Measurement of charged jet properties in pp collision at 2.76 TeV

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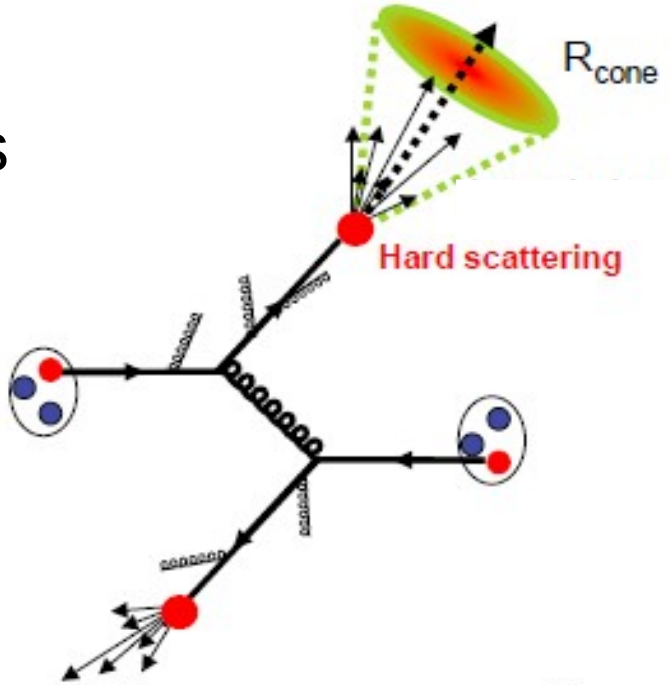
Outline

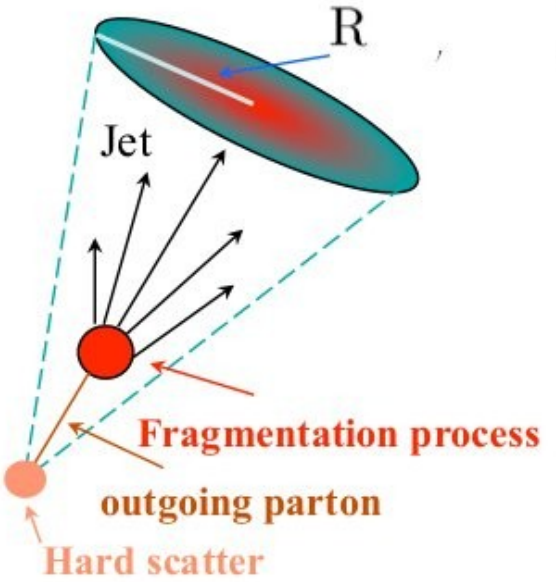
- Introduction and Motivation
- Observable studied
- Analysis details
- Status upto previous meeting
- Study of systematic uncertainty
- Results
- Summary and outlook

Introduction of jet:

Jet is the collimated spray of hadrons produced from the fragmentation of hard parton produced in high energy collision



Experimentally, jet is reconstructed from the measured hadrons with the help of jet finding algorithm



Jets : Connection between theory and experiment

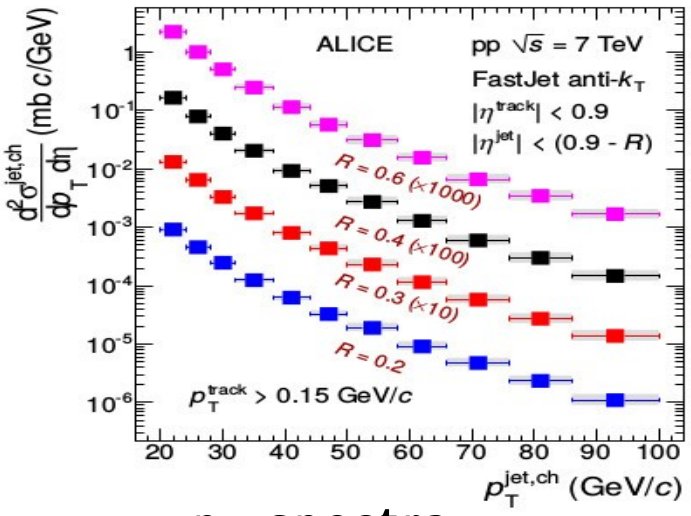
Jets are the experimental tool to understand parton kinematics:

- pQCD : partonic level
- Experiments measure hadrons
- Re-associate measurable hadrons to accurately reconstruct parton kinematics
- Tools : Jet finding algorithms. Same algorithm for experimental and theoretical calculations

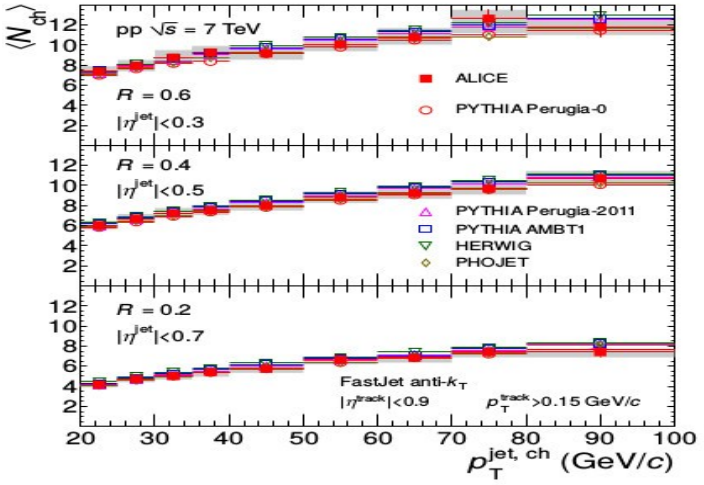
Jets provide :

- Proxy to the high p_T partons produced in the collision
- An important tool to test pQCD
- Details of parton to jet fragmentation
- A smoking gun signature to probe the hot and dense medium produced in AA collisions

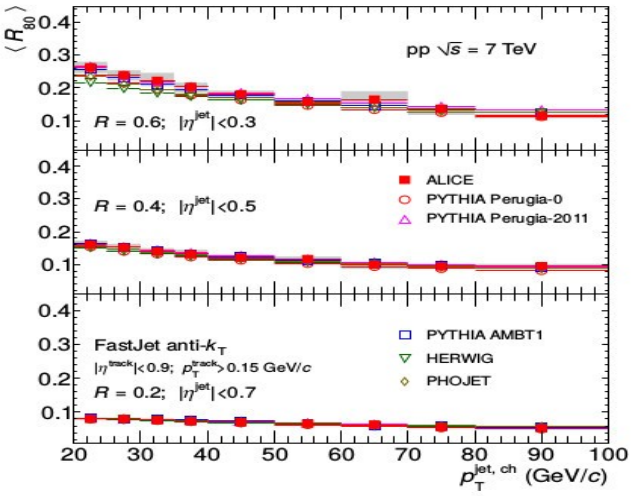
Jet cross-section and jet shape observ -ables measurement in ALICE



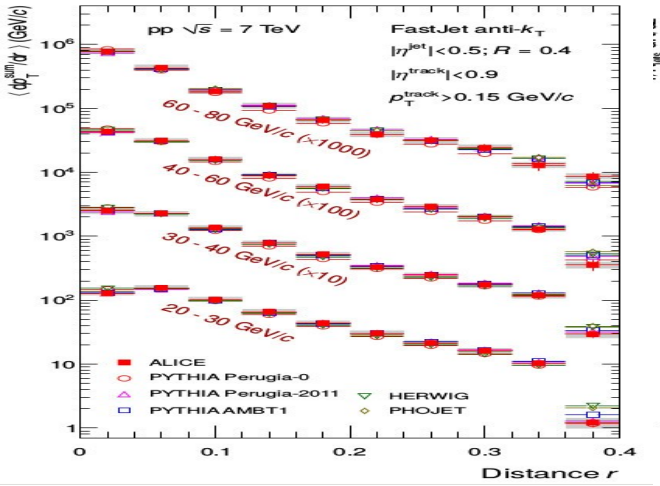
p_T spectra



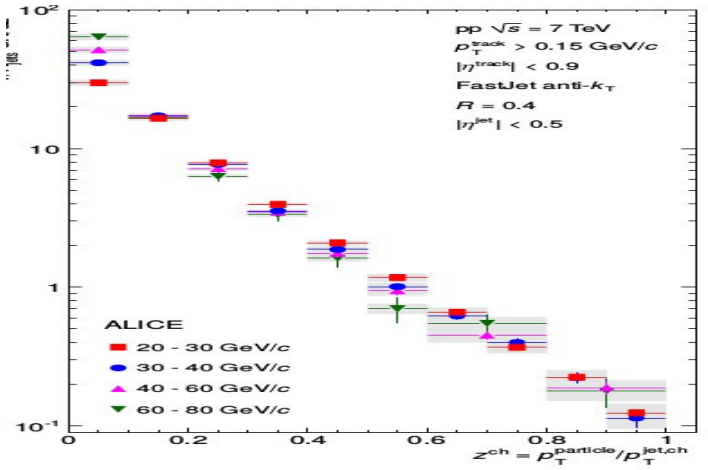
$<N_{ch}>$

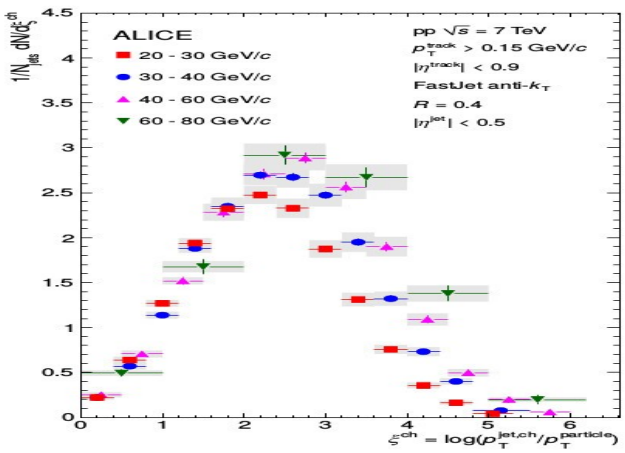


$<R_{80}>$



$<p_T^{sum}>$

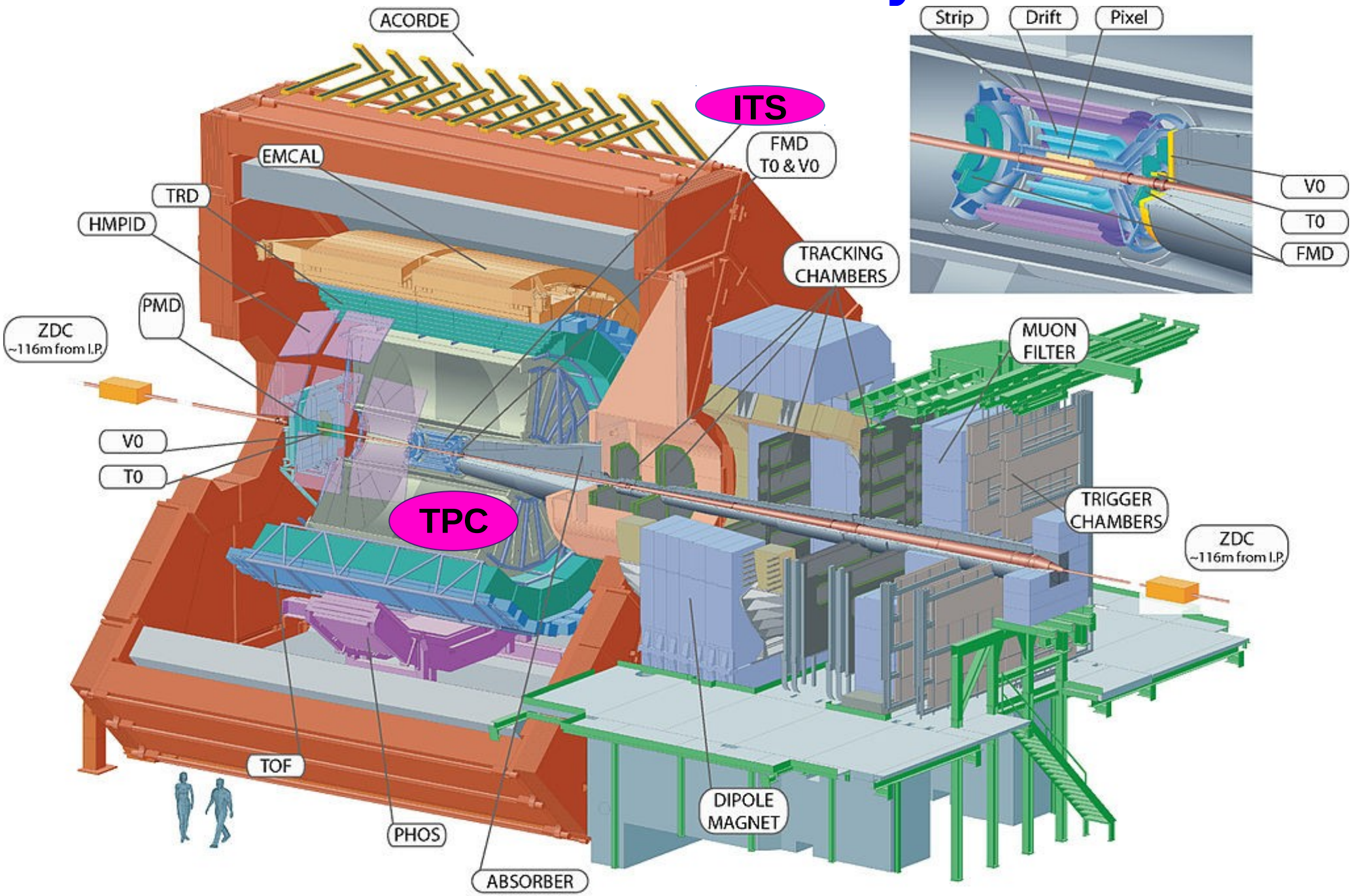




Fragmentation distribution

Charged jet cross-sections and properties in proton-proton Collisions at √s = 7 TeV :arXiv:1411.4969

The ALICE detector system



Observables studied :

- Jet production cross section
- Charged particle multiplicity within leading jet ($\mathbf{N_{ch}}$)
- Leading charged jet size ($\mathbf{R_{80}}$)
- Radial momentum distribution ($\mathbf{p_T^{SUM}}$)
- Underlying events
- Fragmentation distribution

Significance of this study :

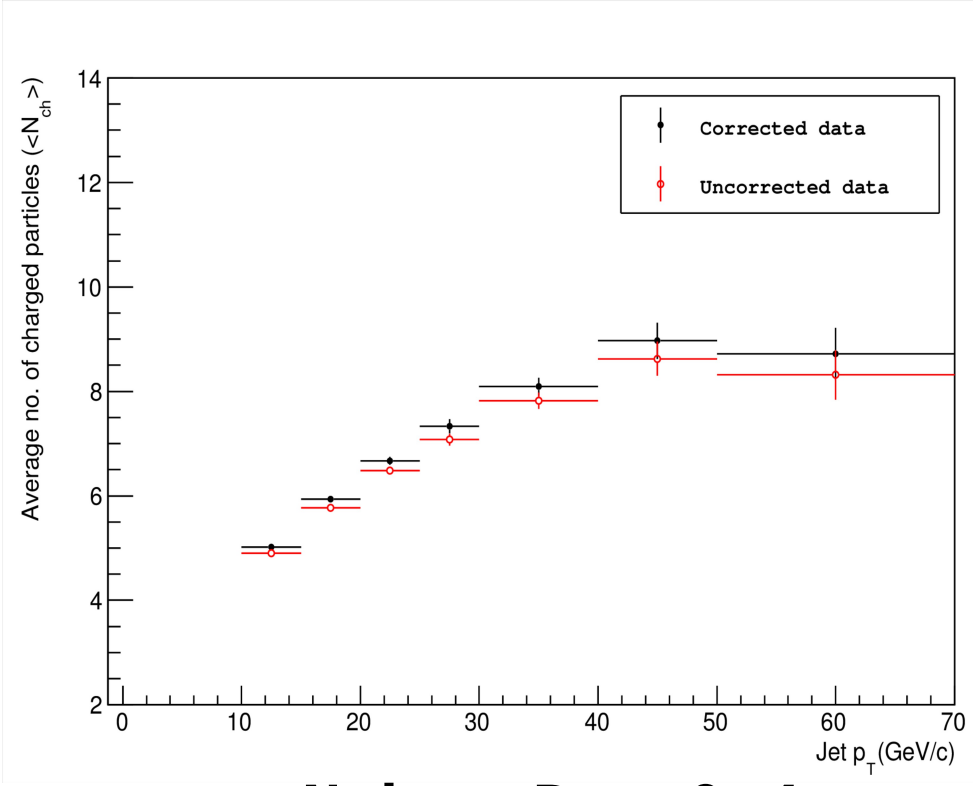
- Baseline reference for Pb-Pb measurements
- Comparison with theory (models)

Analysis details :

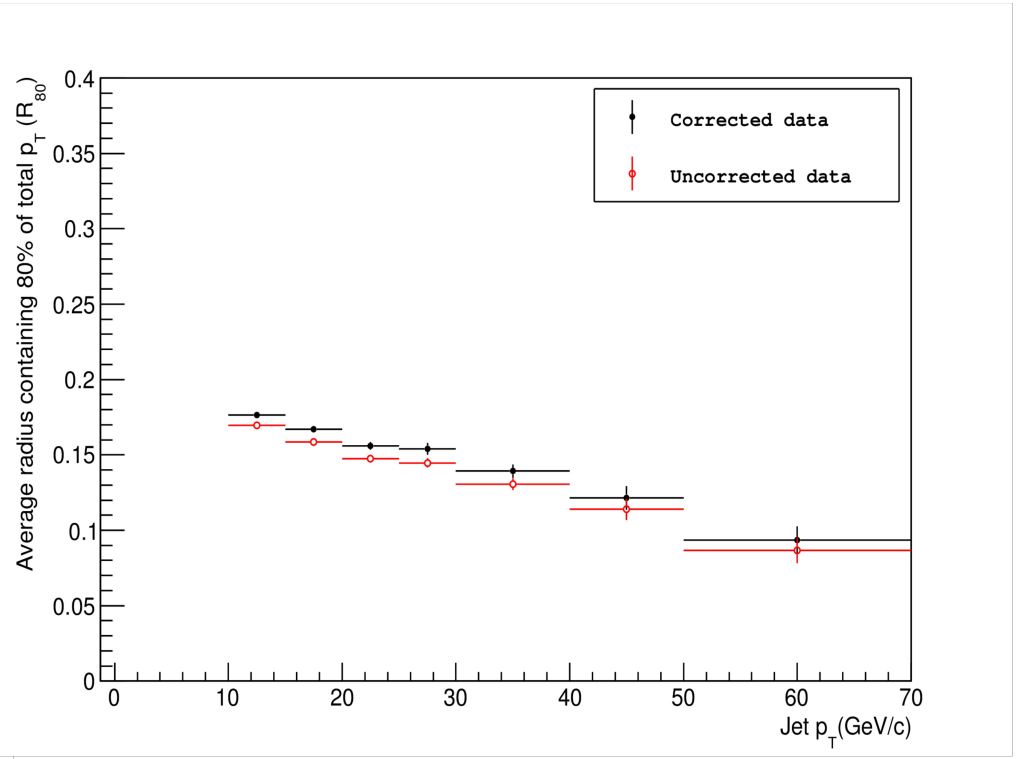
- Data set used : LHC11a
- Z-Vertex cut : *Abs (Vz) < 10 cm*
- Track selection : *Filter mask 272* (using only TPC and ITS)
- Tracks are selected if *|eta-track| < 0.9*
- p_T threshold at track level : *150 MeV*
- Jets are selected if *|eta-jet| < 0.3 (R=0.6), 0.5 (R=0.4), 0.7(R=0.2)*
- Only charged particles are taken into consideration
- Full azimuthal coverage
- Jet reconstruction : Anti k_T algorithm

Recap upto previous meetings :

1. Obtained raw distributions
2. Obtained MC Pythia distributions
3. Correction factors calculated from MC
4. Raw distributions corrected bin-by-bin



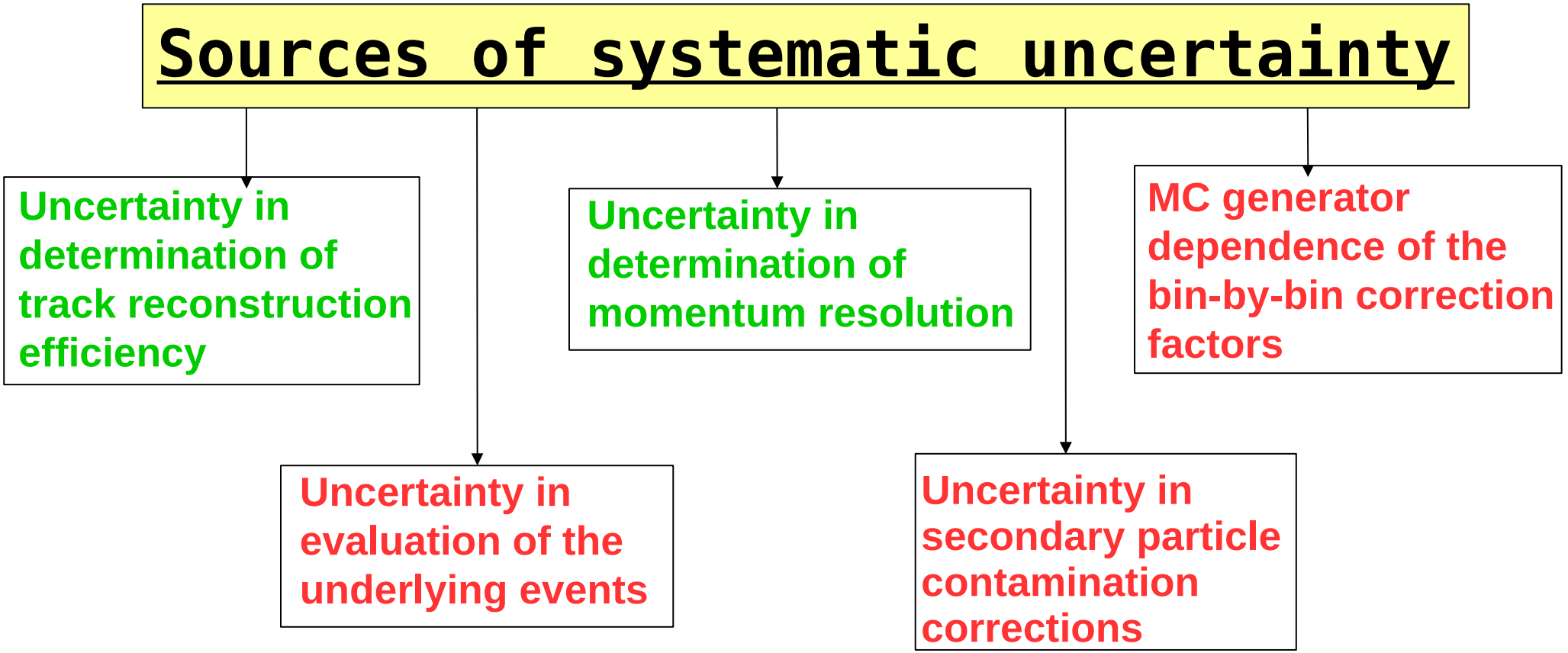
<Nch>, R = 0.4



<R80>, R = 0.4

Systematic uncertainty study

Systematic uncertainty stands for the error in the measurements induced by the techniques we use for measurements, limitation of the systems/apparatus we use for measurements.



Systematic Uncertainty measurement due to tracking efficiency

Steps:

1. Particles are removed according to a parametrized track reconstruction efficiency which is obtained from full GEANT reconstruction. Transverse momenta of the rest of the particles are smeared according to a param--etrized momentum resolution. Jets are reconstructed from these tracks event by event and finally observables are calculated.

2. The efficiency is varied by ±5% and two sets of production are obtained. observables are finally calculated following the same procedure.

Systematic Uncertainty measurement due to momentum resolution

1. Step 1 is same as above

2. The relative track momentum resolution is varied by ±20% and two sets of production are obtained. Observables are finally calculated following the same procedure.

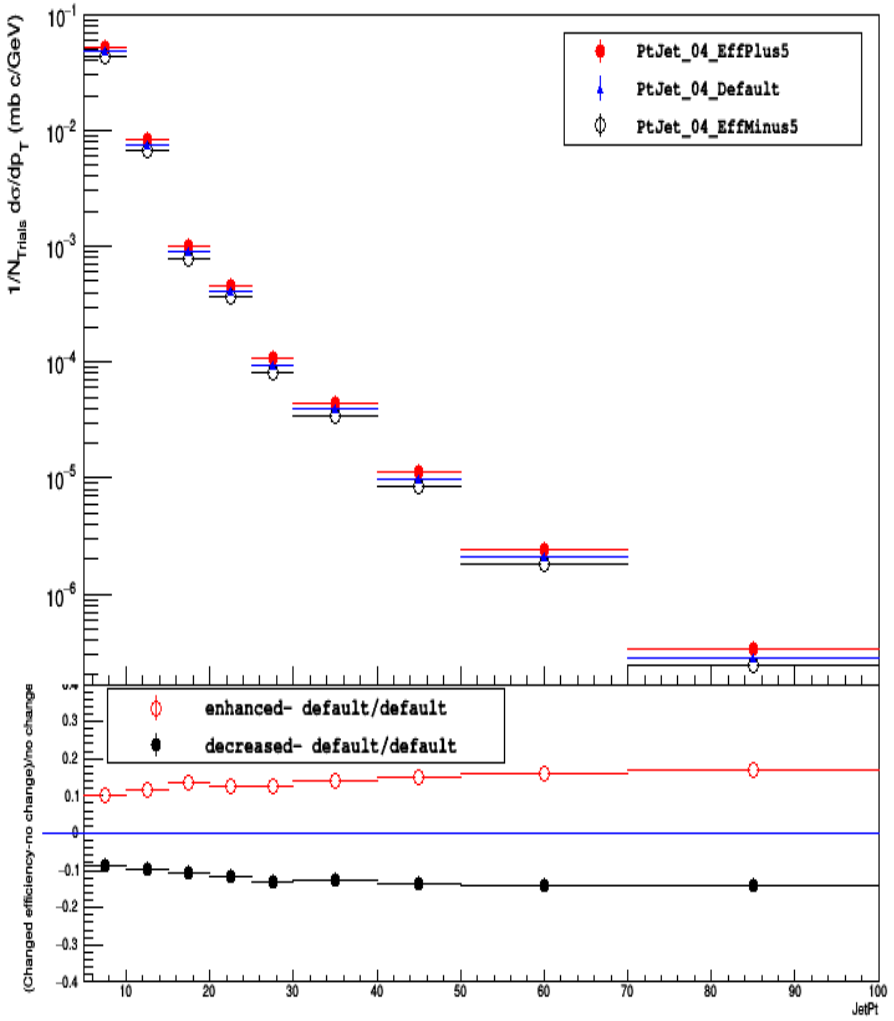
The systematic uncertainty is estimated as :

$$\frac{\text{Observable}^{\text{changed efficiency/resolution}} - \text{Observable}^{\text{no change}}}{\text{Observable}^{\text{no change}}}$$

Results

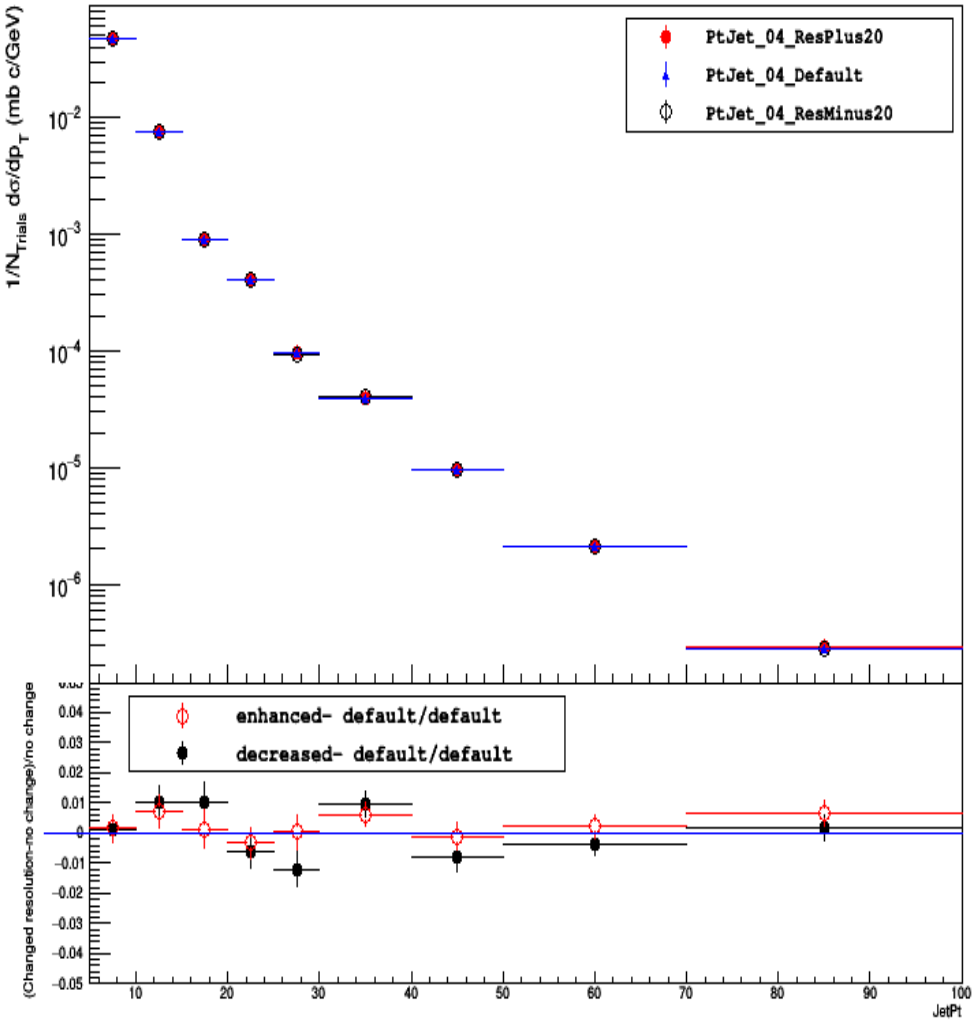
(Shown in the PWG last week)

Jet p_T distribution



Uncertainty due to tracking efficiency

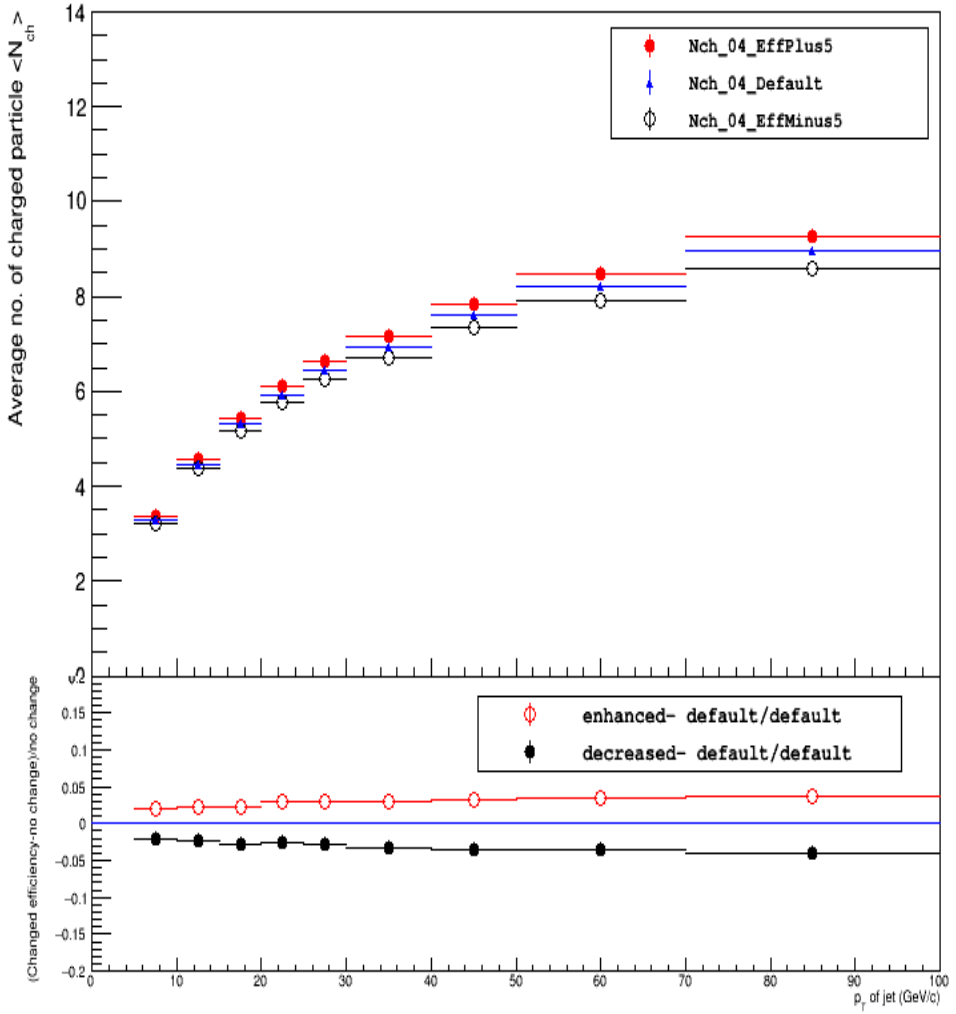
Within ~ 10-18%



Uncertainty dute to momentum resolution

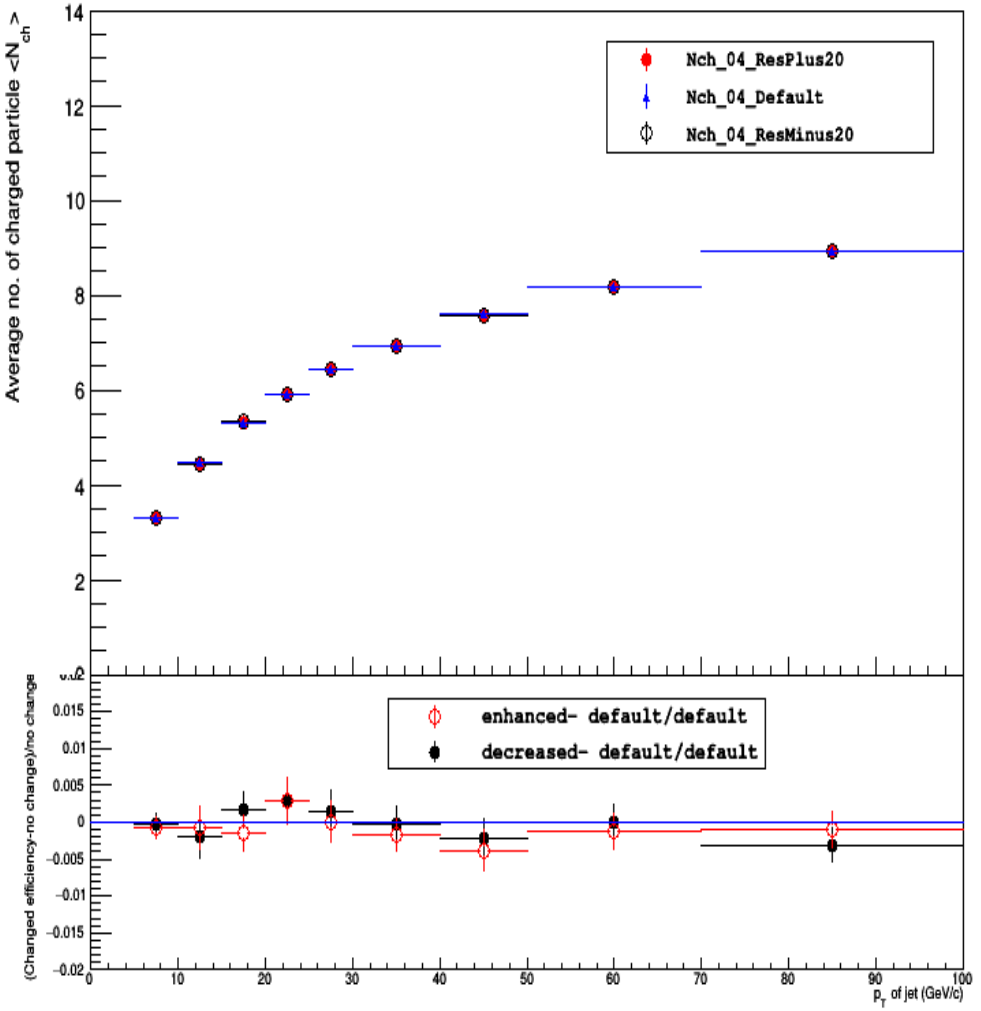
Within ~ 1%

Charged particle multiplicity distribution in leading jet



Uncertainty due to tracking efficiency

Within ~ 5%

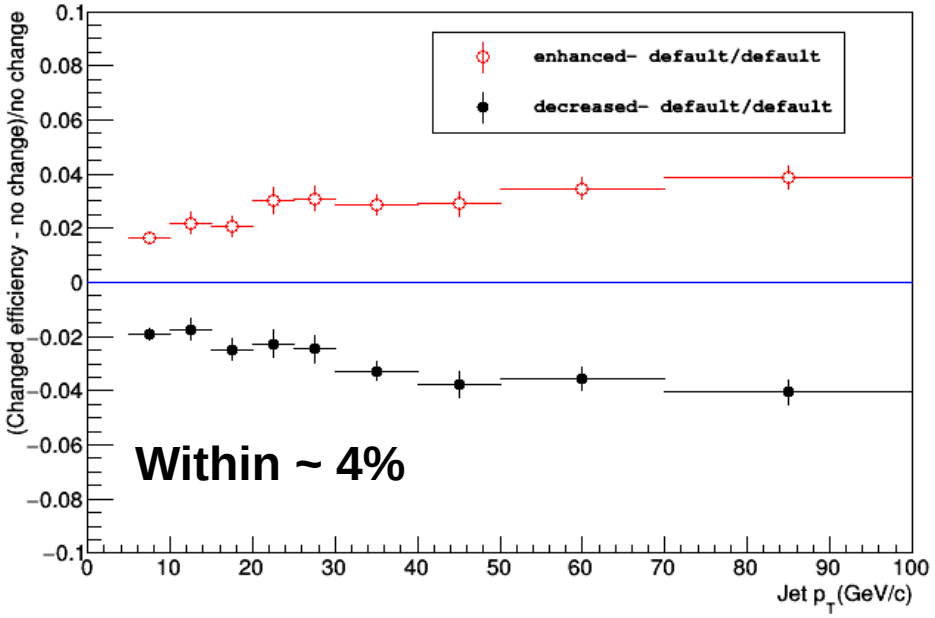


Uncertainty due to momentum resolution

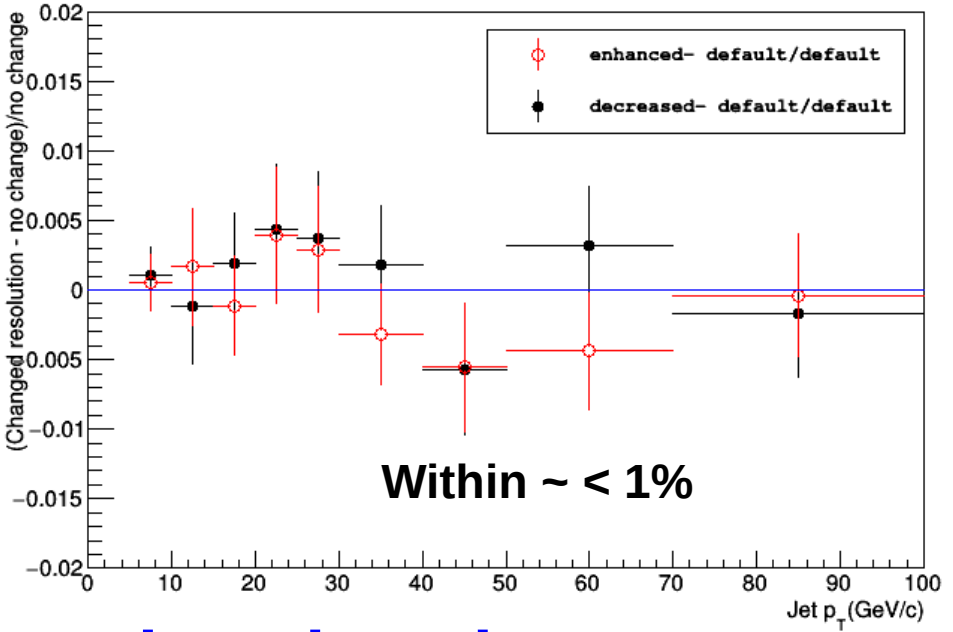
Within ~ < 1%

R80 distribution of jet p_T

Uncertainty due to tracking efficiency

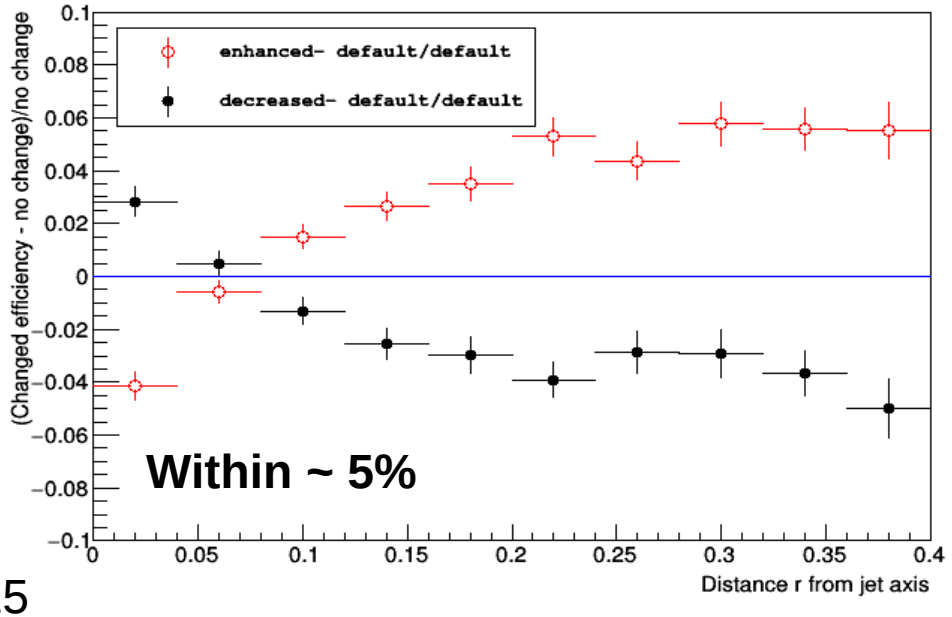


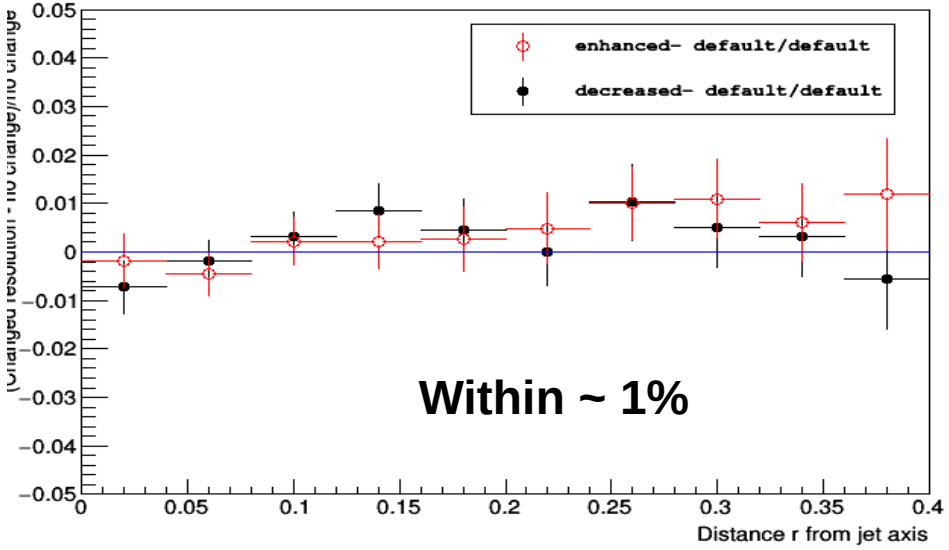
Uncertainty due to momentum resolution



Radial momentum distribution

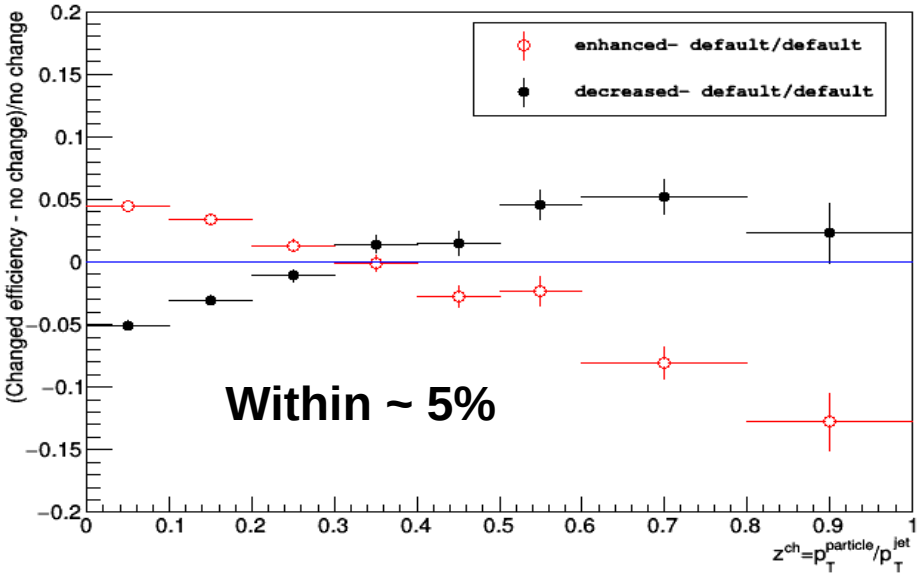
Jet p_T bin 20 to 30 GeV/c



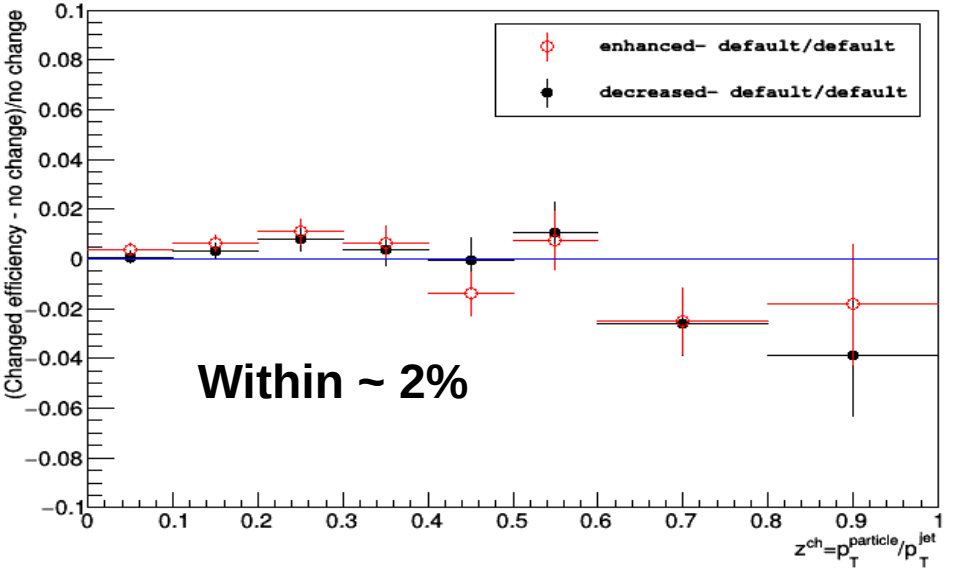


Jet Fragmentation distribution

Uncertainty due to tracking efficiency

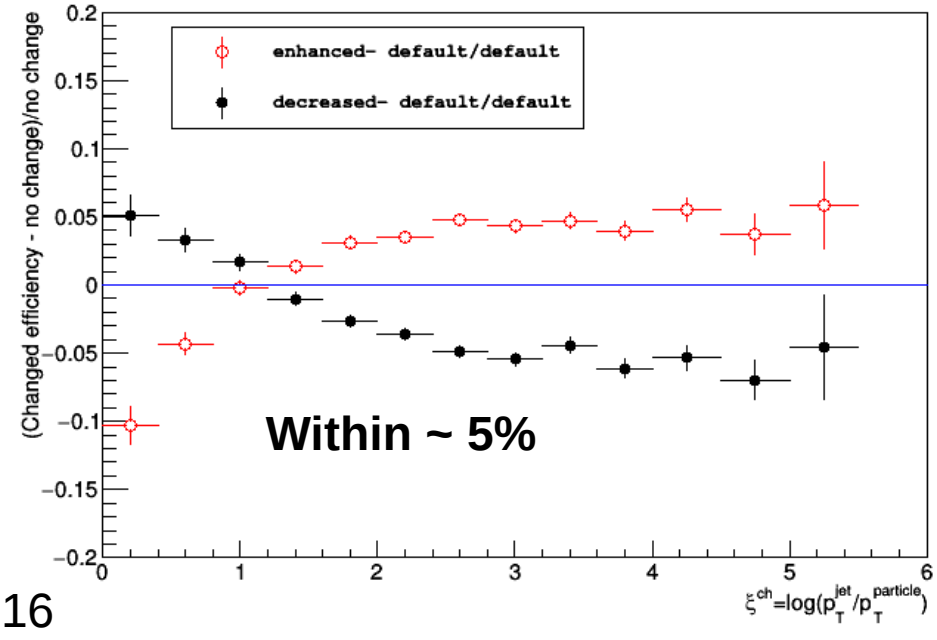


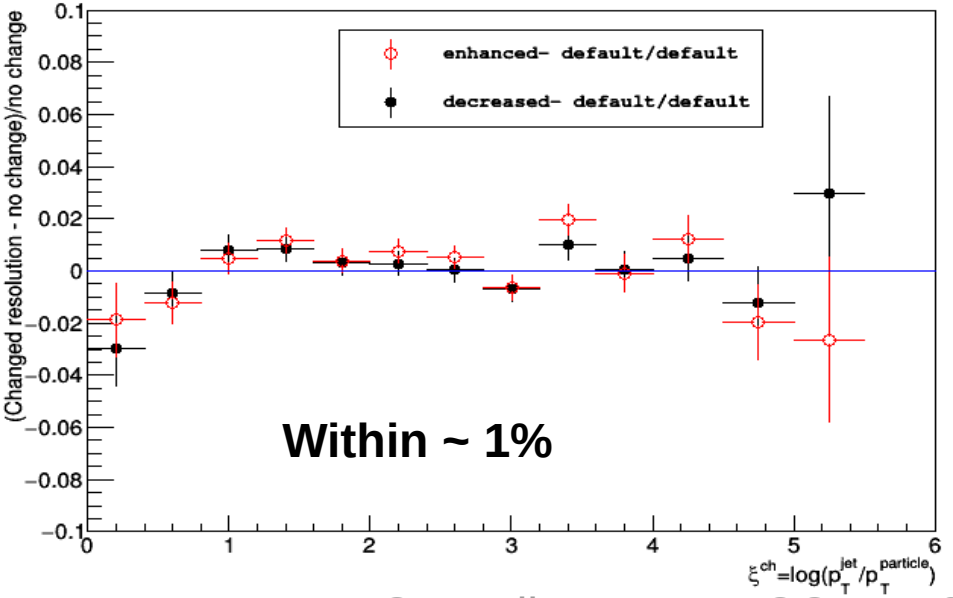
Uncertainty due to momentum resolution



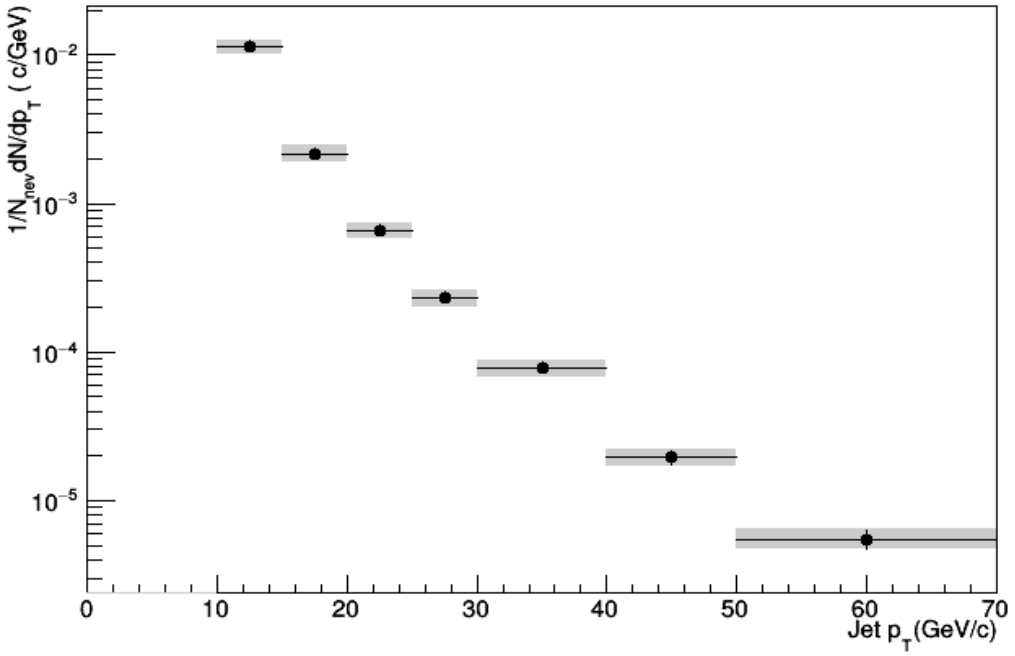
Ksi distribution

Jet p_T bin 20 to 30 GeV/c



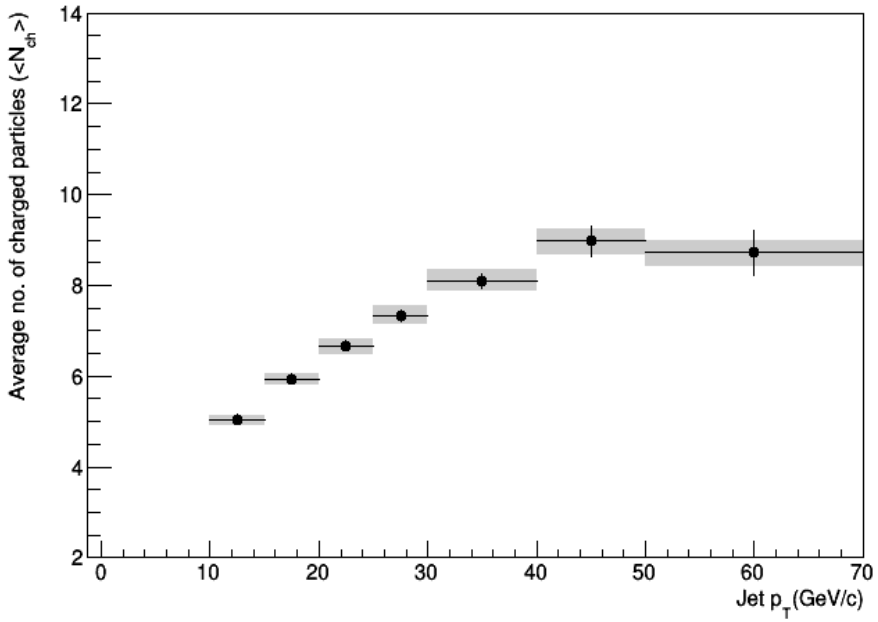


Observables after implementing Systematic Uncertainty

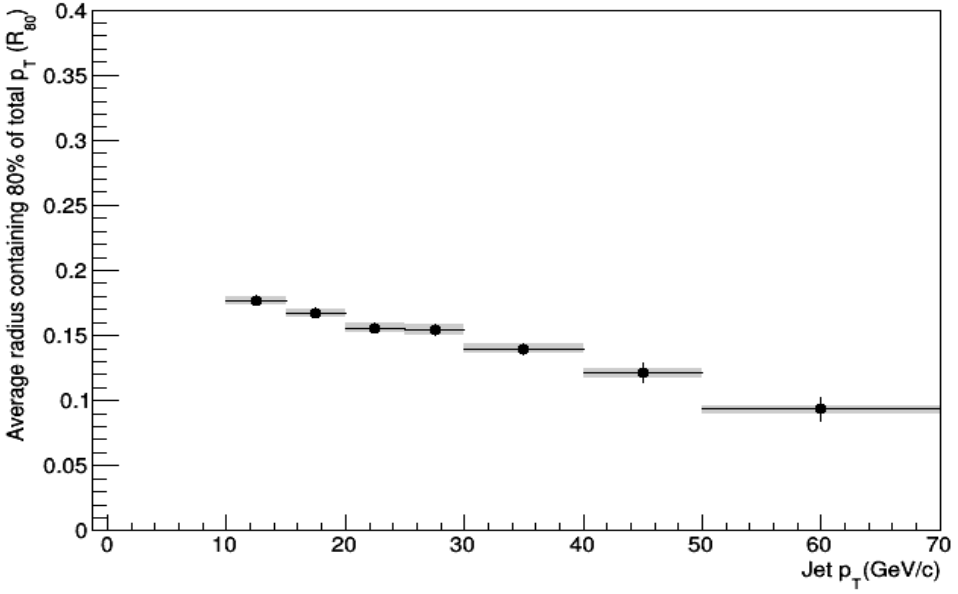


Jet p_T spectra

R = 0.4



<Nch>, R = 0.4



<R80>, R = 0.4

Task to do:

- Finish systematic studies for all the sources (target in the next 30-40 days)
- Comparison to available model prediction
- Go for paper proposal

Back up slides

7 TeV charged jet paper analysis note links

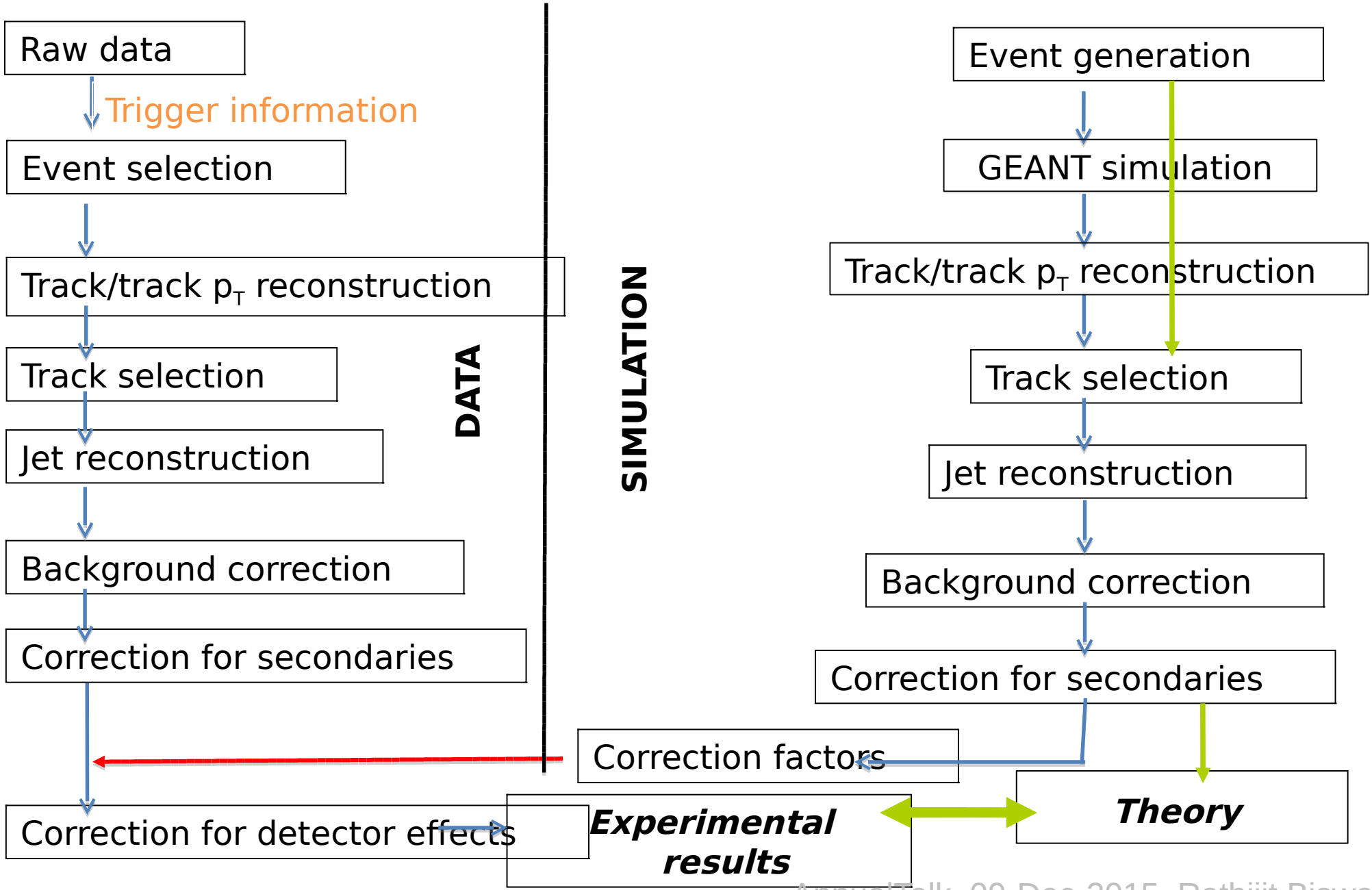
https://aliceinfo.cern.ch/Notes/node/205

https://aliceinfo.cern.ch/Notes/node/40

https://aliceinfo.cern.ch/Notes/node/128

Technical details (I) :

Extracting observables : Overview



Technical details (II) :

Jet Finding algorithm : Successive recombination Anti-k_T

1. $$d_{ij} = \min\left(\frac{1}{p_{ti}^2}, \frac{1}{p_{tj}^2}\right)\frac{\Delta R_{ij}^2}{R^2} \qquad \Delta R_{ij}^2 = (y_i - y_j)^2 + (\phi_i - \phi_j)$$
2. $d_{iB} = 1/p_{ti}^2$

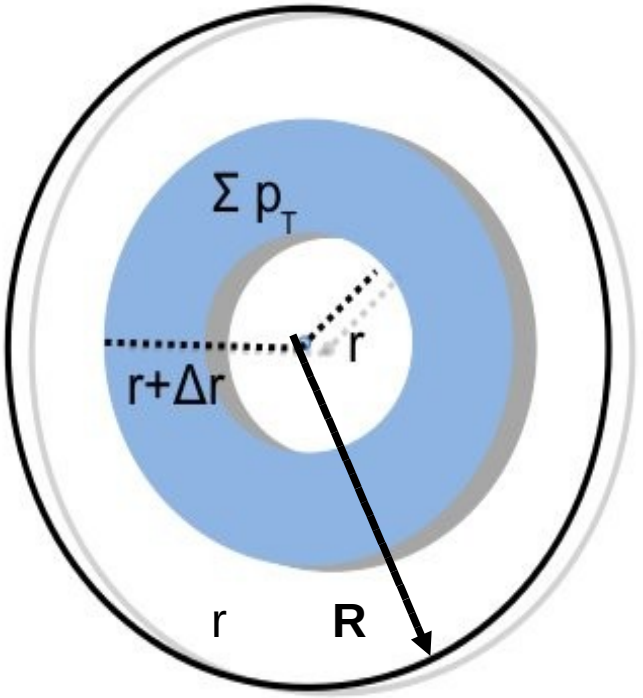
Steps :

- Each object to be clustered are considered as proto-jets and a list of proto-jet is made
- For each object, $\boldsymbol{d_{ij}}$ and $\boldsymbol{d_{iB}}$ are computed
- A comparison is made to find the minimum between each $\boldsymbol{d_{ij}}$ and $\boldsymbol{d_{iB}}$
- If $\boldsymbol{d_{iB}}$ is smaller, then this particular proto-jet is declared as a jet and removed from the list
- If $\boldsymbol{d_{ij}}$ is smaller, then proto-jet “i” and “j” are merged into a new single proto-jet and removed from the list
- Repeat untill all the proto-jet becomes jet

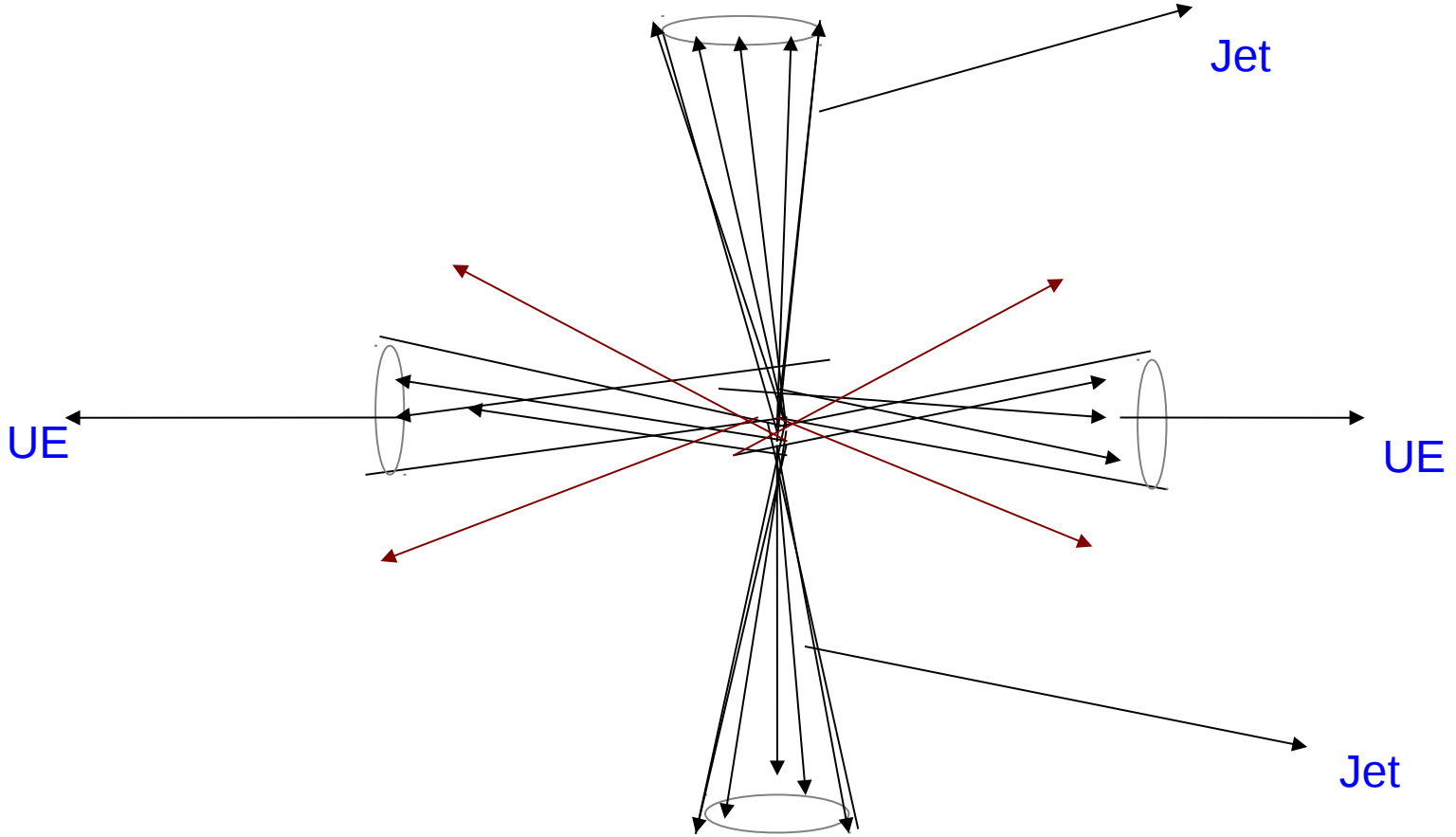
Radial Momentum Distribution

- **Radial distribution of transverse momentum about the jet axis:**

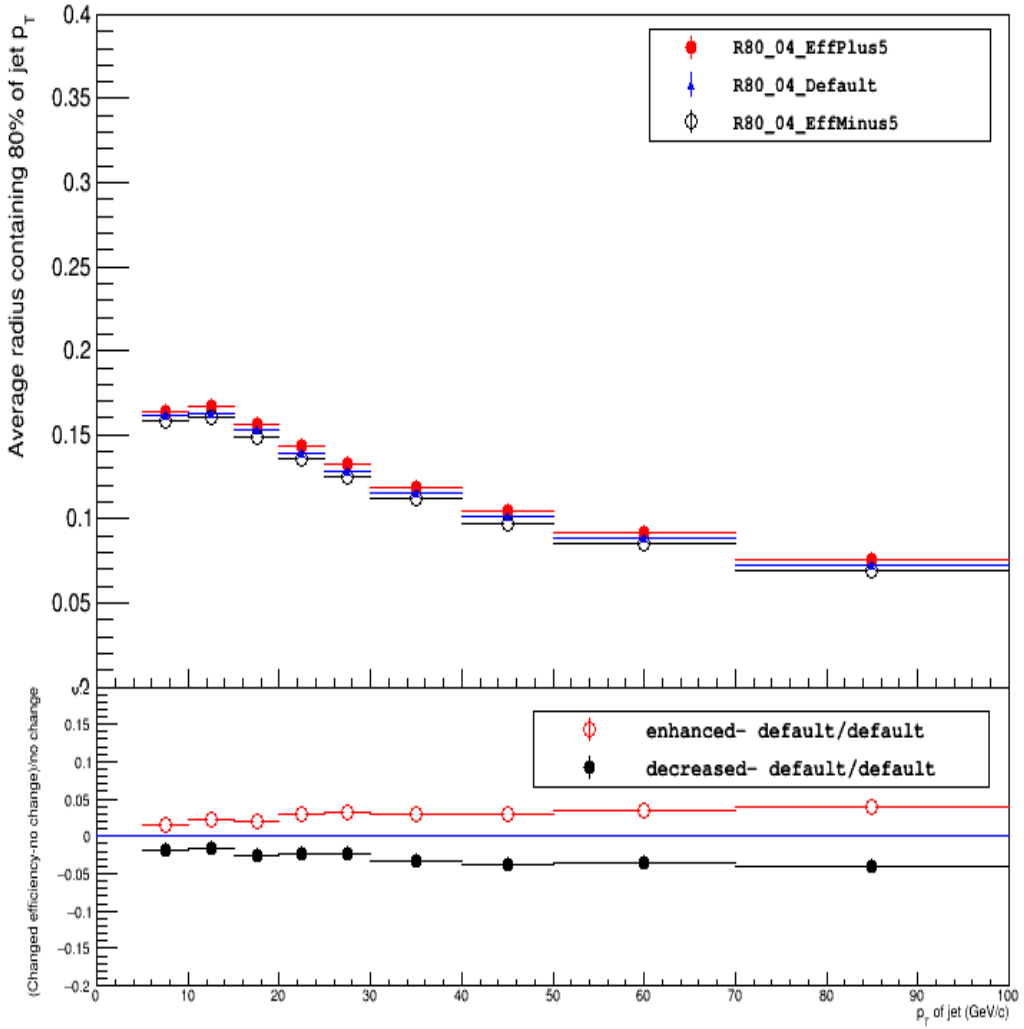
$$< p_t^{sum} > (r) = \frac{\sum_{jets} (\sum p_t)}{N_{jets}}$$

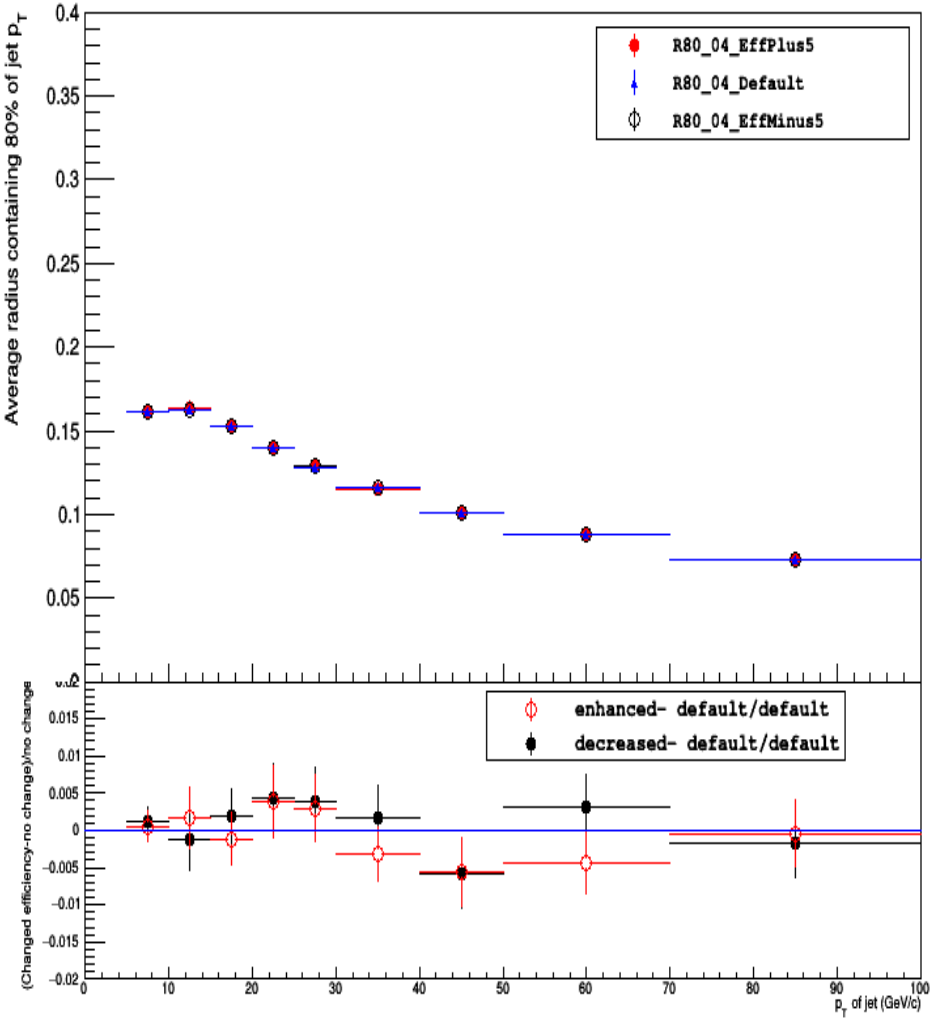


Underlying events measurements

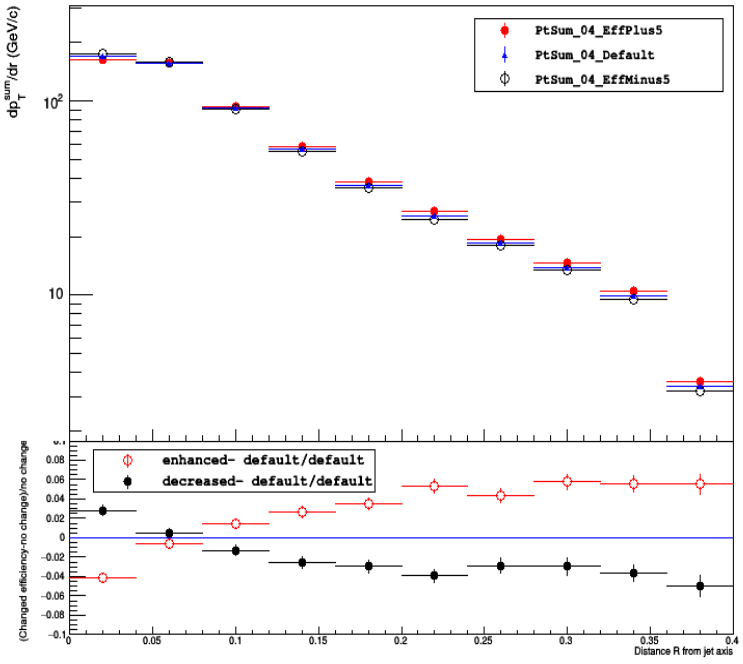


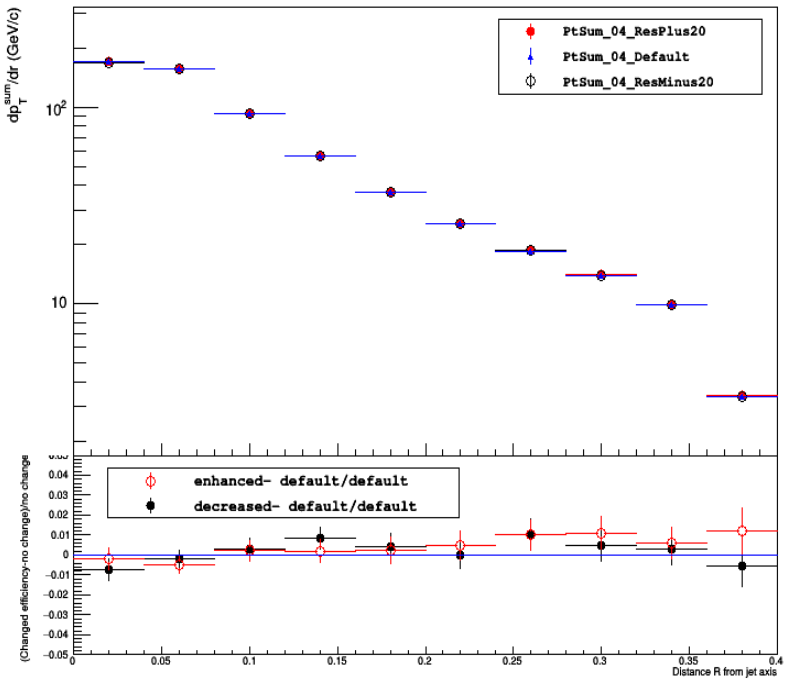
R80 distribution of jet p_T

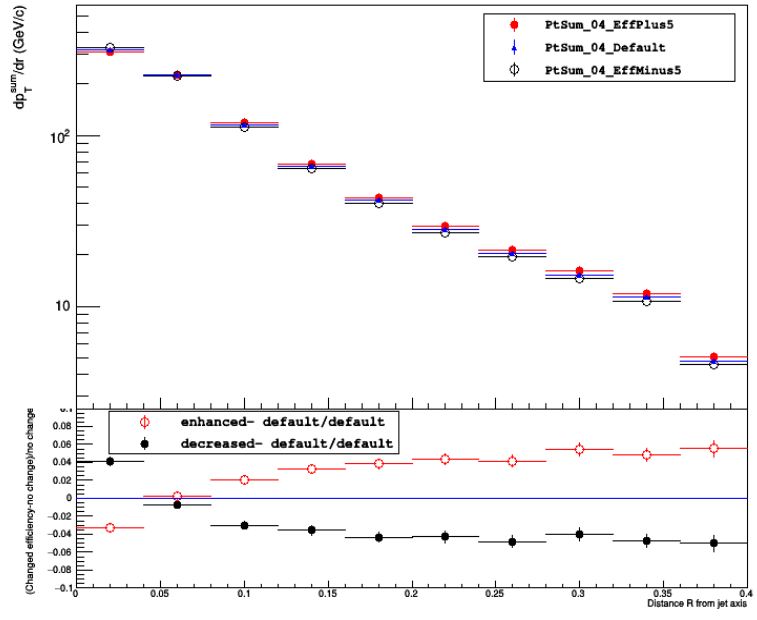


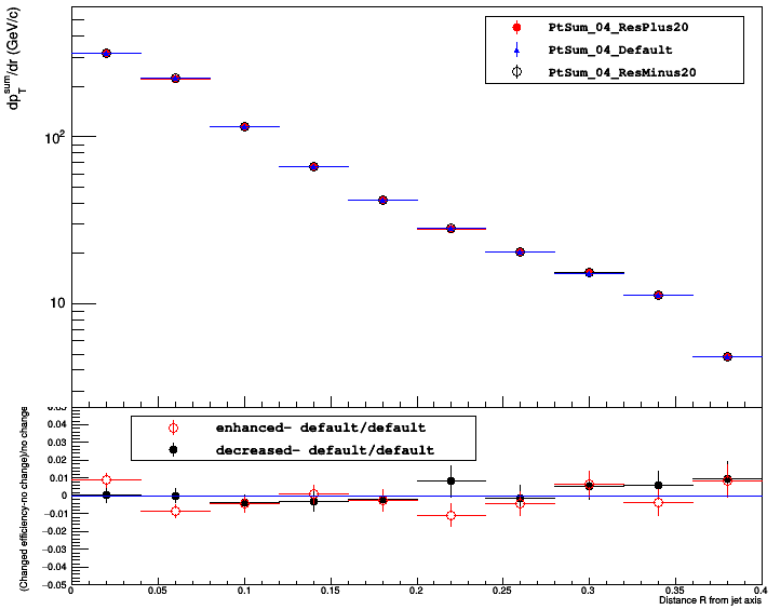


Radial momentum distribution

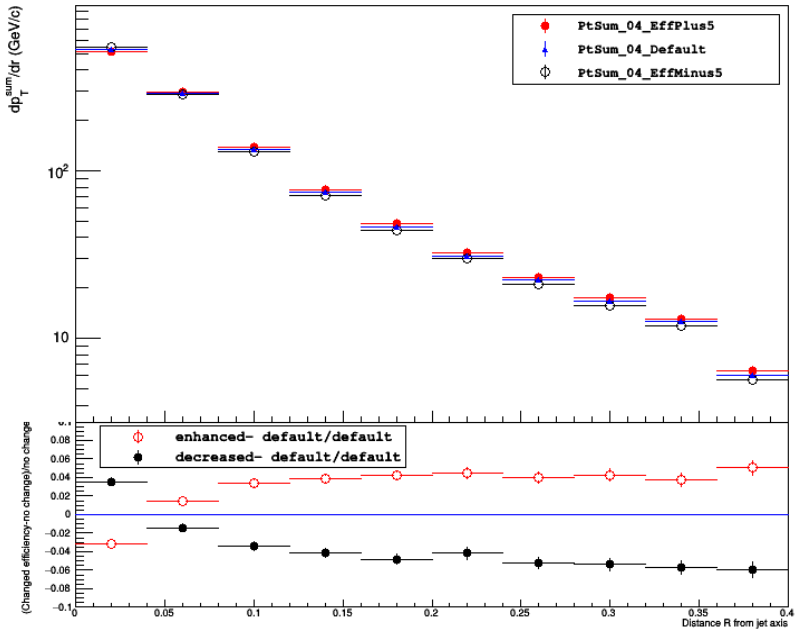


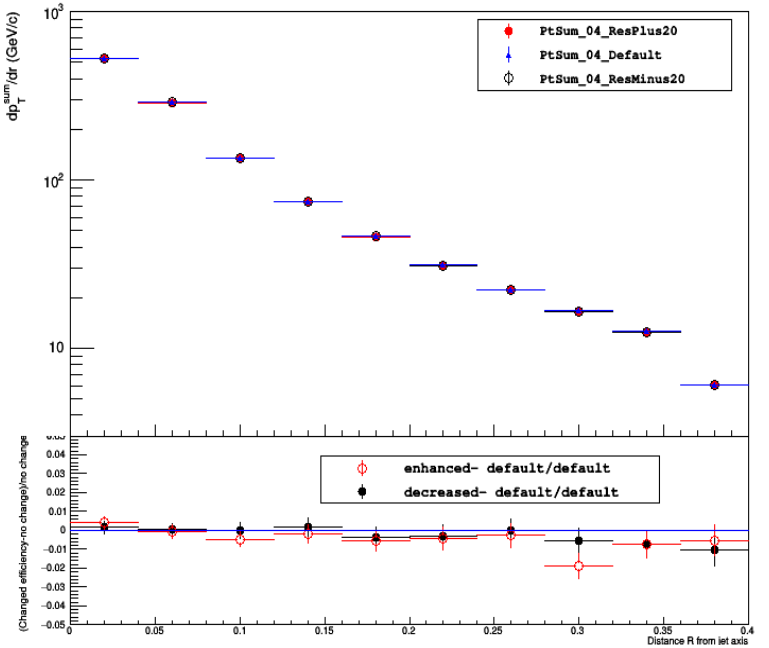


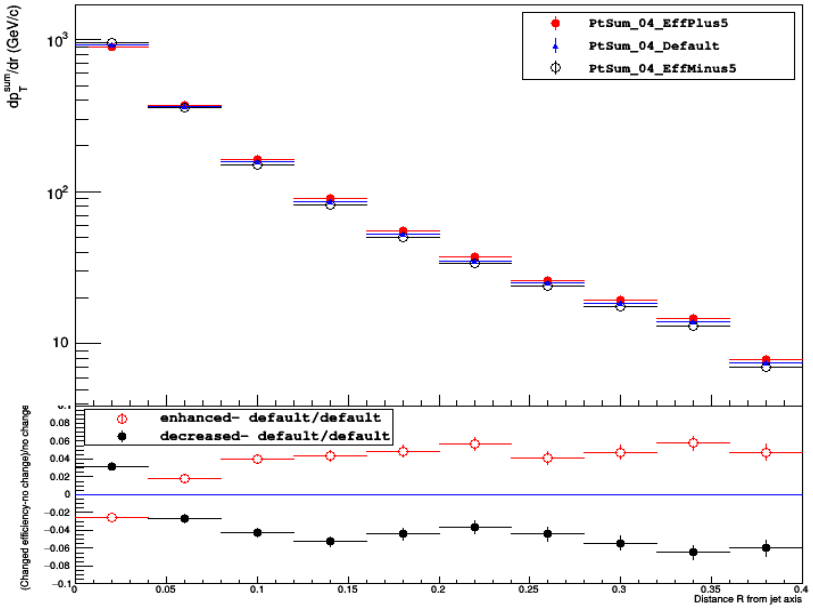


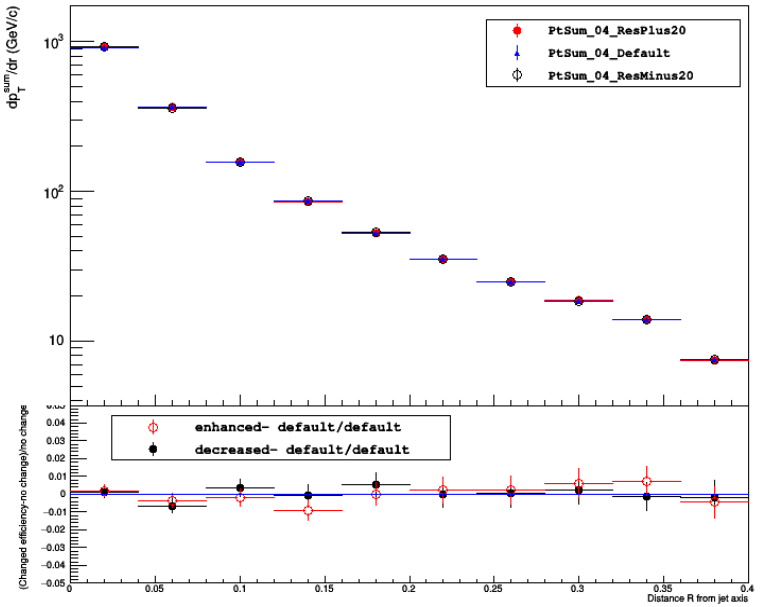


Radial momentum distribution

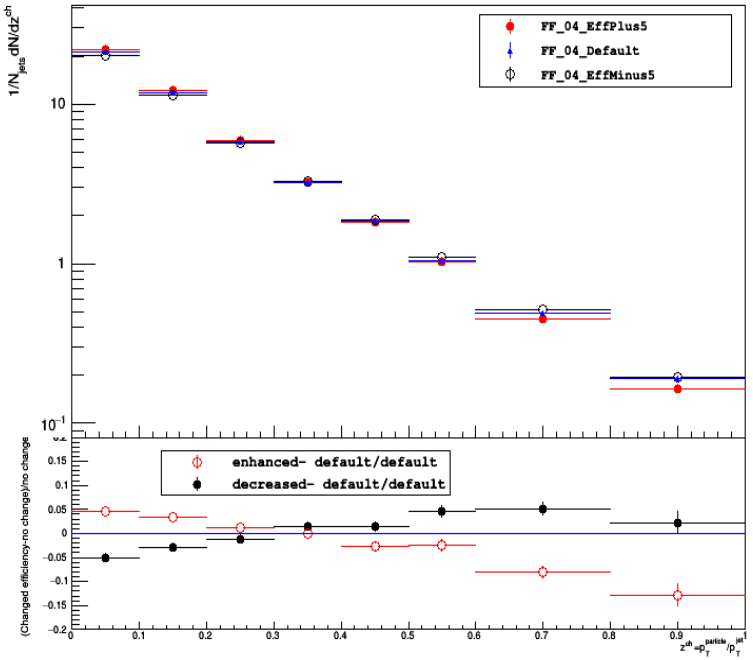


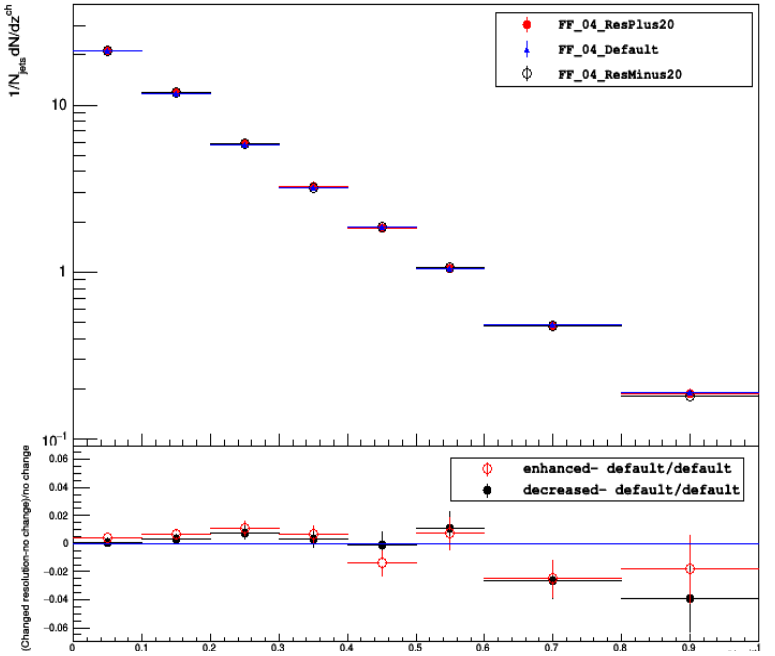


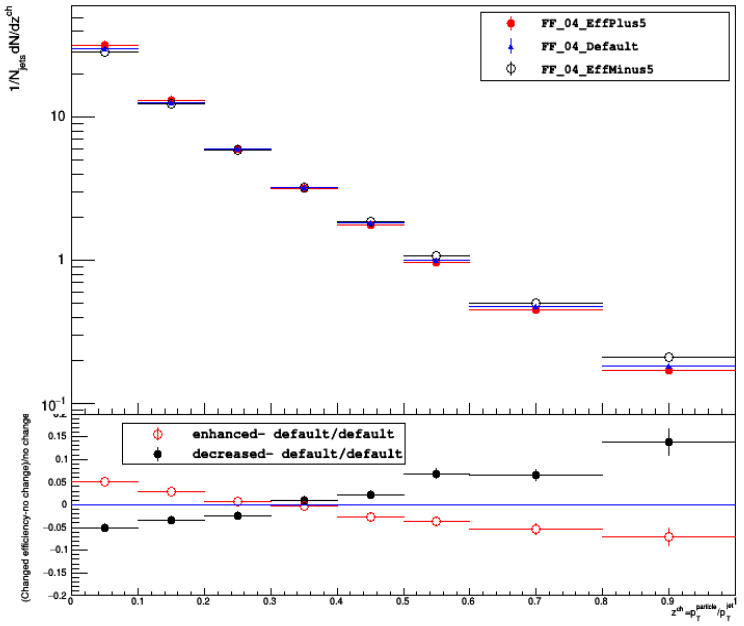


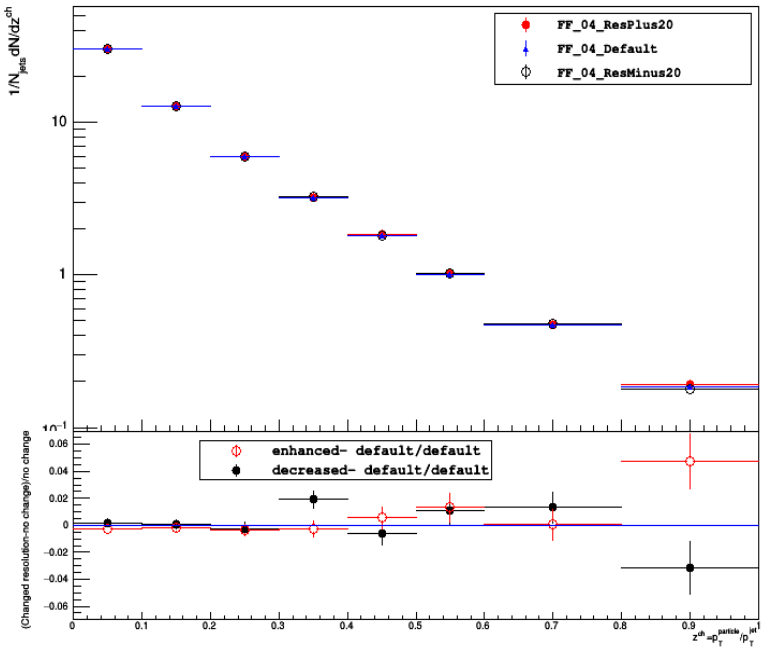


Jet Fragmentation distribution

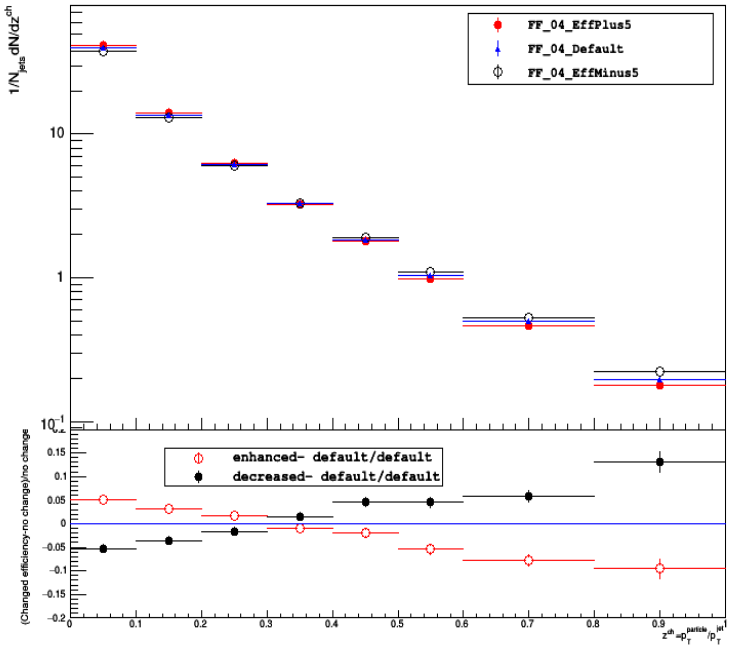


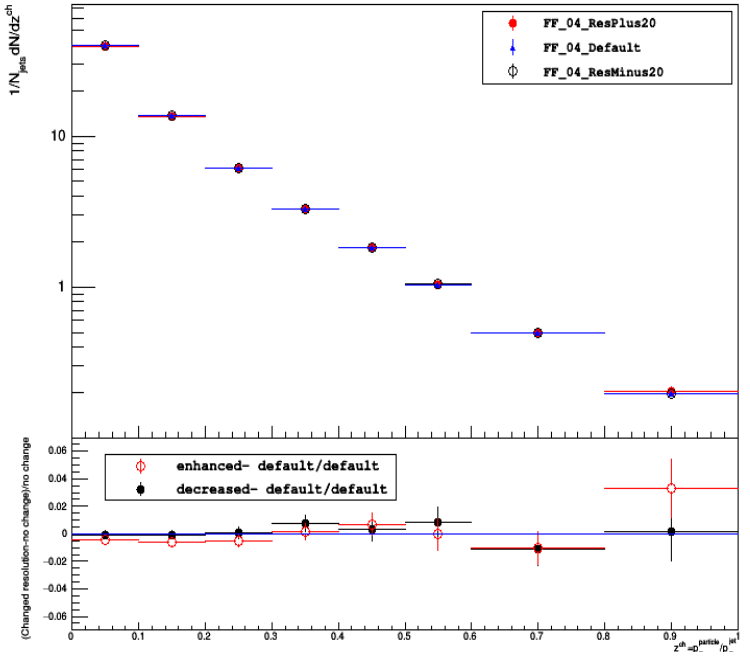


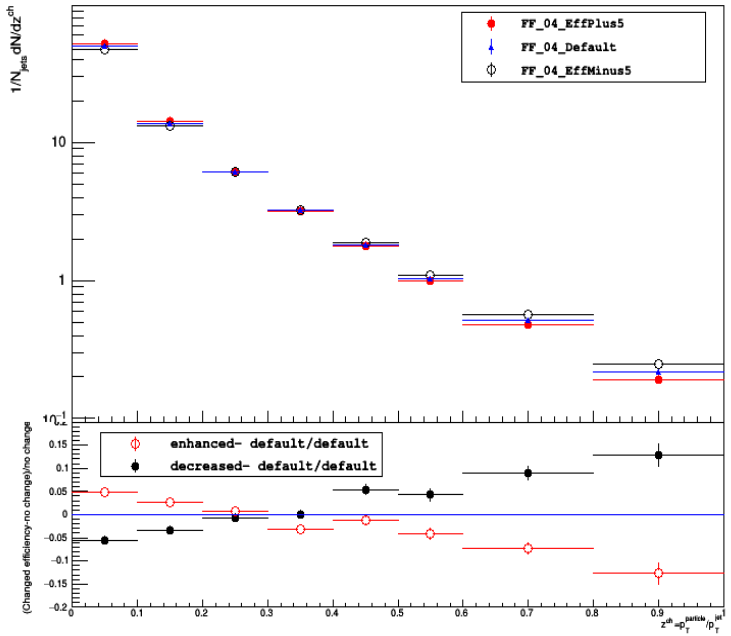


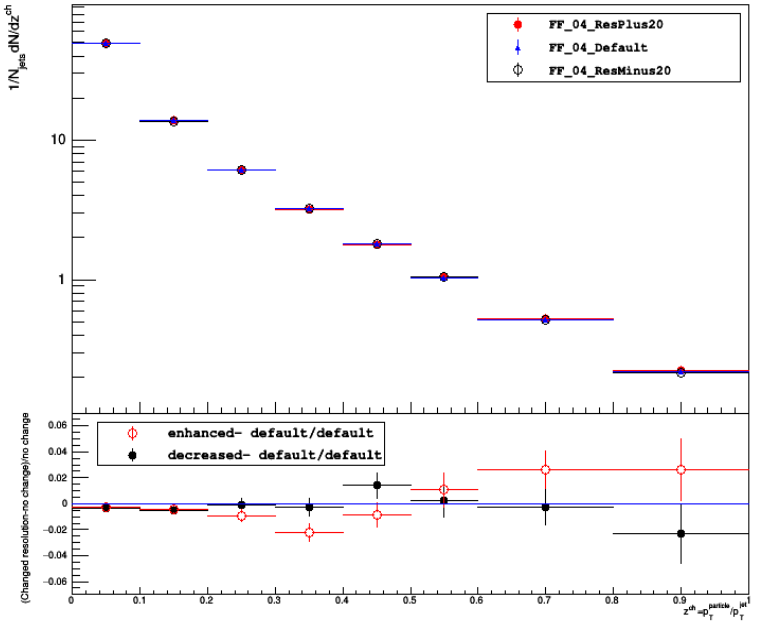


Jet Fragmentation distribution

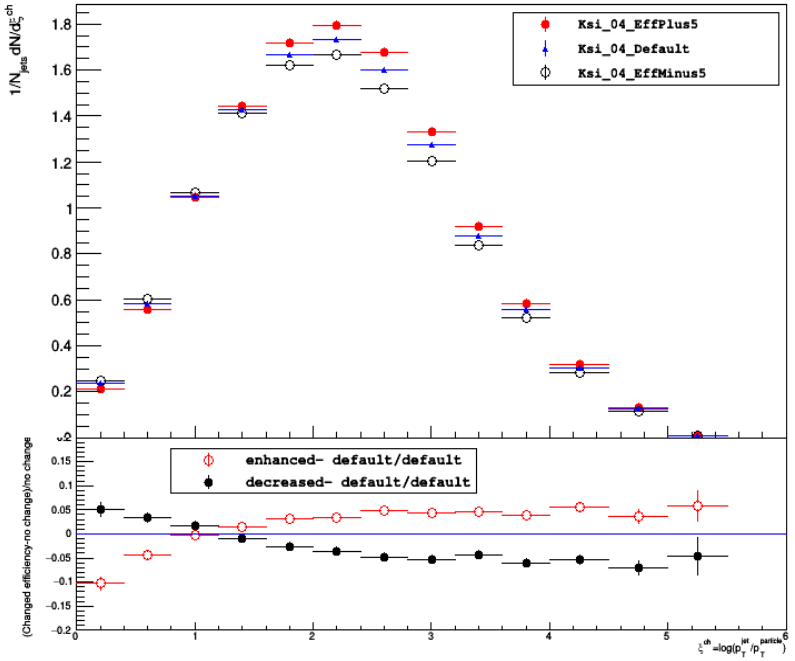


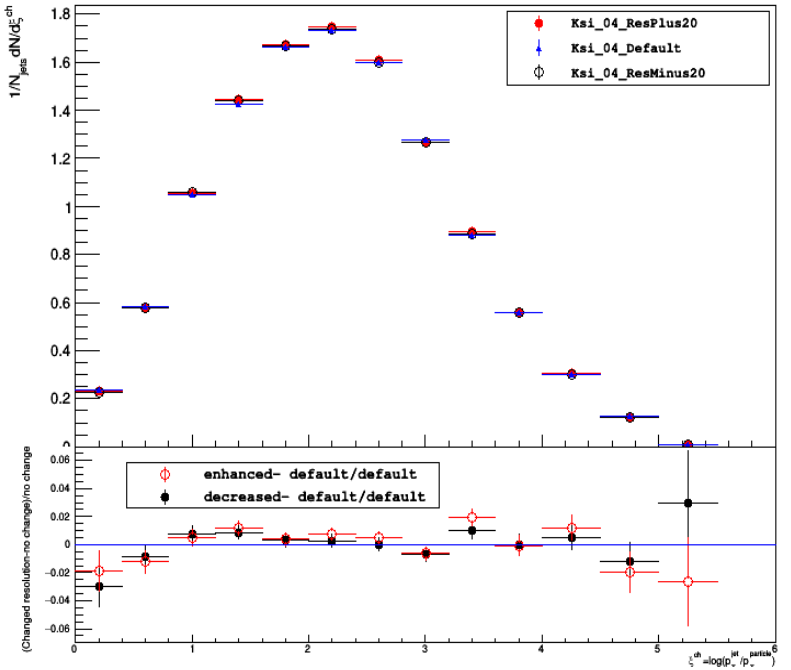


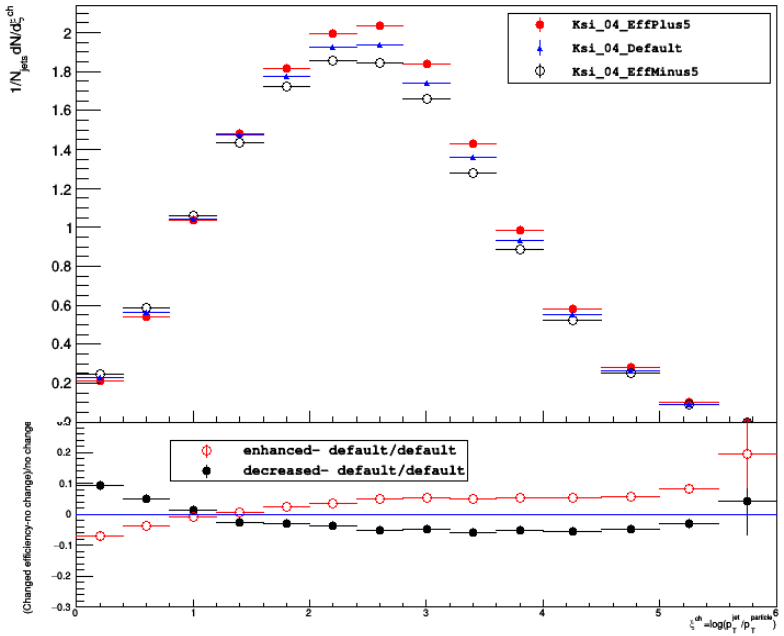


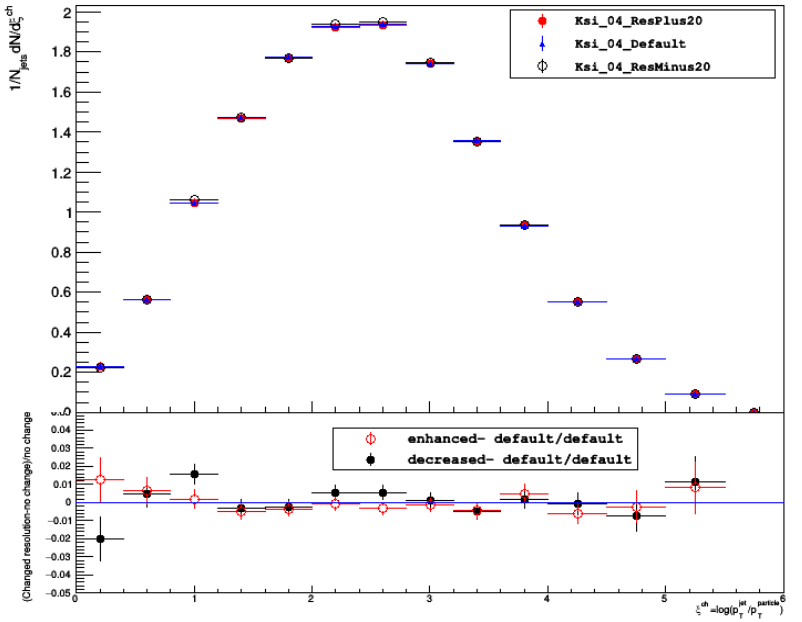


Ksi distribution









Ksi distribution