Ξ_c^0 production vs multiplicity via hadronic decay in pp@ 13 TeV

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Outline

- **Motivation of the analysis**
- **Data sample and event selection**
- **Analysis strategy**
  - Machine learning training and testing
  - Raw yield extraction
  - Efficiency calculation
  - Cross-section
- **Systematic uncertainties**
- **Summary and outlook**

Motivation

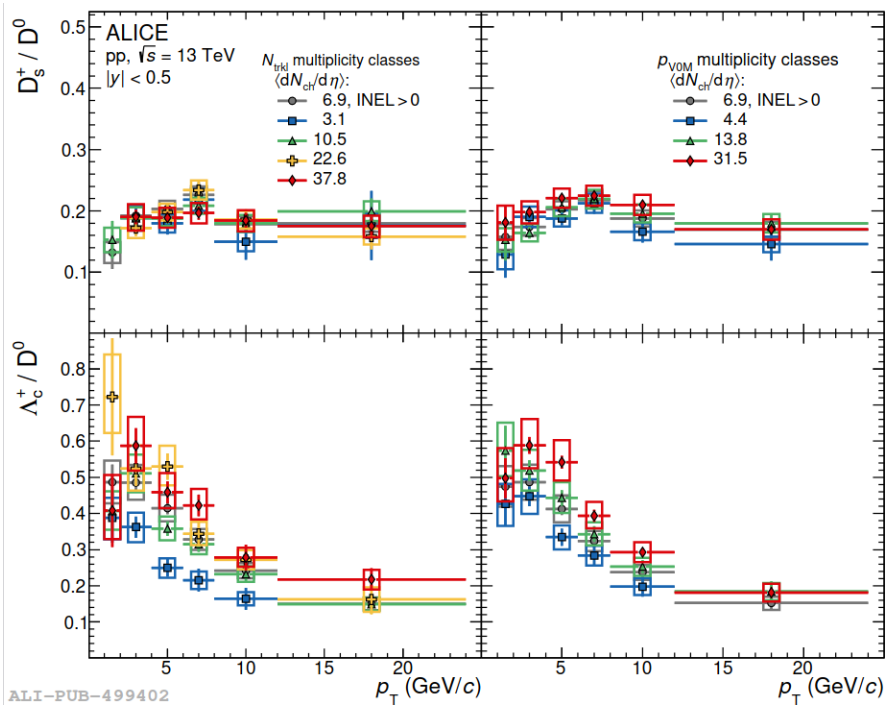
The heavy-flavour production cross section can be calculated as a convolution of three factors

- the parton distribution functions (PDFs)
- the partonic cross section calculated with perturbative QCD calculations
- the fragmentation functions (FFs).

The pre-measurements of the baryon-to-meson Λ_c^0/D^0 and $\Xi_c^{0,+}/D^0$cross section ratios in pp collisions are inconsistent with measurements in $e^+e^-$and ep collision

The p_T-differential yield ratio of Λ_c^+/D^0 shows a significant multiplicity dependence. (right)

The measurement of the multiplicity dependence of Ξ_c^0/D^0 yield ratio can provide further constraints on the study of charm hadronization.



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Data samples

MC sample

MB:LHC19g6f3_XcP8_2016, LHC19g6f2_XcP8_2017
LHC19g6f1_XcP8_2018

HM:LHC20k7a2_HMV0M_18_p8, LHC20k7b_HMV0M_17_p8
LHC20k7c_HMV0M_16_p8 (general D2H productio)

Data sample(Run 2)

- LHC2016 AOD208 kl 13TeV
- LHC2016 AOD208 deghjop 13TeV
- LHC2017 AOD208 cefhijklmor 13TeV
- LHC2018 AOD208 bdefghijklmnop 13TeV

Event selection

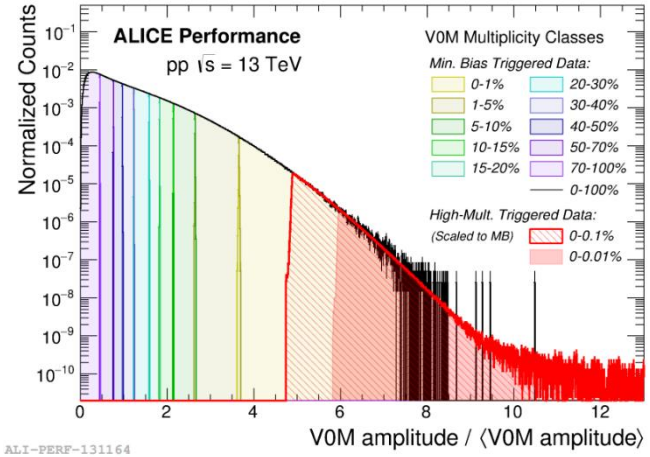
- Trigger Class:
  - kINT7 : MB
  - kHighMultV0 : HMV0
- Pileup rejection only for real data
- Primary vertex Z < 10 cm

Multiplicity

The selected events are grouped by multiplicity which is based on V0M percentile

$V0M_{pre}[\%]$	$\langle dNch/d\eta \rangle$	trigger	trigger efficiency	number event
[0.1-30]+INEL > 0	13.81	MB	0.92 ± 0.003	5.1×10^{8}
[30-100]+INEL > 0	4.41	MB	0.897 ± 0.013	1.34×10^{9}
[0-100]+INEL > 0	6.93	MB	0.997 ± 0.001	1.86×10^{9}
[0-0.1]+INEL > 0	31.53	HMV0M	1.0 ± 0.0	4.60×10^{8}

Table 6: The table showing V0M percentile multiplicity bins, the average charged particle density $\langle dNch/d\eta \rangle$, the trigger used, trigger efficiency, and number of events.



Analysis strategy

1. Reconstruction of $\Xi_c^0 \to \pi^+ + \Xi^- \to \pi^+(\pi^-\Lambda) \to \pi^+(\pi^-(p\pi^-))$ use Kalman Filter (KF) package
2. Use pre-selection and ML to separate of signal and background
   - ML training using XGBoost (integrated in hipe4ml package)
3. Extract raw yield via invariant mass fit
4. Efficiency calculation from MC
   - p_{T} re-weight
   - Mult. re-weight
5. Per-event yields calculation
6. Systematics

Cuts variables	Cuts
AOD filter bit	4 (Standard cuts with very loose DCA)
Number of TPC crossed rows	> 70
TPC cross rows / findable ratio	> 0.8
Number of TPC clusters for $\mathrm{d}E/\mathrm{d}x$	> 50
χ^2/NDF of momentum fit	< 5
Number of points in ITS	> 3

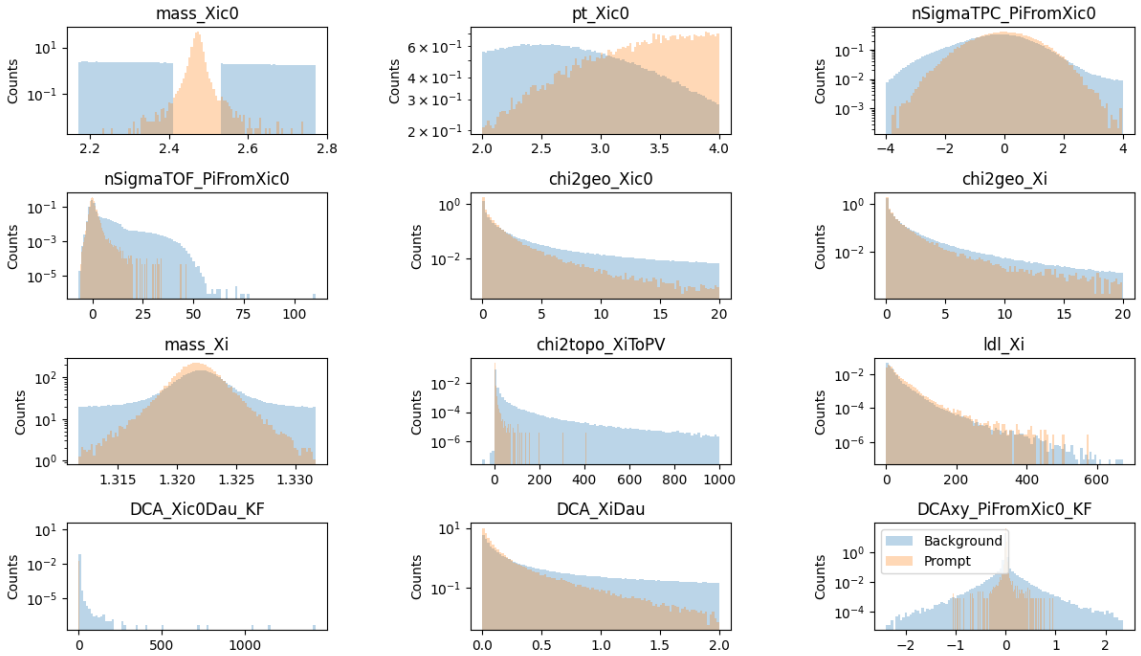
$p_{\mathrm{T}}^{\Xi_c^0}$ (GeV/c)	(2, 4)	(4, 6)	(6, 8)	(8, 12)
$p_{\mathrm{T}}^{\pi \leftarrow \Xi_c^0}$ cut	1.0	1.0	0.4	0.4

Cuts variables	Cuts
Number of TPC crossed rows	> 70
TPC cross rows / findable ratio	> 0.8
Number of TPC clusters for $\mathrm{d}E/\mathrm{d}x$	> 50

ML

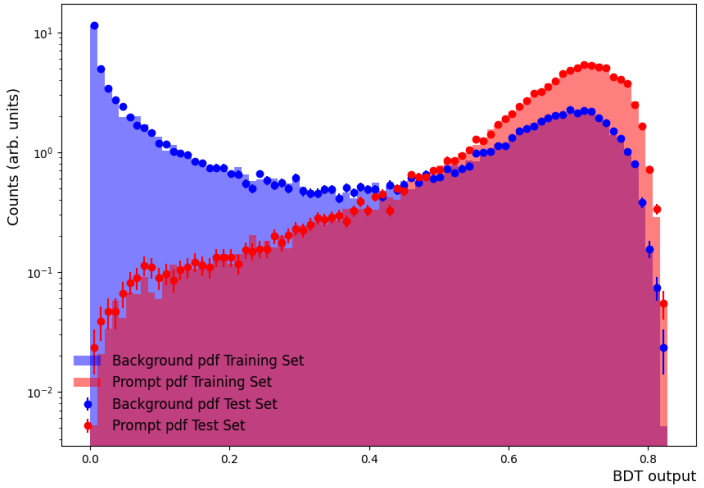
ML is able to handle complex data, make predictions, automate processes

$2 < p_{\mathrm{T}} < 4$ GeV/c



training_columns: [nSigmaTPC_PiFromXic0, nSigmaTOF_PiFromXic0, chi2geo_Xic0, chi2geo_Xi, mass_Xi, chi2topo_XiToPV, ldl_Xi, DCA_Xic0Dau_KF, DCA_XiDau, DCAxy_PiFromXic0_KF]

BDT distribution



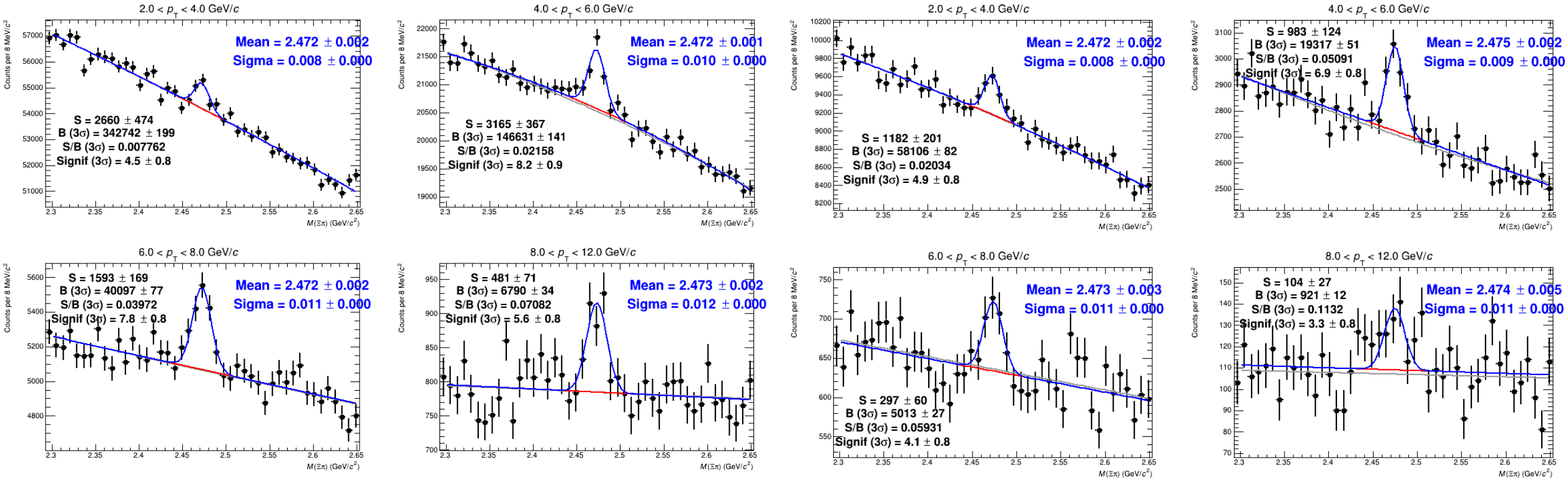
The distribution indicates the contribution and relative importance of each tree to the final model

Invariant mass

Fit function

Signal: Gaussian

Bkg: Pol2 for [2-4] & [4-6], Pol1 for [6-8] & [8-12]



HM [0-0.1]

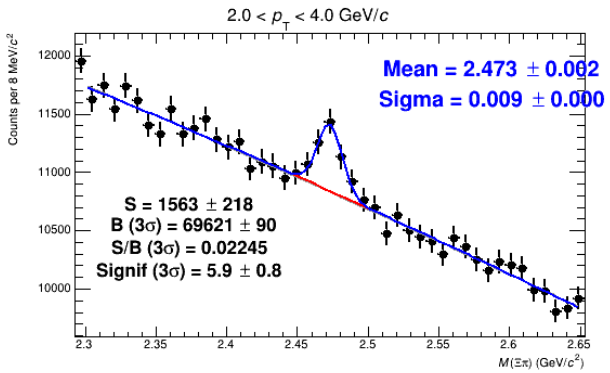
MB [0.1-30]

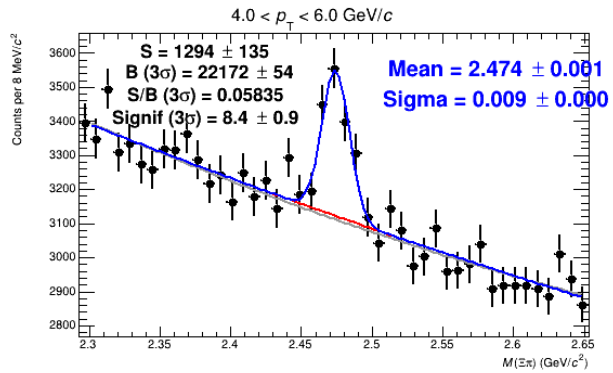
Invariant mass

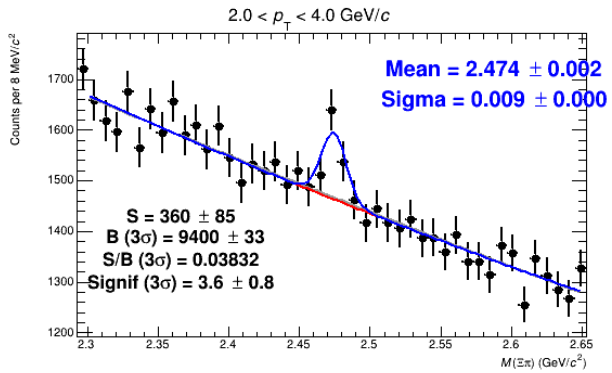
Fit function

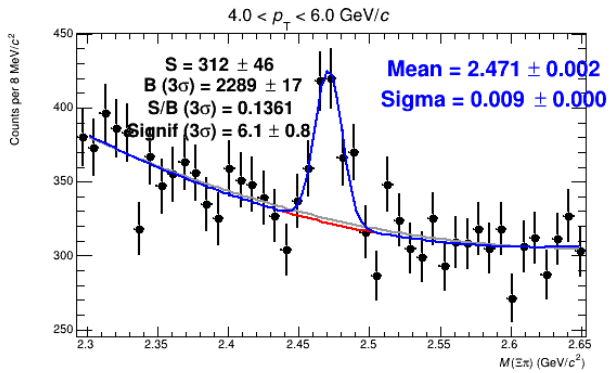
Signal: Gaussian

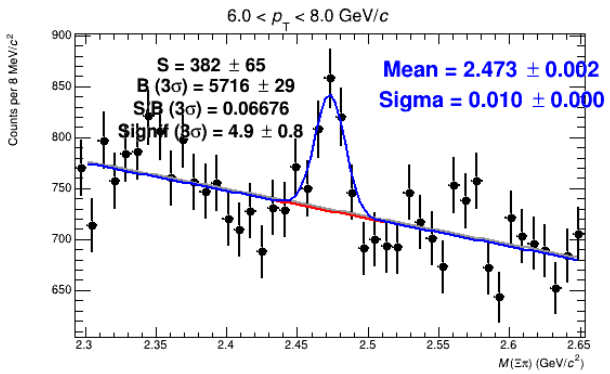
Bkg: Pol2 for [2-4] & [4-6], Pol1 for [6-8] & [8-12] (not include in MB[30-100])

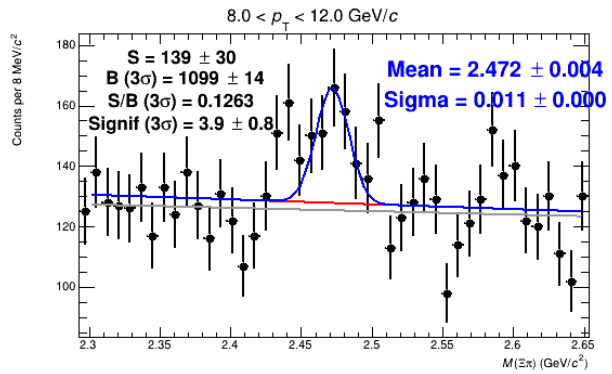


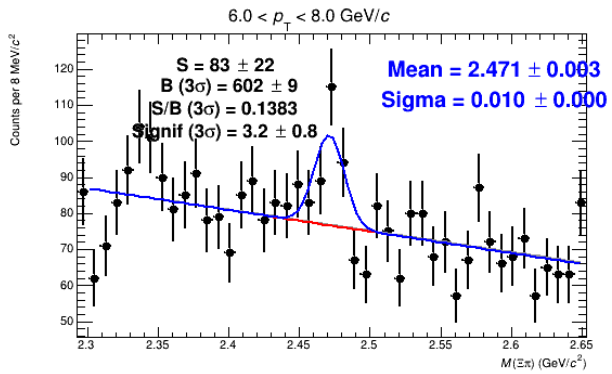


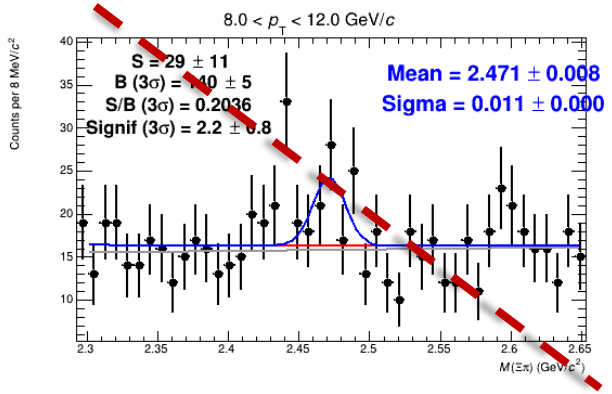










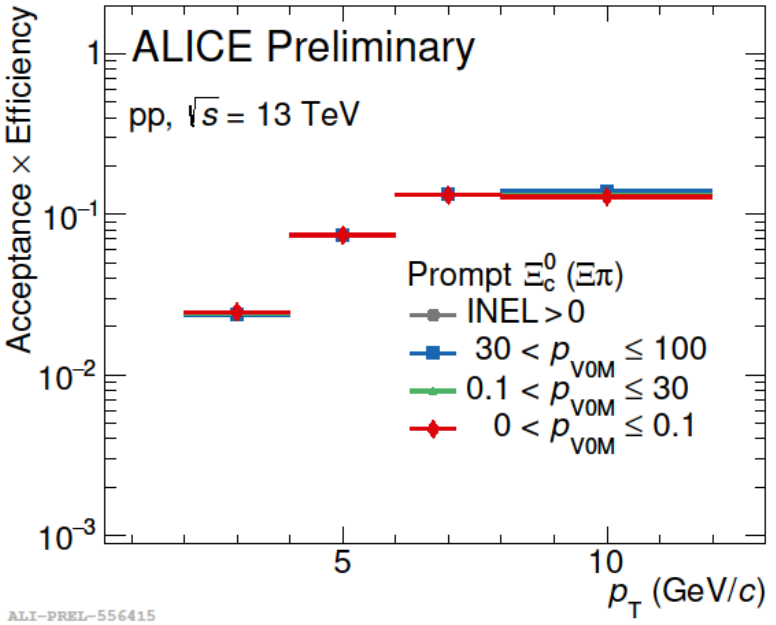


MB [0-100]

MB [30-100]

Acceptance-times-efficiency

The different pt and multiplicity bin were corrected by reconstruction and selection efficiency as well as acceptance



Prompt accept-times-efficiency of V0M percentile multiplicity bin as function of pt

Feed-Down correction

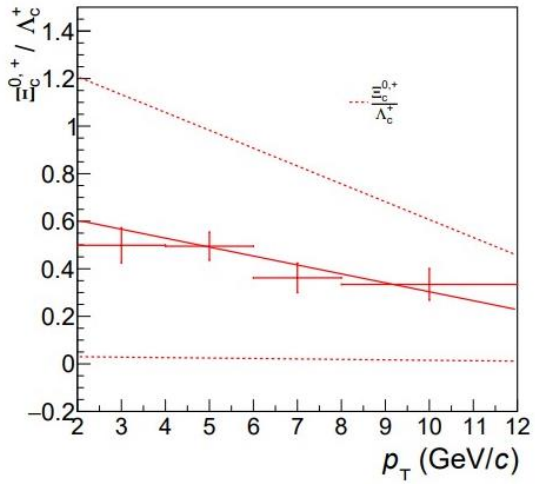
$$f_{prompt} = 1 - \frac{N_{\Xi_c^0\ from\ b}}{N_{\Xi_c^0,raw}} = 1 - \frac{1}{N_{\Xi_c^0,raw}} \cdot \frac{\left(\frac{d^2\sigma}{dp_T dy}\right)^{theory}_{b\to X\to \Xi_C}}{dp_T dy} \cdot 2 \cdot (Acc * \varepsilon)_{feed-down} \cdot \Delta p_T \cdot \Delta y \cdot BR \cdot L_{int}$$

$$\left(\frac{d^2\sigma}{dp_T dy}\right)^{theory}_{b\to X\to \Xi_C} = \left(\frac{d^2\sigma}{dp_T dy}\right)^{FONLL}_{b\to X\to \Lambda_C} * \left(\frac{\sum_{H_b} F(b\to H_b\to \Xi_c)}{\sum_{H_b} F(b\to H_b\to \Lambda_c)}\right)$$

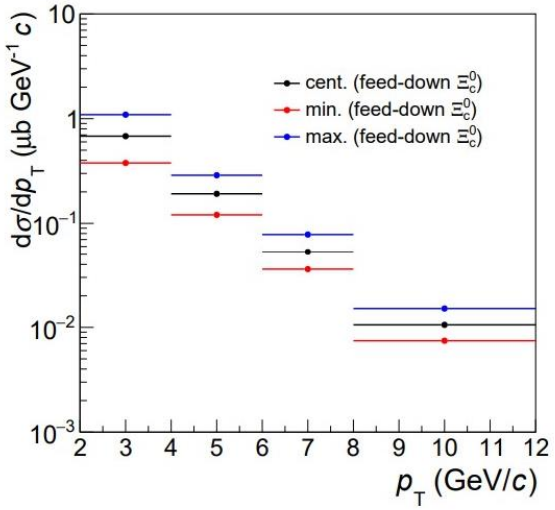
$$\approx \left(\frac{d^2\sigma}{dp_T dy}\right)^{FONLL}_{b\to X\to \Lambda_C} * \frac{c\to \Xi_c}{c\to \Lambda_c}$$

Assumption:

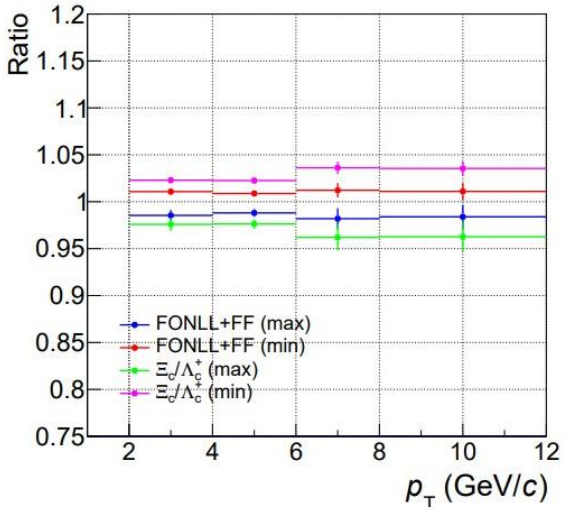
- The $b \to \Lambda_b \to \Lambda_c$ and $b \to \Xi_b \to \Xi_c$ dominant
- The ratio of Ξ_c^0/Λ_c is constant for both inclusive and feed-down baryons.



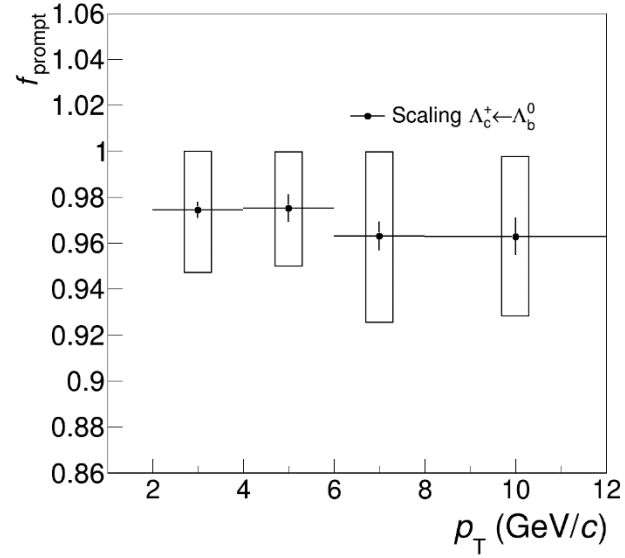
The ratio Ξ_c of over Λ_c uncertainty



The cross section of feed-down Ξ_c^0 obtained with the scaling procedure



Different scan method



systematic uncertainty for the prompt Ξ_c^0

Systematic uncertainty

$\Xi_c^0 \to \pi^+\Xi^- \to \pi^+(\pi^-\Lambda) \to \pi^+(\pi^-(p\pi^-))$	p_T interval(GeV/c)			
[0-100]	(2, 4)	(4, 6)	(6, 8)	(8 ,12)
Raw Yield	6%	6%	8%	10%
Tracking	5%	5%	5%	8%
BDT	8%	6%	7%	4%
MC p_T	3%	1%	0%	0%
Multiplicity weight	0%	0%	1%	1%
Prompt fraction	2%	2%	3%	3%
Prompt fraction(mult. dep.)	-	-	-	-
[30-100]	(2, 4)	(4, 6)	(6, 8)	(8, 12)
Raw Yield	8%	12%	6%	-
Tracking	5%	5%	5%	-
BDT	12%	10%	8%	-
MC p_T	3%	1%	0%	-
Multiplicity weight	0%	0%	0%	-
Prompt fraction	2%	2%	3%	-
Prompt fraction(mult.dep.)	2%	2%	2%	-

[0.1-30]	(2, 4)	(4, 6)	(6, 8)	(8, 12)
Raw Yield	8%	6%	10%	10%
Tracking	5%	5%	5%	8%
BDT	6%	4%	7%	8%
MC p_T	3%	1%	0%	0%
Multiplicity weight	0%	0%	1%	1%
Prompt fraction	2%	2%	3%	3%
Prompt fraction(mult. dep.)	1%	1%	2%	3%
[0-0.1]	(2, 4)	(4, 6)	(6, 8)	(8, 12)
Raw Yield	10%	12%	10%	6%
Tracking	5%	5%	5%	8%
BDT	6%	4%	10%	6%
MC p_T	3%	1%	0%	0%
Multiplicity weight	0%	0%	0%	0%
Prompt fraction	2%	2%	3%	3%
Prompt fraction(mult. dep.)	2%	2%	2%	3%

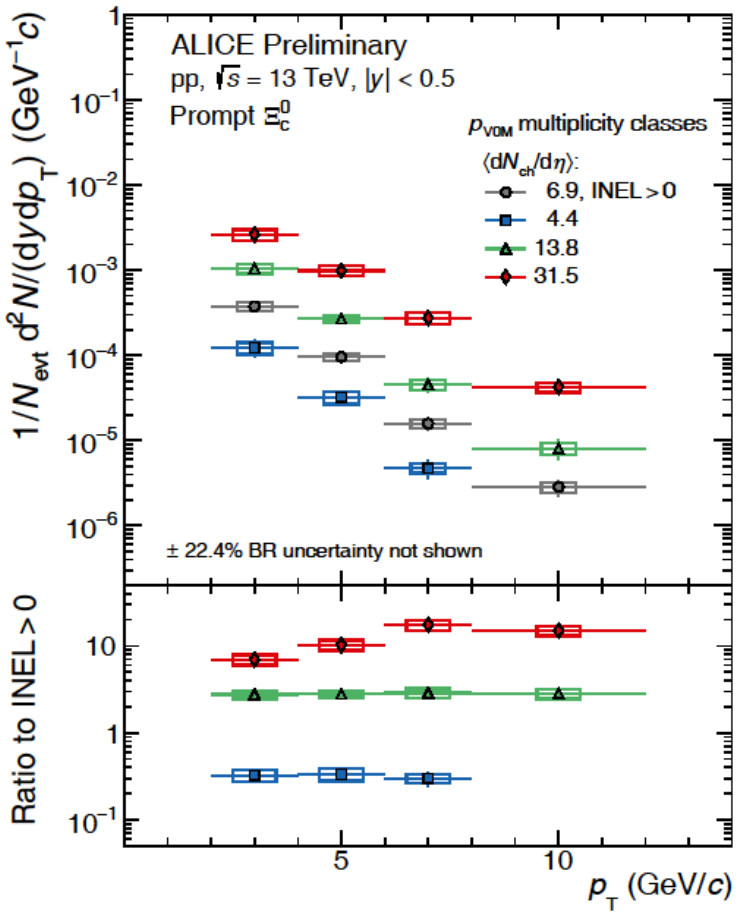
Table 17: The systematic uncertainties for Ξ_c^0 in each p_T bin. (22.4% uncertaities of branch ratio not show)

Systematics $\Xi_c^0 \to \pi^+\Xi^- \to \pi^+(\pi^-\Lambda) \to \pi^+(\pi^-(p\pi^-))$ for V0M percentile estimator (except for brancing ratio $\pm$22.38%)

More detail in backup

p_{T} spectra of Ξ_{c}^{0} in different mult.

$$\frac{1}{N_{mult}}\frac{dN_{mult}^{hadron}}{dp_{\mathrm{T}}} = \frac{1}{N_{mult}}\frac{1}{\Delta p_{\mathrm{T}}}\frac{1}{\mathrm{BR}_{\mathrm{channel}}}\frac{f_{prompt}\varepsilon_{triger}N_{mult}^{hadron,raw}}{2y_{fid}(Acc\times\varepsilon)_{prompt}}$$

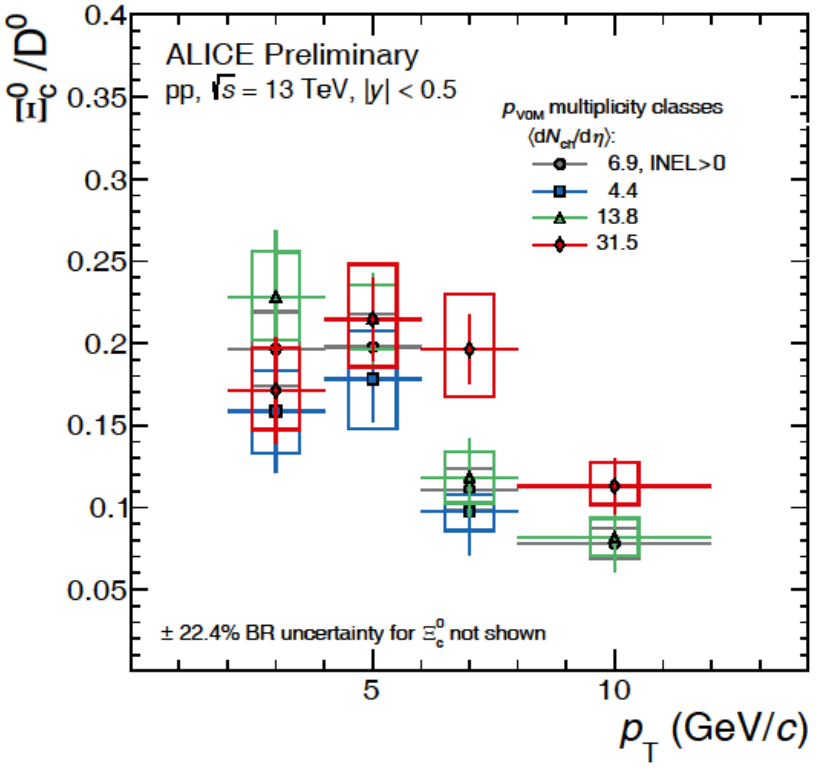


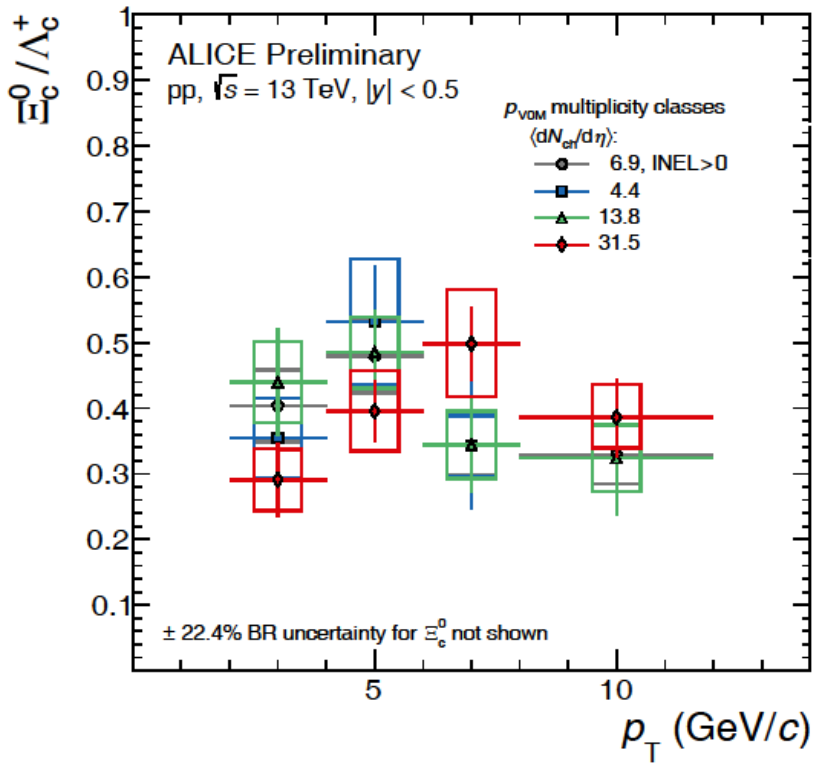
pt spectra of Ξ_{c}^{0} measured in different multiplicity classes selected with V0M at forward rapidity.

The corresponding ratios to inelastic collisions event with at least one charged particle in the pseudorapidity range $|\eta| < 1$(INEL > 0)

Ξ_c^0/D^0 and Ξ_c^0/Λ_c^+

The Ξ_c^0/D^0 and Ξ_c^0/Λ_c^+ ratios at different multiplicity classes in pp collisions

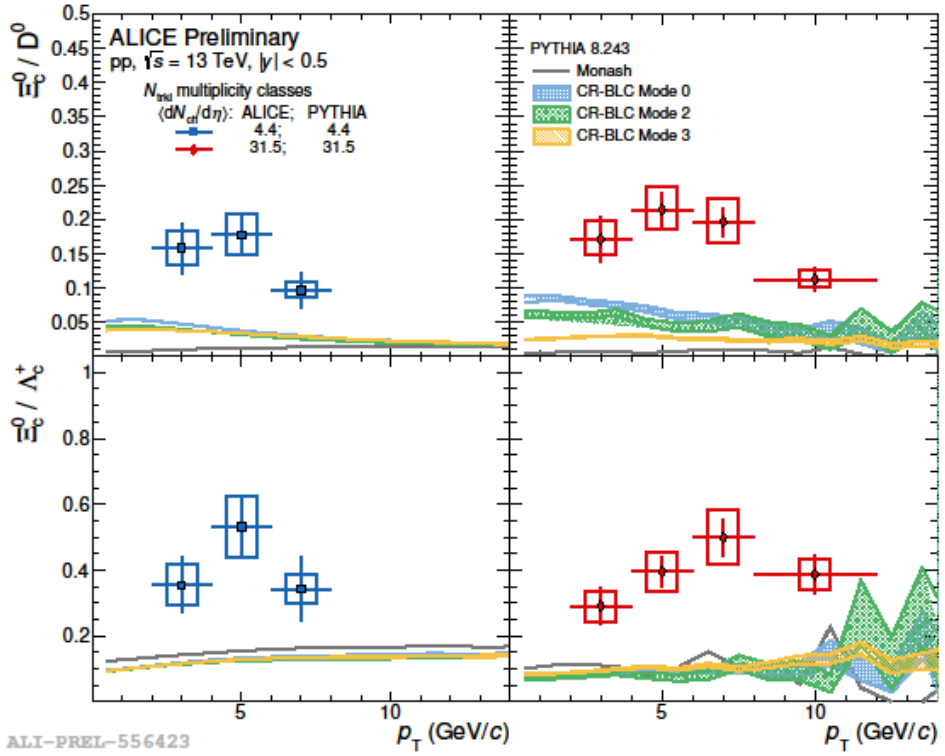




The multiplicity dependence of Ξ_c^0/D^0 and Ξ_c^0/Λ_c^+ is not observed with the current uncertainties

Ξ_c^0/D^0 and Ξ_c^0/Λ_c^+ compared to PYTHIA

The Ξ_c^0/D^0(top) and Ξ_c^0/Λ_c^+(bottom) ratios measured in pp collisions for the lowest(left) and highest (right) multiplicity. The measurements are compared to PYTHIA 8 predictions with the Monash estimated in similar multiplicity classes.



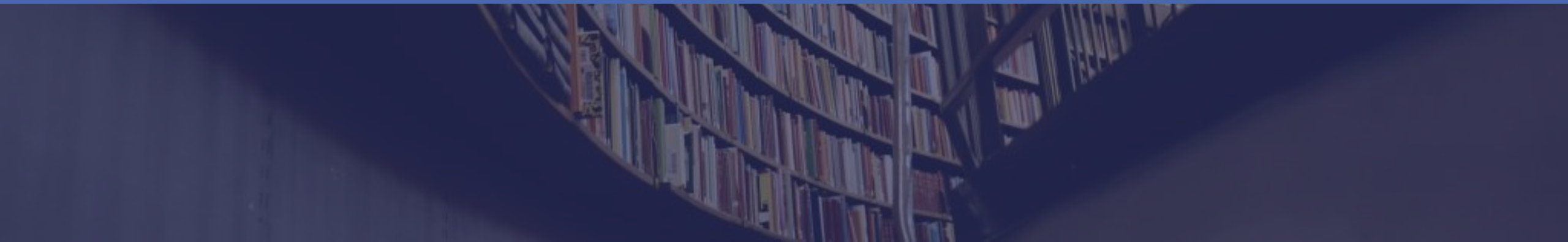
The Monash and CR-BLC tune does not reproduce the Ξ_c^0/D^0 and Ξ_c^0/Λ_c^+ ratio, and the Model does not show a multiplicity dependence.

Summary

Done:
The first measurement of Ξ_c^0/D^0 and Ξ_c^0/Λ_c^+ ratios as a function of charged-particle multiplicity in pp collisions at $\sqrt{s} = 13\ \mathrm{TeV}$. The p_T-differential Ξ_c^0/D^0 and Ξ_c^0/Λ_c^+ yield ratio does not show a strong multiplicity dependence as function of p_T with the uncertainties.

Next:
More precise measurements with the data sample collected during the Run 3 of the LHC will allow us to further investigate the shape of the p_T-integrated baryon-to-meson ratios versus multiplicity, extending the multiplicity reach to lower and higher multiplicity intervals.

Back up



Mult. weight

MC weight obtained by following step

1. Full event on MC and Data
2. Event selection in MC and Data at last one Ξ_c^0 candidate and require invariant mass off the PDG value 2 sigma (2.452, 2.488) Gev/c
3. Normalize Ntrack for Data and MC
4. Divide from Data by MC to obtain event weight in each multiplicity bin

$$(Acc * \varepsilon)(\Delta p_T)^{prompt,mult} = \frac{\sum_i N_{sel,i}(\Delta p_T)\omega_i^{mult}}{\sum_i N_{gen,i}(\Delta p_T)\omega_i^{mult}}$$

$N_{sel,i}$: Selected number of prompt

$N_{gen,i}$:Generated number of prompt

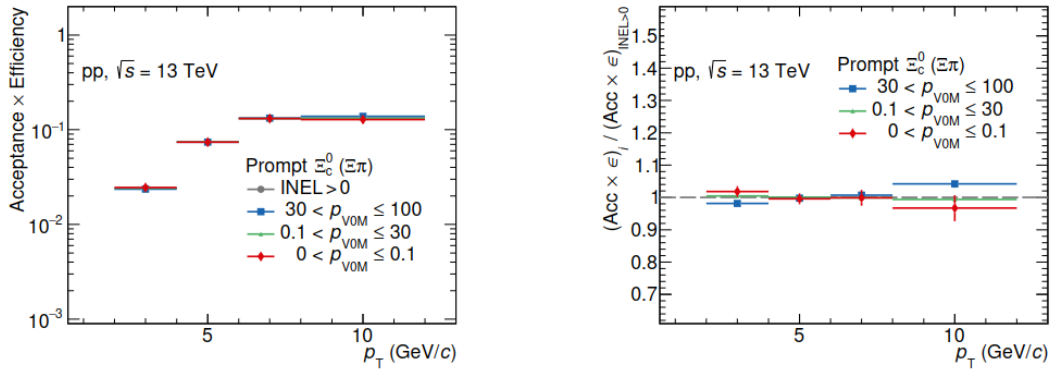
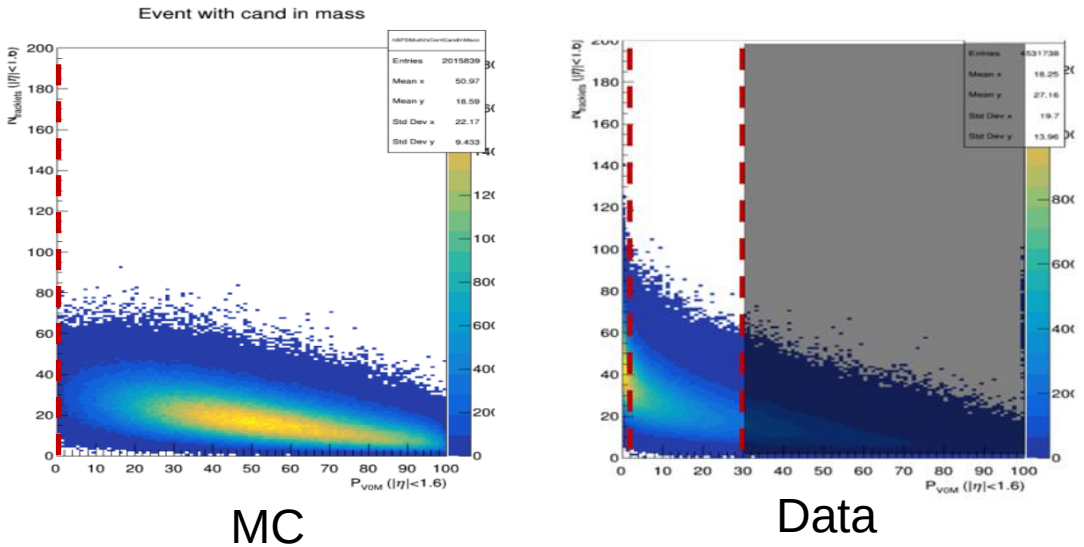
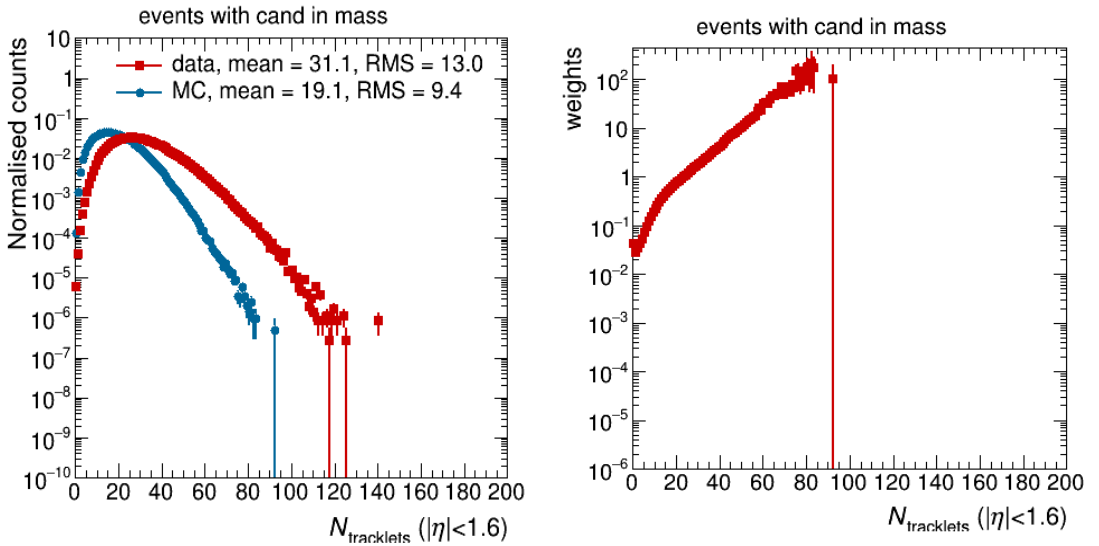


Fig. 38: Prompt acceptance-times-efficiency of V0M percentile multiplicity bins as a function of p_T for Ξ_c^0 per multiplicity interval, The left panels show the ratio with the minimun bias efficiency

Example in p_{V0M}[0.1,30]





Raw yield extraction

The systematic uncertainties on the raw yield extraction are estimated with a multi-trial approach

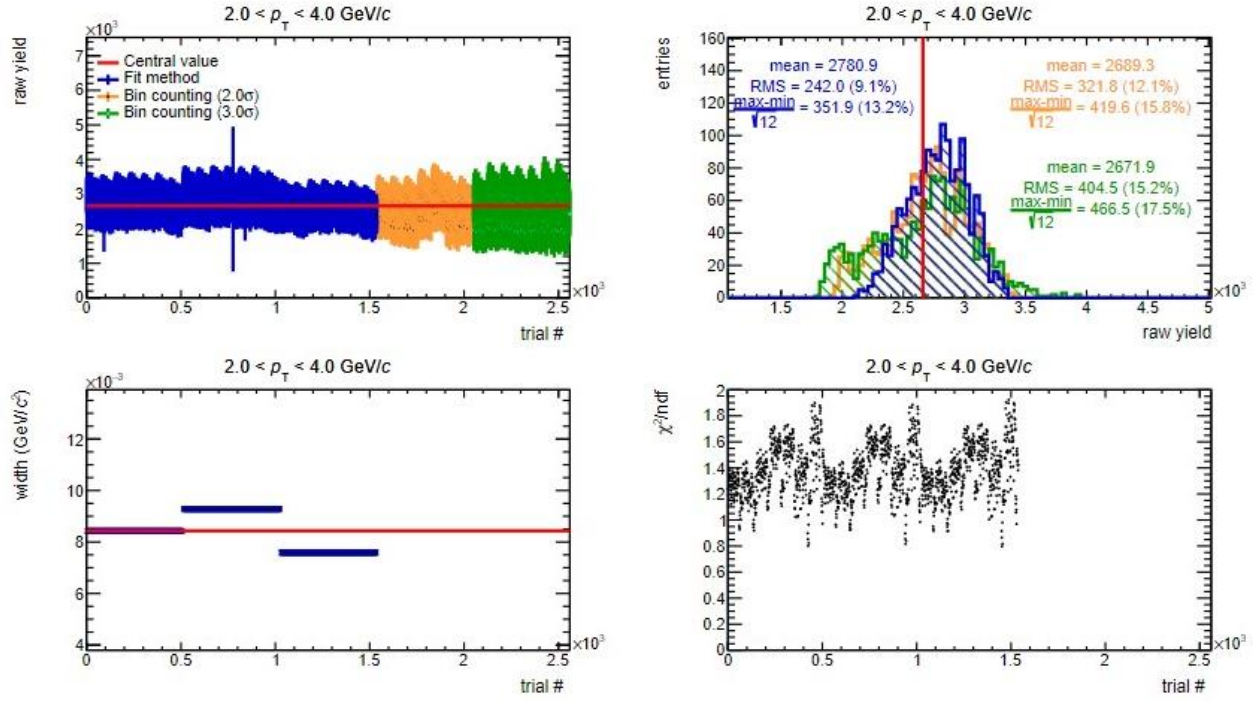


Fig. 30: Raw yield systematic for p_T bin 2GeV/c-4GeV/c and [0,0.1]V0M percentile multiplicity

Fit configurations

- Sigma variation: 10%
- Background fit function: lin, expo, pol2
- Mass mins: 2.26, 2.28, 2.30, 2.32, 2.34
- Mass maxs: 2.61, 2.63, 2.65, 2.67, 2.69
- Rebins: 4, 5, 6, 7, 8, 9, 10

- Systematics evaluated as:

$$\sqrt{\mathrm{RMS}^2 + \mathrm{shift}^2}$$

Assigned systematics range from 6% to12%

more detailed information is in backup

BDT selection

Test the effect of the applied selections by varying in a given range.

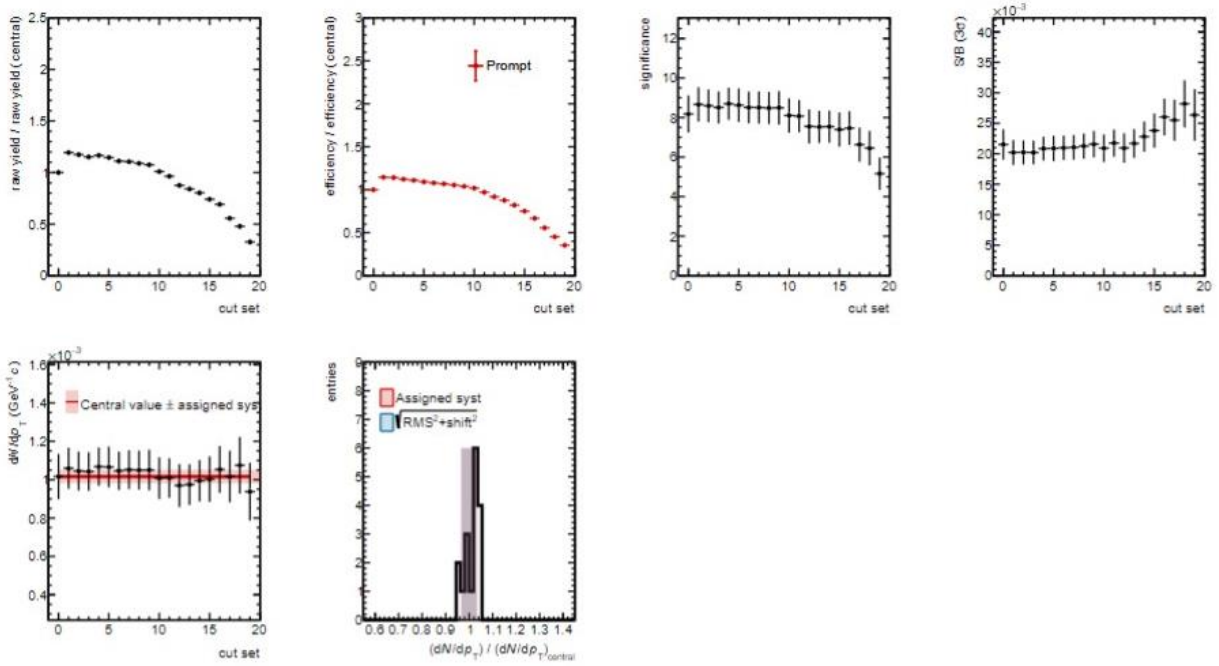


Fig. 43: The cut-variation studies for p_T bin 4GeV/c-6GeV/c and [0,0.1]V0M percentile multiplicity

Trial contributes to systematic if

- Prompt efficiency variation < 35%
  (approximately ±0.2 from the working point)
- Significance > 2.5
- $\chi^2 < 2$

Systematics evaluated as:

$$\sqrt{\mathrm{RMS}^2 + \mathrm{shift}^2}$$

Assigned systematics range from 4% to10%

more detailed information is in backup

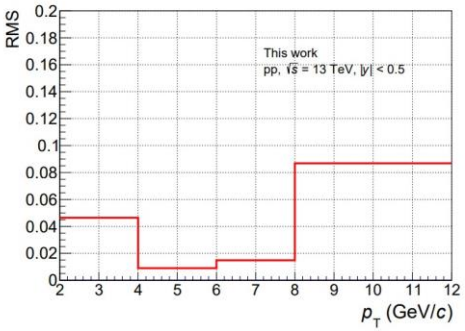
Tracking efficiency

The systematic of tracking in the pre-selection before creating the tree for machine learning

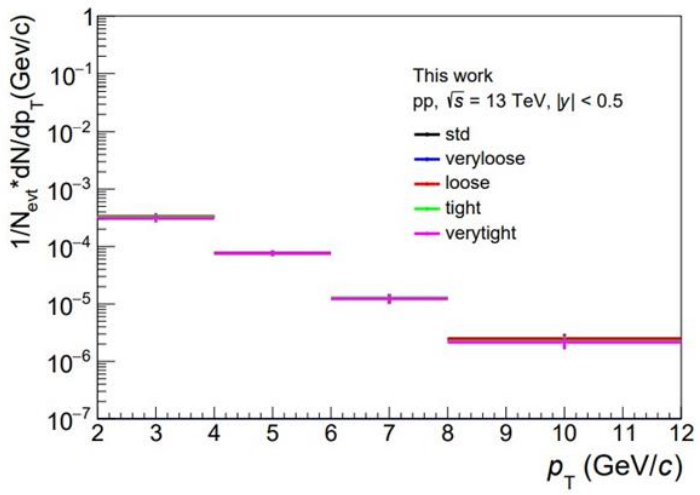
The TPC applied cuts are shown in

Cuts variables	Very loose	Loose	Standard	Tight	Very tight
Number of TPC crossed rows	> 65	> 70	> 70	> 75	> 80
TPC crossed rows / findable ratio	> 0.75	> 0.75	> 0.80	> 0.85	> 0.90
Number of TPC clusters for dE/dx	> 40	> 45	> 50	> 55	> 60

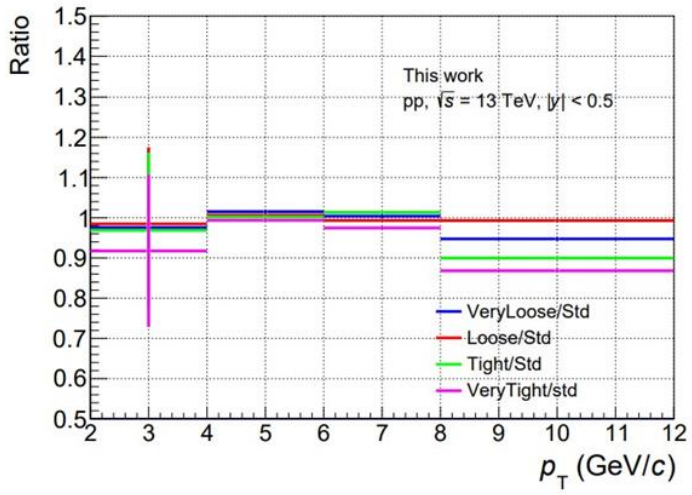
Table 11: The variations of TPC parameters in the pre-selection.



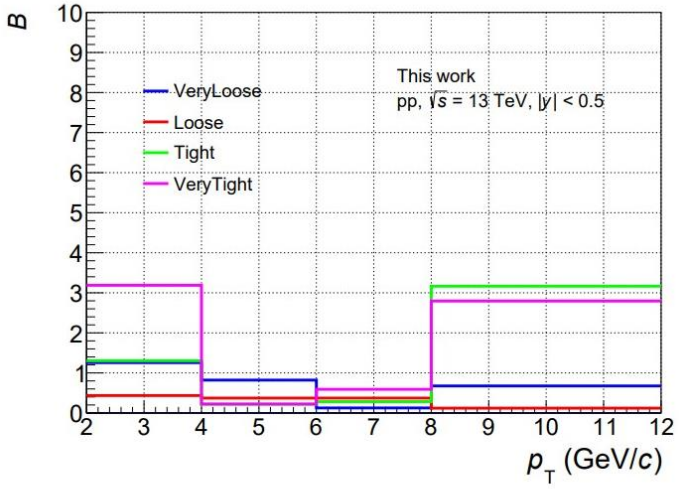
(d) RMS of deviations from 1.



(a) Ξ_c^0 p_T spectrum with different cuts.



(b) The ratio with different cuts to the standard one.



(c) Barlow value for each p_T bin.

Assigned systematics 5% according ratio of corrected yield

Working point evaluation

The choice of the ML output scores is performed by guarantees a sufficiently sedu-significance and a sufficiently selection efficiency.

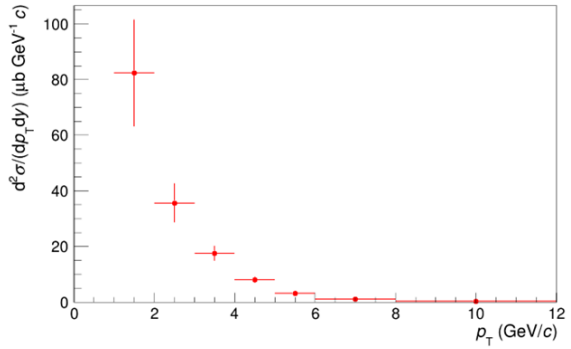
1. Calculate the yield of background (B) in (−3σMC, 3σMC):
   take 10% fraction of data to reduce the effect of statistical fluctuation, fit side bands with “pol1”

2. Calculate the yield of signal (S) in (−3σMC, 3σMC):
   use the published cross section and correct it by acceptance × efficiency.

$$S_{expect} = 2 \cdot \left(\frac{d\sigma^2}{dp_T dy}|_{pp}\right) \cdot (Acc \times \varepsilon)_{prompt} \cdot \Delta y \cdot \Delta p_T \cdot BR \cdot L_{int} / f_{prompt}$$

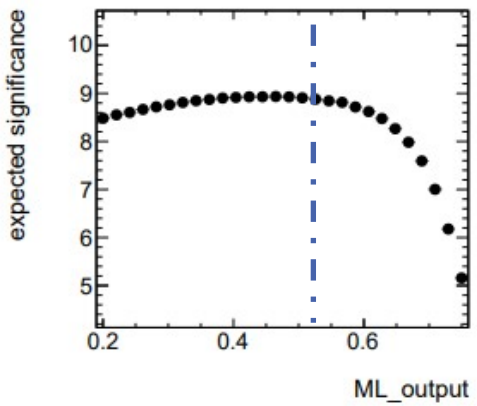
3. Calculate the significance S√(S+B)

Published Xic0 crossection

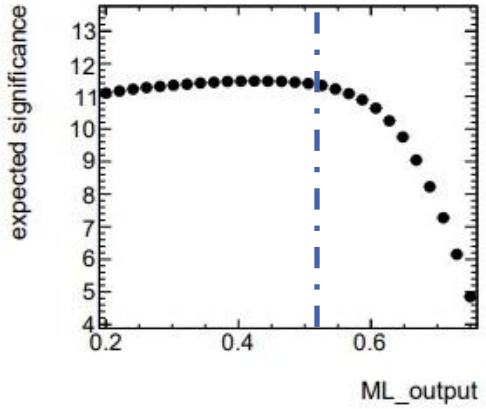


$p_T^{\Xi_c^0}$ (GeV/c)	(2, 4)	(4, 6)	(6, 8)	(8, 12)
BDT cut	0.52	0.5	0.42	0.38

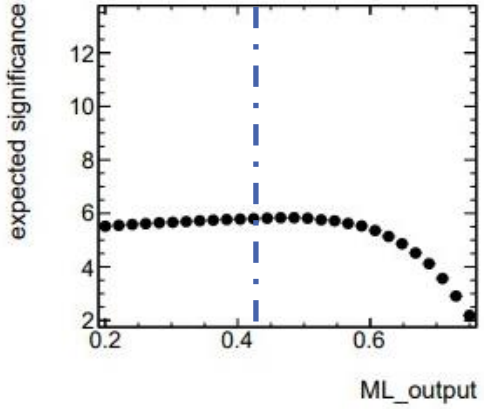
Table 5: Working point in different $p_T^{\Xi_c^0}$ bin.



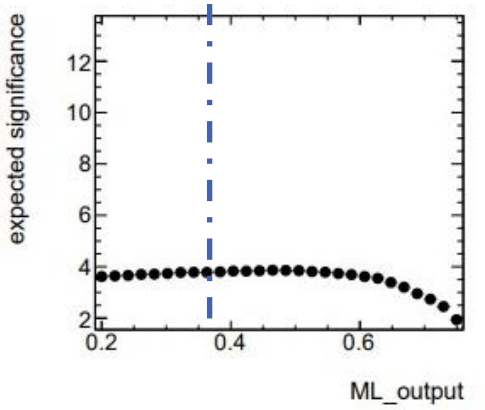
2 < p_T < 4 GeV/c



4 < p_T < 6 GeV/c



6 < p_T < 8 GeV/c



8 < p_T < 12 GeV/c

Keep enough statistics for low-mult

ITS-TPC matching efficiency

ITS has only been used for $\pi \leftarrow \Xi_c^0$

Only need to propagate the ITS-TPC matching efficiency of π to Ξ_c^0

Systematics evaluated as:

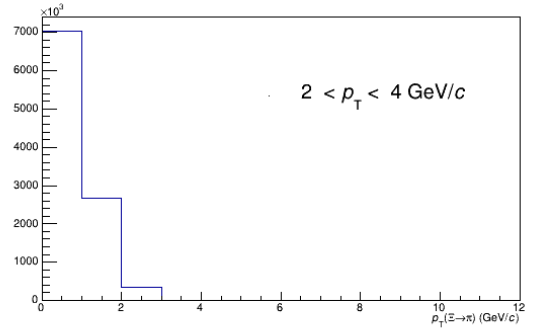
$$\mathrm{Syst}^{\Xi_c^0}_{\mathrm{ITS-TPC\ matching}} = \frac{\sum_{i=1}^{N}(\mathrm{Syst}_i^{\pi\leftarrow\Xi_c^0} * \mathrm{BC}_i)}{\sum_{i=1}^{N}\mathrm{BC}_i}$$

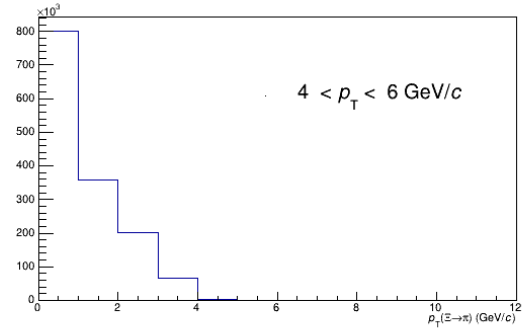
- $Syst_i^{\pi\leftarrow\Xi_c^0}$ is the systematic of ITS-TPC matching in i^{th} $p_{\mathrm{T}}^{\pi\leftarrow\Xi_c^0}$ bin

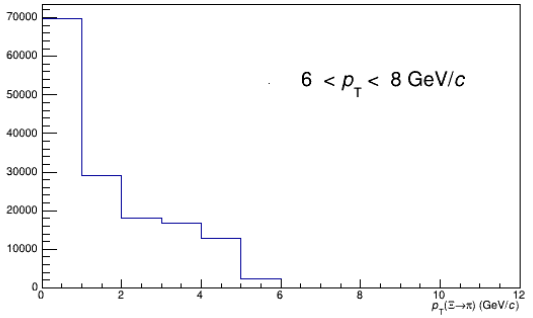
$p_{\mathrm{T}}^{\pi\leftarrow\Xi_c^0}$ (GeV/c)	(0.5, 1.0)	(1, 2)	(2, 3)	(3, 4)	(4, 5)	(5, 6)	(6, 7)	(7, 8)	(8, 9)
ITS-TPC matching	1.1%	1.8%	2.7%	2.7%	2.3%	2.3%	2.4%	2.4%	3%

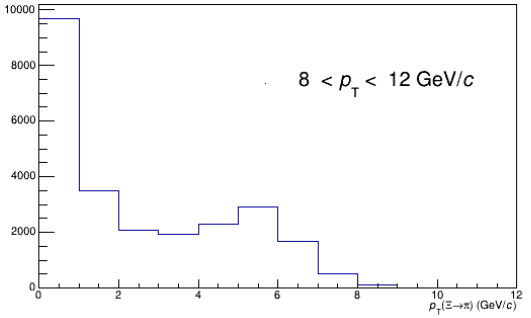
Table 9: The systematic uncertainties of ITS-TPC matching efficiency of $\pi \leftarrow \Xi_c^0$ from DPG in each p_{T} bin.

- $\sum_{i=1}^{N}\mathrm{BC_i}$ is the i^{th} bin content in $p_{\mathrm{T}}^{\pi\leftarrow\Xi_c^0}$ distribution for each bin $p_{\mathrm{T}}^{\Xi_c^0}$







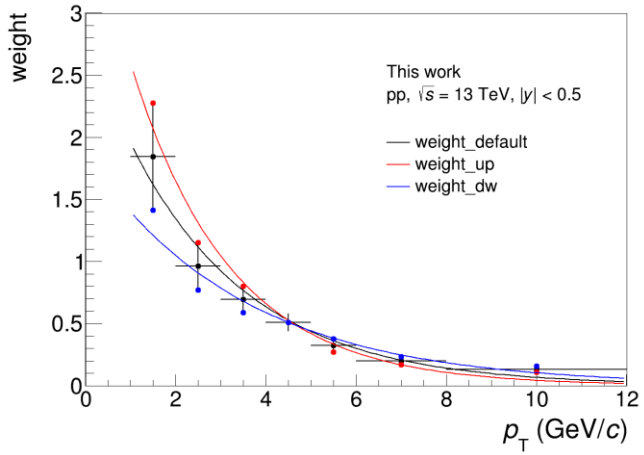


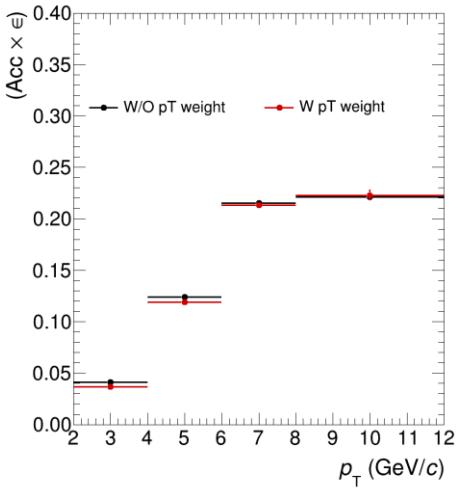
$p_{\mathrm{T}}^{\Xi_c^0}$ (GeV/c)	(2, 4)	(4, 6)	(6, 8)	(8,12)
ITS-TPC matching	1%	2%	2%	2%

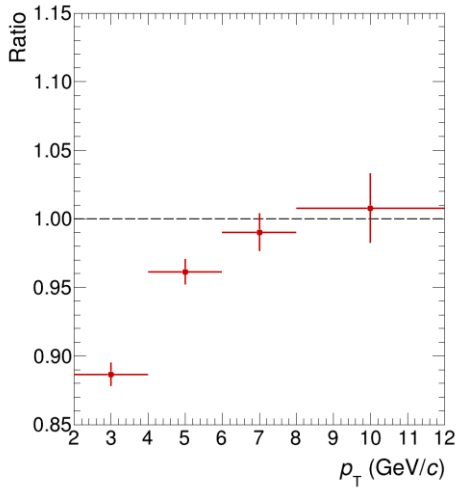
The systematic uncertainties of ITS-TPC matching efficiency for Ξ_c^0 in each p_{T} bin.

p_{T} weight

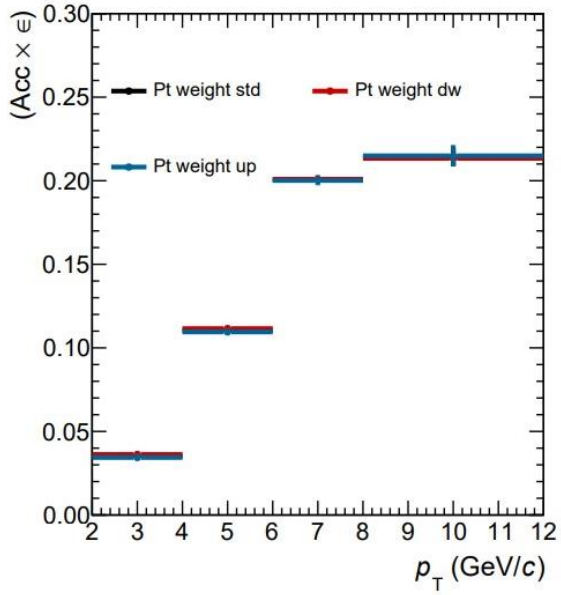
The weights are computed dividing the p_{T} shape obtained from data and obtained from PYTHIA 8

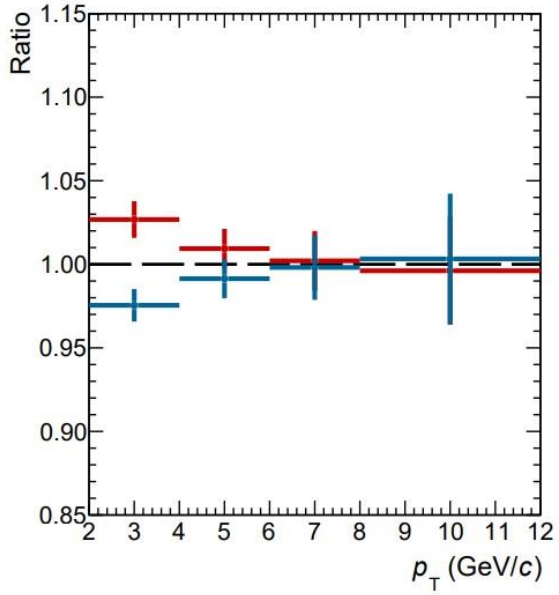






Eff W and W/O p_{T} central-weight





Comparison between the efficiencies obtained by re-weighting the p_{T} shape

Systematics evaluated at: RMS

$p_{\mathrm{T}}^{\Xi_c^0}$ (GeV/c)	(2, 4)	(4, 6)	(6, 8)	(8, 12)
MC p_{T} shape	3.0%	1.0%	0.%	0%

Th The systematic uncertainties of MC p_{T} shape for Ξ_c^0 in each p_{T} bin.

Multiplicity dependence of feed-down

The dependence of B hadrons on the charged particle density may var

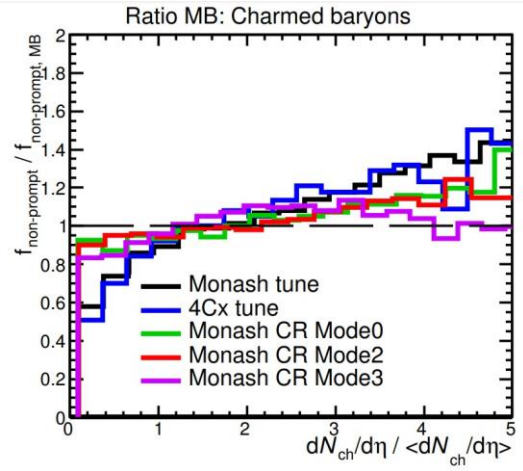
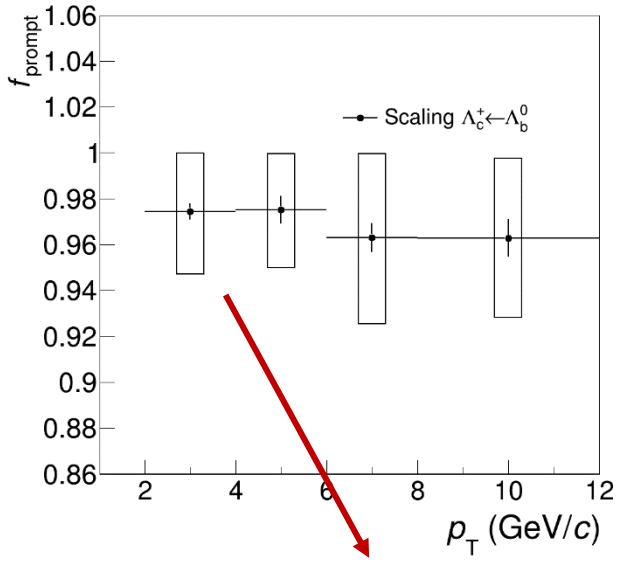


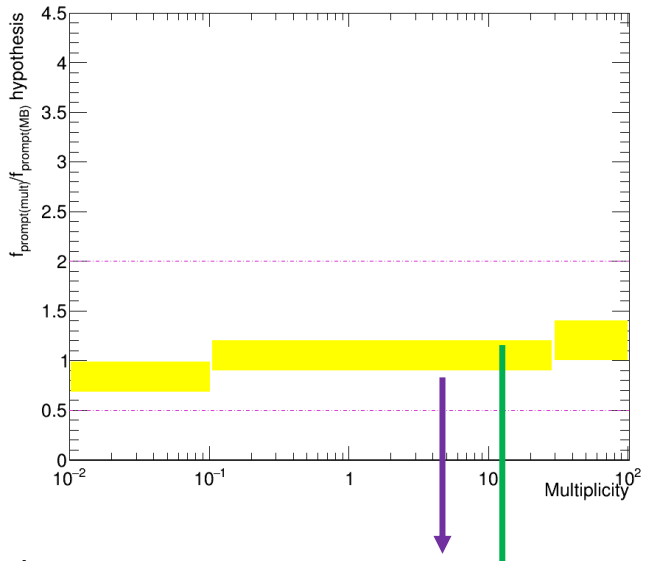
figure come from Λ_c

Single spectra:

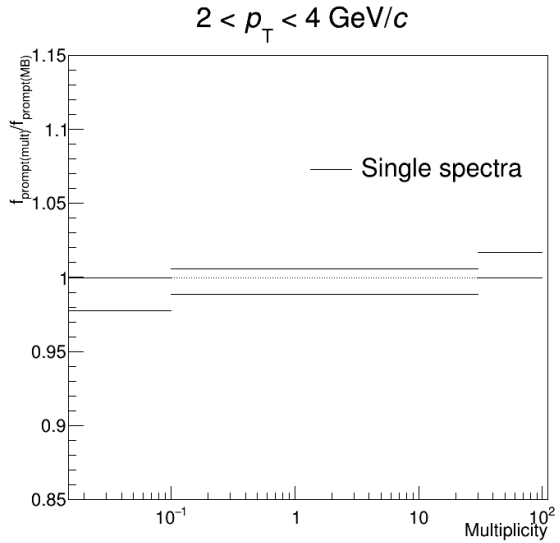
Consider the upper and lower values of the uncertainties on fprompt and the same parameter considered in the multiplicity-integrated and multiplicity bins.



$$f_B(MB) = 1 - f_{prompt}(MB)$$



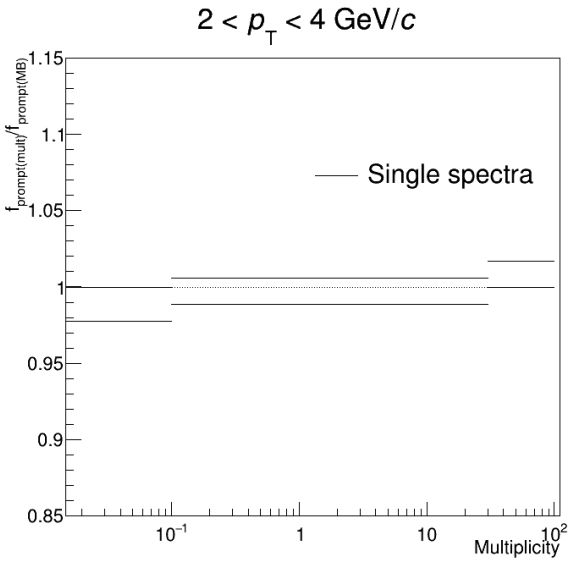
$$f_B^{Min}(mult) = f_B(MB) * r^{MIN}(mult)$$
$$f_B^{Max}(mult) = f_B(MB) * r^{MAX}(mult)$$

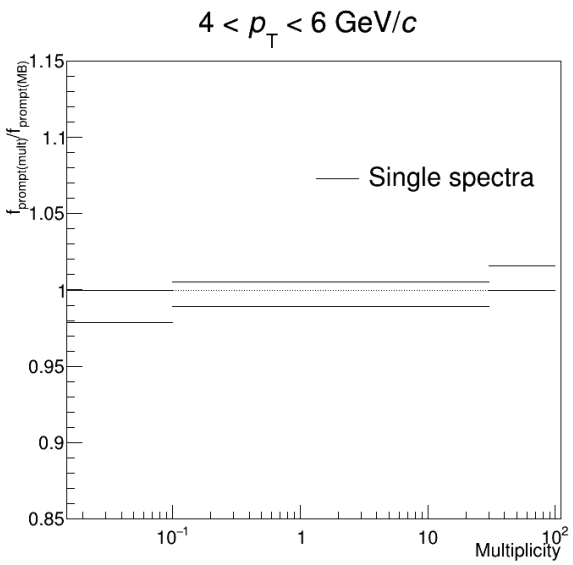


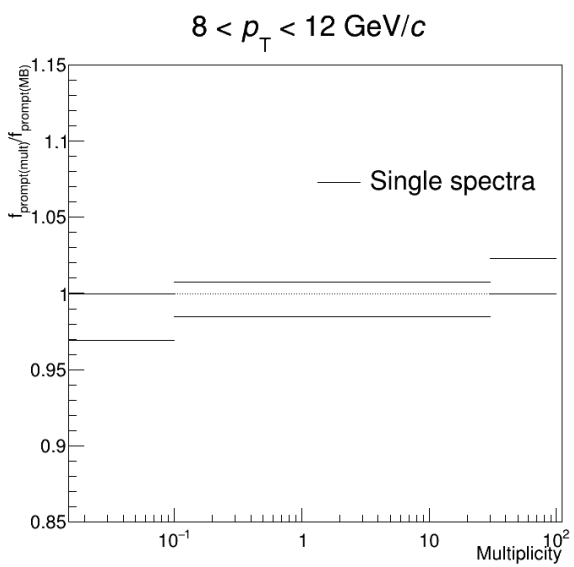
$$f_{prompt}^{Max}(mult) = 1 - f_B^{Min}(mult)$$
$$f_{prompt}^{Min}(mult) = 1 - f_B^{Max}(mult)$$

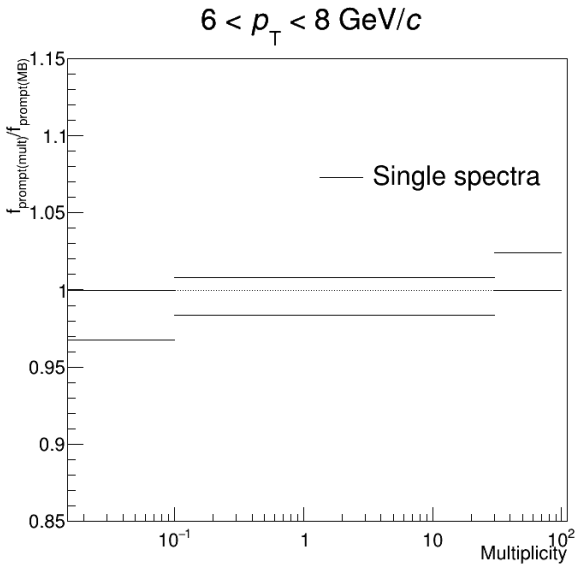
Same structure as Λ_c

Multiplicity dependence of feed-down









Multiplicity interval	$f_{non-prompt}$ variation
30-100 $V0M_{perc}$	[0.7 - 1.0]
0.1-30 $V0M_{perc}$	[0.9 - 1.2]
0-0.1 $V0M_{perc}$	[1.0 - 1.4]

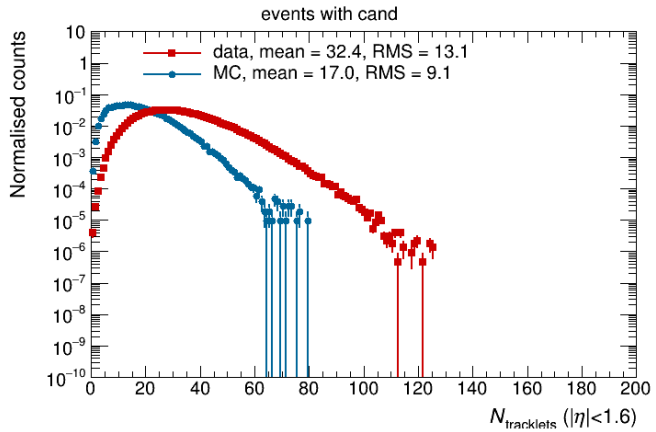
Table 13: Variations on fnon-prompt used for the different multiplicity bins.

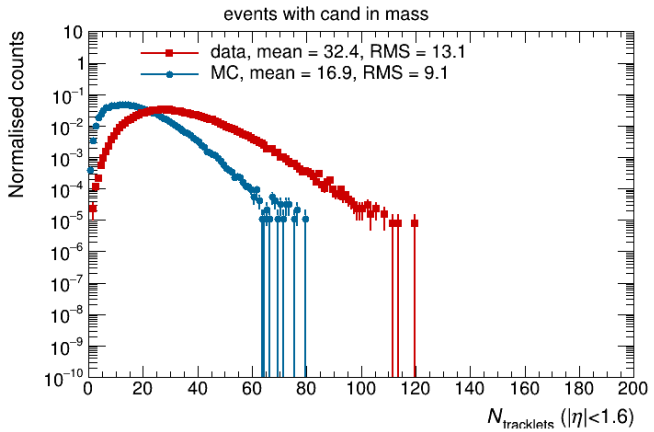
$p_T^{\Xi_c^0}$ (GeV/c)		(2, 4)	(4, 6)	(6, 8)	(8, 12)
30-100	up	1.7%	1.6%	2.4%	-
	dw	0.0%	0.0%	0.0%	-
0.1-30	up	0.6%	0.5%	0.8%	0.7%
	dw	1.2%	1.1%	1.7%	2.5%
0-0.1	up	0.0%	0.0%	0.0%	0.0%
	dw	2.2%	2.2%	2.4%	3.1%

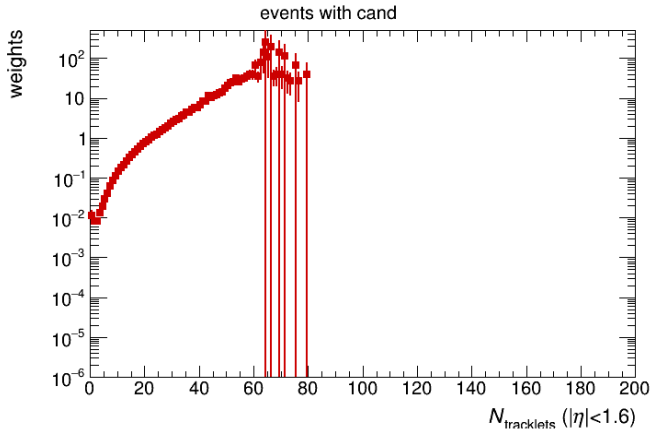
Systematic uncertainties due to the multiplicity dependence in the feed-down subtraction for Xic.

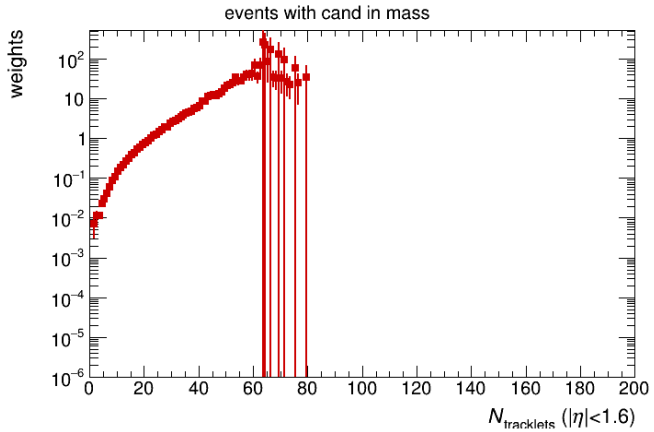
Mult.-weight

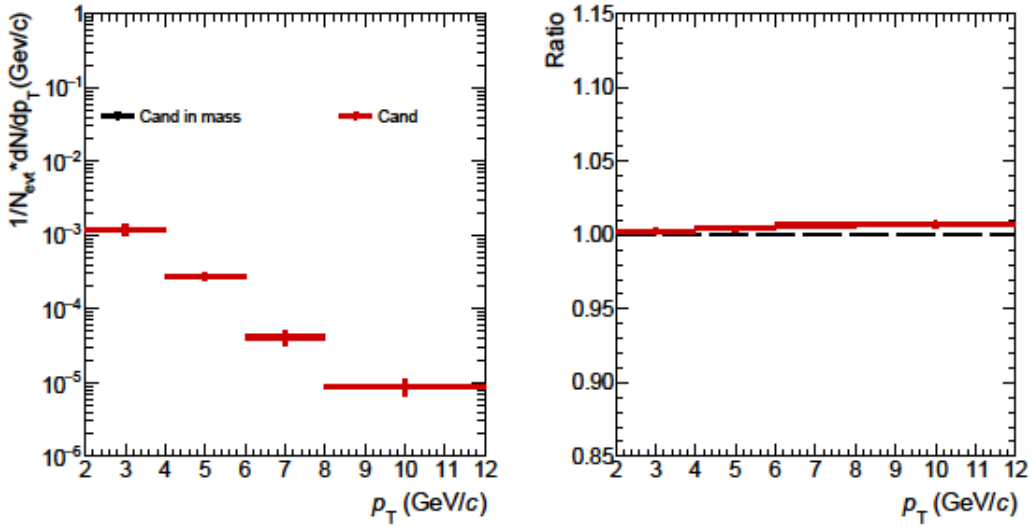
Ntrkl distribution of the events in the 0.1%-30% multiplicity with at least a Ξ_c^0 candidate (left) and events with at least a Ξ_c^0 candidate in mass range of PDG mass ±2σ MeV (right) [2.452, 2.488]. Bottom is ratio of the data with respect to MC for two cases.











Systematics evaluated at: $Shift$
Assigned systematics to 0-1%

Raw yield extraction

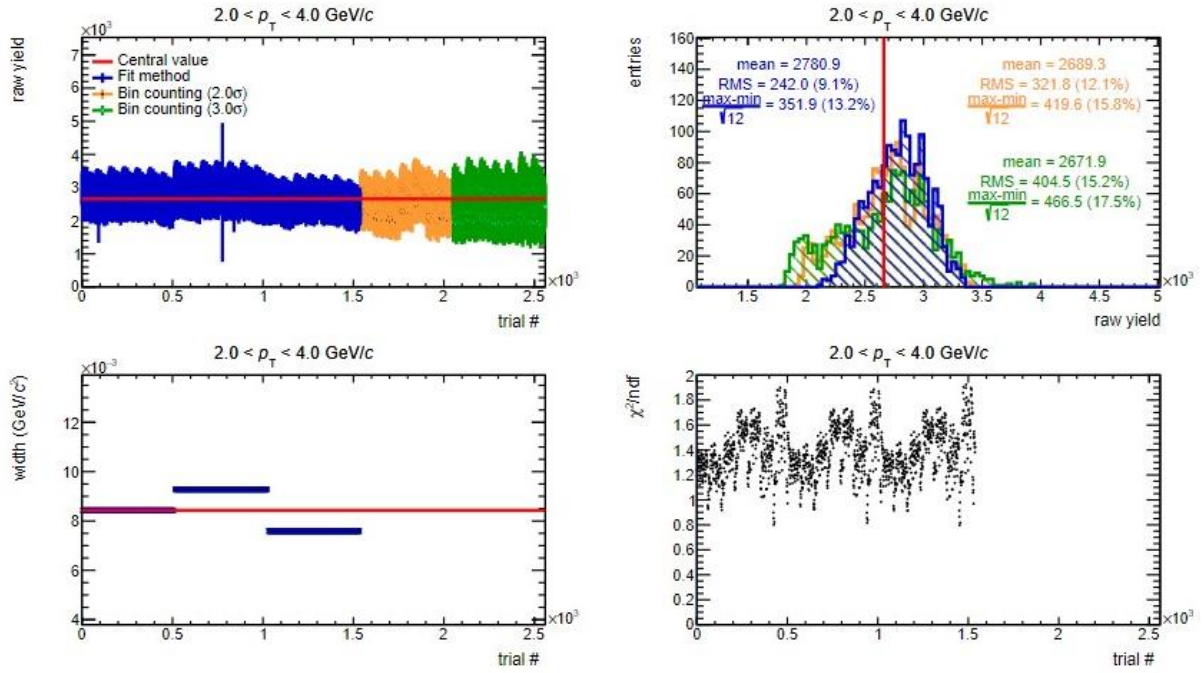


Fig. 30: Raw yield systematic for p_T bin 2GeV/c-4GeV/c and [0,0.1]V0M percentile multiplicity

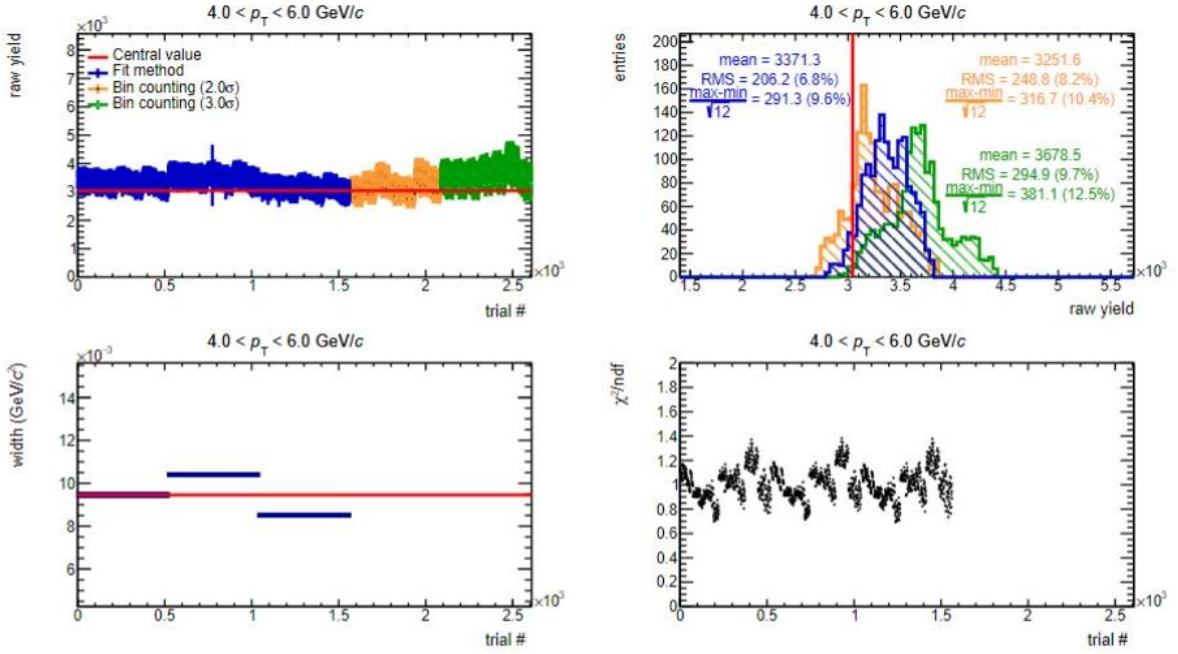


Fig. 28: Raw yield systematic for p_T bin 4GeV/c-6GeV/c and [0,0.1]V0M percentile multiplicity

Raw yield extraction

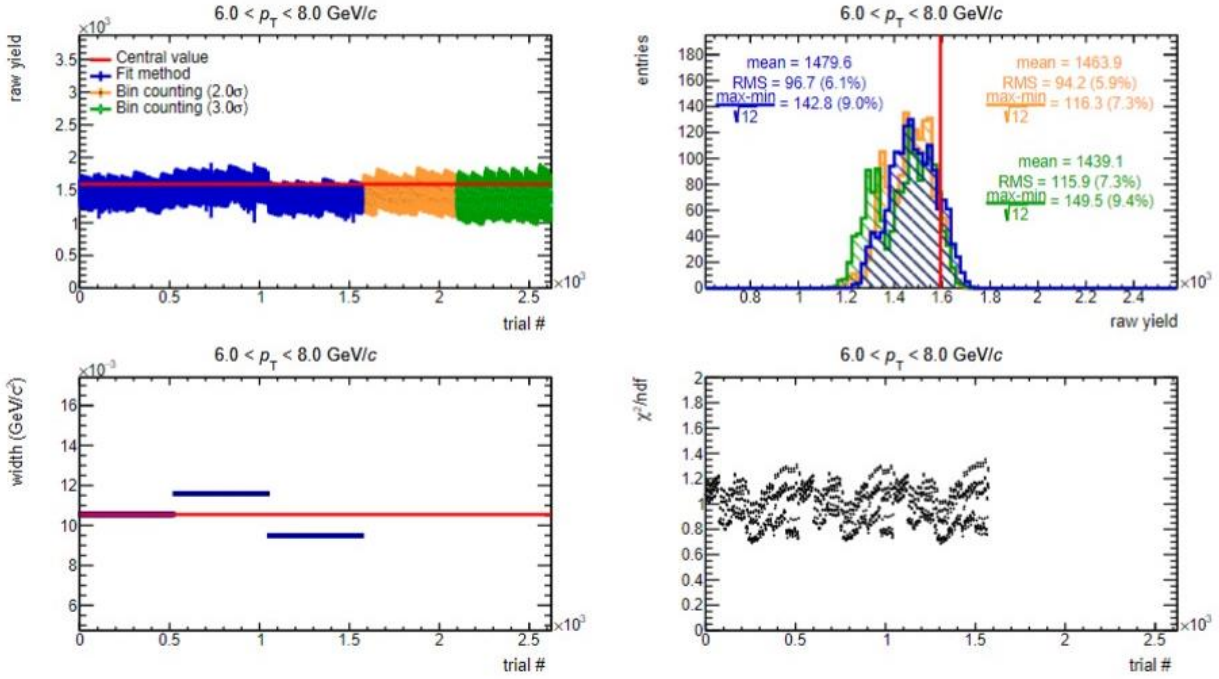


Fig. 29: Raw yield systematic for p_T bin 6GeV/c-8GeV/c and [0,0.1]V0M percentile multiplicity

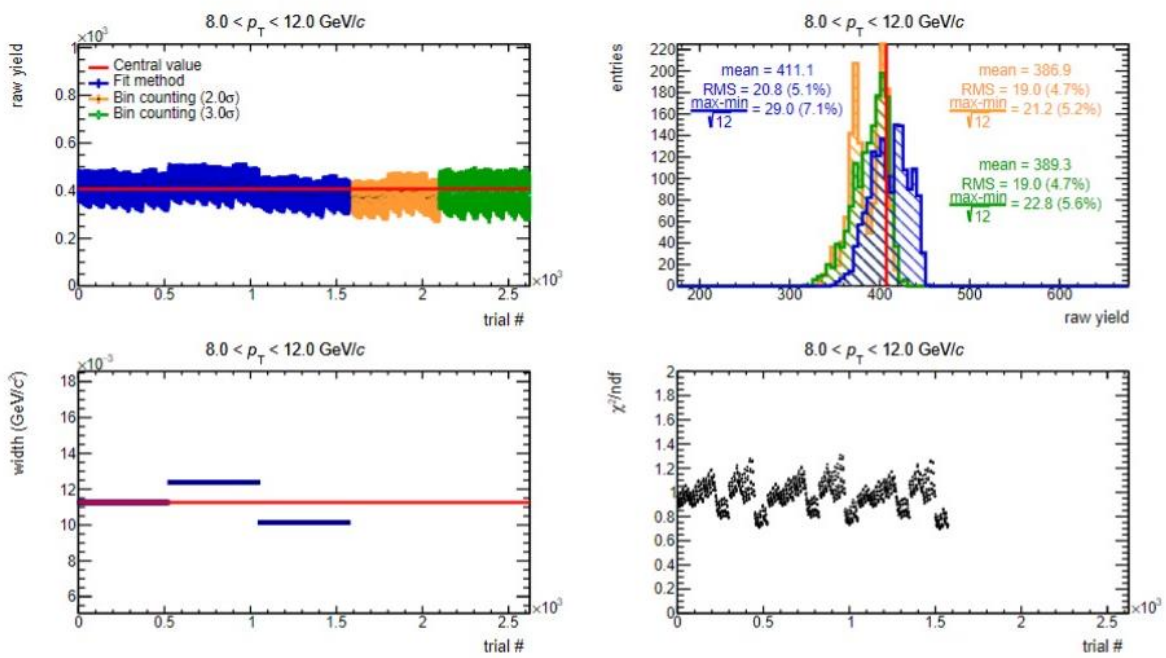


Fig. 30: Raw yield systematic for p_T bin 8GeV/c-12GeV/c and [0,0.1]V0M percentile multiplicity

Raw yield extraction

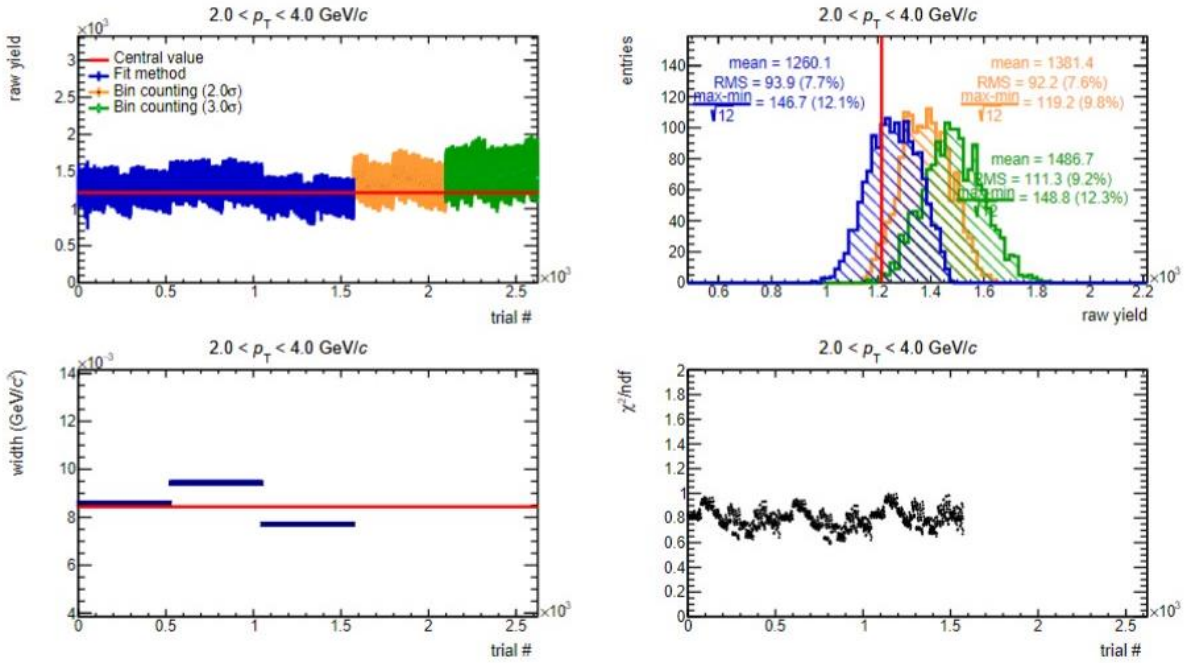


Fig. 31: Raw yield systematic for p_T bin 2GeV/c-4GeV/c and [0.1,30]V0M percentile multiplicity

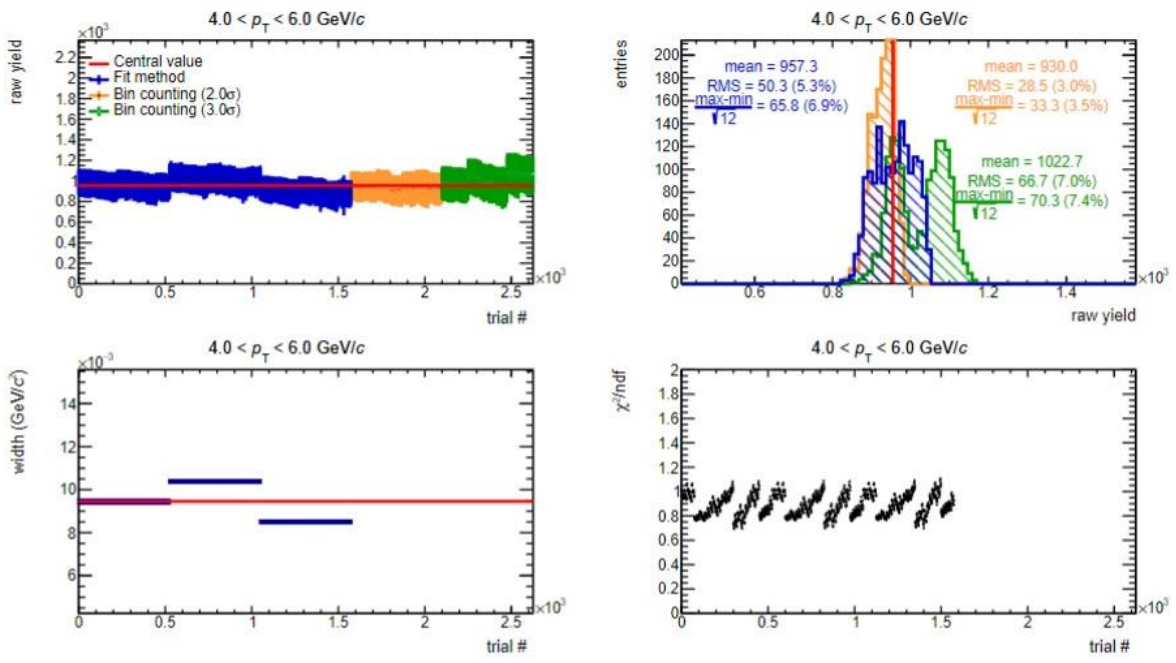


Fig. 32: Raw yield systematic for p_T bin 4GeV/c-6GeV/c and [0.1,30]V0M percentile multiplicity

Raw yield extraction

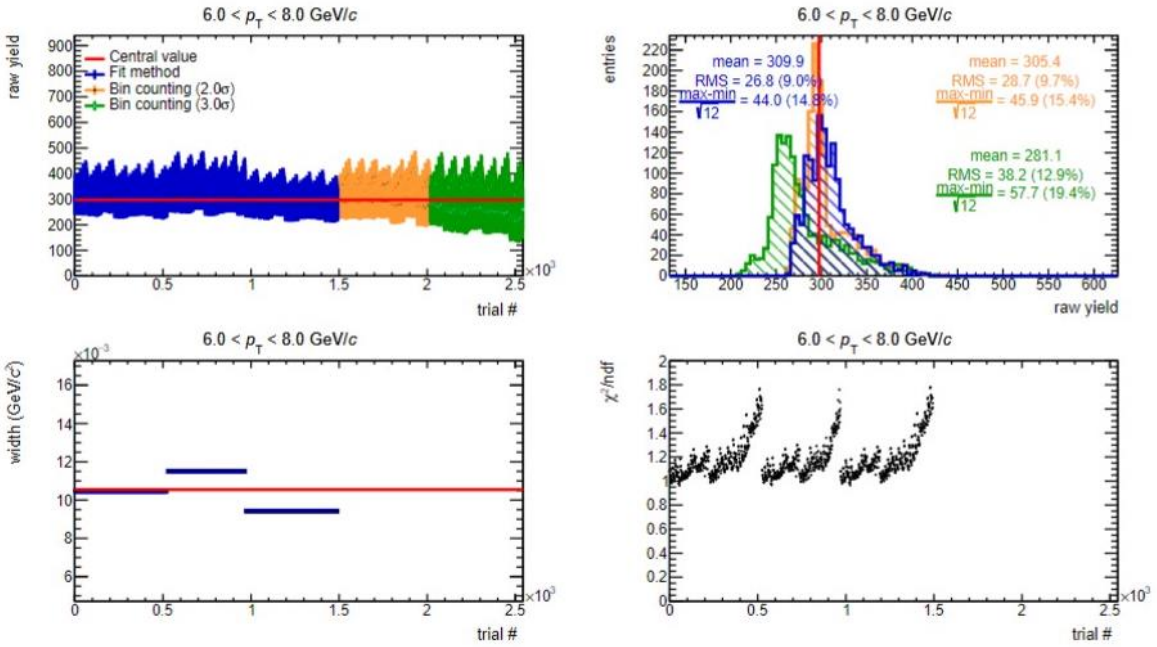


Fig. 33: Raw yield systematic for p_T bin 6GeV/c-8GeV/c and [0.1,30]V0M percentile multiplicity

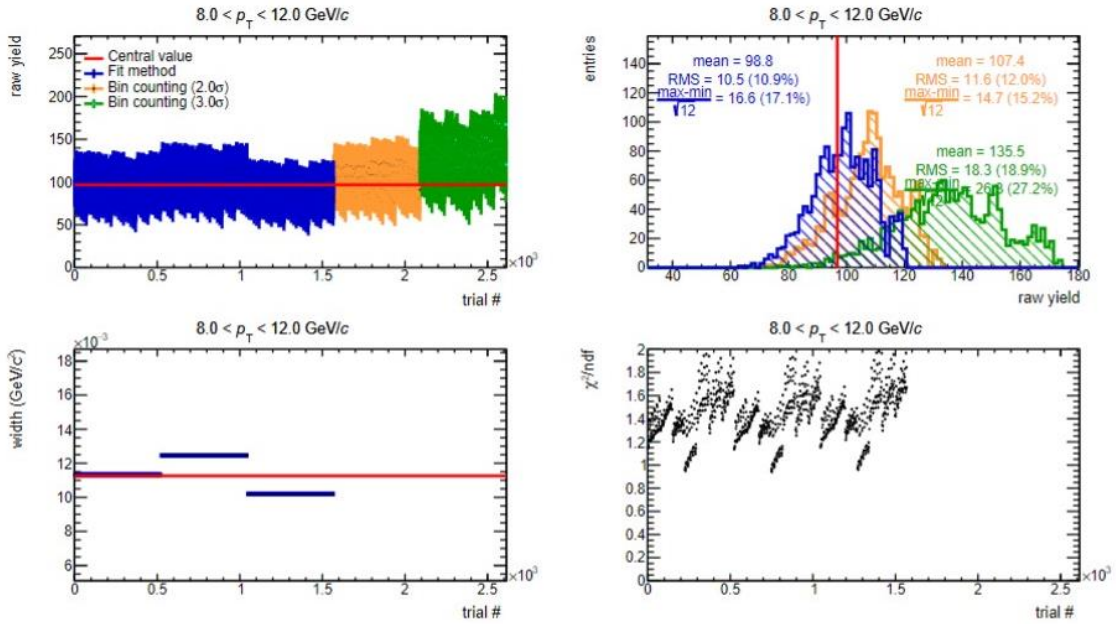


Fig. 34: Raw yield systematic for p_T bin 8GeV/c-12GeV/c and [0.1,30]V0M percentile multiplicity

Raw yield extraction

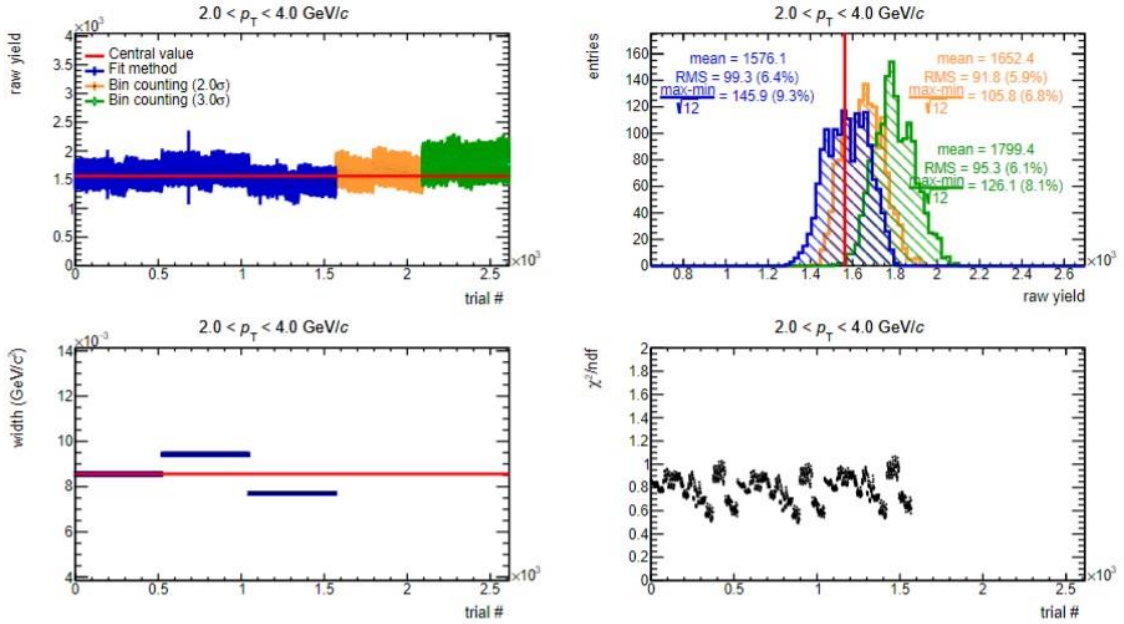


Fig. 35: Raw yield systematic for p_T bin 2GeV/c-4GeV/c and integrated V0M percentile multiplicity

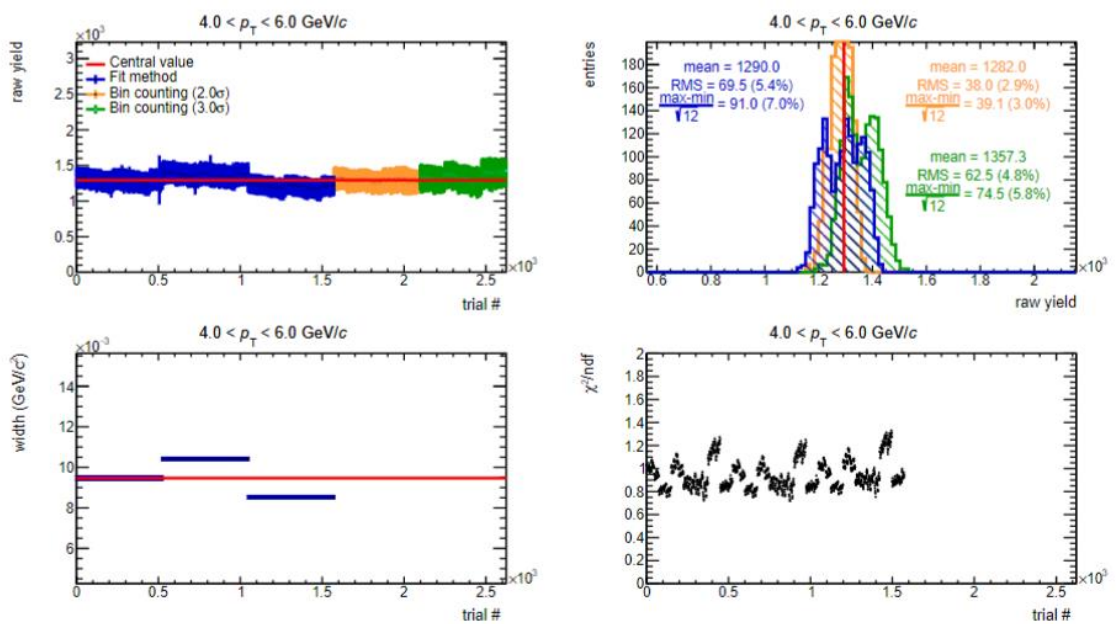


Fig. 36: Raw yield systematic for p_T bin 4GeV/c-6GeV/c and integrated V0M percentile multiplicity

Raw yield extraction

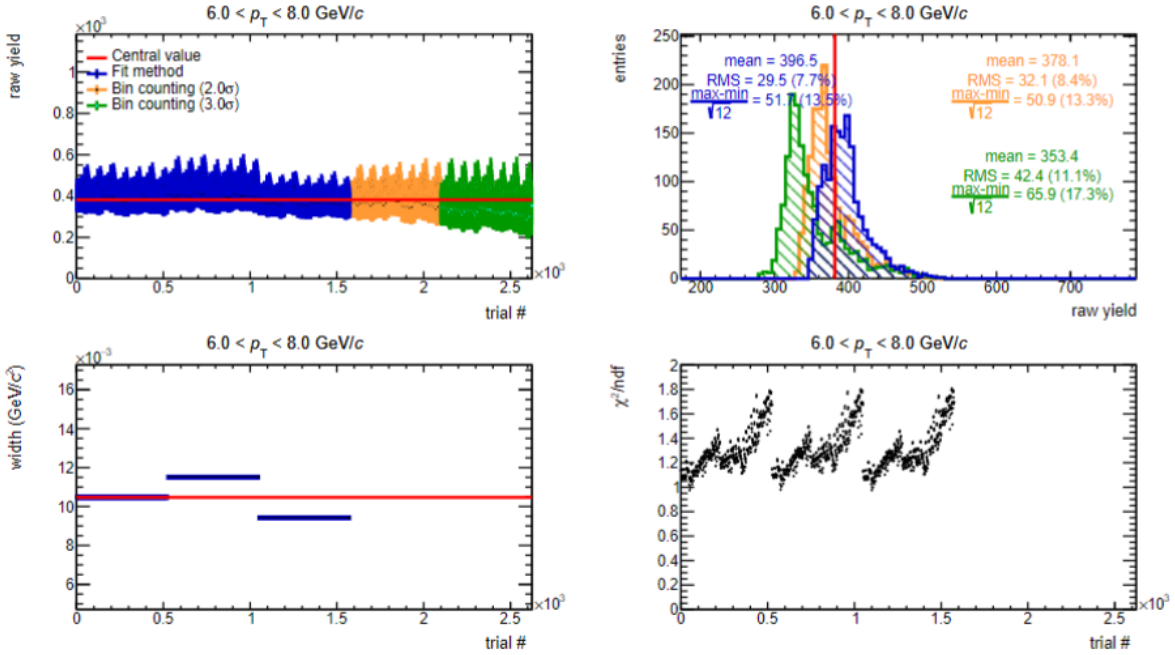


Fig. 37: Raw yield systematic for p_T bin 6GeV/c-8GeV/c and integrated V0M percentile multiplicity

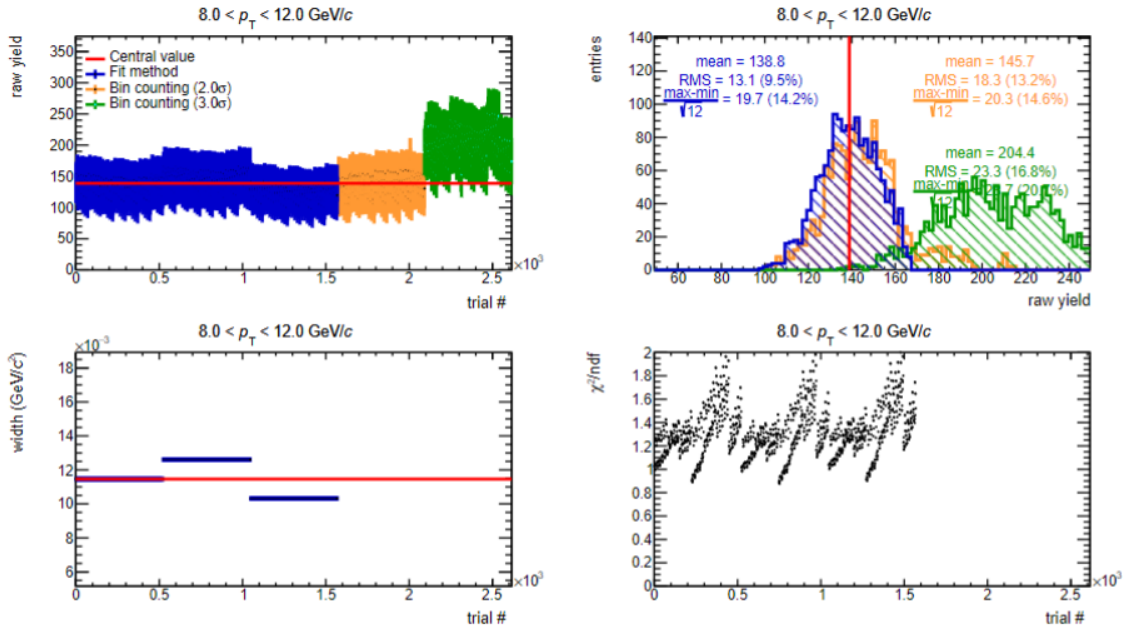


Fig. 38: Raw yield systematic for p_T bin 8GeV/c-12GeV/c and integrated V0M percentile multiplicity

Raw yield extraction

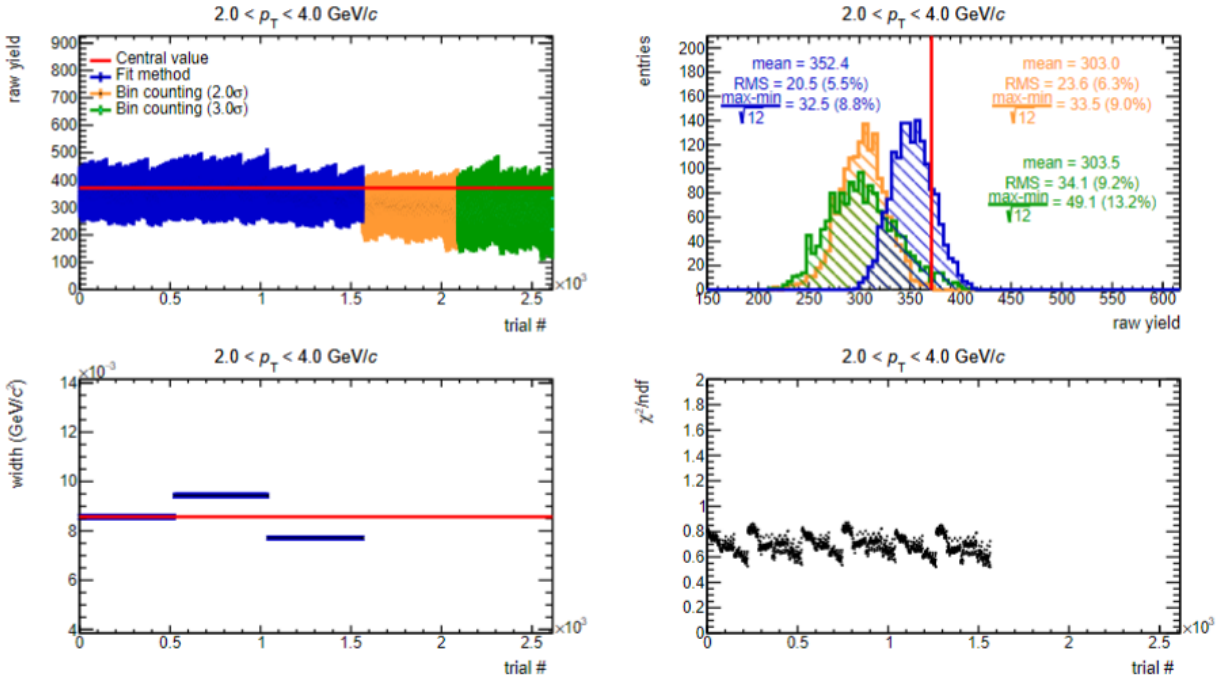


Fig. 39: Raw yield systematic for p_T bin 2GeV/c-4GeV/c and [30,100]V0M percentile multiplicity

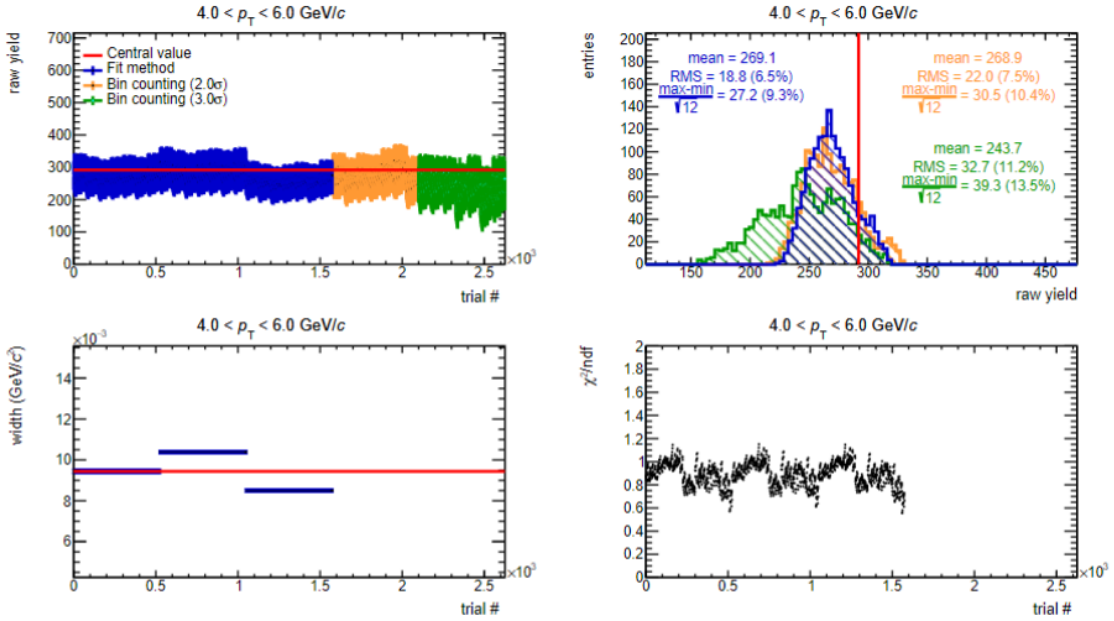


Fig. 40: Raw yield systematic for p_T bin 4GeV/c-6GeV/c and [30,100]V0M percentile multiplicity

Raw yield extraction

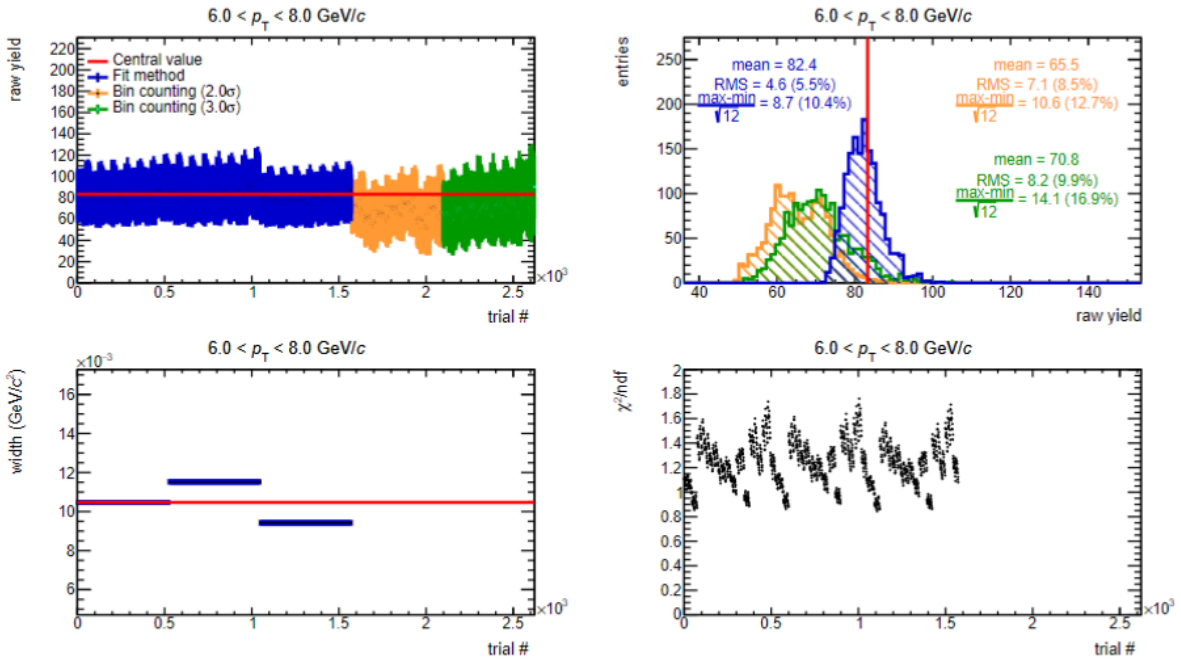


Fig. 41: Raw yield systematic for p_T bin 6GeV/c-8GeV/c and [30,100]V0M percentile multiplicity

BDT

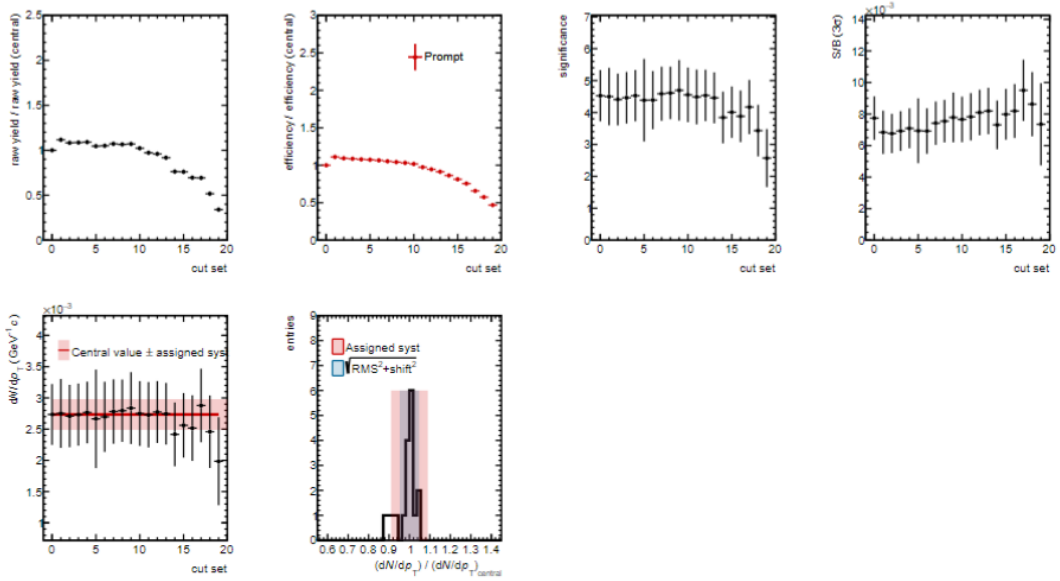


Fig. 42: The cut-variation studies for p_T bin 2GeV/c-4GeV/c and [0,0.1]V0M percentile multiplicity

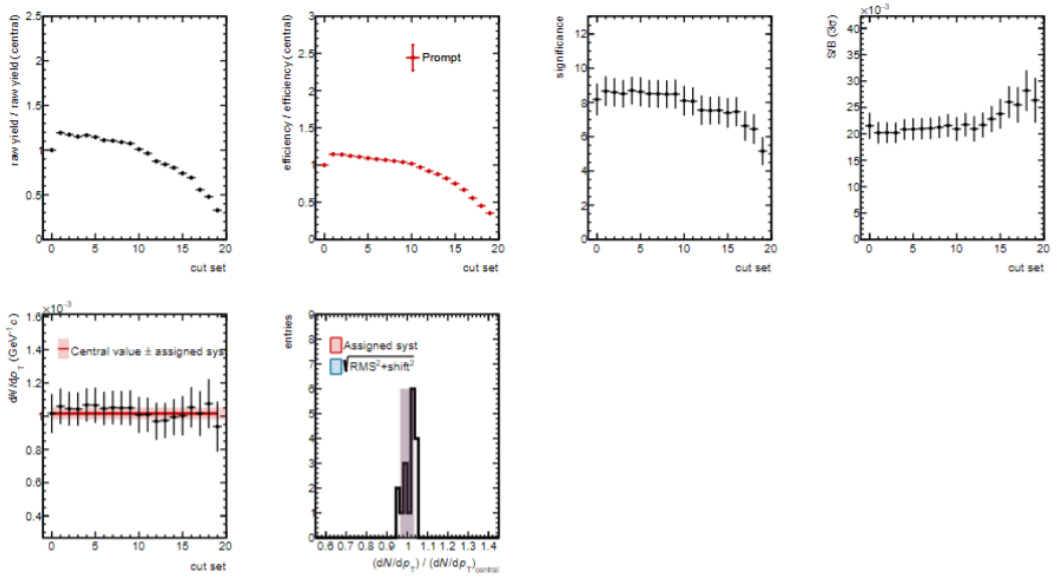
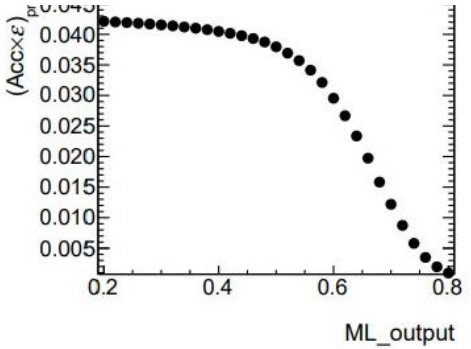


Fig. 43: The cut-variation studies for p_T bin 4GeV/c-6GeV/c and [0,0.1]V0M percentile multiplicity



Eff at 2-4GeV/c

BDT

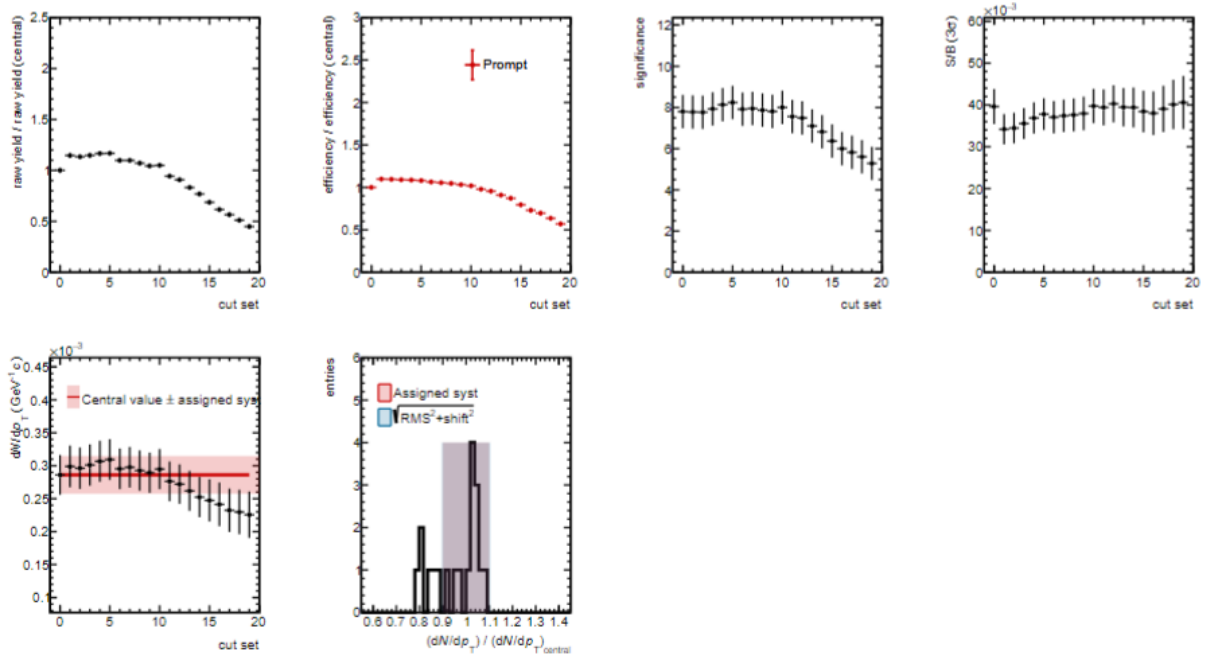


Fig. 44: The cut-variation studies for p_T bin 6GeV/c-8GeV/c and [0,0.1]V0M percentile multiplicity

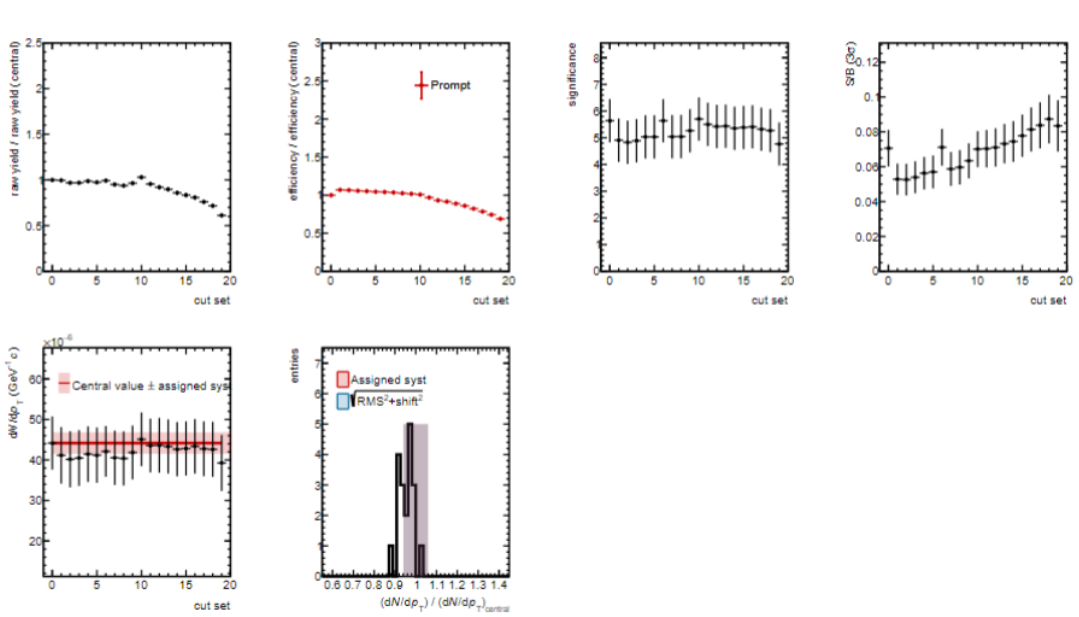


Fig. 45: The cut-variation studies for p_T bin 8GeV/c-12GeV/c and [0,0.1]V0M percentile multiplicity

BDT

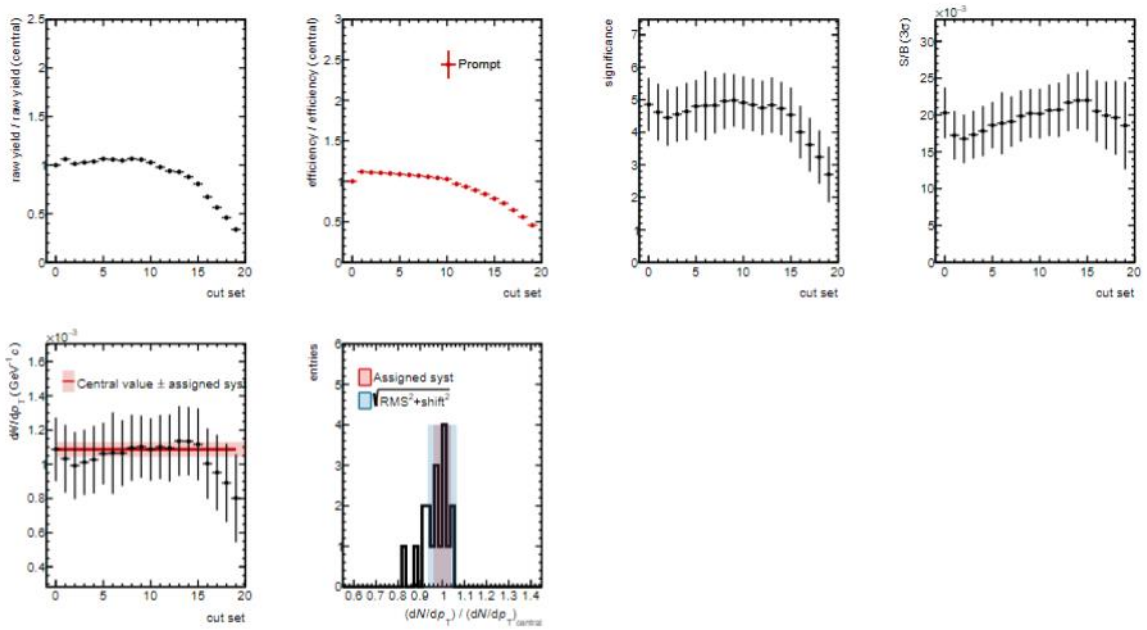


Fig. 46: The cut-variation studies for p_T bin 2GeV/c-4GeV/c and [0.1,30]V0M percentile multiplicity

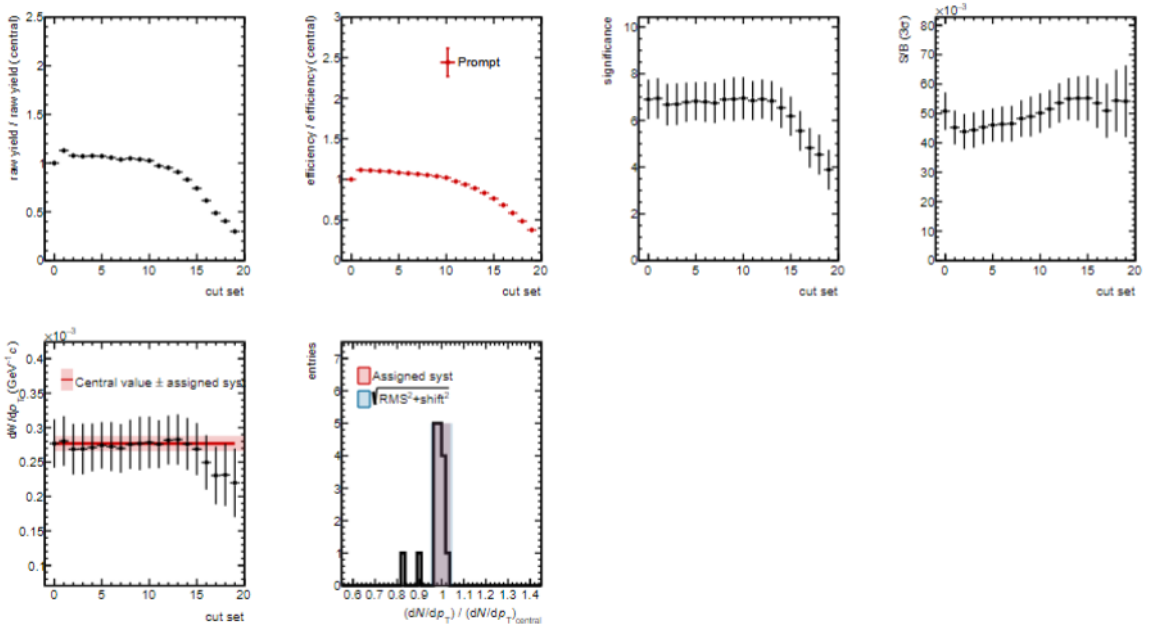


Fig. 47: The cut-variation studies for p_T bin 4GeV/c-6GeV/c and [0.1,30]V0M percentile multiplicity

BDT

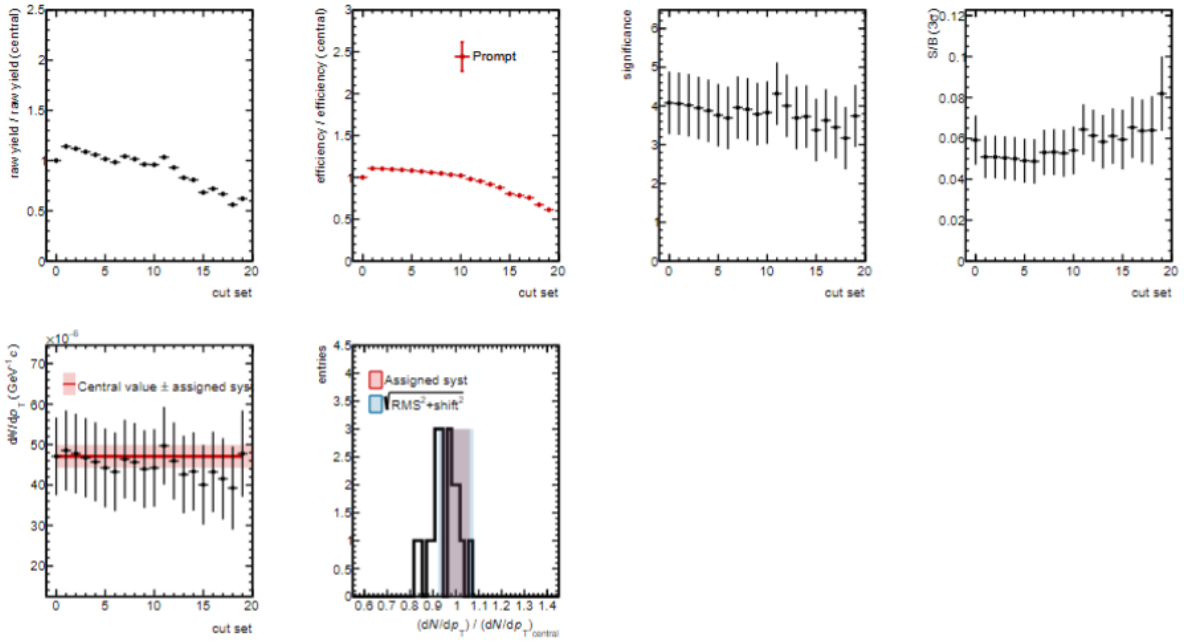


Fig. 48: The cut-variation studies for p_T bin 6GeV/c-8GeV/c and [0.1,30]V0M percentile multiplicity

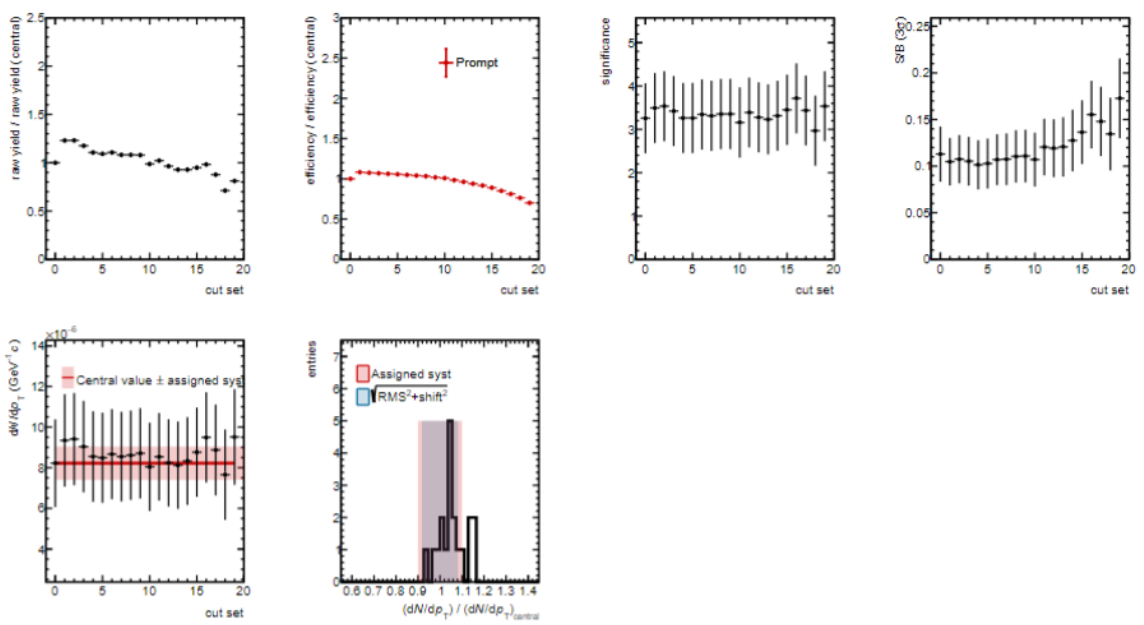


Fig. 49: The cut-variation studies for p_T bin 8GeV/c-12GeV/c and [0.1,30]V0M percentile multiplicity

BDT

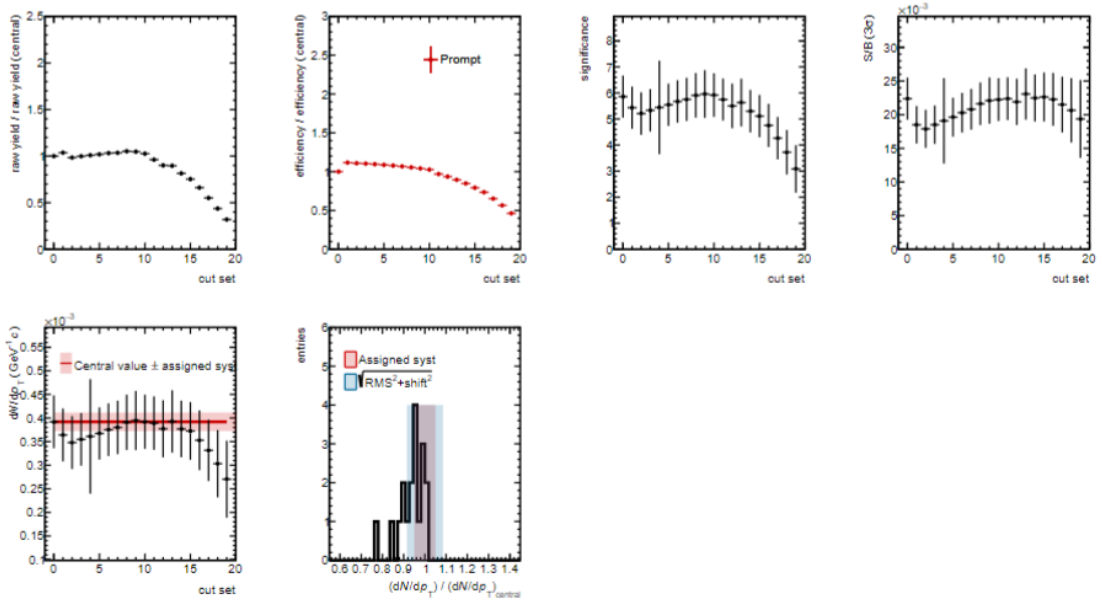


Fig. 50: The cut-variation studies for p_{T} bin 2GeV/c-4GeV/c and [0,100]V0M percentile multiplicity

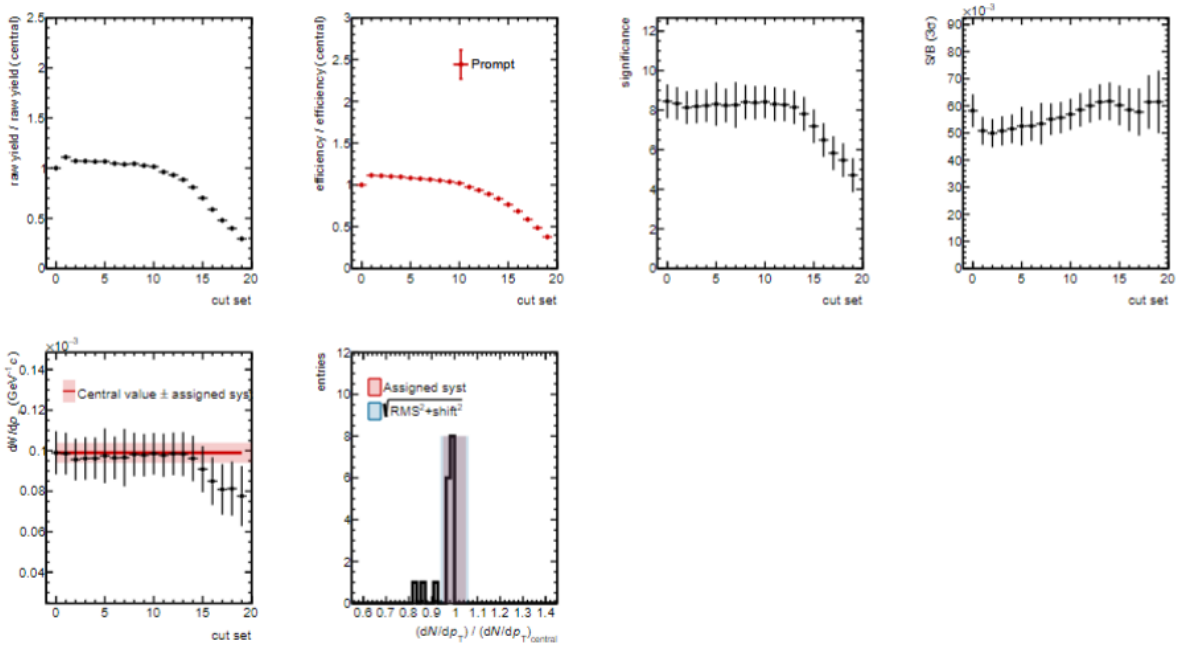


Fig. 51: The cut-variation studies for p_{T} bin 4GeV/c-6GeV/c and [0,100]V0M percentile multiplicity

BDT

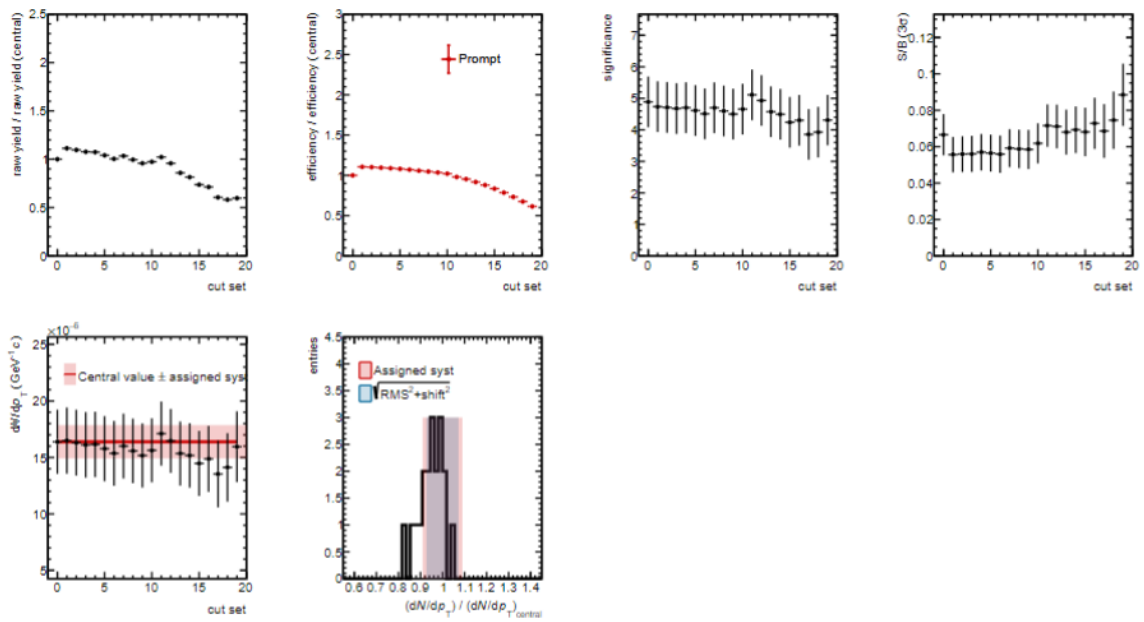


Fig. 52: The cut-variation studies for p_{T} bin 6GeV/c-8GeV/c and [0,100]V0M percentile multiplicity

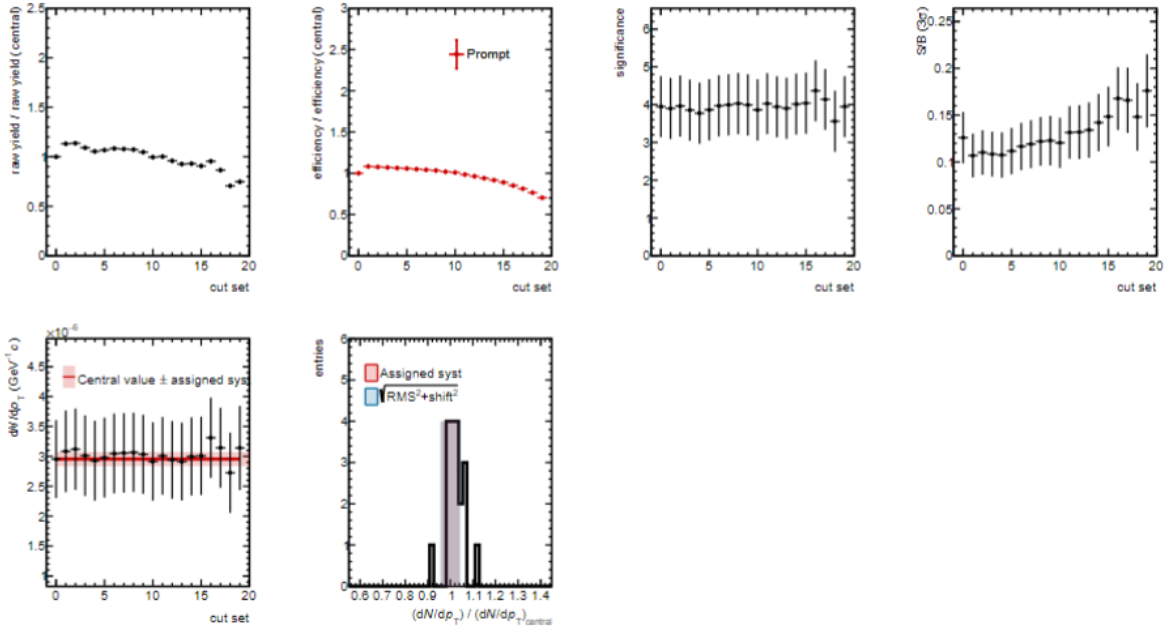


Fig. 53: The cut-variation studies for p_{T} bin 8GeV/c-12GeV/c and [0,100]V0M percentile multiplicity

BDT

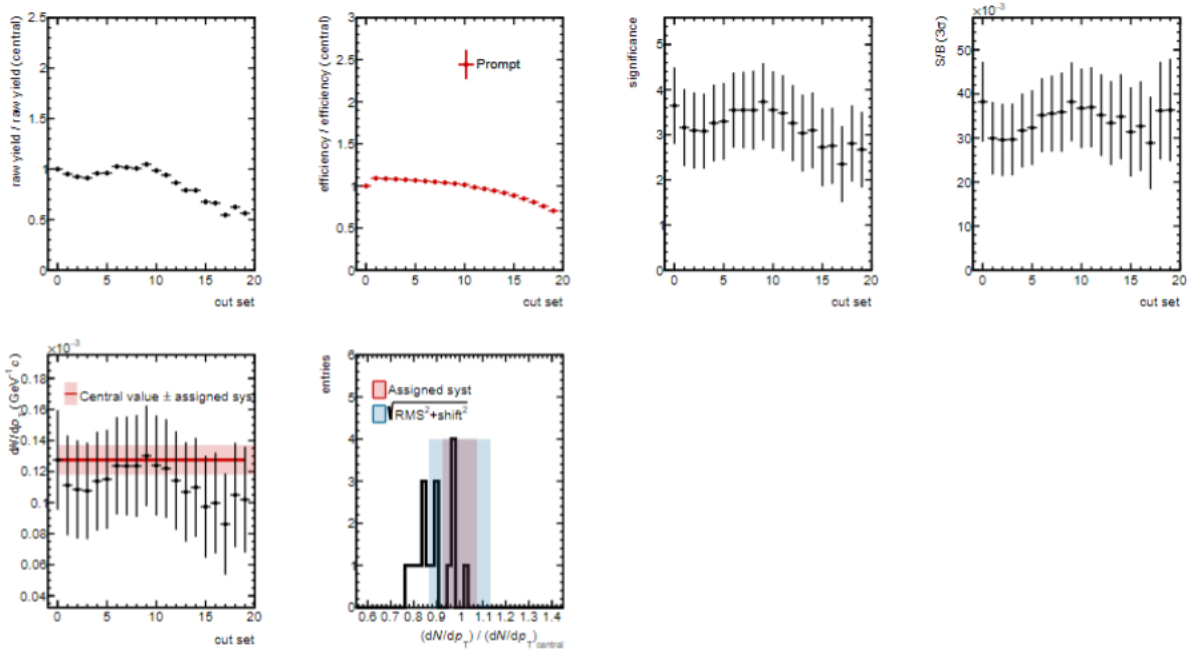


Fig. 54: The cut-variation studies for p_T bin 2GeV/c-4GeV/c and [30,100]V0M percentile multiplicity

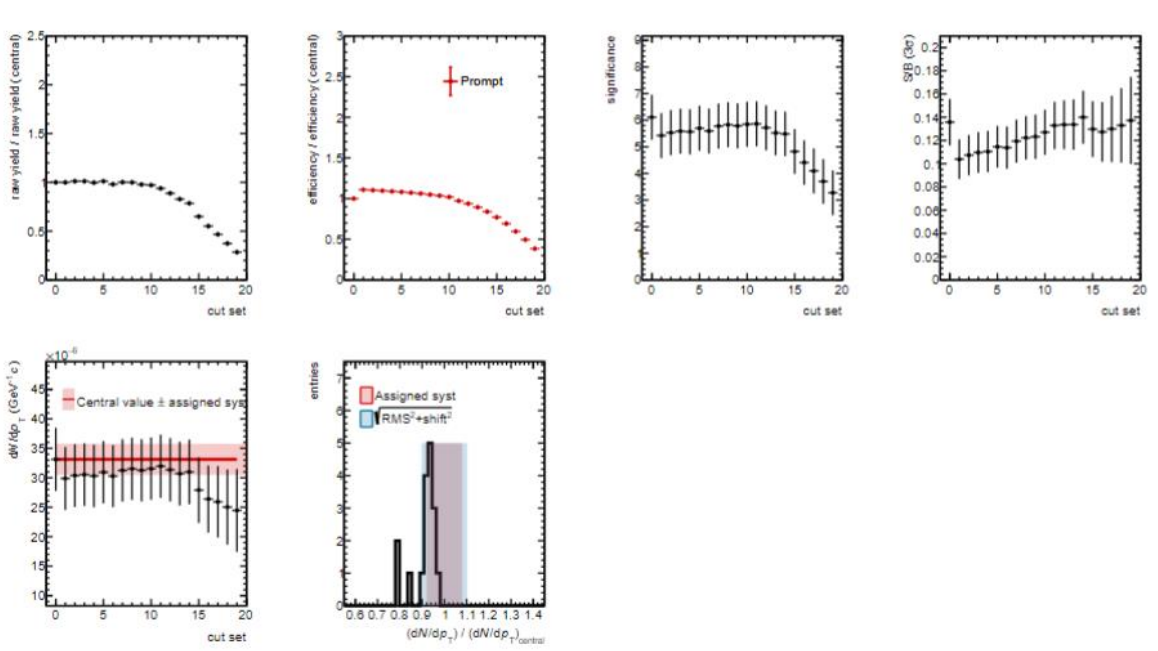


Fig. 55: The cut-variation studies for p_T bin 4GeV/c-6GeV/c and [30,100]V0M percentile multiplicity

BDT

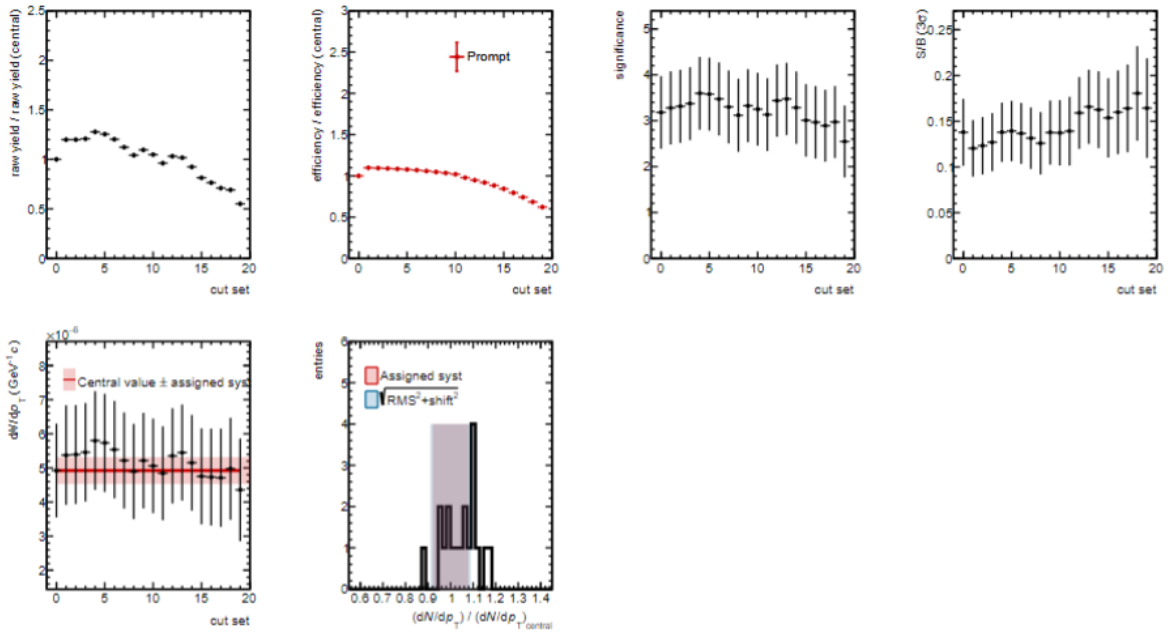
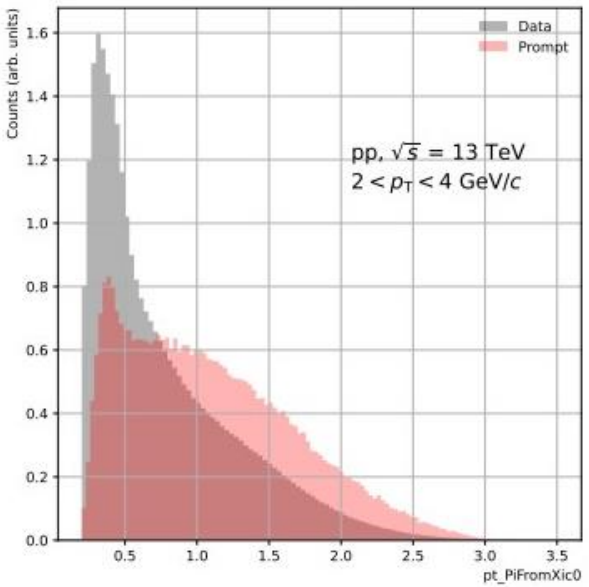
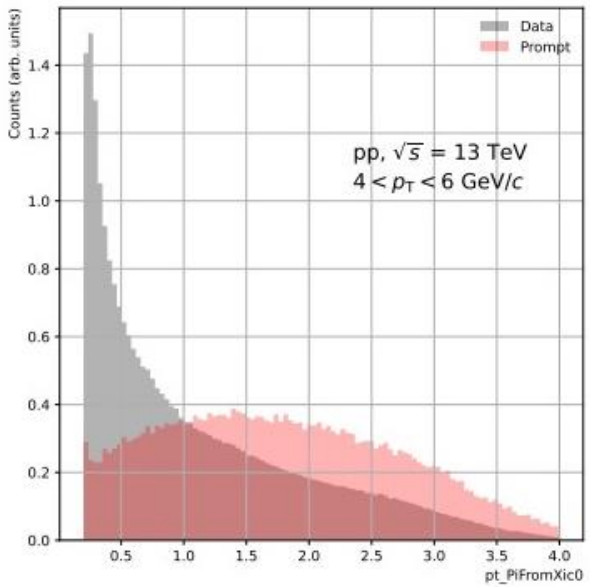


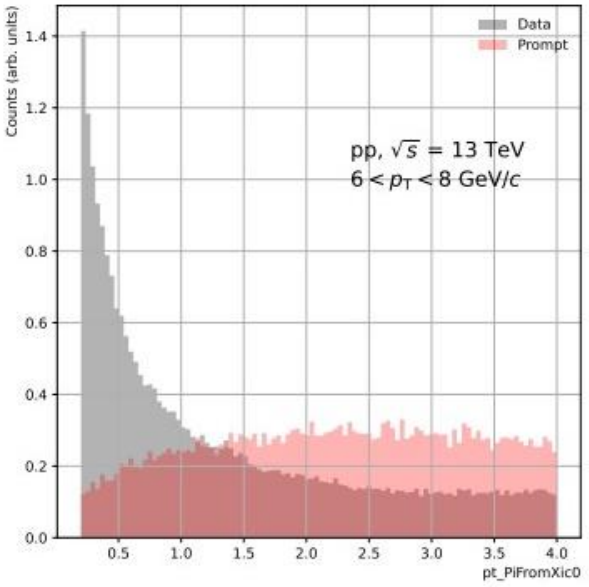
Fig. 56: The cut-variation studies for p_T bin 6GeV/c-8GeV/c and [30,100]V0M percentile multiplicity

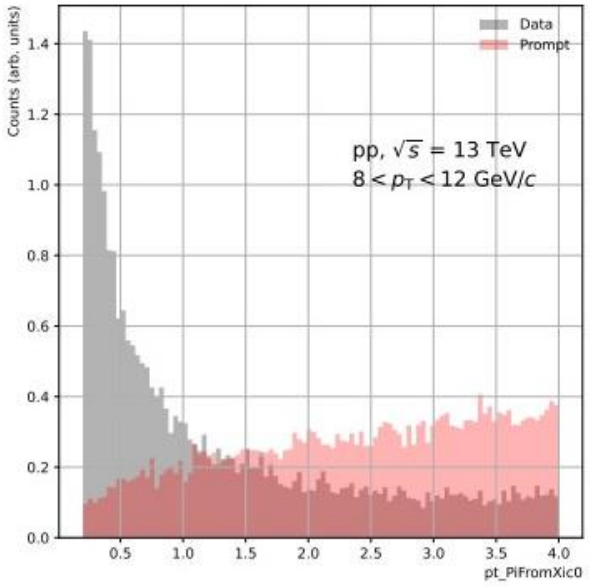
p_{T}^{π} cut

MB[0,100]





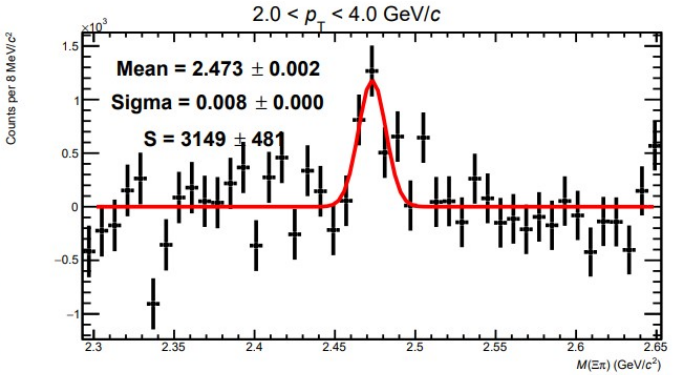


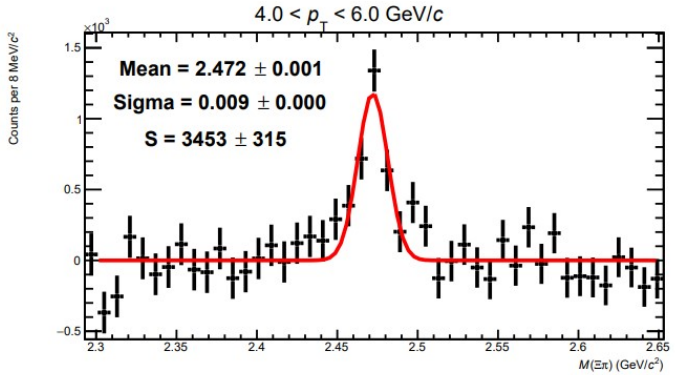


2 < p_{T} < 4 GeV/c 4 < p_{T} < 6 GeV/c 6 < p_{T} < 8 GeV/c 6 < p_{T} < 8 GeV/c

The normalized $p_{\mathrm{T}}^{\pi\leftarrow\Xi_{\mathrm{c}}^{0}}$ distributions of MC signal and side band of data in each $p_{\mathrm{T}}^{\Xi_{\mathrm{c}}^{0}}$ bin.

Bkg fit function p_V0M[0, 0.1]





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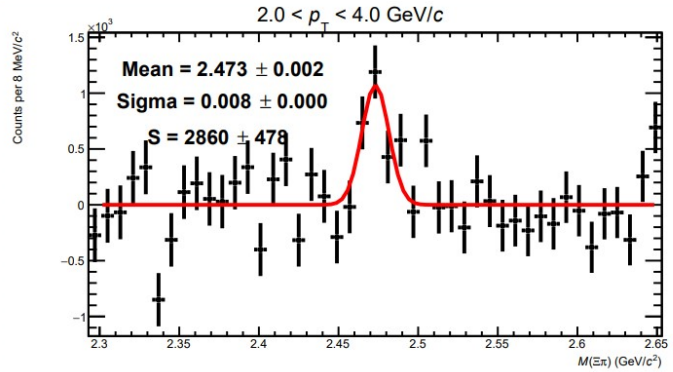
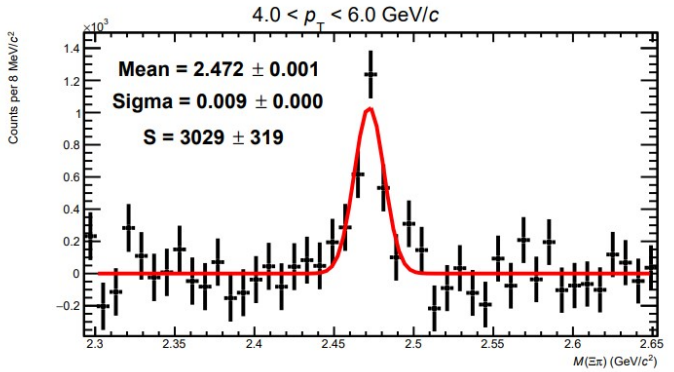
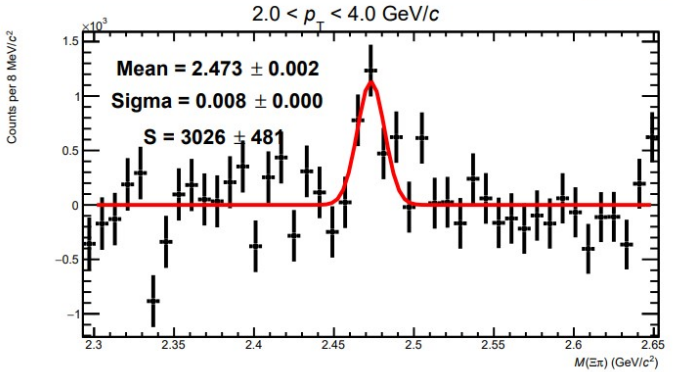
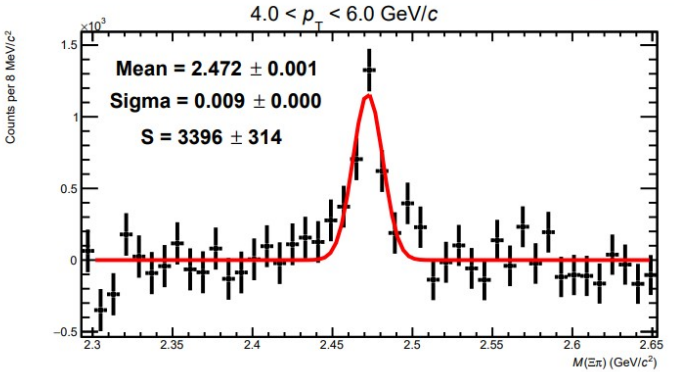




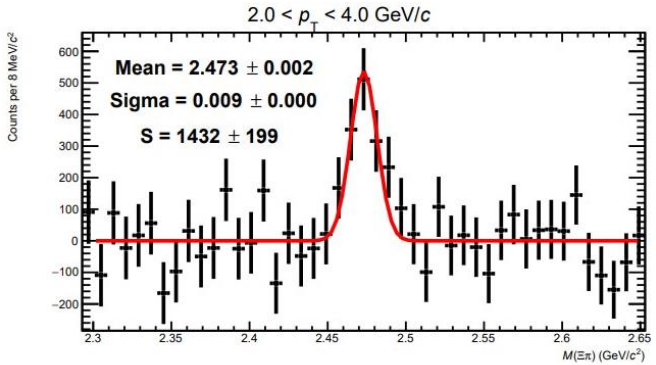
Plo2

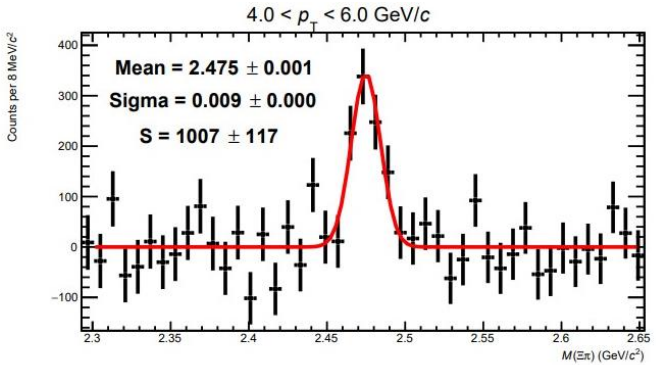




Plo1

Bkg fit function p_V0M[0.1, 30]





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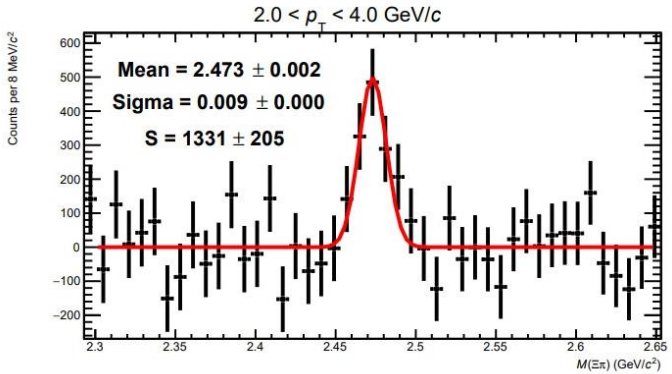
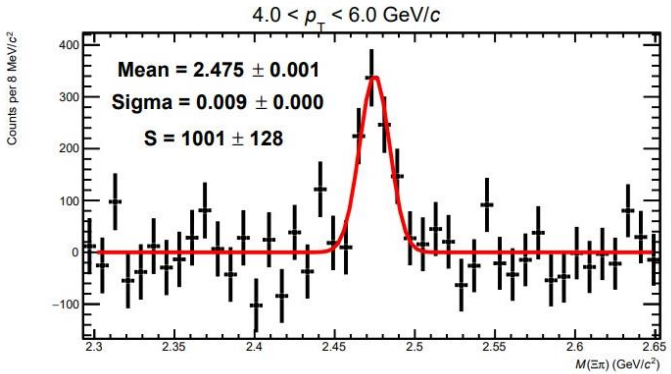
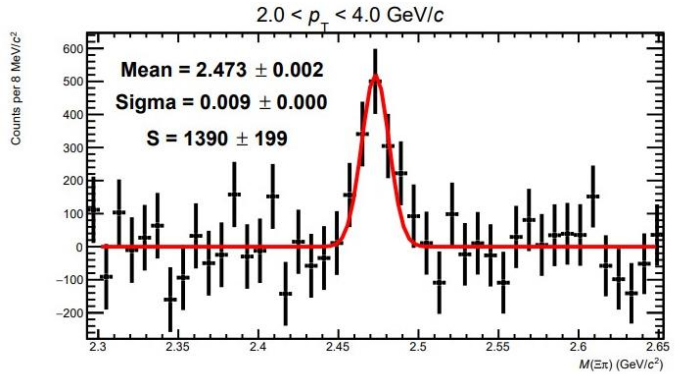
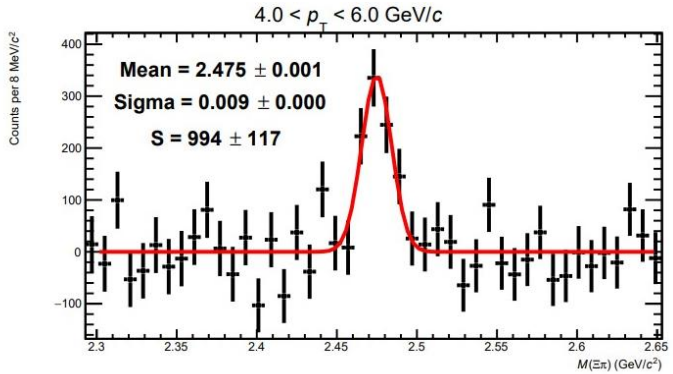




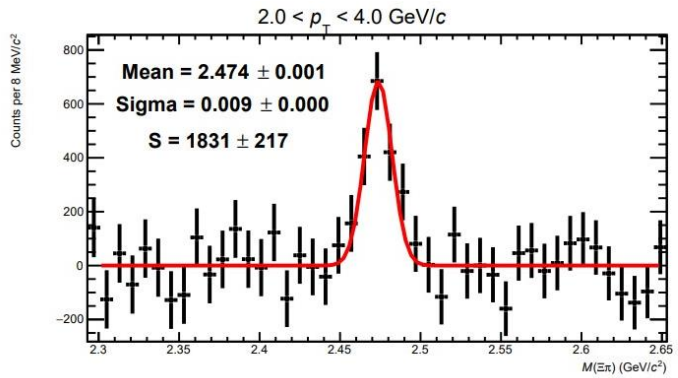
Plo2

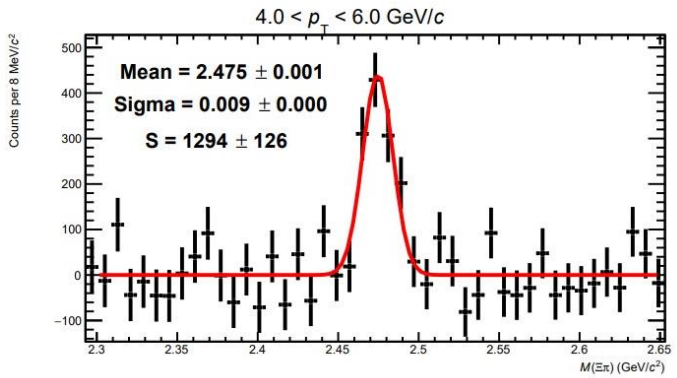




Plo1

Bkg fit function p_V0M[0, 100]





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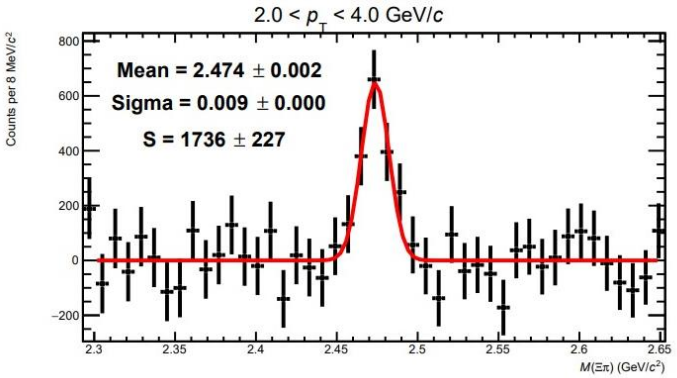
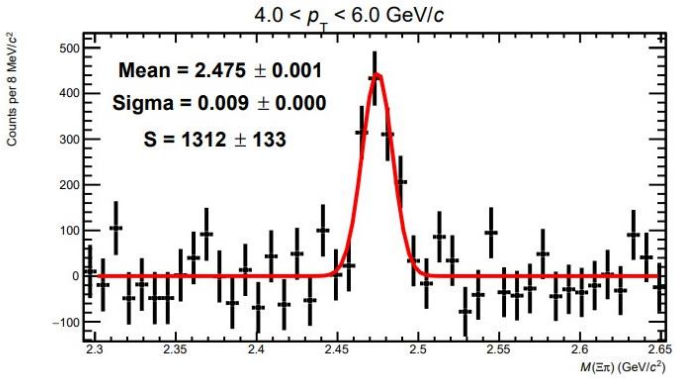
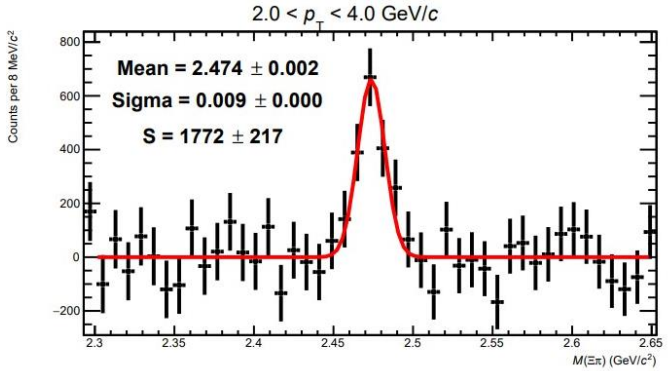
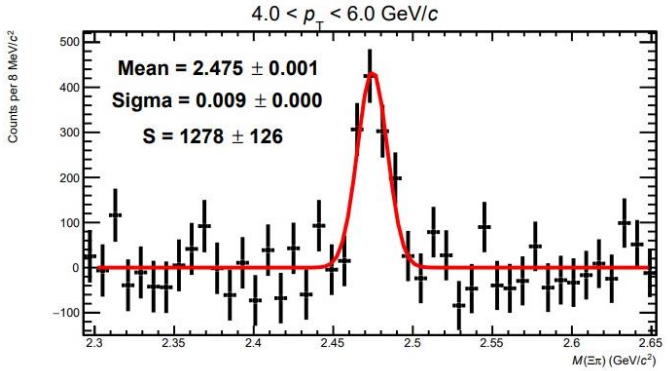




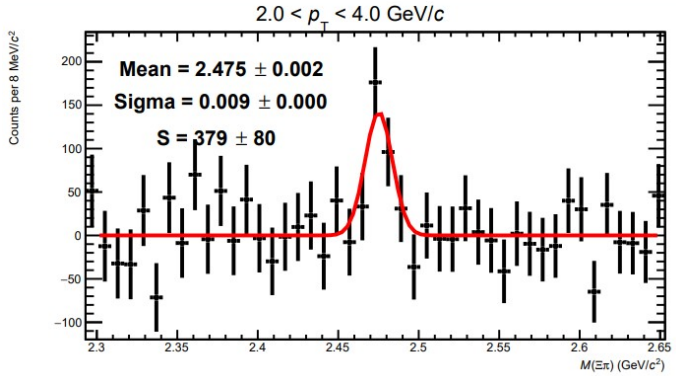
Plo2

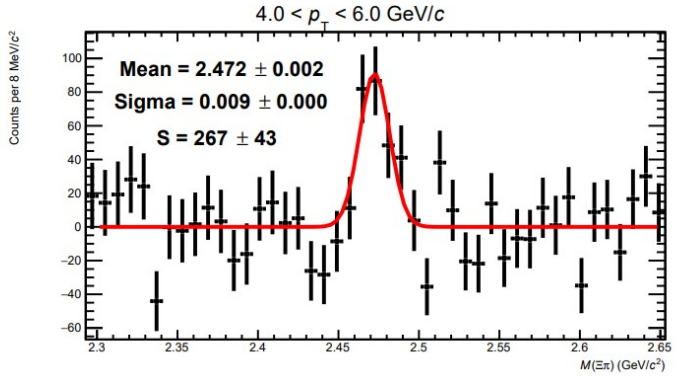




Plo1

Bkg fit function p_V0M[30, 100]





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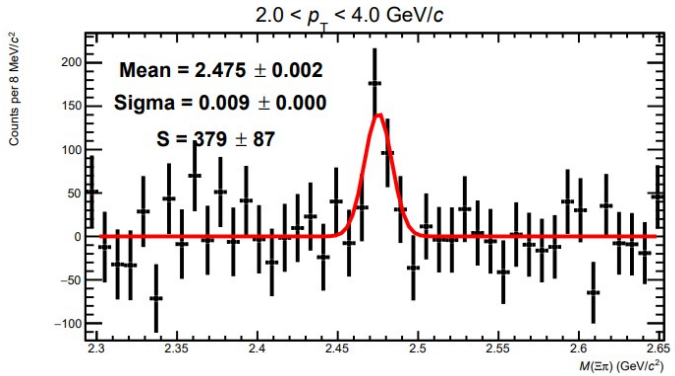
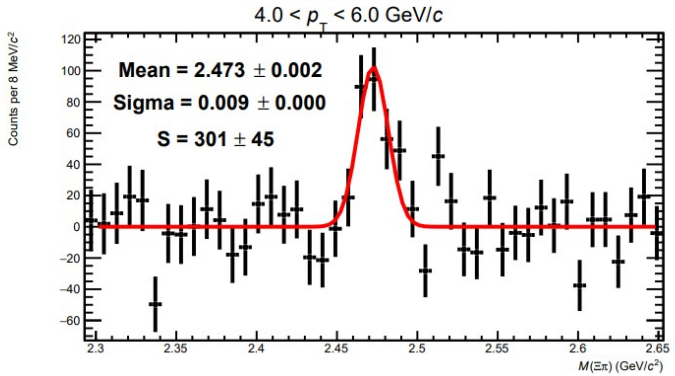
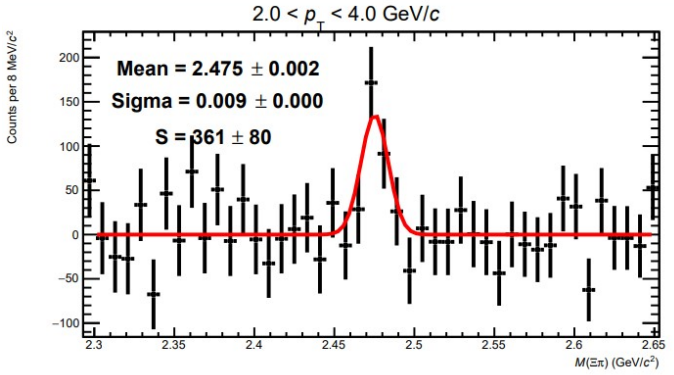
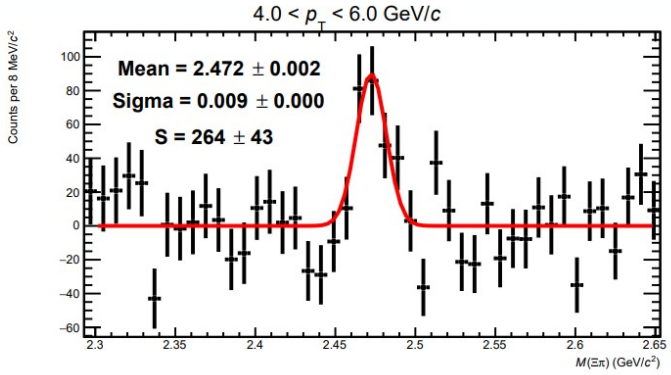




Plo2





Plo1