Beomkyu KIM

June 19, 2017

Overview

$p_{\mathrm{T}}^{\mathrm{jet,ch}}$ at $\sqrt{s} = 8$ TeV

Charged dijet

Gamma study

DATA SAMPLES

ALICE data

Type	$\sqrt{s}$	Period	Trigger	# of events
pp	8	LHC12h	INT7 EMCEJE	29.3×10^6 6.06×10^6

Monte Carlo

Type	$\sqrt{s}$	Period	# of p_{T} hard bins	# of events
PYTHIA8	8	LHC16c2	20 [1]	28.1×10^6

[1] 5-7-9-12-16-21-28-36-45-57-70-85-99-115-132-150-169-190-212-235- GeV/c

p_T HARD-BIN NORMALIZATION

Steps

- Follows the official procedure [1]
- Weighted by σ/ntirals given by MC header per event
- Each hard-bin merged separately
- Then divided by # of filled events for the given hard bin
- Finally all hard bins are merged
- Observables have the unit, mb
  (normalised to the cross-section)

[1] https://twiki.cern.ch/twiki/bin/view/ALICE/PPEventNormalisation

CORRECTIONS

$\frac{1}{N_{\mathrm{evt}}^{\mathrm{EMCEJE}}} \frac{\mathrm{d}N}{\mathrm{d}p_{\mathrm{T,raw}}^{\mathrm{jet,ch}}}$ is corrected by

- EMCEJE to INT7 trigger efficiency

$$\frac{1}{N_{\mathrm{evt}}^{\mathrm{EMCEJE}}} \frac{\mathrm{d}N}{\mathrm{d}p_{\mathrm{T,raw}}^{\mathrm{jet,ch}}} \times \frac{\frac{1}{N_{\mathrm{evt}}^{\mathrm{INT7}}} \frac{\mathrm{d}N}{\mathrm{d}p_{\mathrm{T,raw}}^{\mathrm{jet,ch}}}}{\frac{1}{N_{\mathrm{evt}}^{\mathrm{EMCEJE}}} \frac{\mathrm{d}N}{\mathrm{d}p_{\mathrm{T,raw}}^{\mathrm{jet,ch}}}}$$

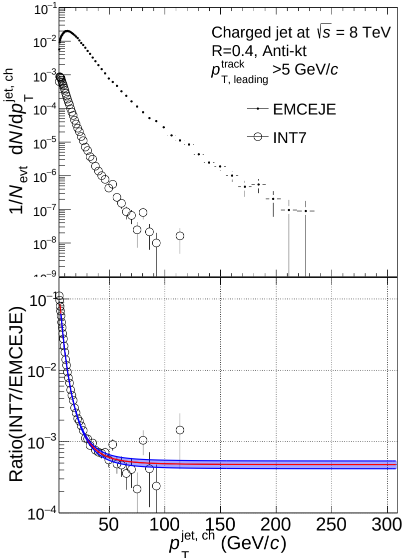
- Detector and vertex efficiency correction by the unfolding

$$\frac{1}{N_{\mathrm{evt}}^{\mathrm{EMCEJE}}} \frac{\mathrm{d}N}{\mathrm{d}p_{\mathrm{T,raw}}^{\mathrm{jet,ch}}} \times \frac{\frac{1}{N_{\mathrm{evt}}^{\mathrm{INT7}}} \frac{\mathrm{d}N}{\mathrm{d}p_{\mathrm{T,raw}}^{\mathrm{jet,ch}}}}{\frac{1}{N_{\mathrm{evt}}^{\mathrm{EMCEJE}}} \frac{\mathrm{d}N}{\mathrm{d}p_{\mathrm{T,raw}}^{\mathrm{jet,ch}}}} \times \mathcal{R}^{-1}\left(\frac{1}{N_{\mathrm{evt}}^{\mathrm{mcrec}}} \frac{\mathrm{d}N}{\mathrm{d}p_{\mathrm{T,mcrec}}^{\mathrm{jet,ch}}}, \frac{1}{N_{\mathrm{evt}}^{\mathrm{mcgen}}} \frac{\mathrm{d}N}{\mathrm{d}p_{\mathrm{T,mcgen}}^{\mathrm{jet,ch}}}\right)$$

- Cross-section scaling and INT7 to INEL trigger efficiency
  - Multiplied by cross-section scaling : 55.8 ± 1.2 mb [1]
  - Divided by trigger efficiency : 85 %

[1] https://aliceinfo.cern.ch/Notes/node/531

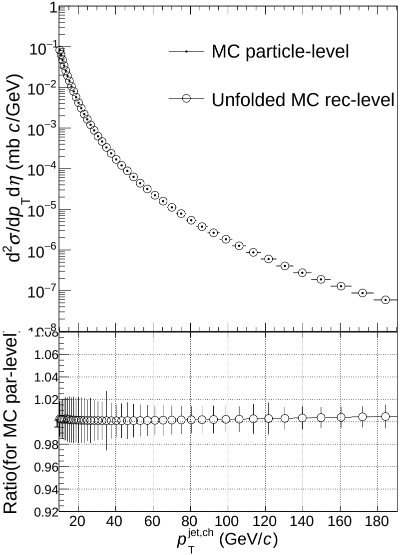
EMCEJE to INT7 scaling



- Ratio shows $\dfrac{\frac{1}{N_{\mathrm{evt}}^{\mathrm{INT7}}}\frac{\mathrm{d}N}{\mathrm{d}p_{\mathrm{T,raw}}^{\mathrm{jet,ch}}}}{\frac{1}{N_{\mathrm{evt}}^{\mathrm{EMCEJE}}}\frac{\mathrm{d}N}{\mathrm{d}p_{\mathrm{T,raw}}^{\mathrm{jet,ch}}}}$
- Fitted with $\frac{A}{(B+x^4)^C} + D$
- 95 % confidence-range
  - Shown with blue
  - Systematic uncertainty
- Fit function
  - when on-the-fly filling

UNFOLDING - CLOSURE TEST

Detector efficiency is corrected by the unfolding method



- Unfolding process

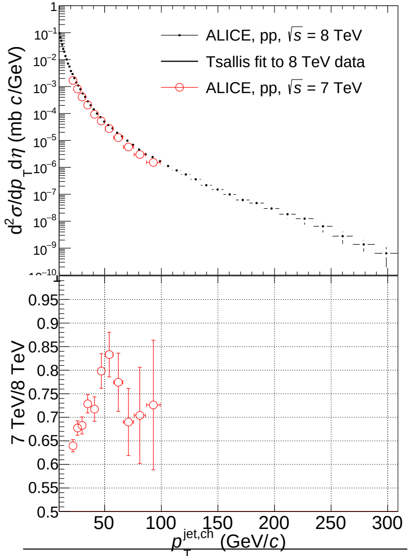
$$\frac{1}{N_{\mathrm{evt}}^{\mathrm{EMCEJE}}}\frac{\mathrm{d}N}{\mathrm{d}p_{\mathrm{T,raw}}^{\mathrm{jet,ch}}} \times \frac{\frac{1}{N_{\mathrm{evt}}^{\mathrm{INT7}}}\frac{\mathrm{d}N}{\mathrm{d}p_{\mathrm{T,raw}}^{\mathrm{jet,ch}}}}{\frac{1}{N_{\mathrm{evt}}^{\mathrm{EMCEJE}}}\frac{\mathrm{d}N}{\mathrm{d}p_{\mathrm{T,raw}}^{\mathrm{jet,ch}}}}$$

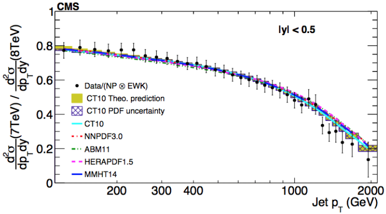
$$\times$$

$$\mathcal{R}^{-1}\left(\frac{1}{N_{\mathrm{evt}}^{\mathrm{mcrec}}}\frac{\mathrm{d}N}{\mathrm{d}p_{\mathrm{T,mcrec}}^{\mathrm{jet,ch}}}, \frac{1}{N_{\mathrm{evt}}^{\mathrm{mcgen}}}\frac{\mathrm{d}N}{\mathrm{d}p_{\mathrm{T,mcgen}}^{\mathrm{jet,ch}}}\right)$$

- Package : RooUnfold
- Algorithm : Iterative(Bayesian)
- Regularization parameter : 4

FINAL RESULT





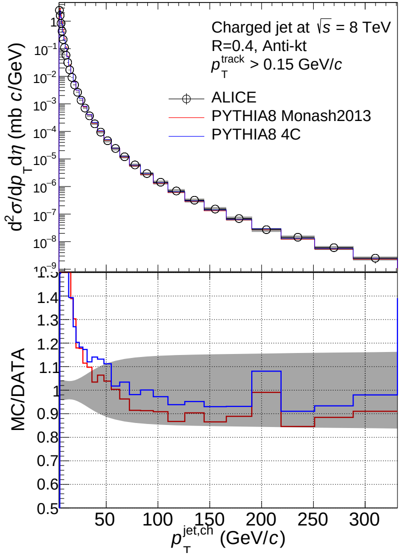
Ratio of CMS full jet spectra beteen 7 and 8 TeV[1]

- around 0.8
- support the new 8 TeV result

The new 8 TeV result extends to 300 GeV/c (7 TeV, 100 GeV/c)

[1] arXiv:1609.05331v2 [hep-ex] 4 Apr 2017

Final result v.s models



Systematic uncertainty

- Jet to INT7 trigger scaling : 10 %
- INT7 to INEL normalisation : 2.95% (0.7718±0.0228 (2.95%))
- Unfolding : 3 %

Overview

$p_{\mathrm{T}}^{\mathrm{jet,ch}}$ at $\sqrt{s} = 8$ TeV

Charged dijet

Gamma study

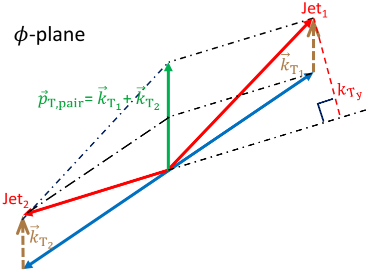
MOTIVATION FOR THE k_{T} MEASUREMENT

The goal of the k_{T} ($p_{\mathrm{T,pair}}$) analysis

- Net pair momentum of charged dijets $\sqrt{\langle p^2_{\mathrm{T,pair}} \rangle}$ (M_{jj})
- partonic Fermi motion + initial state gluon radiation

ALICE published

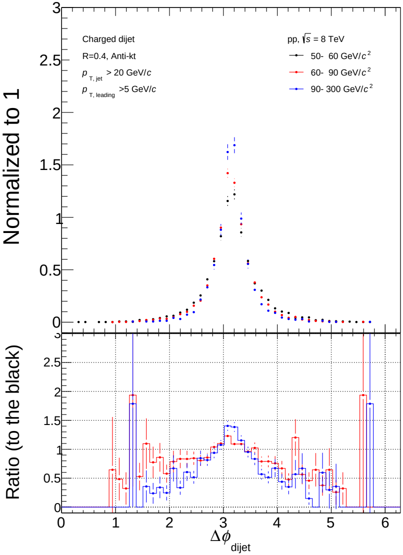
- $k_{\mathrm{T_y}}$ of $\mathrm{jet}^{\mathrm{ch+ne}}_{\mathrm{trig}} + \mathrm{jet}^{\mathrm{ch}}_{\mathrm{asso}}$
- for different $p^{\mathrm{ch+ne}}_{\mathrm{T,jet}}$ bins
- for p-Pb and PYTHIA8
- biased towards the trigger $p^{\mathrm{ch+ne}}_{\mathrm{T,jet}}$

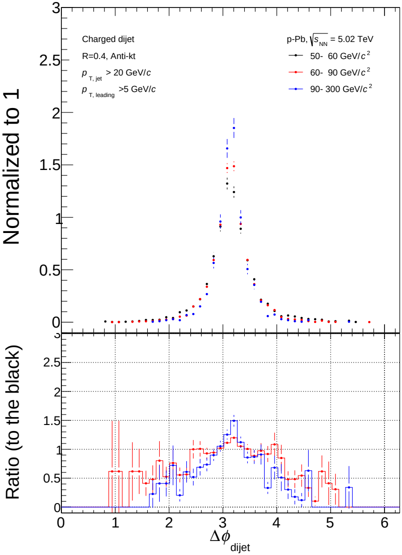


This topic

- Unbiased $p_{\mathrm{T,pair}}$ measurement with $\mathrm{jet}^{\mathrm{ch}}_{\mathrm{leading}} + \mathrm{jet}^{\mathrm{ch}}_{\mathrm{sub-leading}}$
- for Pb-Pb, p-Pb, pp and PYTHIA8

$\Delta\phi_{\mathrm{dijet}}$ FOR PP AND P-PB COLLISIONS





UNFOLDING

Detector efficiency is corrected by multi-dimensional unfolding method

- Package : RooUnfold
- Algorithm : Iterative

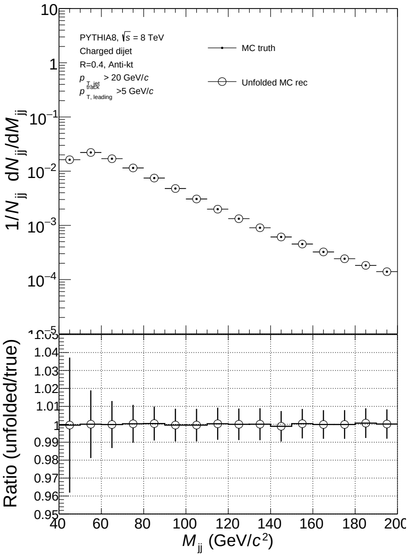
$$(M_{\mathrm{jj}}^{\mathrm{raw}}, p_{\mathrm{T,jj}}^{\mathrm{raw}}) \times \mathcal{R}(M_{\mathrm{jj}}^{\mathrm{mcrec}}, M_{\mathrm{jj}}^{\mathrm{mctrue}}, p_{\mathrm{T,jj}}^{\mathrm{mcrec}}, p_{\mathrm{T,jj}}^{\mathrm{mctrue}}) \tag{1}$$

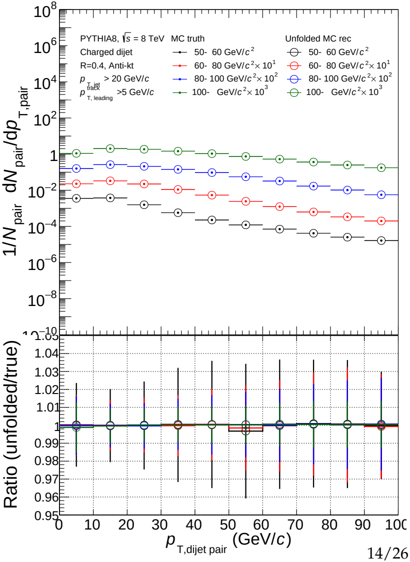
Corrected $(M_{\mathrm{jj}}^{\mathrm{corrected}}, p_{\mathrm{T,jj}}^{\mathrm{corrected}})$

- projection on M_{jj} axis
- projection on $p_{\mathrm{T,jj}}$ axis for different M_{jj} bin ranges

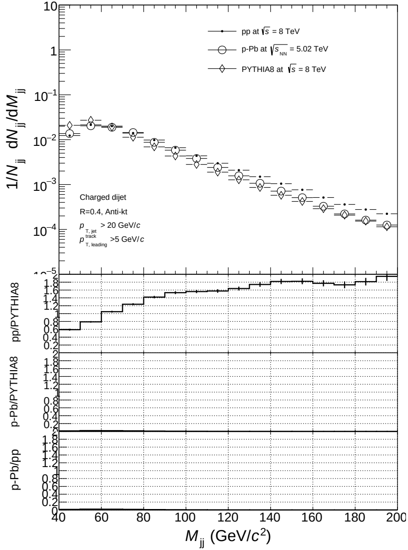
UNFOLDING - CLOSURE TEST

Closure test for the unfolding with MC samples





CHARGED DIJET MASS



Motivation

- To see medium effect of dijet invariant mass
- In medium, high virtuality
  $\rightarrow$ Broad jet profile
  $\rightarrow$ jet mass increases
  $\rightarrow$ dijet mass increases

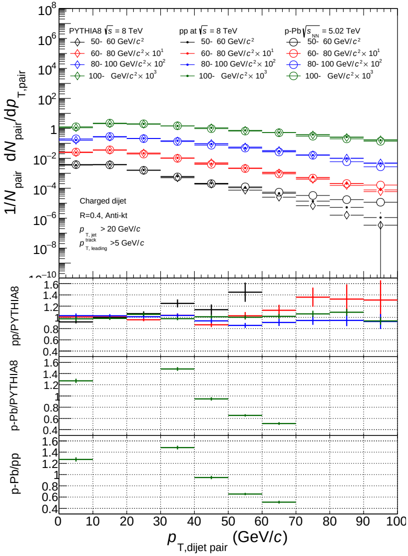
p-Pb v.s pp

- Finalizing study

Pb-Pb v.s pp

- Study ongoing

CHARGED DIJET k_{T}



Motivation

- To see medium effect of dijet acoplanarity
- In medium, dijet imbalance increases (increasing k_{T})

p-Pb v.s pp

- Finalizing study

Pb-Pb v.s pp

- Study ongoing

Pb-Pb AT $\sqrt{s} = 5.02$ TeV

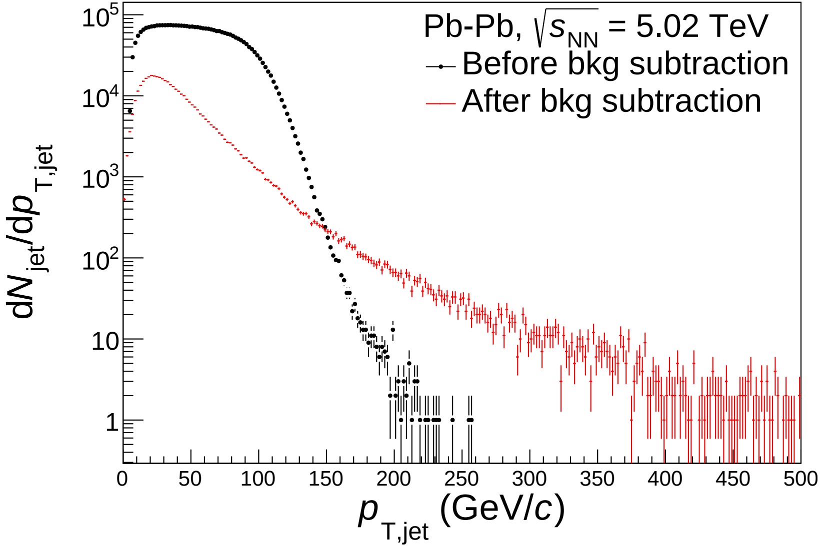
- Data : LHC15o
- Trigger selection : INT7
- # of events scanned : 17 millions
- Underlying events have to be subtracted

CORRECTION FOR THE UNDERLYING EVENT

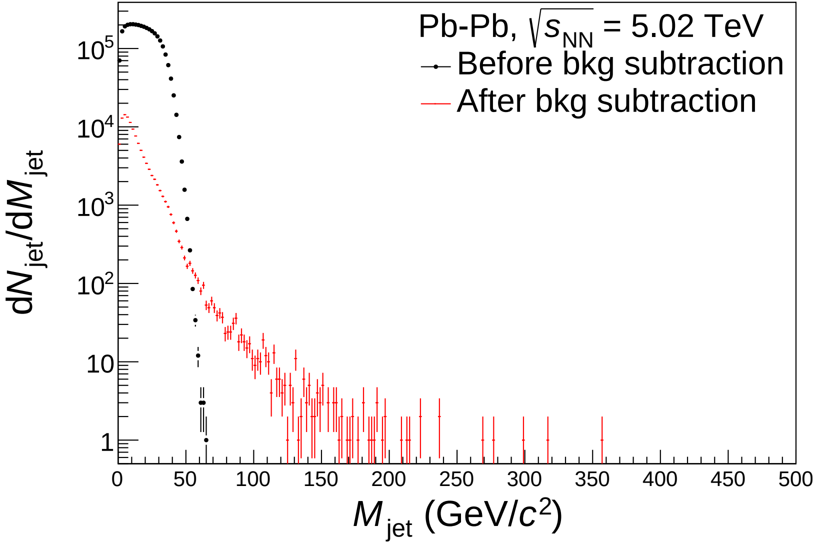
In Pb-Pb, bkg from underlying events is considered!

- Bkg densities are measured with kT cones by median
  - $p_{\mathrm{T,patch}} = \sum_{i\in\mathrm{patch}} p_{\mathrm{T,i}}$, $m_{\delta,patch} = \sum_{i\in\mathrm{patch}}(\sqrt{m_i^2 + p_{\mathrm{T,i}}^2} - p_{\mathrm{T,i}})$
  - ρ=median$_{\mathrm{patches}}$ $\{\frac{p_{\mathrm{T,patch}}}{A_{\mathrm{patch}}}\}$, ρ_m=median$_{\mathrm{patches}}$ $\{\frac{m_{\delta,\mathrm{patch}}}{A_{\mathrm{patch}}}\}$
- anti-kT jets are recalculated by this bkg density with kT cones
  - $p_{\mathrm{corr}}^{\mu} = (p^x - \rho A^x, p^y - \rho A^y, p^z - (\rho + \rho_m)A^z, E - (\rho + \rho_m)A^E)$

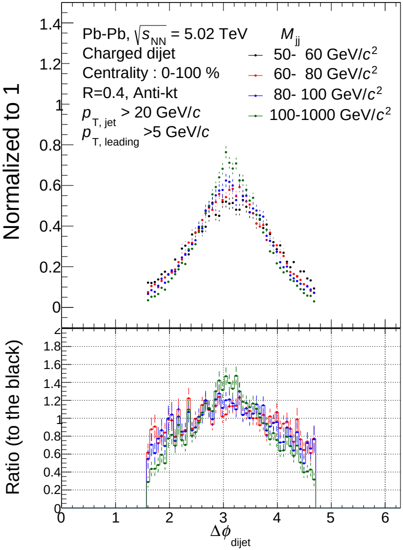
INCLUSIVE $p_{\mathrm{T,jet}}$ BEFORE AND AFTER THE CORRECTION



Inclusive jet mass before and after the correction

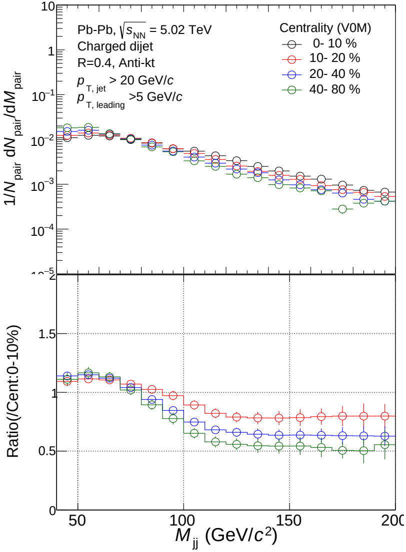


$\Delta\phi_{\mathrm{dijet}}$ FOR PB-PB COLLISIONS



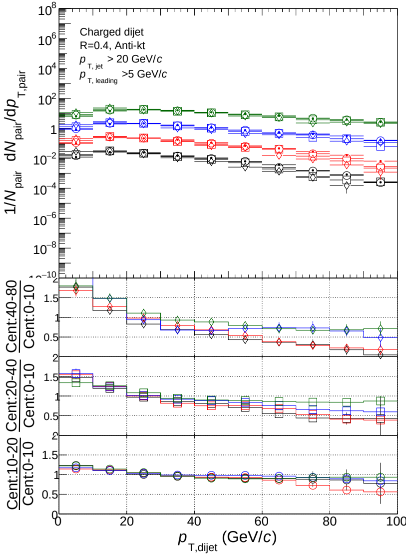
- Bugs were fixed
- 14 millions MB events scanned
- $\Delta\phi$ dist. show good shapes

Raw M_{jj} for Pb-Pb collisions



- More central → higher dijet mass

RAW $p_{\text{T,pair}}$ FOR PB-PB COLLISIONS



- More central → higher $p_{\text{T,pair}}$

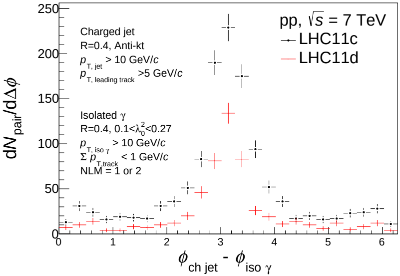
Overview

$p_{\mathrm{T}}^{\mathrm{jet,ch}}$ at $\sqrt{s} = 8$ TeV

Charged dijet

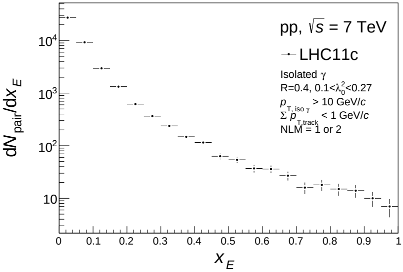
Gamma study

$\Delta\phi$ OF LEADING ISO γ AND LEADING CH JET



- $\Delta\phi$ of leading jet and leading iso γ
- Nominal cluster cuts applied
- Nominal isolation cuts applied

x_E FOR ISO γ AND $h^{\pm}$



- Raw yield without any correction
- Nominal cluster cuts applied
- Nominal isolation cuts applied