Inclusive jets & dijets in *p-Pb*

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2/20/2018

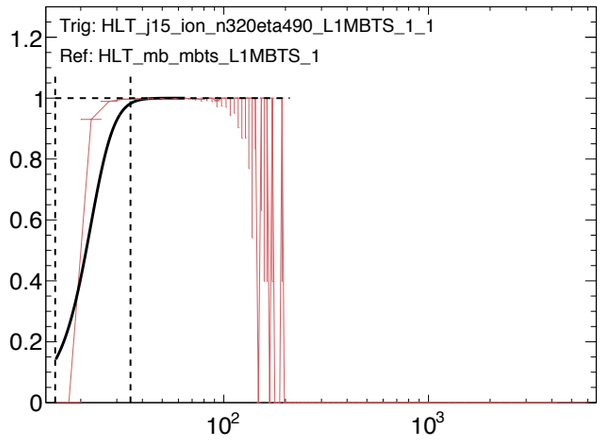
Last Time

- Lumis improved from lumicalc prescale correction
- Trigger efficiency analysis performed via bootstrap
  - now fitting Fermi-Dirac for efficiency with points in (pt, pt+30) domain as suggested by Aaron
- Trigger selection was based on exposed luminosity instead of counts
  - have now added minbias trigger as a “revert” option for low-pt
- Most issues from last time resolved!
  - Excess in Bjorken’s was a miscalculation of luminosity
  - “Hiccup” in inclusive jet spectrum caused by not discarding the disabled HEC region - now accounted for
  - p-going FCAL was incorrectly assigned as Pb-going FCAL, leading to excess in FCAL at high x (so there were more very forward jets)

- Shown are bootstrapped efficiencies from 15-6000 GeV (for convenience with remainder of analysis)
- Left line = listed trigger threshold
- Right line = additional threshold required in analysis
- Fitted curve is a Fermi-Dirac-esque distribution with parameters λ, p_0

$$\varepsilon_{\mathrm{trig}}\left(p_T\right) = \frac{1}{1 + e^{\lambda(p_0 - p_T)}}$$

- Also tried a Gaussian error function, but the fits often missed the turn on region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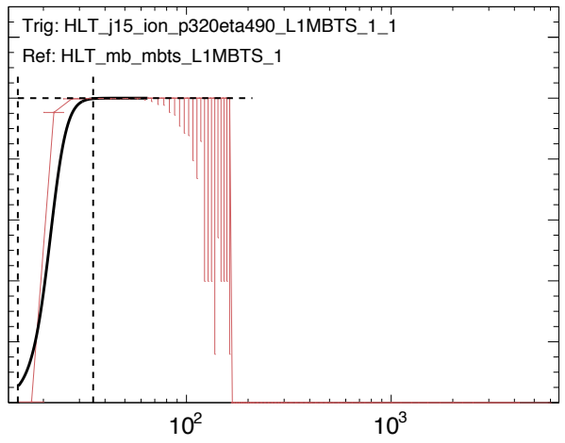
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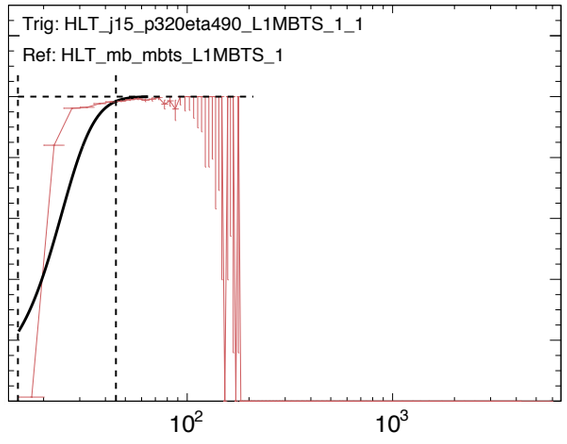
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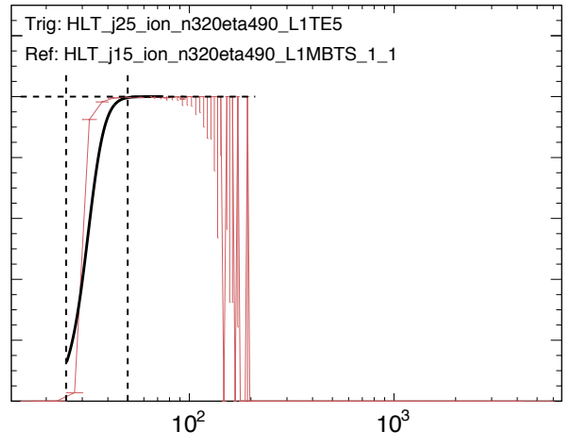
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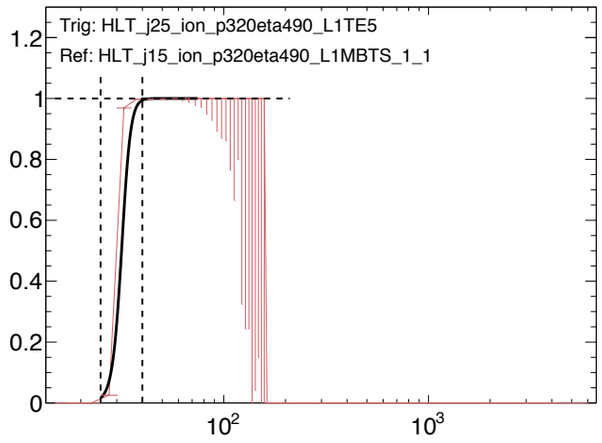
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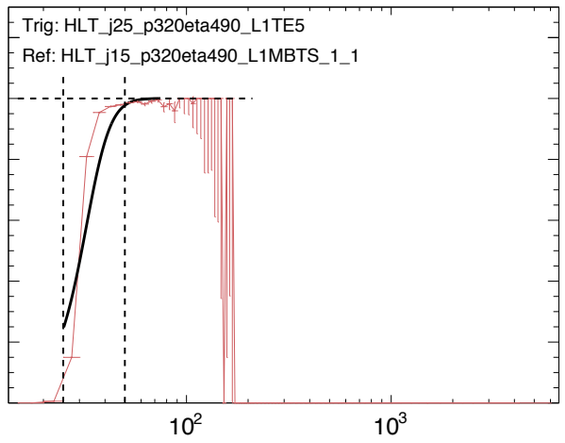
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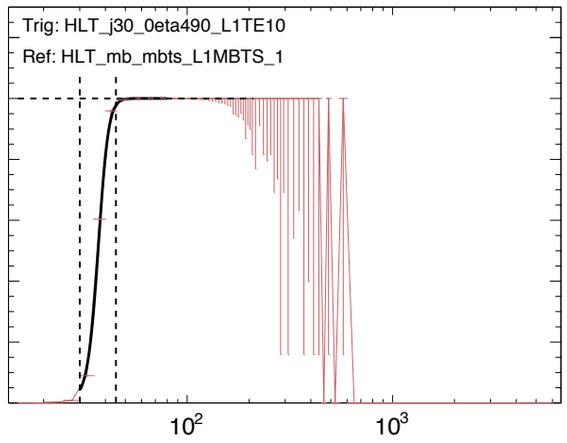
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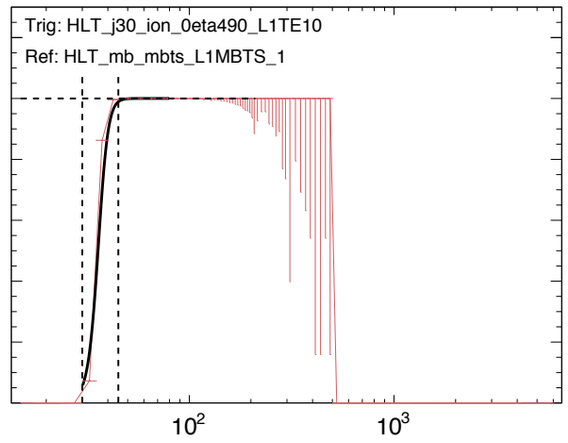
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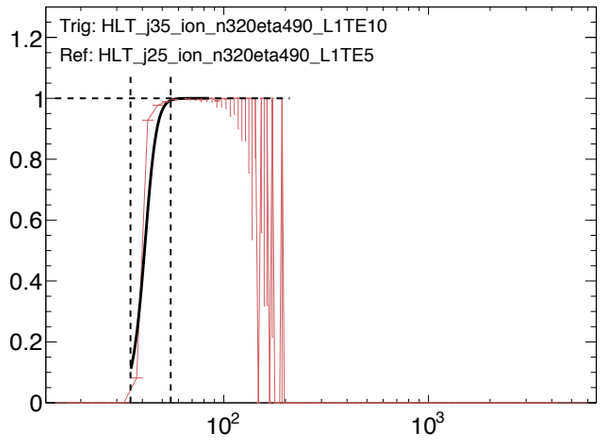
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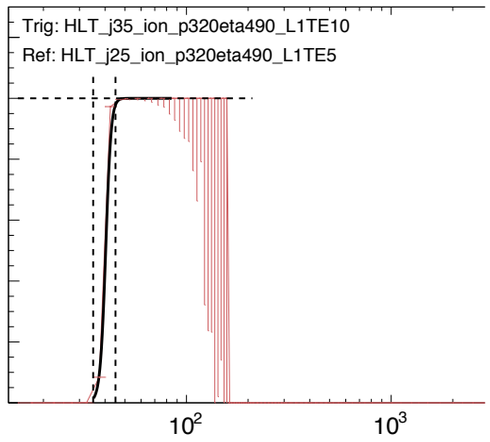
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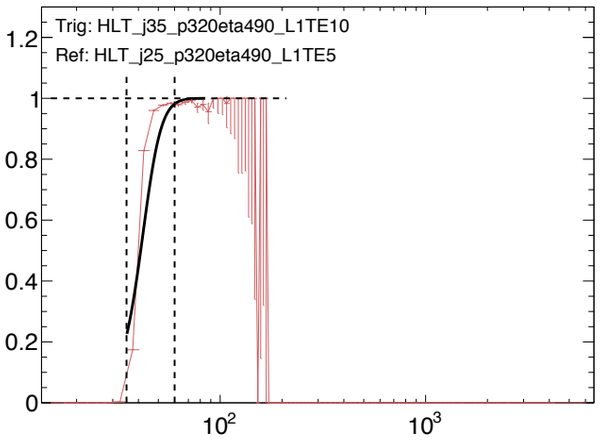
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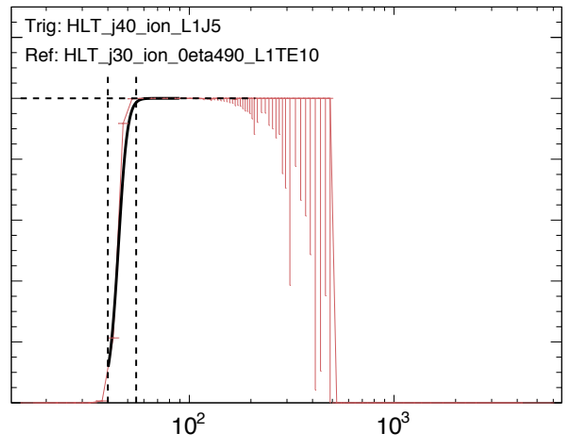
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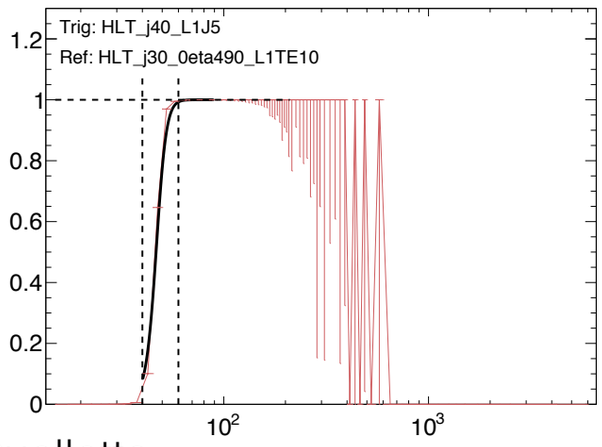
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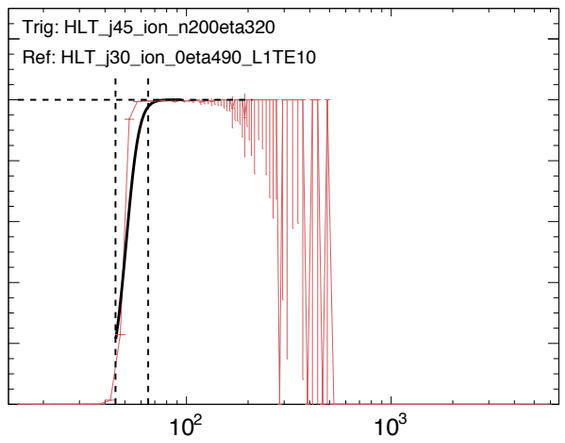
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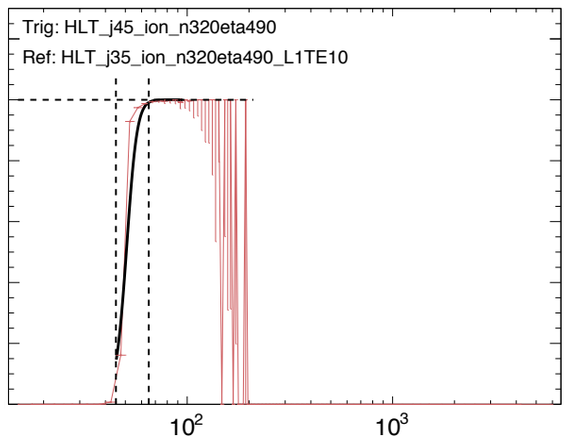
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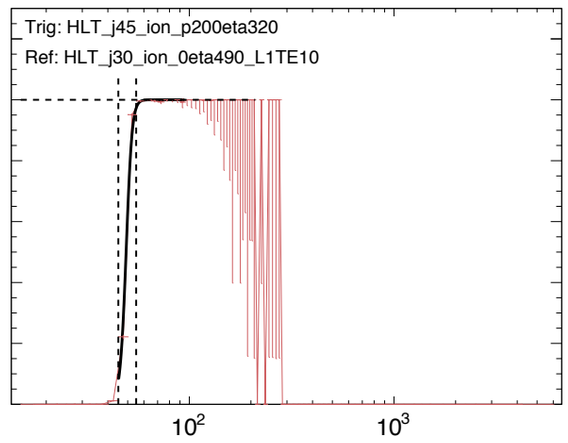
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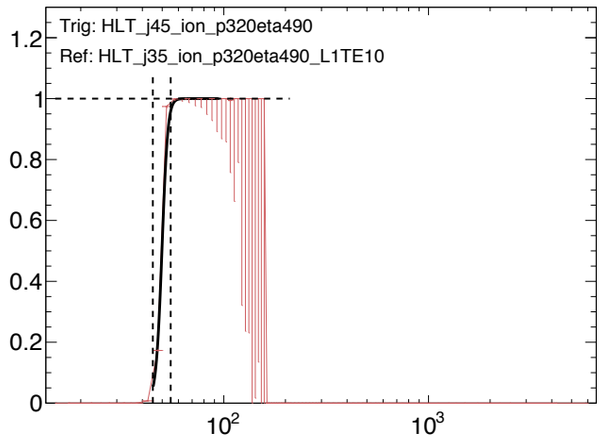
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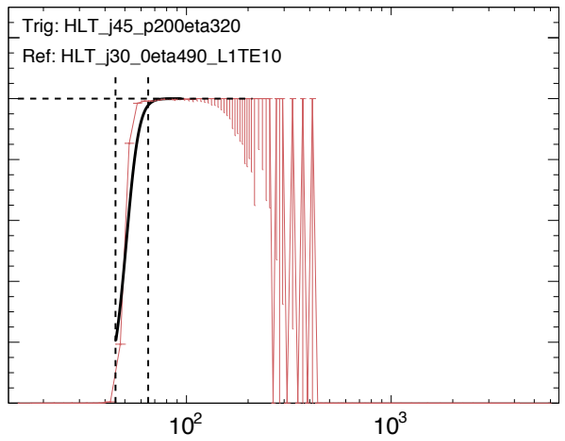
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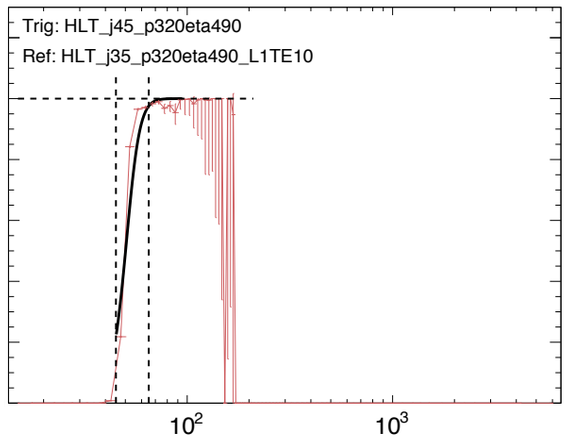
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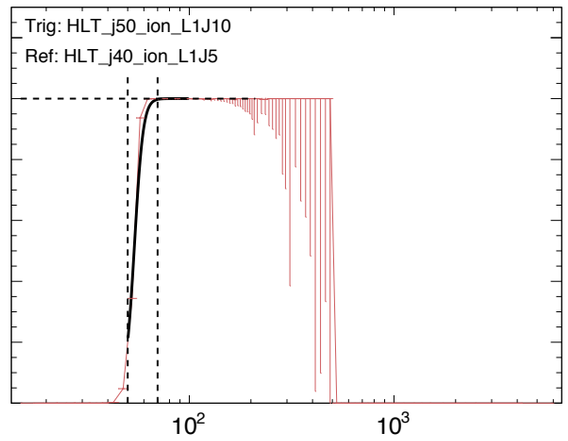
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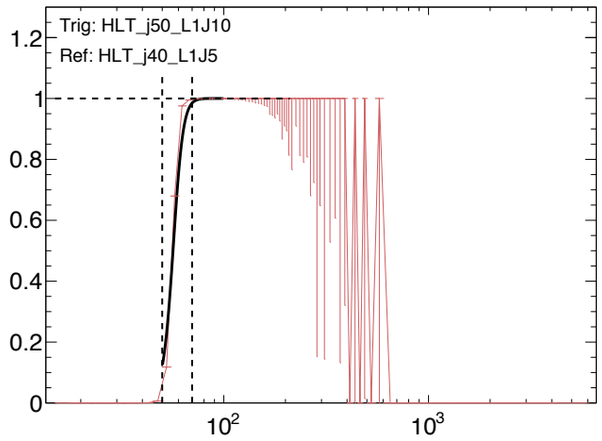
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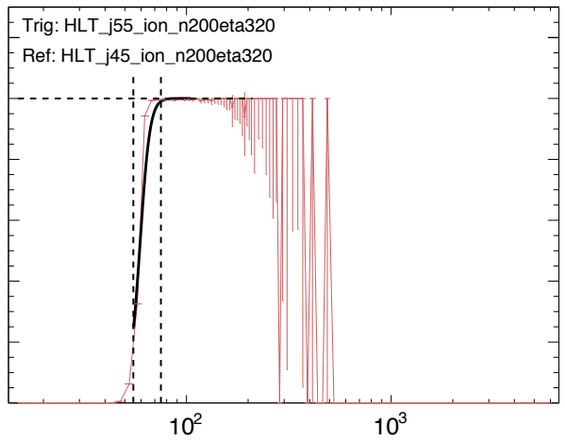
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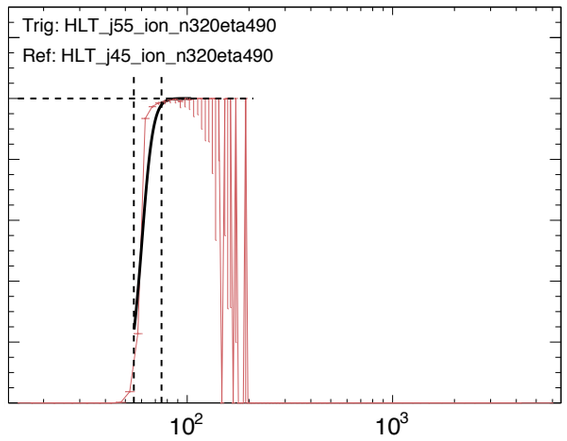
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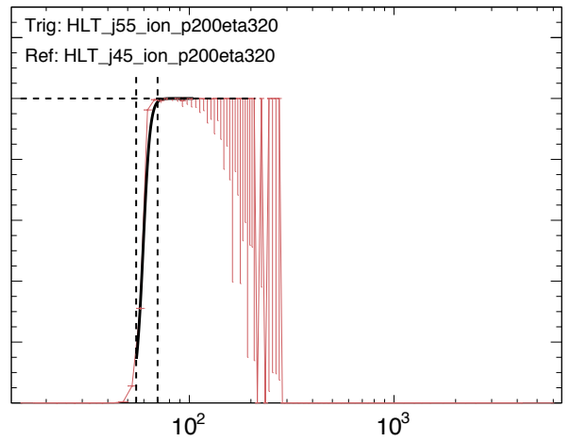
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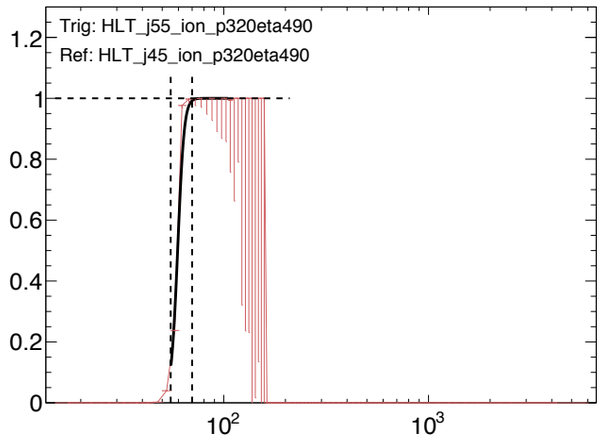
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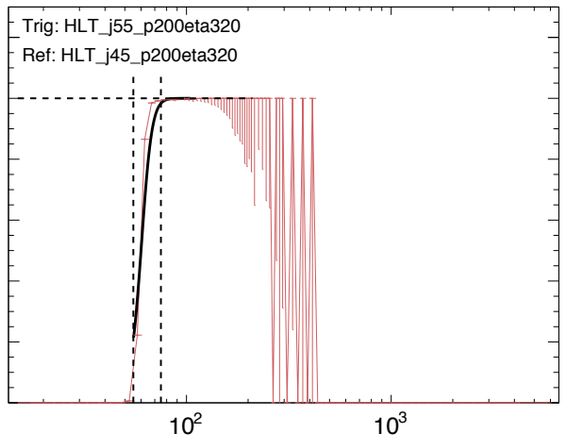
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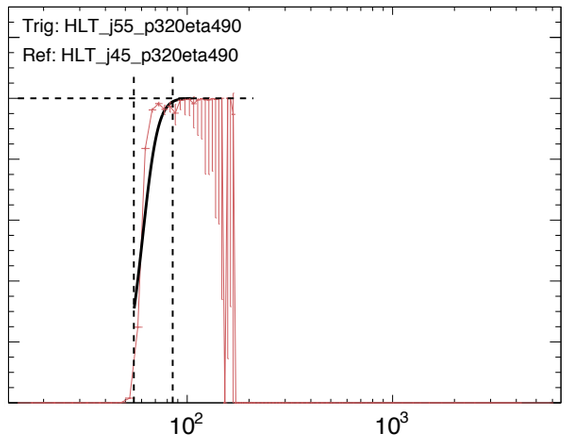
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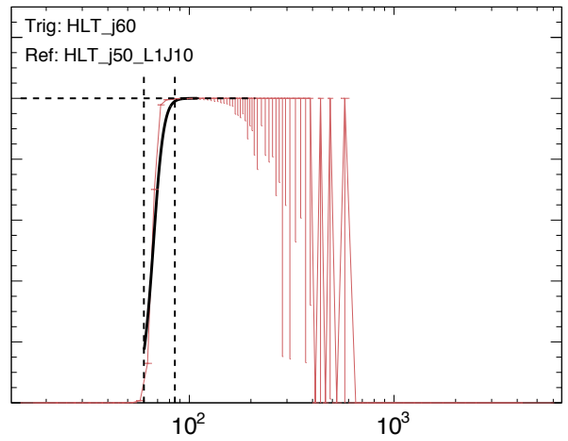
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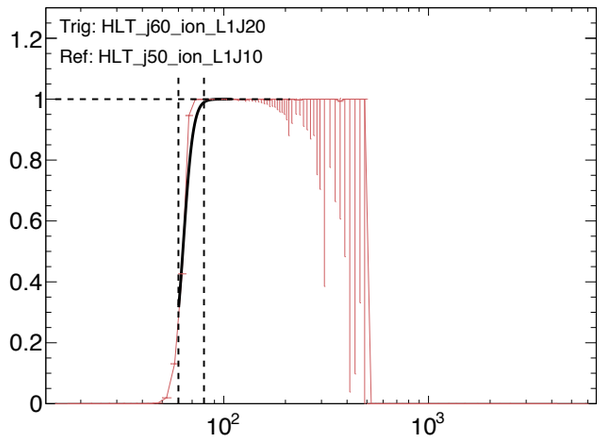
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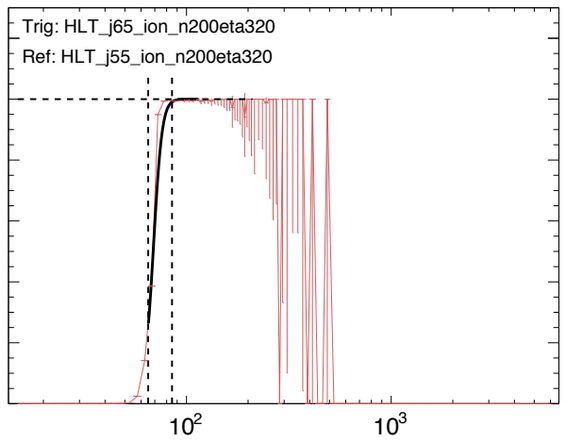
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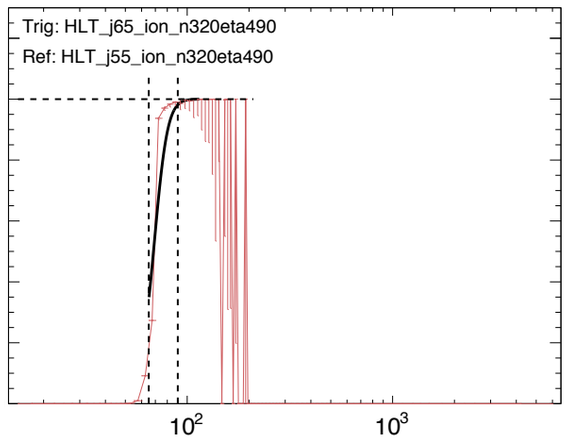
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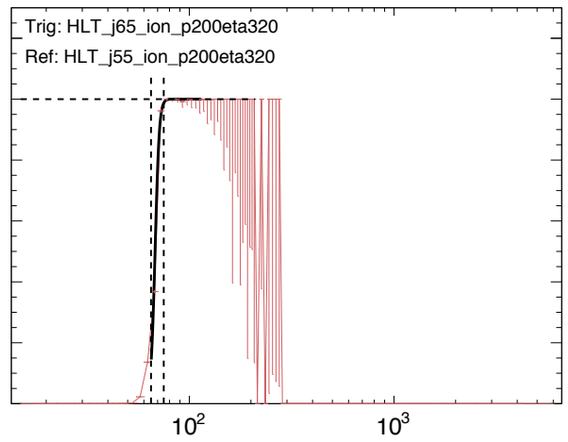
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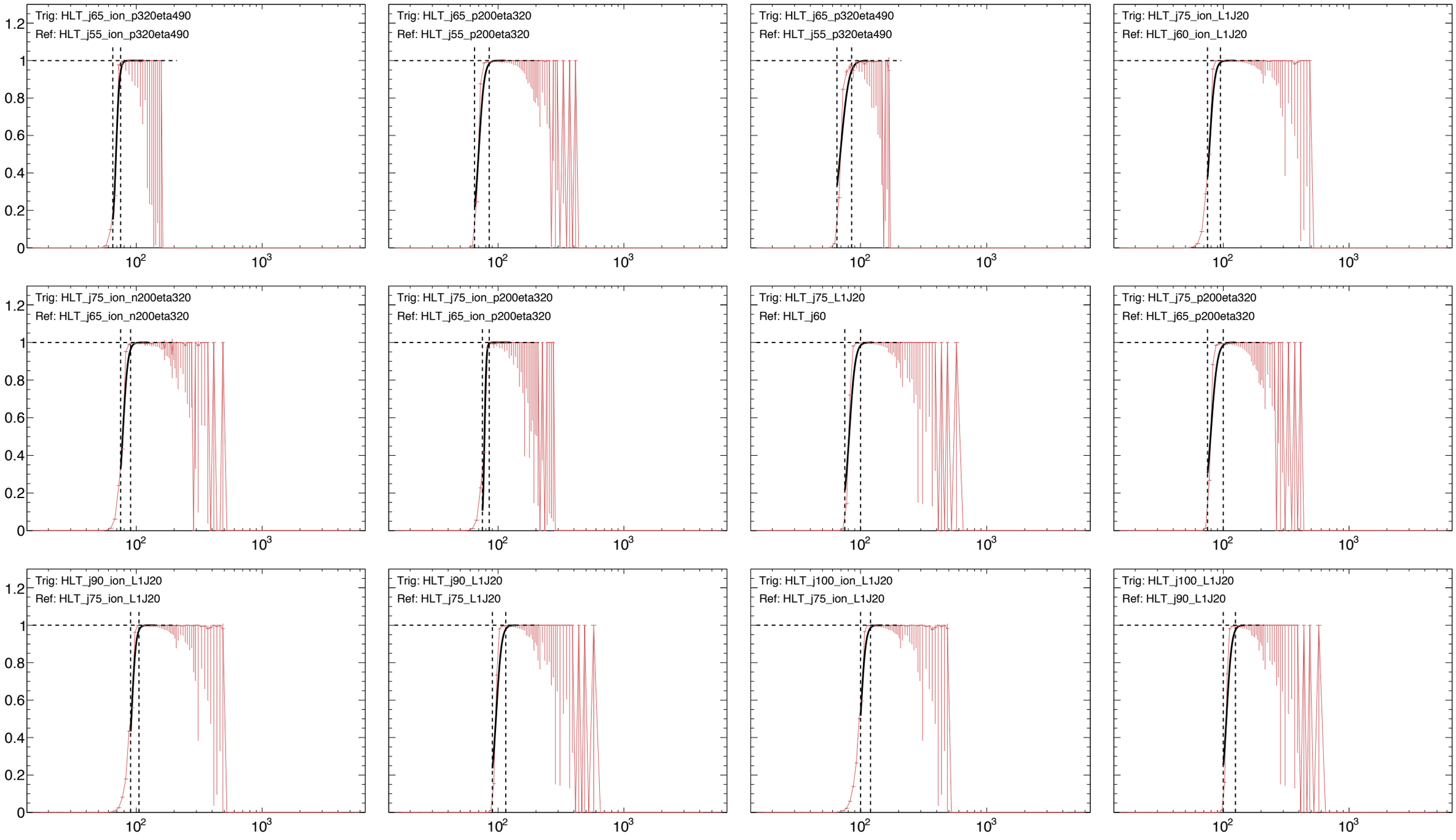
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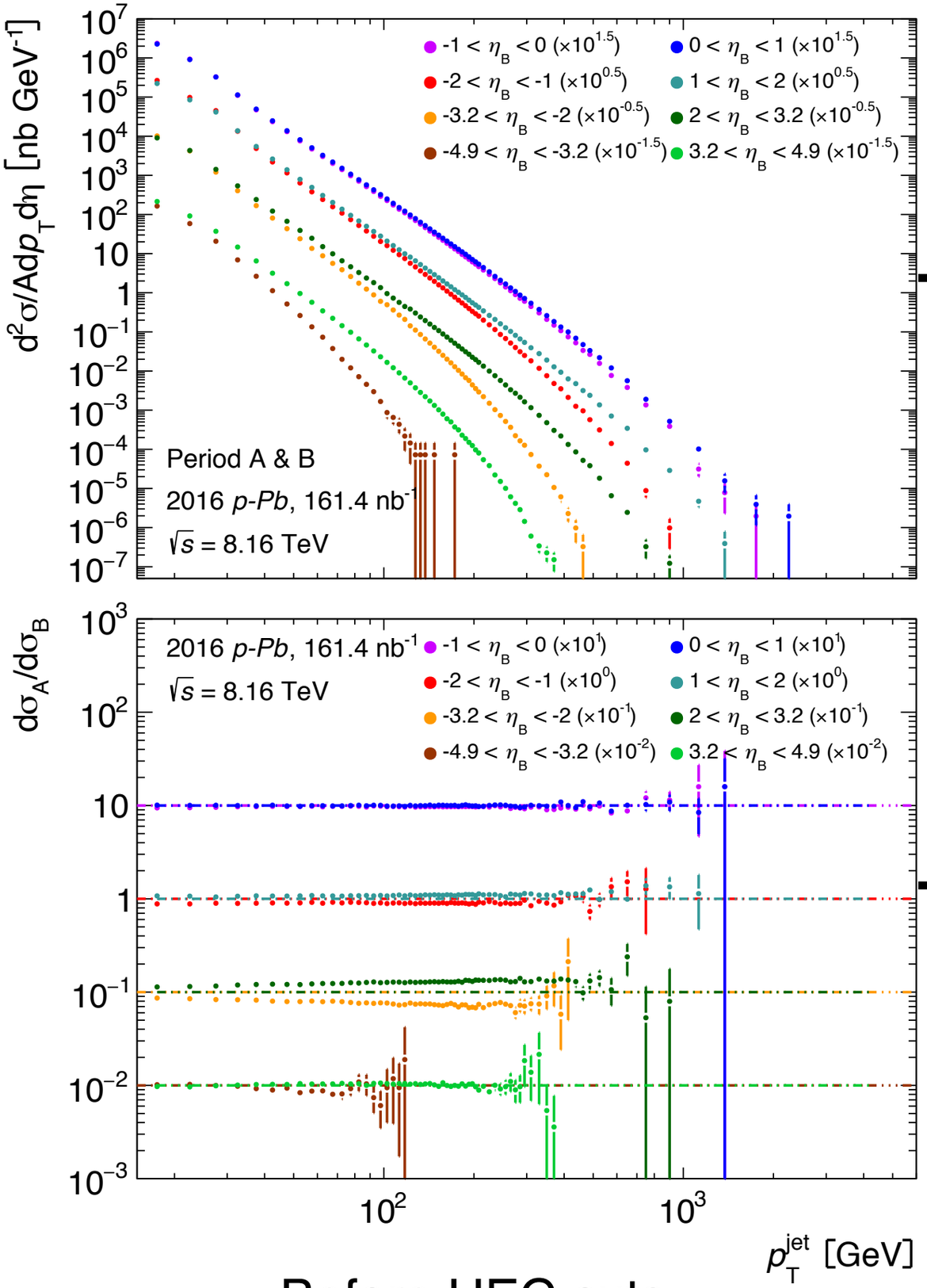
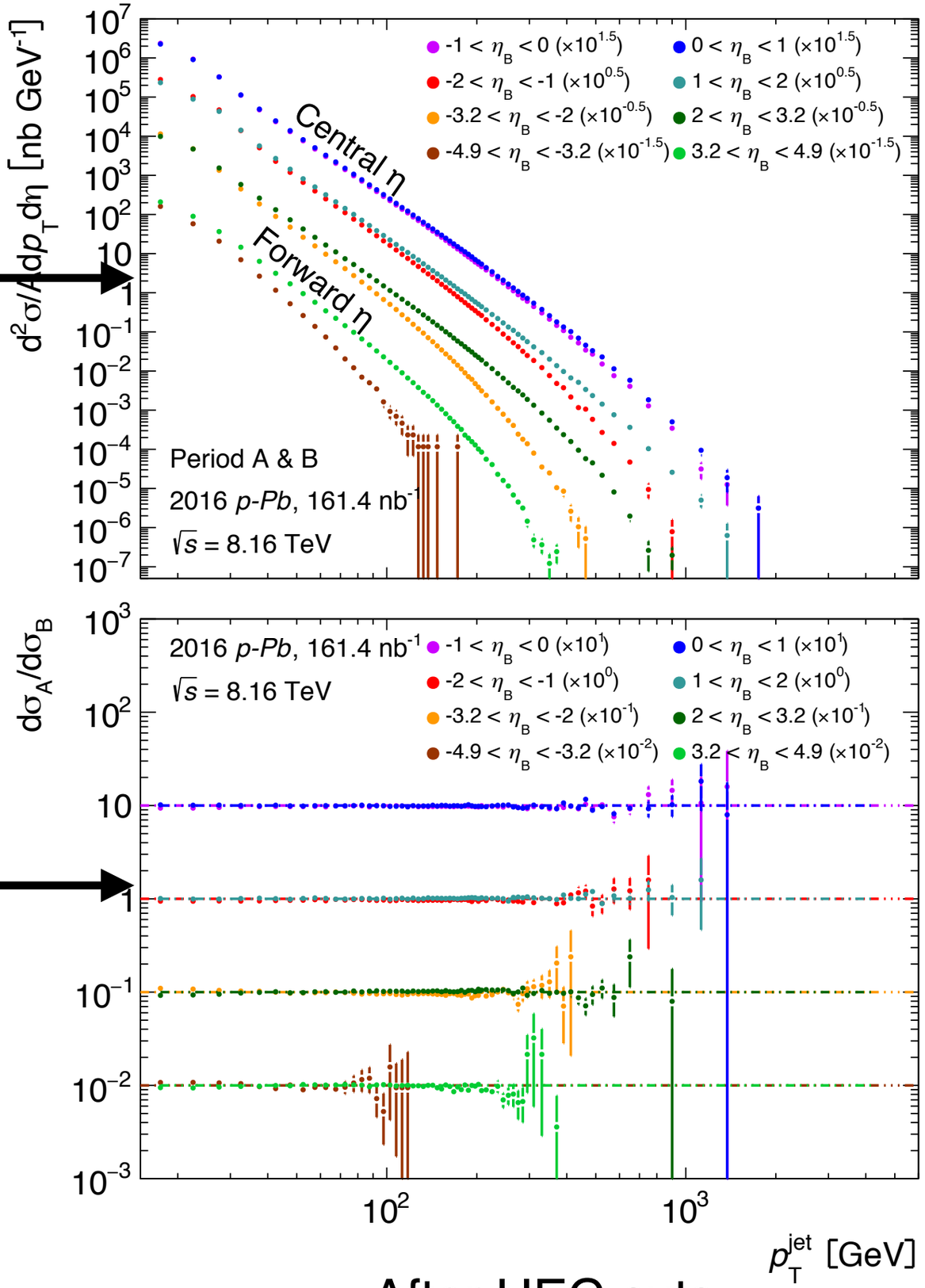
Part 1: Inclusive jets

Inclusive Jets - period A vs. period B

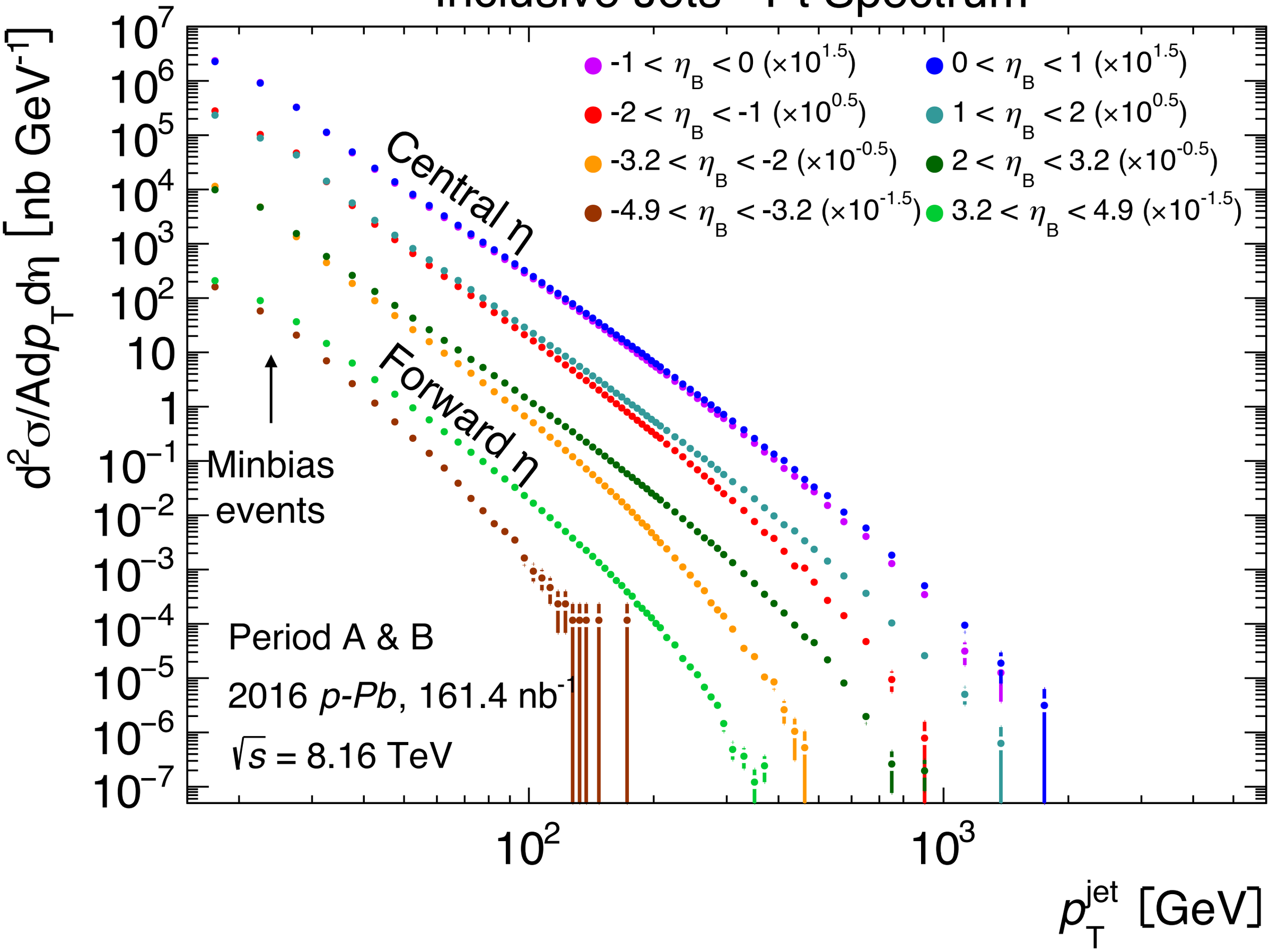


Before HEC cuts



After HEC cuts

Inclusive Jets - Pt Spectrum



Inclusive Jets Pt Spectrum - summary

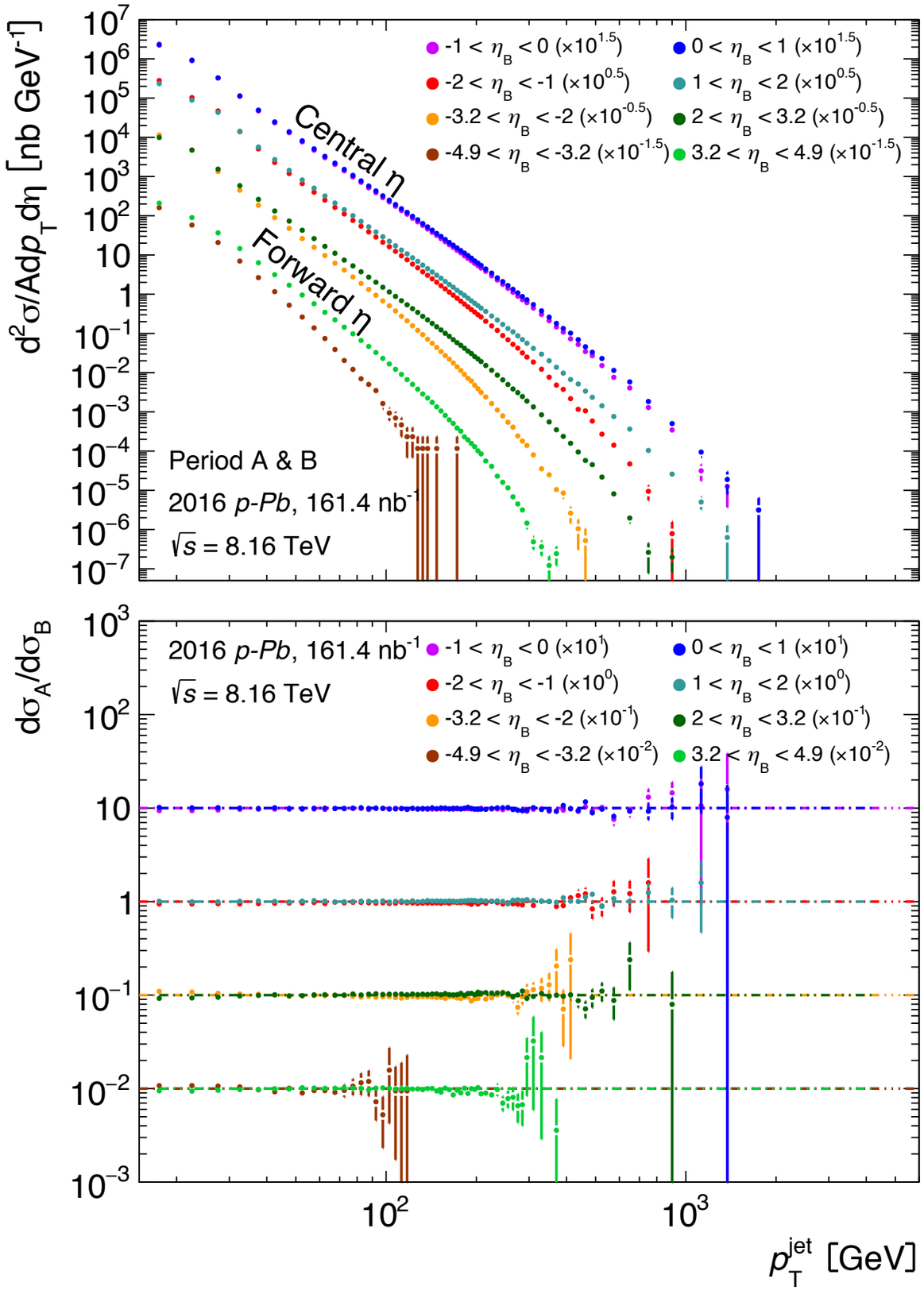
Event selection:

- GRL
- Clean events
- Clean jets
- 1 primary vertex
- Jets outside of HEC

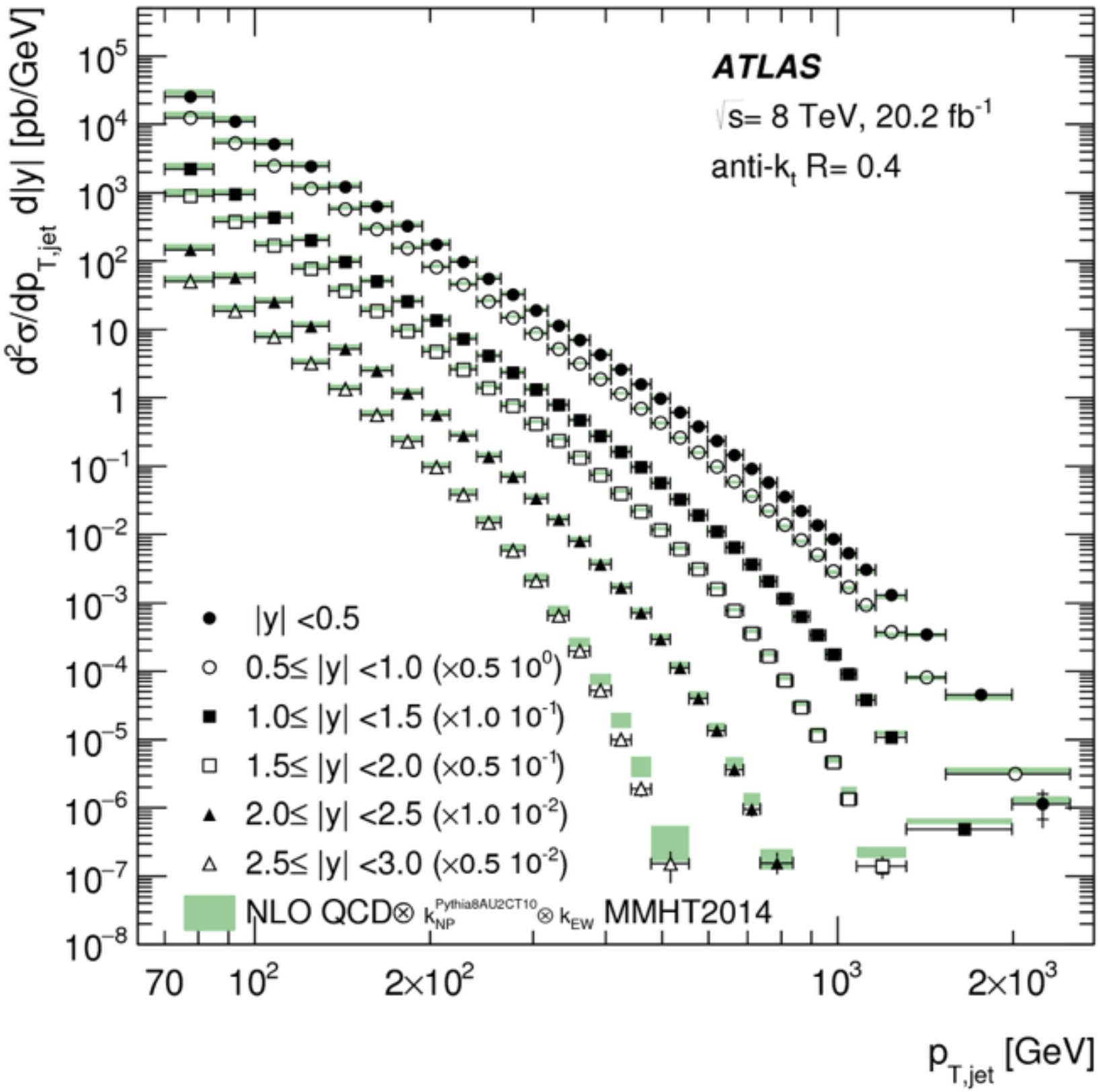
Filling scheme:

- Trigger only above threshold
- Divide by efficiency curve at jet pt and total luminosity (across all runs) in that phase space bin
- Multiply by ratio of area cut out by HEC

So:
jet weight = 2π / (luminosity x efficiency x uncut area in phi)

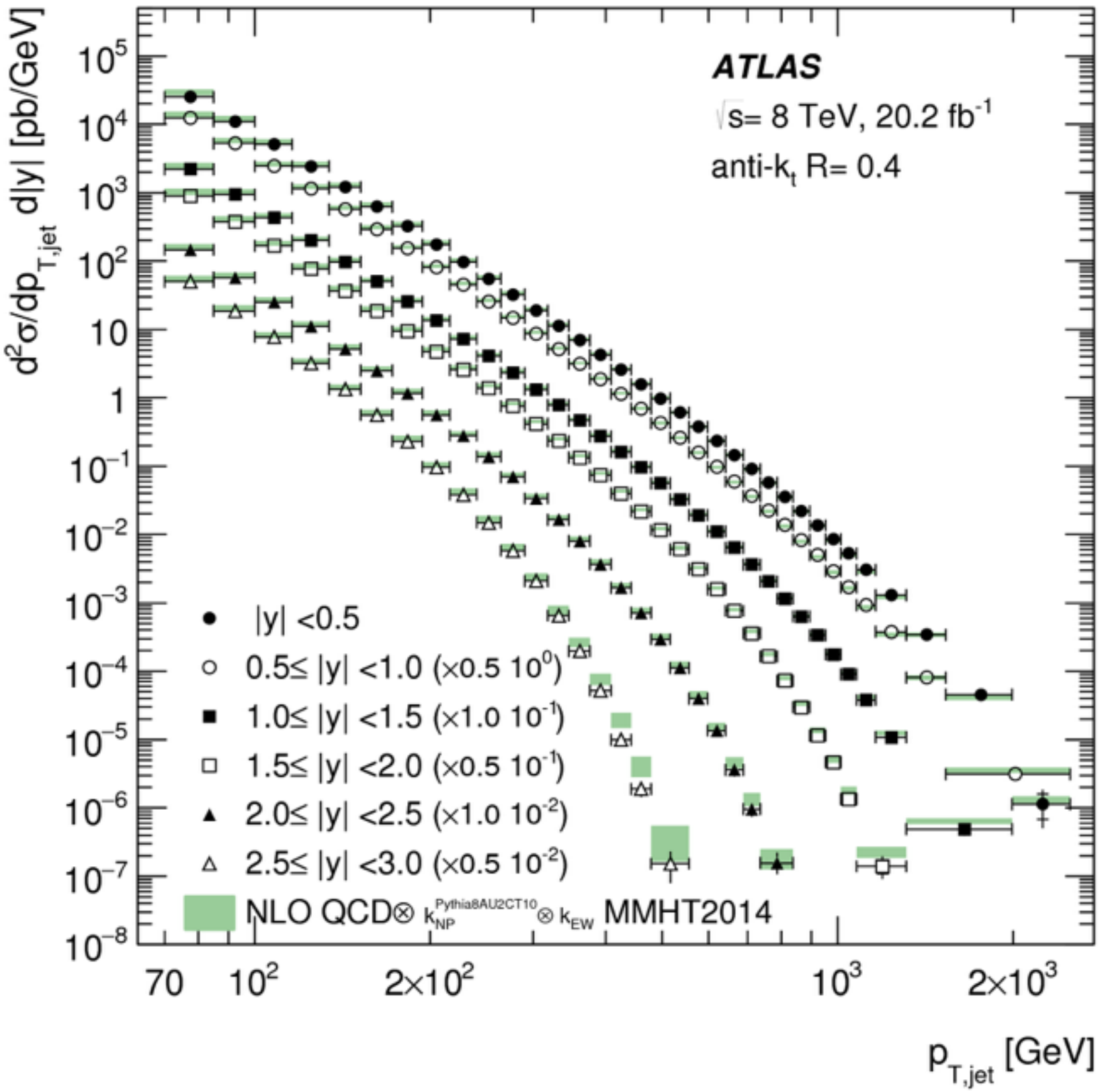


Inclusive Jets - R_{pPb}



(arXiv 1706.03192)

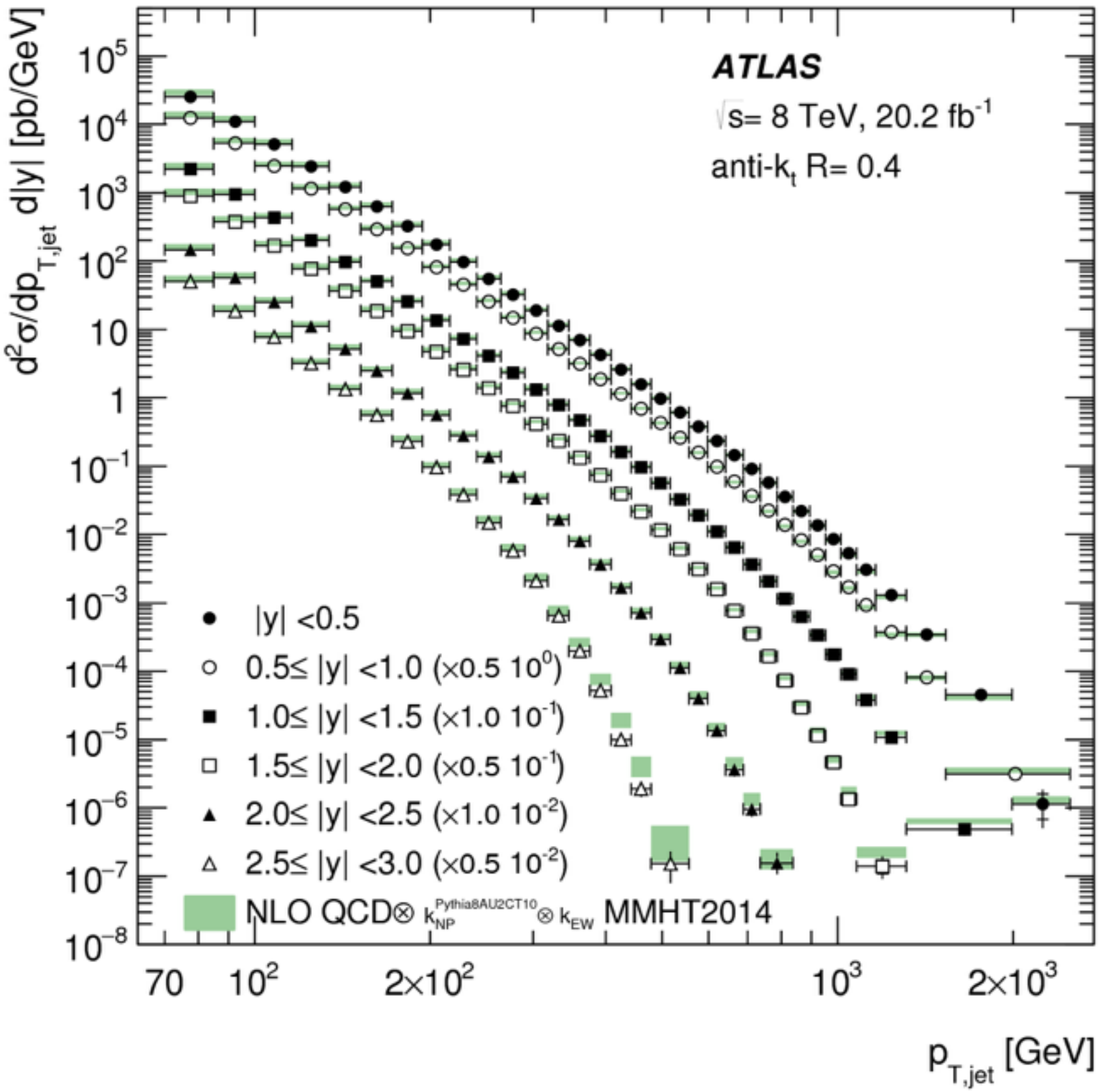
Inclusive Jets - R_{pPb}



Problem: how to maintain triggering scheme while matching bins in rapidity?

(arXiv 1706.03192)

Inclusive Jets - R_{pPb}



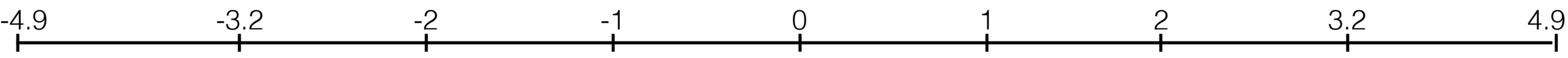
Problem: how to maintain triggering scheme while matching bins in rapidity?

→ cross-sections are probabilities and can be added

(arXiv 1706.03192)

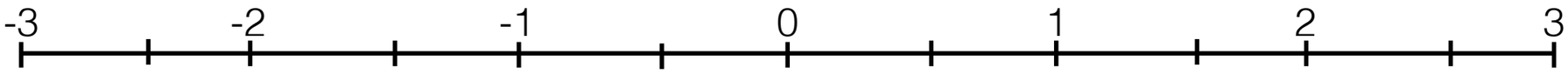
Inclusive Jets - R_{pPb}

Lab frame



+

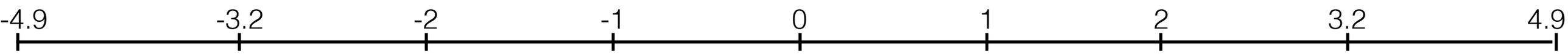
CoM frame ($\eta \rightarrow \eta$ - 0.465)



figures are illustrative and not to scale

Inclusive Jets - R_{pPb}

Lab frame



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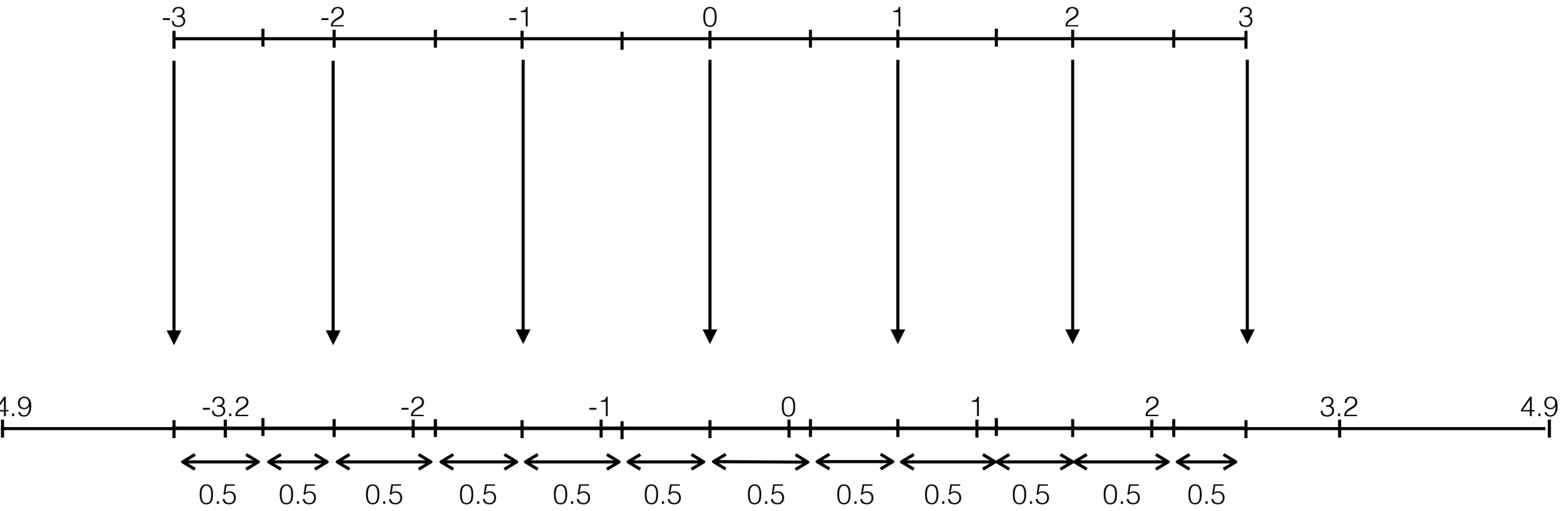
CoM frame ($\eta \rightarrow \eta$ - 0.465)



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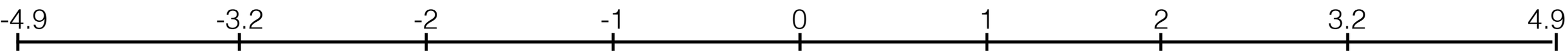
Inclusive Jets - R_{pPb}

Lab frame



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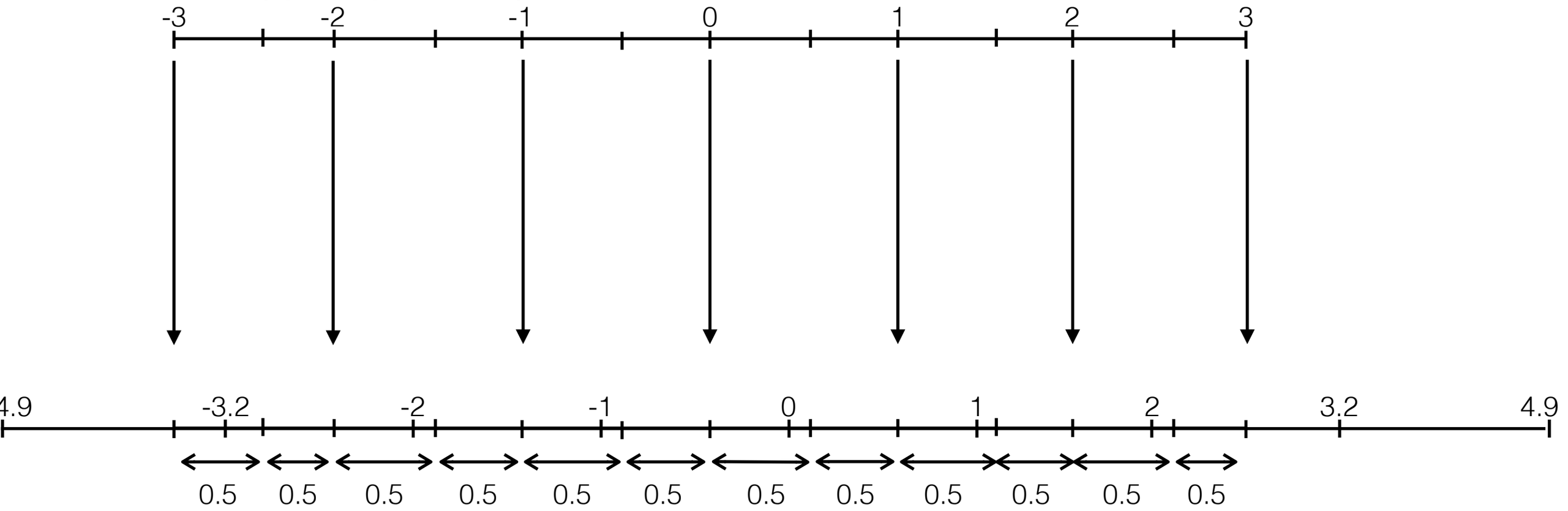
CoM frame ($\eta \rightarrow \eta$ - 0.465)

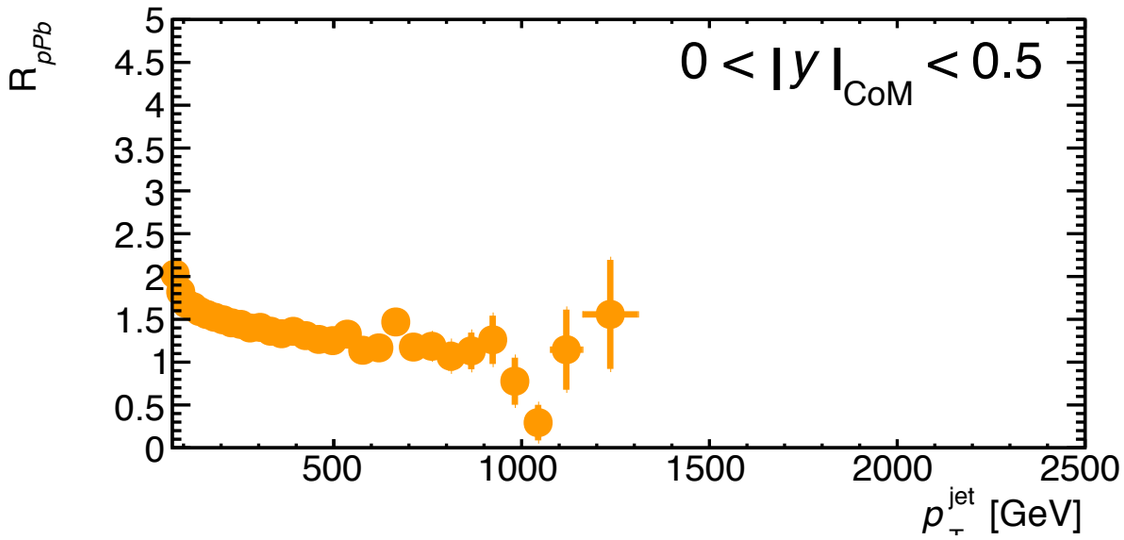


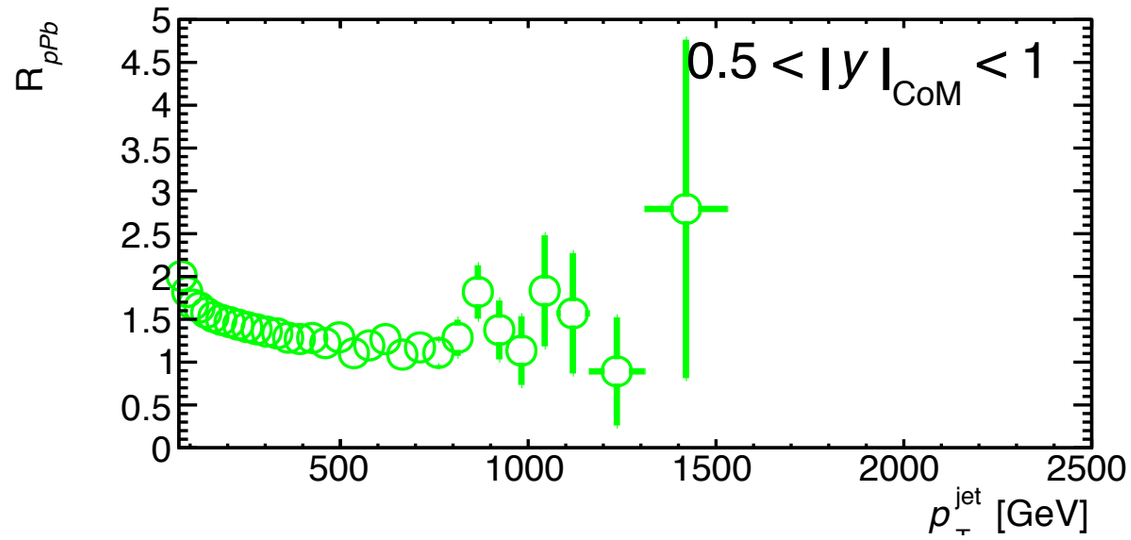
Each bin now has its own trigger and can be treated "normally" until cross-sections are added:

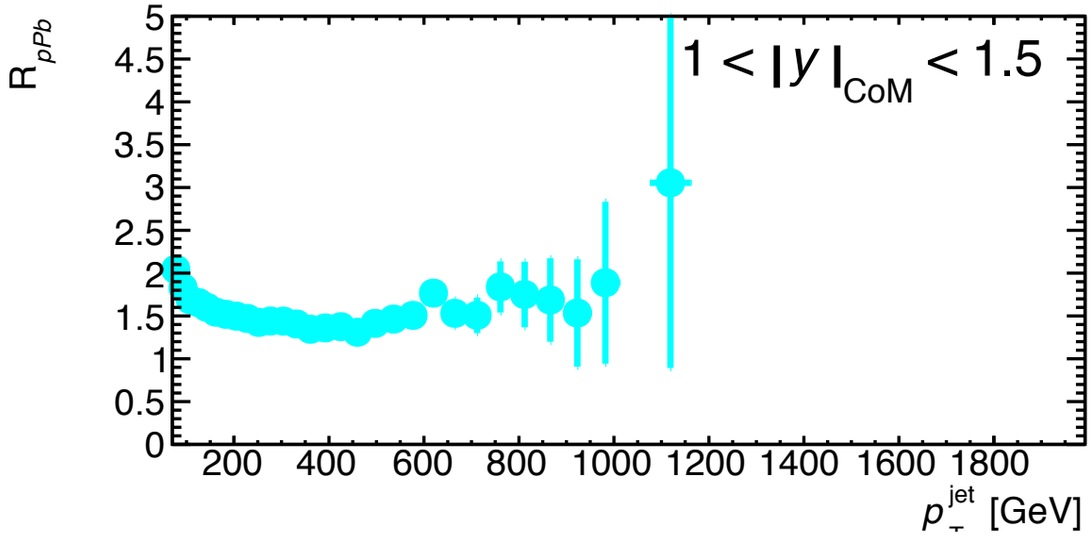
$$\frac{d\sigma}{dp_T}\Big|_{\eta\in(1,2)} = \frac{d\sigma}{dp_T}\Big|_{\eta\in(1,1+\epsilon)} + \frac{d\sigma}{dp_T}\Big|_{\eta\in(1+\epsilon,2)}$$

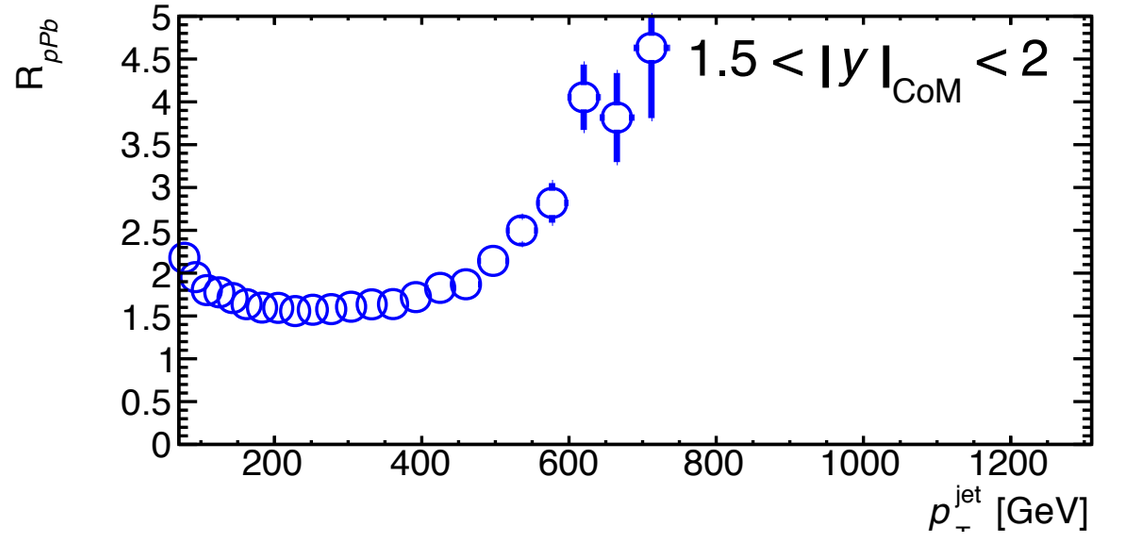
figures are illustrative and not to scale

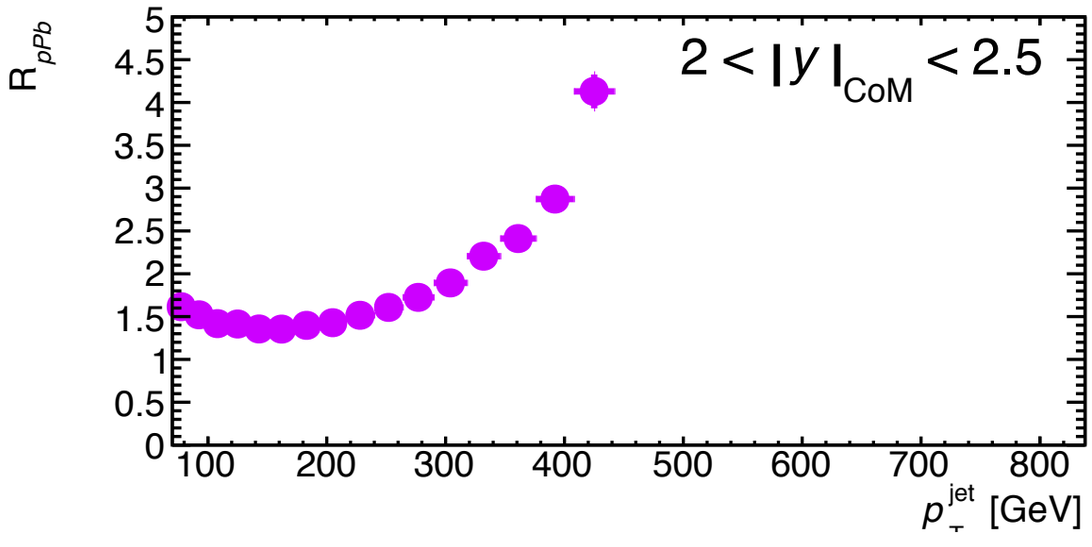
Inclusive Jets - R_{pPb}

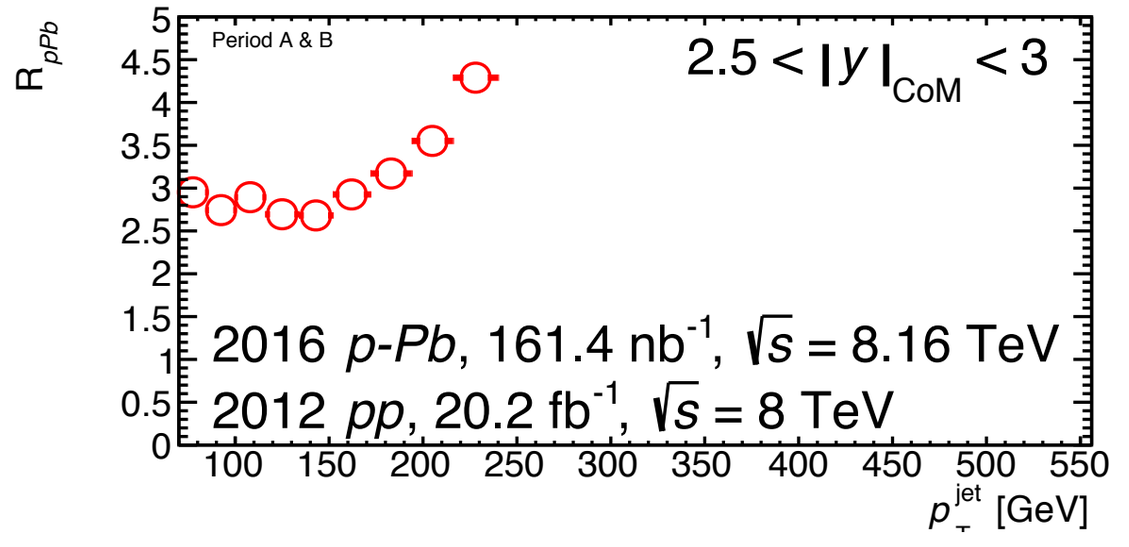












Part 2: Dijets

Recall:

$$x_p = \frac{1}{\sqrt{s_{NN}^{avg}}} \sqrt{\frac{Z}{A}} \left(p_{T3} e^{\eta_3} + p_{T4} e^{\eta_4} \right)$$

$$x_a = \frac{1}{\sqrt{s_{NN}^{avg}}} \sqrt{\frac{A}{Z}} \left(p_{T3} e^{-\eta_3} + p_{T4} e^{-\eta_4} \right)$$

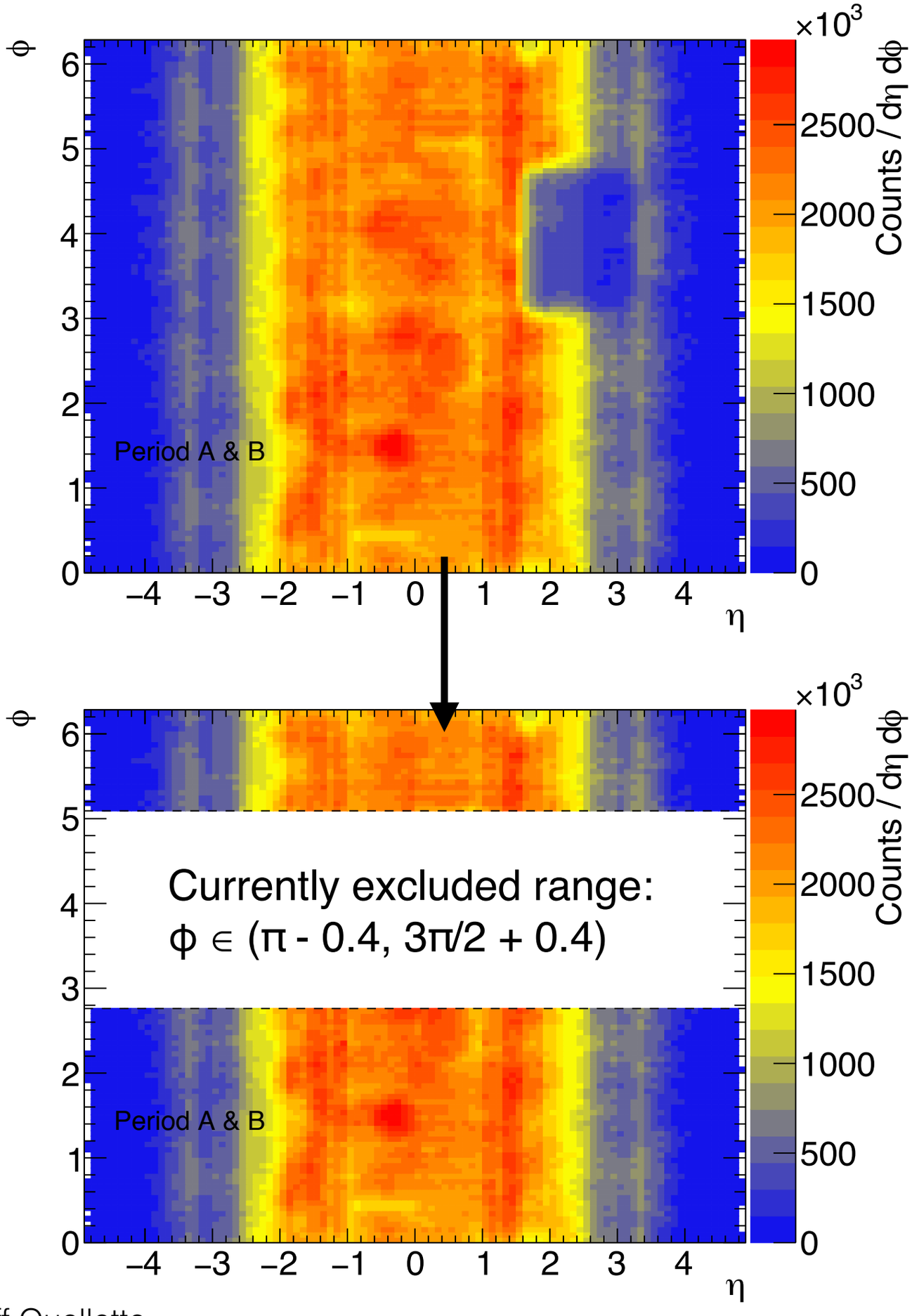
Also note:

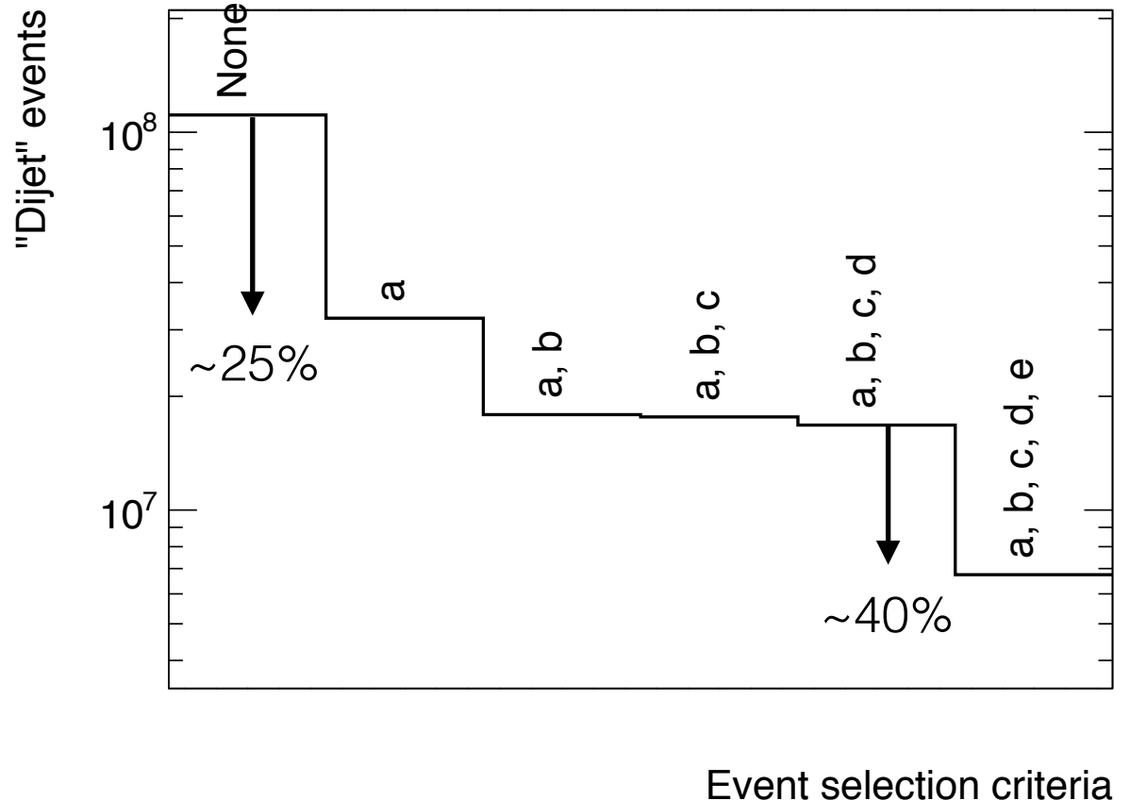
$$Q^2 = \sqrt{\frac{A}{Z}} \sqrt{s} x_p \left(p^0 - \sqrt{(p^0)^2 - p_T^2} \right)$$

(just an exponential transformation of the jets)

Will focus on increasing levels of event selection, and effects on x-distributions

** Note: binning now by η of dijet system **





Can “correct” for cut by dividing out phase space area of HEC region.

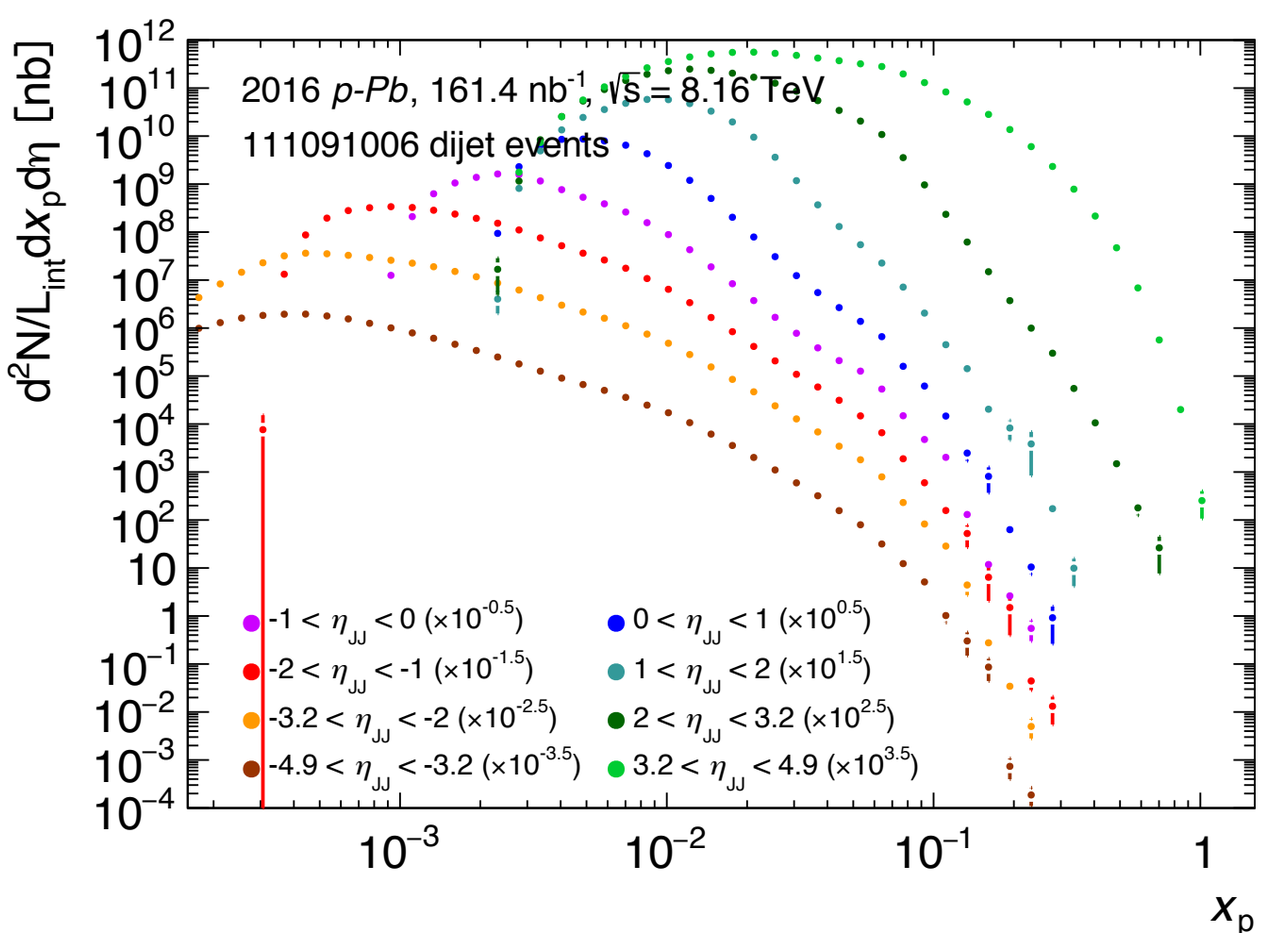
⇒ More detailed cut would need to take into account η dependence in correction.

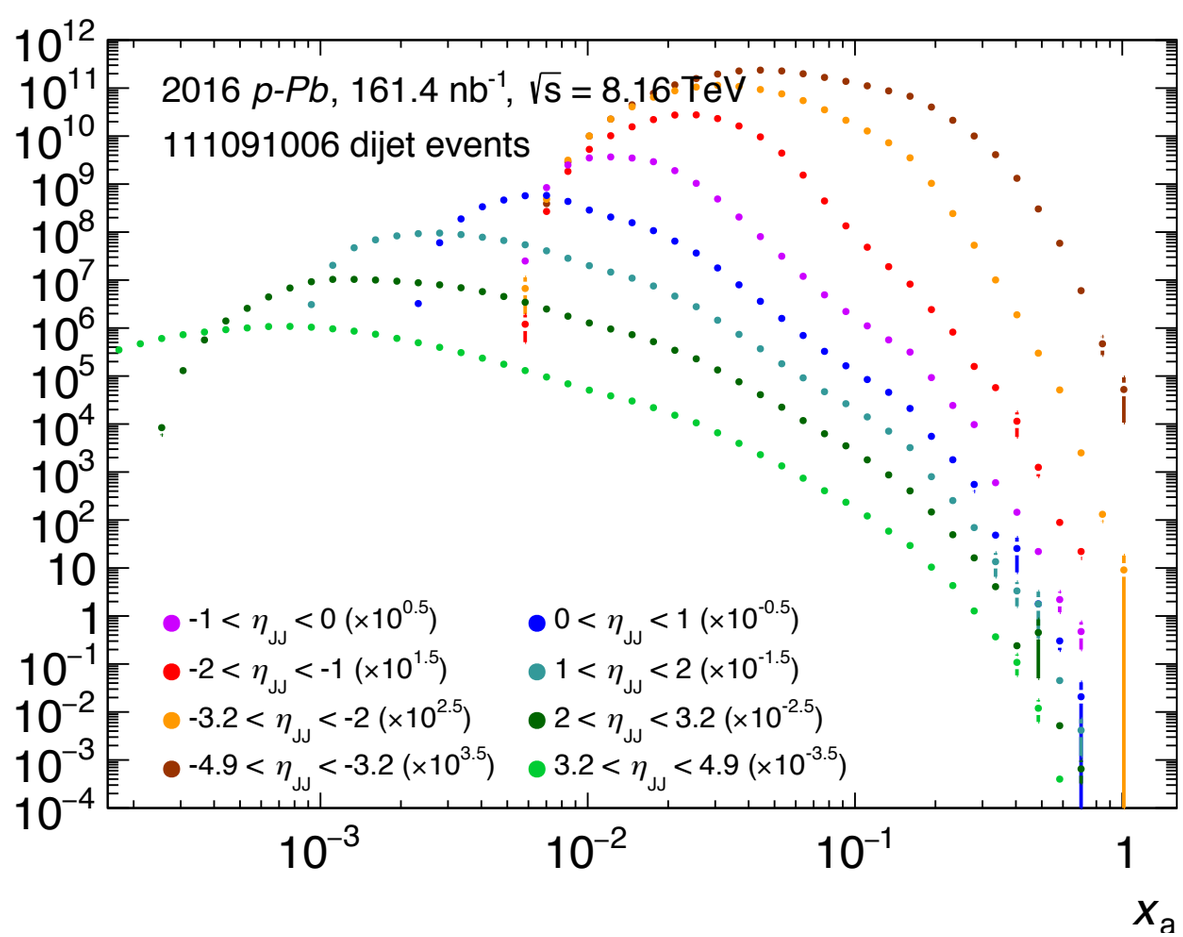
Correction factor is invalid in dijets since available phase space of one jet is constrained by the other.

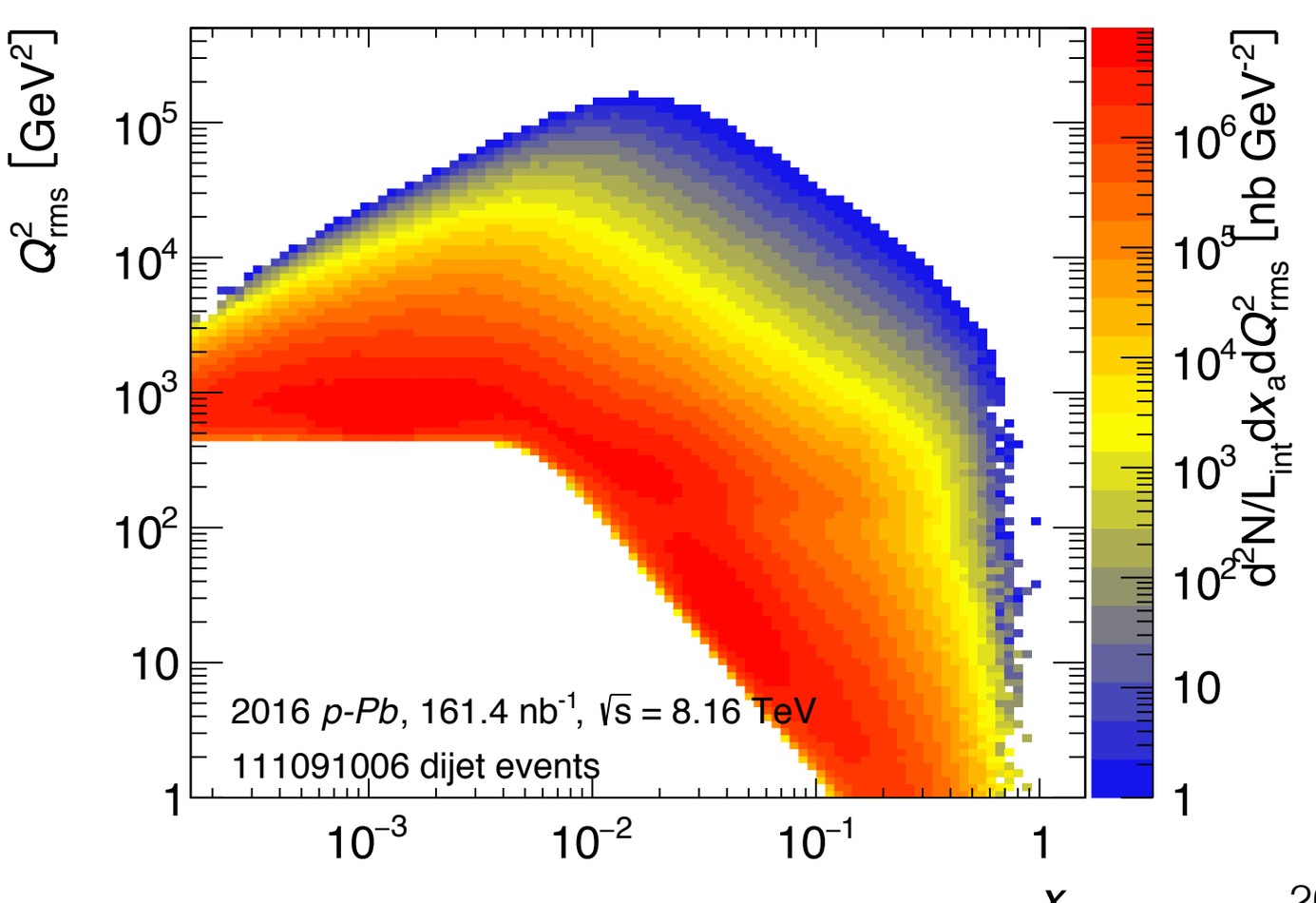
⇒ Counts / luminosity is reported, not “cross-section”

Current approach: use correction in inclusive jets production, but not in dijets.

Dijet event selection criteria:
“standard” selection: GRL, cleaned events, cleaned jets, primary vertex, 2+ jets, leading jet trigger

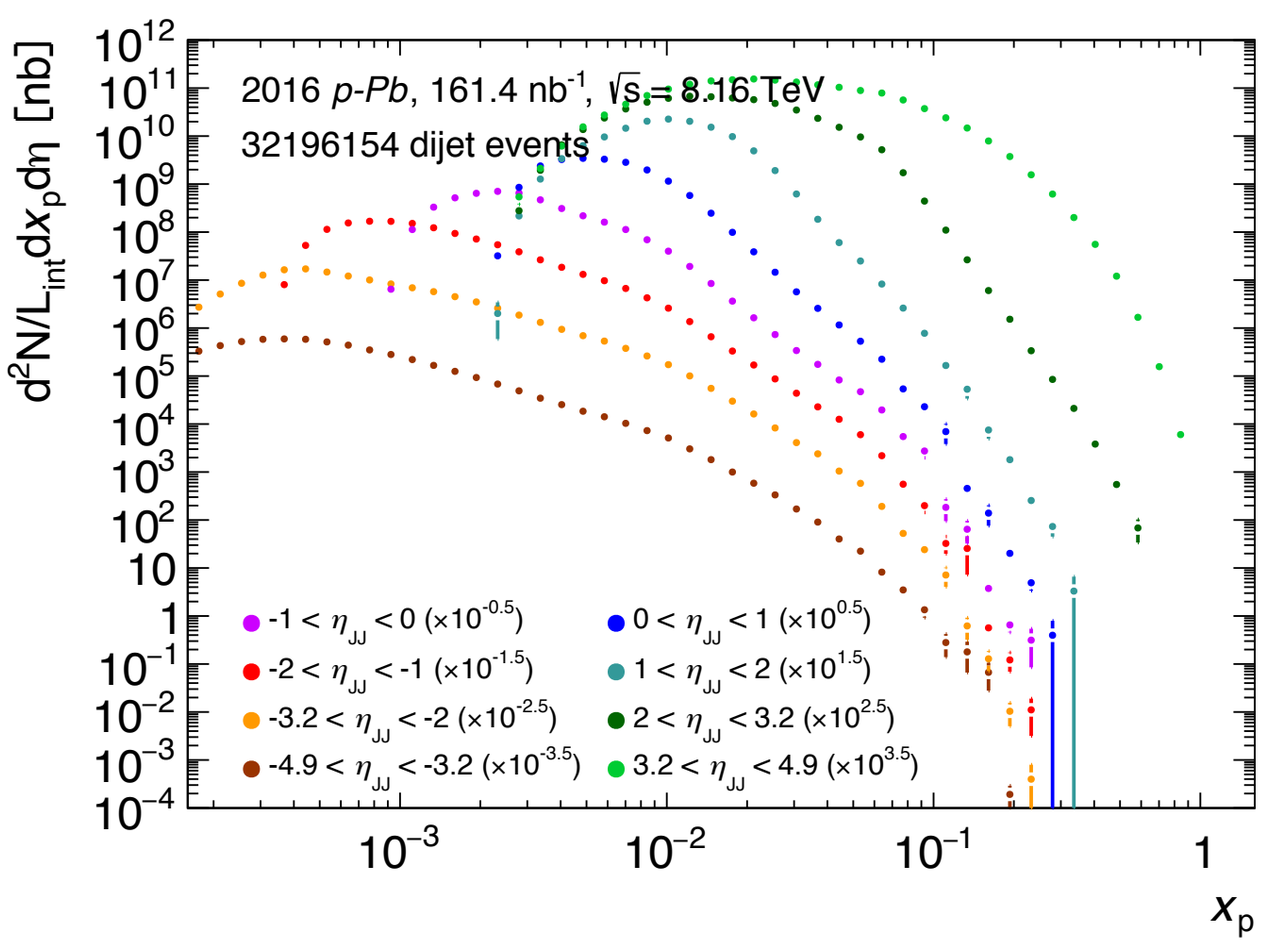


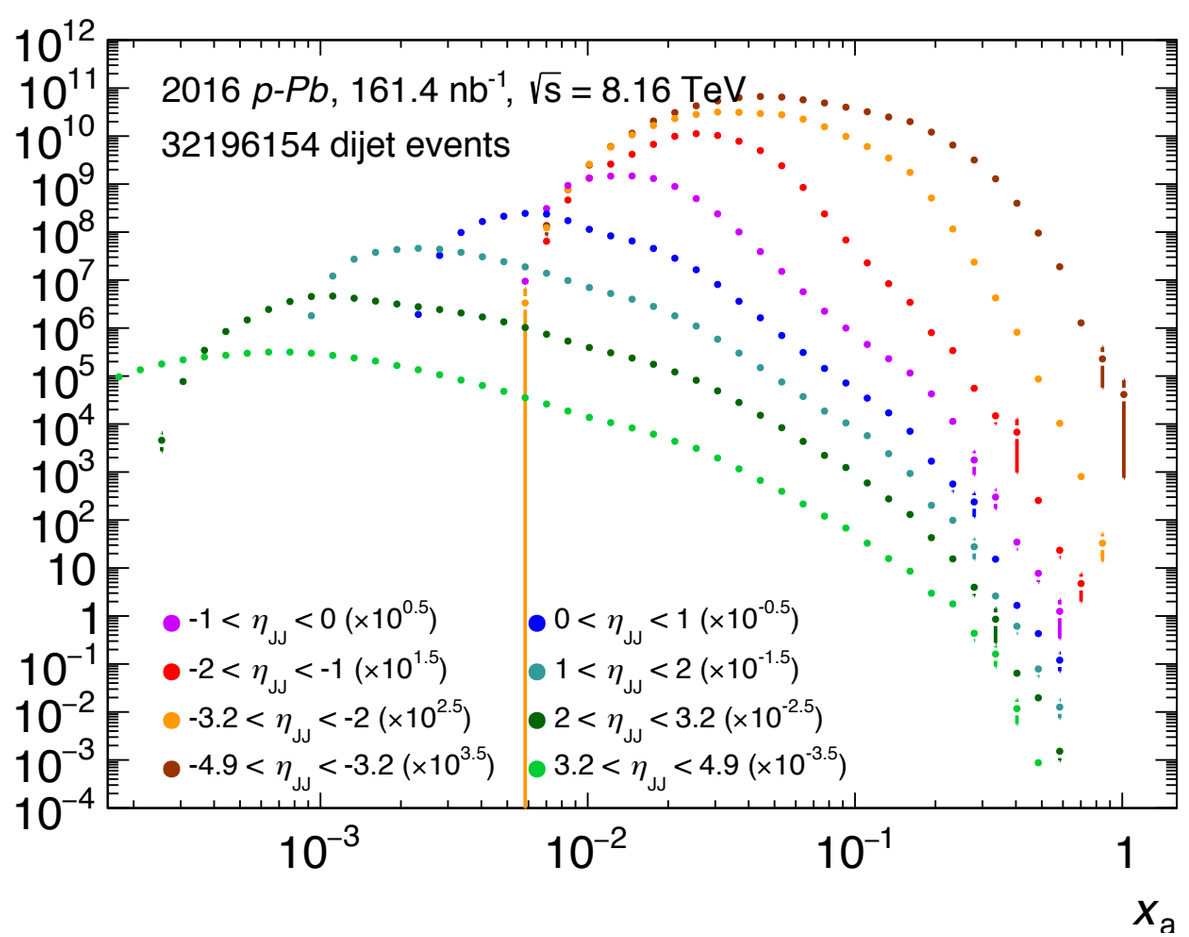


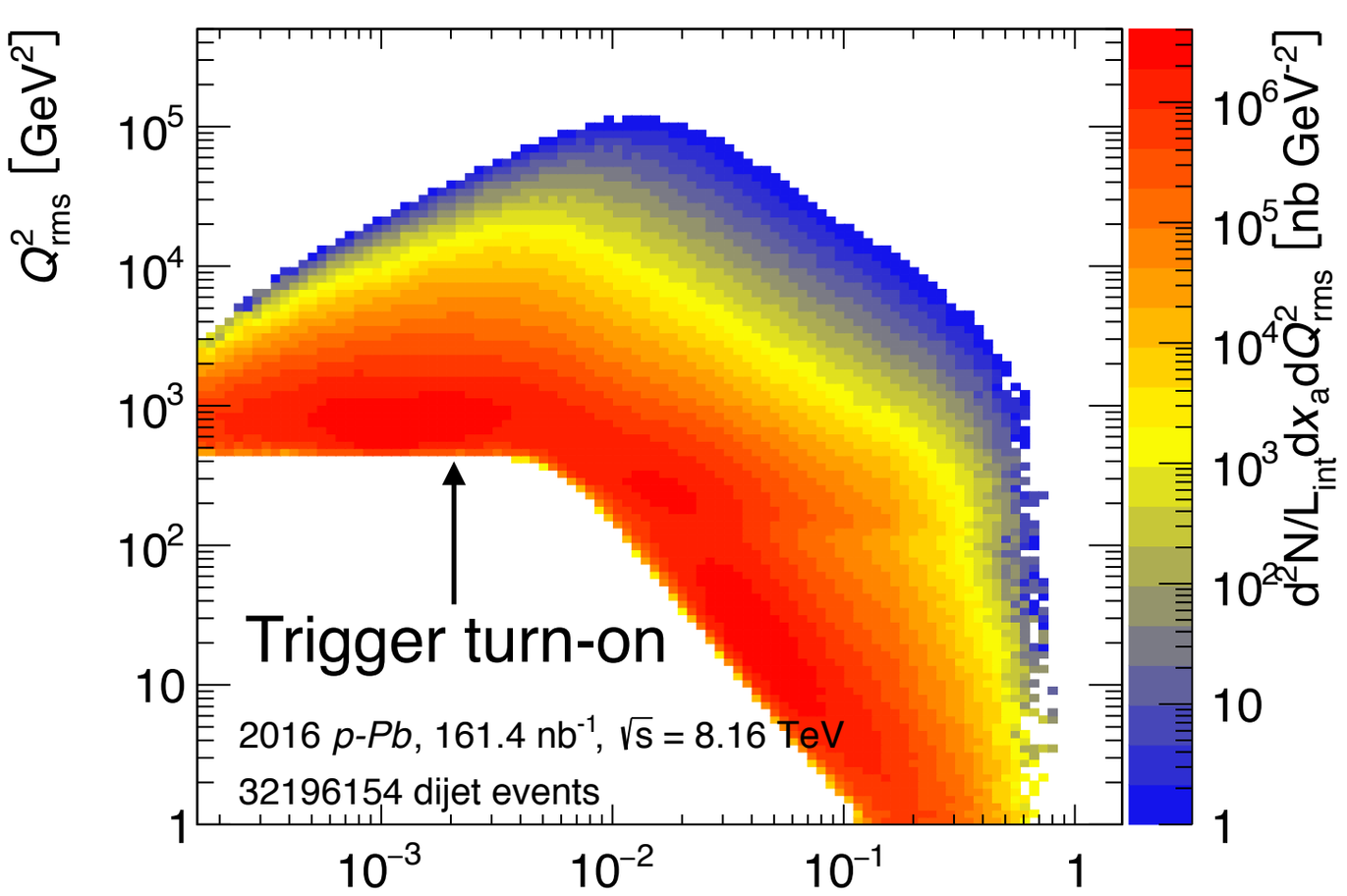


Dijet event selection criteria:
"standard" selection: GRL, cleaned events, cleaned jets, primary vertex, 2+ jets, leading jet trigger

+ (a) jets not inside disabled HEC

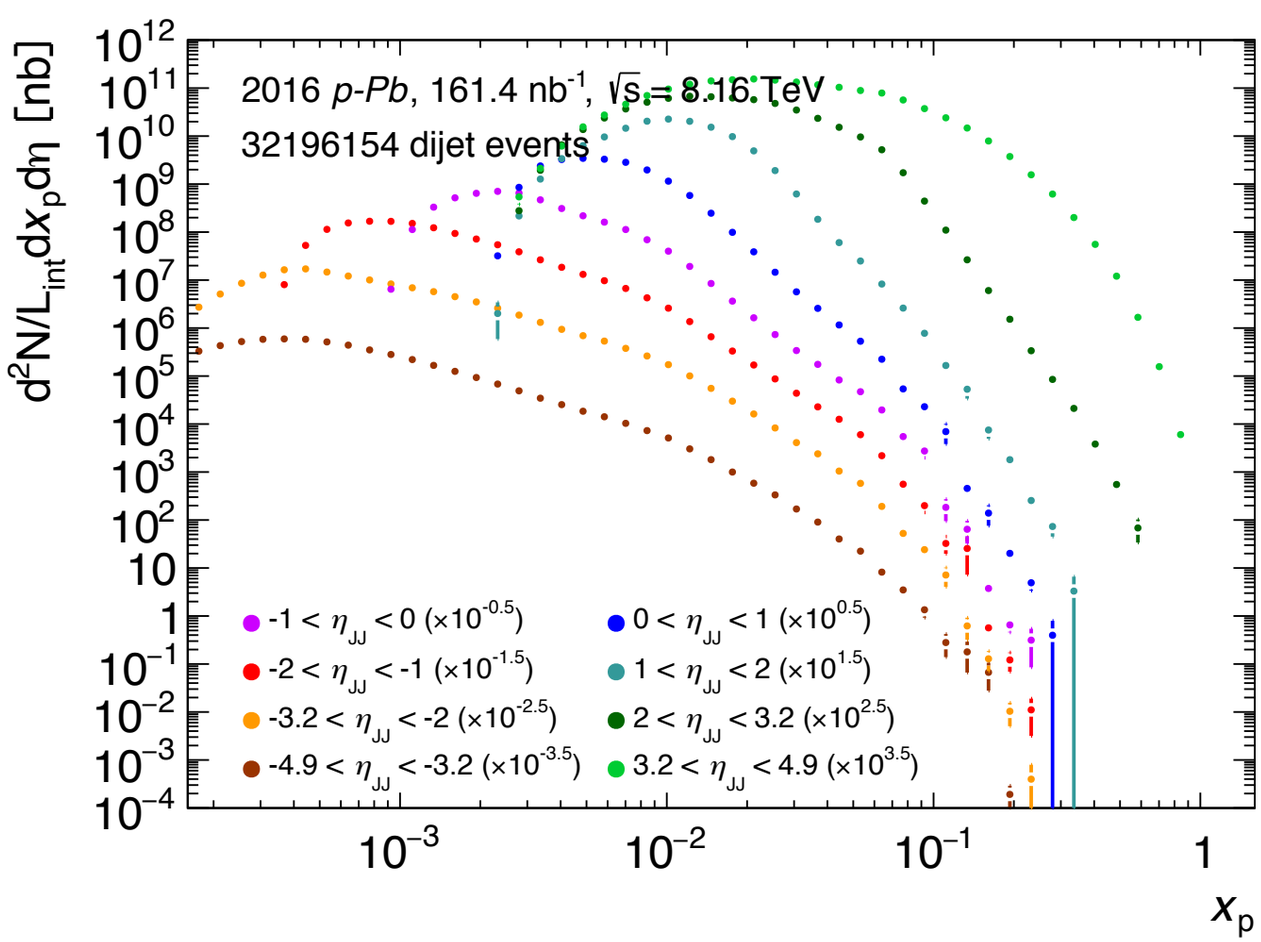


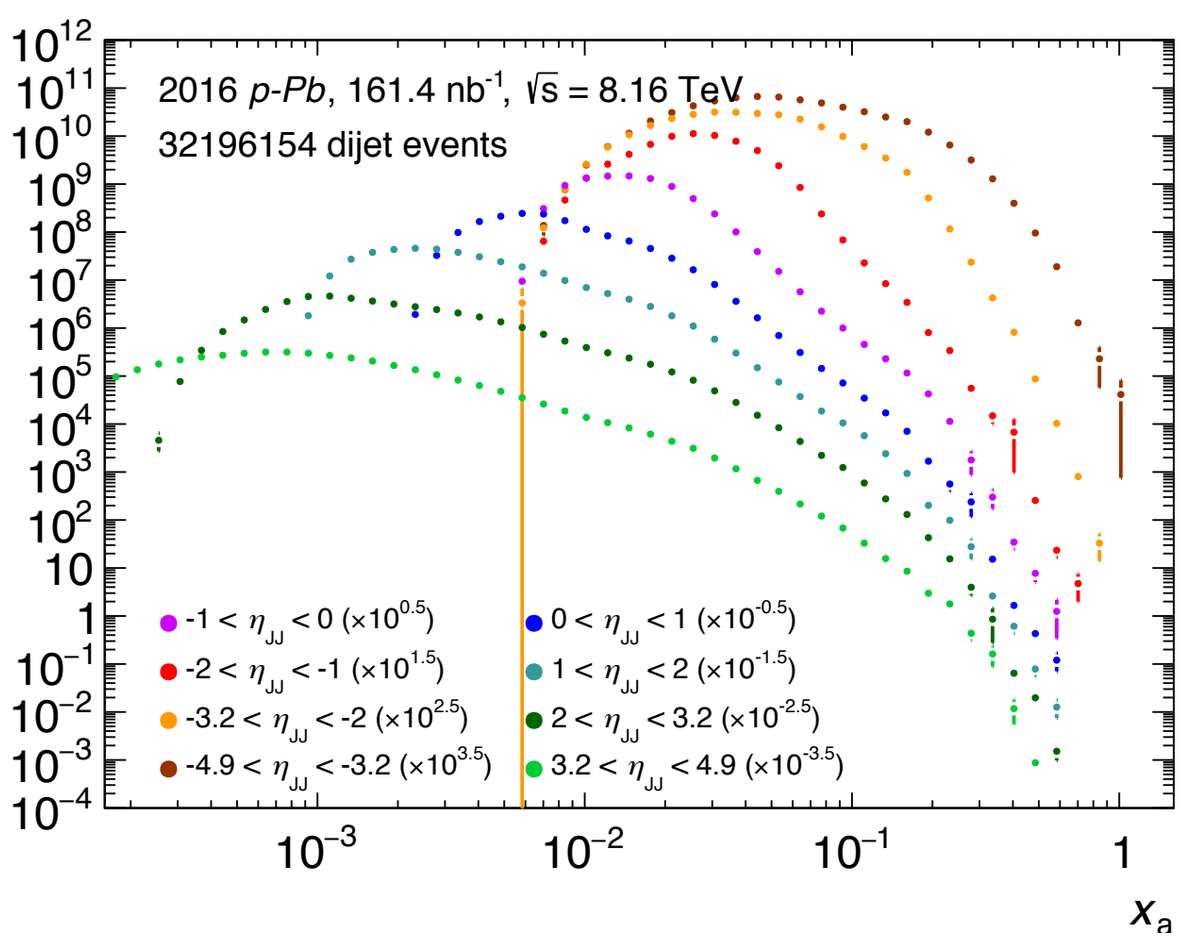


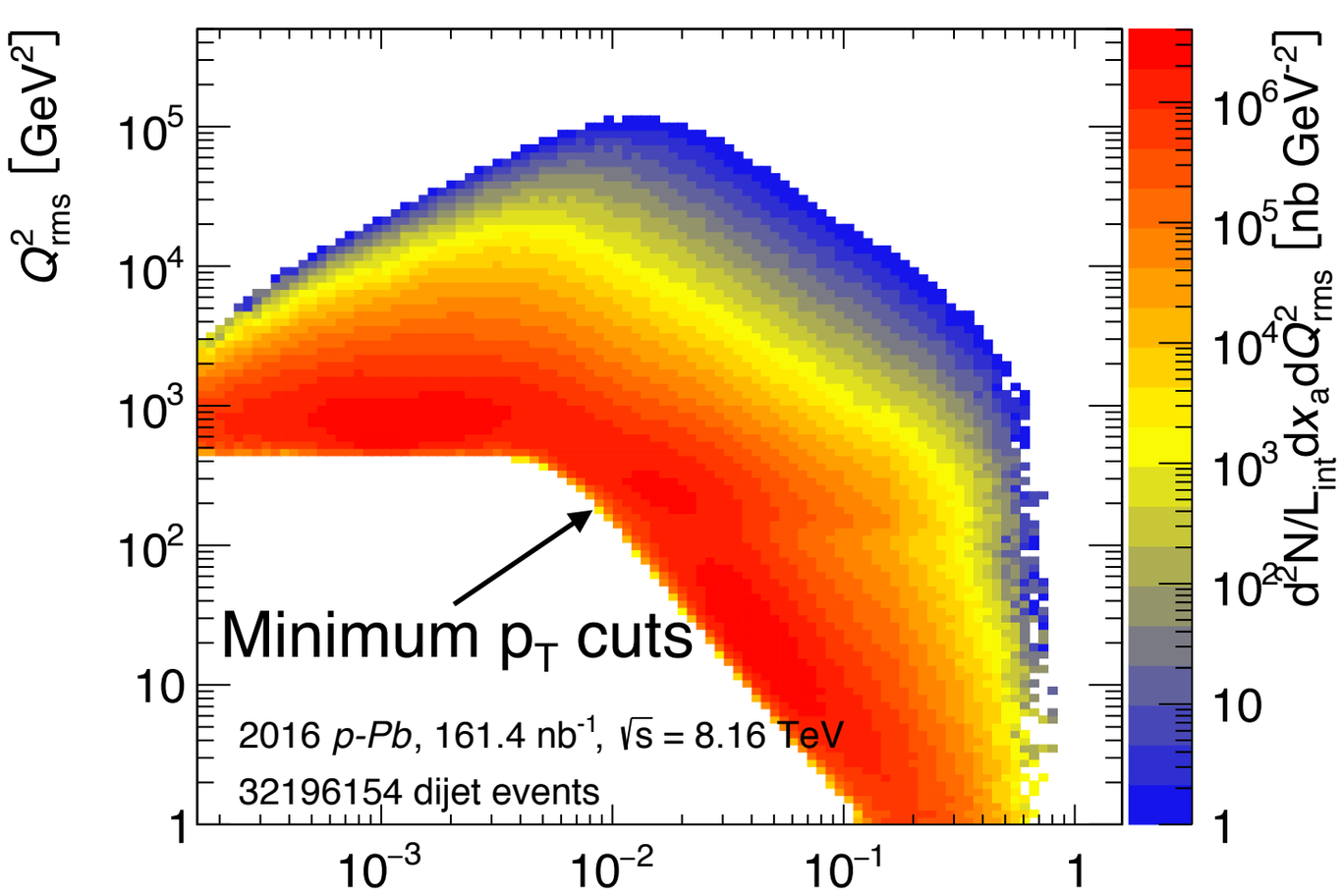


Dijet event selection criteria:
"standard" selection: GRL, cleaned events, cleaned jets, primary vertex, 2+ jets, leading jet trigger

+ (a) jets not inside disabled HEC

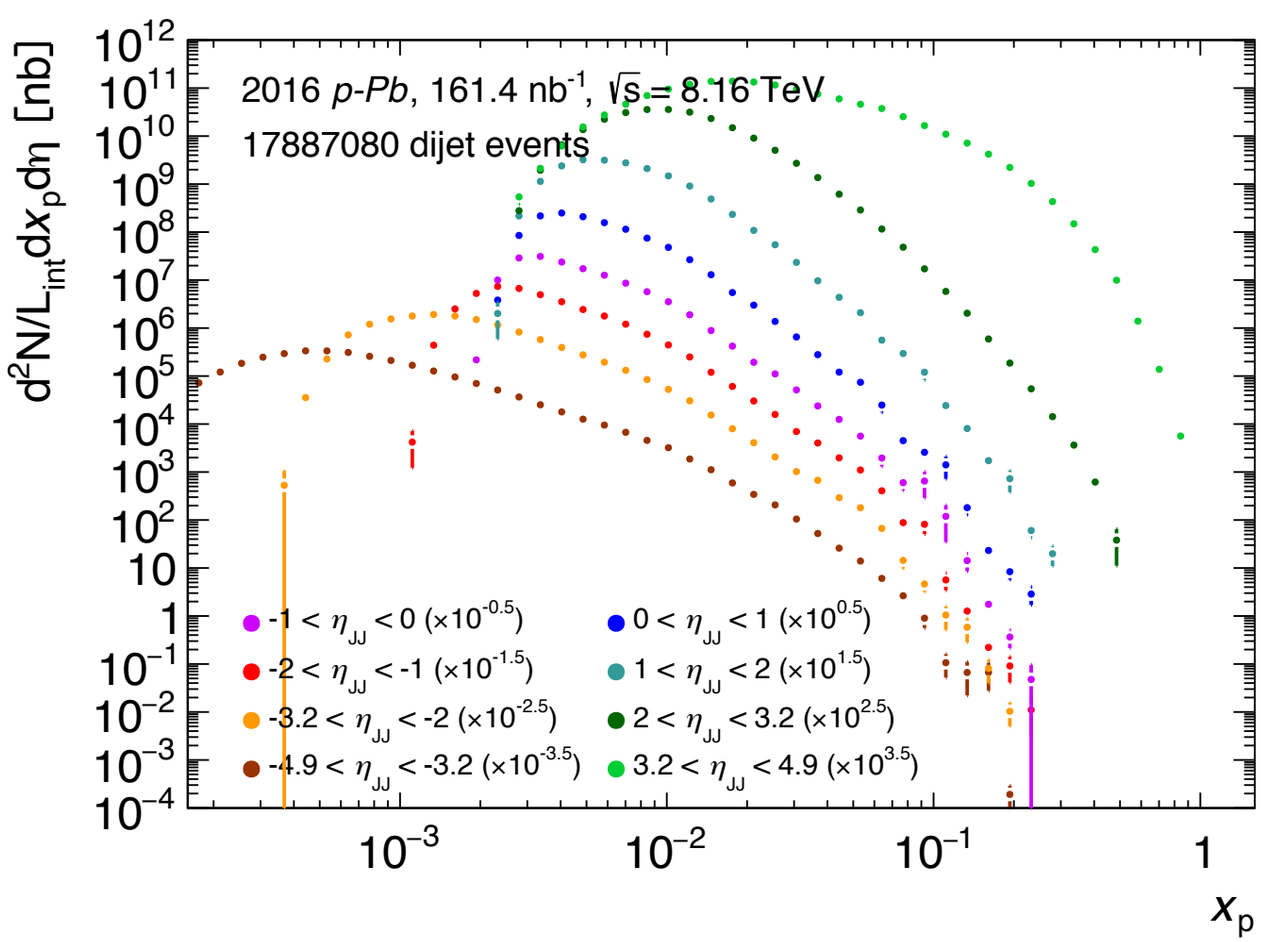


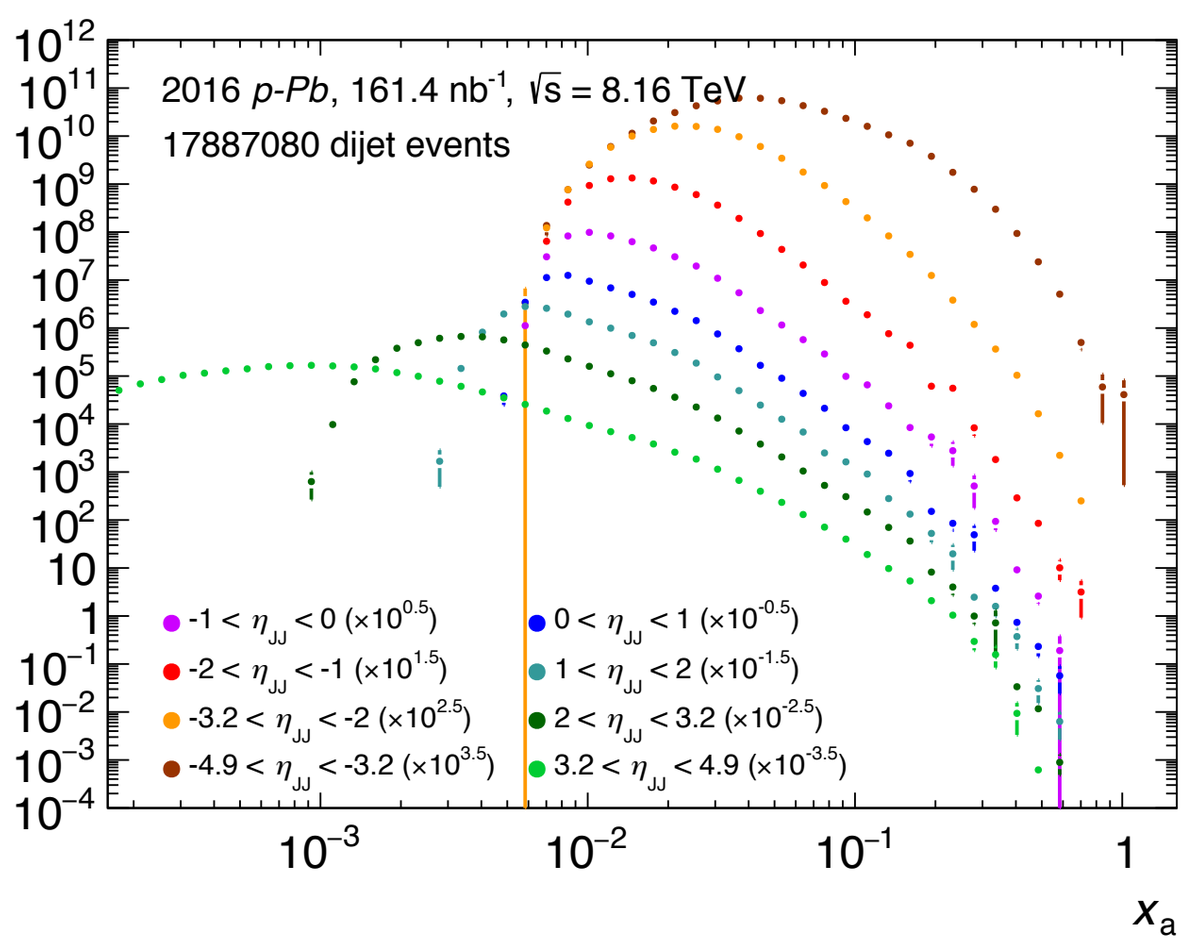


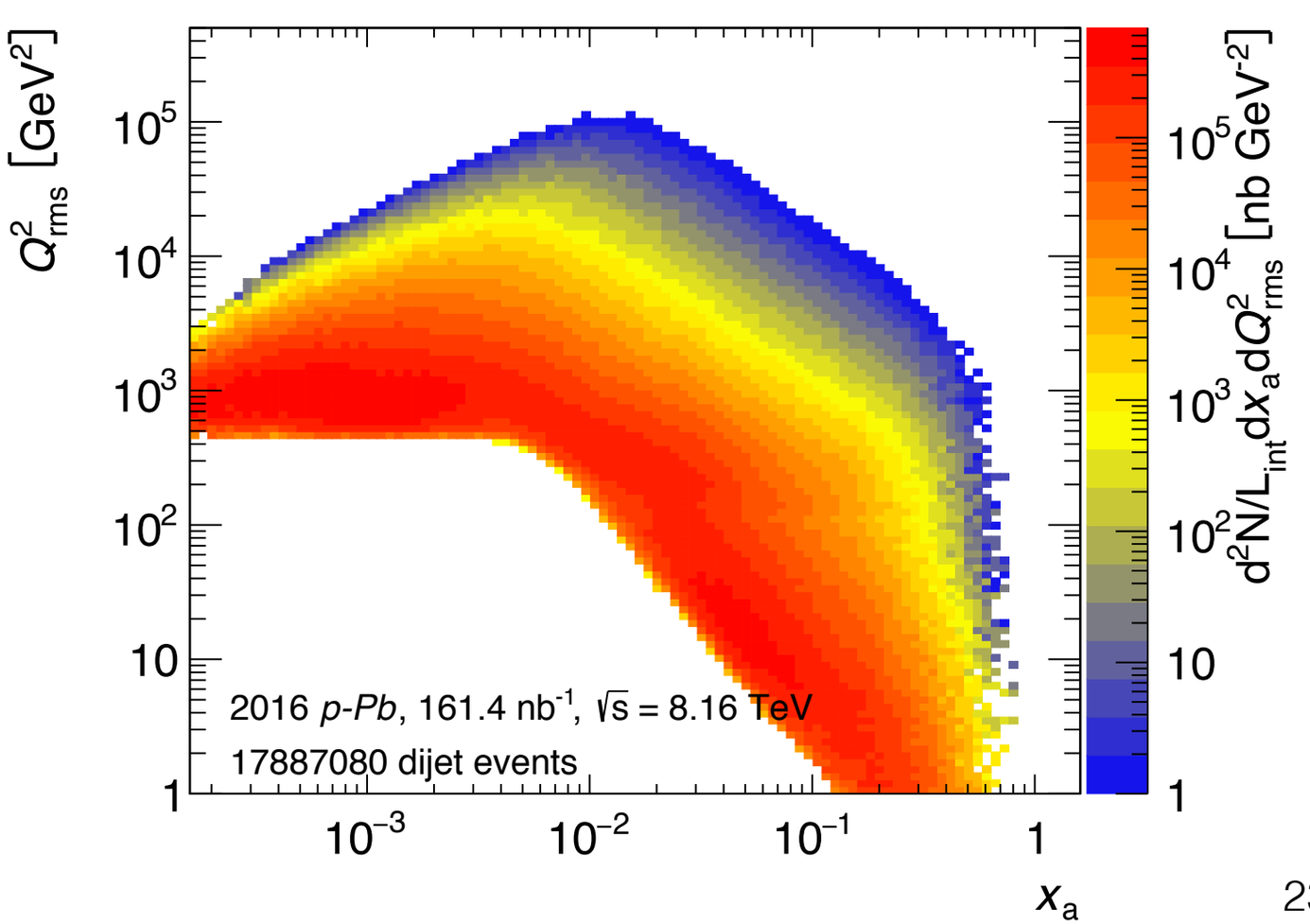


Dijet event selection criteria:
"standard" selection: GRL, cleaned events, cleaned jets, primary vertex, 2+ jets, leading jet trigger

+ (a) jets not inside disabled HEC
+ (b) $\Delta\phi \geqslant 7\pi/8$

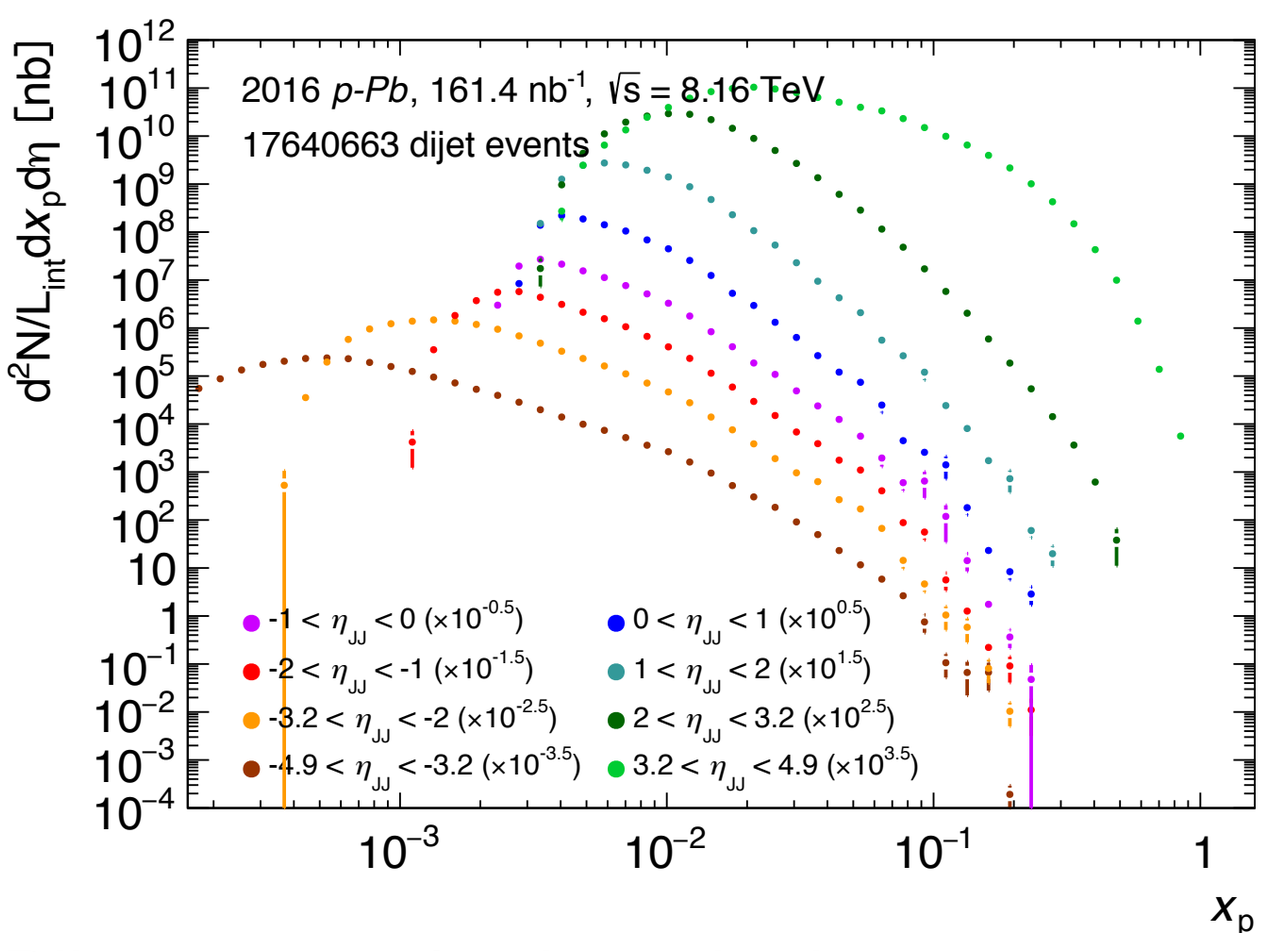


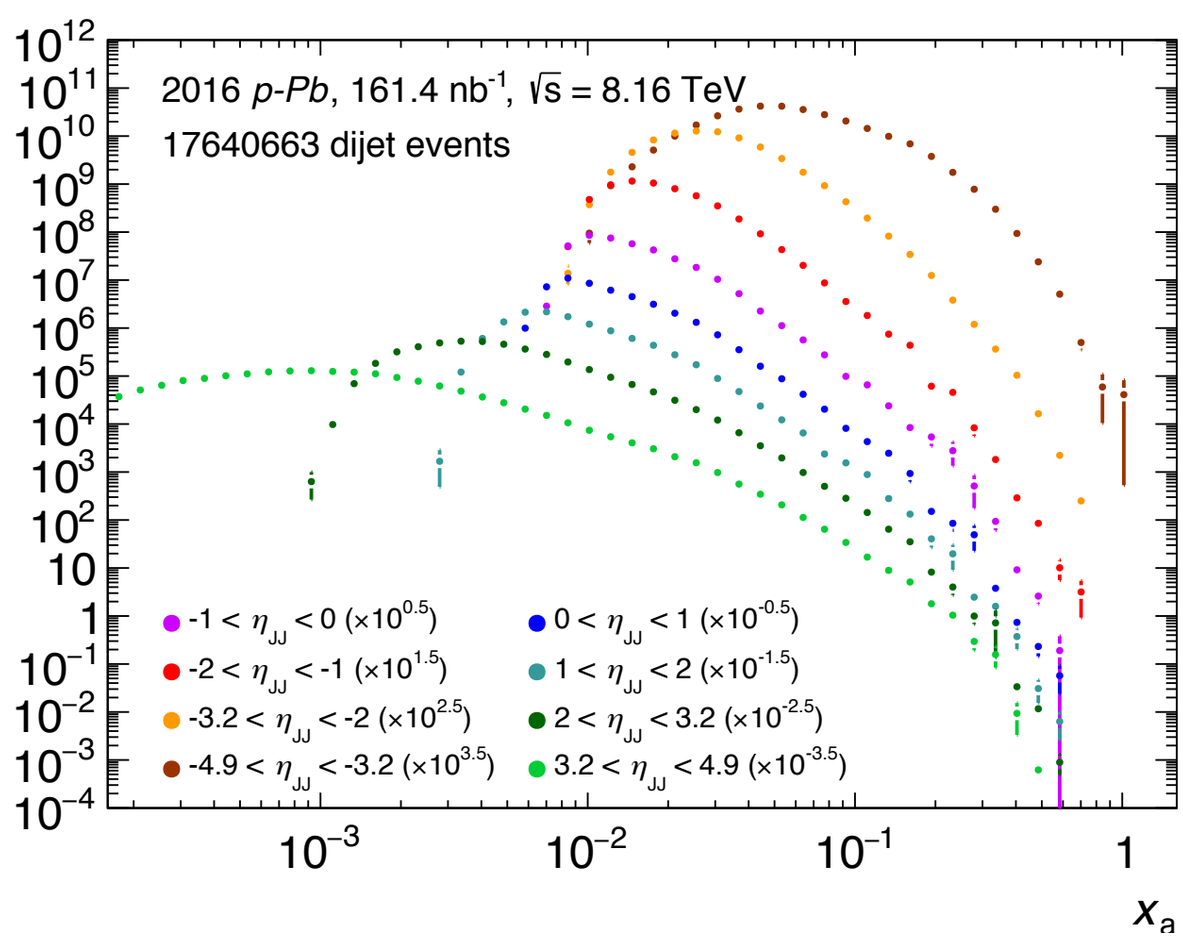


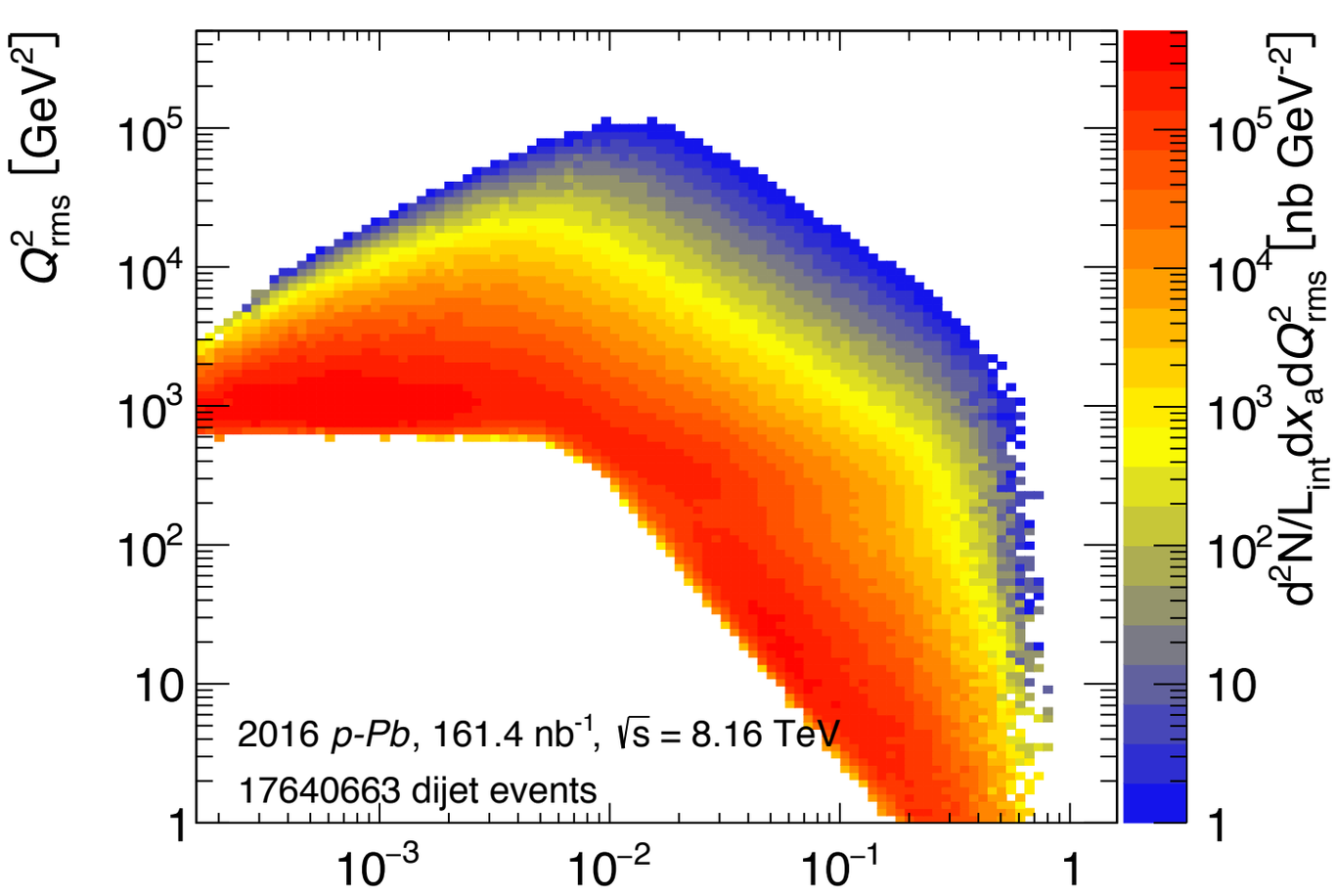


Dijet event selection criteria:
"standard" selection: GRL, cleaned events, cleaned jets, primary vertex, 2+ jets, leading jet trigger

+ (a) jets not inside disabled HEC
+ (b) $\Delta\phi \geqslant 7\pi/8$
+ (c) leading jet $p_T \geqslant 20$ GeV

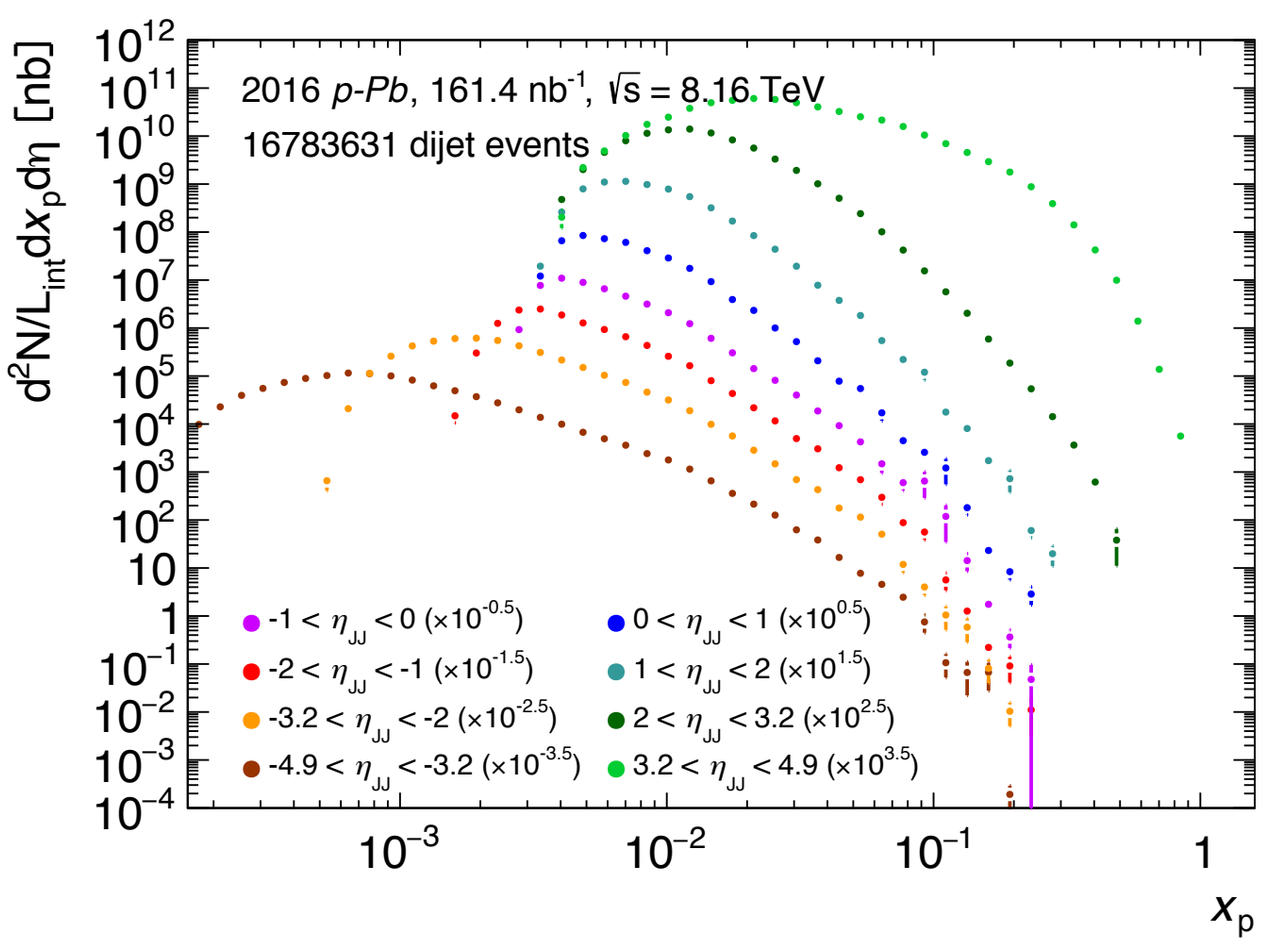


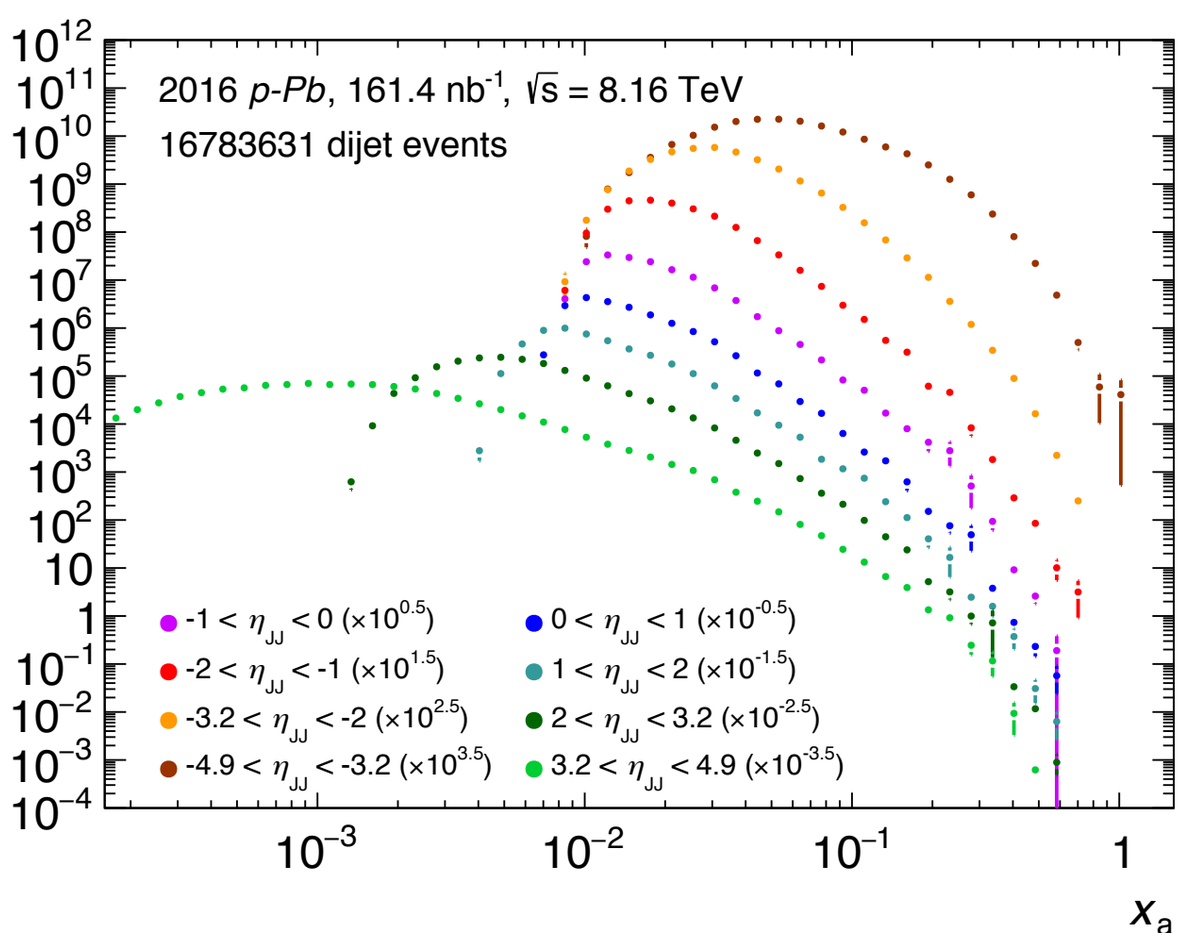


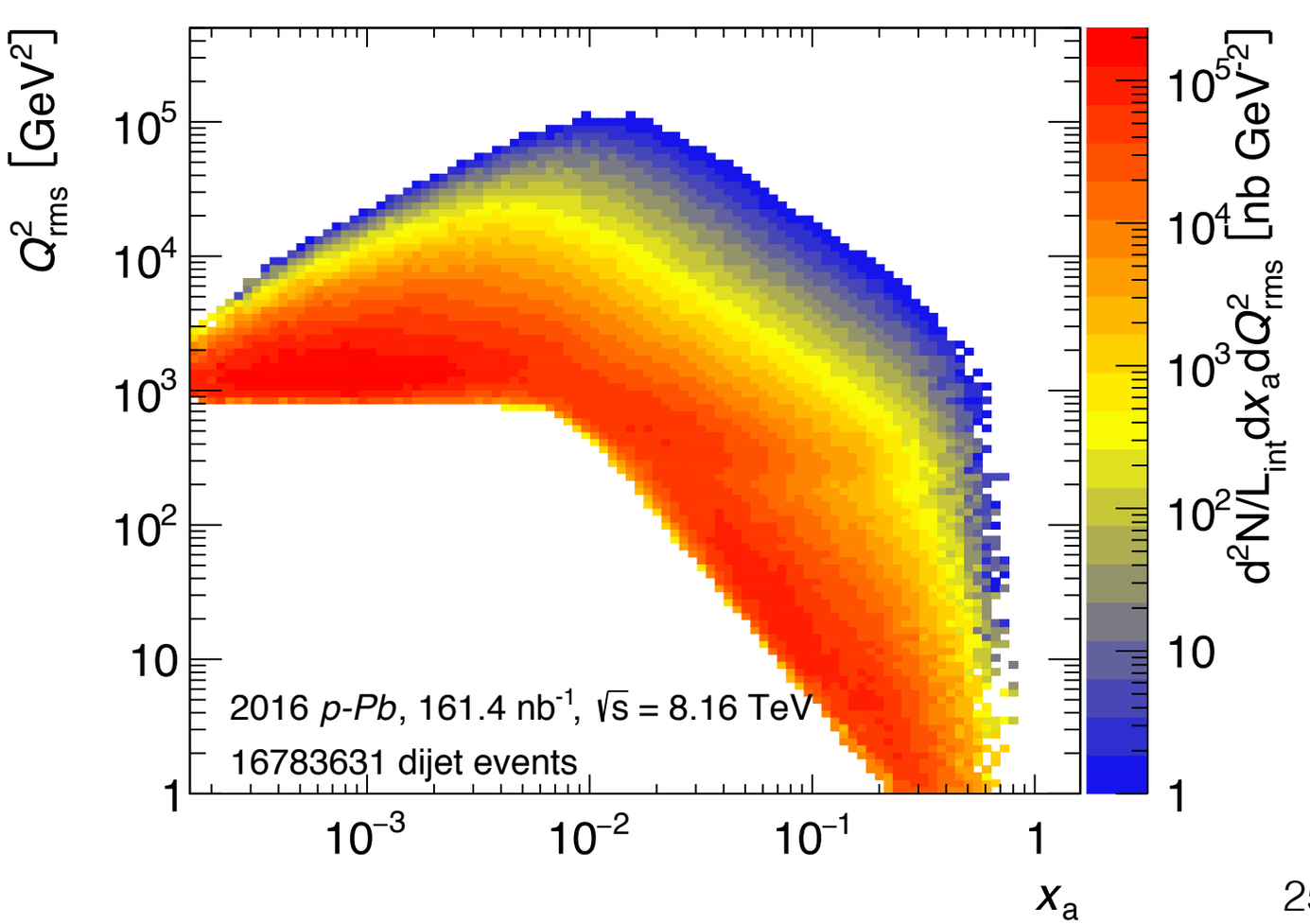


Dijet event selection criteria:
"standard" selection: GRL, cleaned events, cleaned jets, primary vertex, 2+ jets, leading jet trigger

+ (a) jets not inside disabled HEC
+ (b) $\Delta\phi \geqslant 7\pi/8$
+ (c) leading jet $p_T \geqslant 20$ GeV
+ (d) subleading jet $p_T \geqslant 20$ GeV

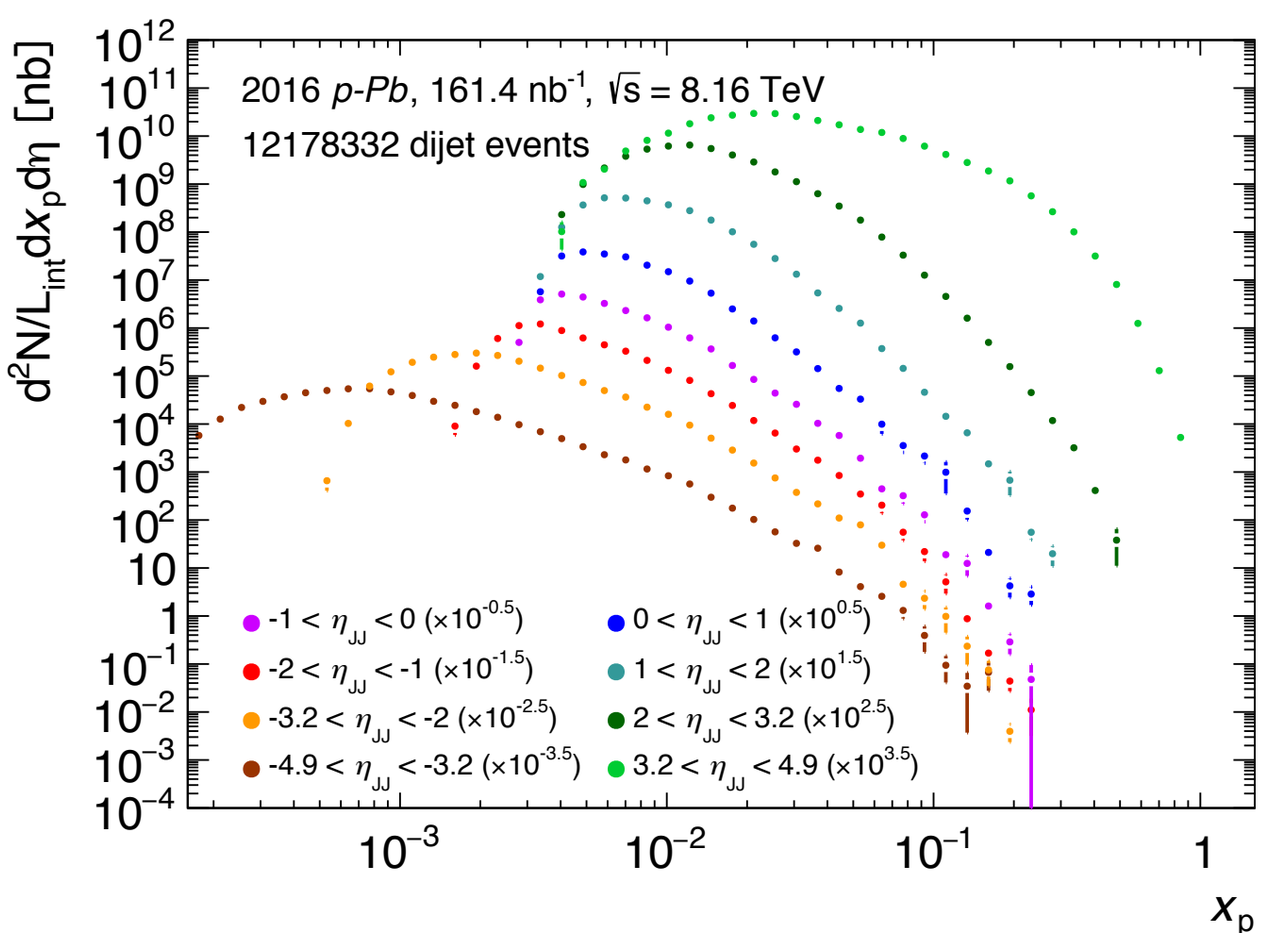


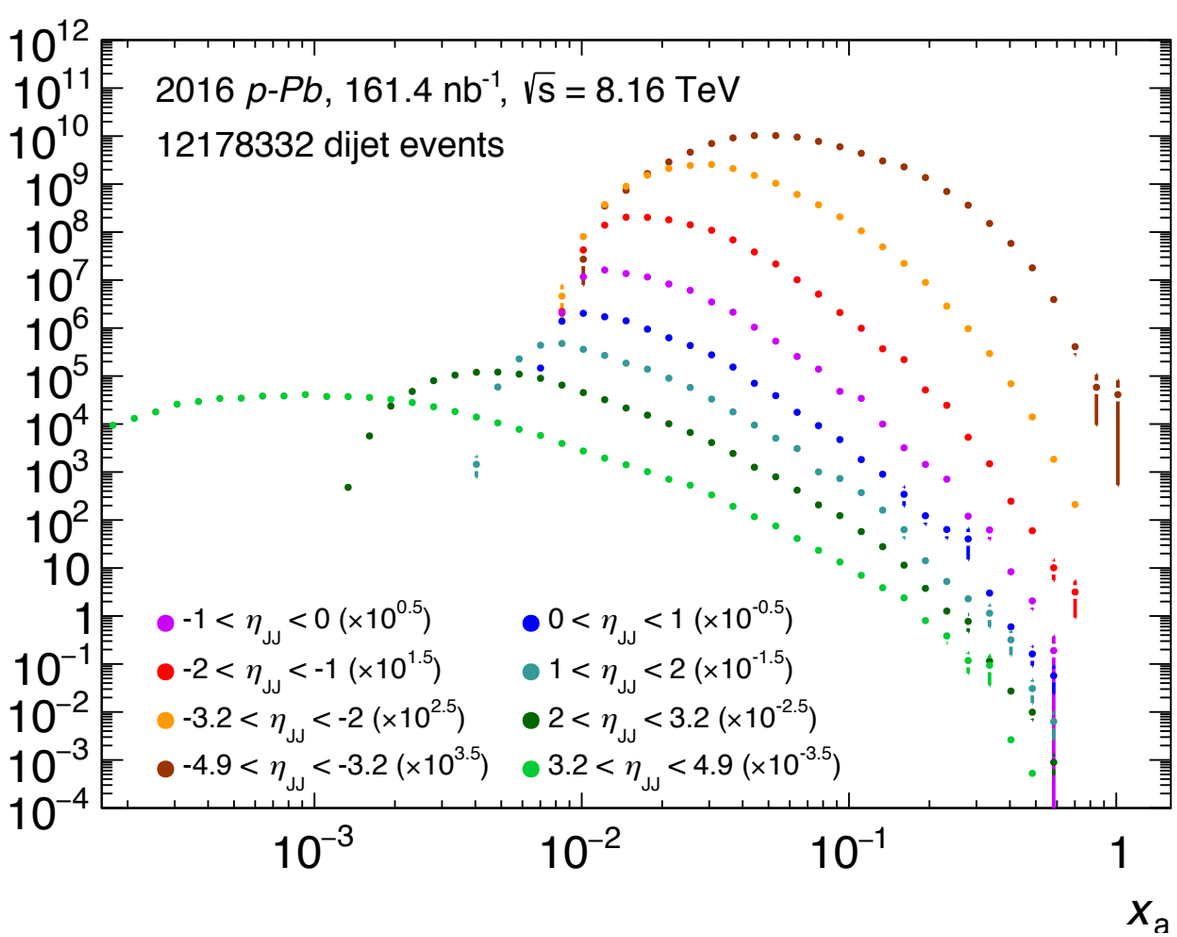


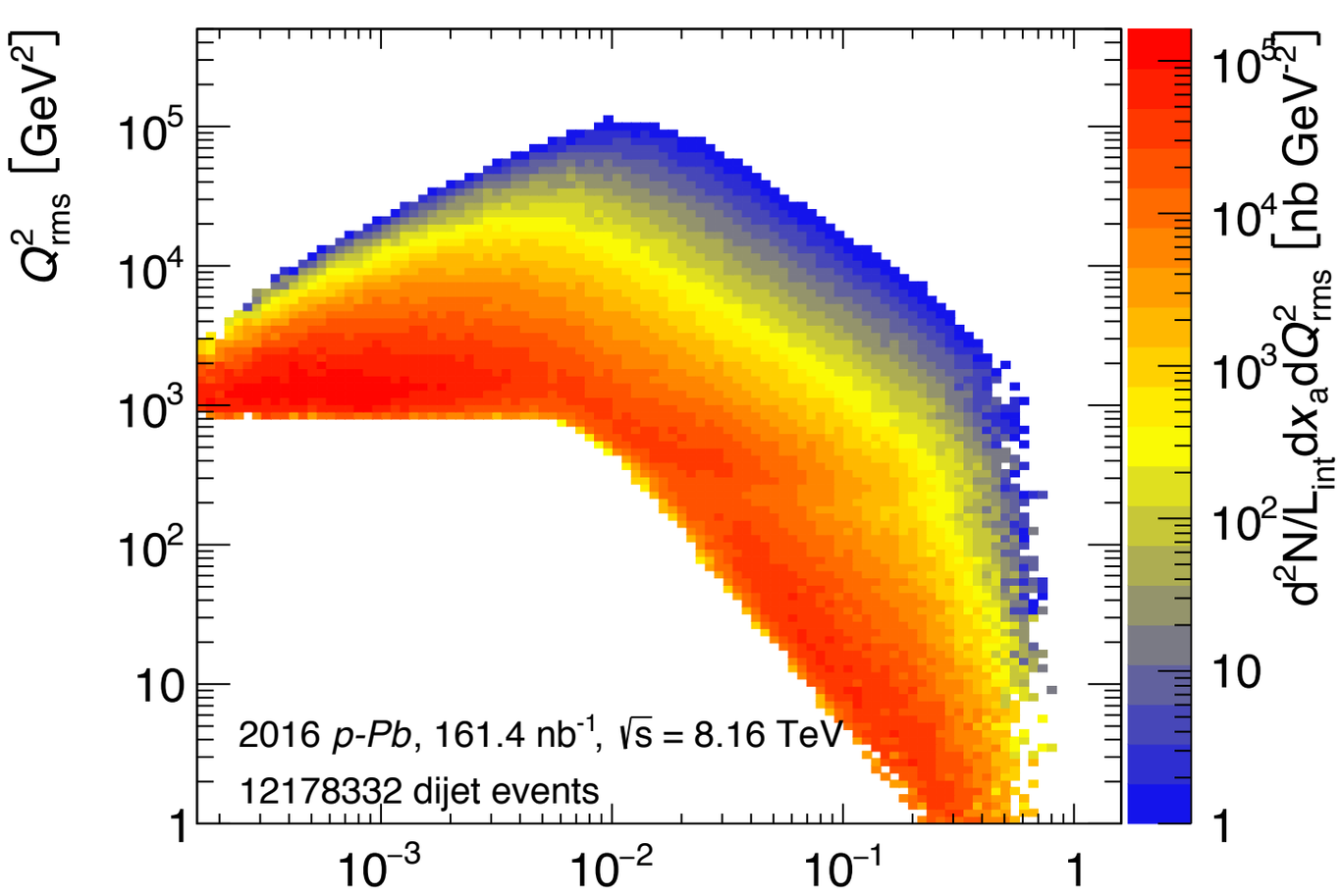


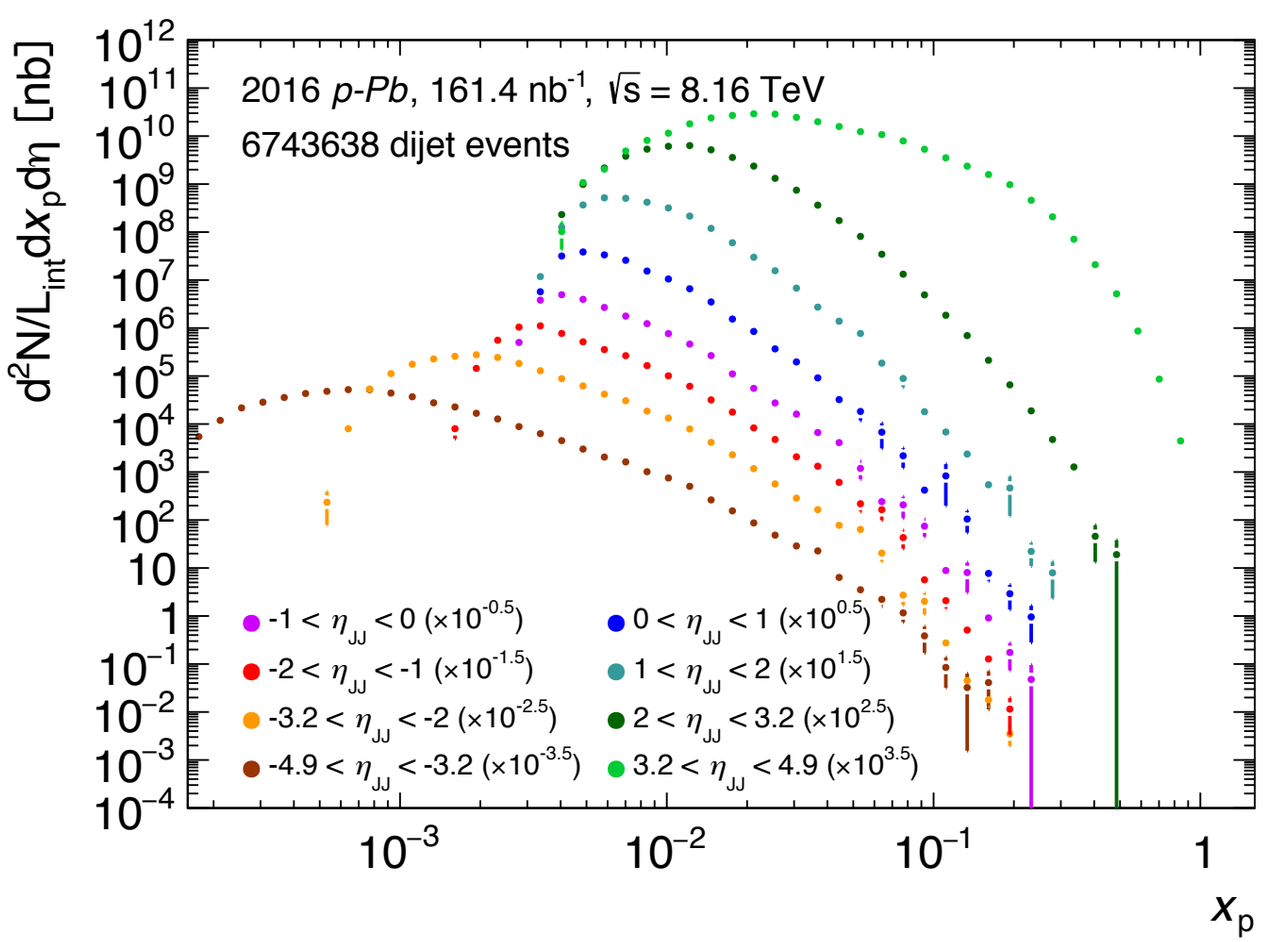
Dijet event selection criteria:
"standard" selection: GRL, cleaned events, cleaned jets, primary vertex, 2+ jets, leading jet trigger

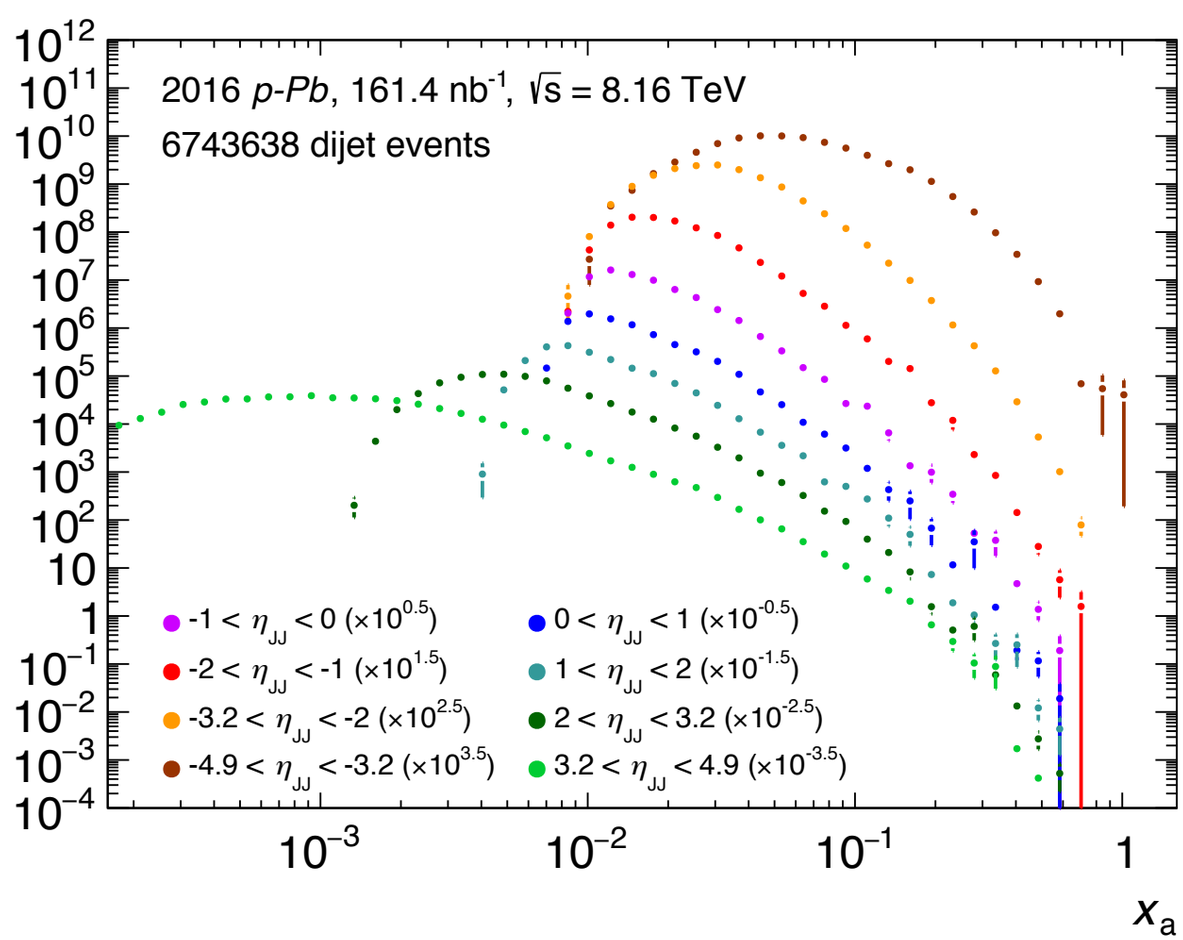
+ (a) jets not inside disabled HEC
+ (b) $\Delta\phi \geqslant 7\pi/8$
+ (c) leading jet $p_T \geqslant 20$ GeV
+ (d) subleading jet $p_T \geqslant 20$ GeV
+ (e) third jet/leading jet $p_T \leqslant 0.4$





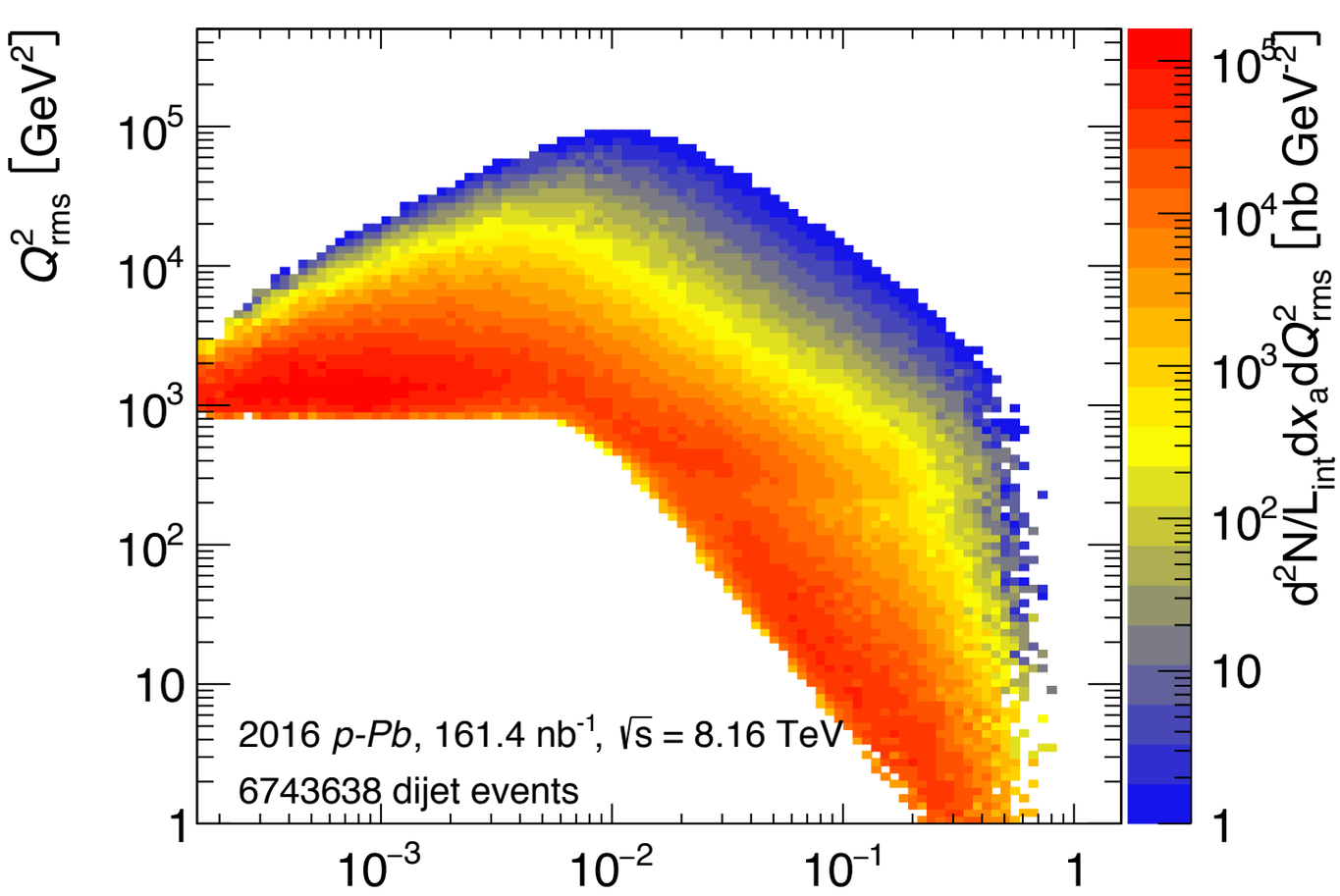




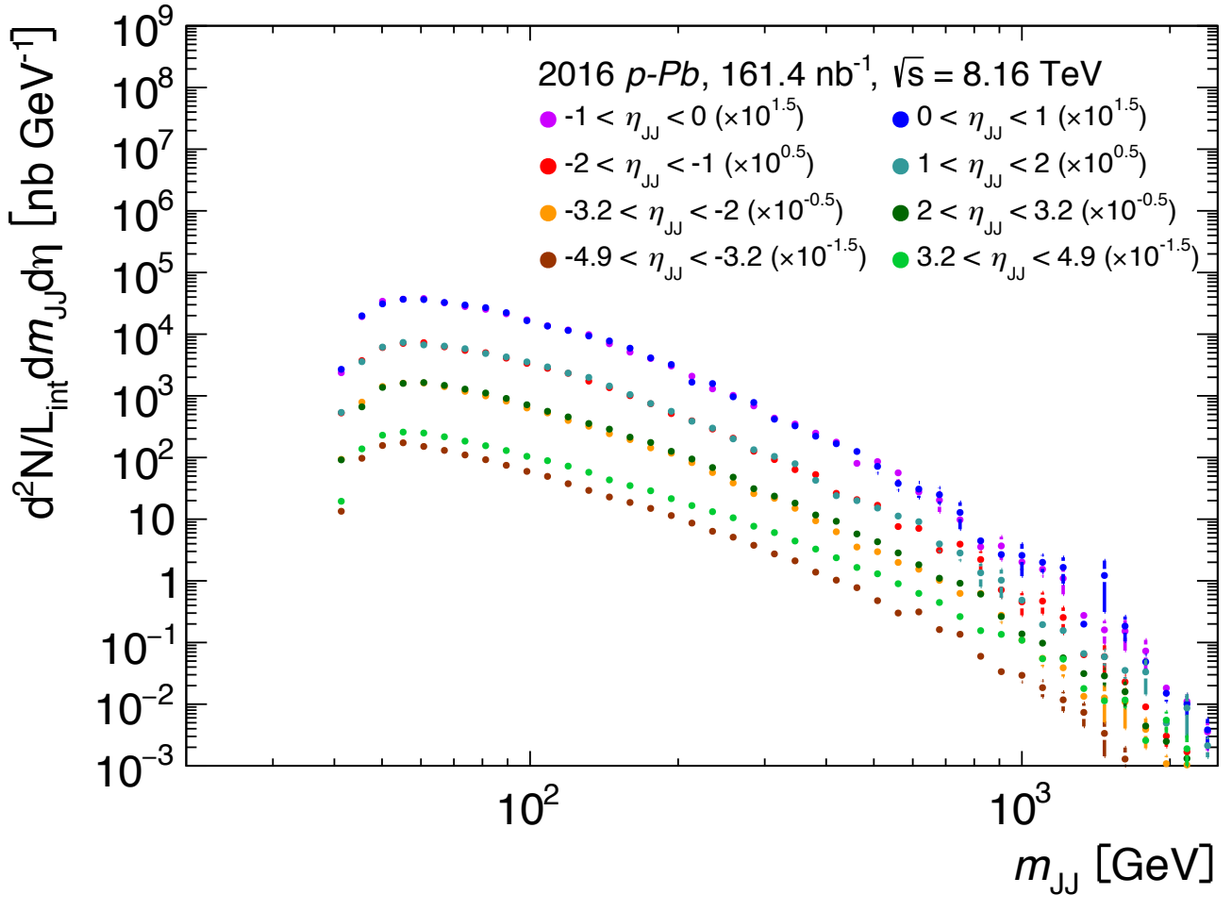


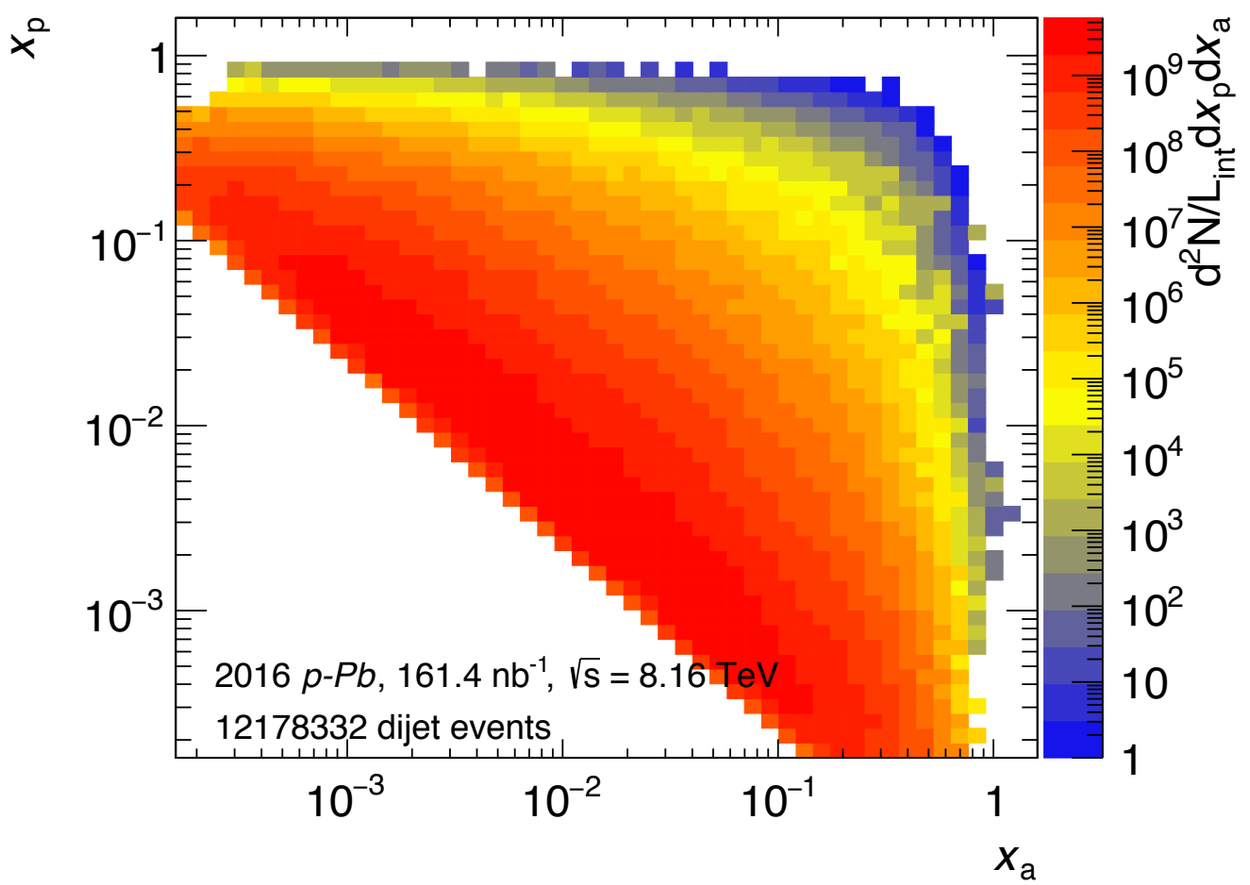
Dijet event selection criteria:
"standard" selection: GRL, cleaned events, cleaned jets, primary vertex, 2+ jets, leading jet trigger

+ (a) jets not inside disabled HEC
+ (b) $\Delta\phi \geqq 7\pi/8$
+ (c) leading jet $p_T \geqq 20$ GeV
+ (d) subleading jet $p_T \geqq 20$ GeV
+ (f) third jet/leading jet $p_T \leqq 0.2$

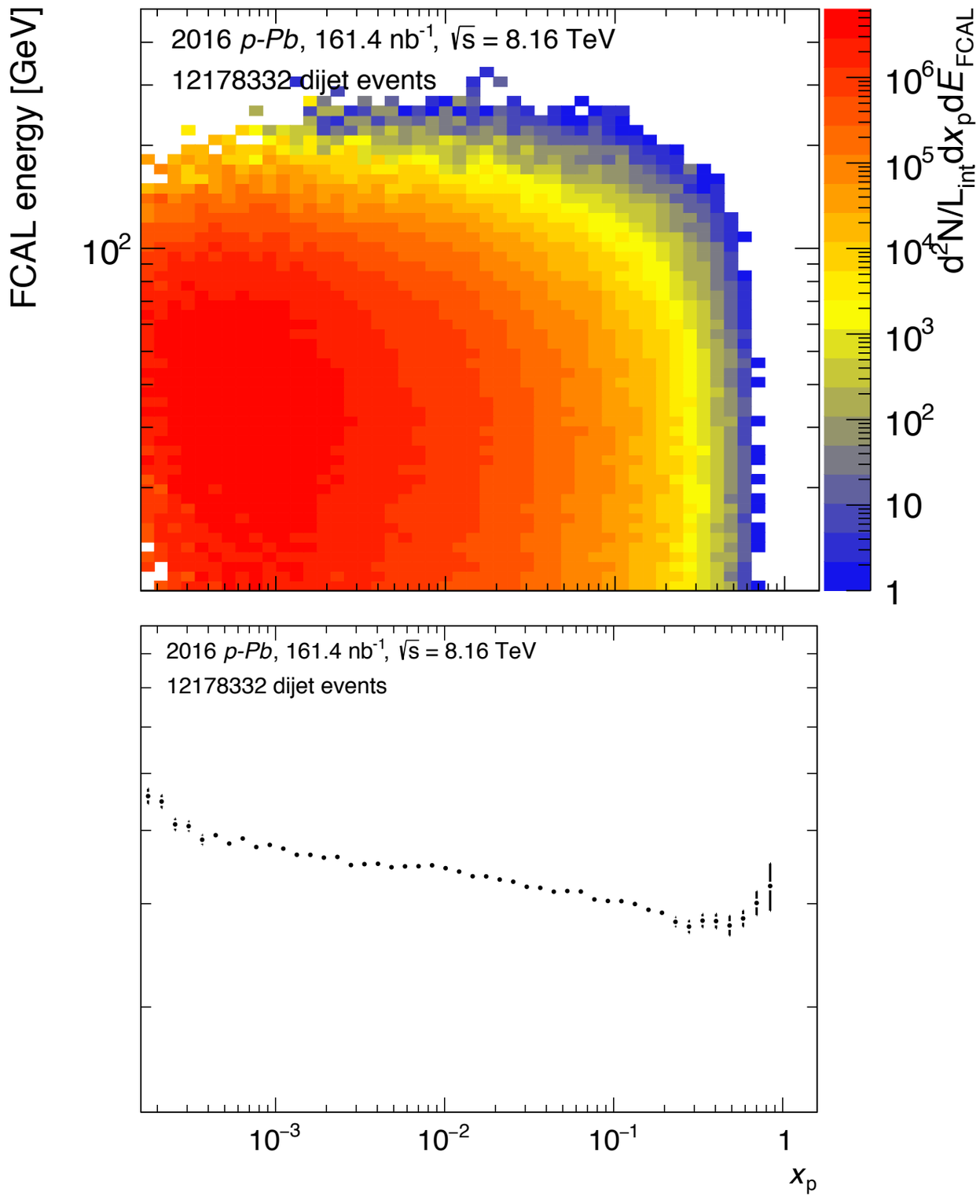


Dijets - invariant mass and x_a-x_p correlation

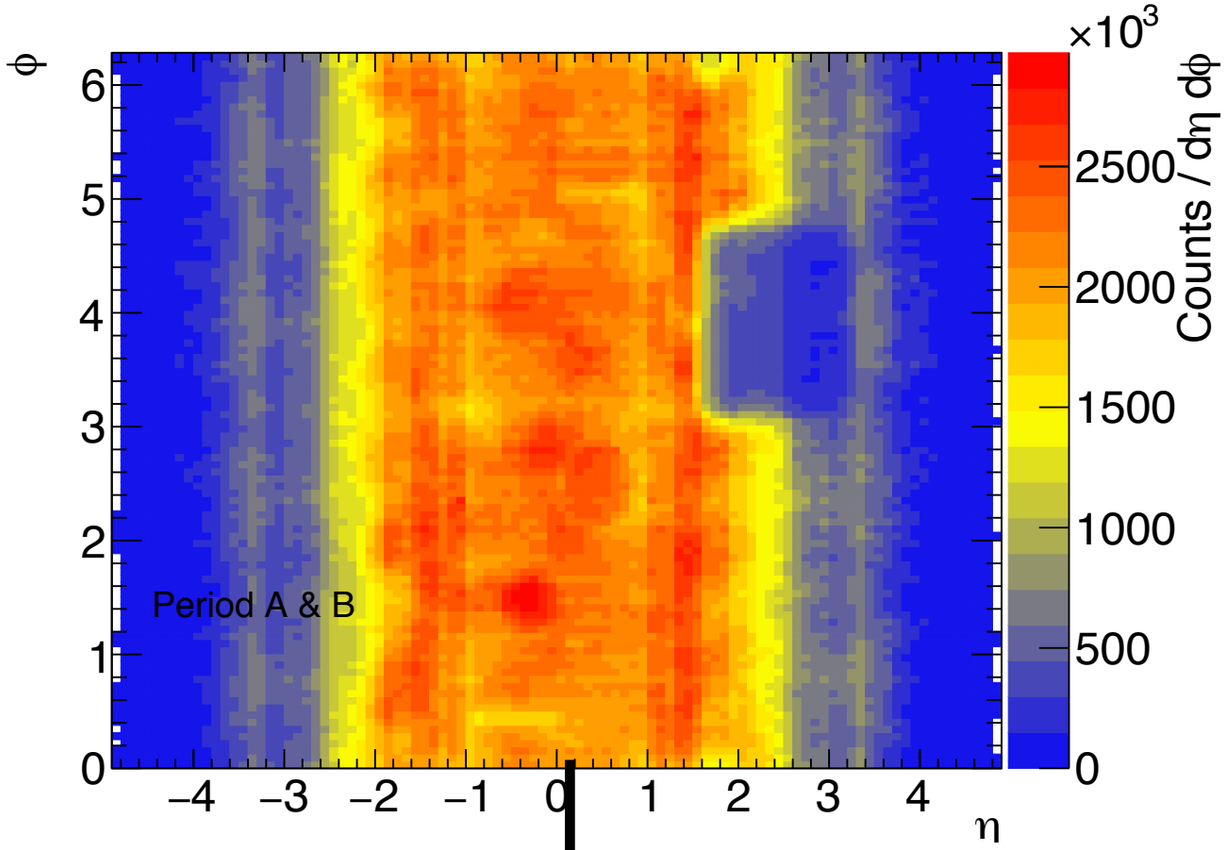




Dijets - Pb-going FCAL “shrinking proton plot”



Next steps - “Averaging out” the HEC?



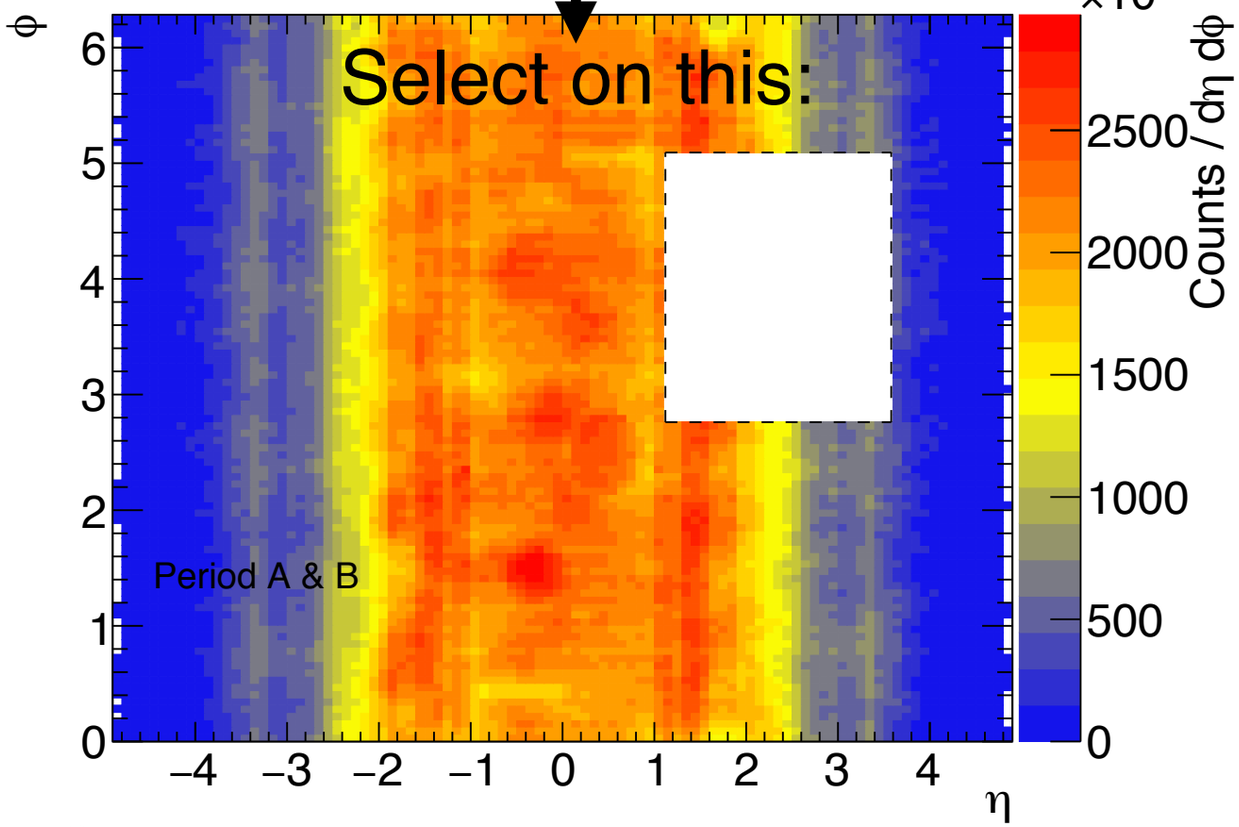
By generalizing previous scale factor, expect to weight jets by:

$$\sim \frac{\int \frac{d^2N}{d\phi d\eta} d\phi d\eta}{\int_{\notin \mathrm{HEC}} \frac{d^2N}{d\phi d\eta} d\phi d\eta}$$

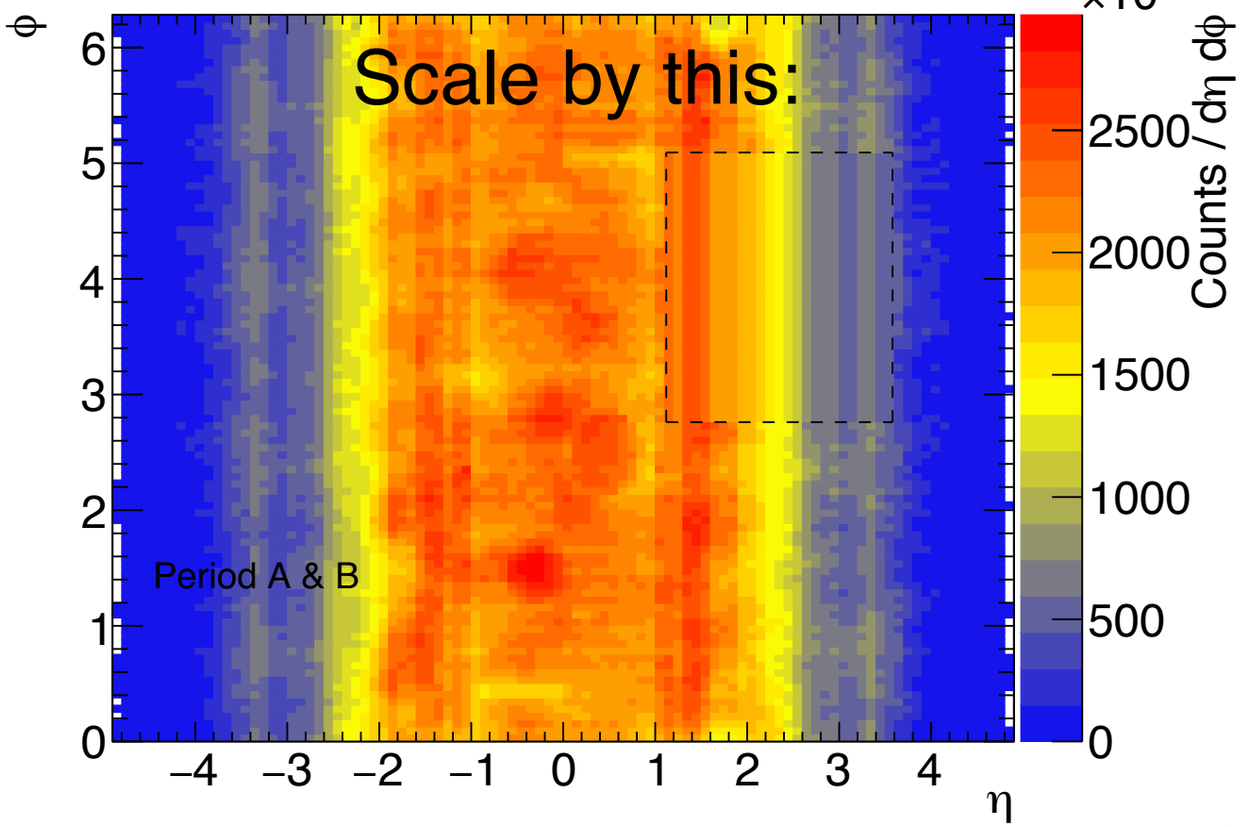
Technicality: in case of η binning, only integrate over relevant bin! ⇒ weight

often reduces to 1

Select on this:



Scale by this:



Summary:

- Biggest problems from last time all fixed
- Different dijet event selection methods examined
- Approaching point where MC is going to be needed - good progress on production being made (https://prodtask-dev.cern.ch/prodtask/inputlist_with_request/14773/)

Current strategy:

- revise HEC region cuts to avoid losing too much coverage in pseudorapidity
- can try “filling” in HEC with average over remaining ϕ coverage?