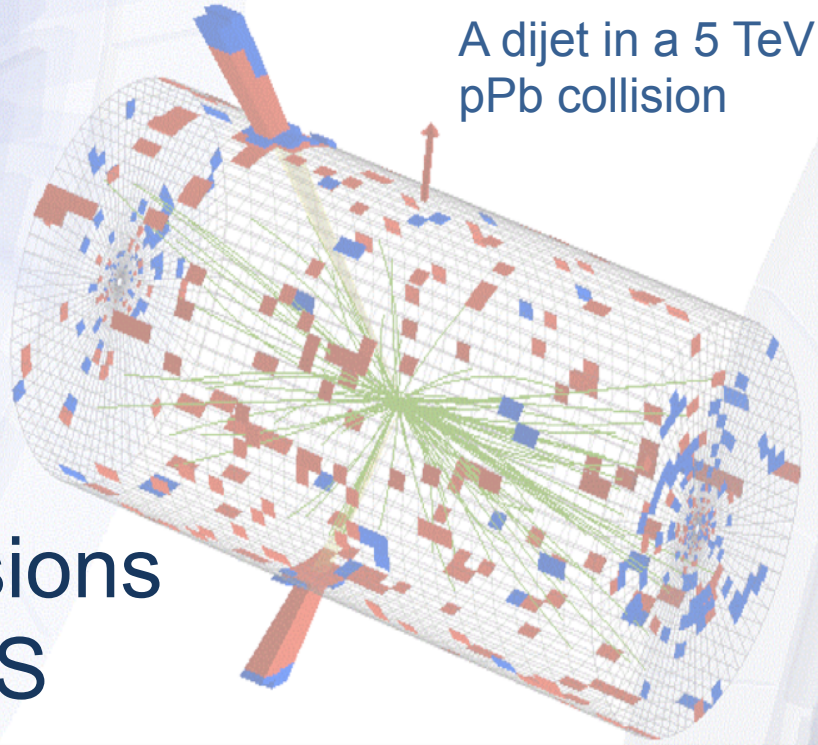

A dijet in a 5 TeV pPb collision

Probing pPb collisions with jets in CMS

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EPS-HEP Stockholm

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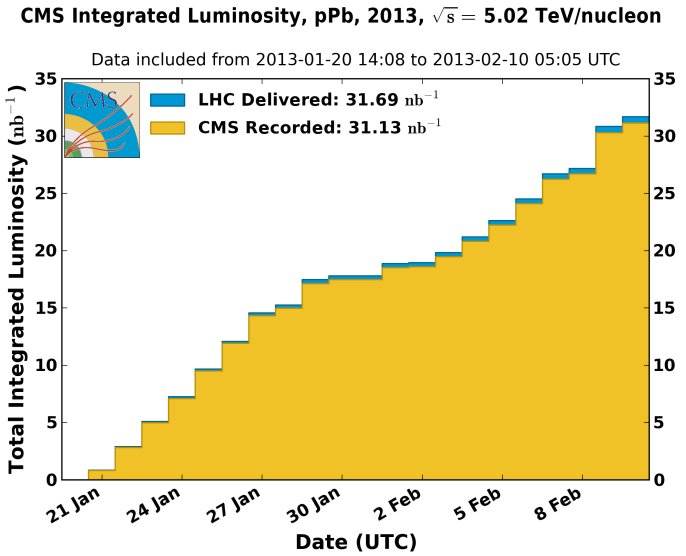
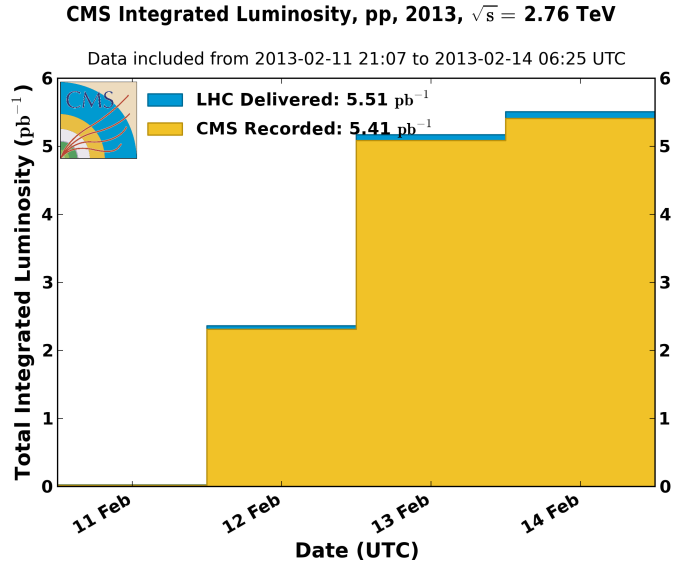
Why collide protons and lead?

- pPb is an essential control system for studies of hot nuclear matter in PbPb
- Initial state effects
  - Nuclear PDFs, low x gluon saturation
  - Parton energy loss
- Final state effects
  - Hydrodynamic flow
  - Jet quenching?

The 2013 pPb Run

- In 2013 the LHC delivered pPb collisions at 5.02 TeV/nucleon
- CMS recorded ~ 31nb^{-1}
- Also a short pp run at 2.76 TeV (~ 5.5 pb^{-1})
- Now have similar statistics for hard probes in pp and PbPb at 2.76 TeV and pPb at 5.02 TeV



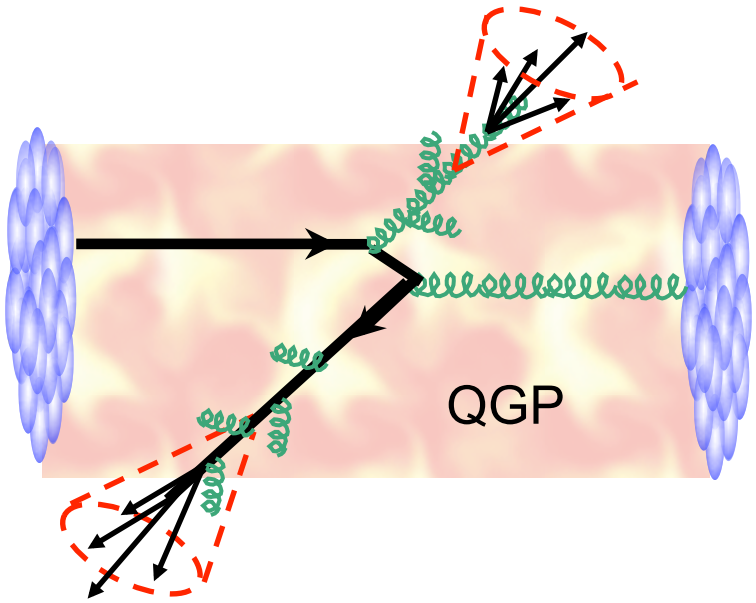


Our pPb results so far

- Dijets in pPb: HIN-13-001 (this presentation)
- The Ridge in pPb: HIN-12-015, arXiv:1210.5482 (Monika's talk)
- Two and four-particle correlations in pPb: HIN-13-002, arXiv:1305.0609 (Monika's talk)
- PID spectra in pPb: HIN-12-016 (Krisztian's talk)

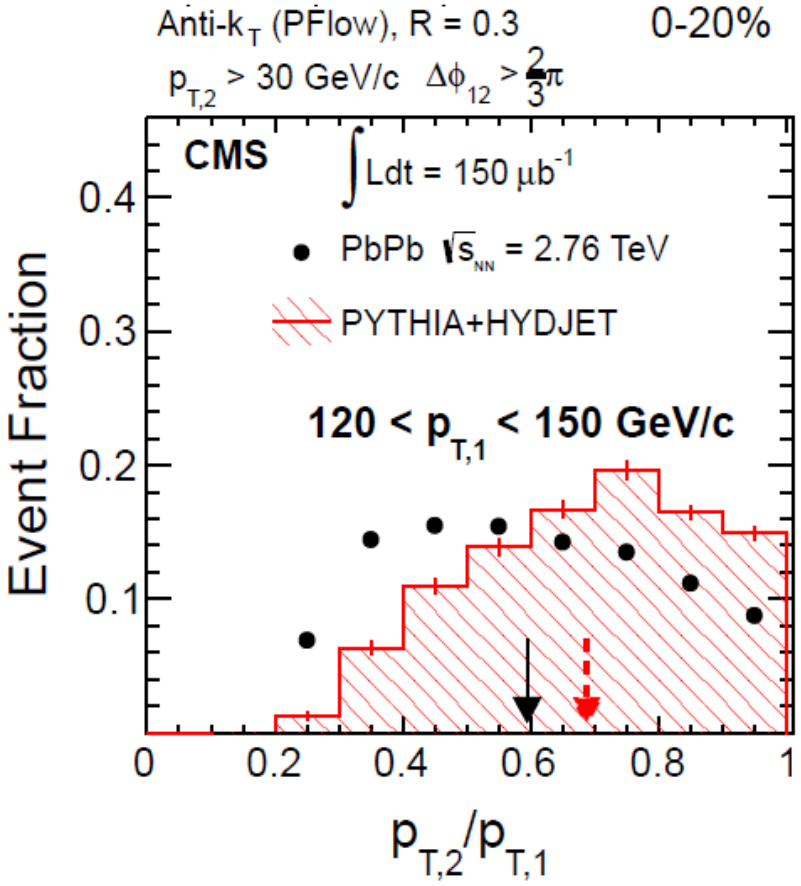
https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsHIN

Dijet Production in AA Collisions



- Jet quenching in PbPb collisions
- Observed as a pronounced dijet p_T imbalance in central collisions

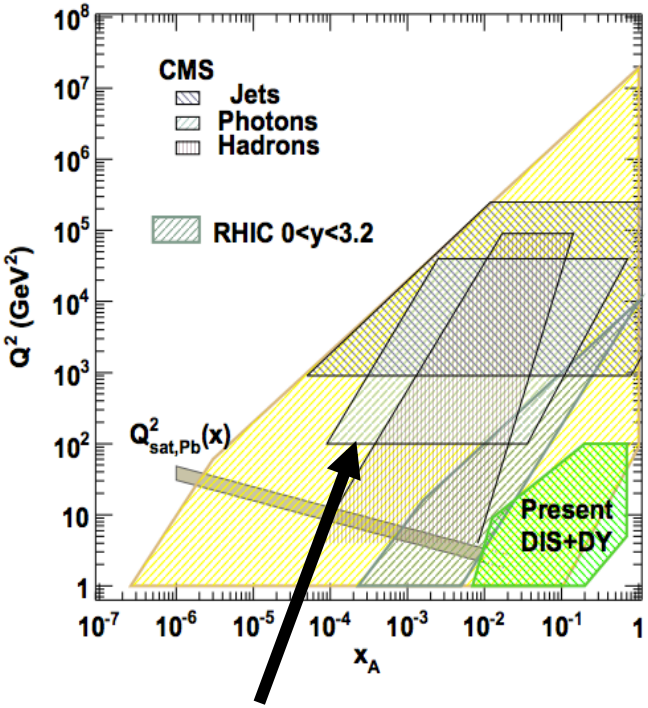
arXiv:1202.5022



More about jet quenching in PbPb in Pelin's talk in this session

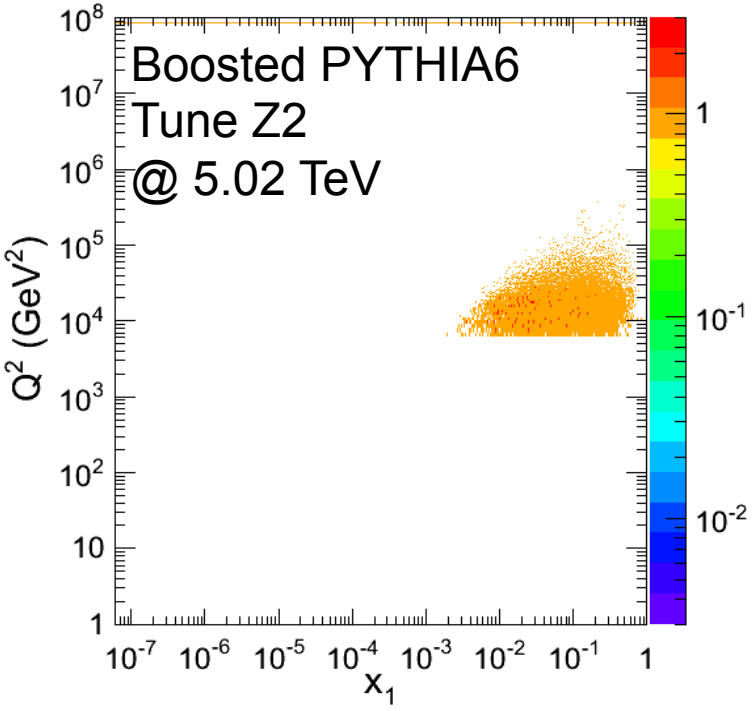
Probing PDFs

Kinematic reach for CMS,
pPb @ $\sqrt{s}$ = 8.8 TeV (0.1 pb^{-1})



Salgado, et. al. J Phys G39 (2012) 015010

Inclusive jets access high Q^2 and x ~ 10^{-4}

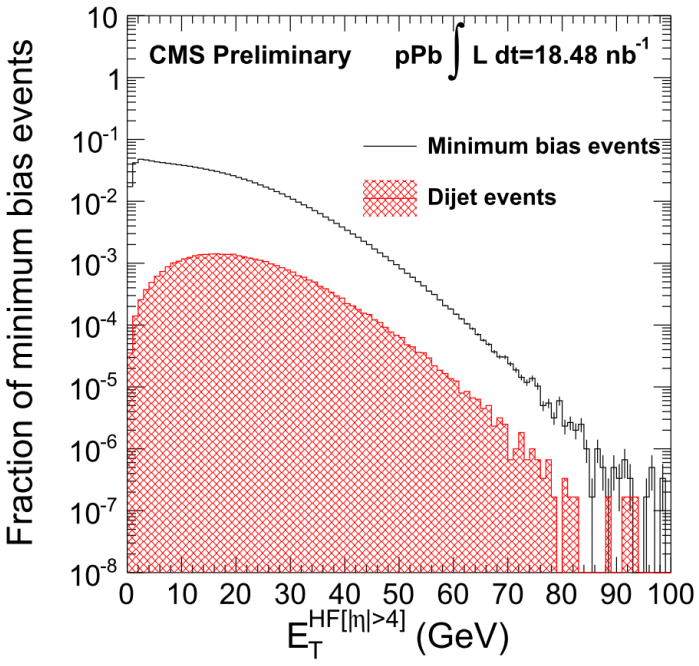


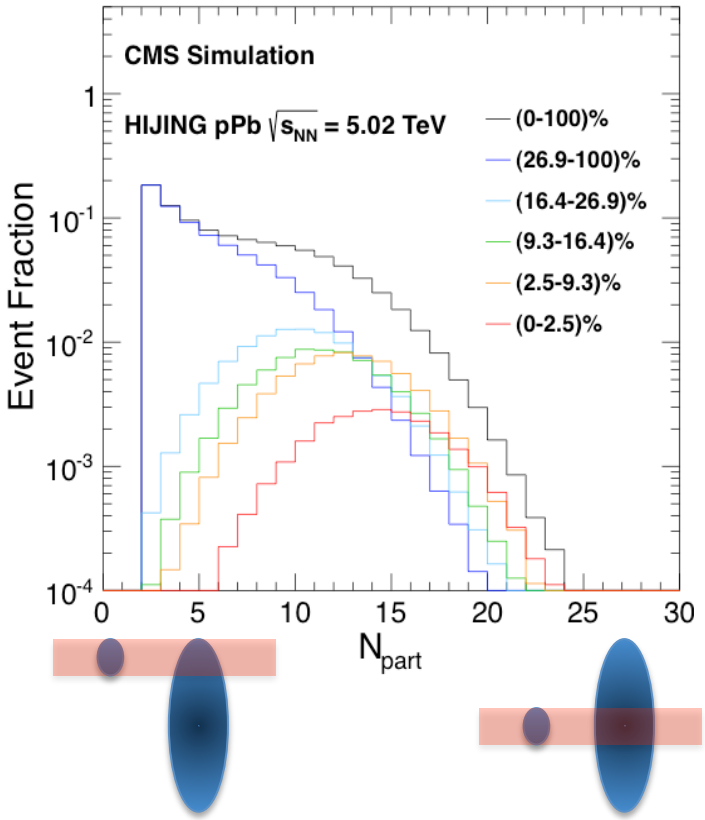
Dijets w/ selection:

- $p_{T,1}$ > 120 GeV/c
- $p_{T,2}$ > 30 GeV/c
- $\Delta\varphi_{12}$ > 2π/3

pPb Event Selection

HIN-13-001

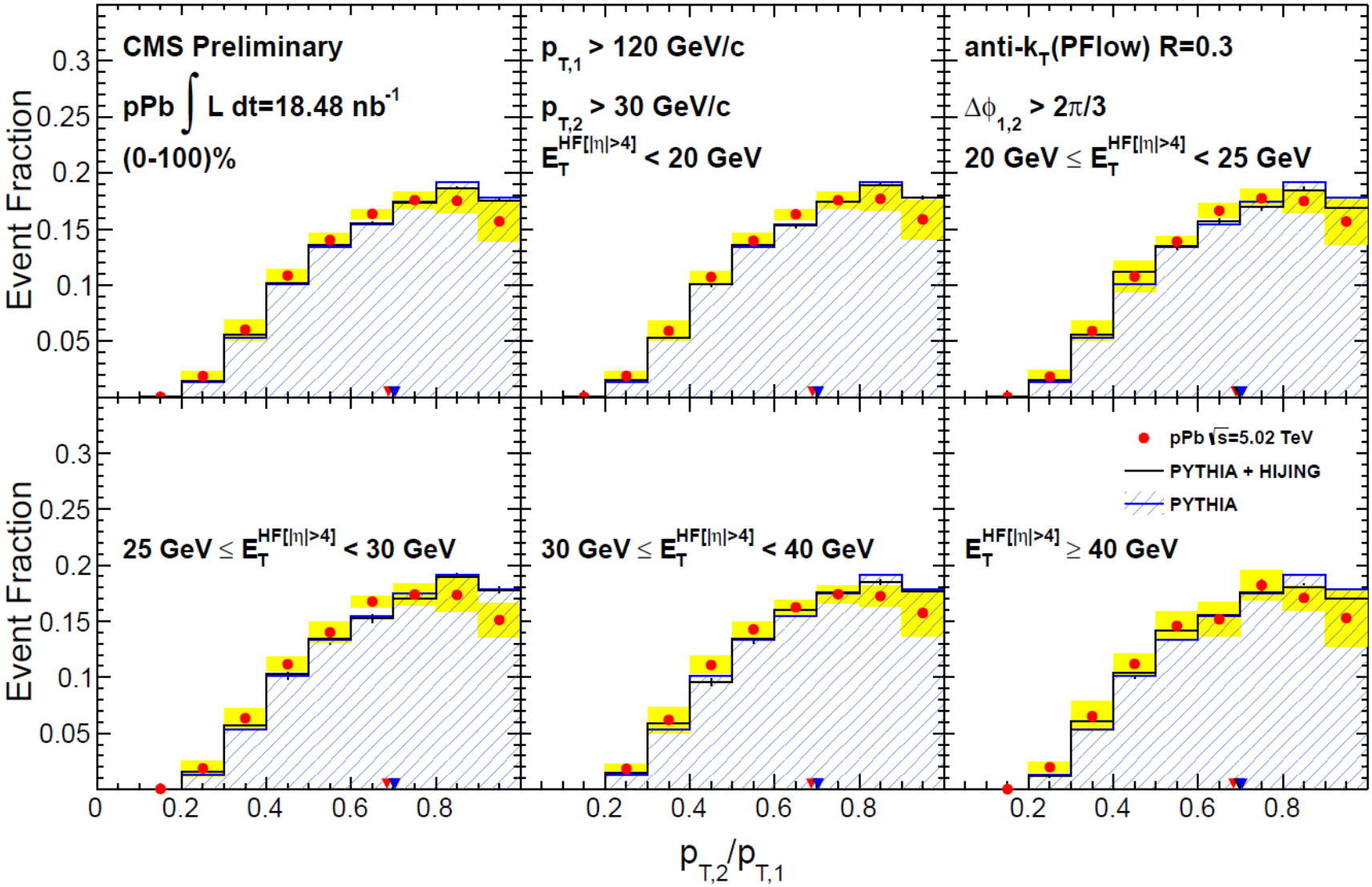




- Double sided selection: At least one tower above threshold required in forward and backward HF. Rejects EM, diffractive events and beam backgrounds
- Inelastic cross section is binned in HF E_T ($\eta > 4$)
- HF energy is (loosely) correlated to the # of participating nucleons

pPb Dijet Asymmetry

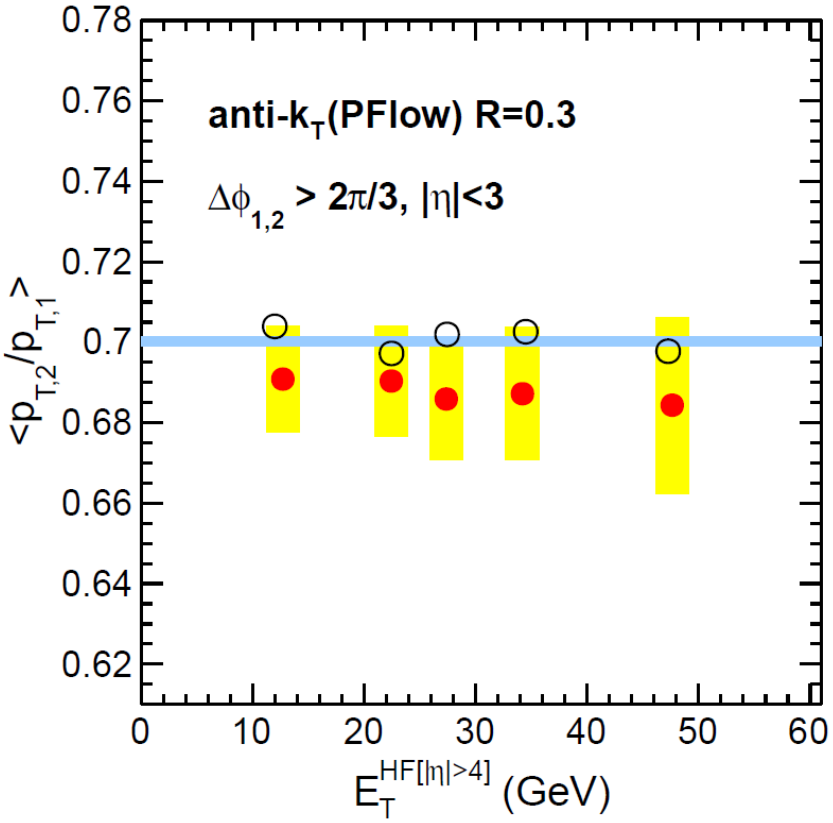
HIN-13-001



No sign of the anomalous dijet imbalance, i.e., jet quenching

More quantitatively …

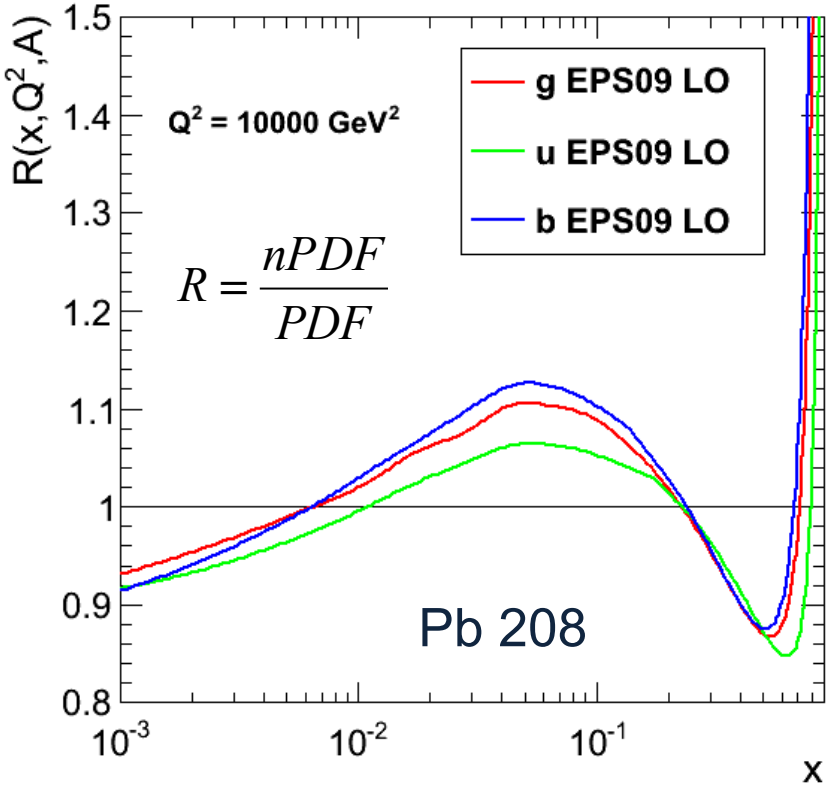
HIN-13-001

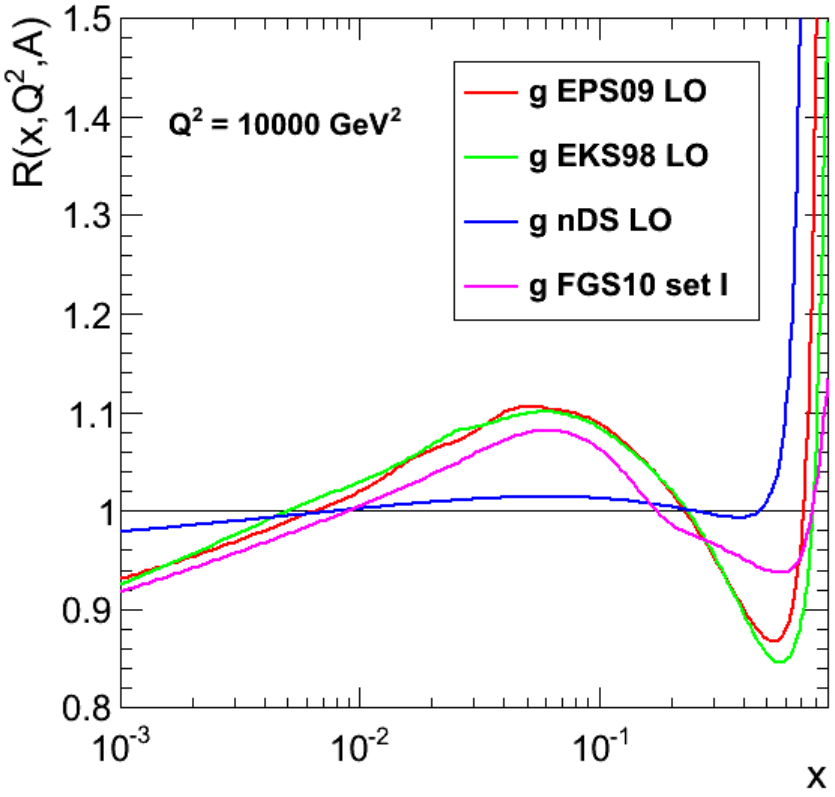


pPb dijet asymmetry consistent with MC to within systematic uncertainties

Nuclear Parton Distributions

Source: François Arleo and Jean-Philippe Guillet
http://lapth.cnrs.fr/npdfgenerator/





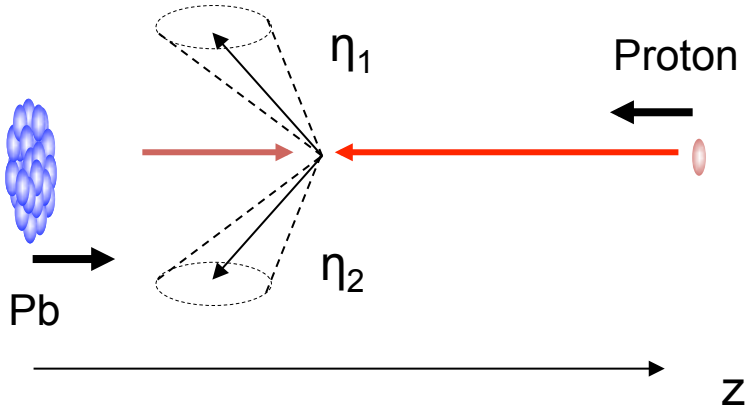
- Distributions of partons in nuclei are modified by ~10% for the relevant Q^2
- Some disagreement between various global fit analyses

Kinematics

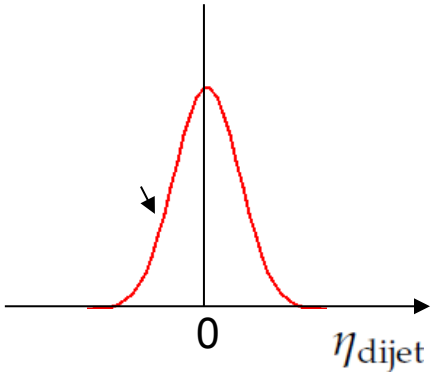
$$\eta_{dijet} = \frac{\eta_1 + \eta_2}{2}$$

Center of mass frame

An event with x_2 (proton) > x_1 (lead)

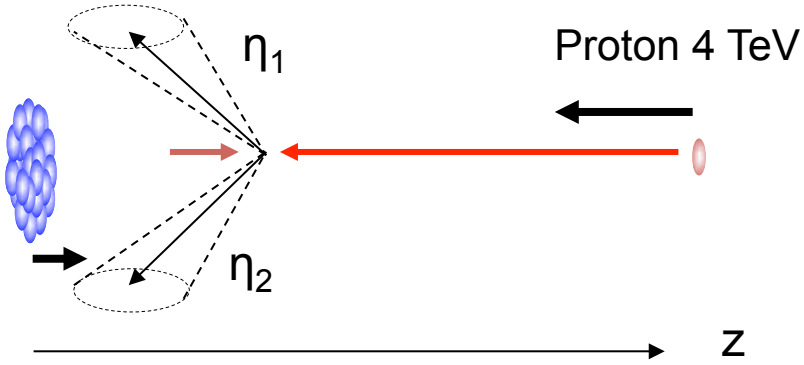


Dijet η distribution is symmetric in the center of mass frame

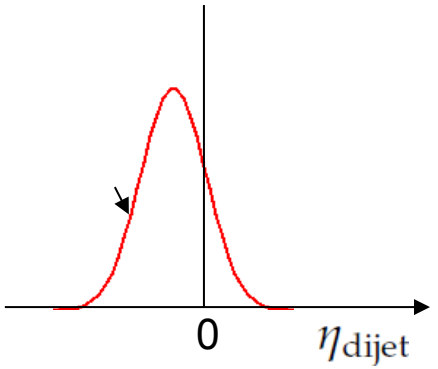


Lab frame

Pb 1.58 TeV/nucleon

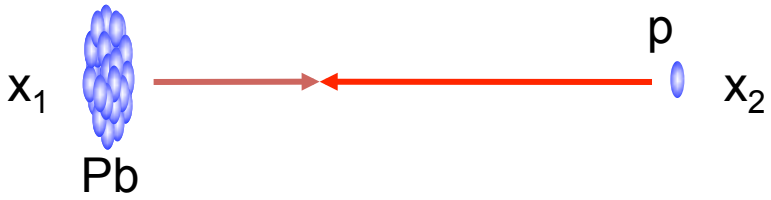


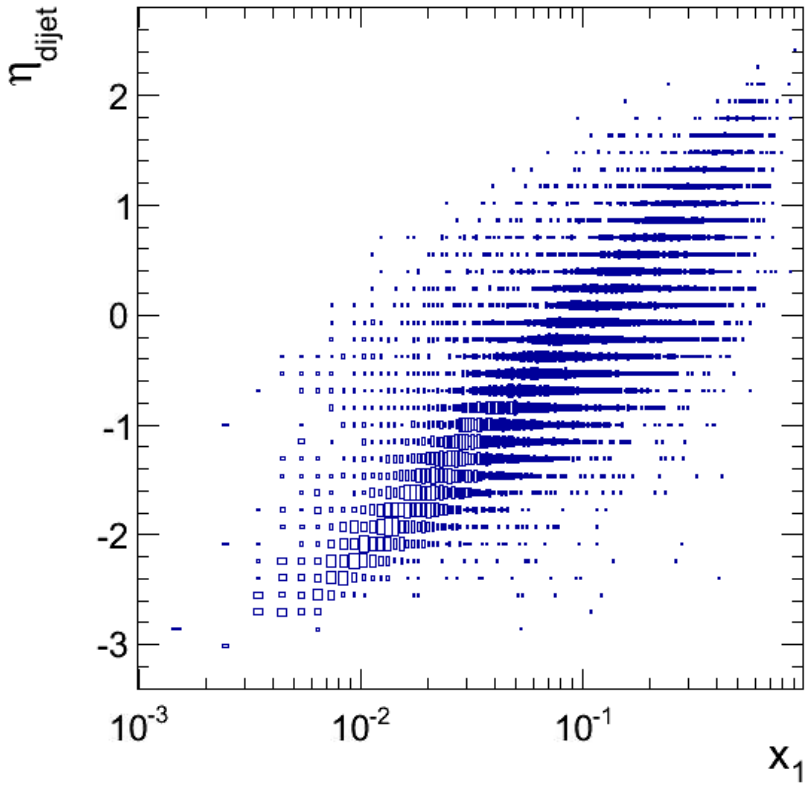
LHC delivers asymmetric collisions, boost gives rise to trivial η asymmetry



Translating dijet η to x_1

Dijet selection:
Leading jet $p_{T,1} > 120$ GeV/c
Subleading jet $p_{T,2} > 30$ GeV/c
$|\Delta\varphi_{12}| > 2\pi/3$

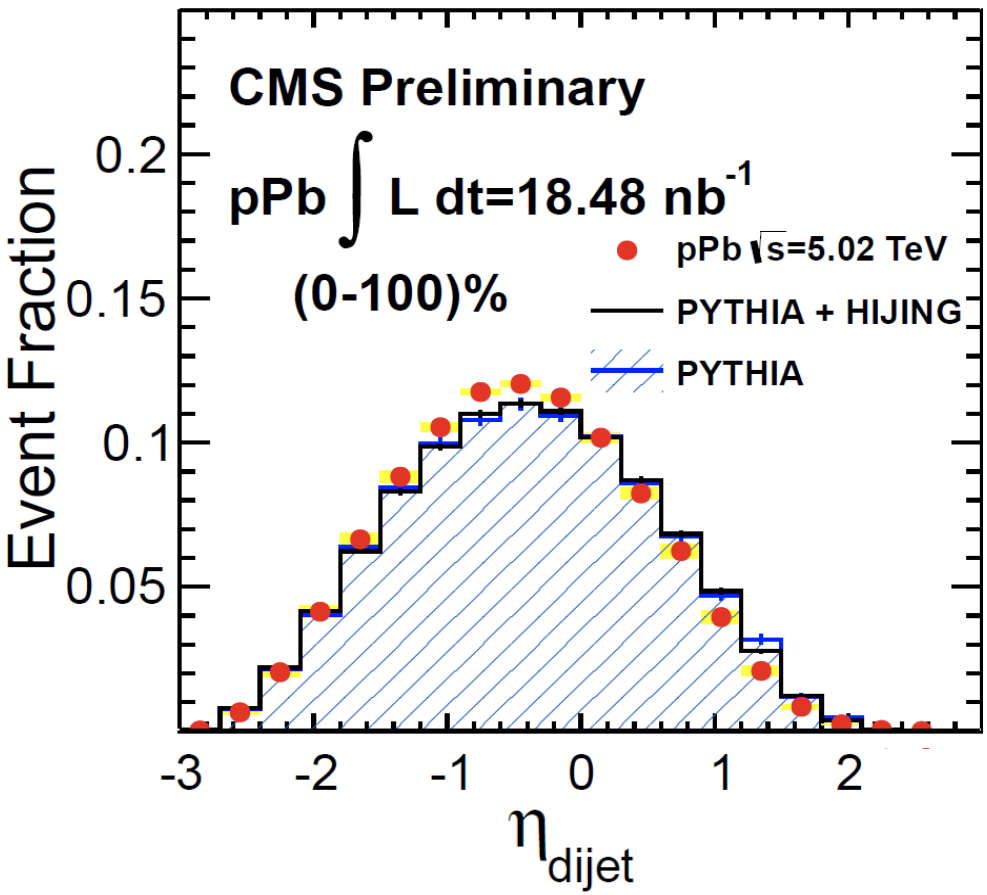


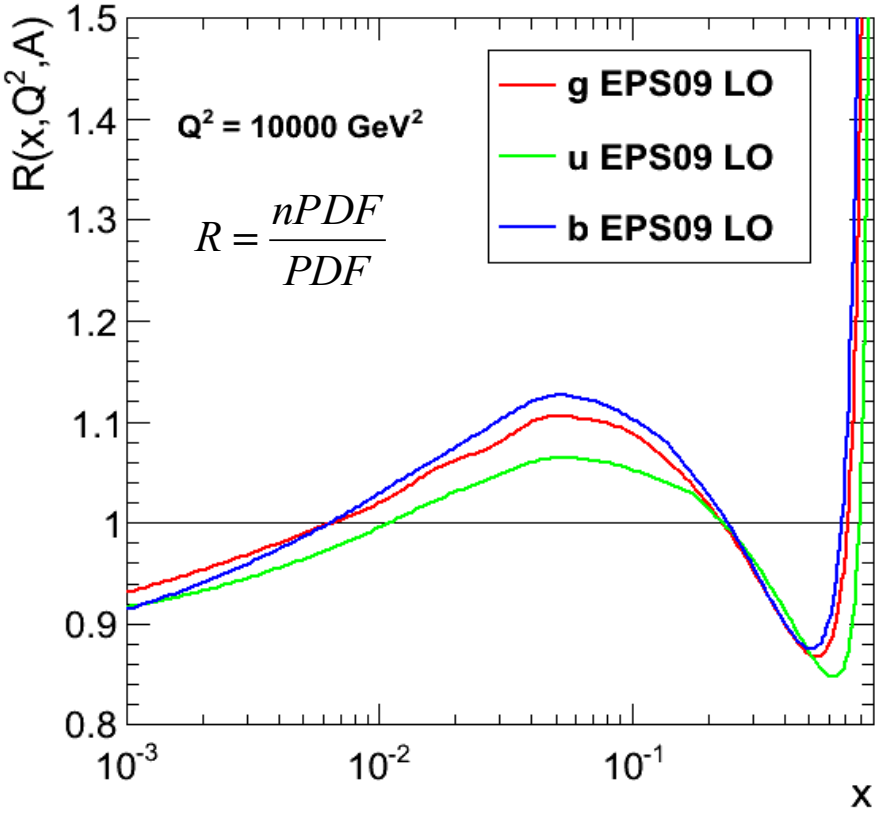


Dijet Pseudorapidity

$$\eta_{dijet} = \frac{\eta_1 + \eta_2}{2}$$

HIN-13-001





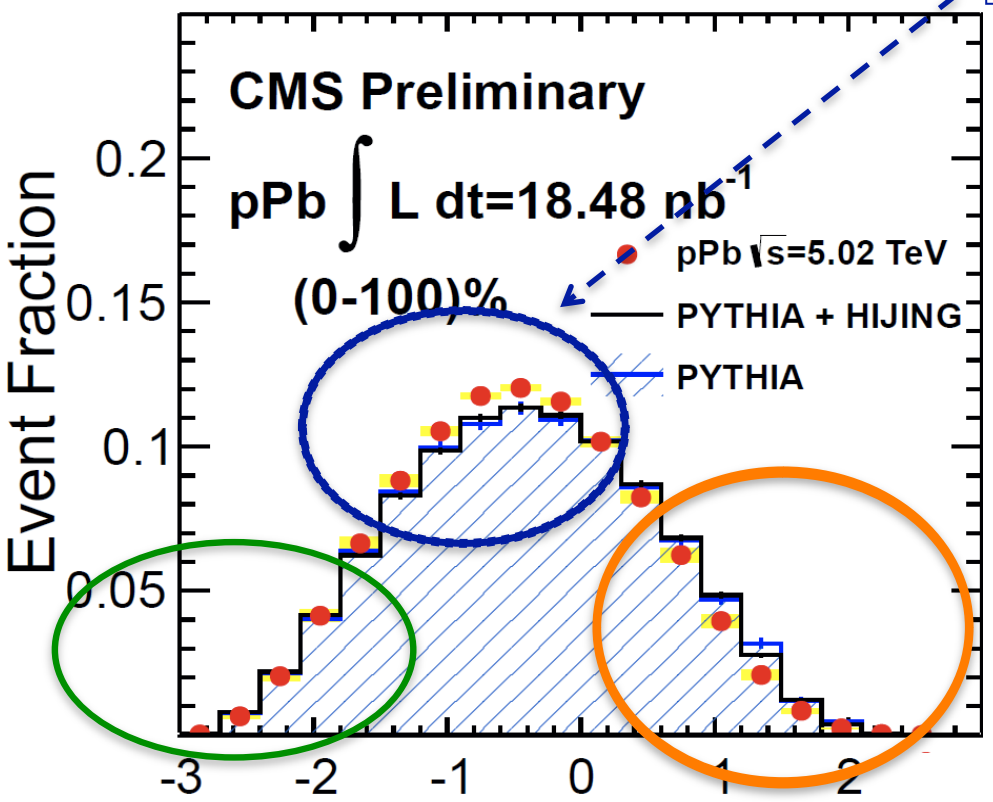
Results qualitatively consistent with nPDF expectations

Quantitative comparisons to be different global fits still on the

Dijet Pseudorapidity

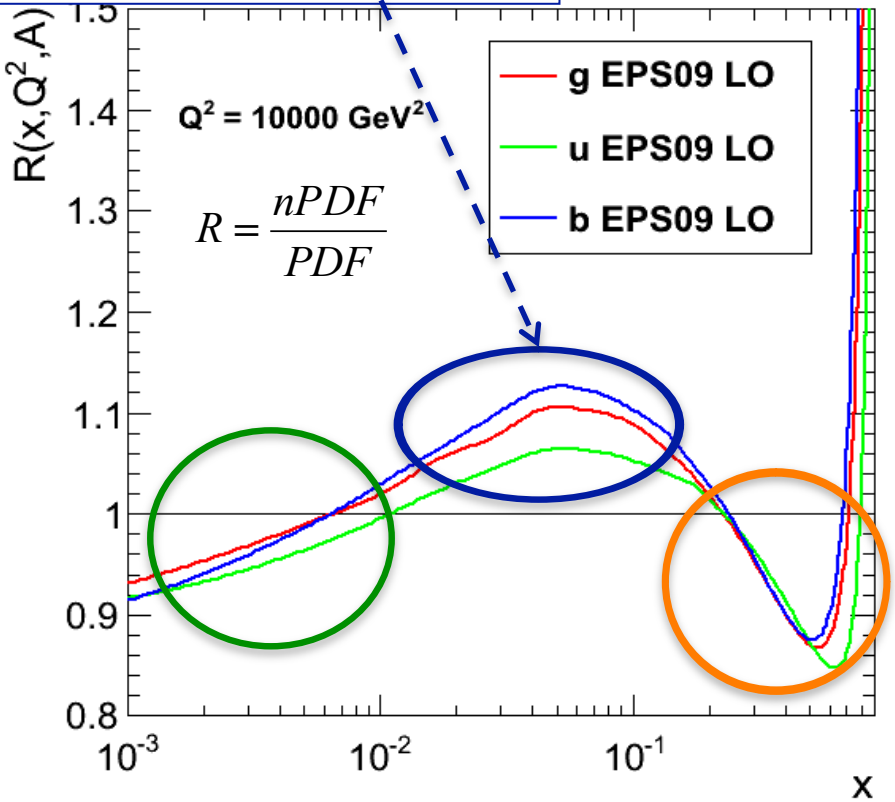
$$\eta_{dijet} = \frac{\eta_1 + \eta_2}{2}$$

HIN-13-001



Shadowing

Anti-shadowing

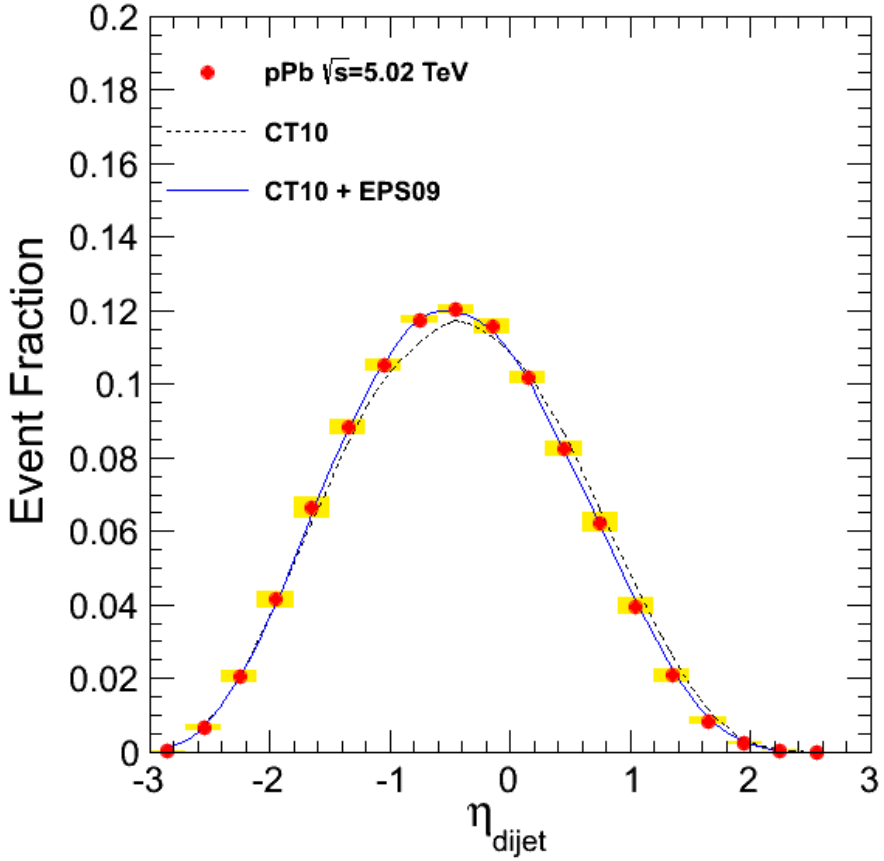


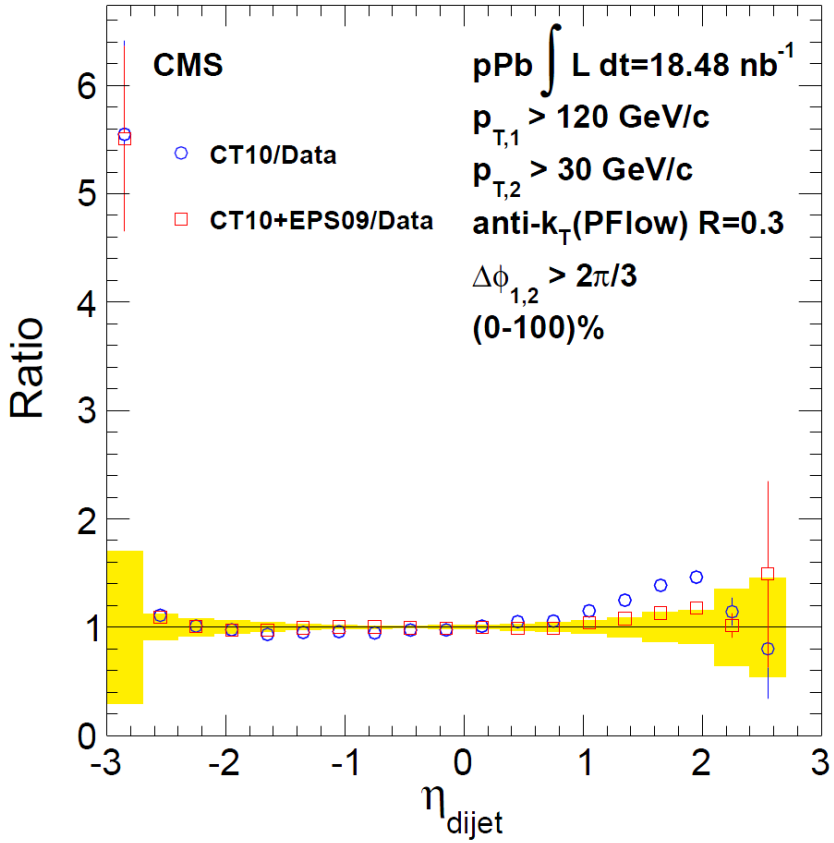
EMC

Results qualitatively consistent with nPDF expectations

Quantitative comparisons to be different global fits still on the

Comparison to nPDF predictions





- Agreement with EPS09 nPDFs within systematics
- Data show good sensitivity to nPDFs

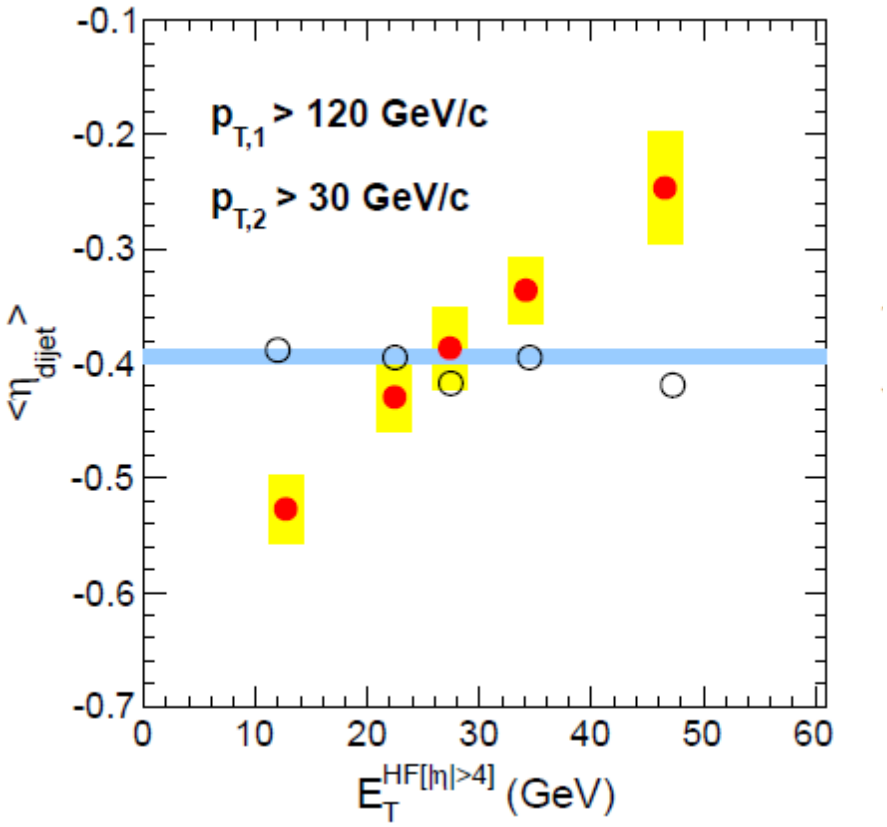
Conclusions

- Careful studies in pA are essential to understand effects in AA and are interesting in their own right
- No jet quenching observed in pA collisions
- Sensitivity to nPDFs established
- Results are in agreement with the EPS09 nPDFs

Backup

“Centrality” Dependence

HIN-13-001



- Significant dependence of dijet <η> on forward calorimeter energy
- Difficult to relate to impact parameter dependence of nPDFs,