Annual report

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CERN-KEK meeting 14/Dec./2010

Contents

- In-situ calibration of gap and crack scintillator in the ATLAS detector.
  - Muons from cosmic rays (2008 and 2009 data)
  - 7TeV collision data

- Inclusive Jet cross section measurement with full 2010 data.
  - bin-by-bin correction

Gap and Crack scintillator

Scintillators at the crack region

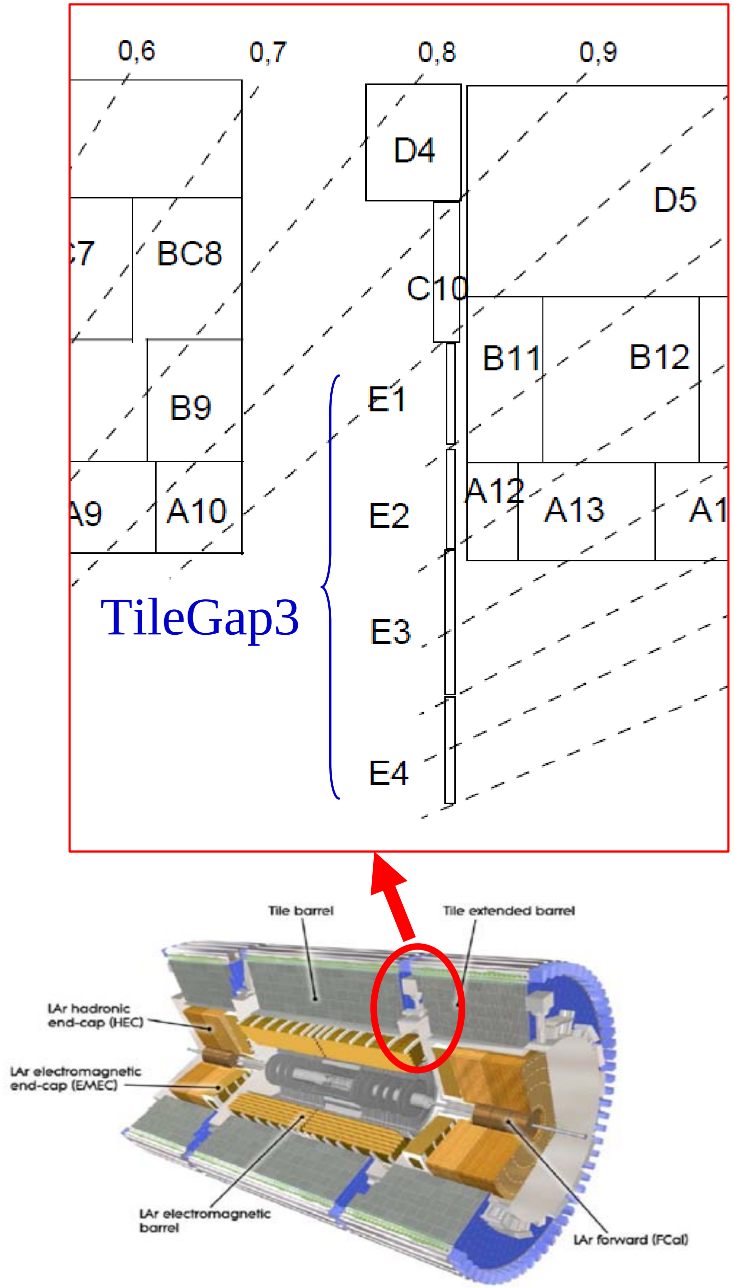
E1, E2: Gap scintillators

E3, E4: Crack scintillators

- Crack regions filled with inactive materials.
- Installed to correct for the energy loss in the crack region.
- Absolute energy scale in the scintillator needs to be established.
- Not in the standard Tile calibration procedure.

ITCs (D4, C10)

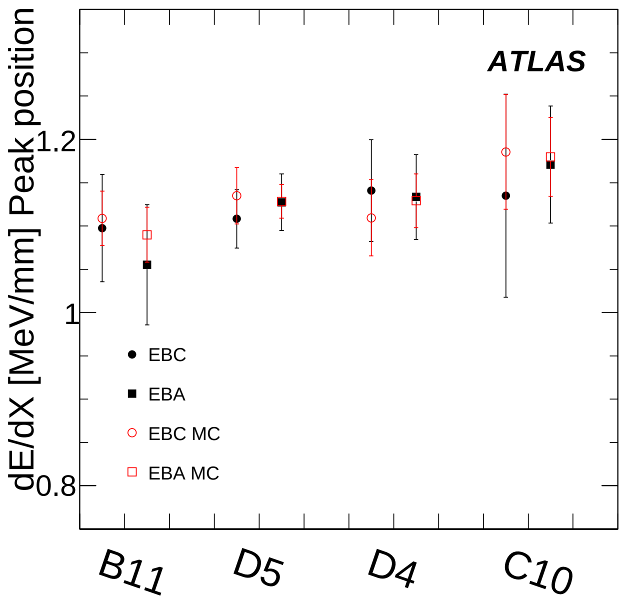
- Steel/scintillator sampling calorimeter as standard Tile calorimeter cells.
- Included in the standard Tile calibration procedure.

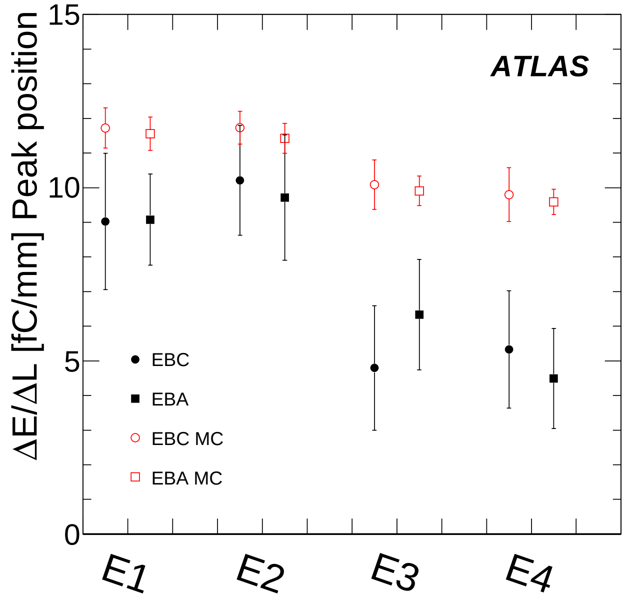


Analysis of muons from cosmic rays

- Calibration among modules (ϕ inter-calibration)
- Absolute calibration: ← Rely on MC (EM process should be well simulated.) Muon provides well known signals for calibration.

2008 cosmic data
- dE/dX
- Vertical bar is RMS among modules





ITC (D4,C10)
- OK: consistent with normal Tile calorimeter cells.

E1, E2

→ ϕ inter-calibration is introduced.

→ Data signal is scaled up in the reconstruction.

E3, E4

→ HV was increased as a result.

Analysis of muons from cosmic rays

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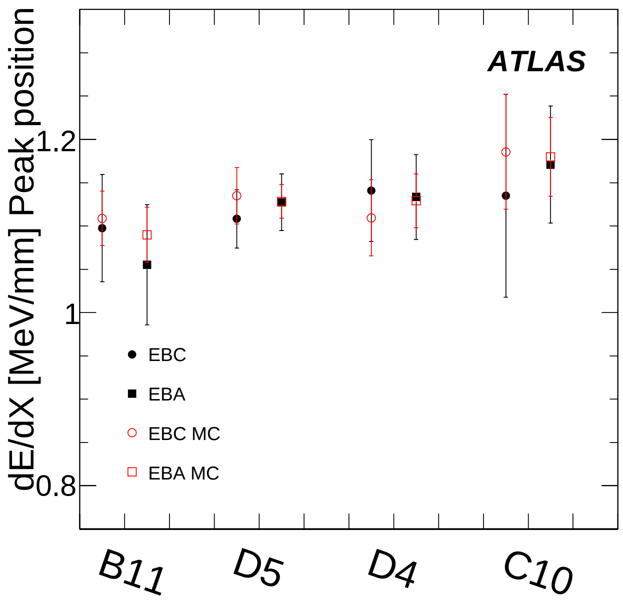
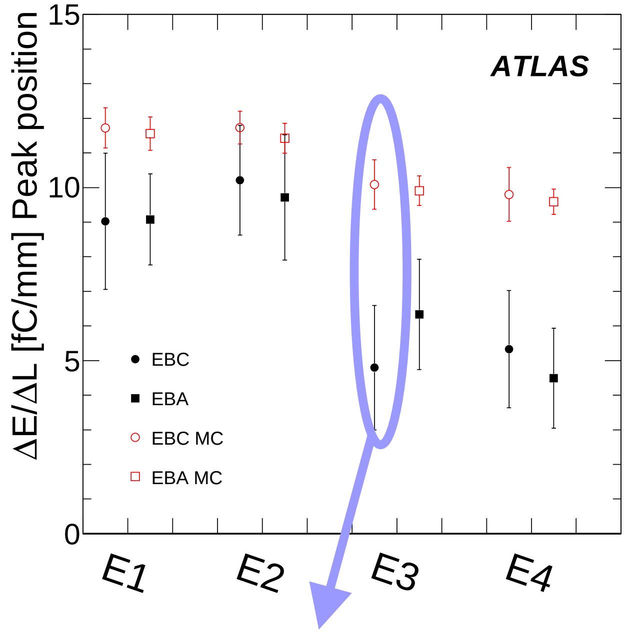
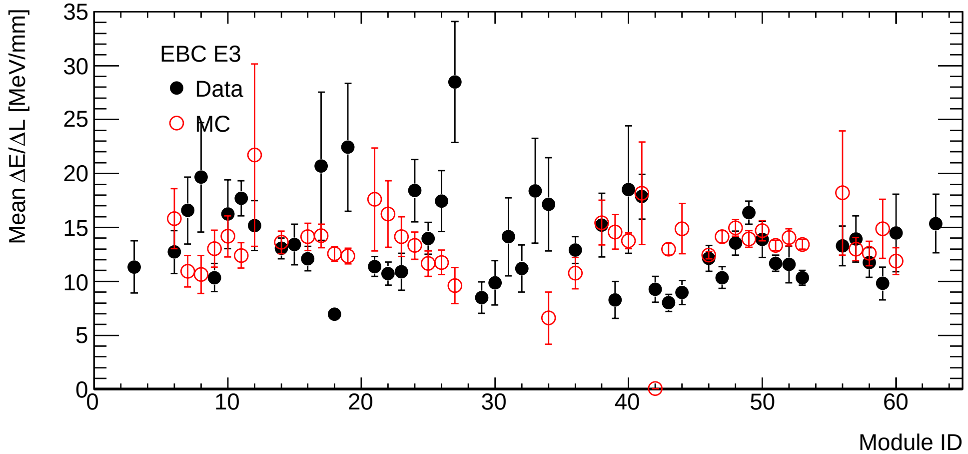




Cosmic data after HV increase (2009)

→ E3 and E4 have similar signal response in data as in MC.



Dijet sample for Gap/Crack analysis

Dijet events were used to check TileGap3 energies in Jets.

- Early 7TeV data of 80nb^{-1}.
  low threshold calo. trigger
- AntiKt jets, R=0.4

Tagged jet: $0 \leq |\eta| < 0.6$

Probed jet:

$1.0<|\eta|<1.1 \leftrightarrow$ E1

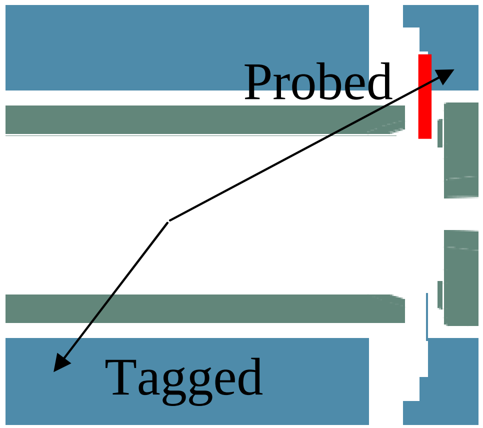
$1.1<|\eta|<1.2 \leftrightarrow$ E2

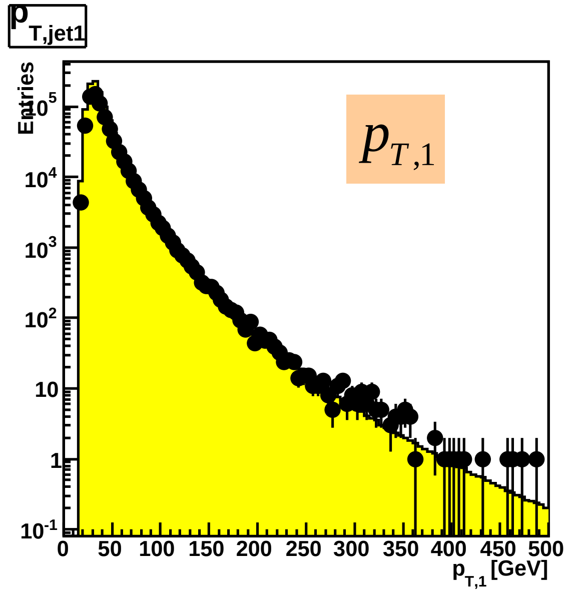
$1.2<|\eta|<1.4 \leftrightarrow$ E3

$1.4<|\eta|<1.6 \leftrightarrow$ E4

p_T balance looks good.

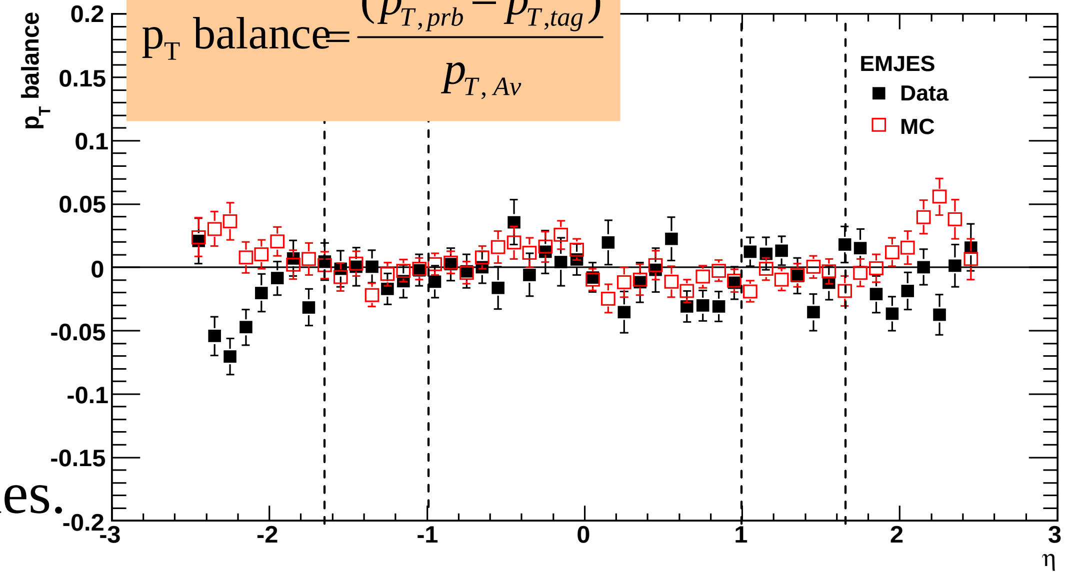
⇔ However, we don't have good understanding of TileGap3energies.



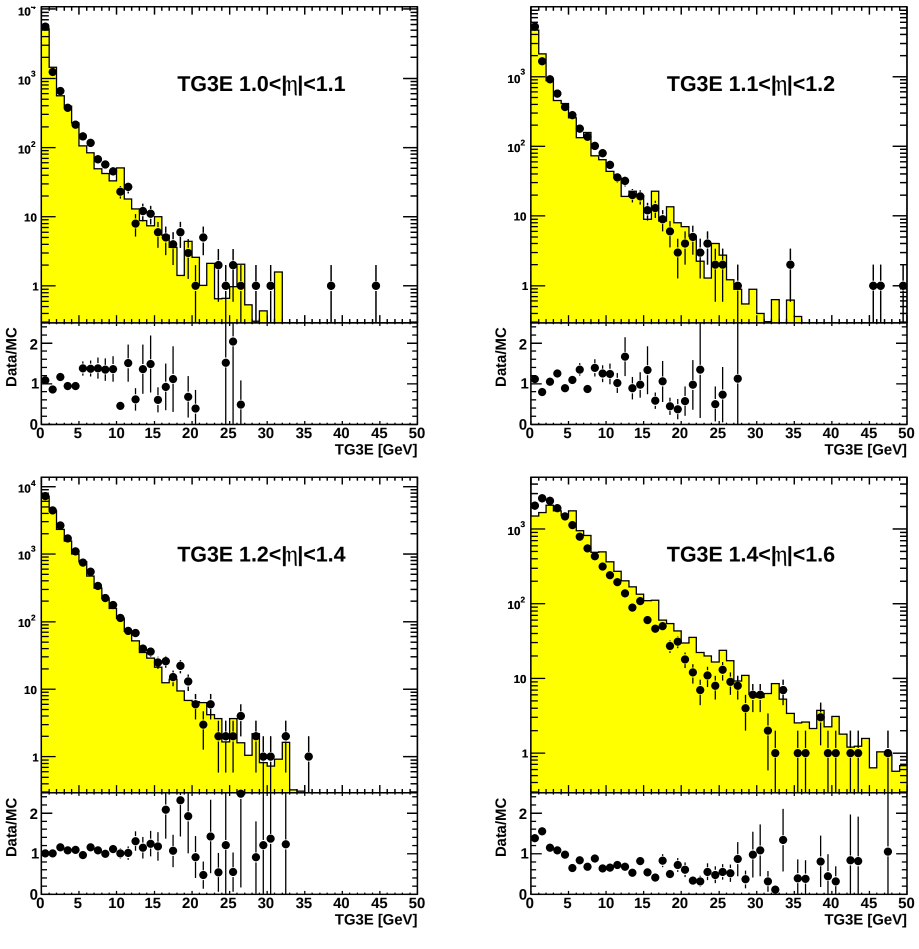


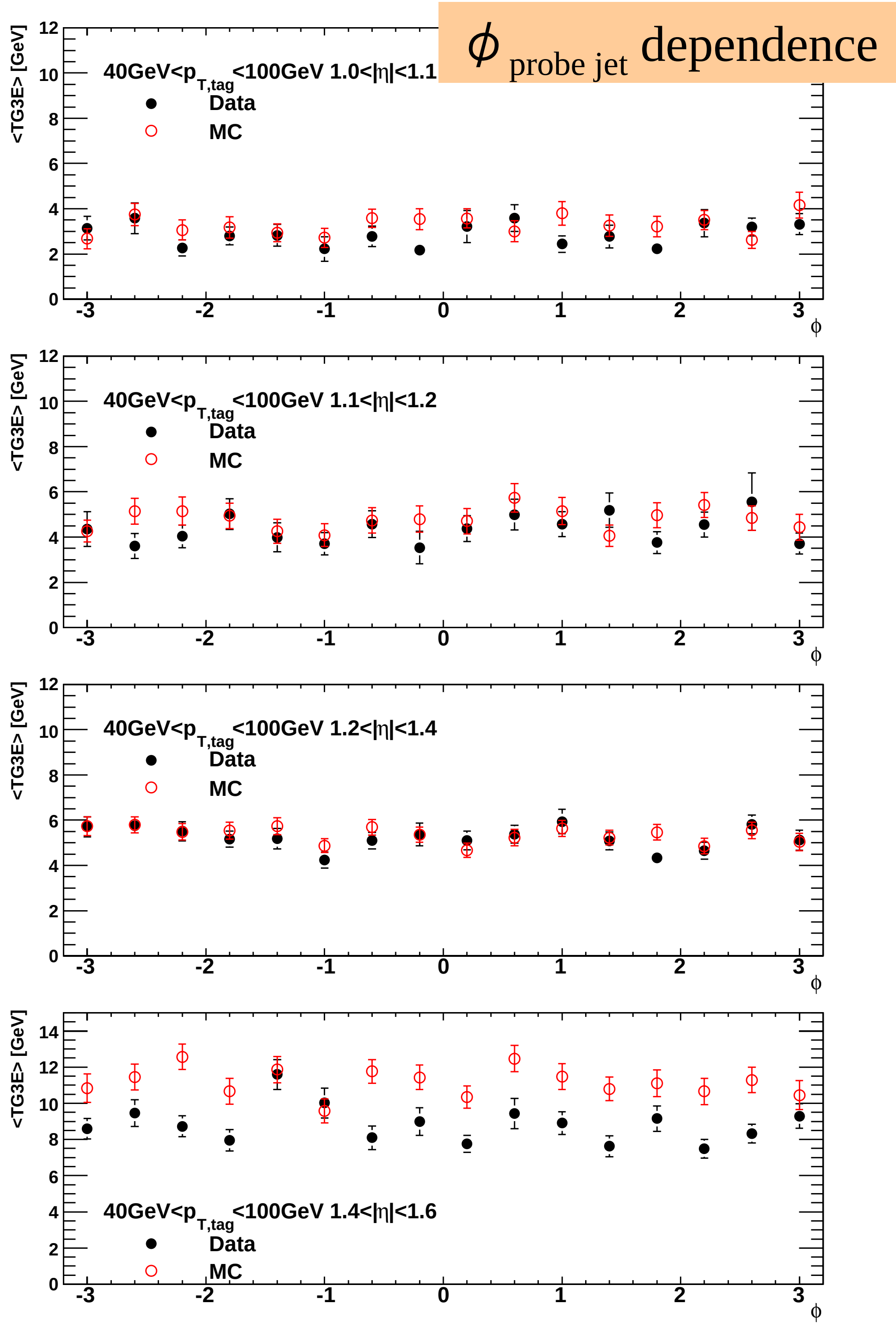
$p_{T,Av.} > 40\text{GeV(EMscale)}$

$p_T \text{ balance} = \frac{(p_{T,prb} - p_{T,tag})}{p_{T,Av}}$



Scintillator energy distribution in Jet





Energy of Gap/Crack scintillators is well simulated by MC in general.

- E4: data/MC discrepancy

← can be biased from $|\eta| > 1.6$

Scintillator energy fraction in Jet

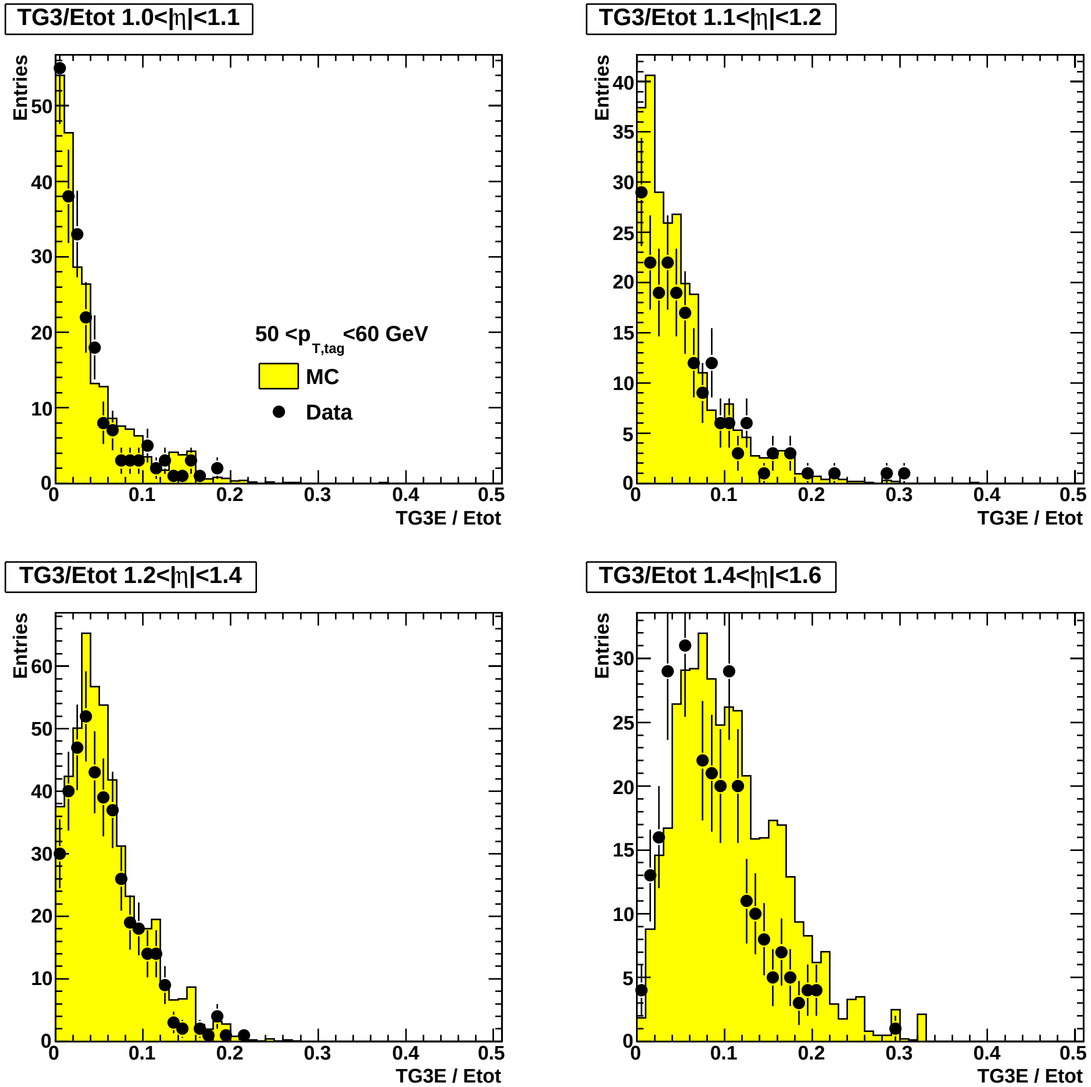
$$f = \frac{\text{TileGap3 energy}}{\text{Probe jet energy}}$$

TileGap3 energy fraction in jets

•Dijet events with
50 $<p_{T,Tag}<$60 GeV

TileGap3 energy is < 10%
for most of jets.

→ Reconstructed jets should
not be affected by
TileGap3 energy largely.



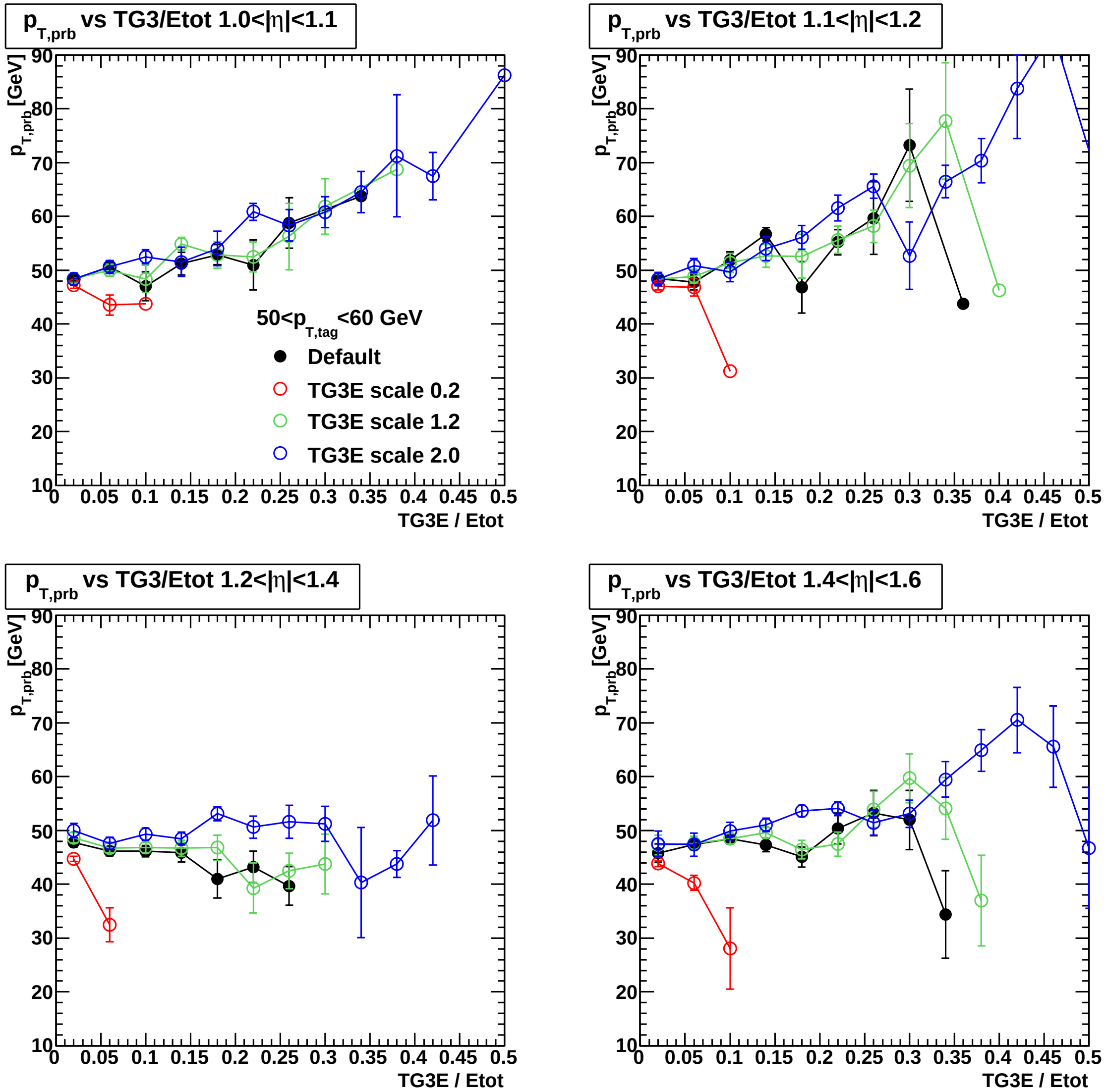
Jet P_T dependence on sci. energy fraction in MC

$p_{T,probe}$ vs TileGap3 energy fraction
(50 <$p_{T,Tag}$<60 GeV)

- Comparison with arbitrary scaling factors on TileGap3 energy.
  - 20%
  - 120%
  - 200%

  → $p_{T,}$ E of jet are also modified.

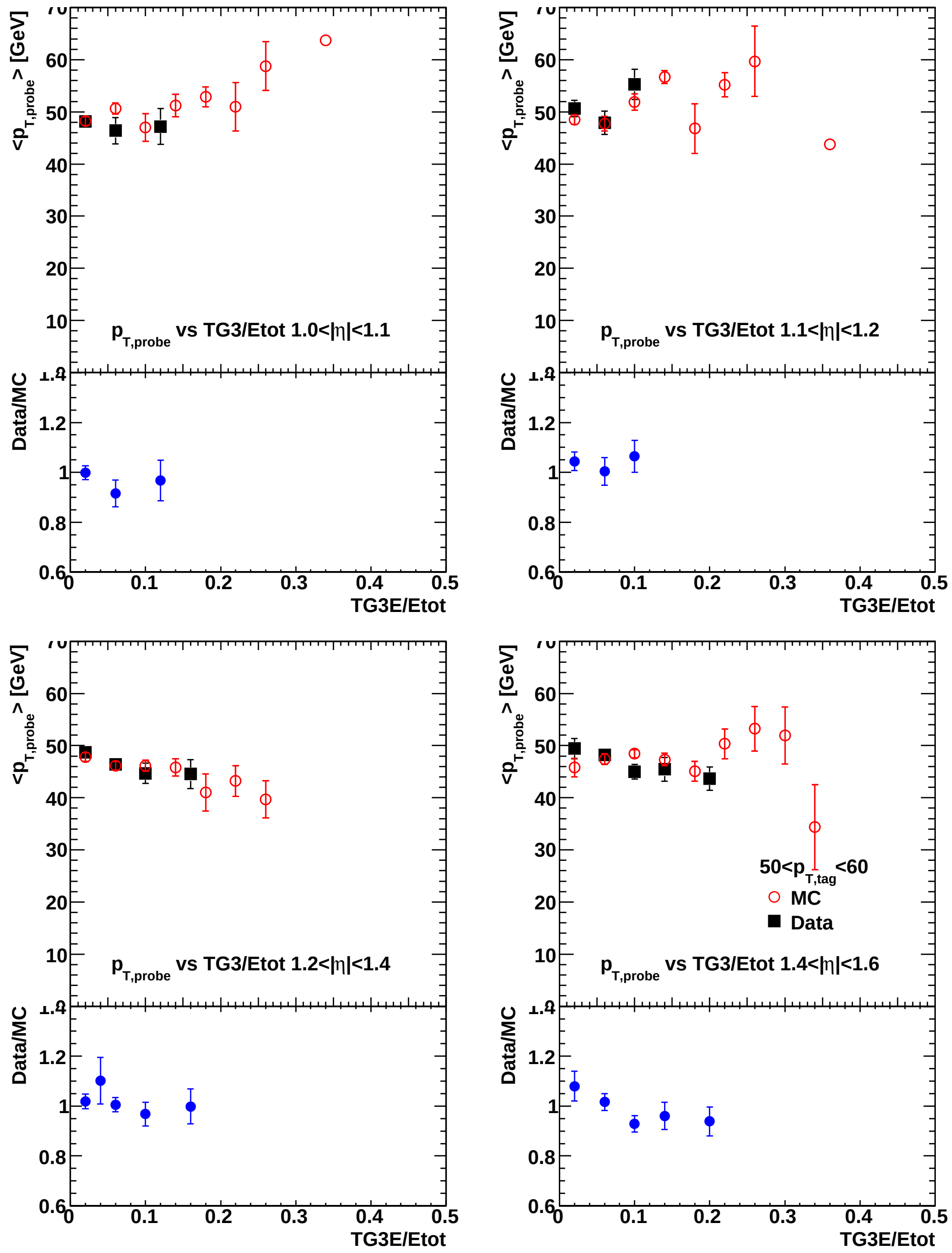
The $p_{T,prb}$ dependence is not sensitive to 200% scaling factor.



Data/MC comparison

$p_{T,probe}$ vs TileGap3 energy fraction
(50 <$p_{T,Tag}$<60 GeV)

Good agreement between data and MC.



TileGap3 energy does not strongly affect on jet reconstruction.

No critical problem is seen.

→ Not critical for Jet calibration.

Low p_T inclusive Jet cross section measurement

- The 1st Inclusive jet cross section measurement has been done for p_T>60 GeV, $|\eta|$<2.8 with $17 nb^{-1}$ data.

published in EPJ, CERN-PH-EP-2010-034, arXiv:1009.5908v2

→ Work ongoing to include full 2010 data sets.

- Extend the measurement of inclusive jet cross section to the lower p_T range.

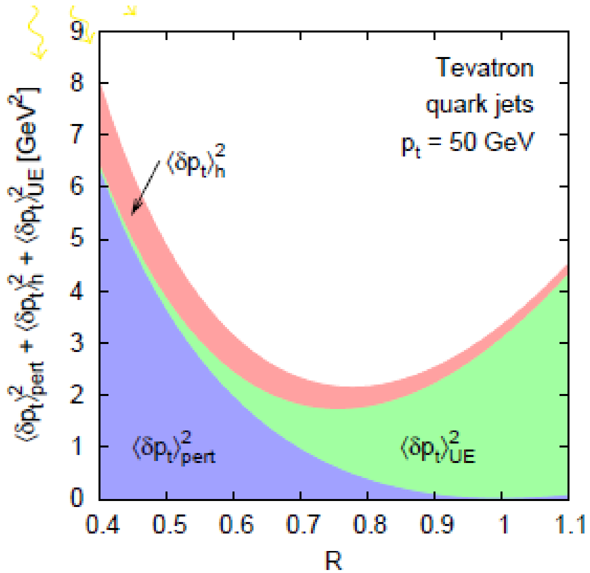
At low p_T, non-perturbative corrections are large.

$$\sigma_{theory} = \sigma_{\text{NLO QCD}} \otimes \sigma_{\text{hadronaization}} \otimes \sigma_{\text{Underlying Event}}$$

non-perturbative corrections

They affect jet shape in different ways.

→ Cross section measurement at R=0.4 and R=0.6 can contribute to the understanding of non-perturbative corrections



Dasgupta, Magnea, Salam
JHEP 0802:055,2008

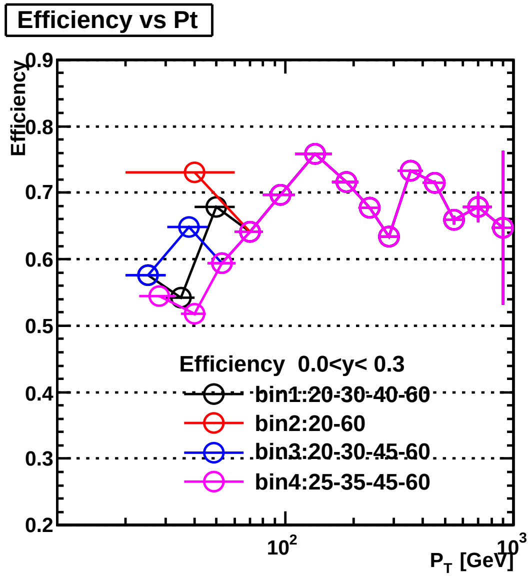
- My main contribution so far: Unfolding detector response
  - Bin-by-bin correction

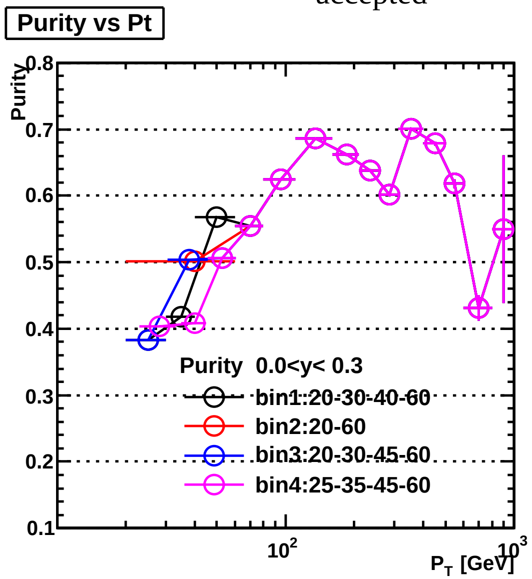
Bin-by-bin correction for detector response

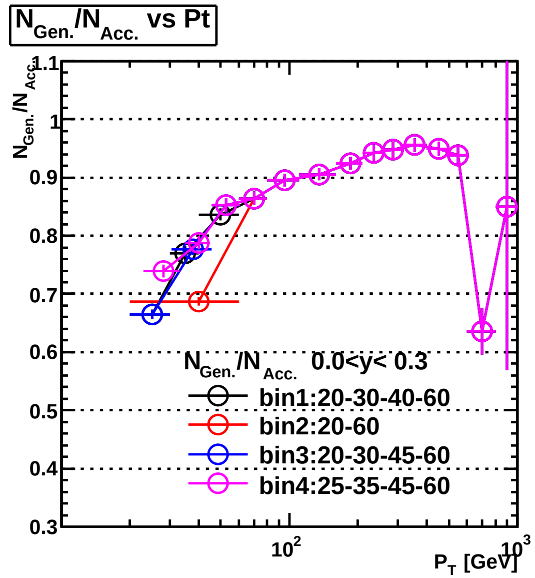
Simple method only working for good purity and efficiency.

→ Check purity and efficiency to look for reasonable lowest p_T.

$$\text{Efficiency} = \frac{N_{\text{generated \&\& accepted}}}{N_{\text{generated}}} \quad \text{Purity} = \frac{N_{\text{generated \&\& accepted}}}{N_{\text{accepted}}} \quad \text{Correction Factor} = \frac{N_{\text{generated}}}{N_{\text{accepted}}} = \frac{P}{E}$$







Bin width directly affects on the purity and efficiency.

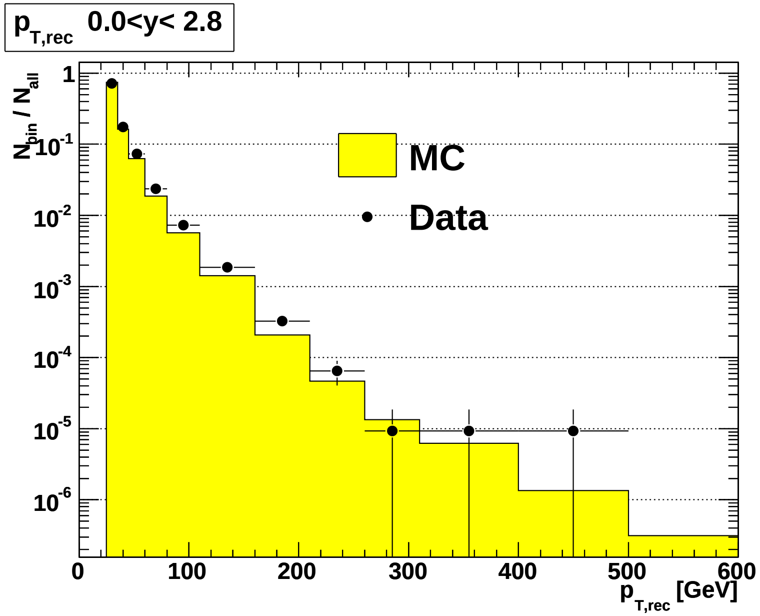
- Binning effect is seen in purity and efficiency at medium p_T.

Purity > ~40%, Efficiency >~50% at low p_T

The measurement probably can go down to p_T = 20 GeV.

Possible bias from bin-by-bin correction

- MC does not describe Data perfectly:
  e.g. p_T distribution



- Unfolding by bin-by-bin correction is based on good description of Data by MC.

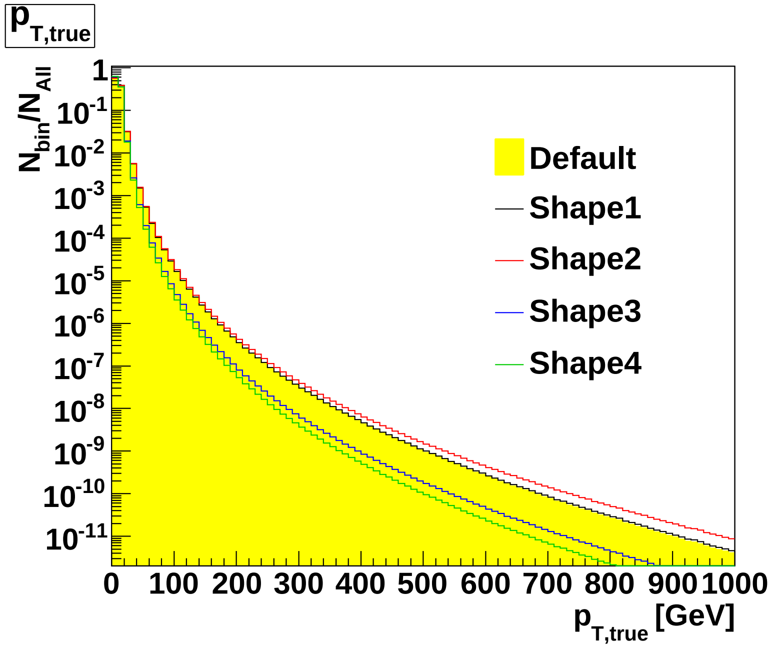
  → Imperfection of MC may introduce bias.
  - Comparison with different unfolding method.

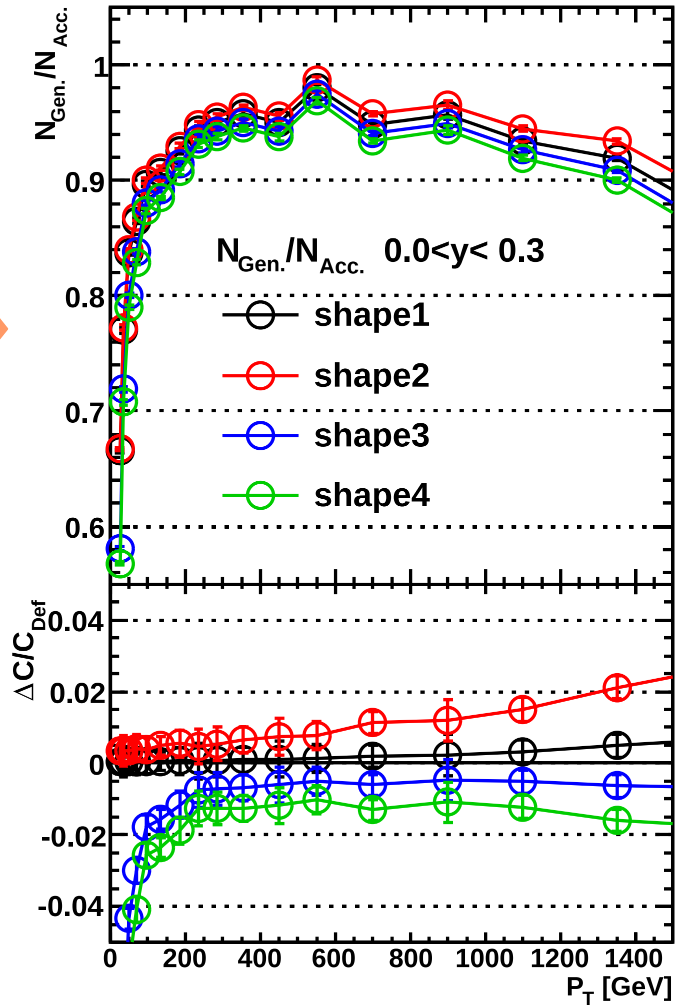
    Unfolding matrix: started to be analyzed.
  - Estimation of systematic uncertainties by p_T shape variation.

    (→ next slide)

Estimation of systematics

- Systematic uncertainty on bin-by-bin correction
  - Shape variation





True MC distribution is weighted to have different p_T distribution.

→ Effect is small (< 5%).

- Other systematic checks (jet resolution, etc.) are also ongoing.

Summary and Plans

- Gap / Crack scintillator analysis
  - Calibration with cosmic data was done.
  - Energy distribution in jets agrees between data and MC in general.
  - Jet p_T is not be largely affected by scintillator energy.
  - No critical problem is seen.
  - Jet calibration in the barrel and extended barrel transition region has small uncertainty.

    → Jet cross section has been measured in this region.

  To do: Look into distribution tails with full statistics.

- Unfolding for Low p_T cross section measurement.
  - Measurement may go down to p_T~20 GeV with Purity ~40% and Efficiency ~50%.

  To do: summarize systematic uncertainties.

Backup

MC study

$\Delta p_T = p_{T,EM} - p_{T,True}$
vs TileGap3 energy

- Using truth information.
- For 3 $p_{T,tag}$ ranges.

→ No strong dependence on TileGap3