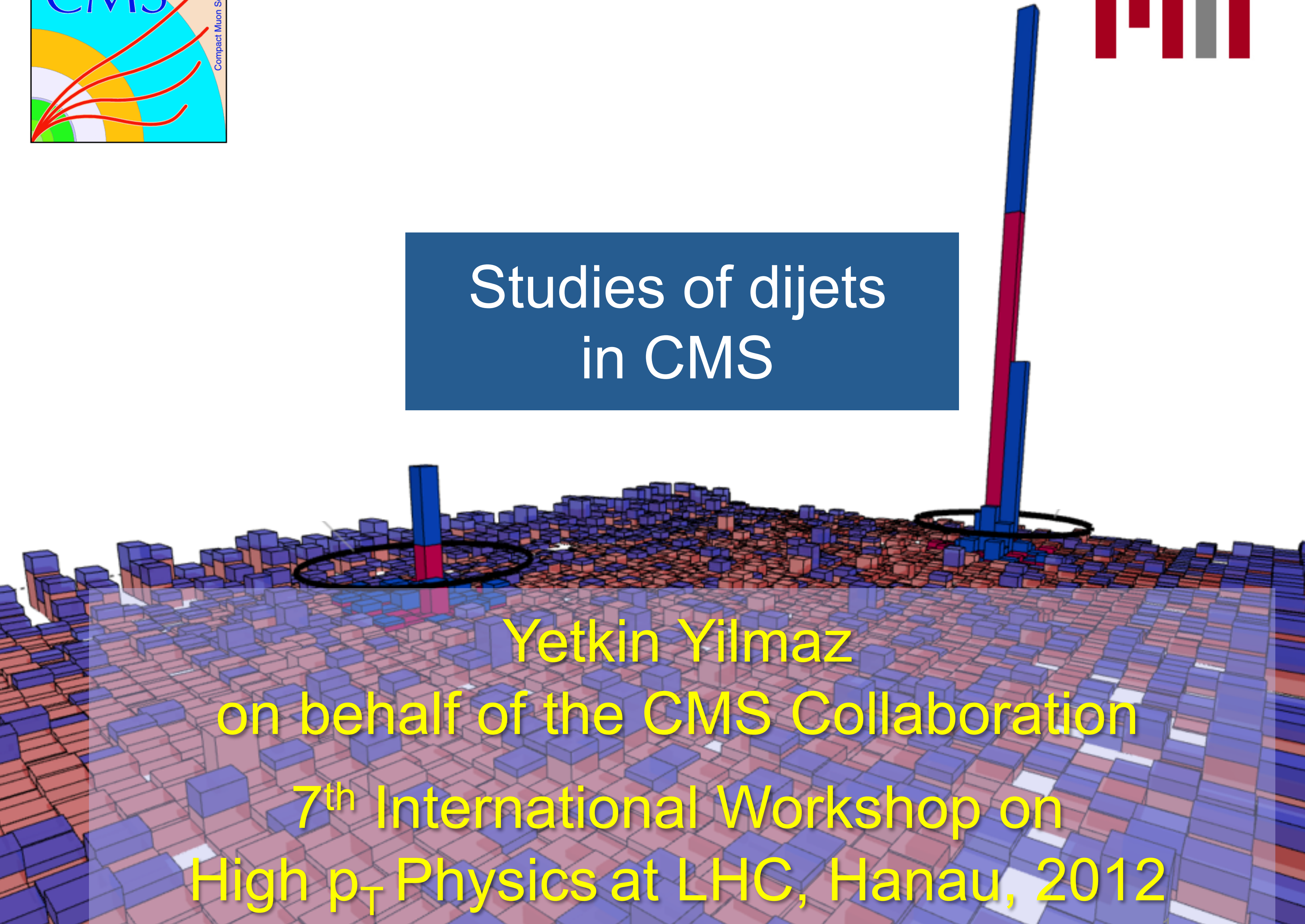
Studies of dijets in CMS

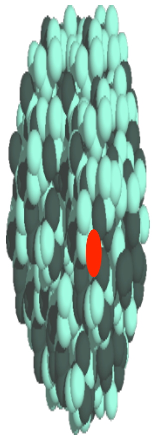


Yetkin Yilmaz
on behalf of the CMS Collaboration

7th International Workshop on High p_T Physics at LHC, Hanau, 2012

Why jets?

Glauber



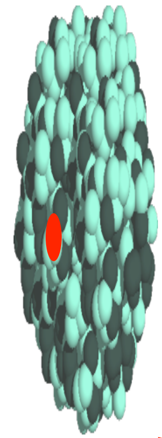
PDF

Higher order terms

&

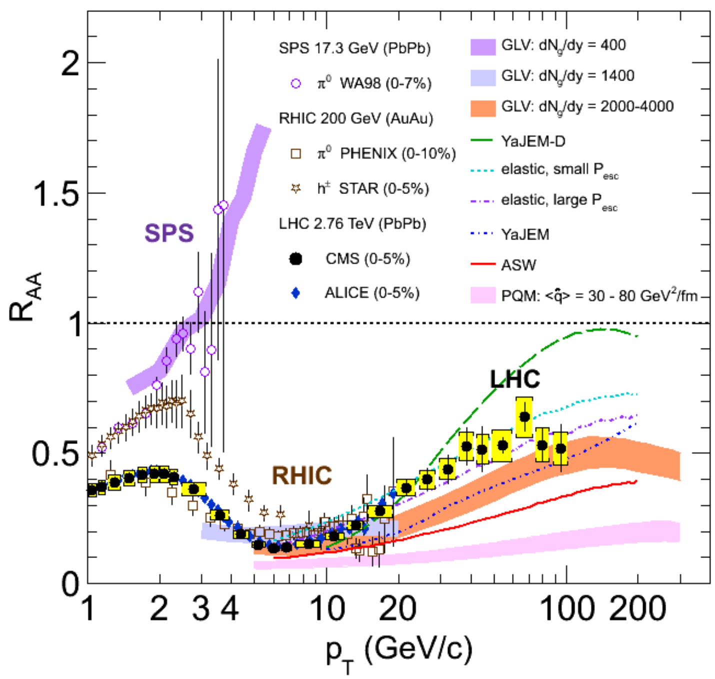
Energy loss

PDF



Glauber

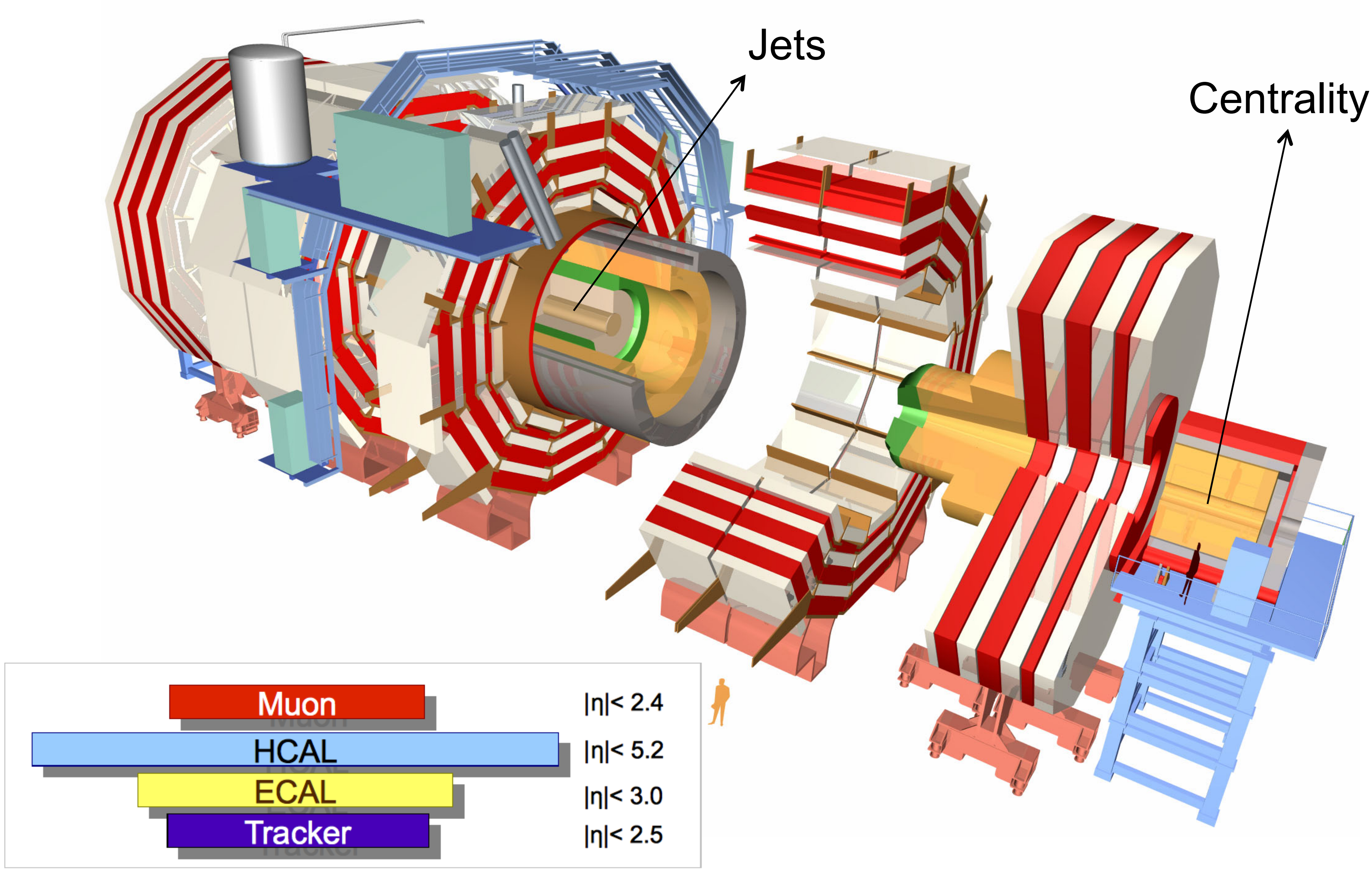
Directly start from this level



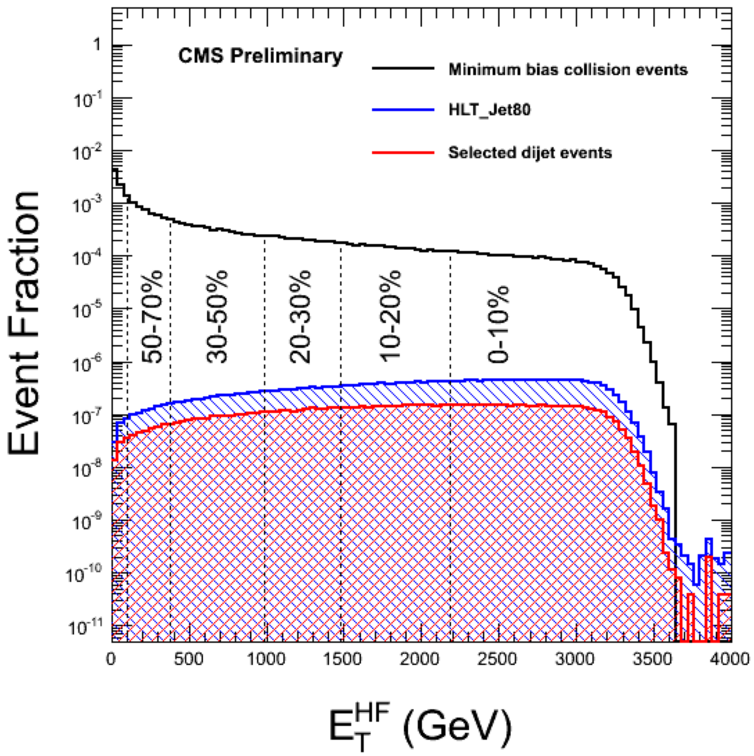
Fragmentation

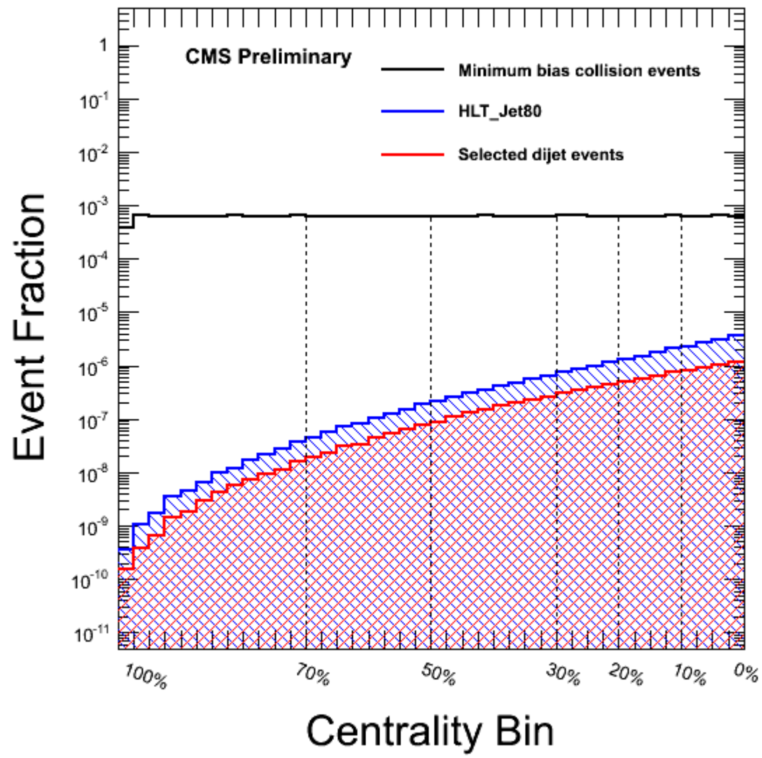
Hadrons

CMS Detector



Centrality

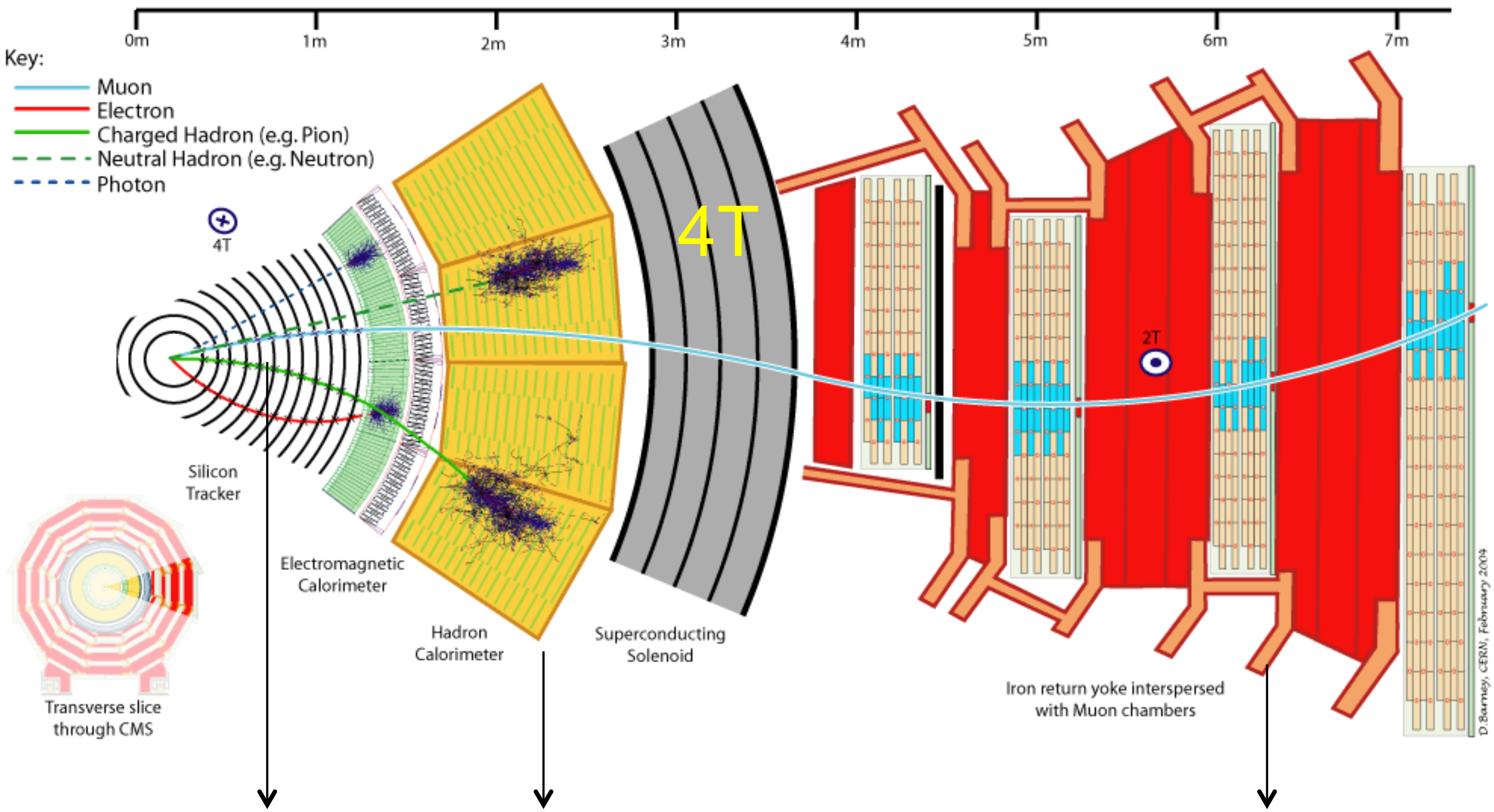




Most peripheral ← 70-100%, 50-70%, 30-50%, 20-30%, 10-20%, 0-10% → Most central

N_{part} : Number of participating nucleons in event
N_{coll} : Number of binary interactions in event
Transverse energy in the forward calorimeter is correlated to N_{part}
Rare probes occur more frequently in central events (N_{coll} scaling)

CMS Detector

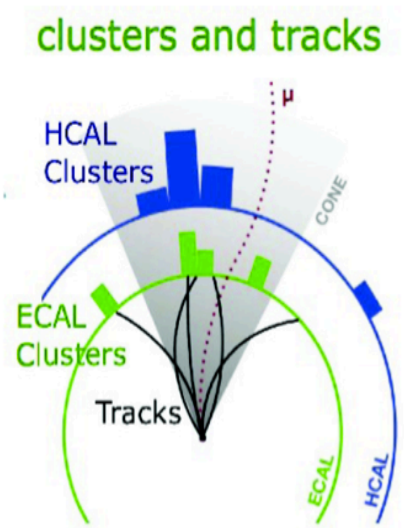


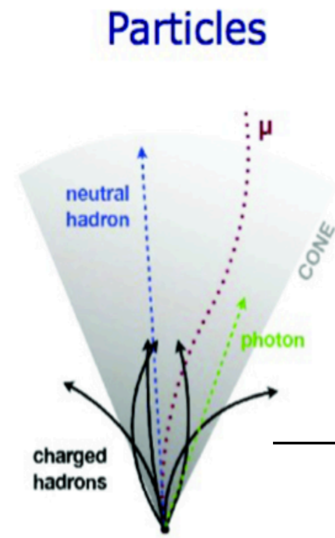
Better resolution of p_T

Neutral energy
and
Safety factor for
tracking efficiency

Muons: see Mihee's talk on "heavier probes" of quenching

Jet measurements





Towers

All Jets
Anti-k_T
R=0.3

(Tracking for only the primary vertex)

$\Delta\eta \times \Delta\phi$
0.076 x 0.076
in barrel

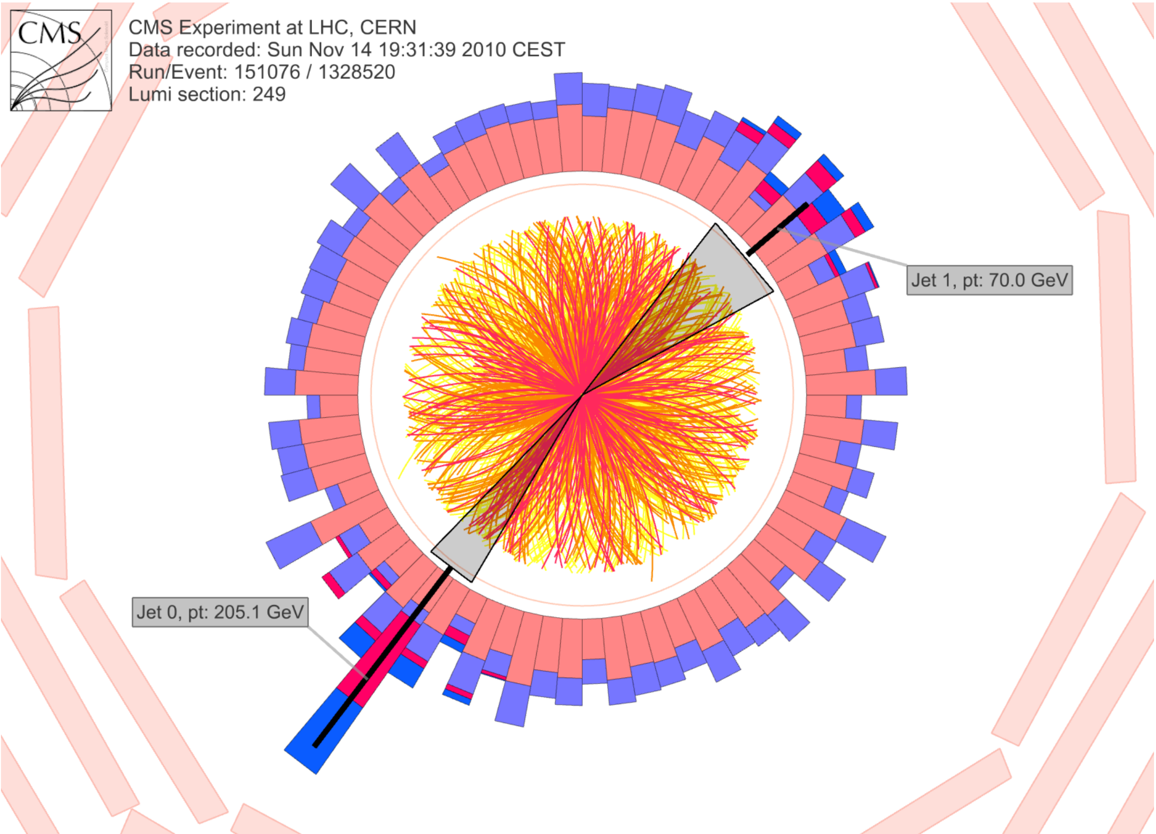
Calorimeter clusters and tracks are matched and combined to obtain most detailed information of particles in the event
(Details: CMS-PAS-HIN-11-004)
Estimated background is subtracted from merged energy in each calorimeter segmentation

Analysis selection

Jet Measurements

Local fluctuations

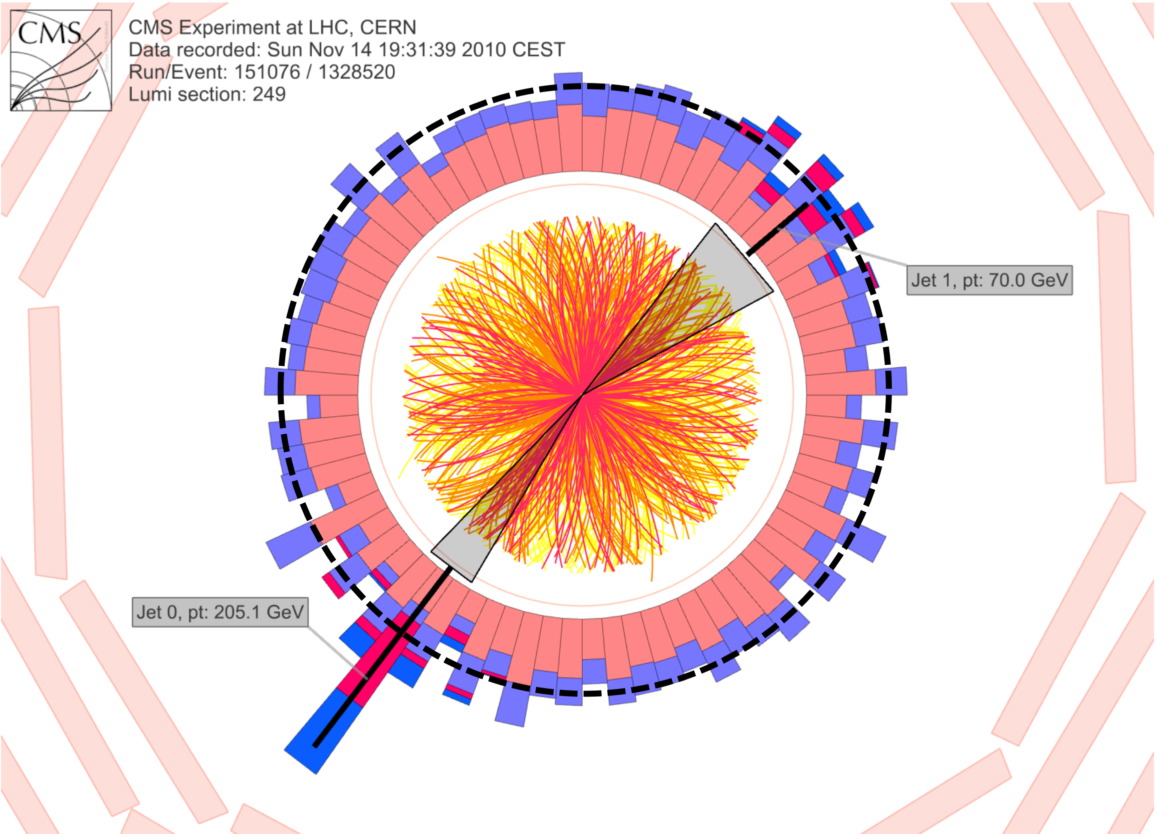
Depends on collision centrality



Jet Measurements

Background estimated for each tower ring of constant η

The background estimation is re-iterated after excluding the jets found in the first iteration

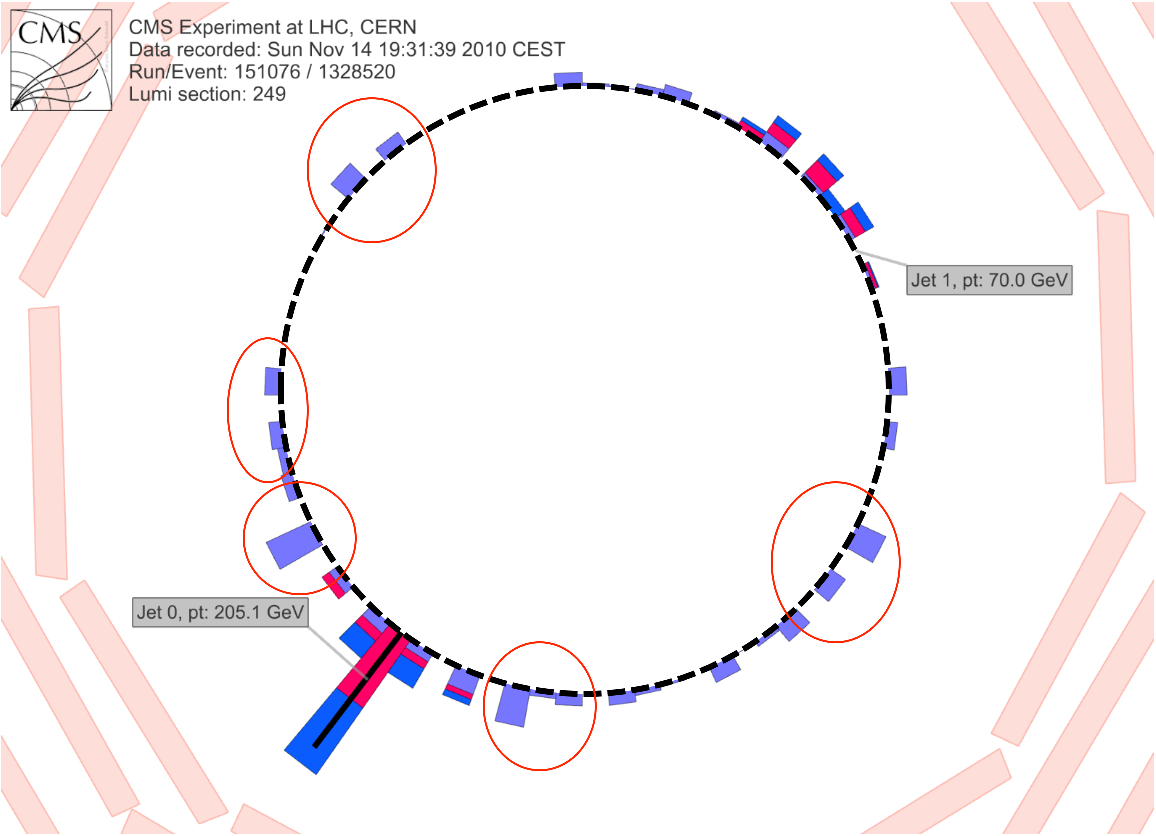


Jet Measurements

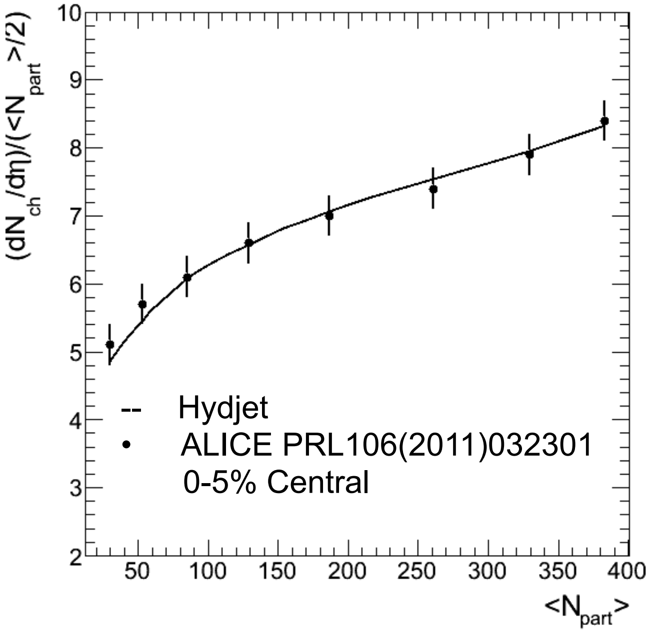
After the background subtraction, some higher local fluctuations remain (fake jets)

The fluctuations also deteriorate the jet resolution in central events

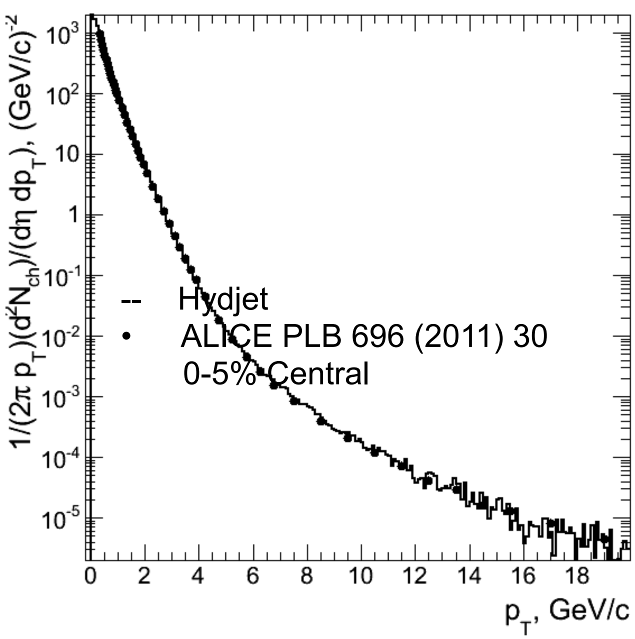
→ Important to represent these fluctuations well in simulated reference

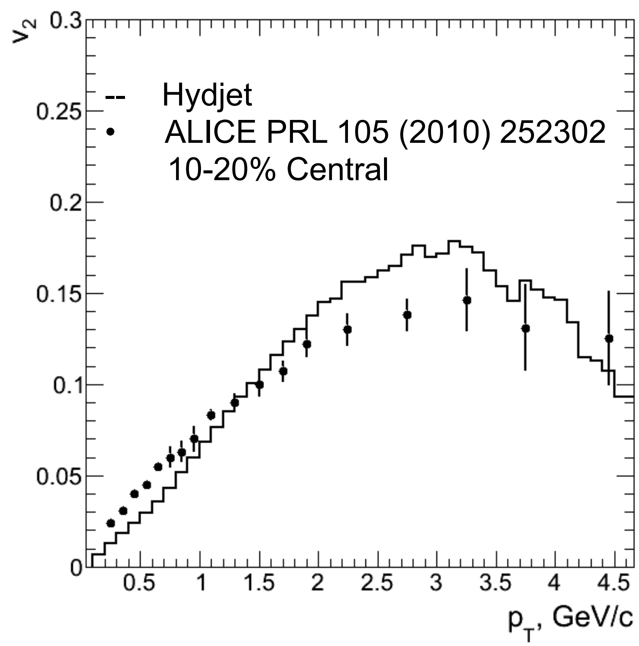


PbPb event simulations with Hydjet 1.8



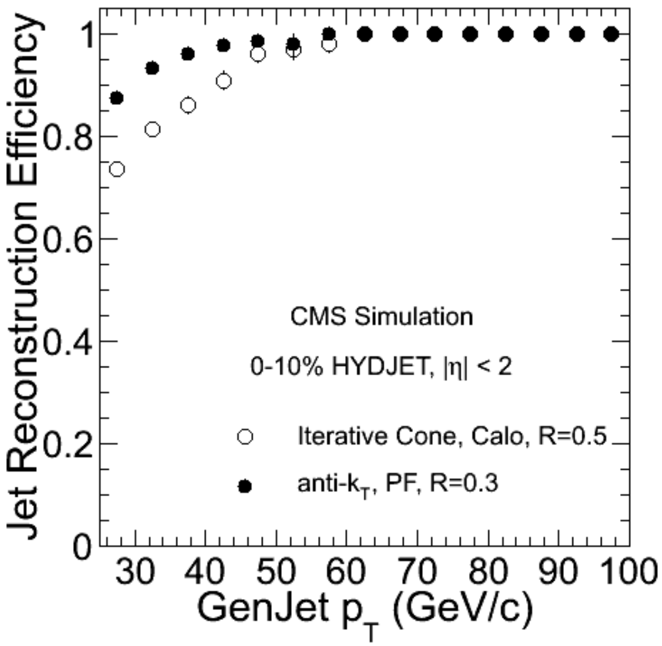
- Hydjet 1.8 default tune successfully reproduces:
  - Charged hadron multiplicity
  - Charged hadron p_T spectrum
  - Azimuthal asymmetry of low-p_T particles (Elliptic Flow)
- Pythia dijet events are mixed with the Hydjet sample at the same vertex

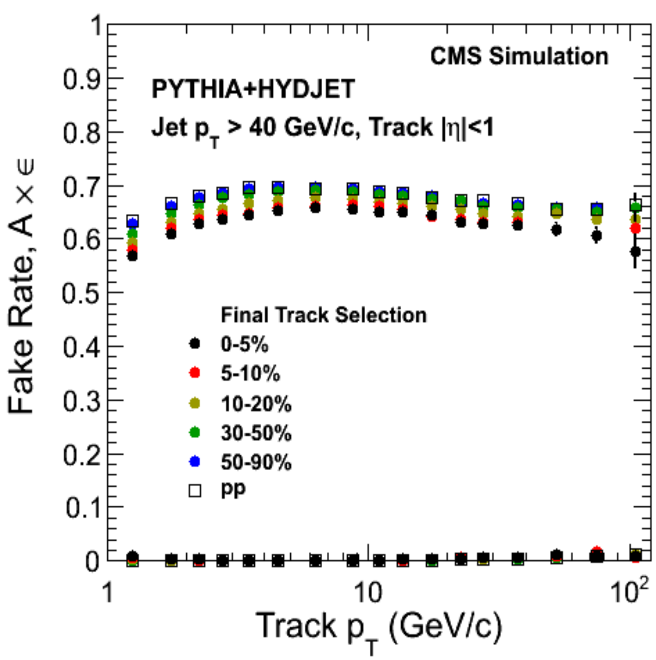


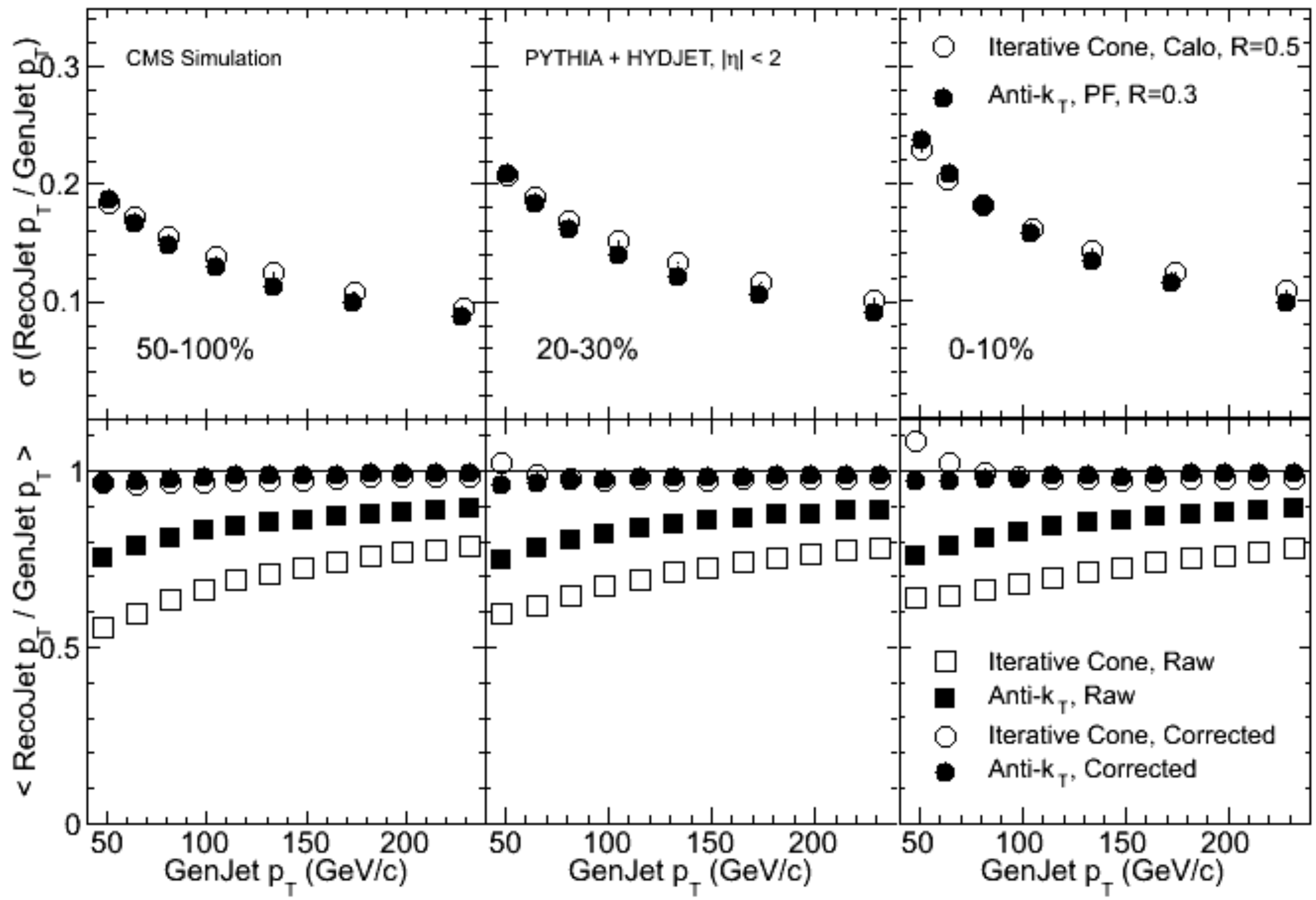


http://lokhtin.web.cern.ch/lokhtin/hydro/plots

Reconstruction Performance





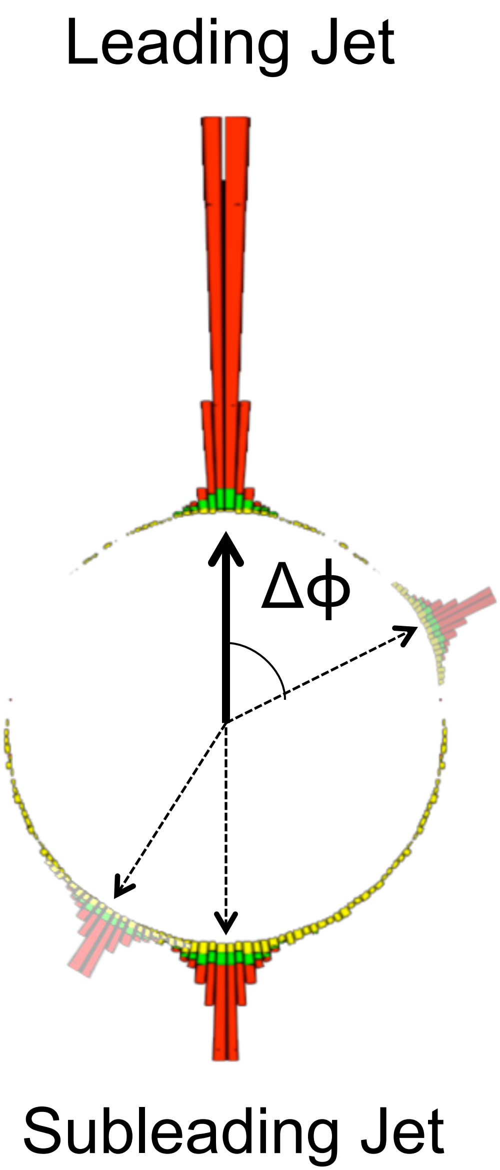


Combining various subdetectors provides powerful tools for analysis of jets

Low p_T efficiency is important for unbiased measurement

See: CMS-PAS-HIN-11-004

Jet measurements

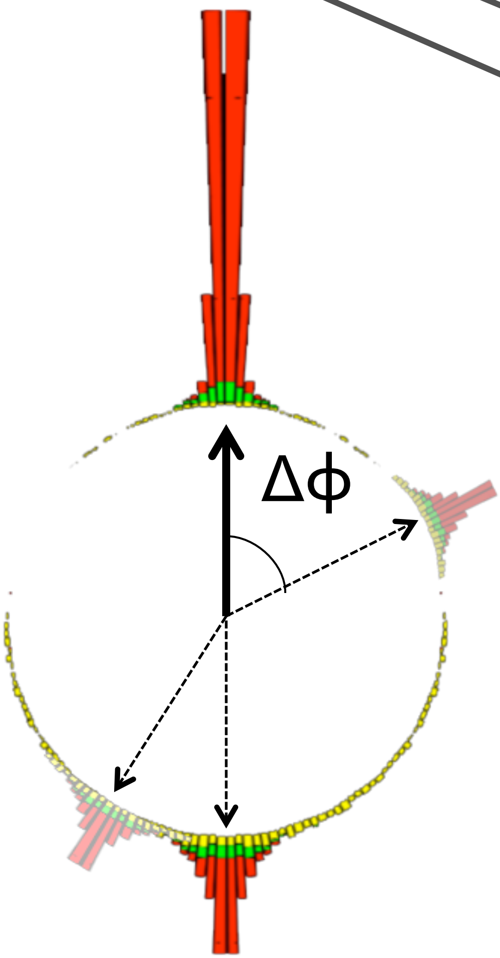


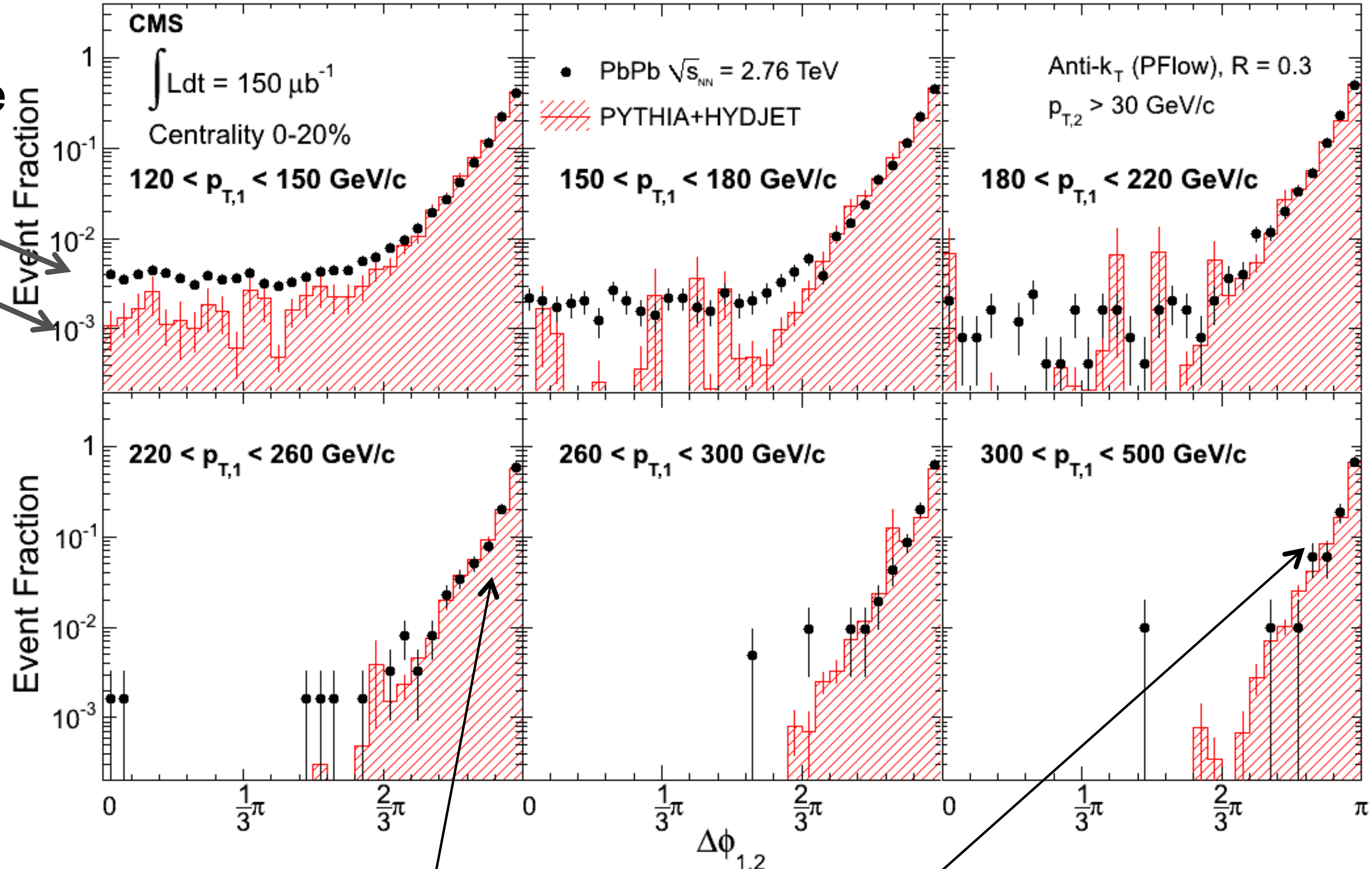
Analysis selection:

- Highest p_T jet in $|\eta| < 2$
- Second highest p_T jet in $|\eta| < 2$
- No a priori angular constraint

Dijet angular correlations

Background fluctuations supersede the recoil jet more often in data



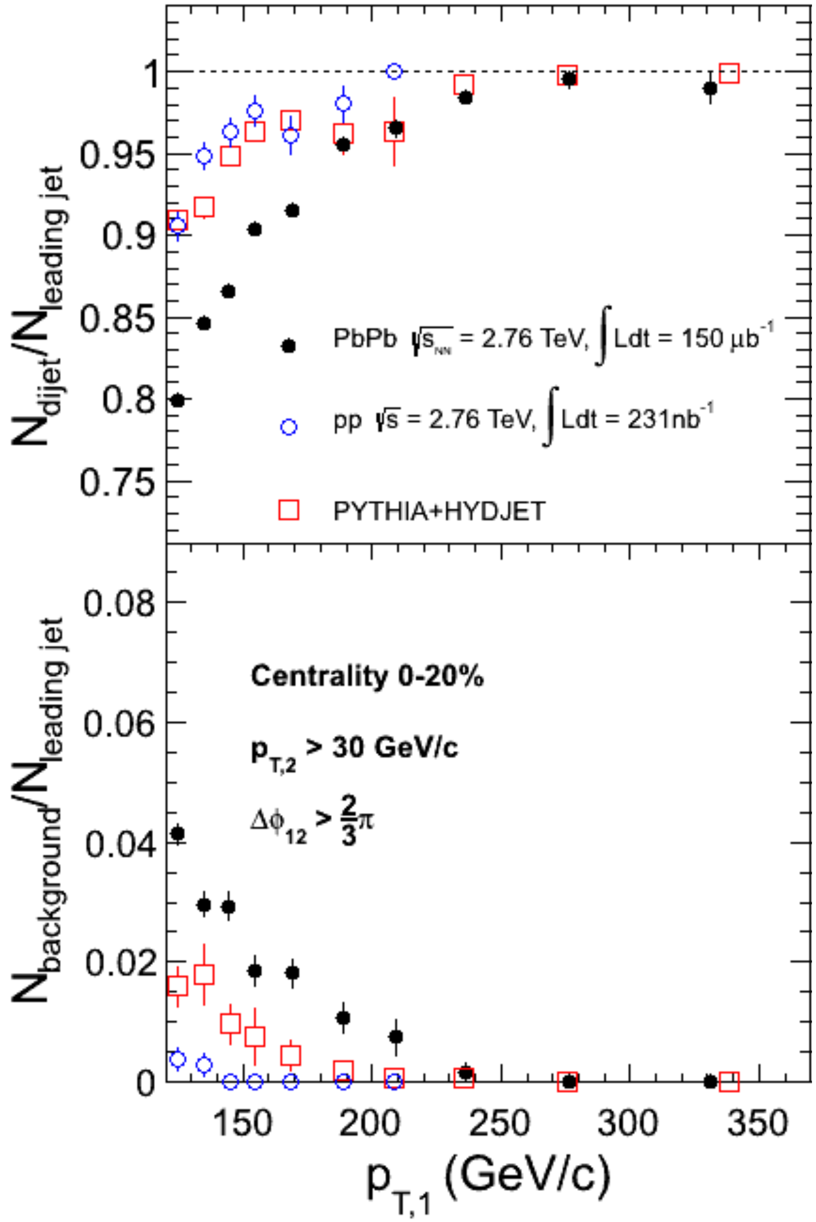


Correlation peak is the same in data and Pythia across all values of p_T

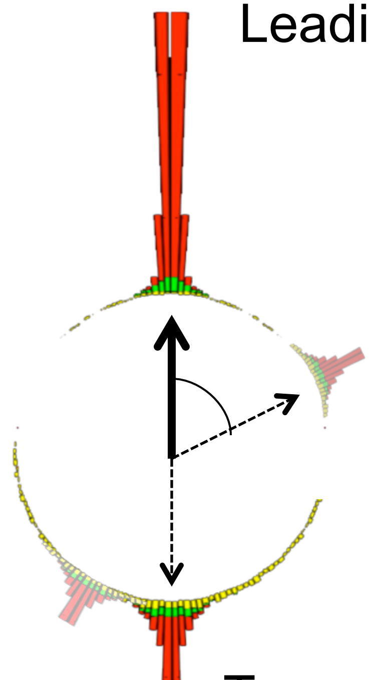
arXiv:1202.5022

No significant angular decorrelation of dijets.

Dijet correlation and background



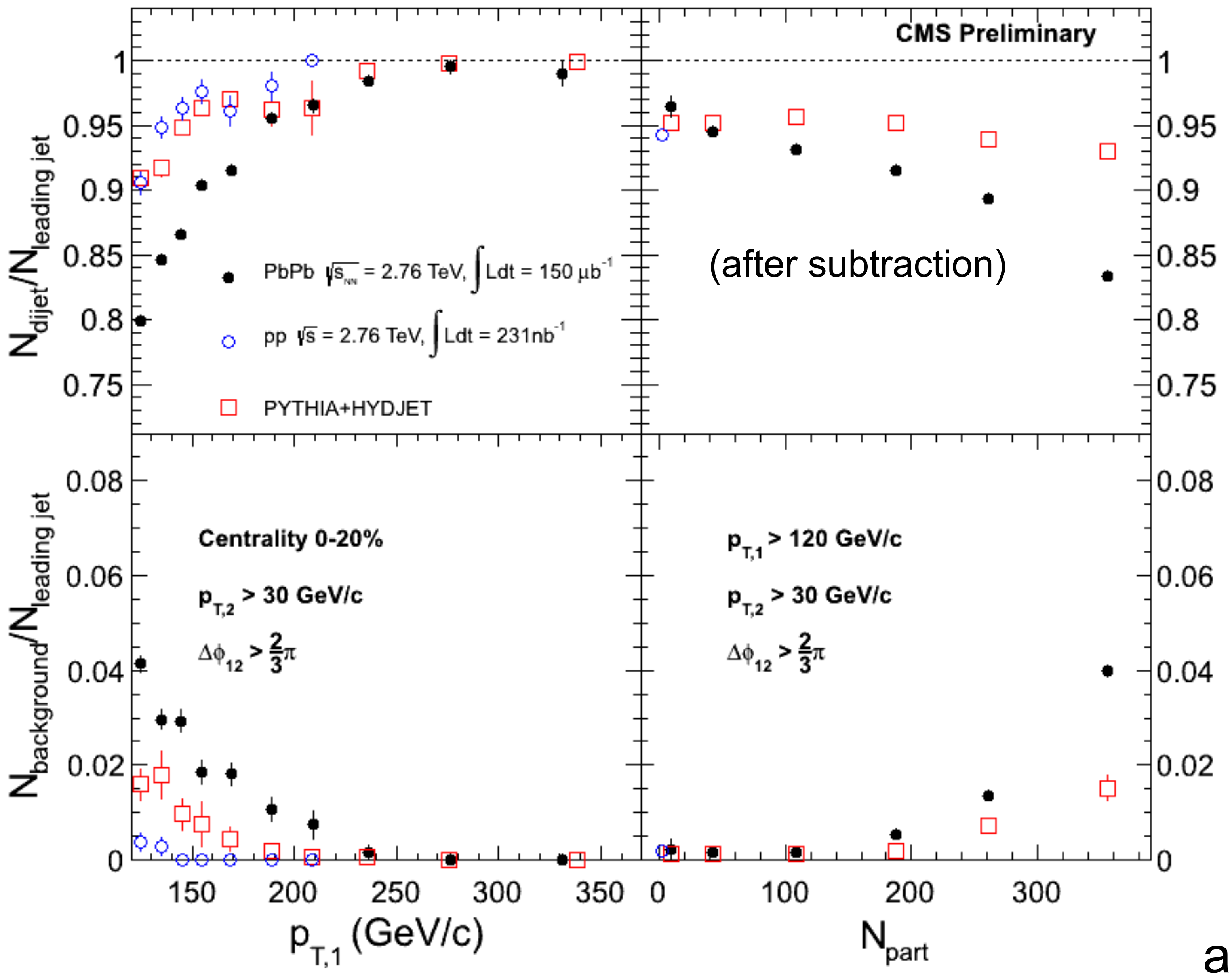
At high p_T, only very few jets get completely lost on the away side



- Background amount enhanced with quenching
- However, very little at high p_T

arXiv:1202.5022

Dijet correlation and background

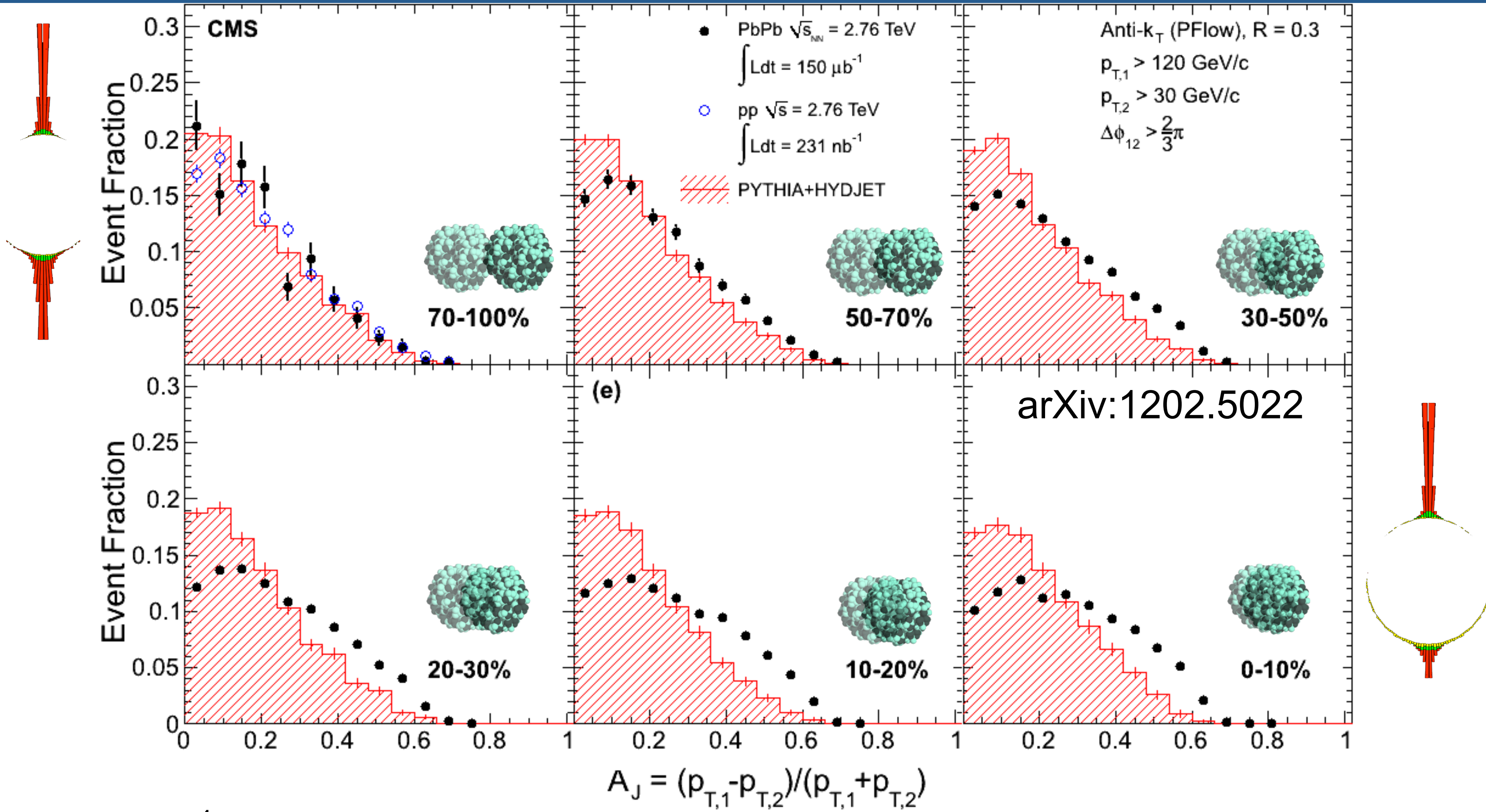


Background increases with centrality:

- Larger UE
- More quenching

arXiv:1202.5022

Dijet imbalance in centrality bins

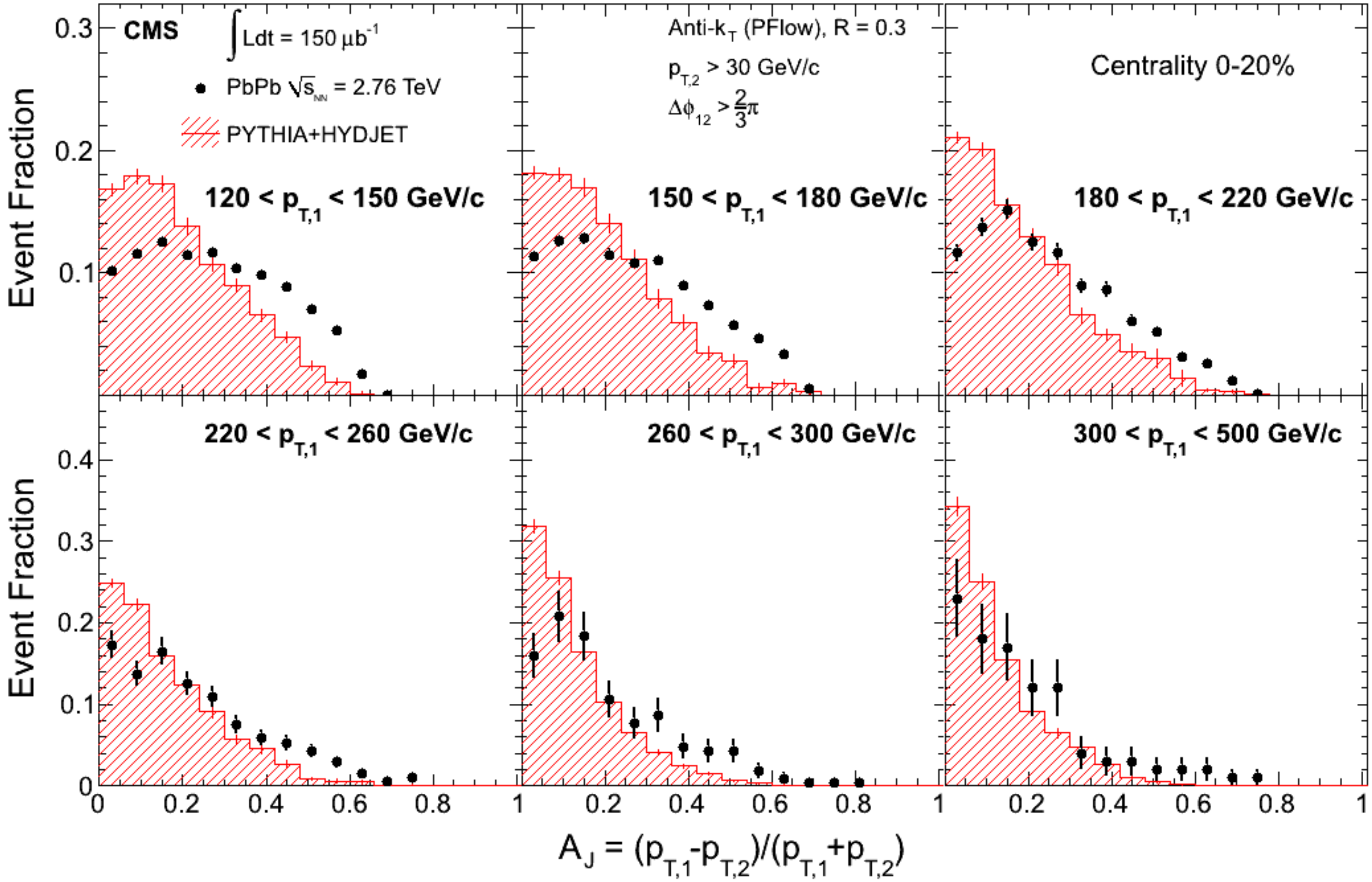


150 μb^{-1} ~ 20 times more data than in 2010!!!

Able to perform same measurements differentially in p_T

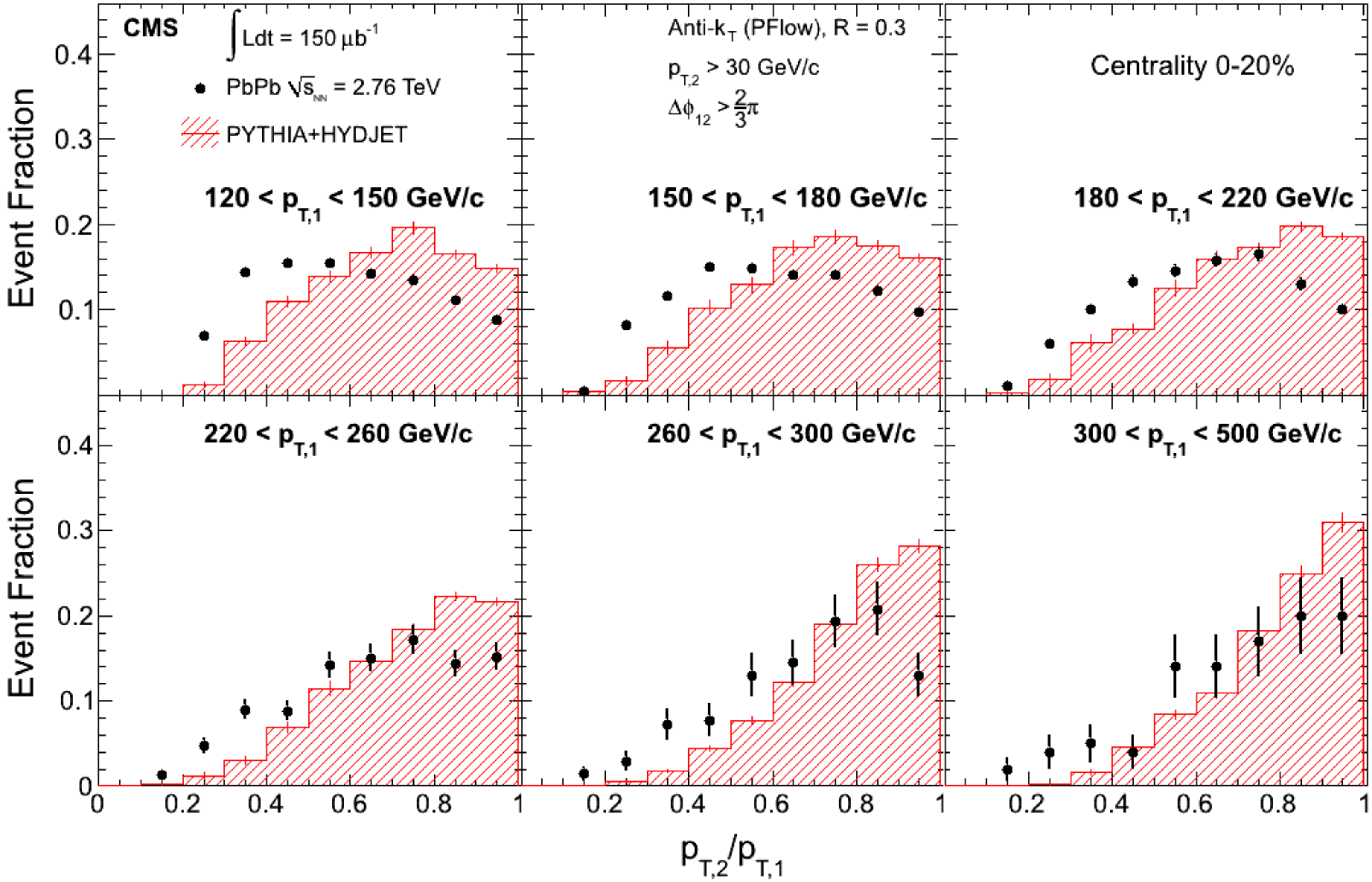
pp data at the same √s available, more statistics welcome!

p_T-dependence of the dijet imbalance



Dijets in PbPb are more imbalanced than Pythia at **all bins of leading jet p_T** arXiv:1202.5022

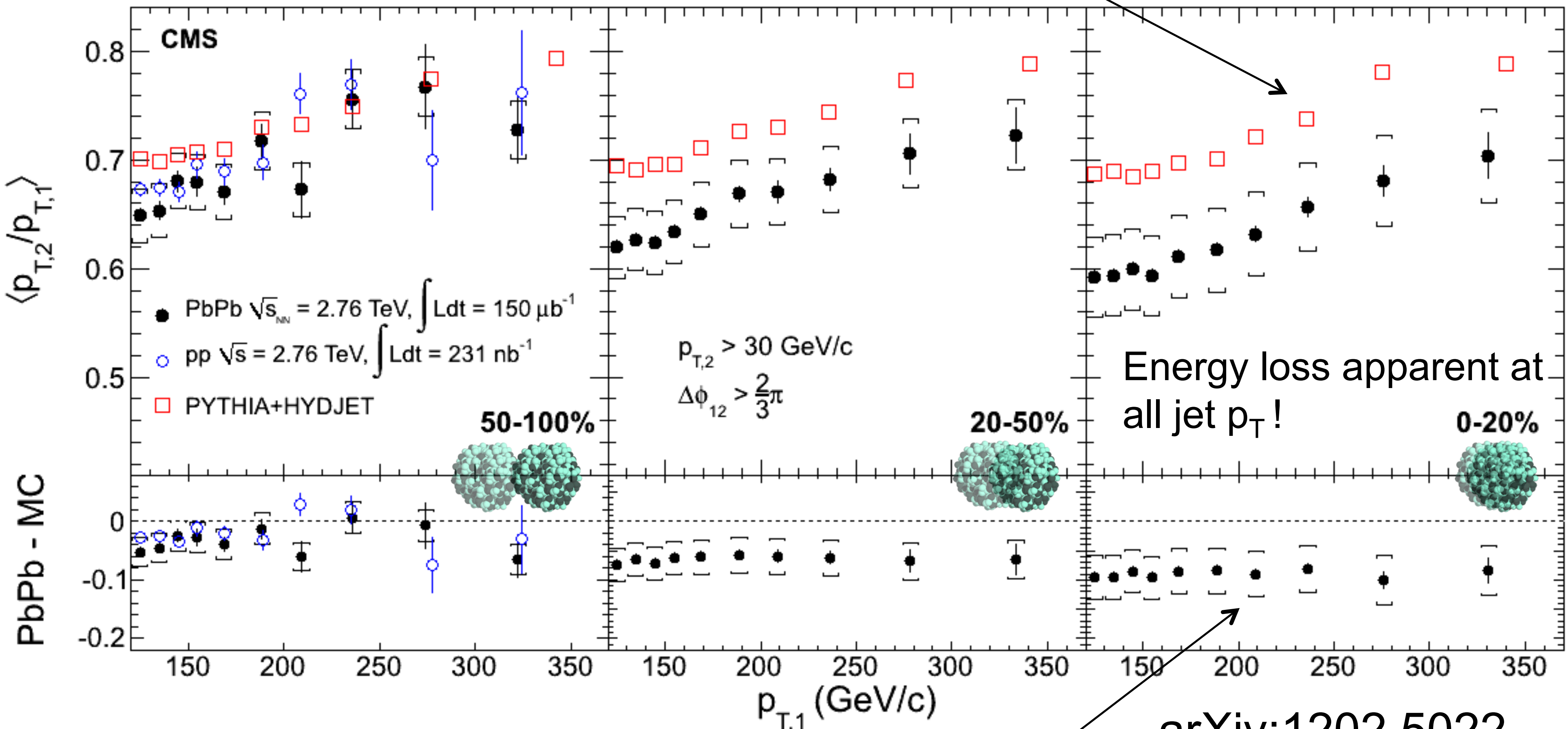
p_T-dependence of the dijet imbalance



Dijets in PbPb are more imbalanced than Pythia at **all bins of leading jet p_T** arXiv:1202.5022

p_T-dependence of the dijet imbalance

Reference itself has an increasing trend

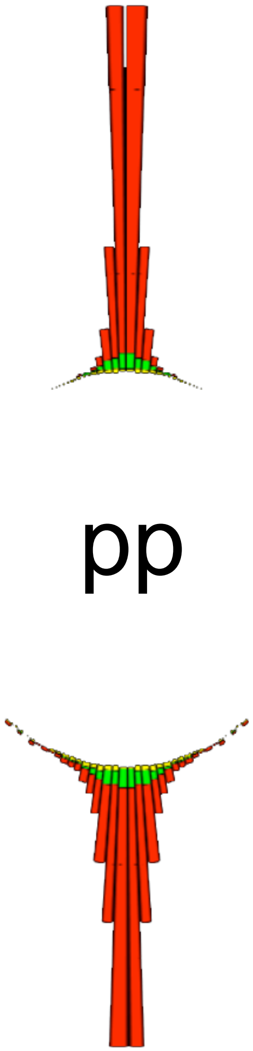


Energy loss apparent at all jet p_T !

arXiv:1202.5022

No significant dependence on jet p_T

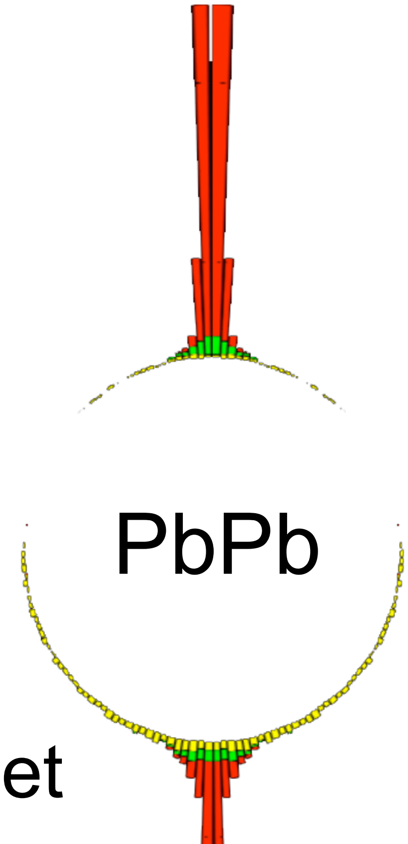
Conclusions



Enhanced imbalance exists at all p_T

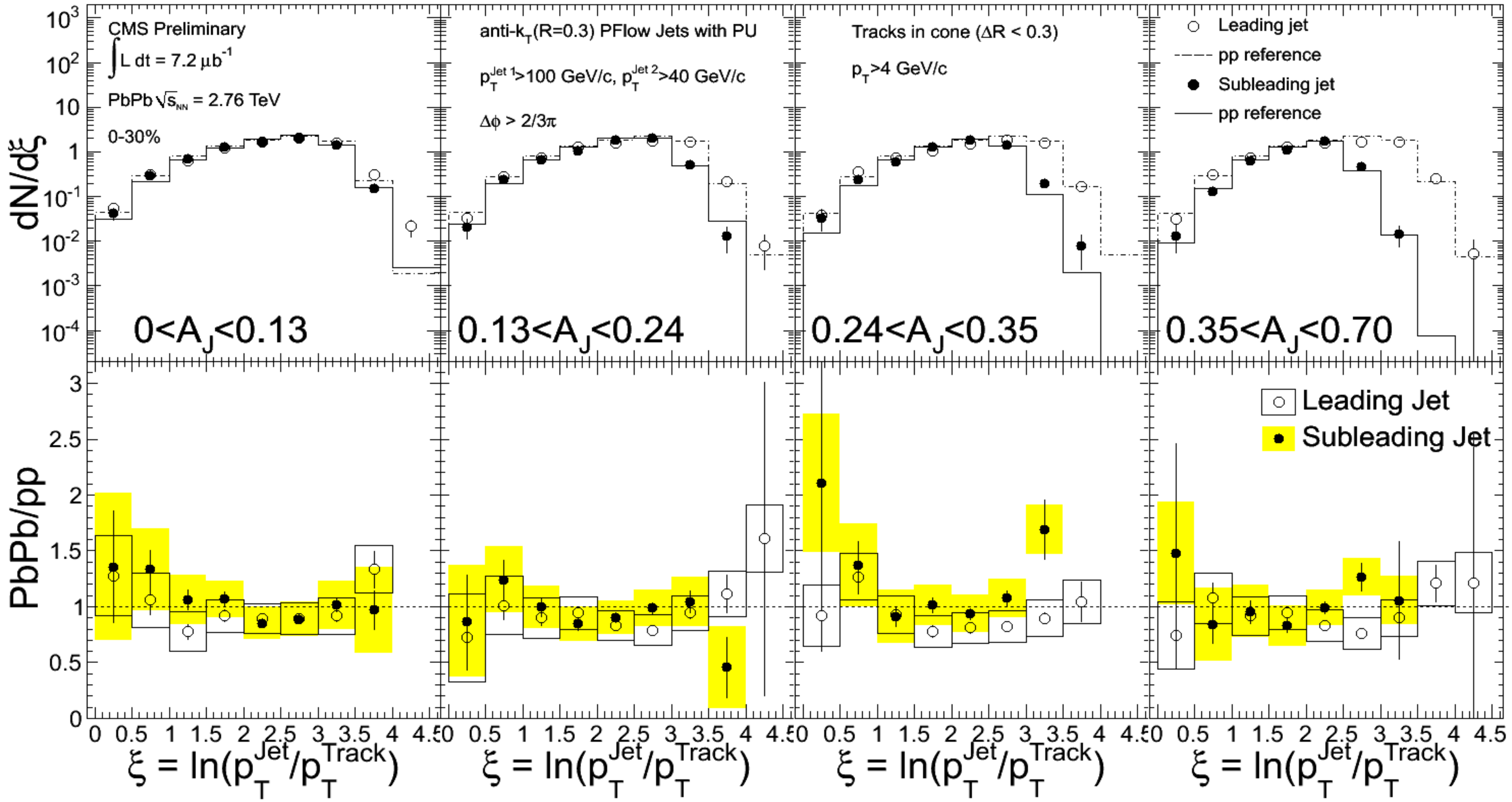
No angular decorrelation

The fraction of the energy that a jet loses **does not** dramatically change with jet p_T



Back up

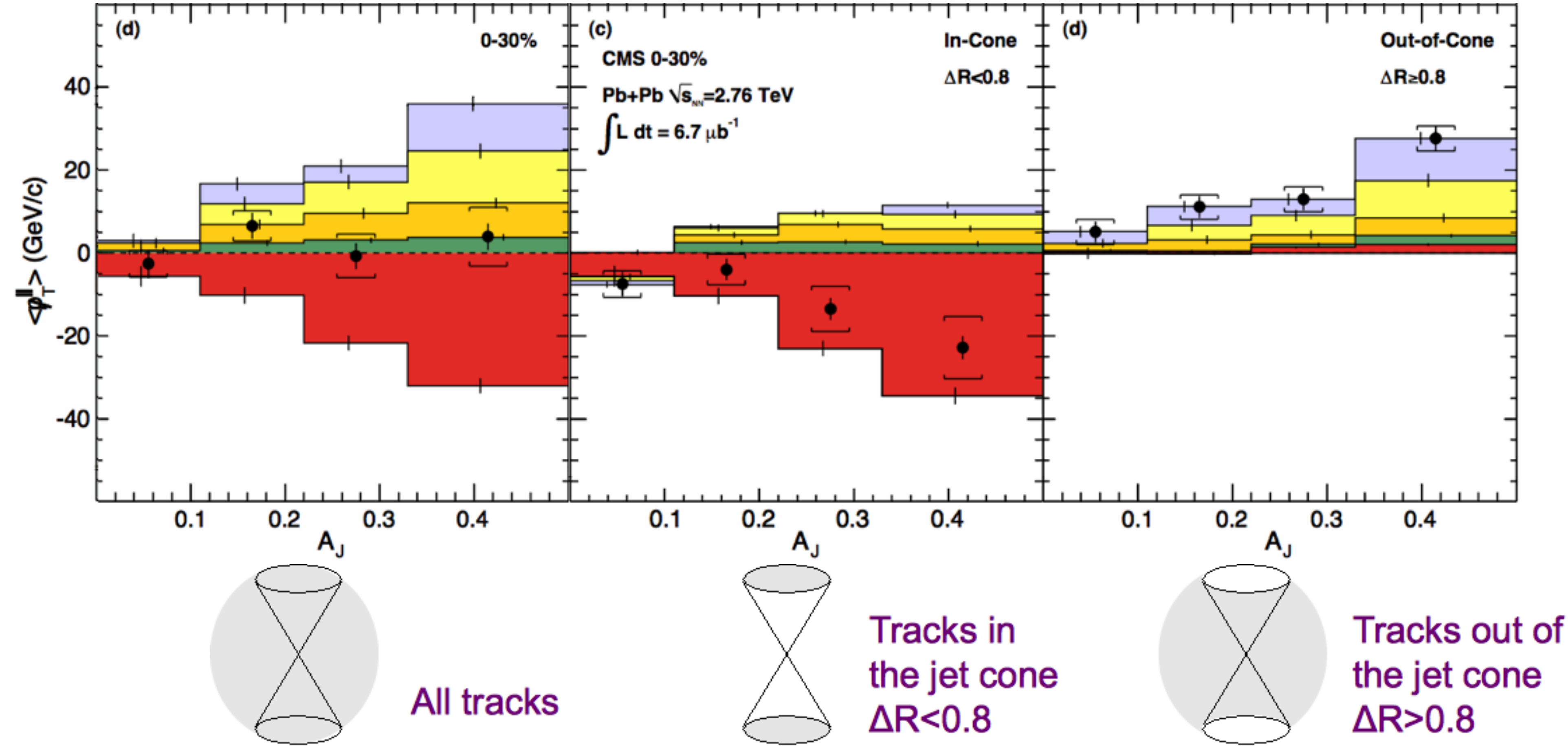
Fragmentation of jets



Structure of reconstructed jets resemble those that were produced in vacuum

No additional hard radiation inside the jet (CMS-PAS-HIN-11-004)

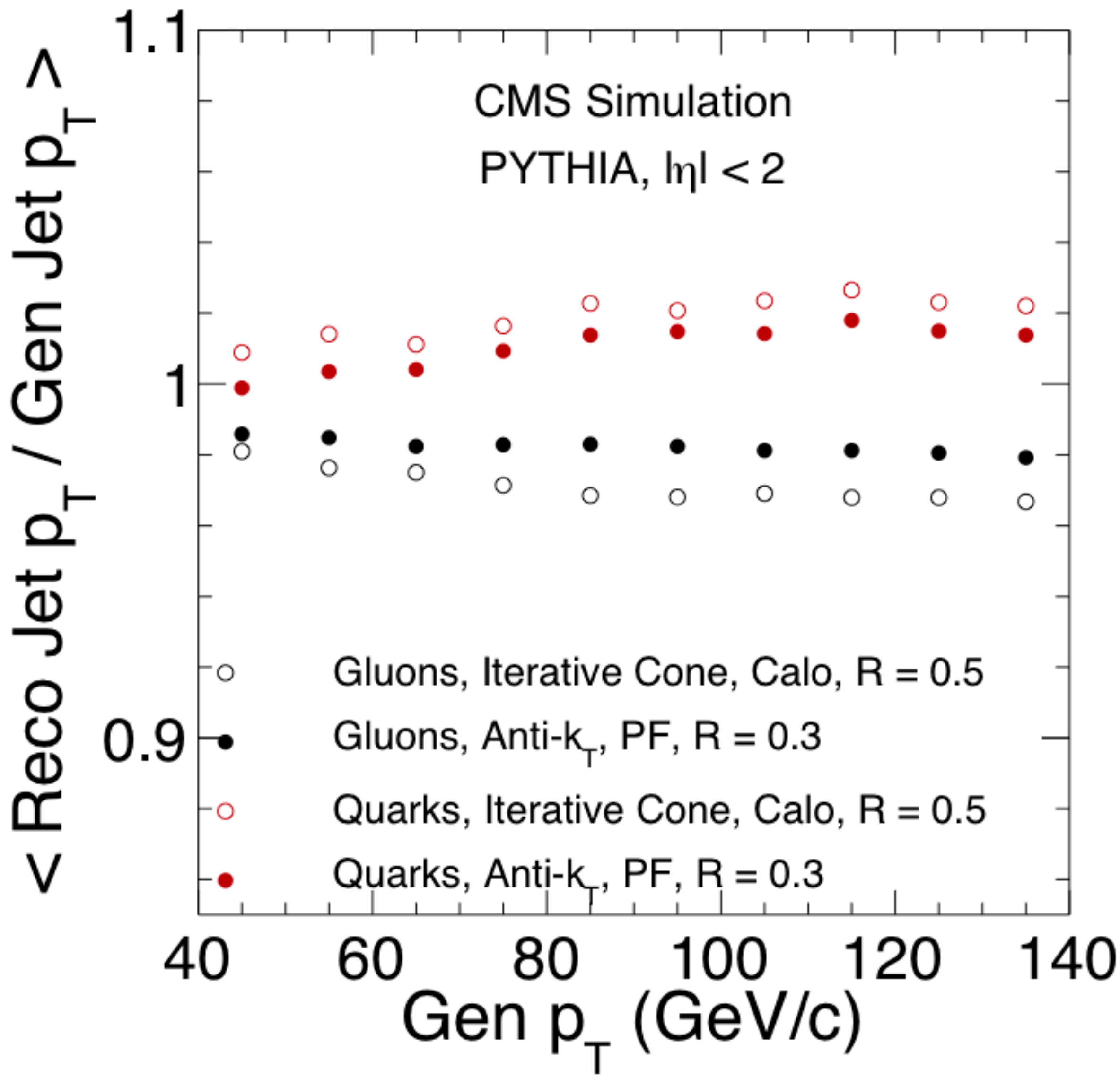
Missing $p_T^{\parallel}$: $$\not{p}_T^{\parallel} = \sum_{\text{Tracks}} -p_T^{\text{Track}} \cos\left(\phi_{\text{Track}} - \phi_{\text{Leading Jet}}\right)$$



The global event properties are modified with the existence of quenching
The missing energy is found at large angles from the jet axis

Phys.Rev.C84:024906,2011

Jet Response to Parton Types



CMS-PAS-HIN-11-004

Background fluctuations in Hydjet 1.8