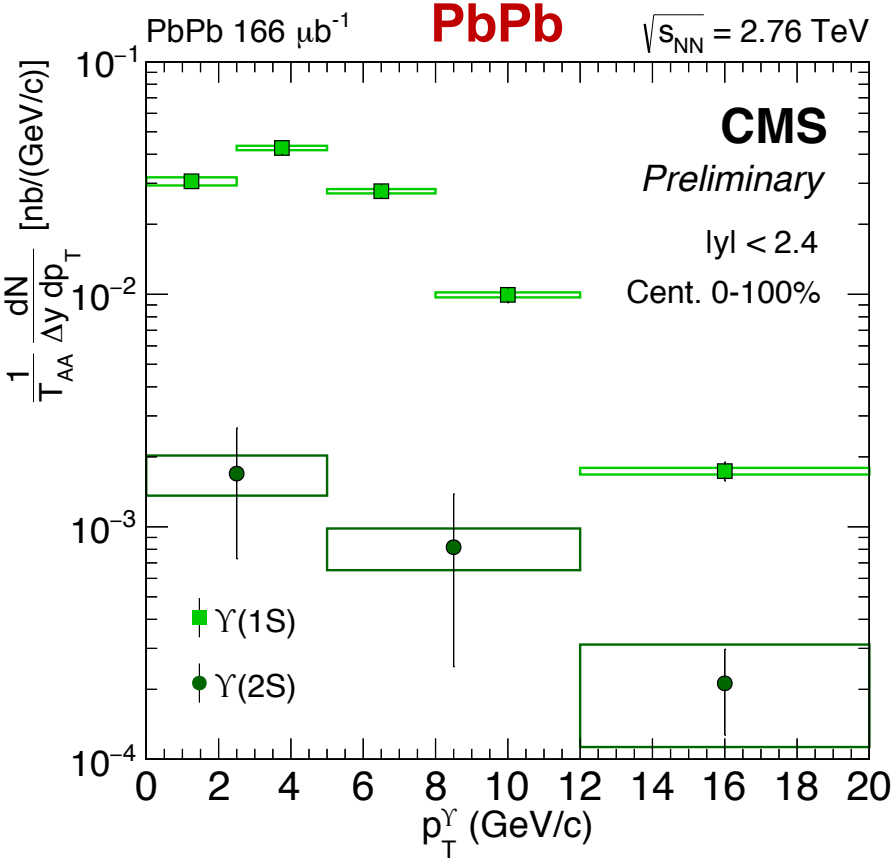

dN/dy: pp and PbPb, $\sqrt{s_{NN}}$ = 2.76 TeV

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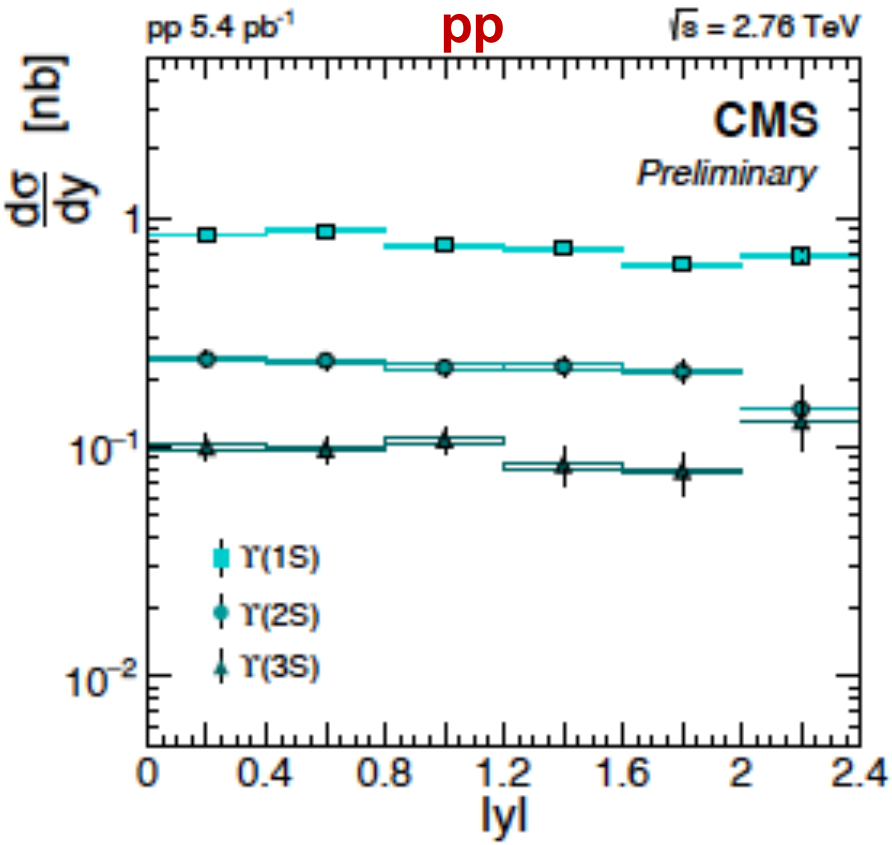

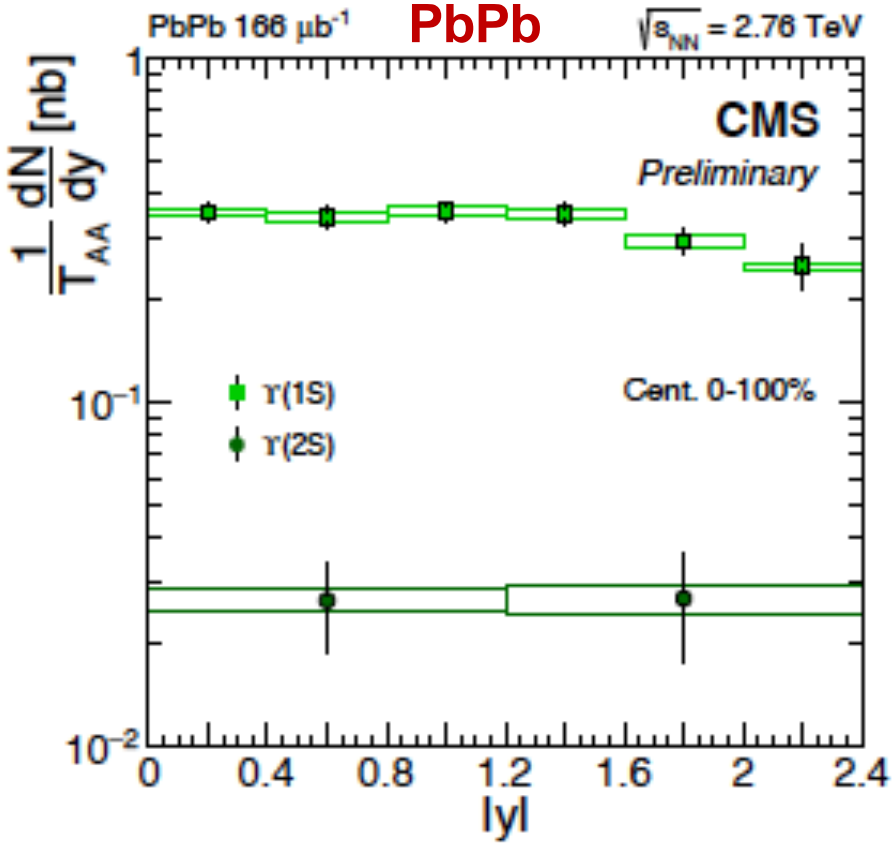

P_T and y dependence of suppression

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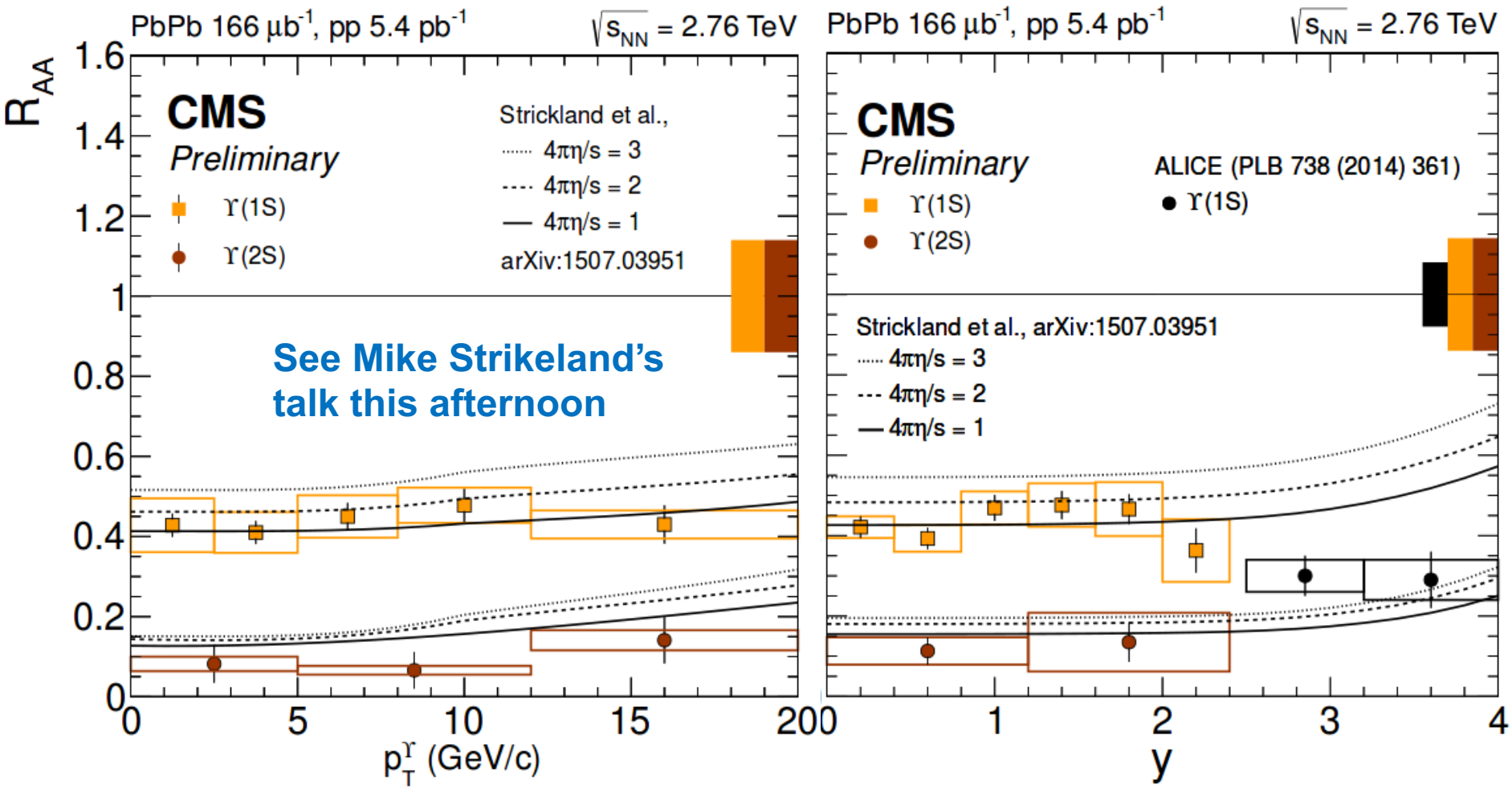
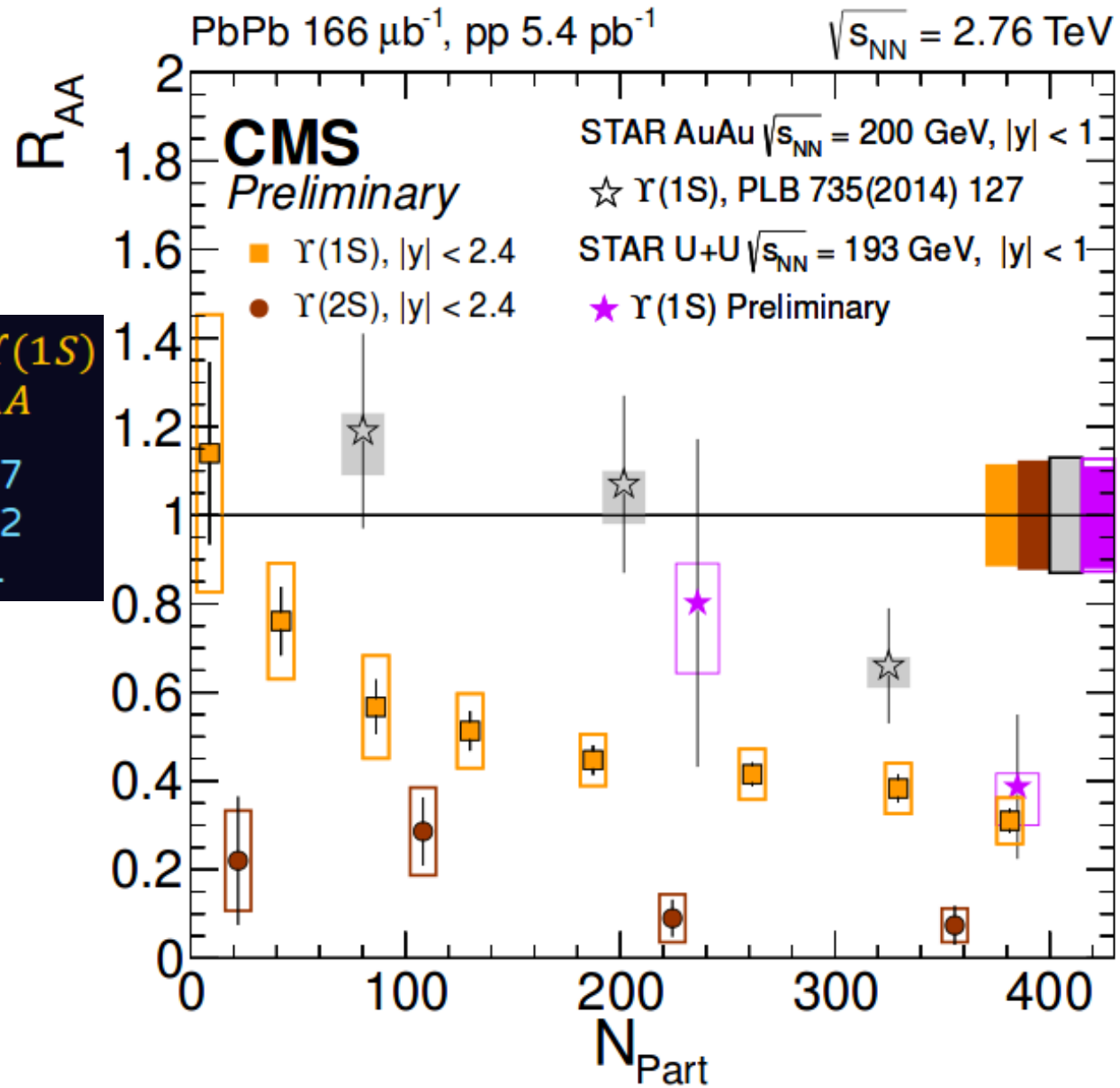


R_{AA} is rather flat vs both p_T and y

Nuclear modification vs N_{part} for Υ(ns)

$$R_{AA}^{\Upsilon(3S)} < R_{AA}^{\Upsilon(2S)} < R_{AA}^{\Upsilon(1S)}$$

$R_{AA}(\Upsilon(1S))= 0.43\pm0.03\pm0.07$
$R_{AA}(\Upsilon(2S))= 0.13\pm0.03\pm0.02$
$R_{AA}(\Upsilon(3S))< 0.14$ at 95% CL



At low p_T expect ~ 30% of Υ(1s) come from feed-down, Woehri QWG 2014

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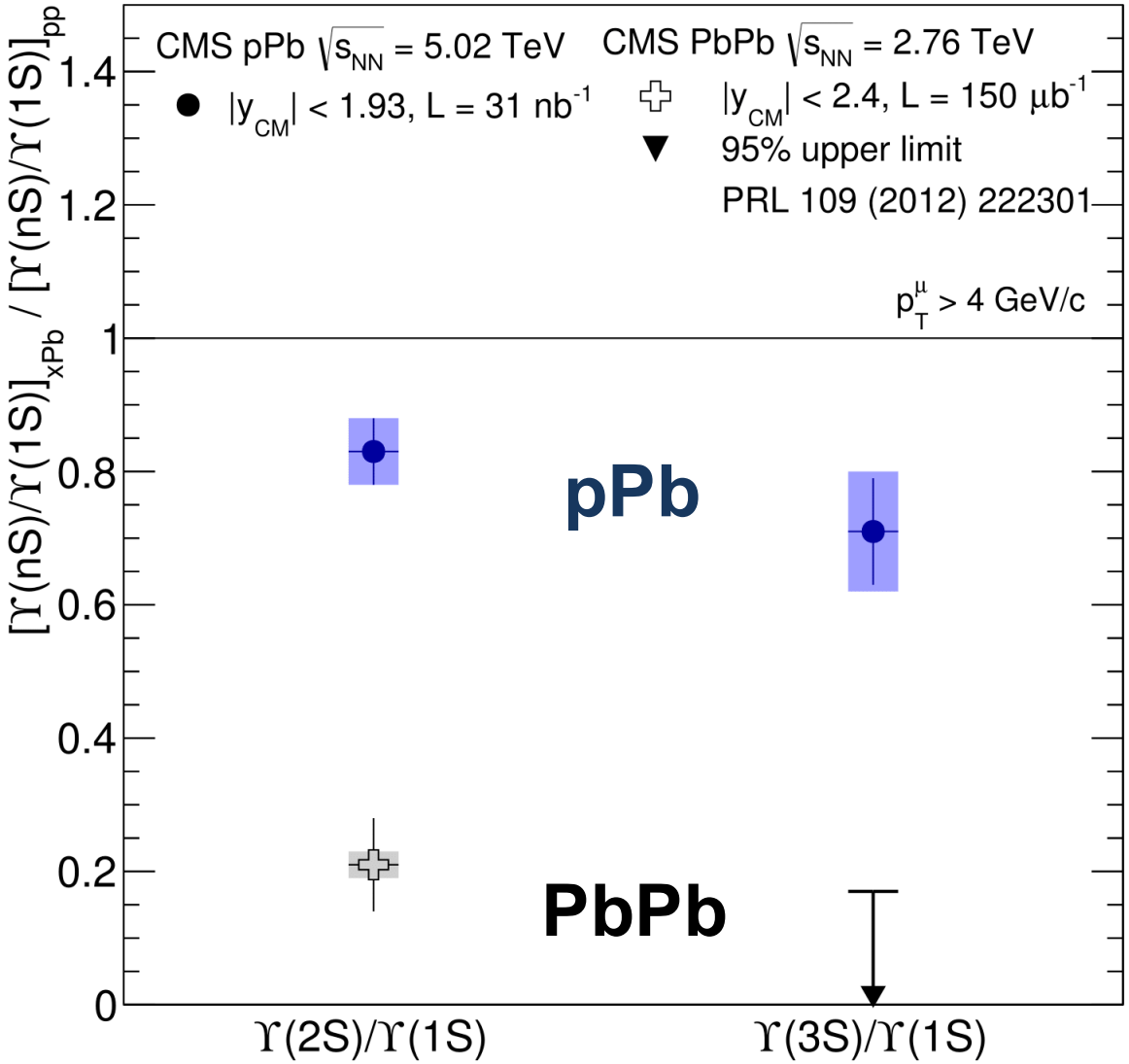
Relative suppression in PbPb and pPb



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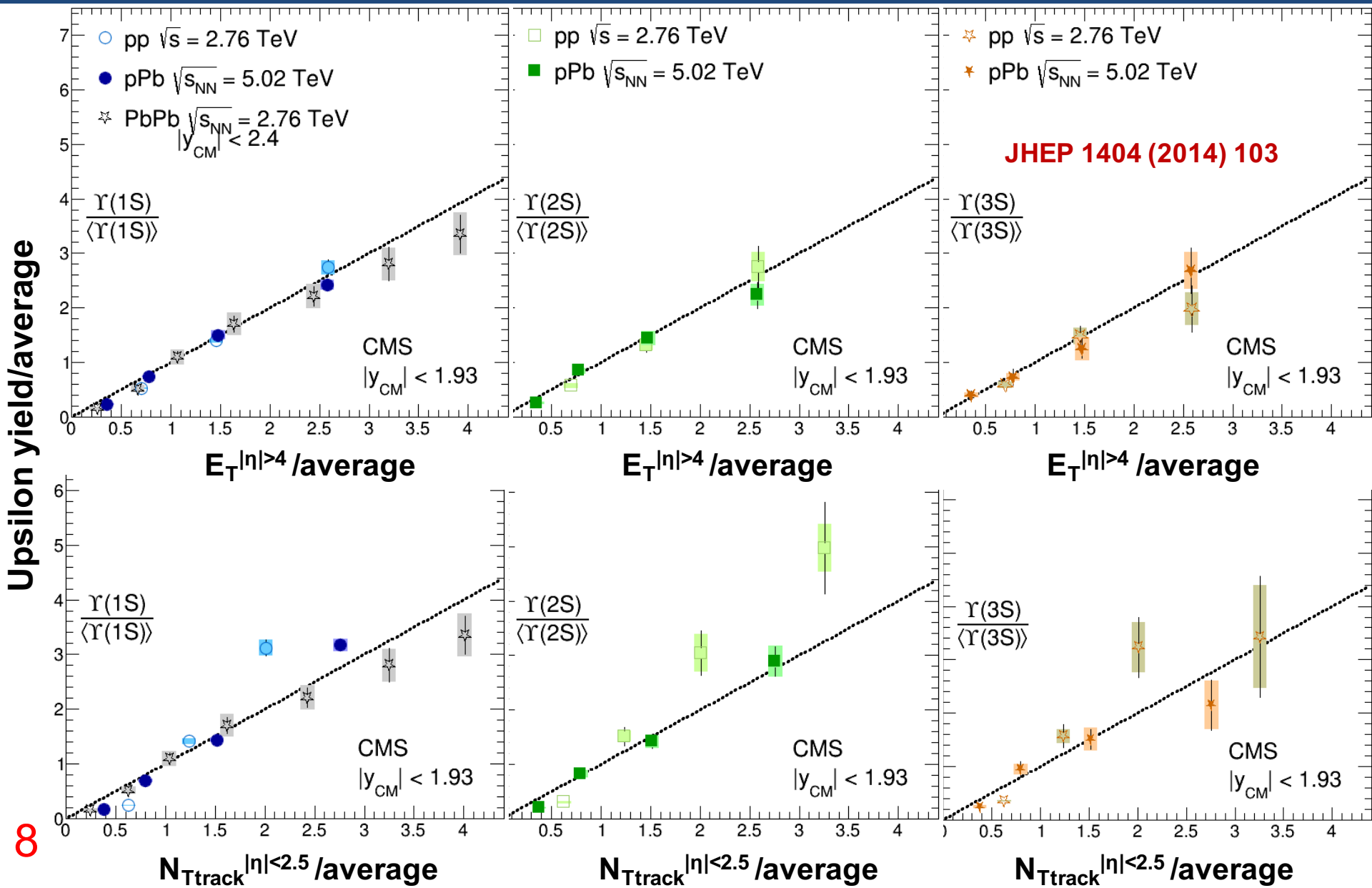
Ratio of excited states to ground state decreases from pp, to pPb to PbPb

Υ(nS) yield vs E_T and N_{tracks} in event



Y(nS)/Y(1S) vs E_T and N_{tracks}

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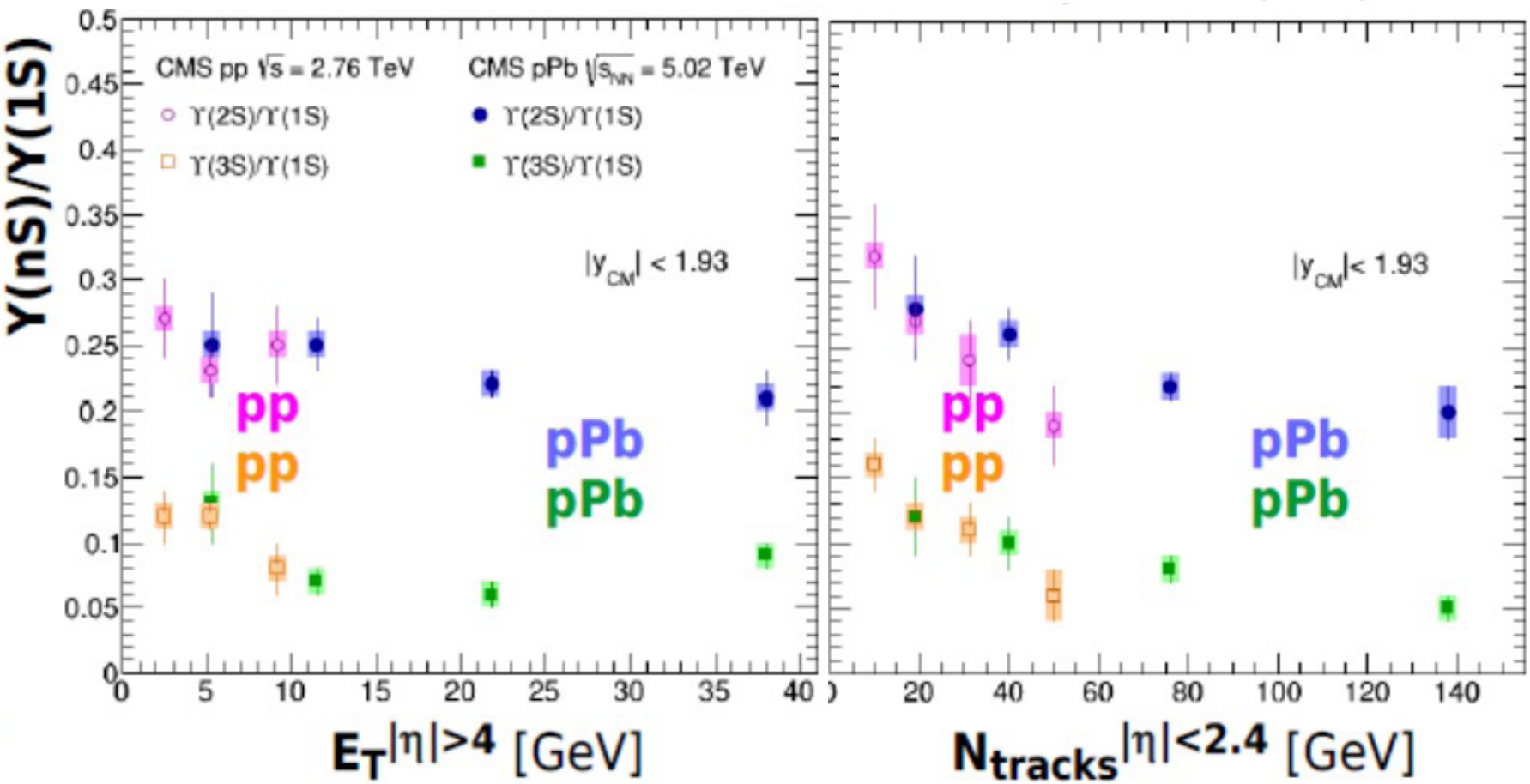

Flat vs E_T but falls vs N_{tracks}

Y(2S)/Y(1S) from pp, pPb & PbPb

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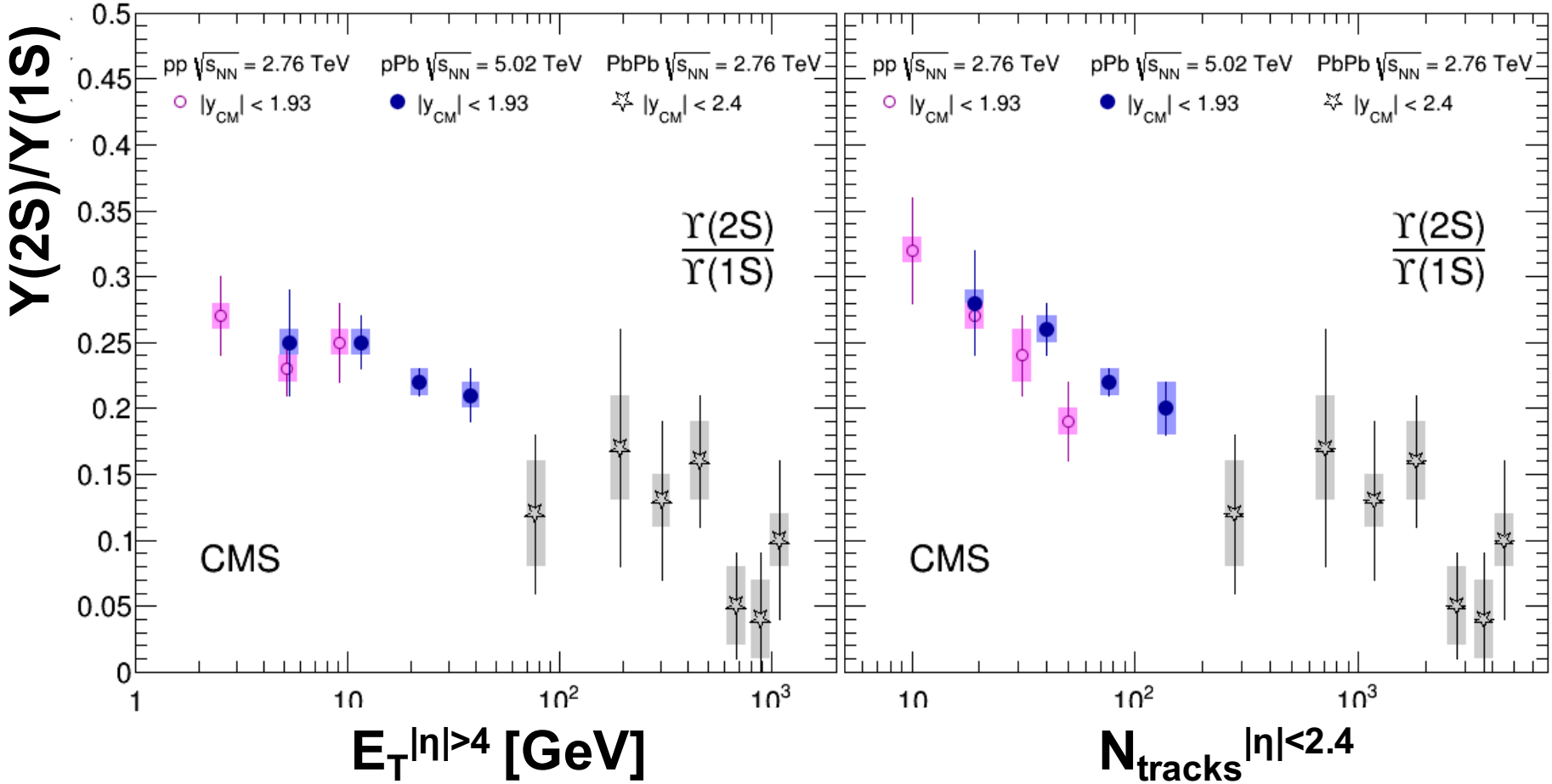
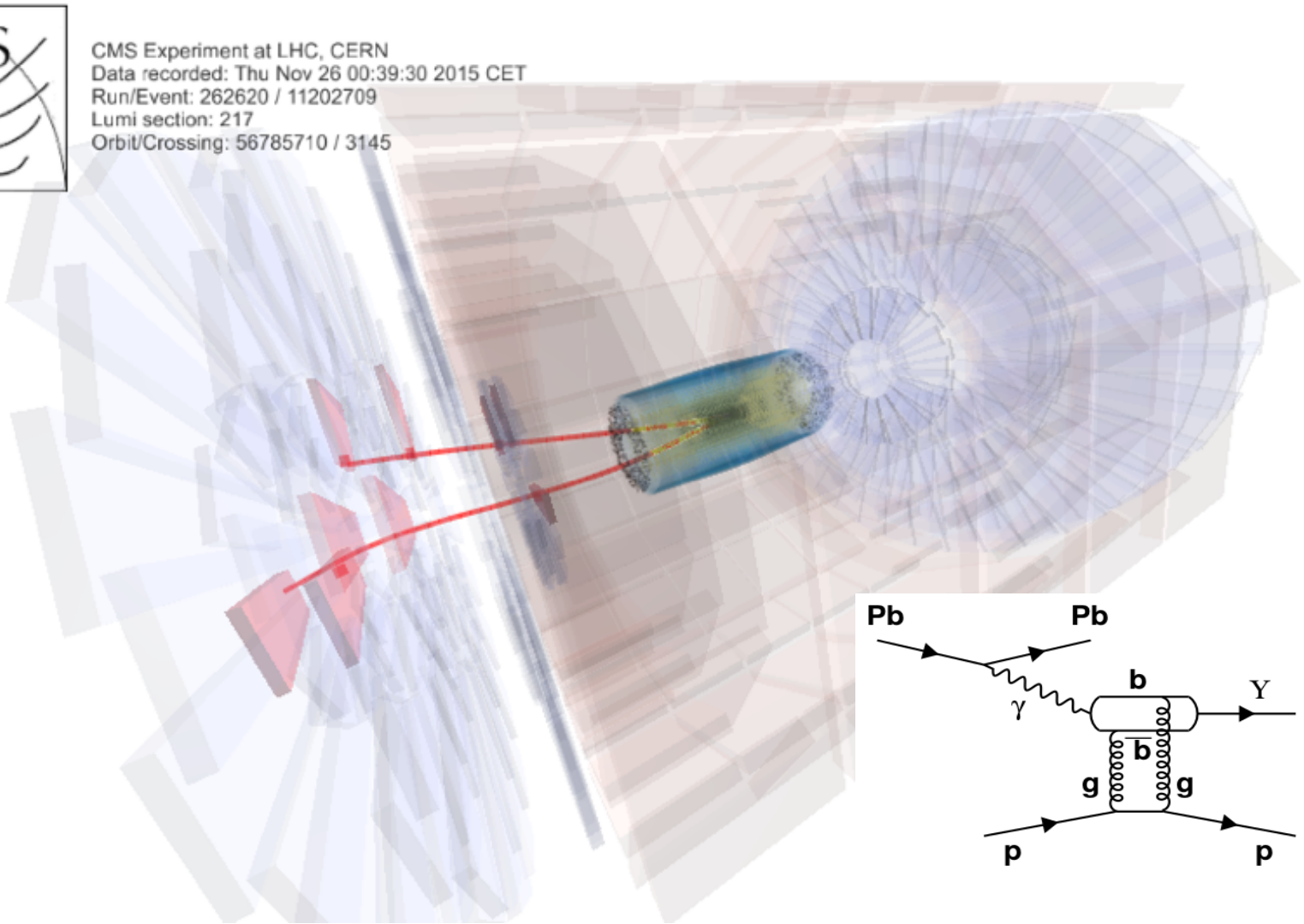


Dependence on E_T is weaker than for N_{tracks}

Cold Matter Studies

Exclusive photo-production of quarkonia



Exclusive PbPb => J/ψ + n

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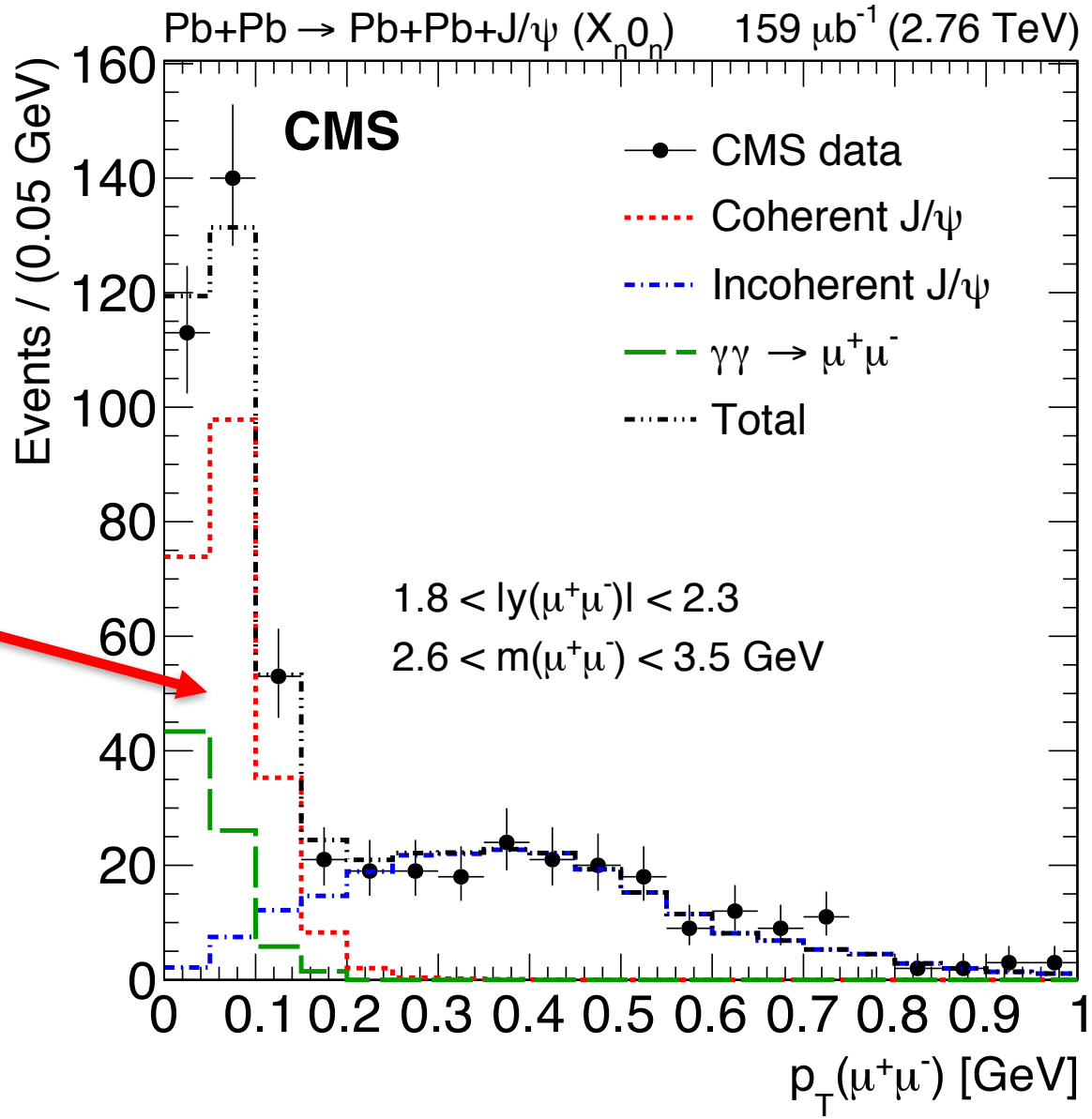
For details see Mihee Jo's talk after this

Coherent photons have $p_T \sim h/R$



Rapidity distribution of coherent J/ψ

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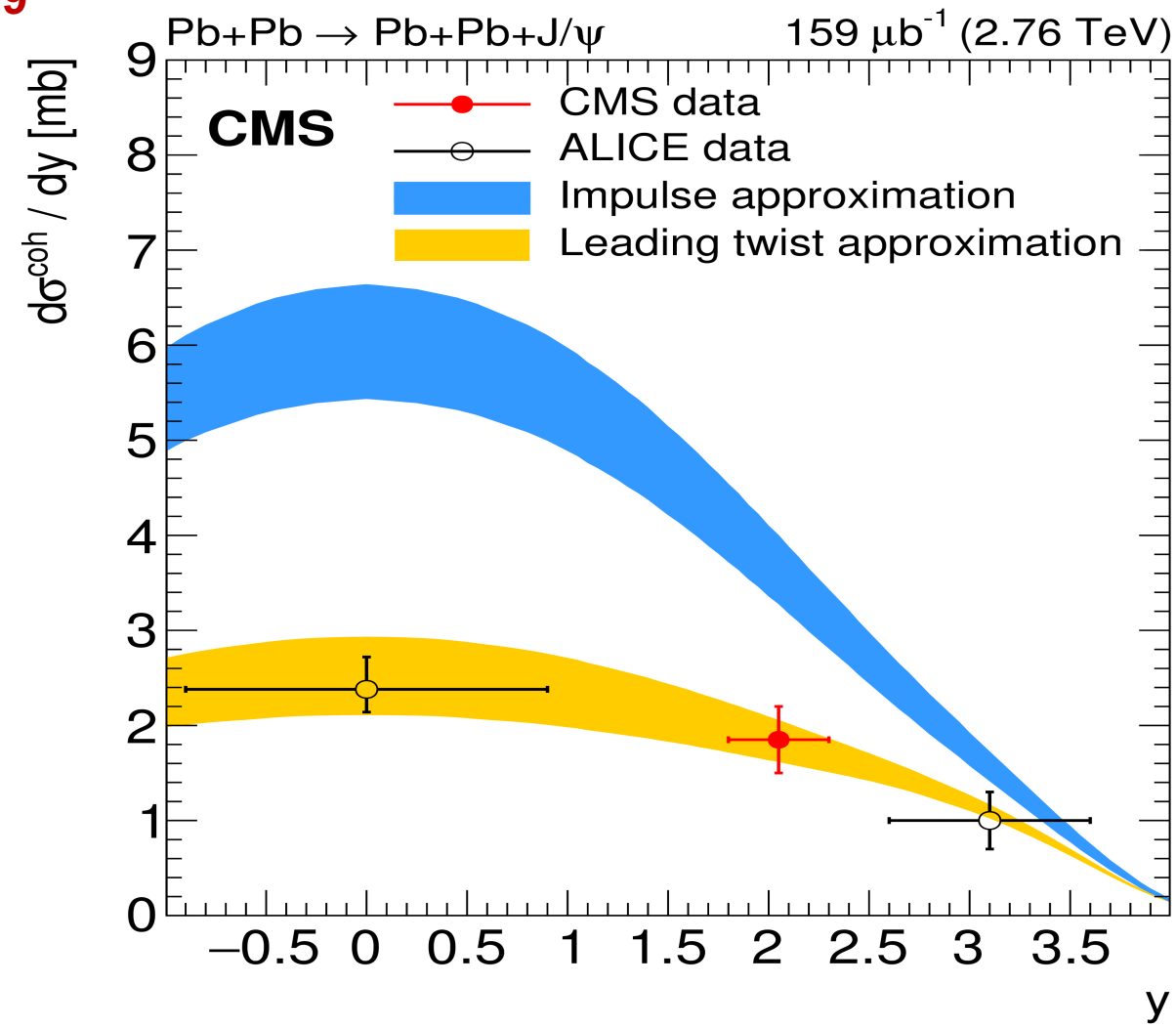
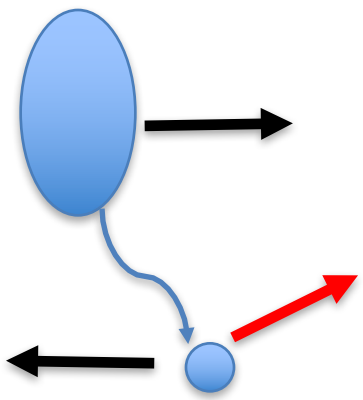


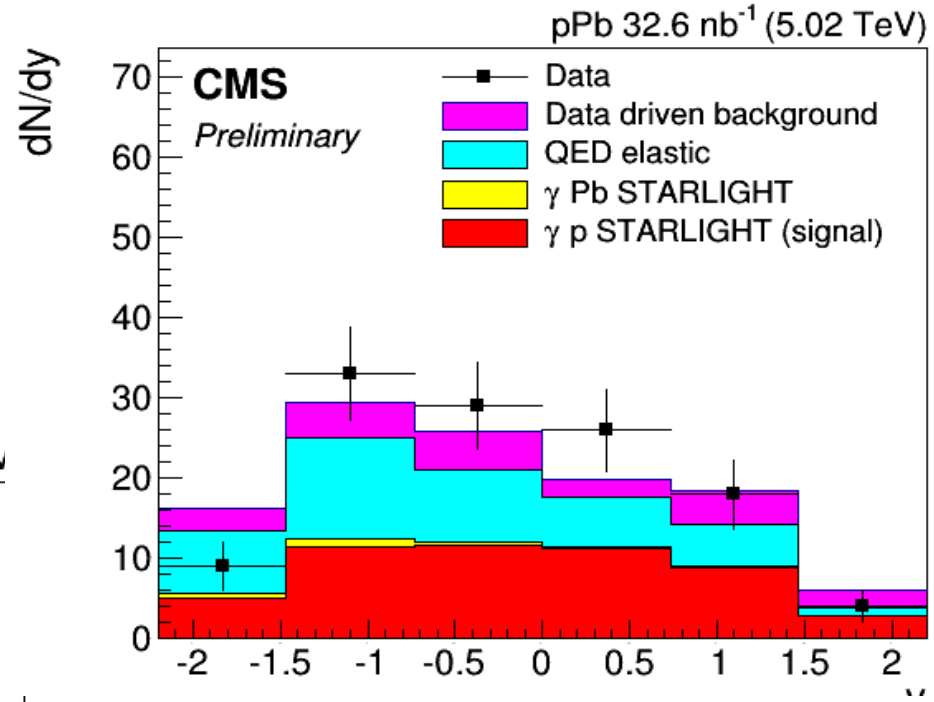
http://arxiv.org/abs/1605.06966v1

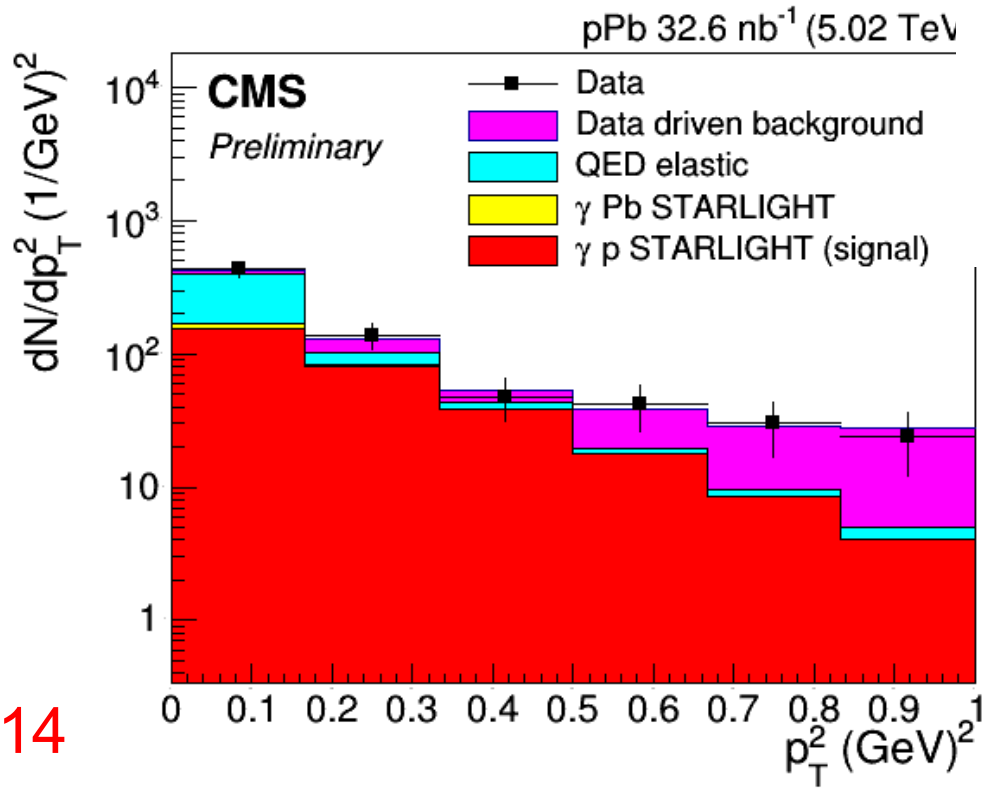
CMS-HIN-12-009

pPb => Exclusive Y at $\sqrt{s_{NN}}$ = 5.02 TeV



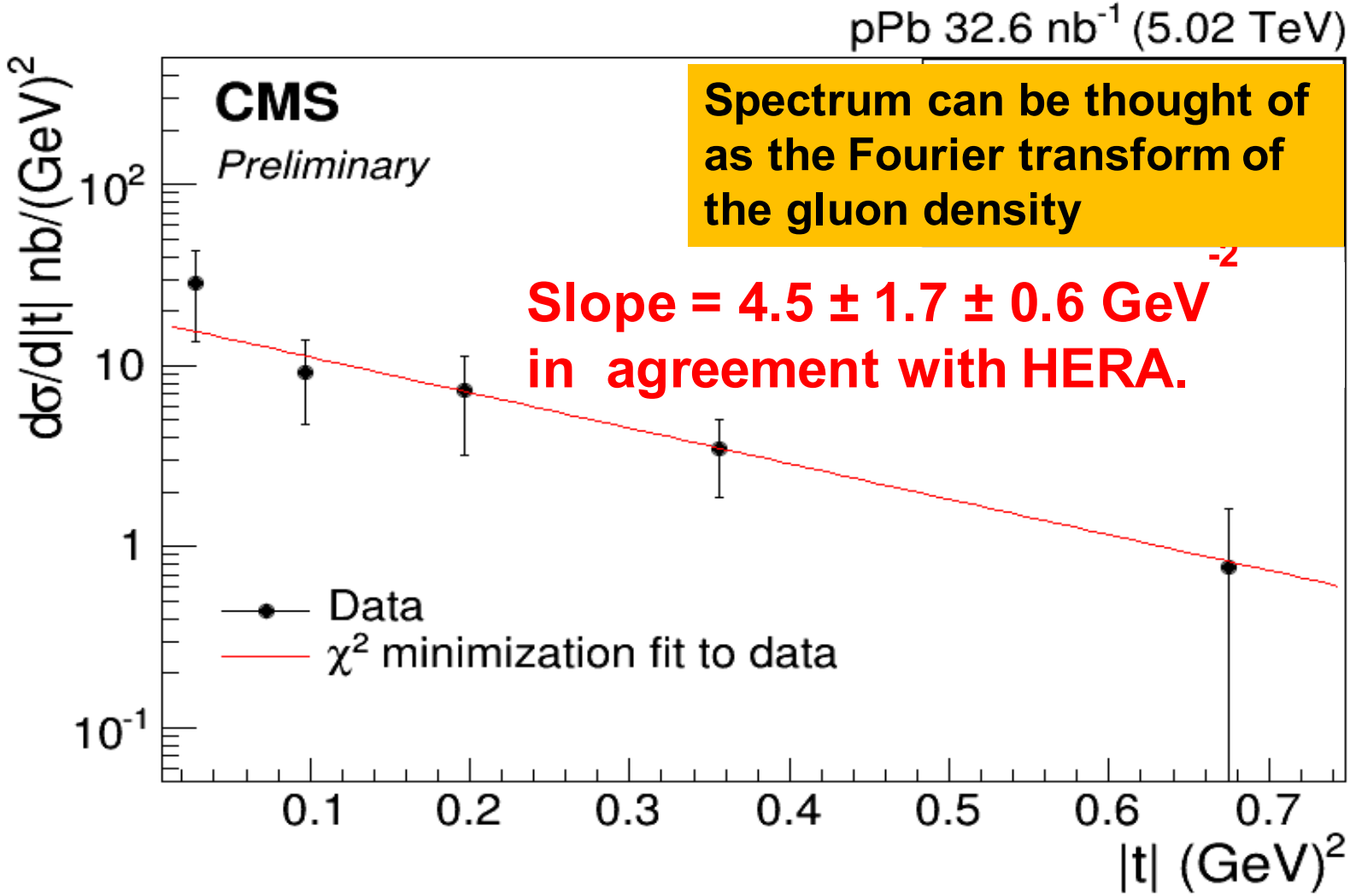
Upsilon





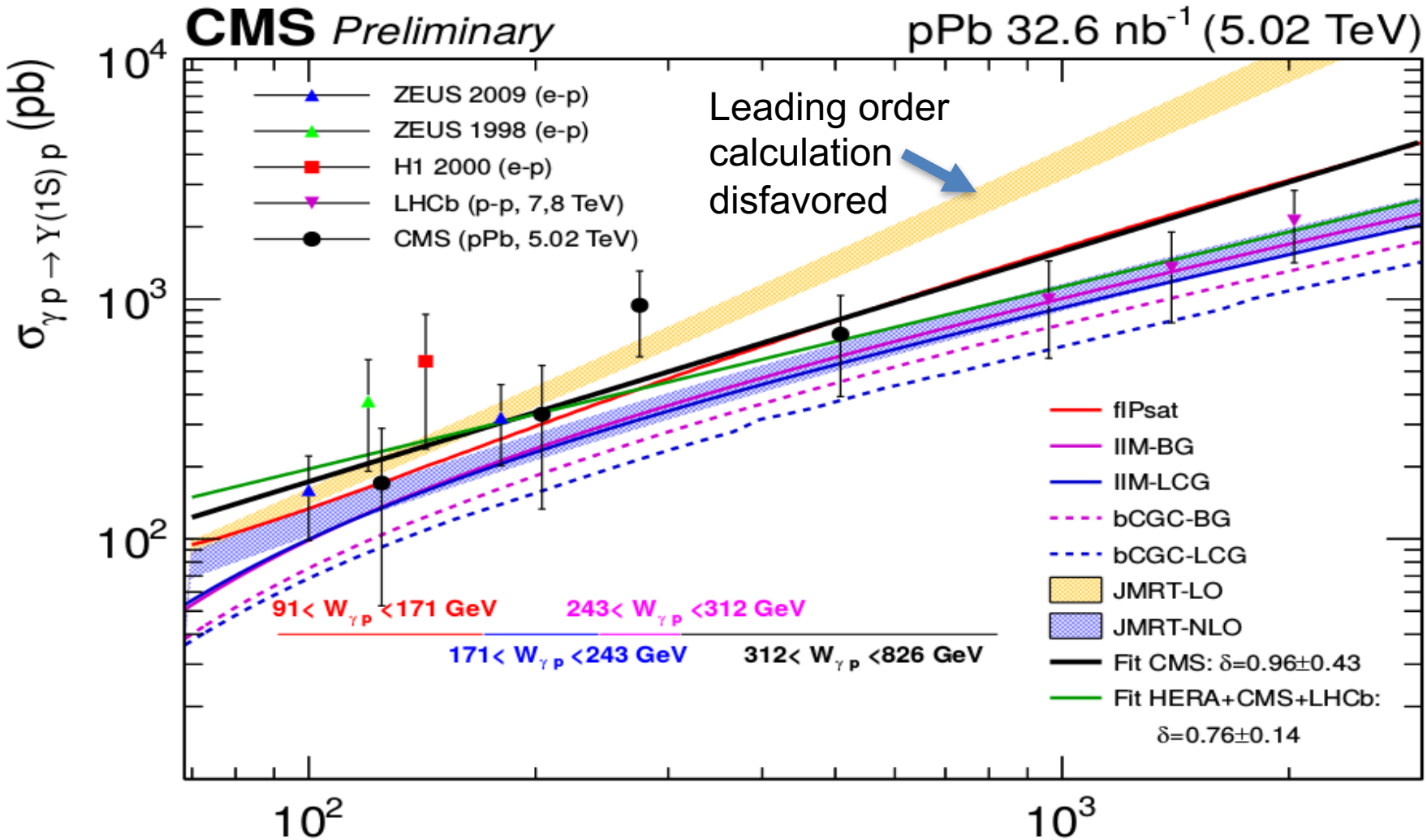
CMS-FSQ-13-009

Exclusive Y vs p_T^2



$|t| = p_T^2$ [GeV^2]

Upsilon cross section vs $\sqrt{S_{\gamma p}}$



Photon-proton center of mass energy (GeV)

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Conclusions

Hot Effects

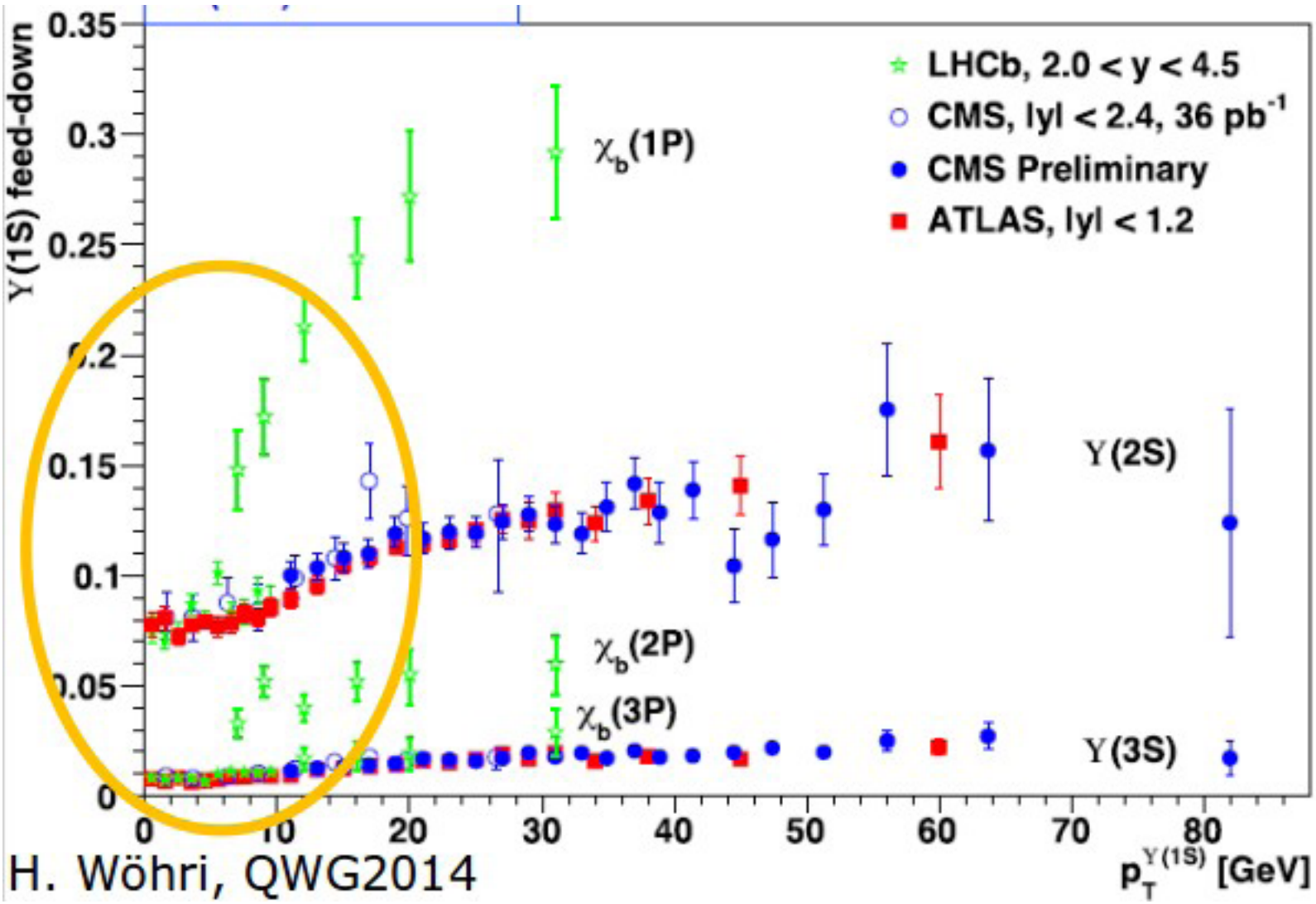
- R_{AA} flat vs both p_T & y
- $R_{AA}(3S)<R_{AA}(2S)<R_{AA}(1S)$
- Ratio of excited states to ground state decreases from pp, to pPb to PbPb
- Y(nS) yield increases with E_T and N_{Tracks} in event
- Y(nS)/Y(1S) decreases with E_T and N_{Tracks}

Cold Effects

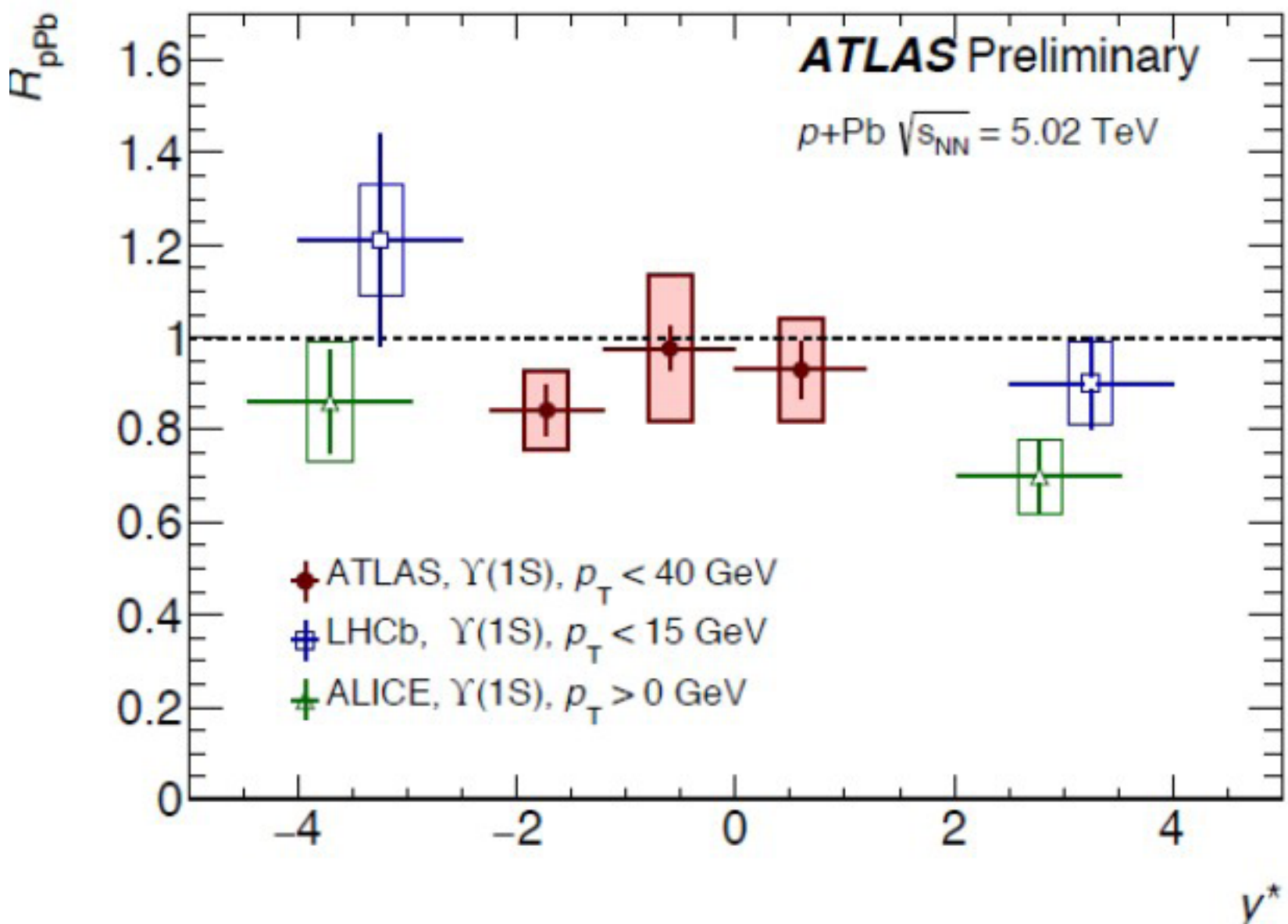
- Cross section for γ+p => upsilon increases as a power law of center of mass energy
- Cross section for γ+Pb => J/ψ suggests that there is significant shadowing of gluons in Pb nuclei

Backup

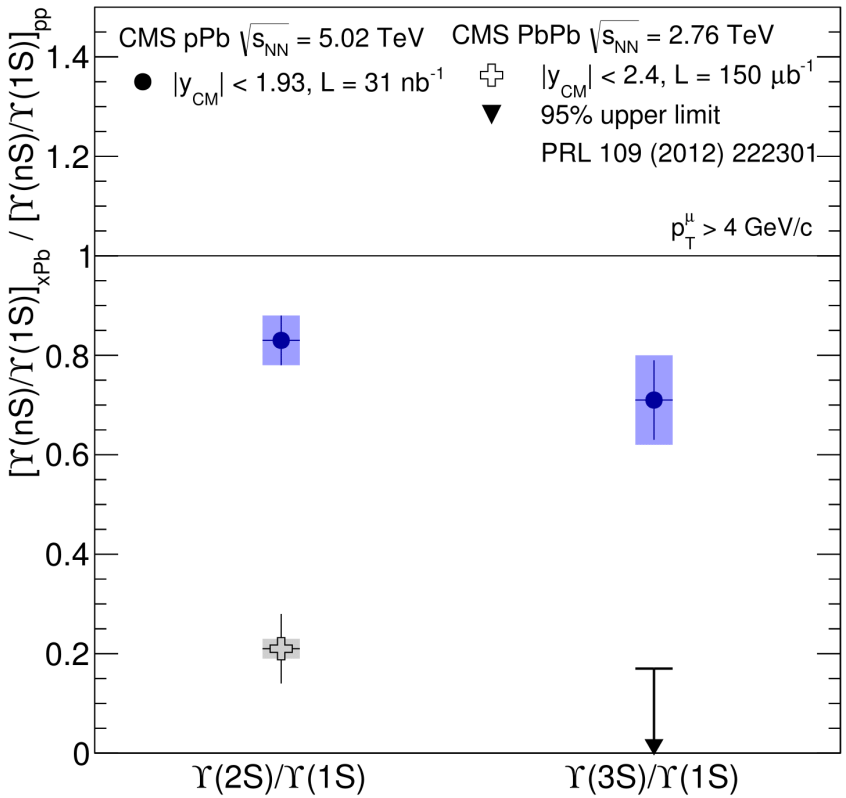
Feed-down to Y(1s)

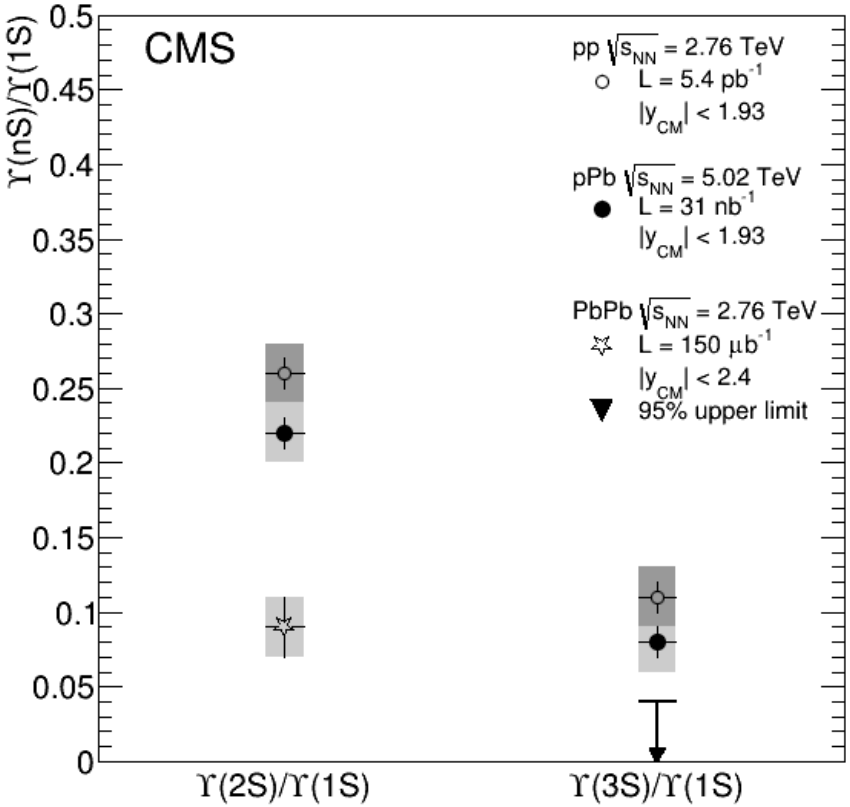


Y(1s) estimated R_{pPb}



Compare PbPb and pPb to pp





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