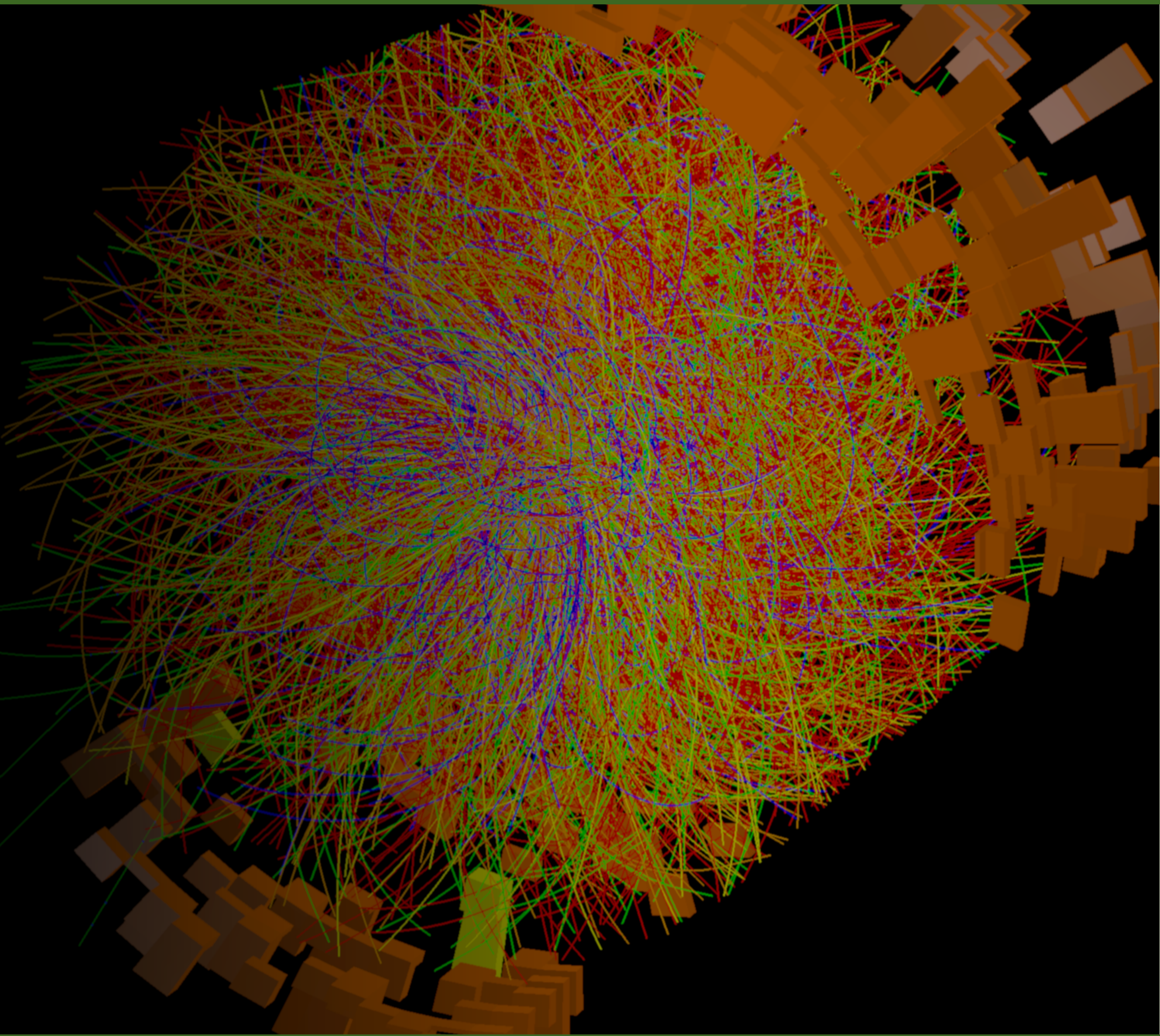
Inclucive Jet Analysis



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This study goal

Inclusive Charged/Full Jet Nueclear Modification Factor Analysis by using High Statistic New Pb-Pb collision data taken by ALICE

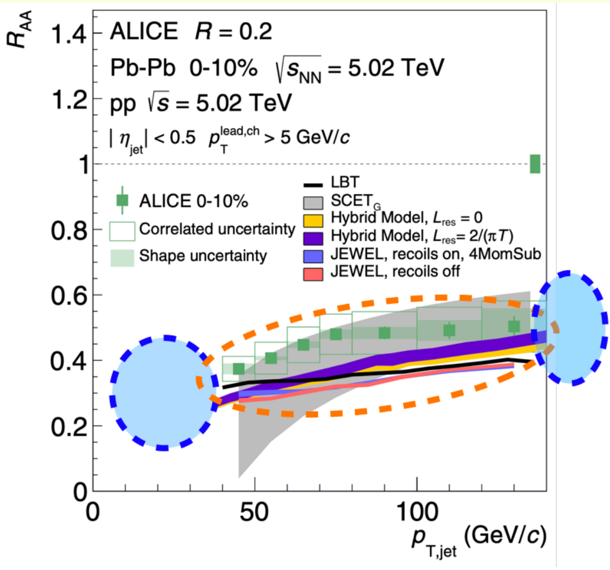
Study Purpose :

1. Investigate the R_{AA} behavior at the ***unknown*** p_T ***range*** in the preceding study.
2. Compare the data result with the theoretical value from the ***two new aspects*** (***Centrality*** dependency and ***Resolution parameter (R)*** dependency).

- By using the ***new data*** having the ***three times statistic*** to the preceding study

The two advantages by using the various centrality data

1. The background is small in the peripheral collision.
   →The systematic uncertainty of the analysis is small and that will realize the search of the R_{AA} ***in the lower*** p_T ***range***.
2. We can estimate the R_{cp} = (yield of the central collision) / (yield of peripheral the collision)
   →It has a ***less systematic uncertainty*** than the R_{AA} because the jets of the various centralities were observed i the same condition. (The data of *p-p* collision experiment is taken in a different condition.)



Measurements of inclusive jet spectra in pp and central Pb-Pb collisions at √sNN = 5.02 TeV
DOI: 10.1103/PhysRevC.101.034911

Study plan

- Data Jet QA (LHC18q/r(pass3): Pb-Pb 5.02 GeV)
- MC Jet QA (LHC19f4(pass1), LHC20g4(pass3))
- Estimate background $\rho(p_T)$
- Confirm the raw jet behavior

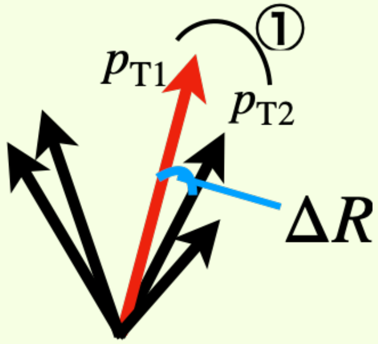
(pT distribution, Rcp, R dependence, jet area, leading pT cut dependency)

- **Embedding process** ← **Now**
- Unfolding ← Next (on going)
- Estimate Systematic Uncertainty

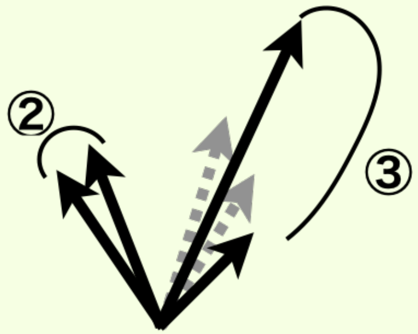
Remain problem: background estimation (differencial of cell threshold and seed threshold), pp (LHC17) tracking efficiency, multiplicity cut (LHC20g4), and etc…

Jet Reconstruction algorithm (anti-kT)

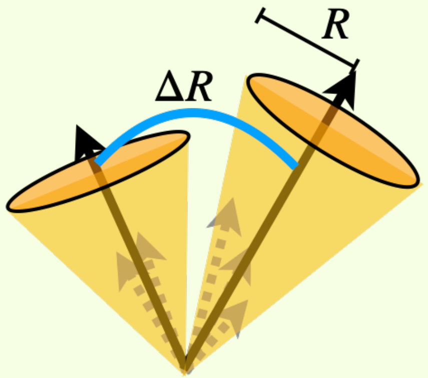
$$R = \sqrt{\eta^2 + \phi^2}$$



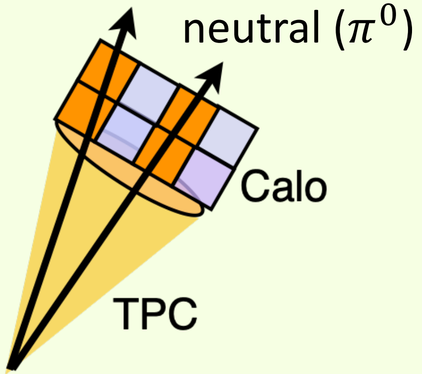
1. Combine the TPC track having the largest p_{T} with the track having the nearest p_{T} and position



2. Repeat the 1. process



3. Finish the 2. process when the ΔR is less than the R of the jets.



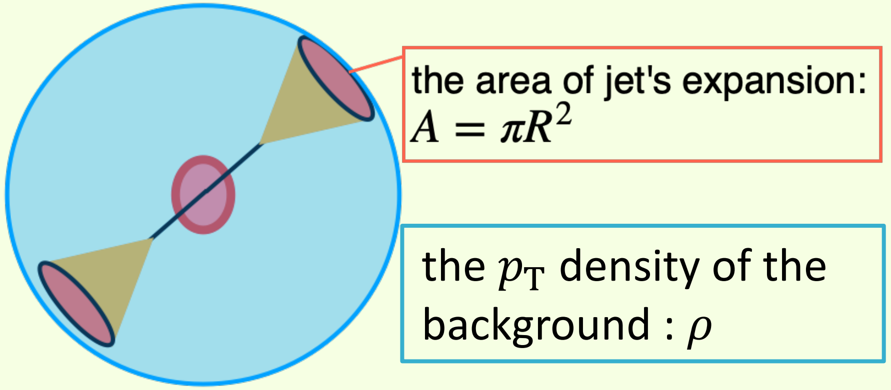
4. Integrate the of the p_{T} EMCal cluster and the jet

Back ground estimation algorithm

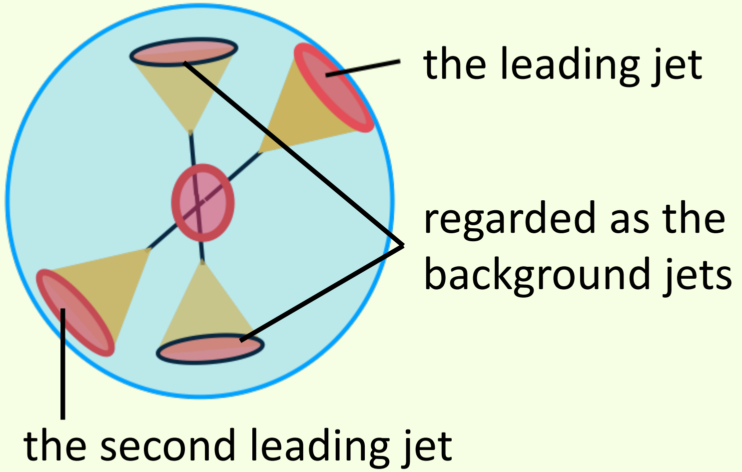
The raw jets have the tracks from the background.

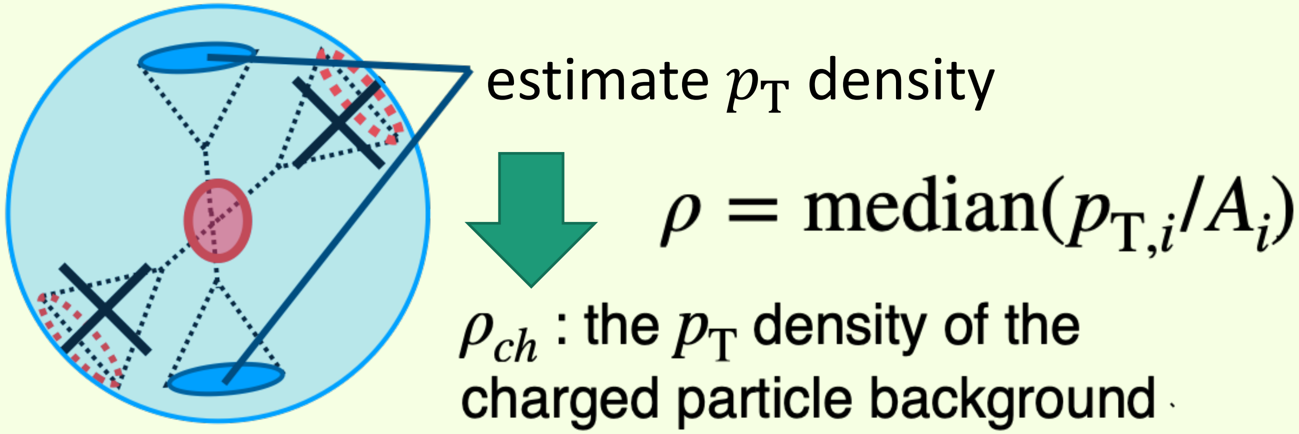
→ Need to subtract the of the background

$$\boxed{p_{\mathrm{T,corr}}^{\mathrm{jet}} = p_{\mathrm{T}}^{\mathrm{jet}} - \rho A}$$



ρ_{ch} estimate algorithm

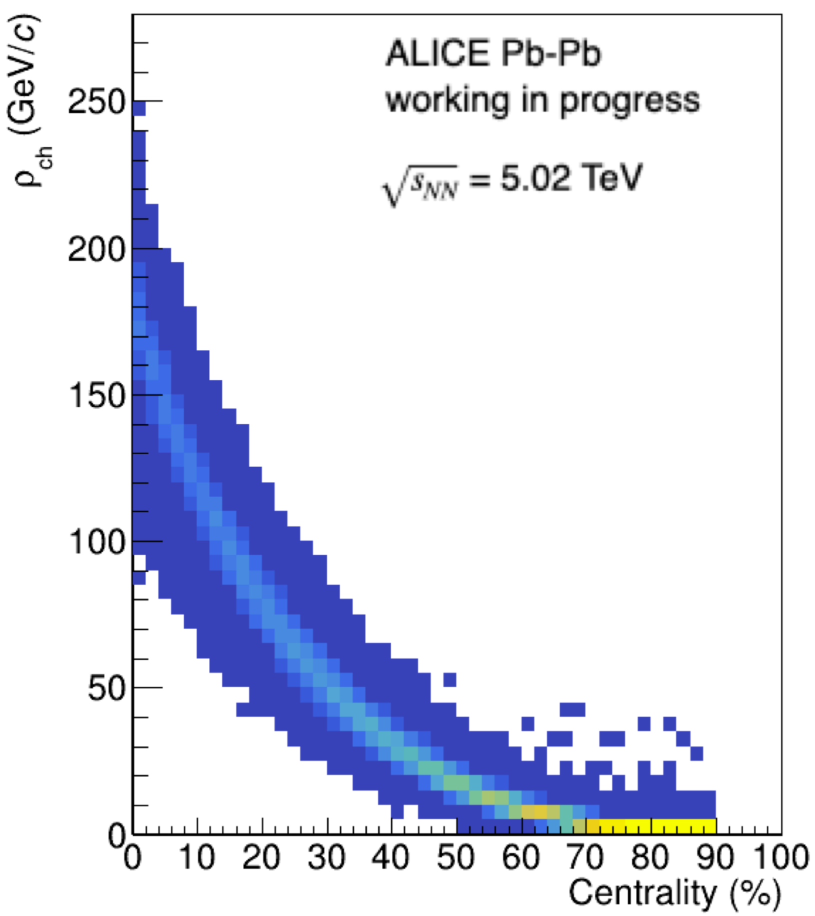


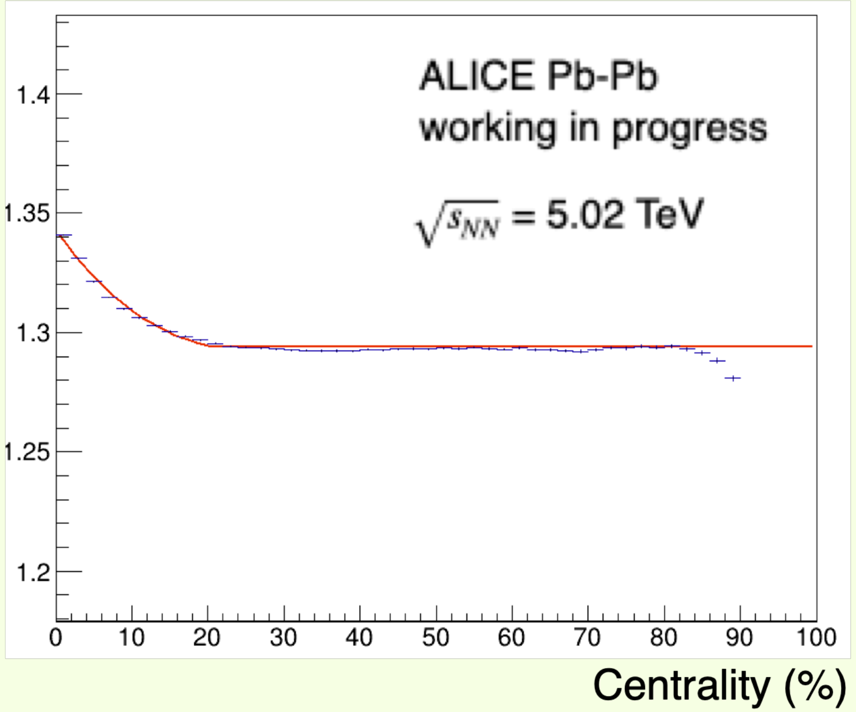


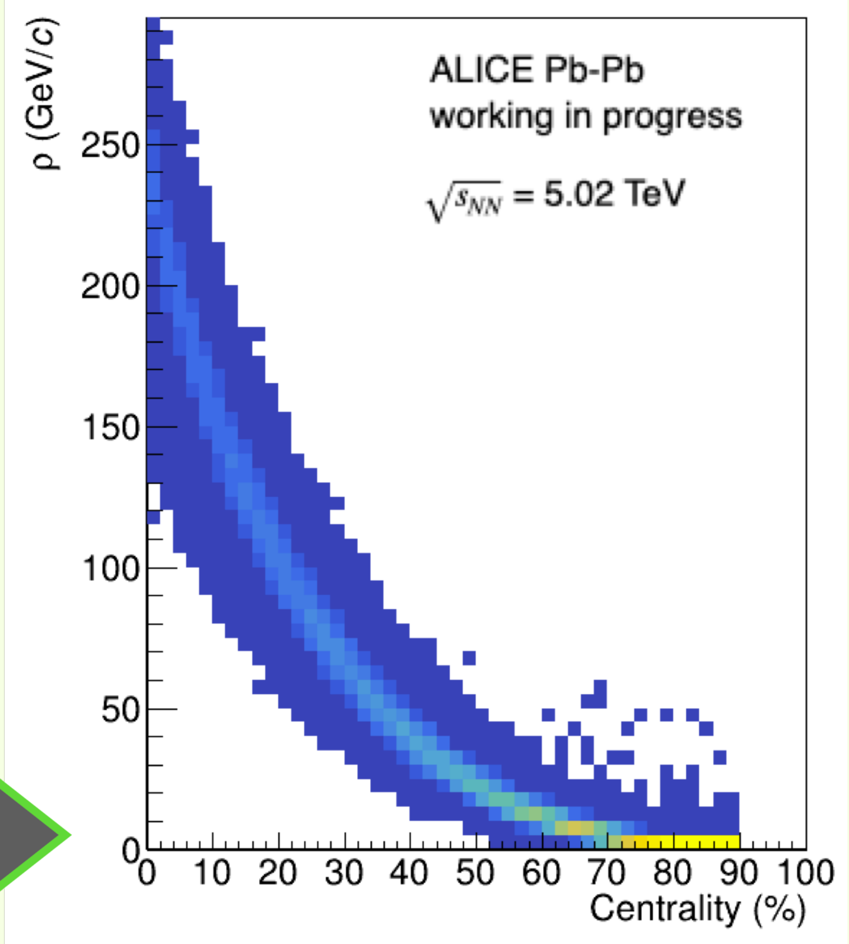
1. Regard the jets having the less p_{T} than the second one as the background jets, and estimate the p_{T} density of them.
2. Suppose the background uniformly distribute, and regard the median of the estimated p_{T} density as the ρ_{ch}.

Estimate background

$$s(C) = \frac{(\sum p_{\mathrm{T,track}}^{\mathrm{calo}} + p_{\mathrm{T,cluster}}^{\mathrm{calo}})/A_{\mathrm{calo}}}{\sum p_{\mathrm{T,track}}^{\mathrm{TPC}}/A_{\mathrm{TPC}}}$$







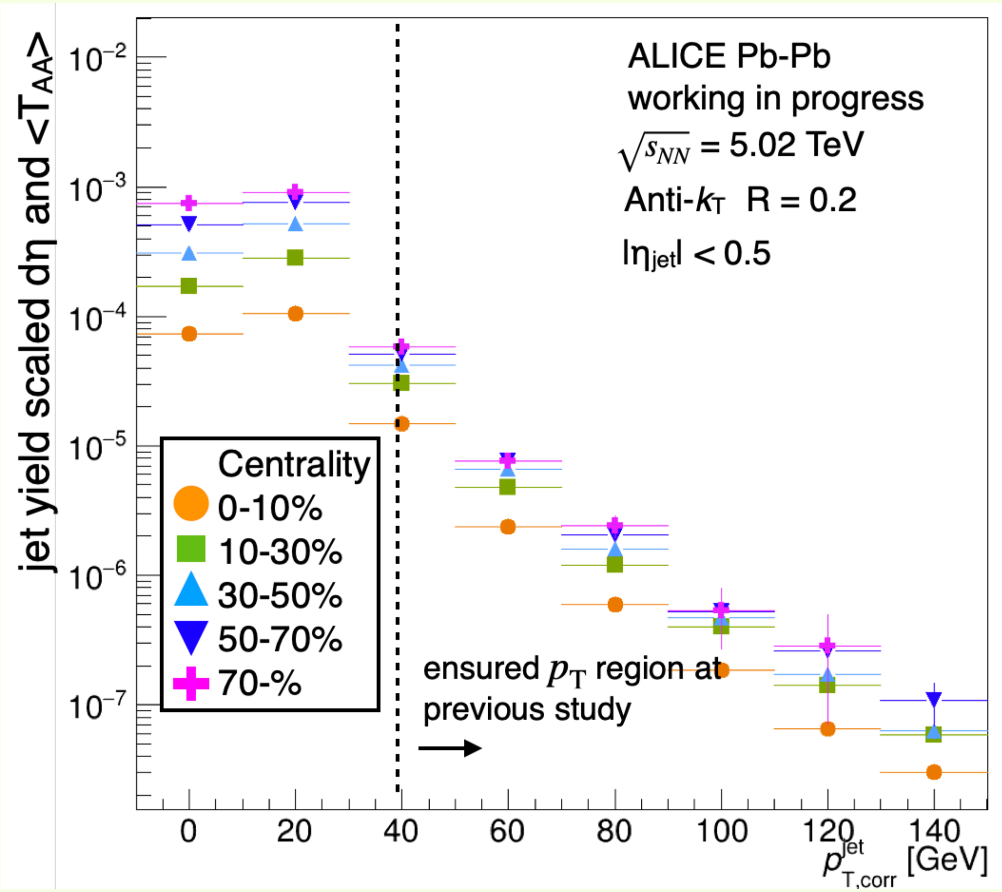
$$\rho(C) = s(C) \times \rho_{\mathrm{ch}}(C)$$

C : Centrality

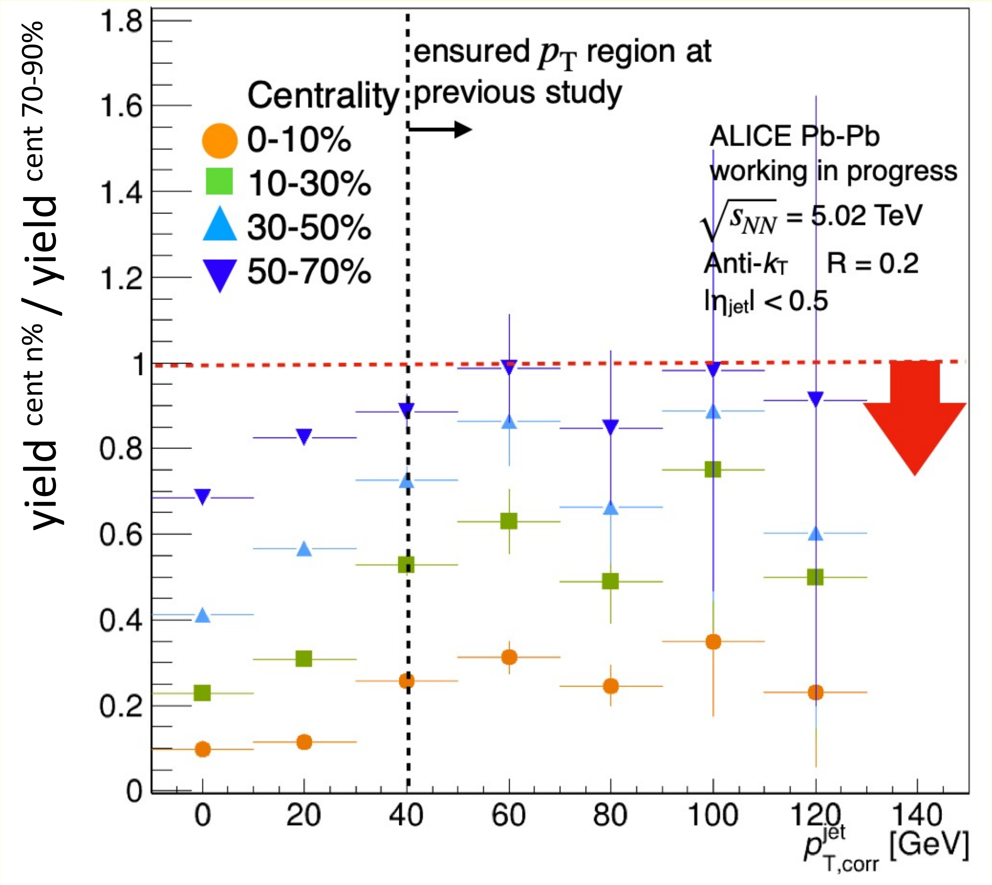
Raw jet p_T distribution for each centrality and R_{cp}

$p_{T,corr}^{jet} = p_T^{jet} - \rho A$

w/o unfolding and correction



various centrality jet distribution



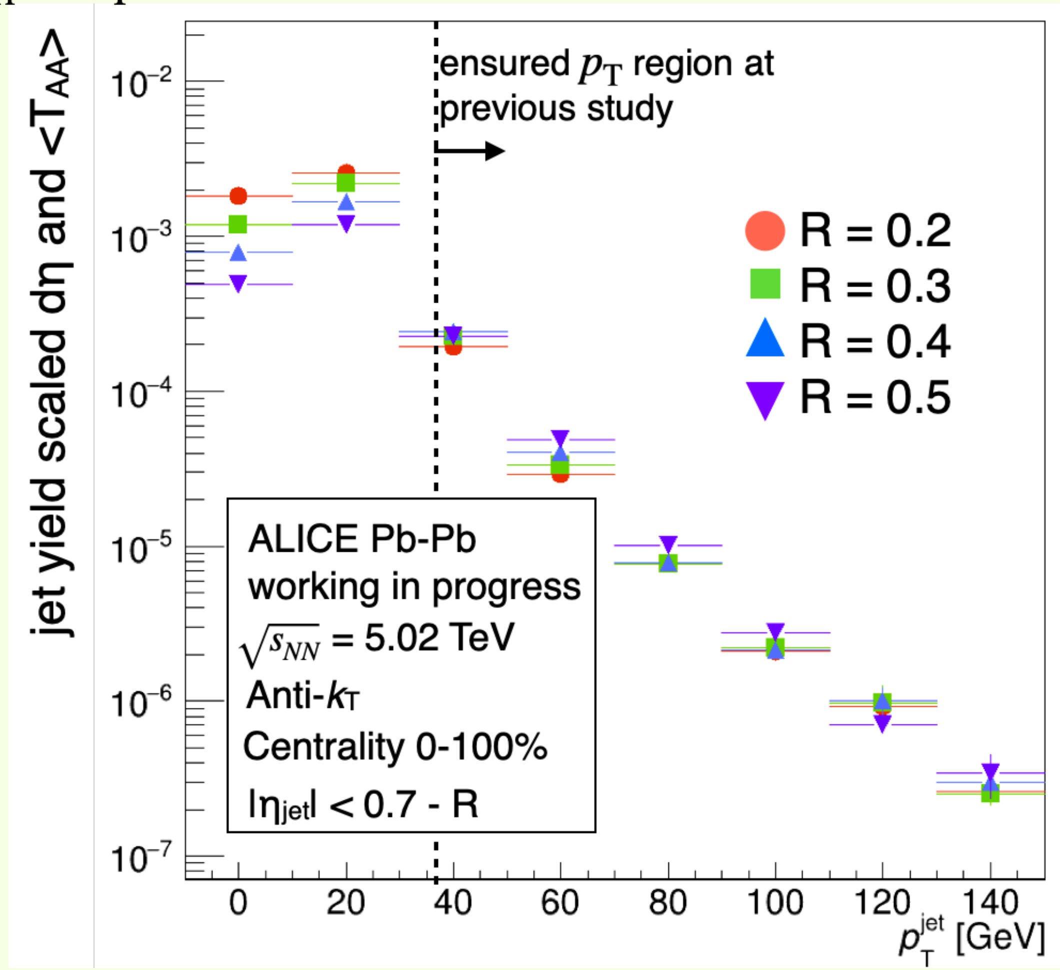
compare the peripheral distribution with various centrality one

These plots show the tendency of the distribution of the more central collision are more suppressed.

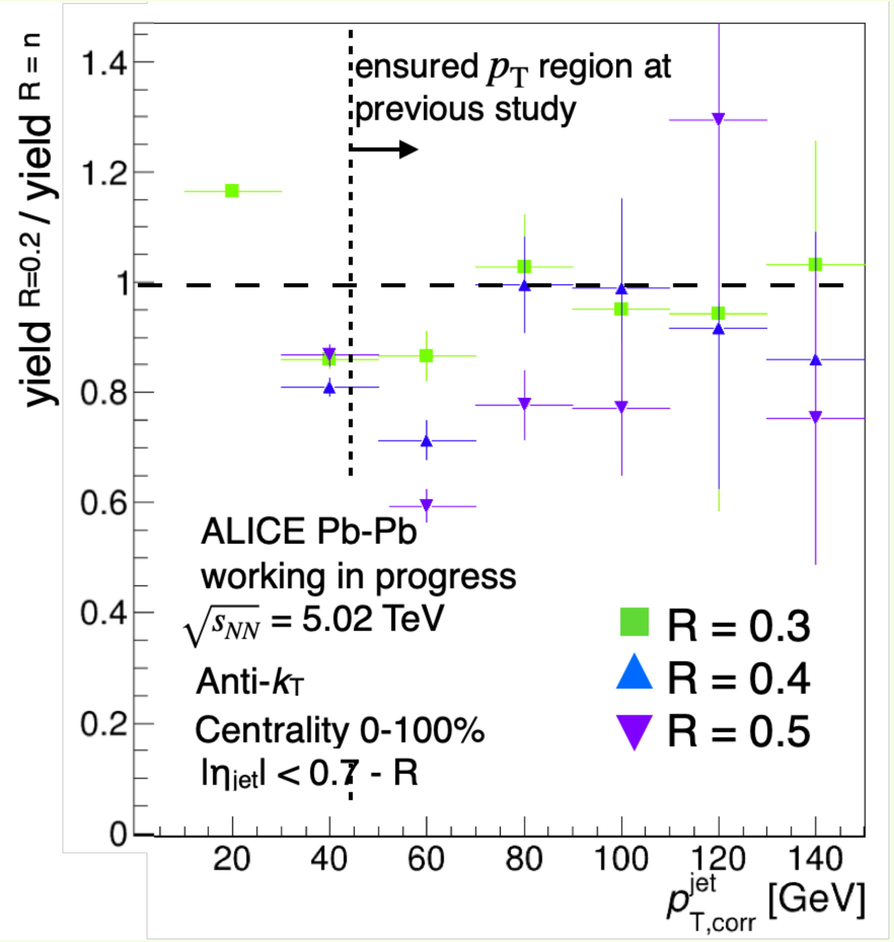
Raw jet p_T distribution for each R

$p^{\text{jet}}_{\text{T,corr}} = p^{\text{jet}}_{\text{T}} - \rho A$

w/o unfolding and correction



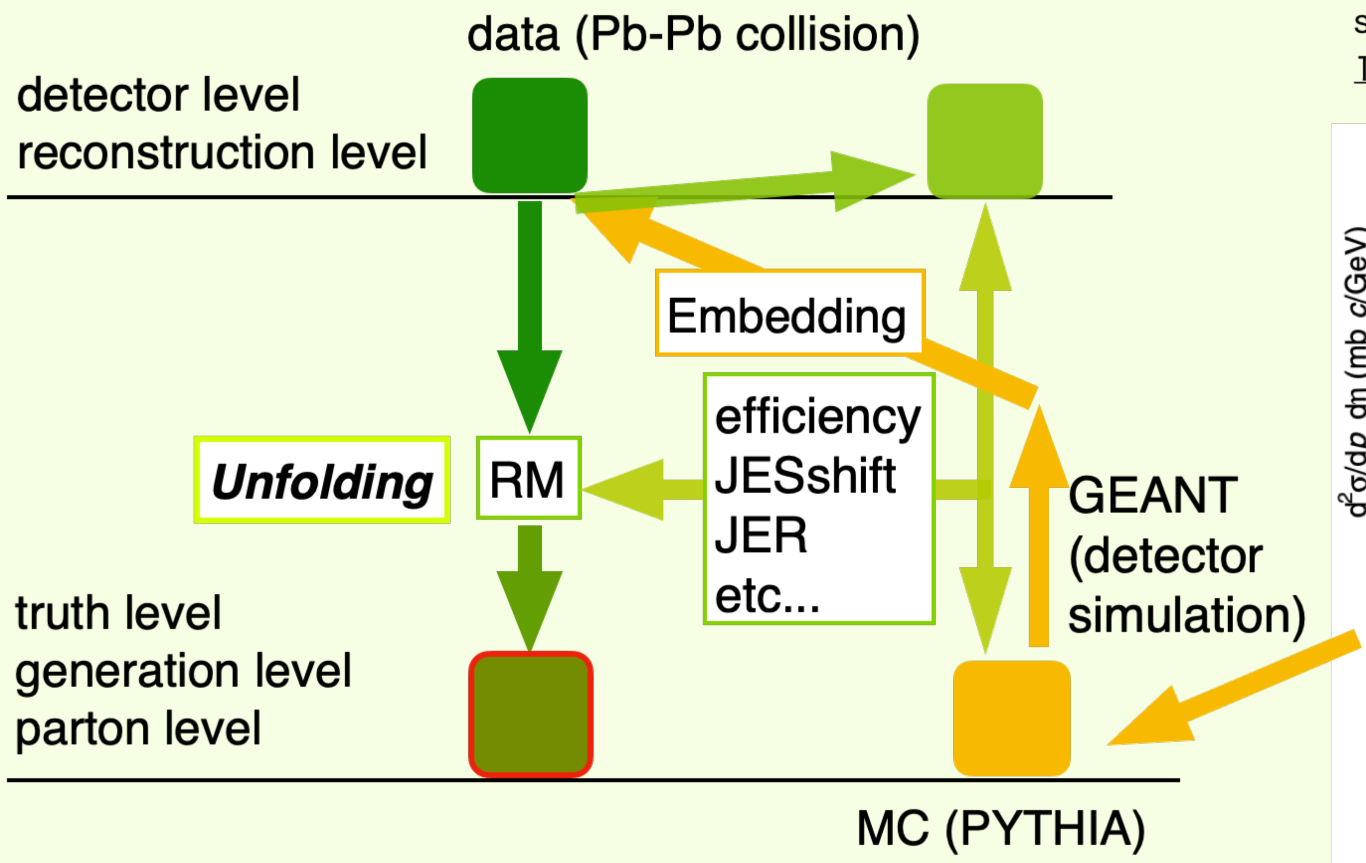
various R jet distribution



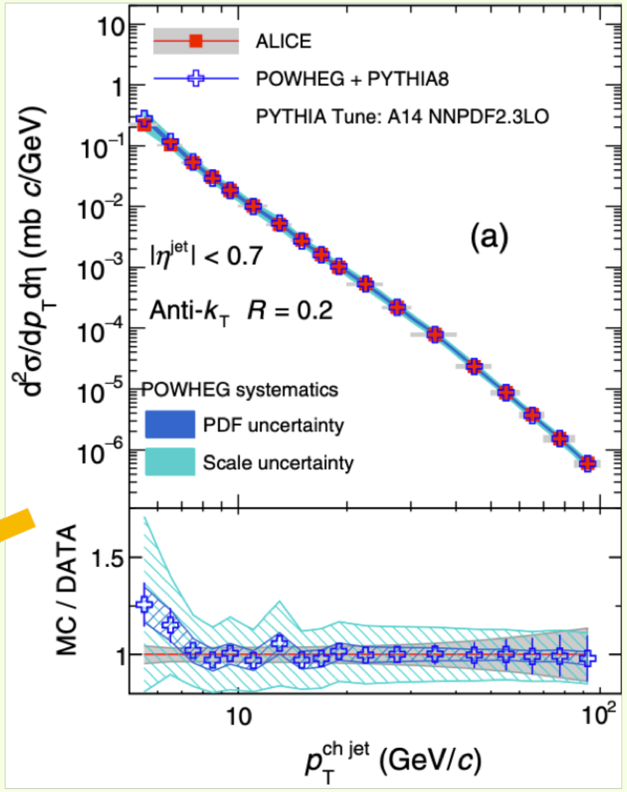
compare R=0.2 distribution with various R one

These plots show the tendency of the distribution having the larger R shifts to the higher .

To get the truth level information in the real Pb-Pb collision, the detector level data is unfolded by using the information of the background effect.

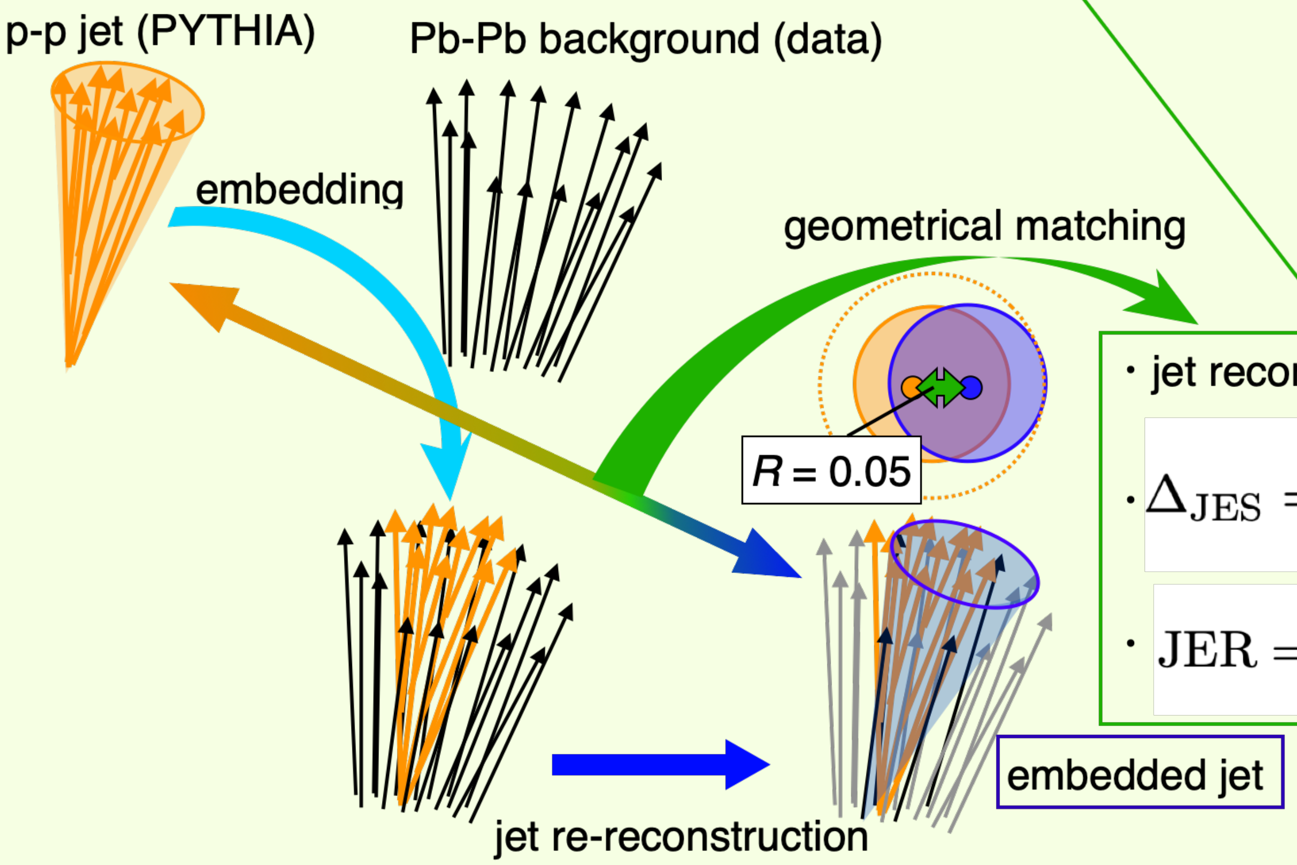


Measurement of charged jet cross section in pp collisions at √s=5.02 TeV
10.1103/PhysRevD.100.092004



The comparison between the data and theoretical model of p-p collision

To make the response matrix (RM), we estimate the degree of correction by the embedding process.



- jet reconstruction efficiency
- $\Delta_{\mathrm{JES}} = \left\langle \dfrac{p^{\mathrm{jet}}_{\mathrm{T,det}} - p^{\mathrm{jet}}_{\mathrm{T,gen}}}{p^{\mathrm{jet}}_{\mathrm{T,gen}}} \right\rangle$
- $\mathrm{JER} = \dfrac{\sigma\left(p^{\mathrm{jet}}_{\mathrm{T,det}}\right)}{p^{\mathrm{jet}}_{\mathrm{T,gen}}}$

I estimated the correction parameters by using the very small data to confirm the programing code working well.

Current status of the embedding process

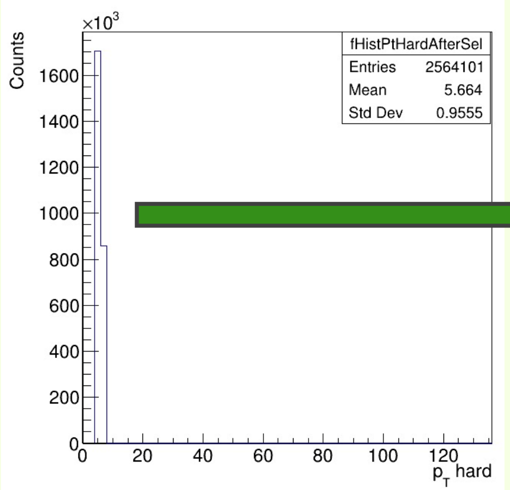
Embedding Condition

MB of LHC18r (Pb-Pb 5.02 GeV)

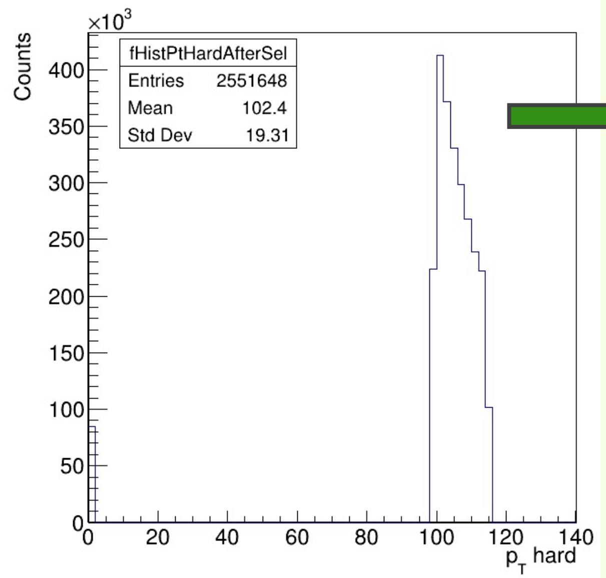
- Geometrical Matching (Matchig R = 0.3)
- Track cut: 0.15 GeV
- pT Bias Jet track: 5 GeV
- Max track cut: 100 GeV
- Jet pT cut: 1 GeV
- Z vertex cut: 10 mm

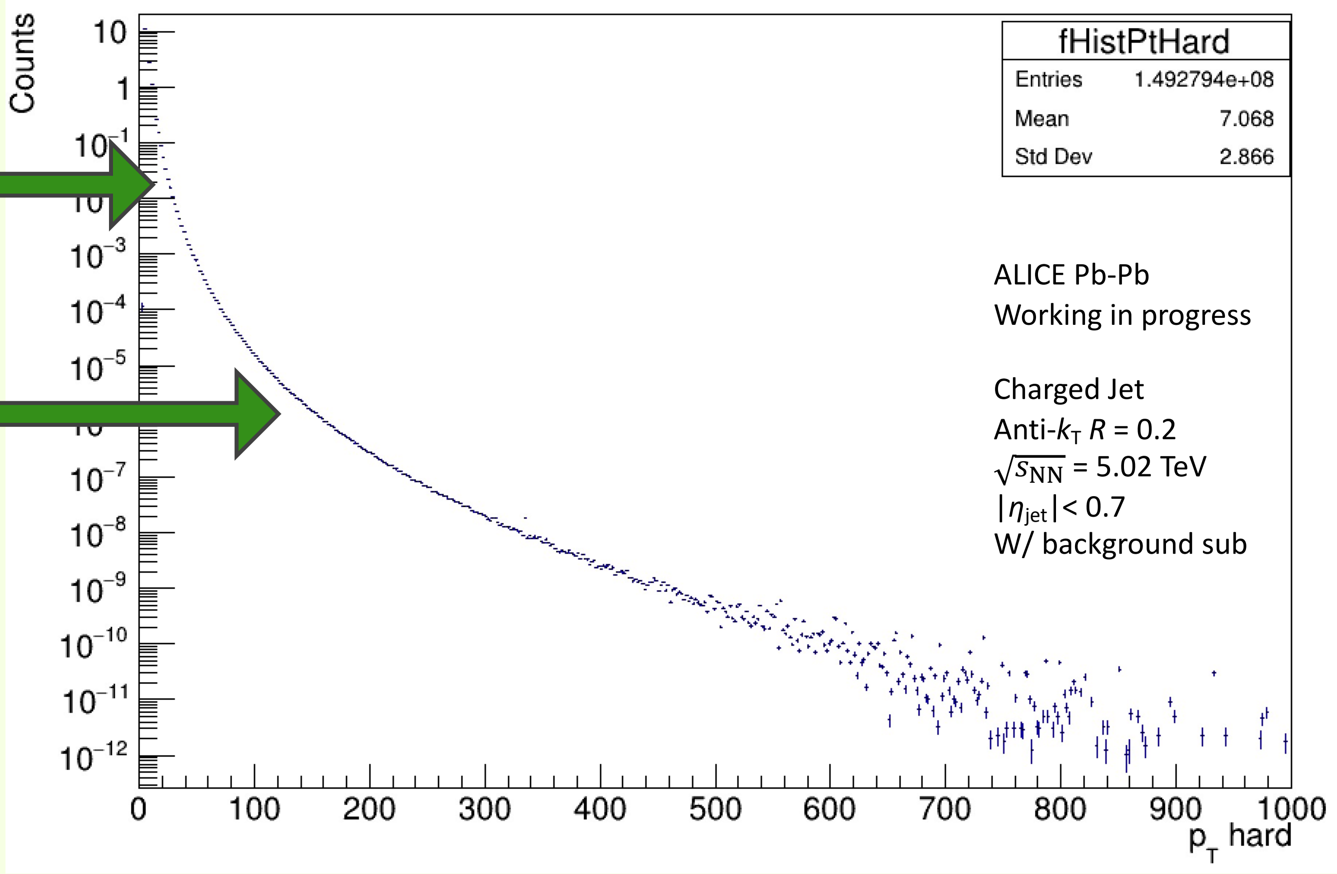
p_T hard bin merging with p_T hard scaling

I get the all pT hard bin charged jet results of only three runs of MB of LHC18r.
And I could smoothly merge these files by calculating p_T hard scaling parameter.



$$\text{Scale factor} = \frac{\text{xSec}_{p_T\ \text{hard}}}{\#\ \text{of trial}_{p_T\ \text{hard}}}$$

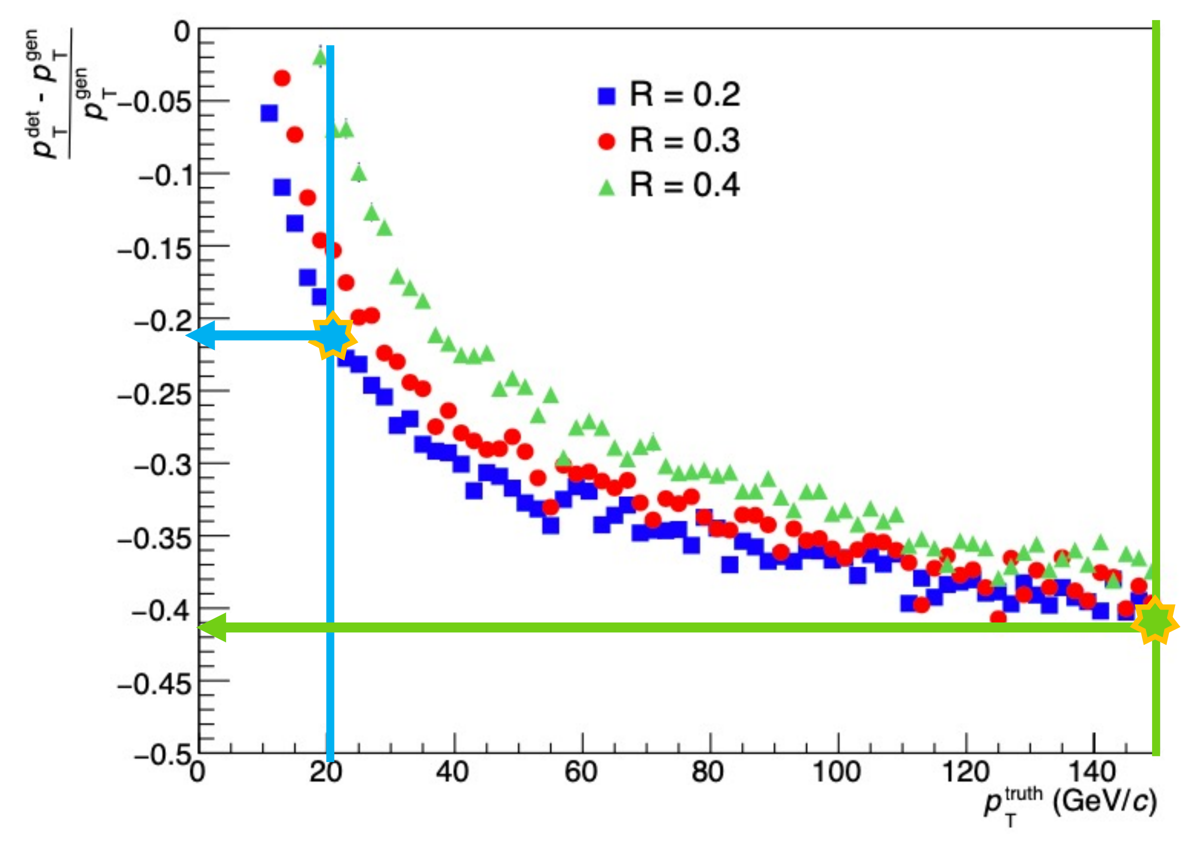




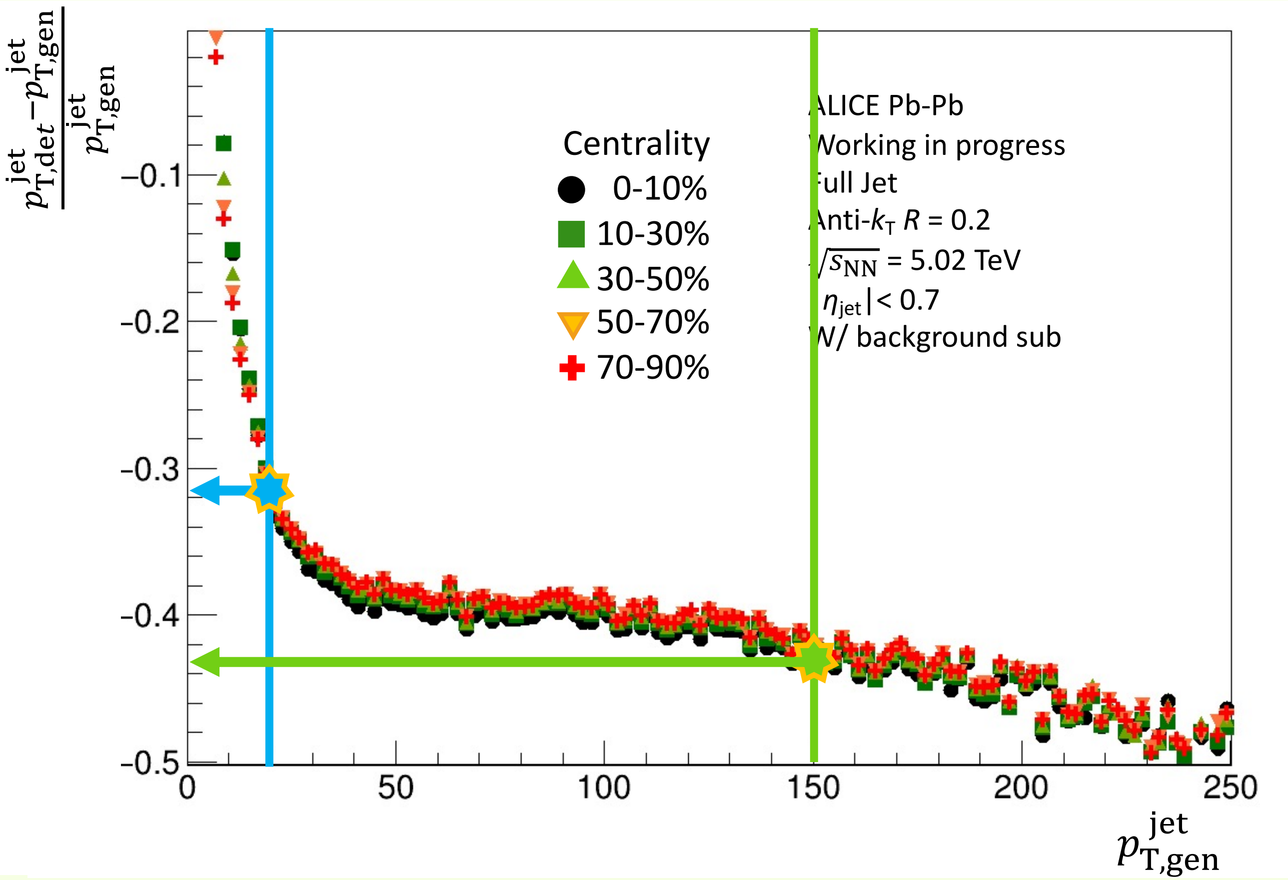
LHC15o Comparison

Jet Energy Scale(JES) shift

Preceding Study (2015)



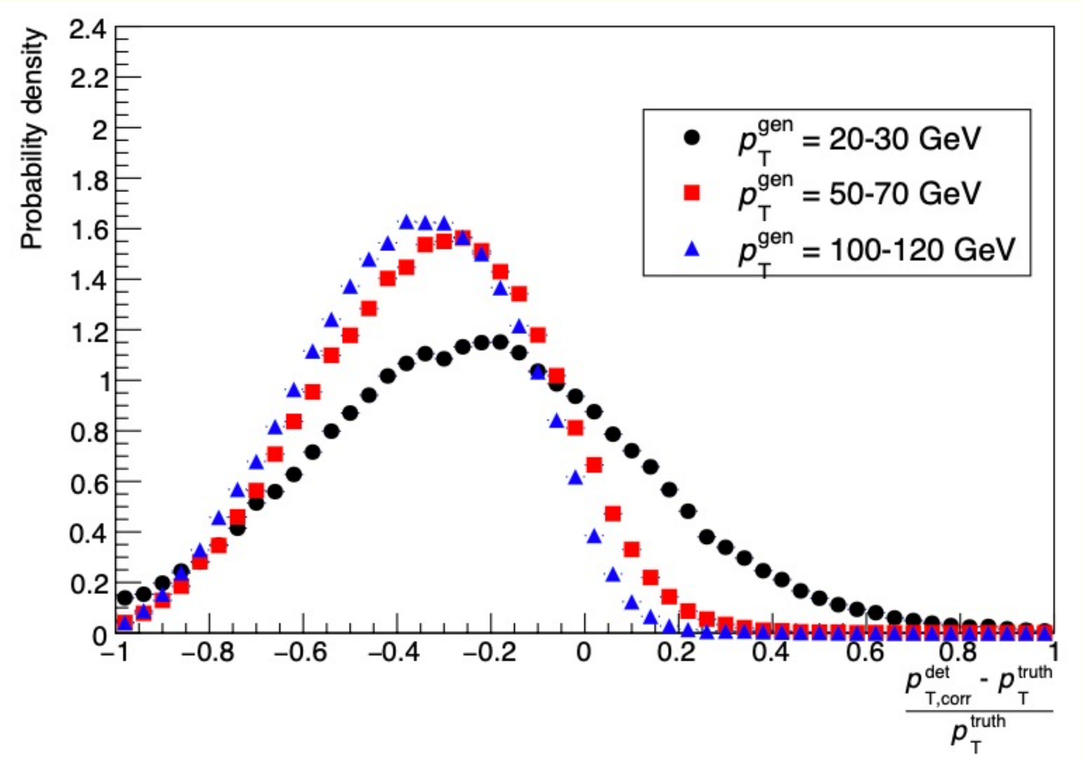
This Study (LHC18r)



And the right plot also does not show the centrality dependence.

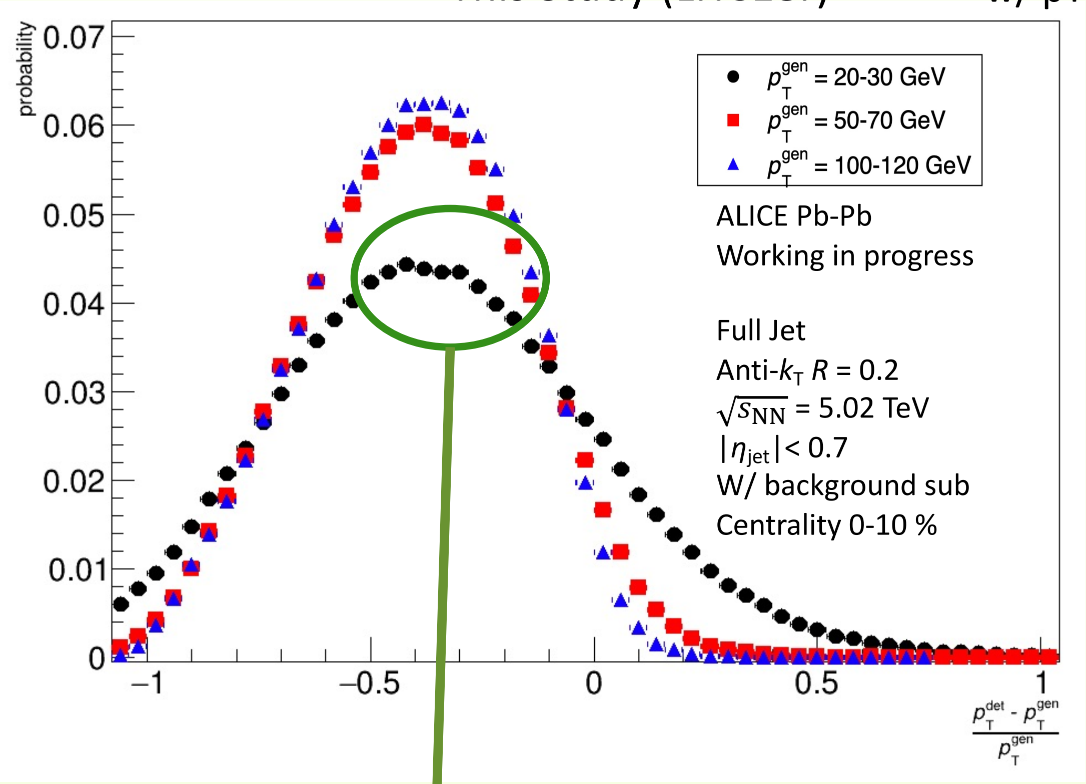
Jet Energy Scale(JES) shift

Preceding Study (2015)



This Study (LHC18r)

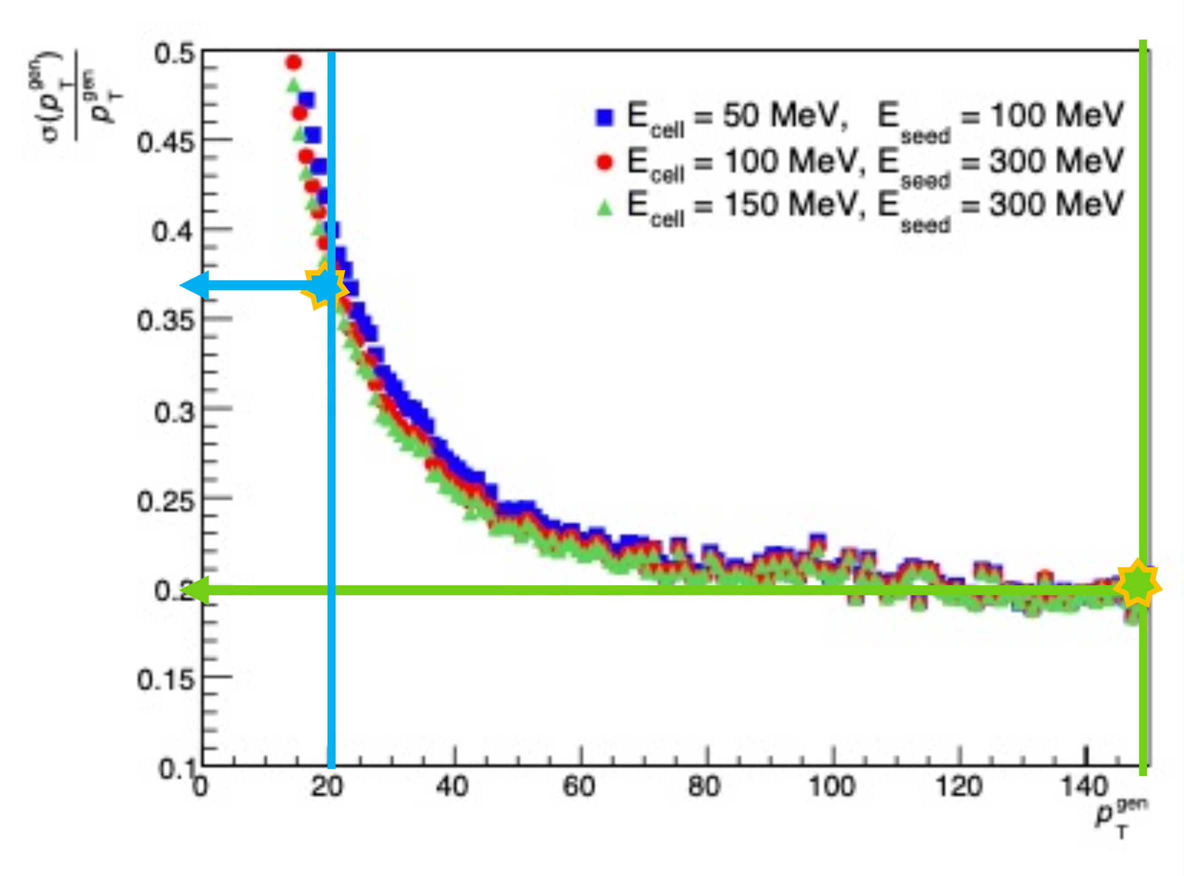
w/ pT scale



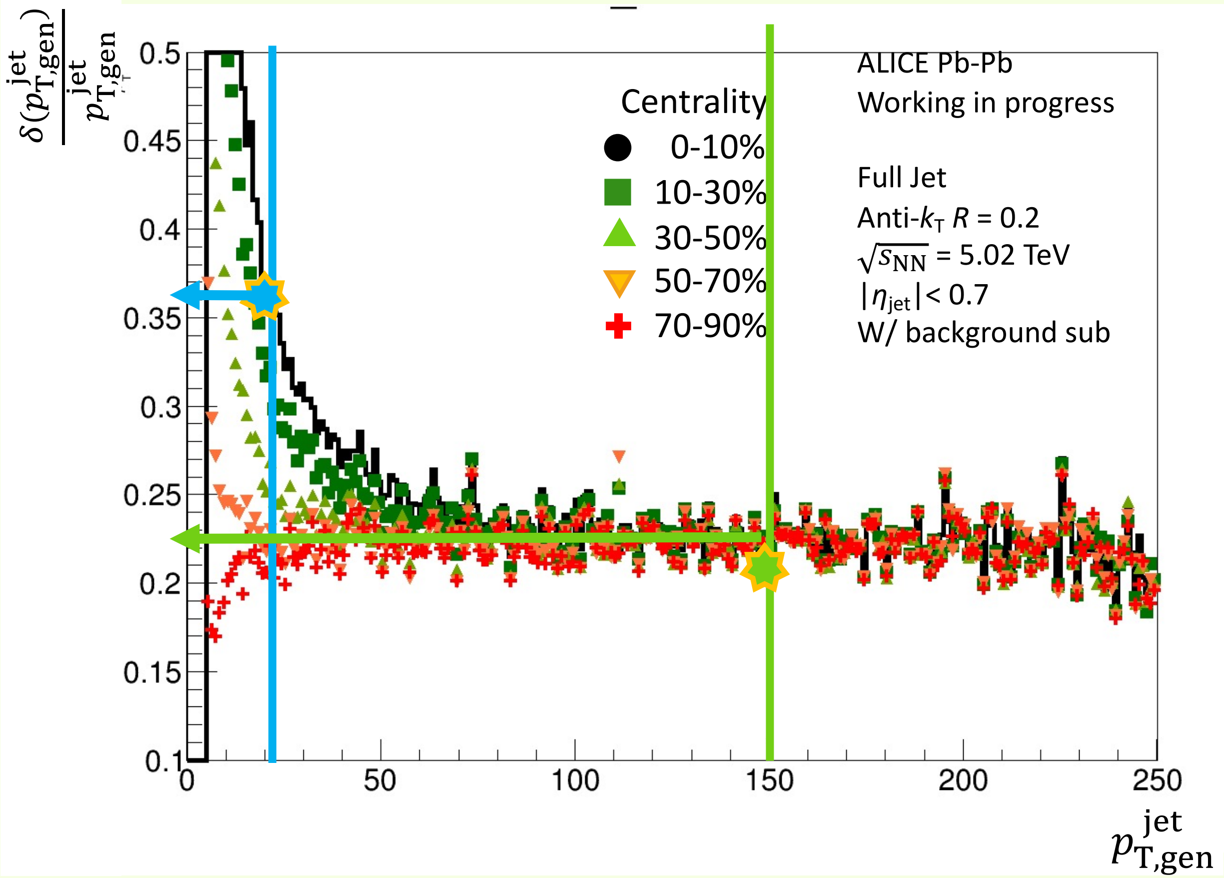
1. These plot's shapes are similar.
2. On the other hand, I could not understand why the left plot over than 1 even though the y axis shows plobability.
3. The plot of pt range 20-30 (black one) in the left plot has a strange peak.

Jet Energy Resolution (JER)

Preceding Study (2015)



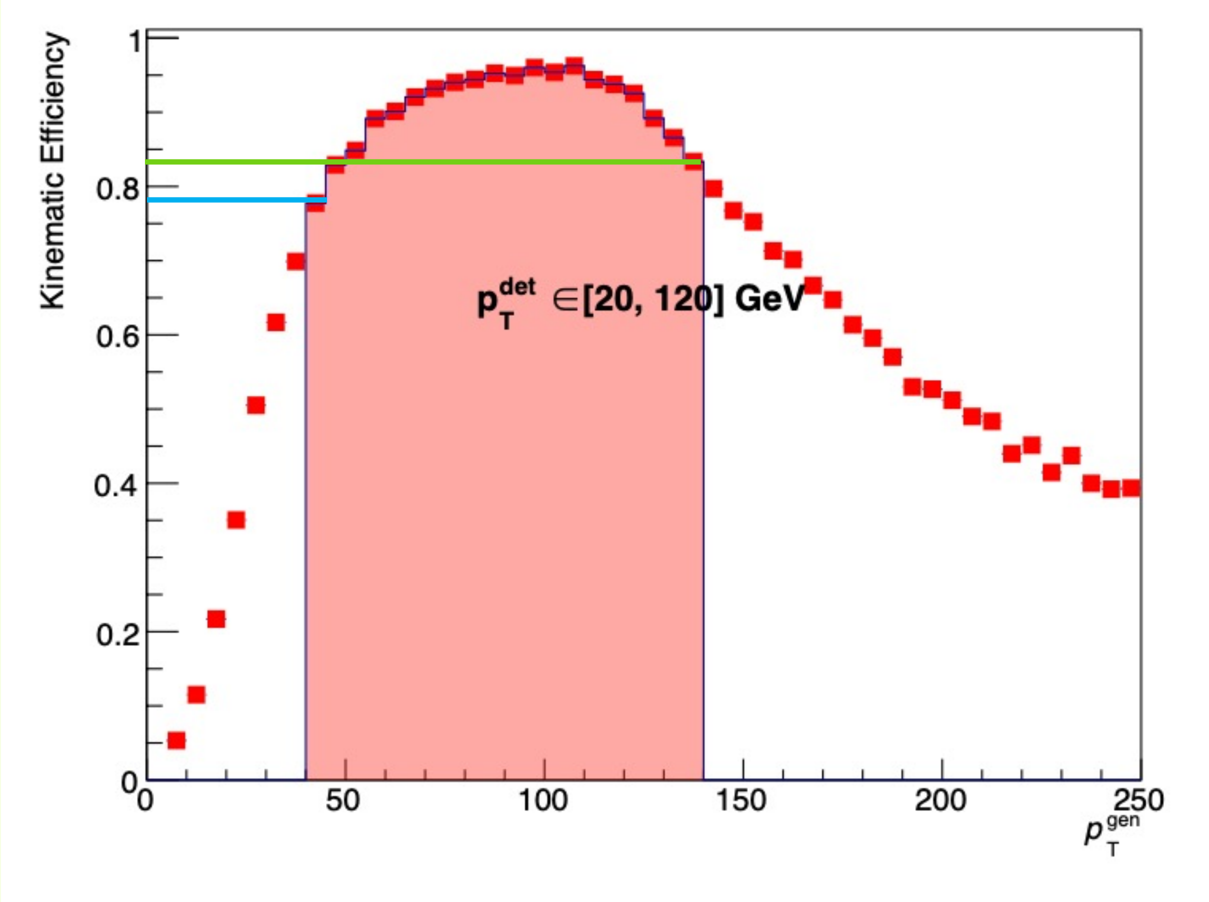
This Study (LHC18r)



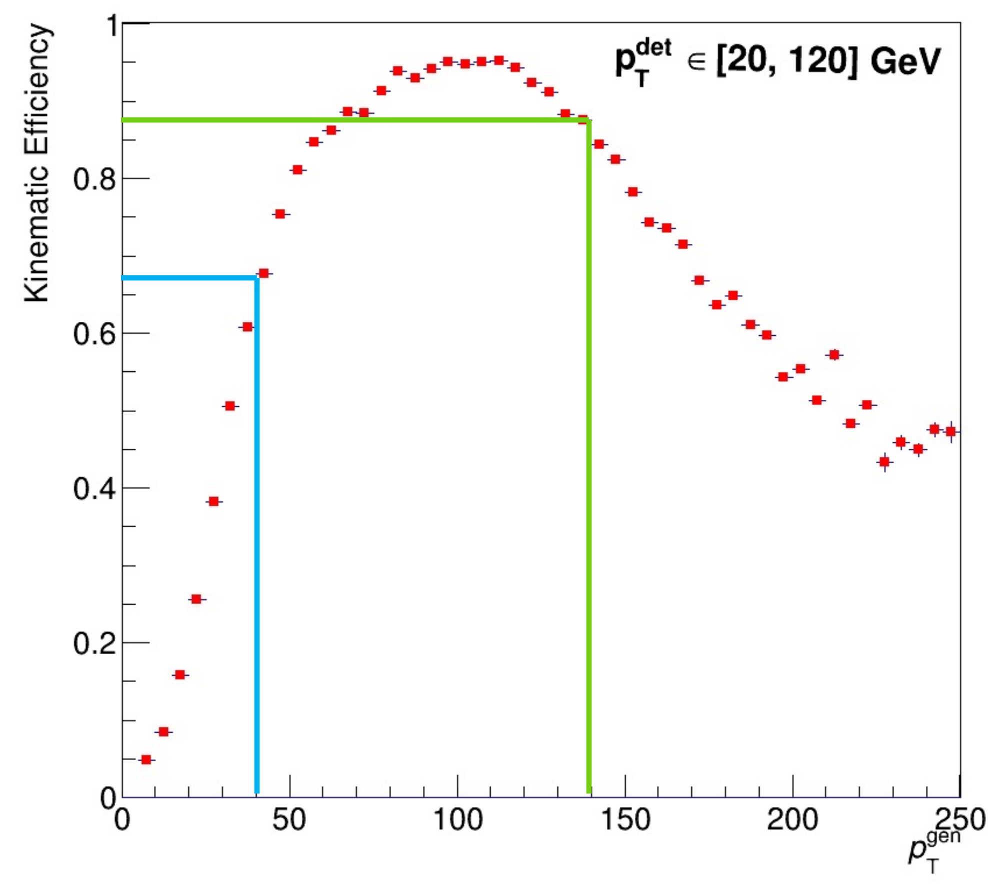
The JER plot of this study is far from the preceding study.
-> I still not understand the reason.

Kinematic efficiency

Preceding Study (2015)



This Study (LHC18r)

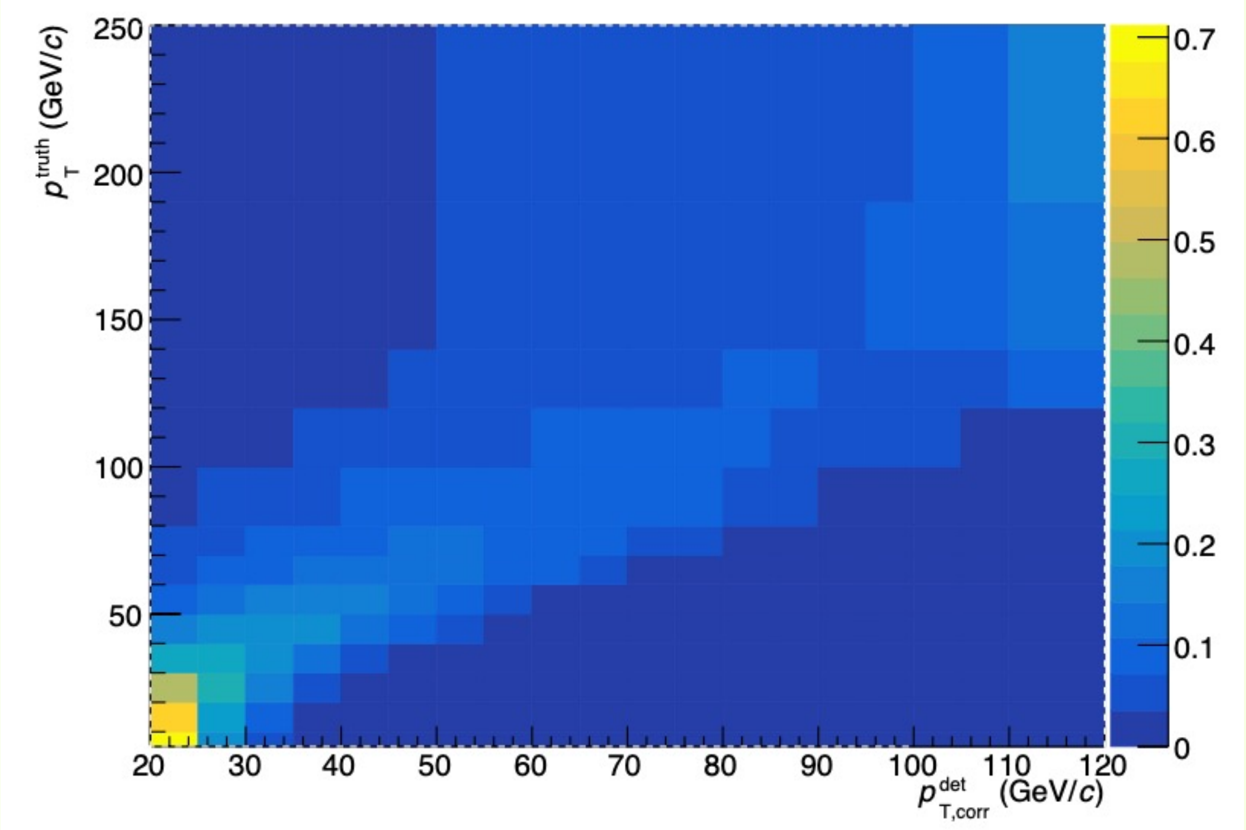


In high pT region, the efficiency seems resonable.

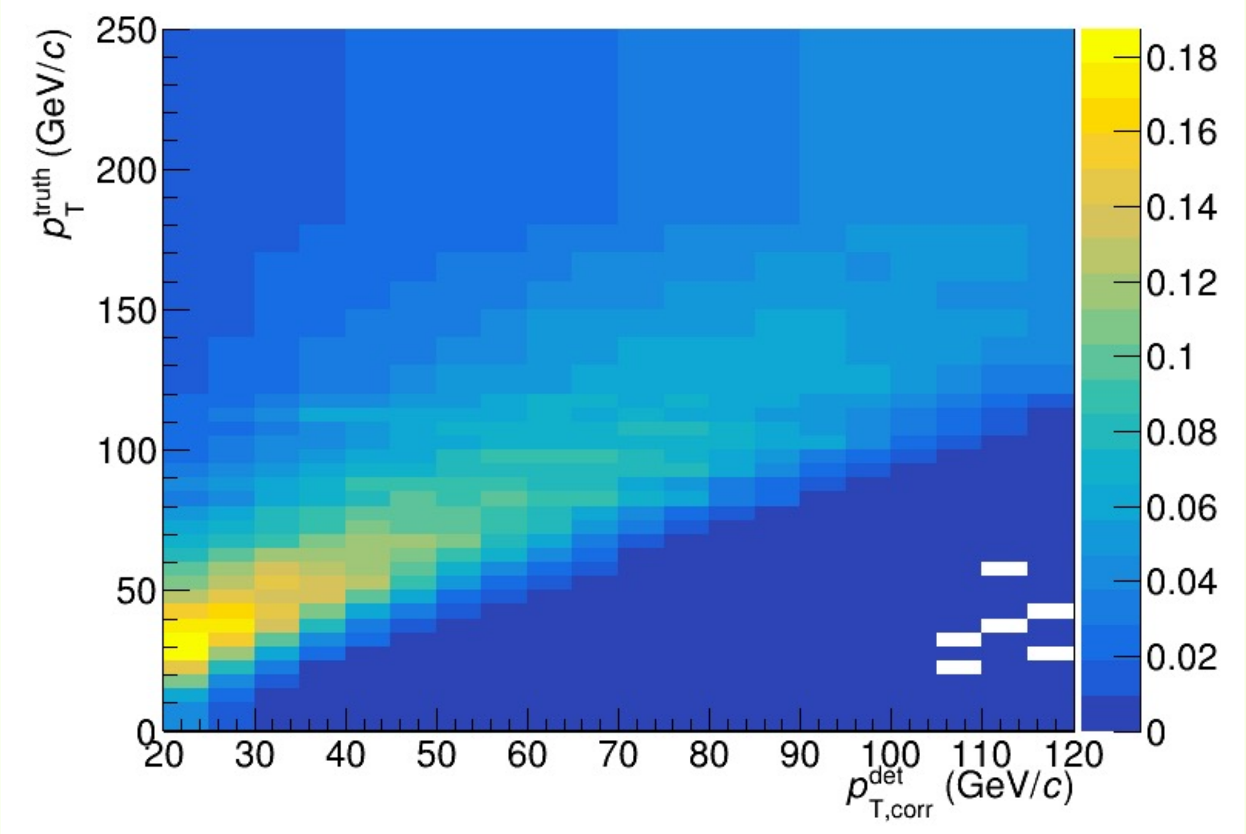
On the other hand, in low pT region, LHC18r result is lower than LHC15o results.

Response matrix

Preceding Study (2015)



This Study (LHC18r)

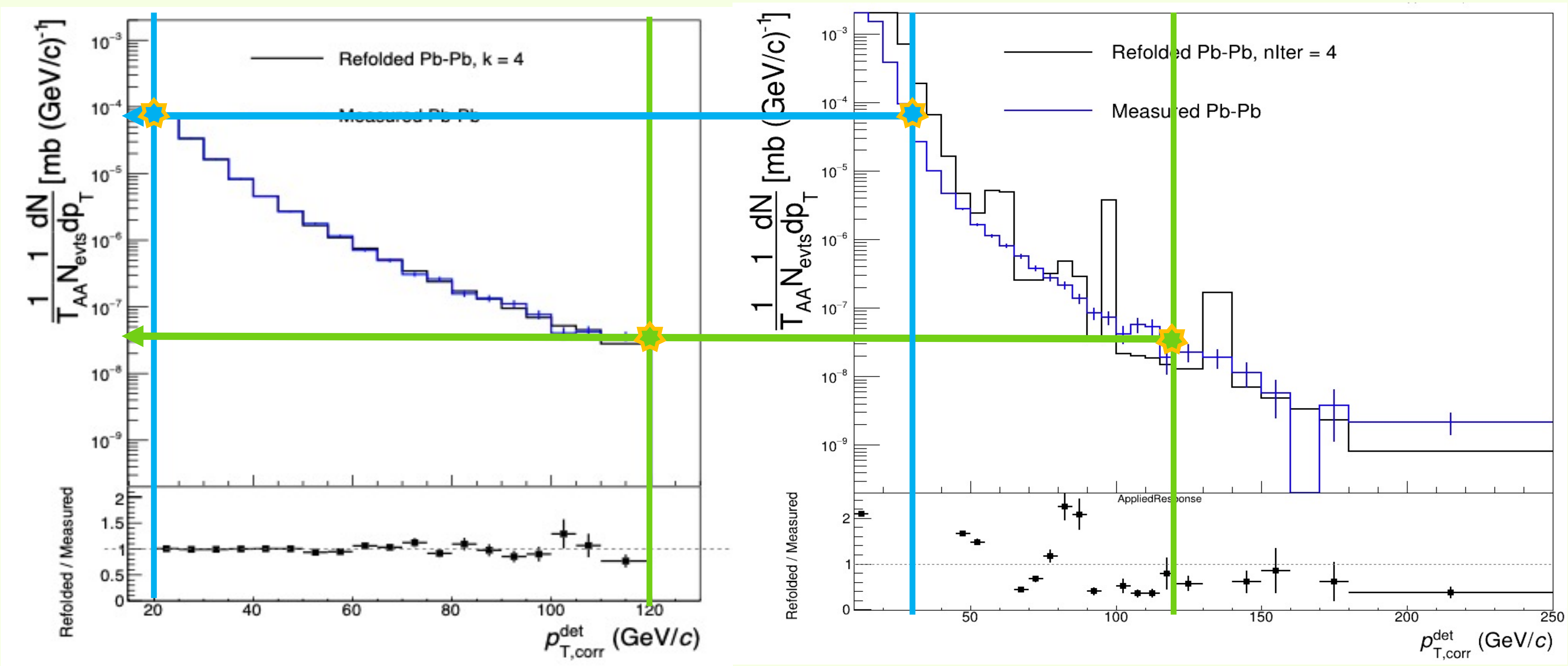


The diagonal components of LHC18r RM spreads than LHC15o one.

Refolding results

Preceding Study (2015)

Preceding Study (LHC18r)



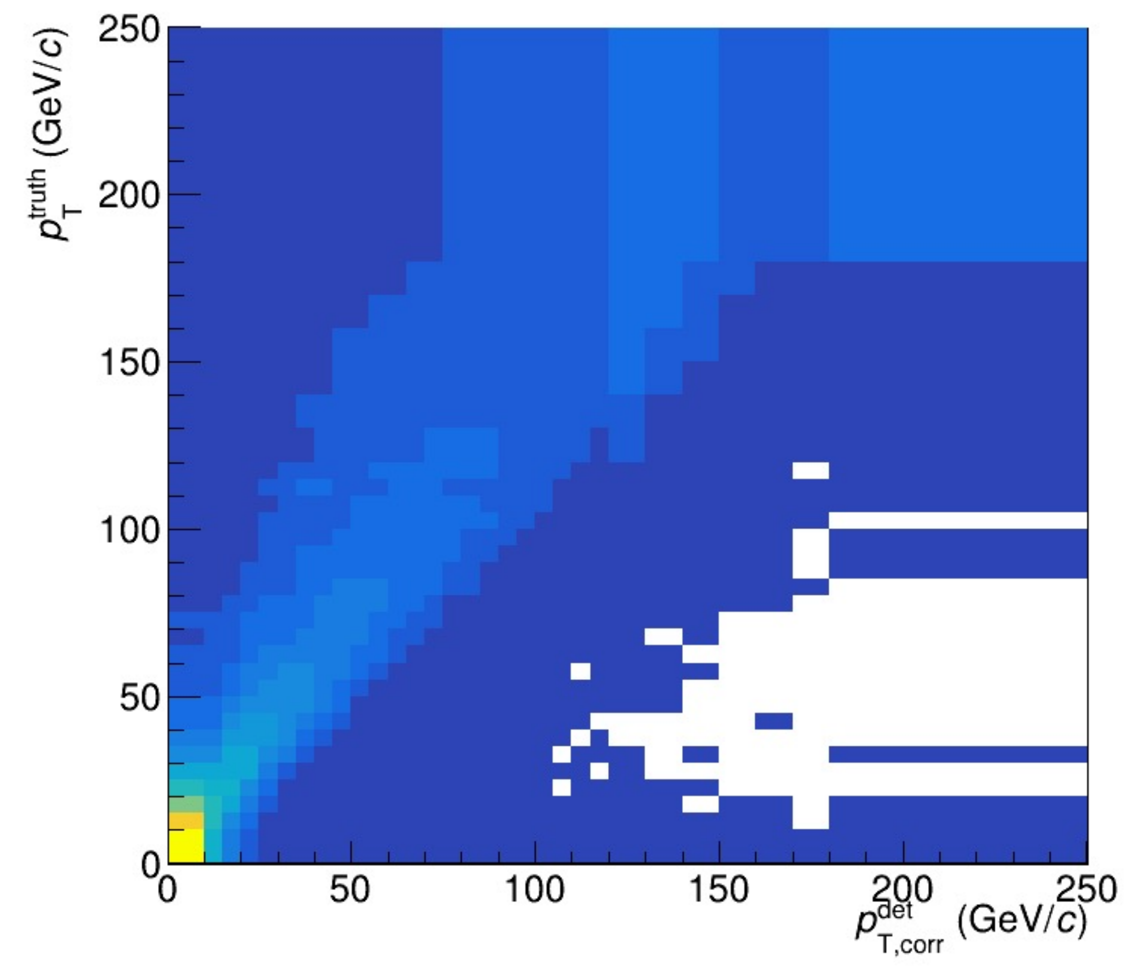
The measured resutls look slimilar.

However, the LHC18r refold results not stable.

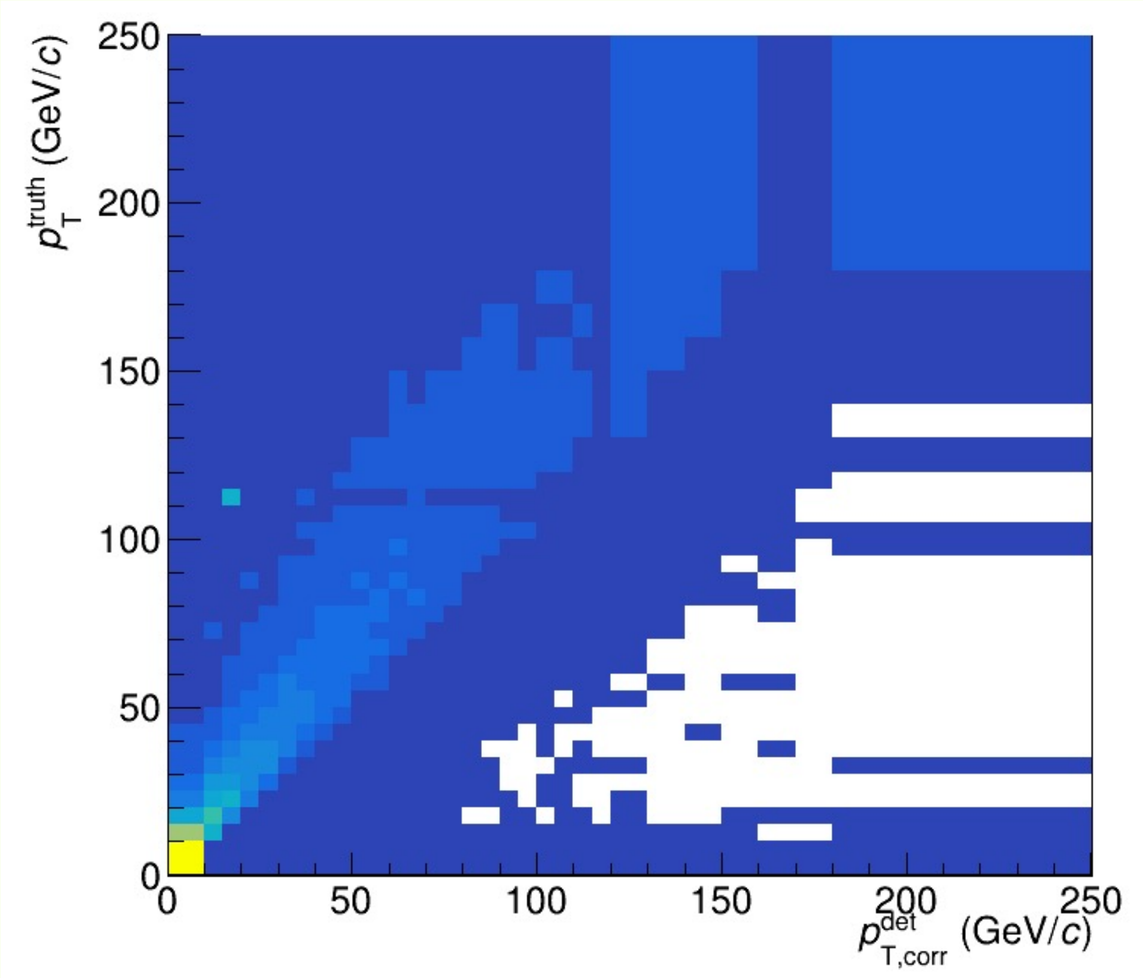
Different Centrality Comparison

Response Matrix (rebinned)

Centrality 0-10 %



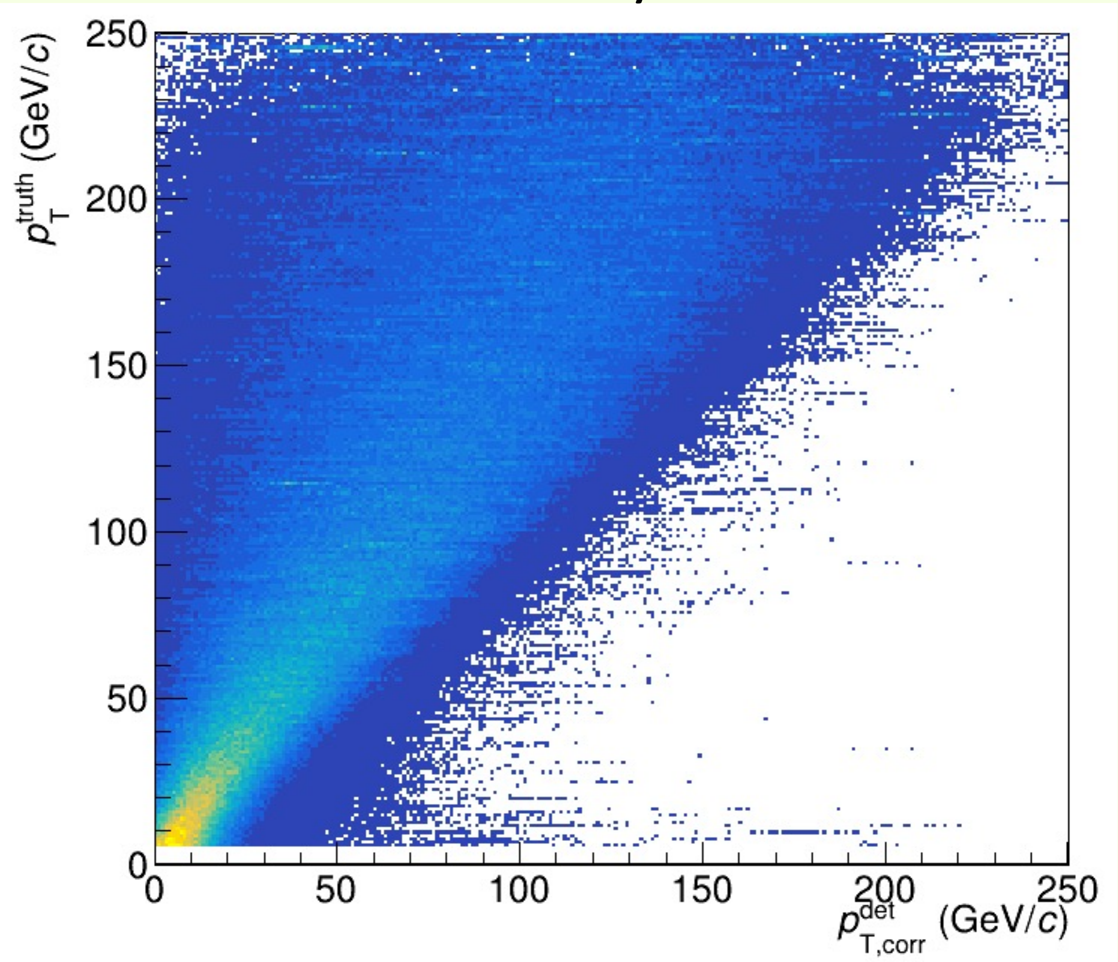
Centrality 70-90 %



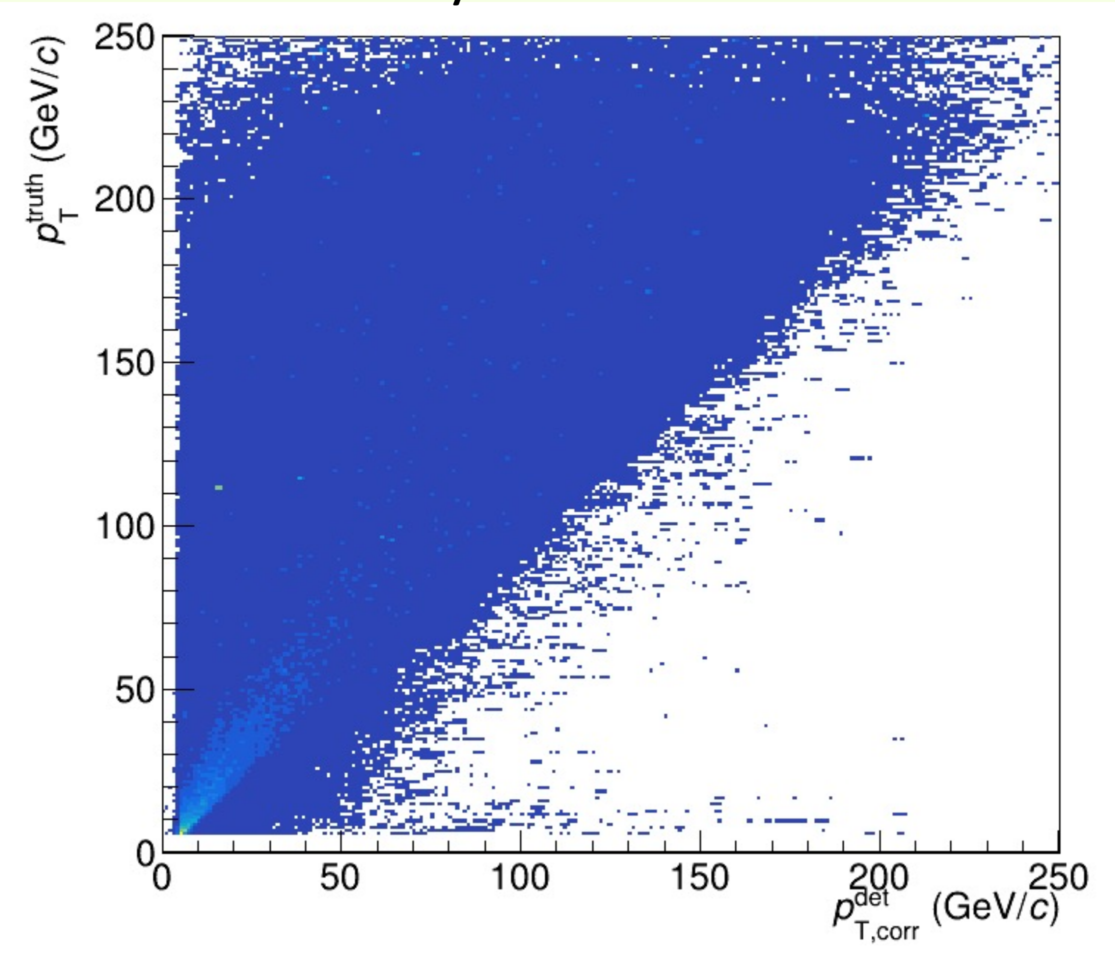
The peripheral RM is shaper than central RM

Response Matrix (fine binning)

Centrality 0-10 %

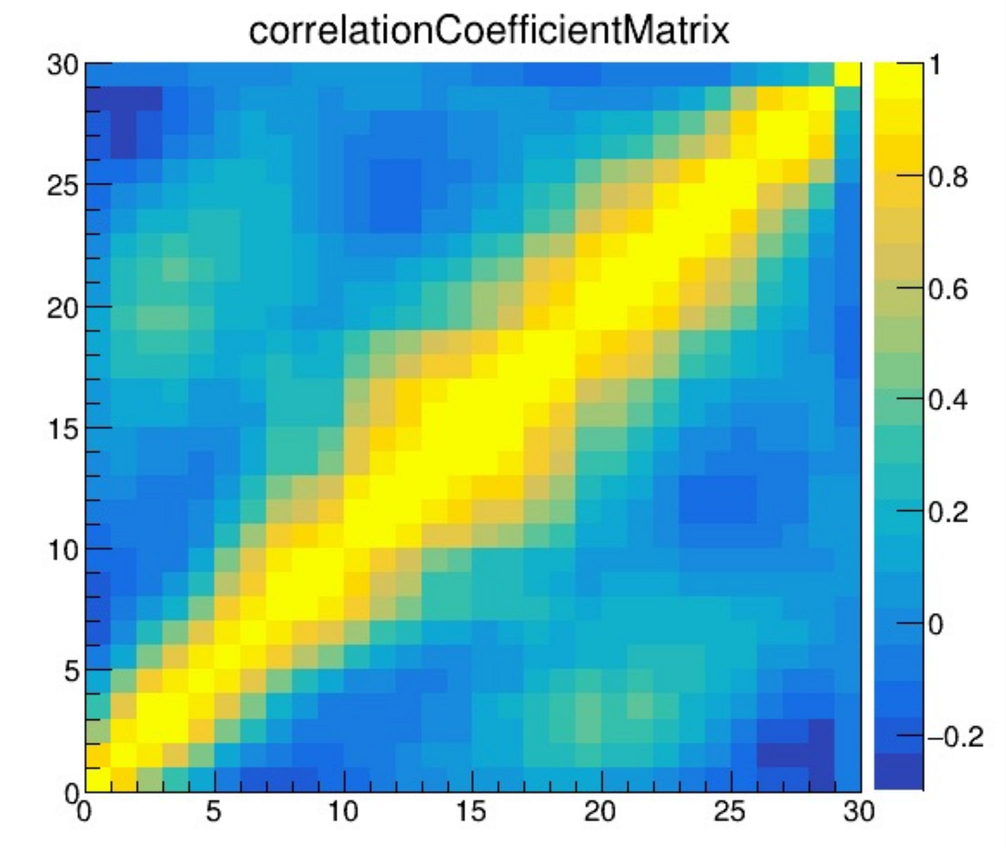


Centrality 70-90 %

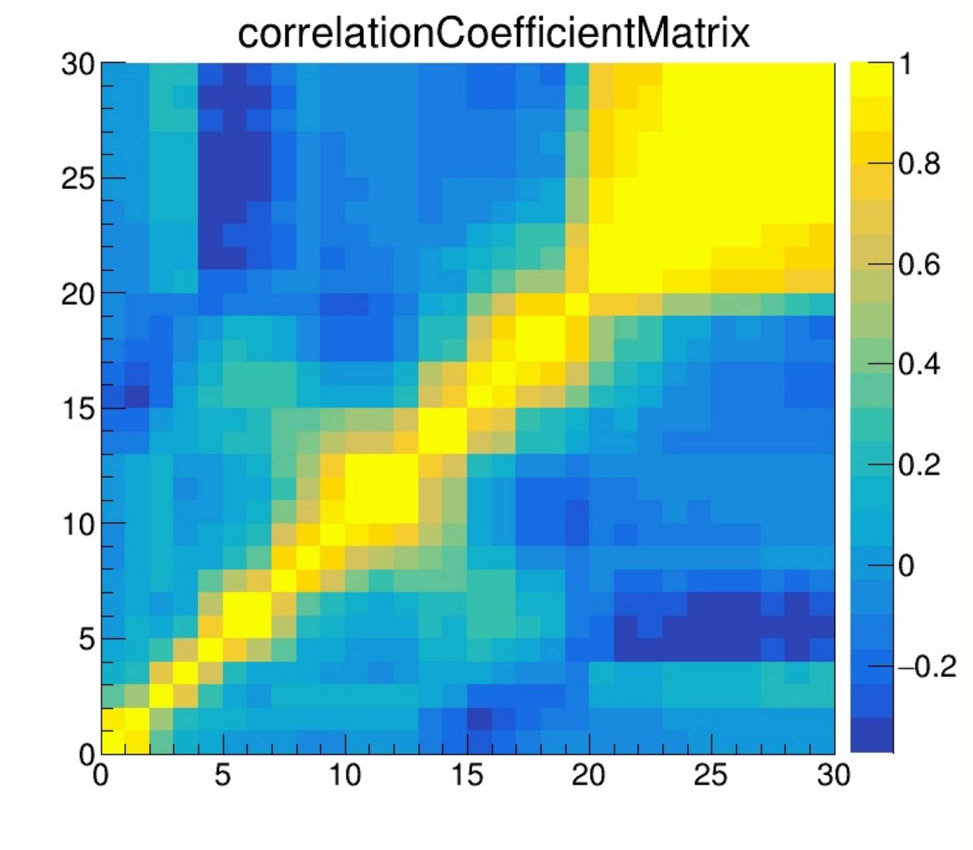


Coefficient Matrix

Centrality 0-10 %



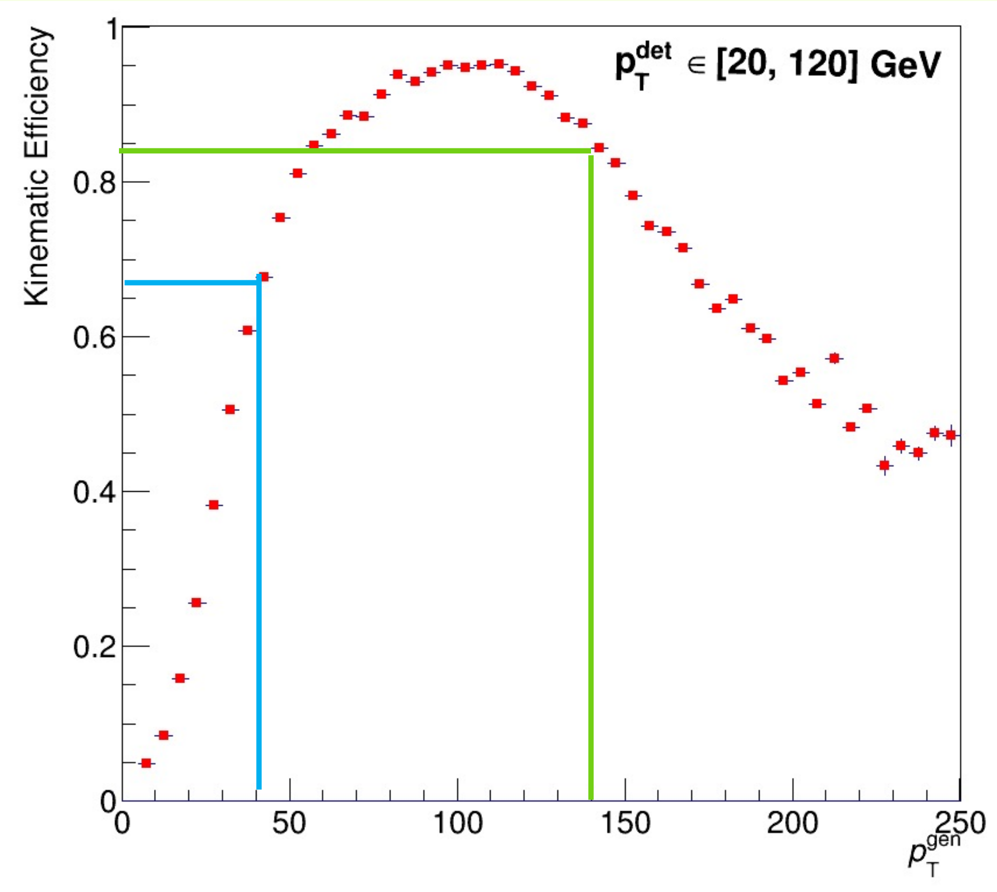
Centrality 70-90 %



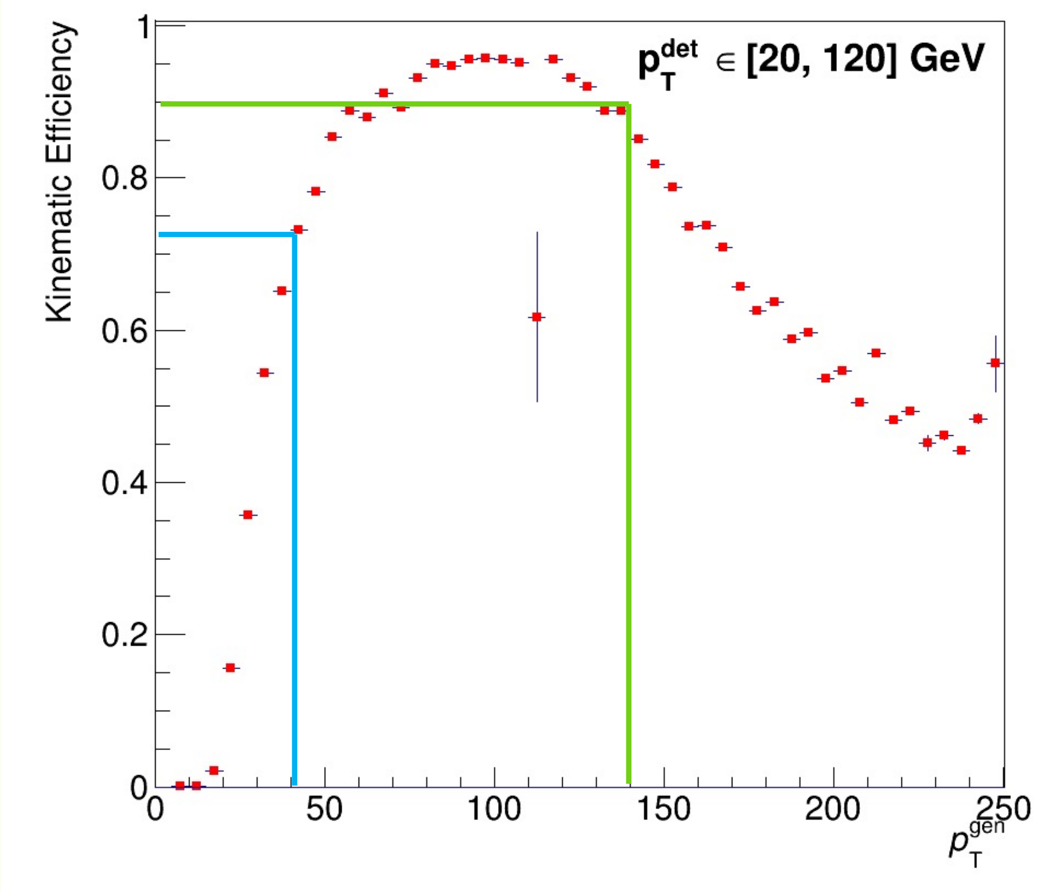
The peripheral RM is shaper than central RM

Kinematic efficiency

Centrality 0-10 %



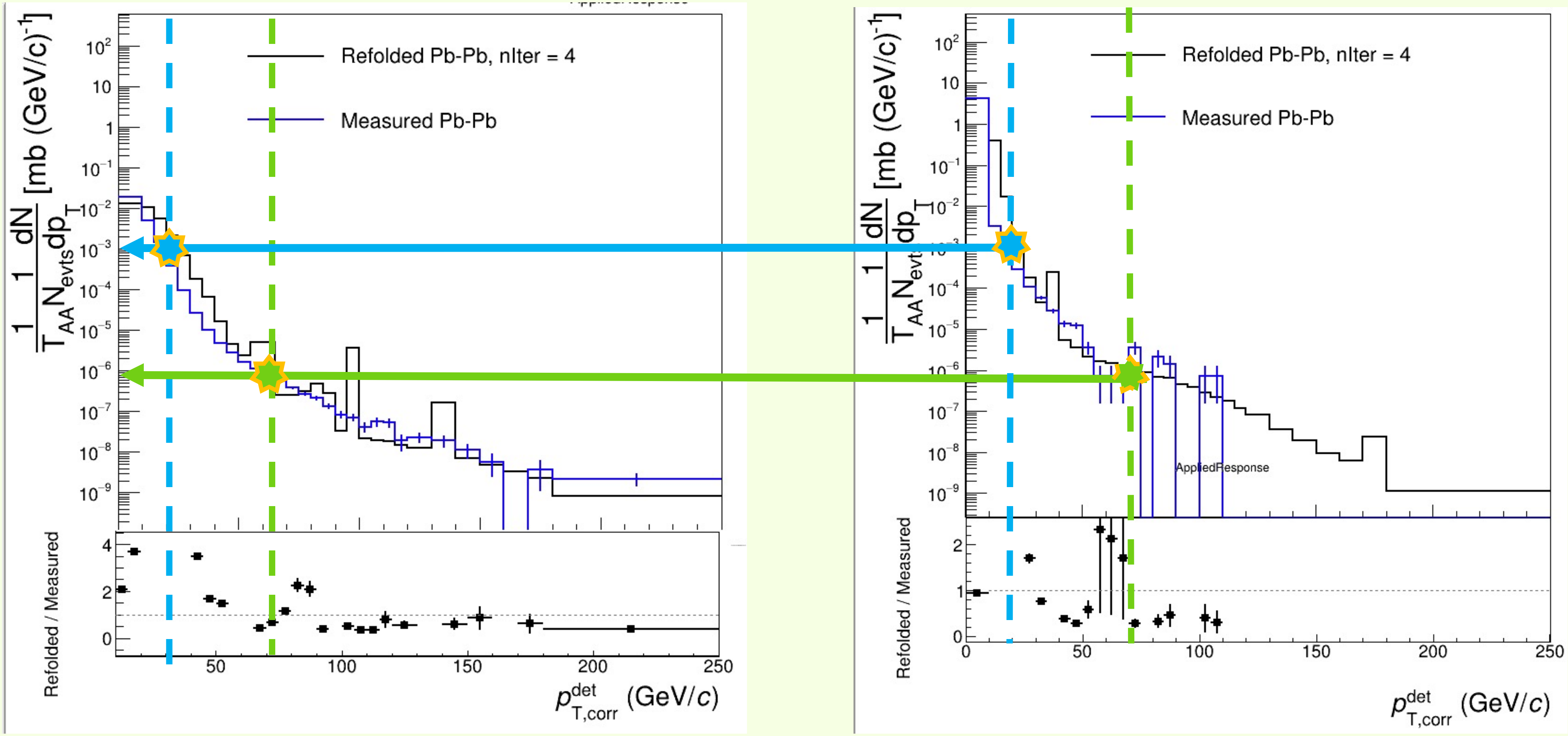
Centrality 70-90 %



Peripehral kinematic efficiency is higher than the central one.
-> This result is reasonable

Unfolding results

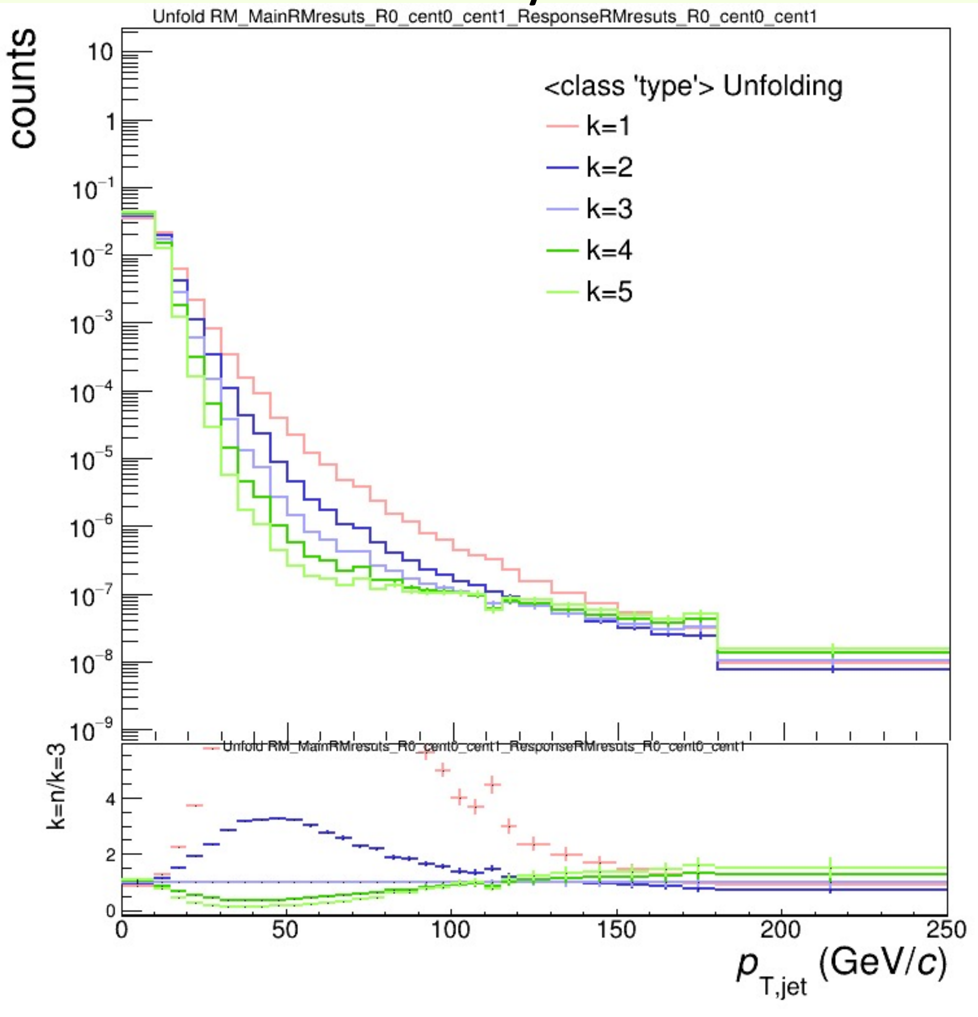
Centrality 0-10 %　　　Centrality 70-90 %



Not found a large difference between these plots.

But the peripheral result lack statistic in high pT region.

Centrality 0-10 %



Centrality 70-90 %