# Status Report

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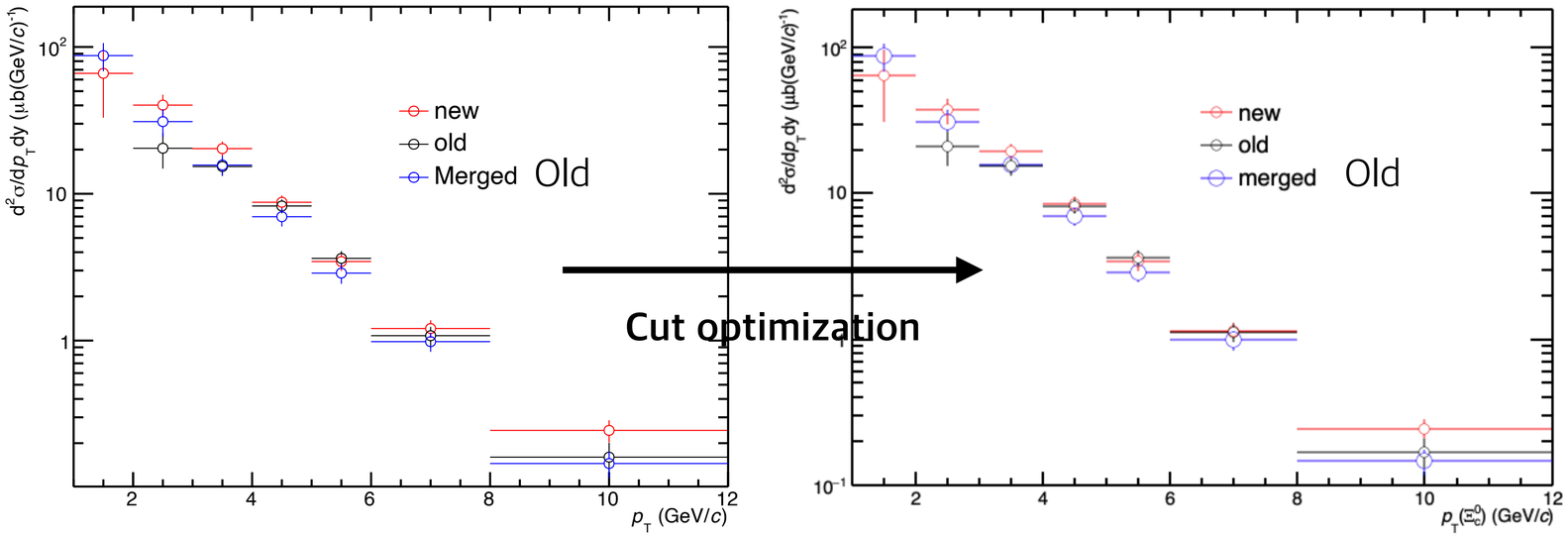
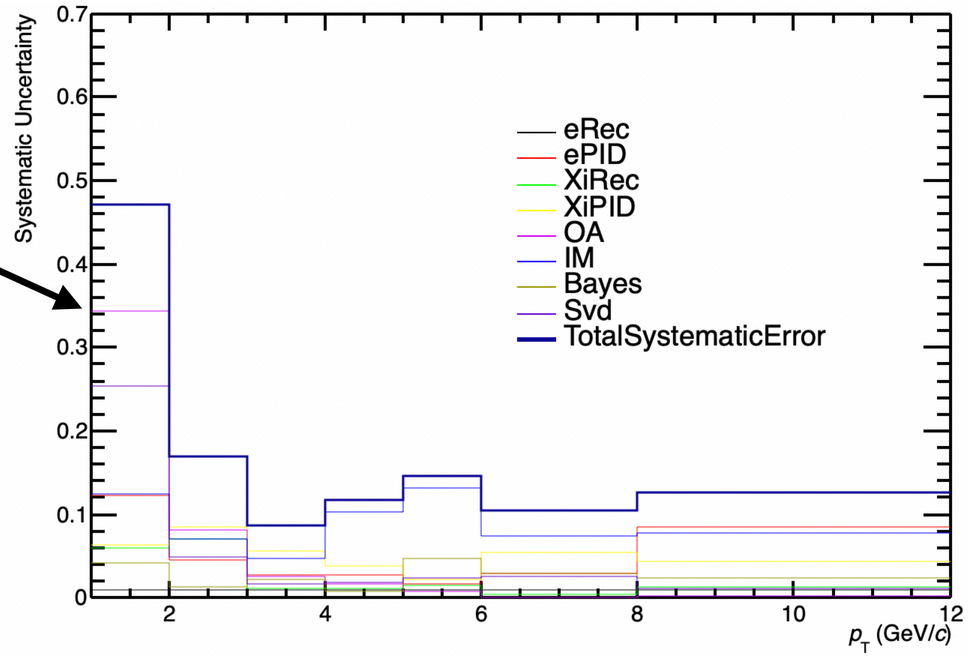
# - Status

- **Finalize the Xic0 analysis**
  - Cut optimization
  - Systematic study
    1. e reconstruction -> **DONE**
    2. e PID -> **DONE**
    3. Xi reconstruction -> **DONE**
    4. Xi PID -> **DONE**
    5. Opening angle -> **NEED TO DISCUSS**
    6. Invariant mass of pair -> **DONE**
    7. Unfolding
       A. Bayesian -> **DONE**
       B. SVD -> **DONE**
       C. Lower limit variation of response matrix -> **DONE**
    8. Weighting -> **TO DO** (waiting the Lego train)
    9. Prompt fraction -> **TO DO** (after the discussion)

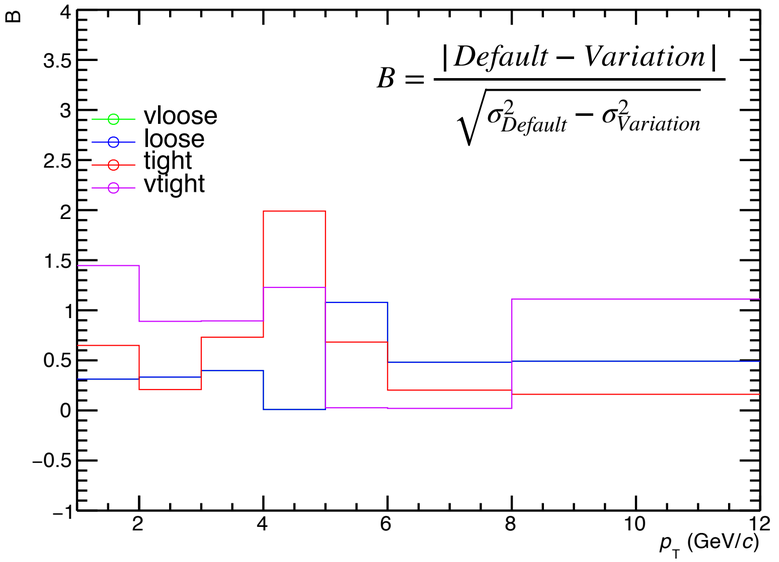


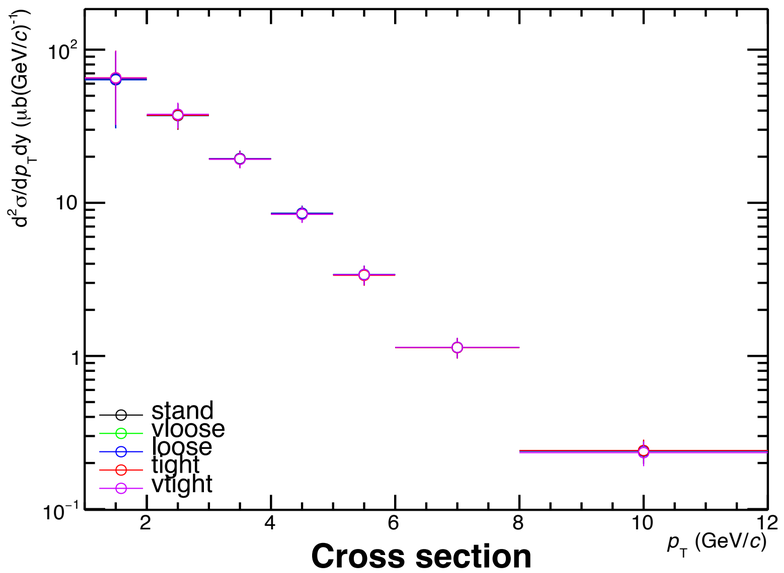



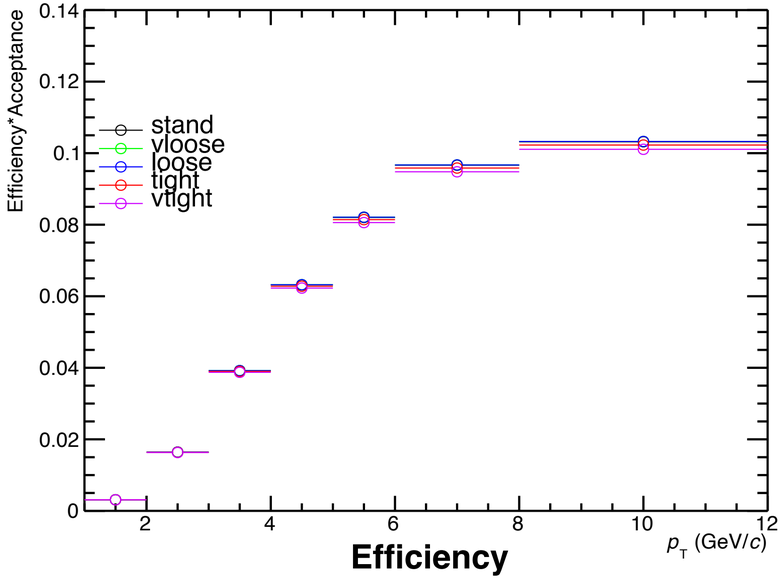
# - Systematic study

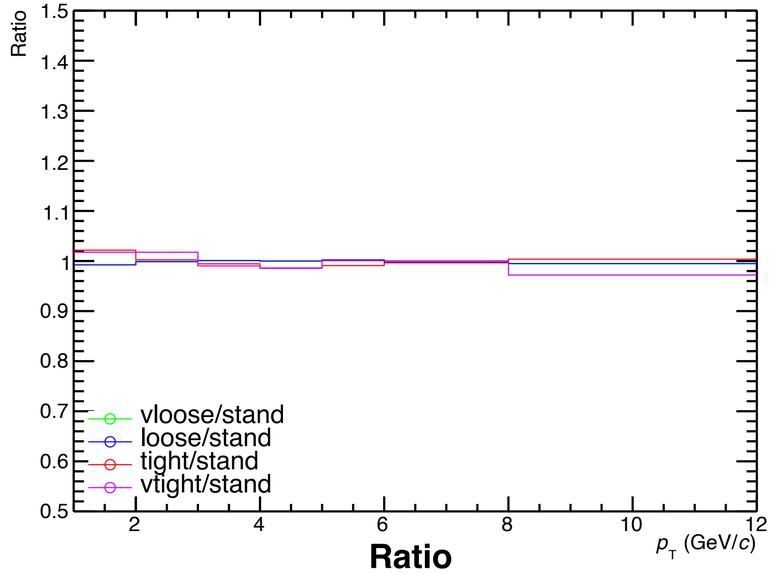
- **e Reconstruction**
  - The TPC CrossedRows and Cluster ratio are varied to study the uncertainties on track reconstruction.

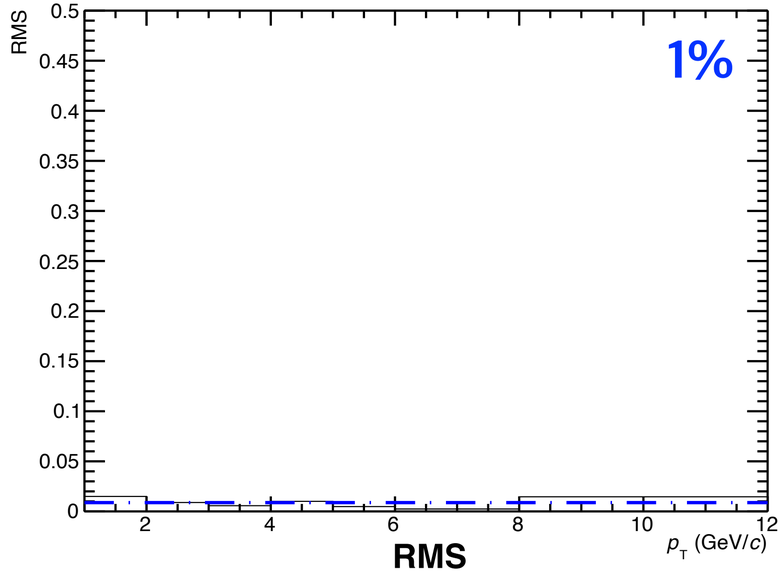
| Cut variables | VeryLoose cut | Loose cut | Standard cut | Tight cut | VeryTight cut |
|---|---|---|---|---|---|
| # of CrossedRows | >65 | >65 | >70 | >75 | >80 |
| CrossedRows/ Findable Cluster | >0.75 | >0.8 | >0.8 | >0.85 | >0.9 |
| # of TPC PID cluster | >40 | >45 | >50 | >55 | >60 |



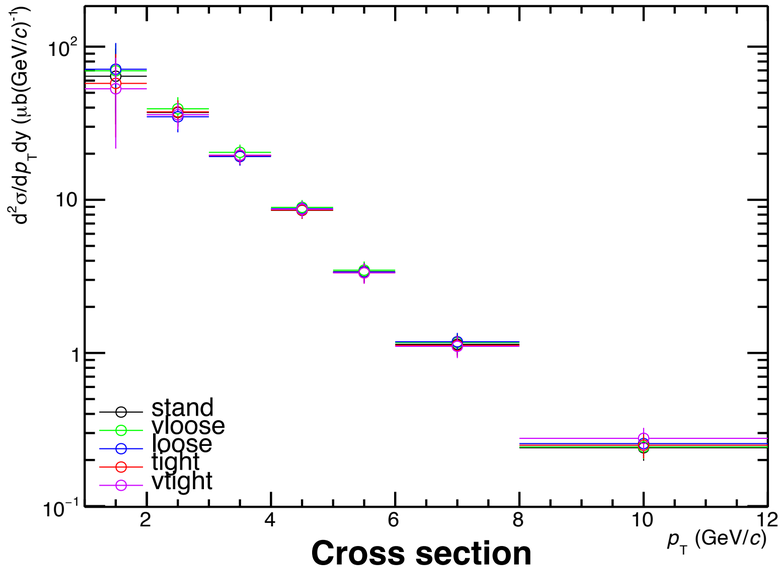



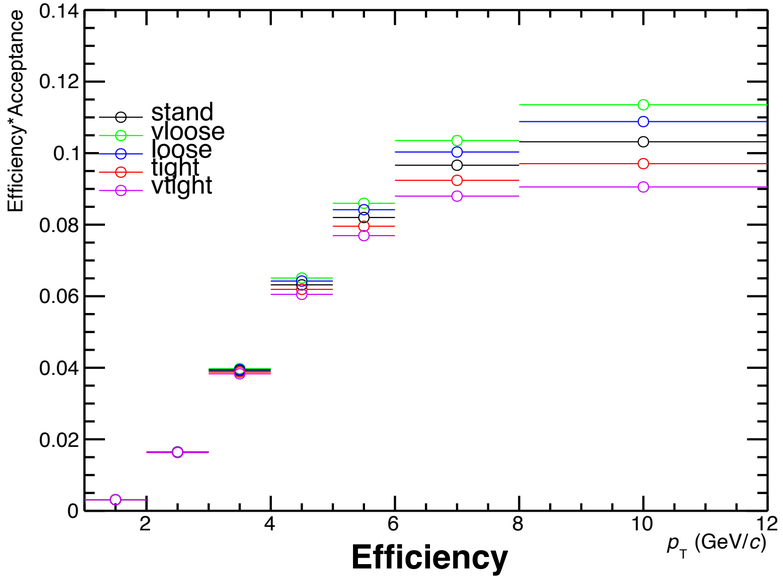



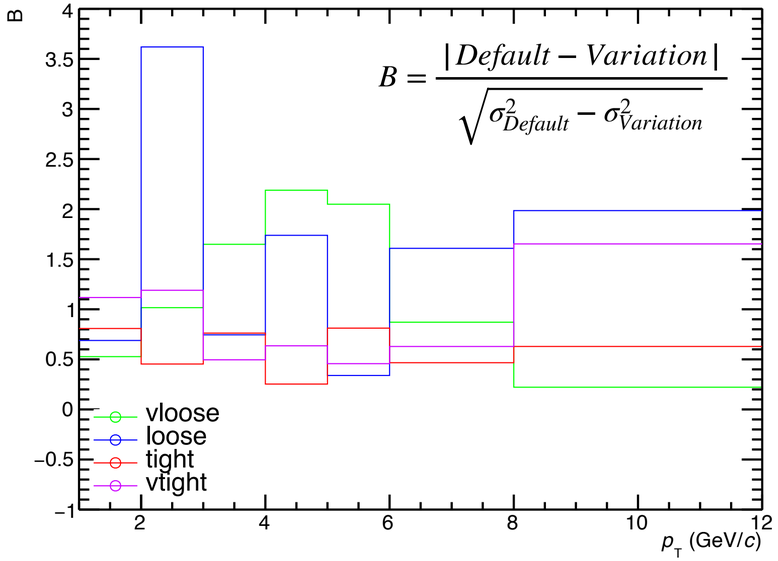
# - Systematic study

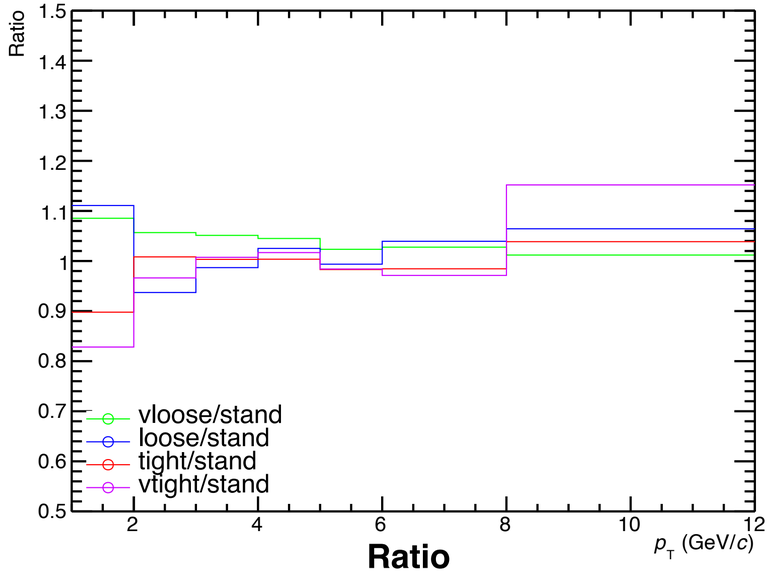
- **e PID**
  - The nSigma TPC is varied to study the track reconstruction.

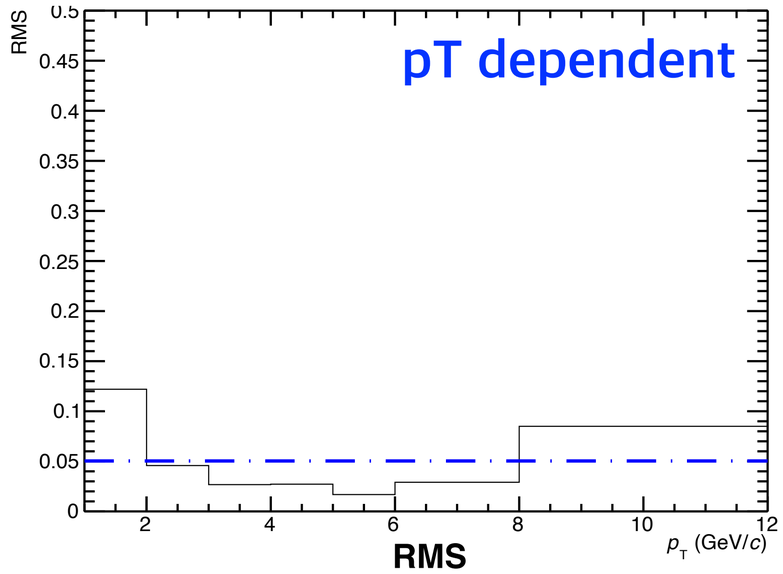
| Cut variable | VeryTight Cuts | Tight Cuts | Standard cut | Loose cut | VeryLoose cut |
|---|---|---|---|---|---|
| \|TOF | <3 | <3 | <3 | <3 | <3 |
| TPC nσ low limit | -3.5+1.15PT-0.09PT$^2$ | -3.7+1.17PT-0.094PT$^2$ | -3.9+1.17PT-0.094PT$^2$ | -4.1+1.17PT-0.094PT$^2$ | -4.3+1.17PT-0.094PT$^2$ |



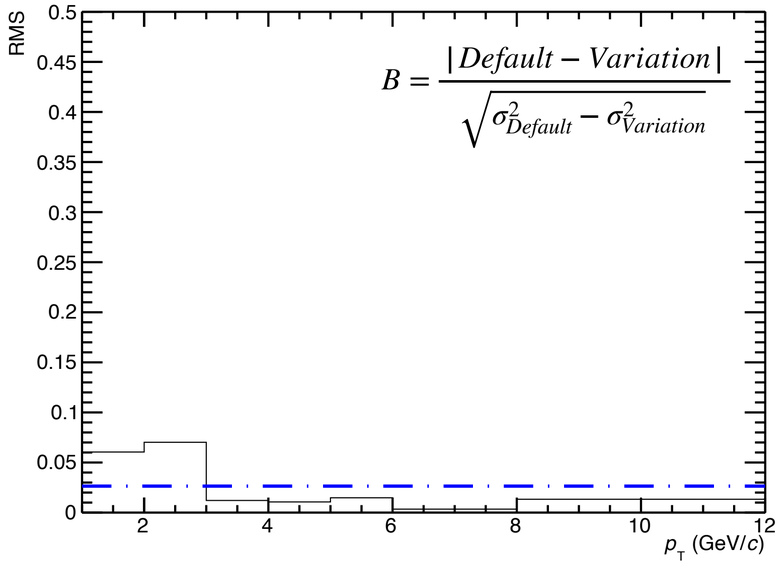



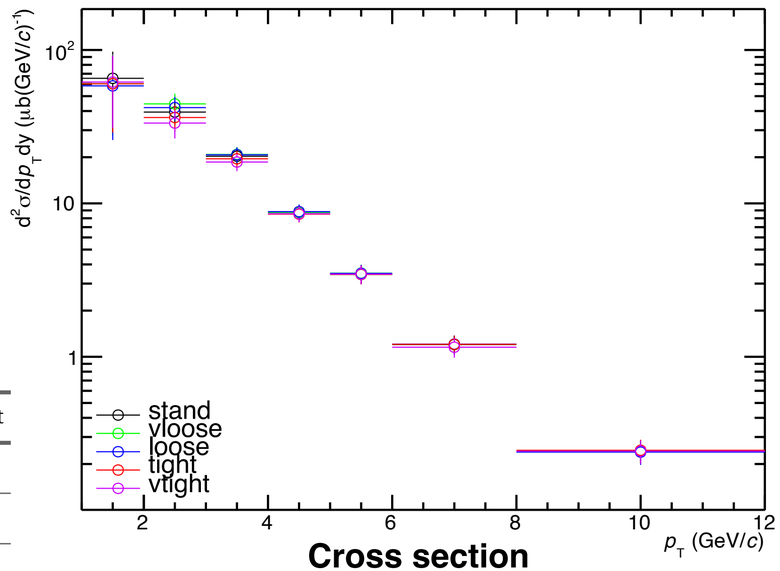



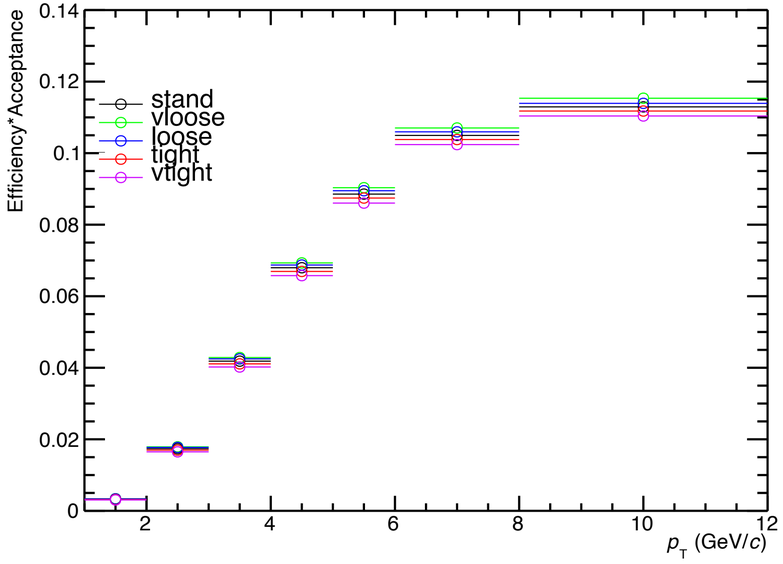
# - Systematic study

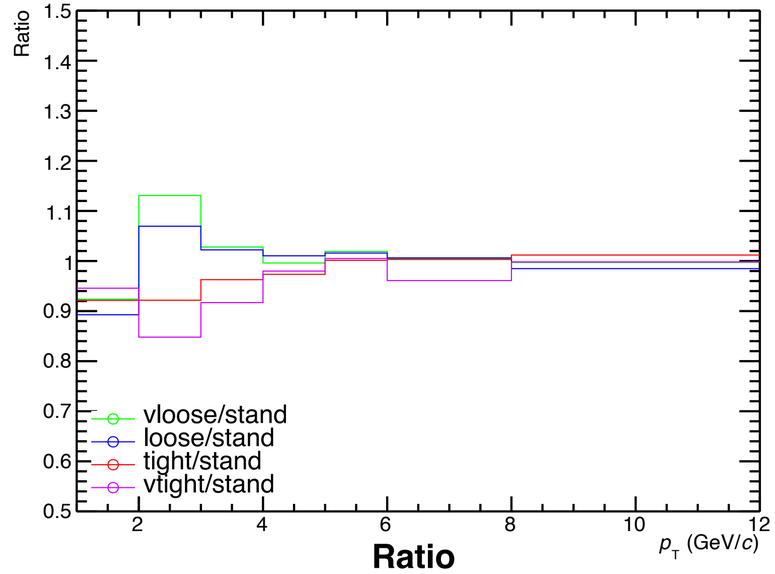
- **Xi Reconstruction (OLD)**
  - The TPC CrossedRows and Cluster ratio are varied to study the uncertainties on track reconstruction.

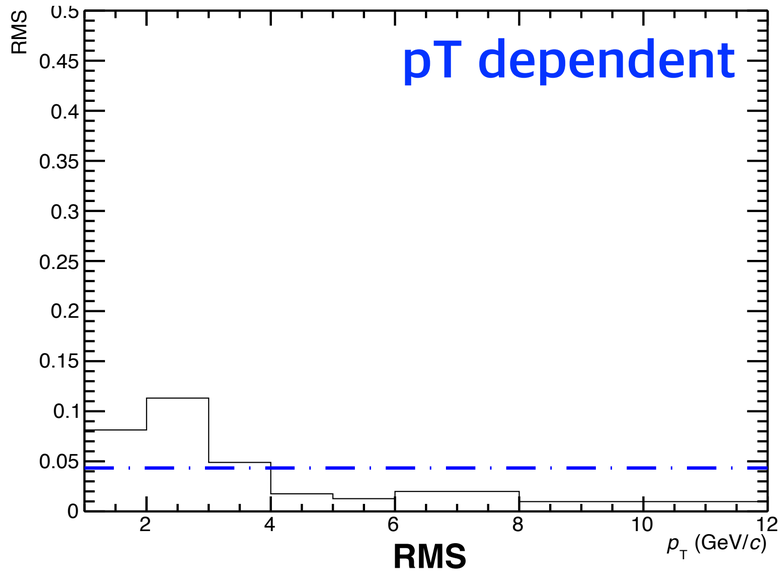
| Cut variables | VeryLoose cut | Loose cut | Standard cut | Tight cut | VeryTight cut |
|---|---|---|---|---|---|
| # of CrossedRows | >65 | >70 | >70 | >75 | >80 |
| CrossedRows/ Findable Cluster | >0.75 | >0.75 | >0.8 | >0.85 | >0.9 |



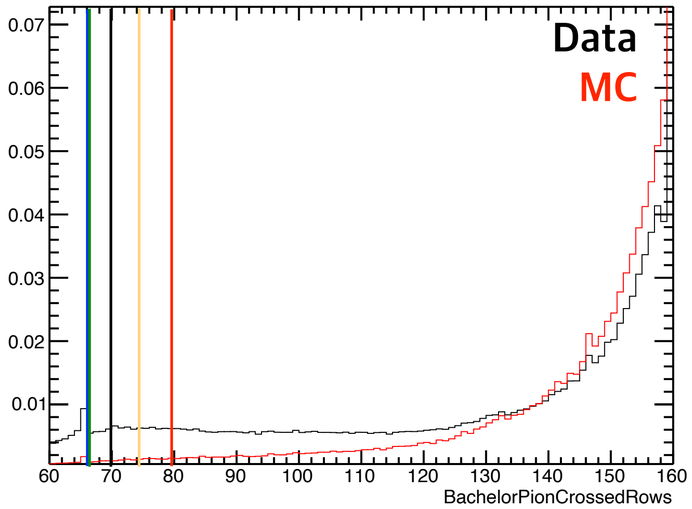



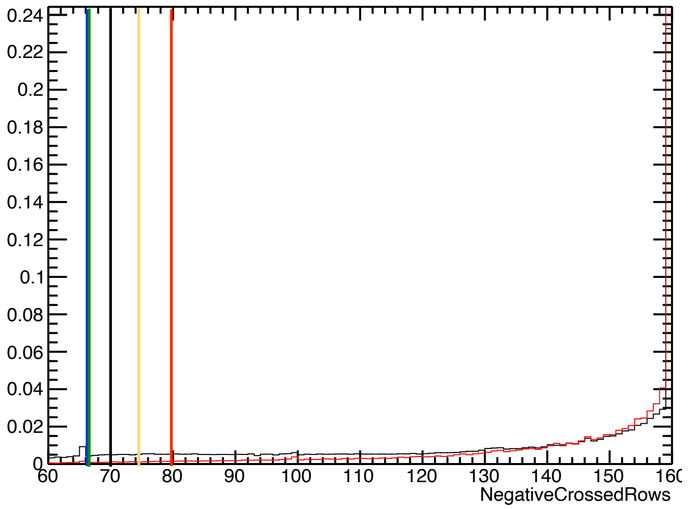



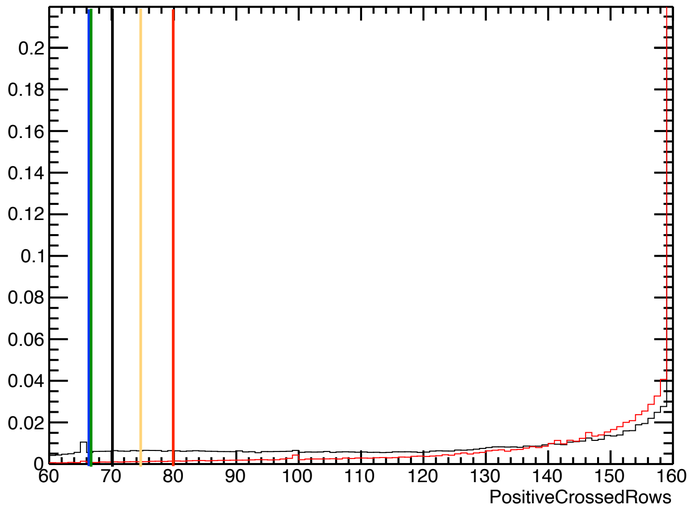
# Status

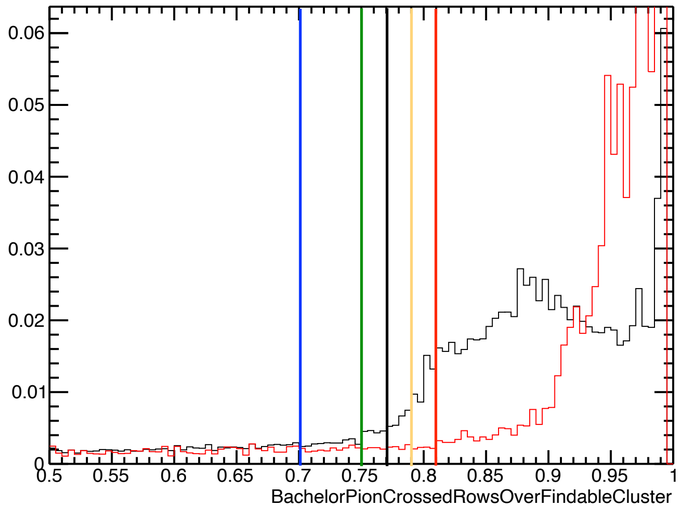
| Cut variables | VeryLoose | Loose cut | Standard | Tight cut | VeryTight |
|---|---|---|---|---|---|
| # of CrossedRows | >65 | >65 | >70 | >75 | >80 |
| CrossedRows/ Findable Cluster | >0.70 | >0.75 | >0.77 | >0.79 | >0.81 |

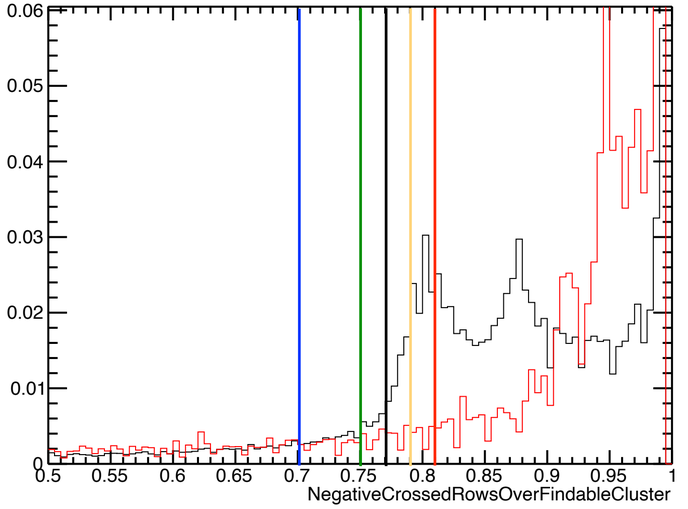
## - Distributions comparison for e cut

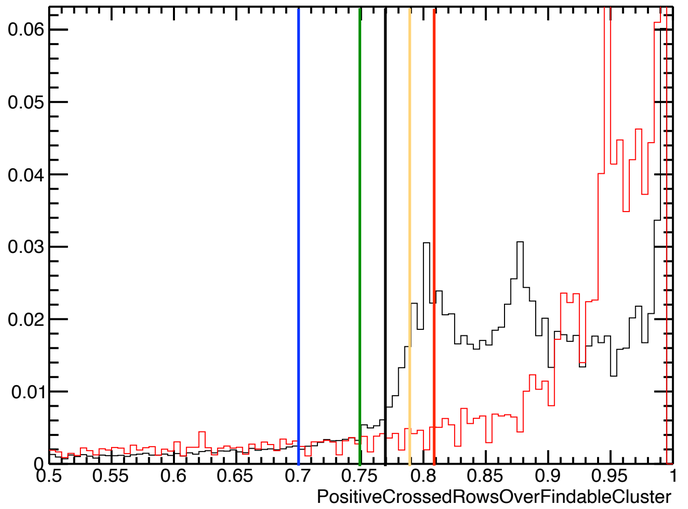


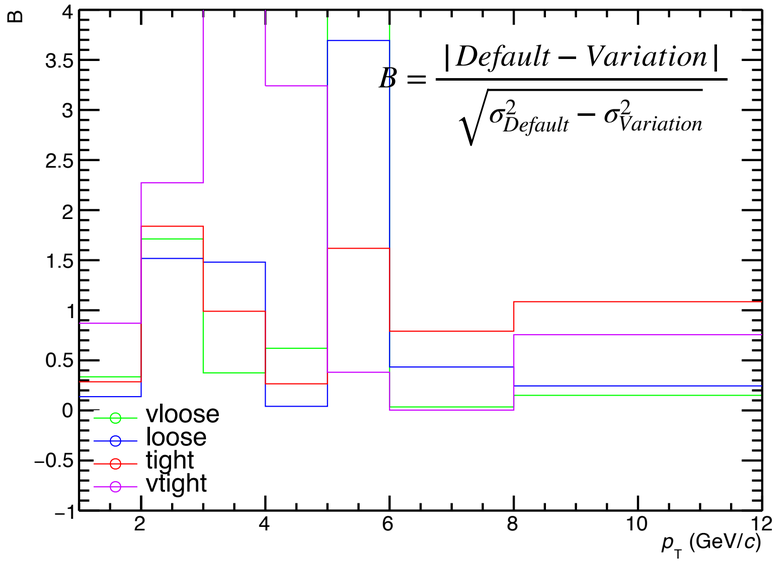



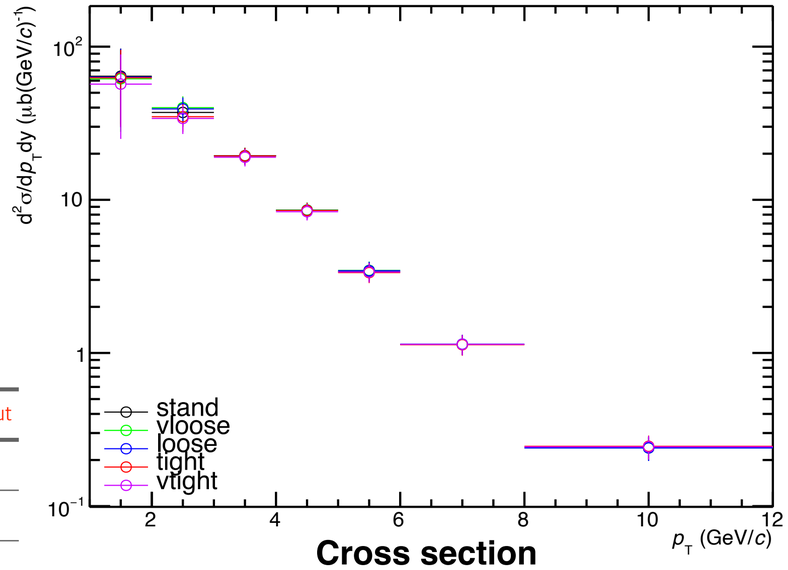



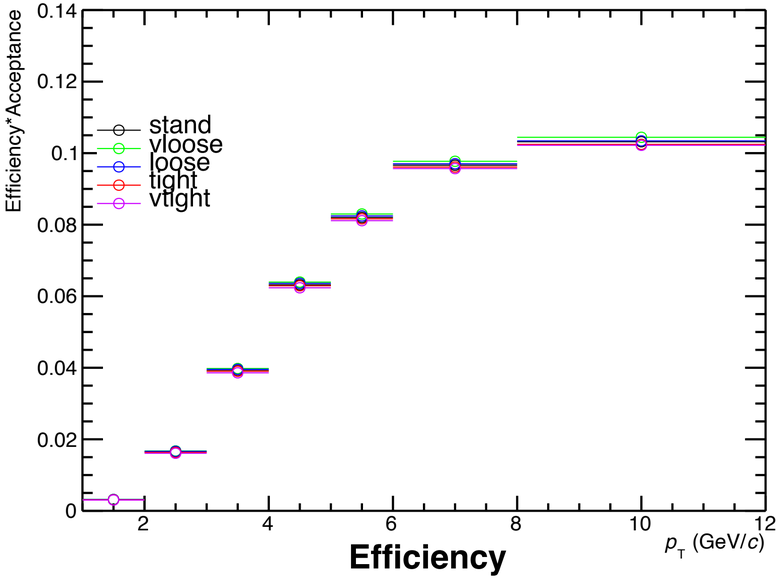
# - Systematic study

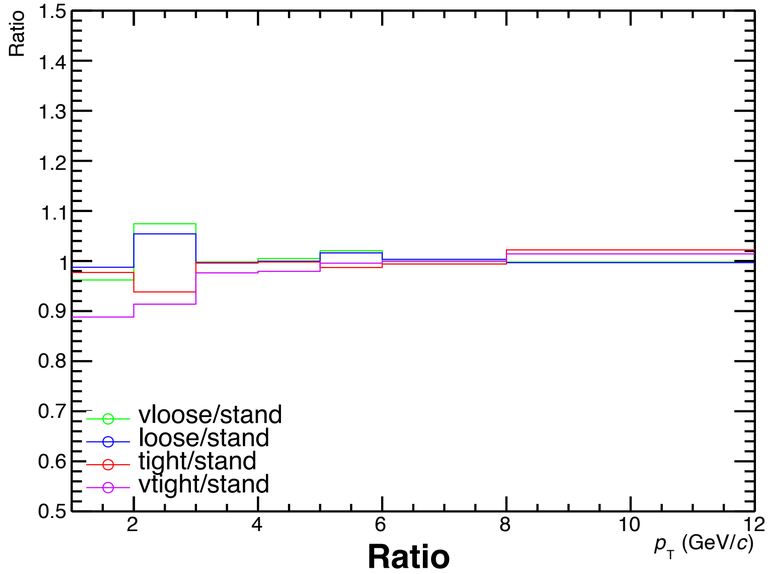
- **Xi Reconstruction**
  - The TPC CrossedRows and Cluster ratio are varied to study the uncertainties on track reconstruction.

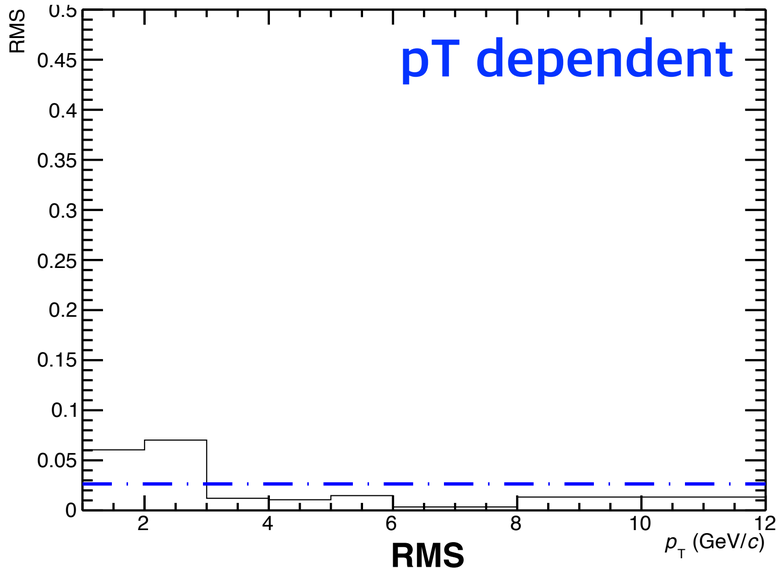
| Cut variables | VeryLoose cut | Loose cut | Standard cut | Tight cut | VeryTight cut |
|---|---|---|---|---|---|
| # of CrossedRows | >66 | >66 | >70 | >70 | >74 |
| CrossedRows/ Findable Cluster | >0.74 | >0.77 | >0.77 | >0.79 | >0.79 |



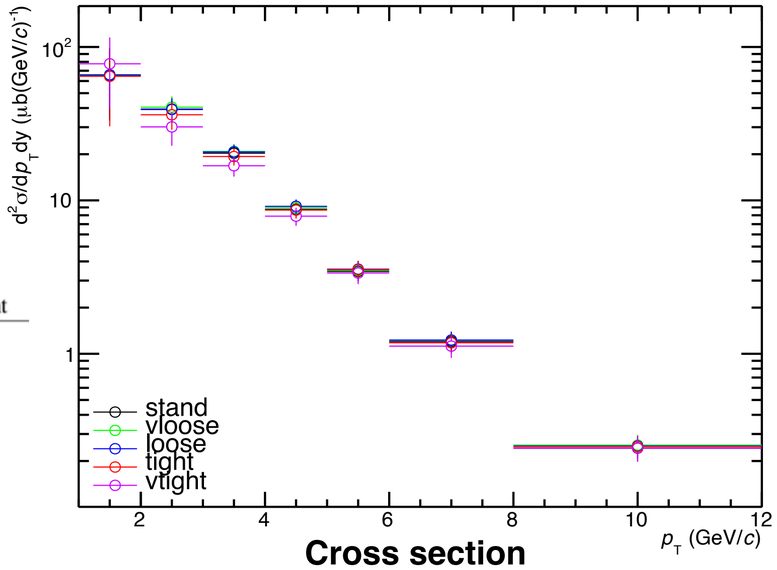



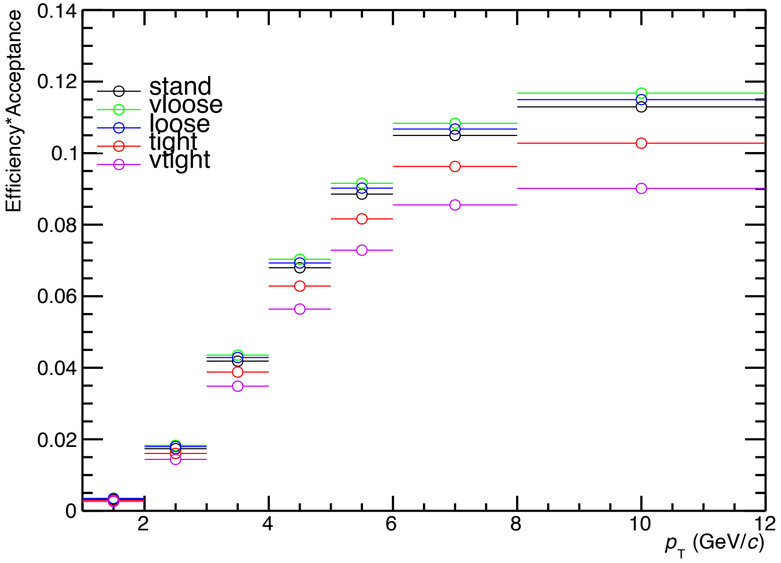
# - Systematic study

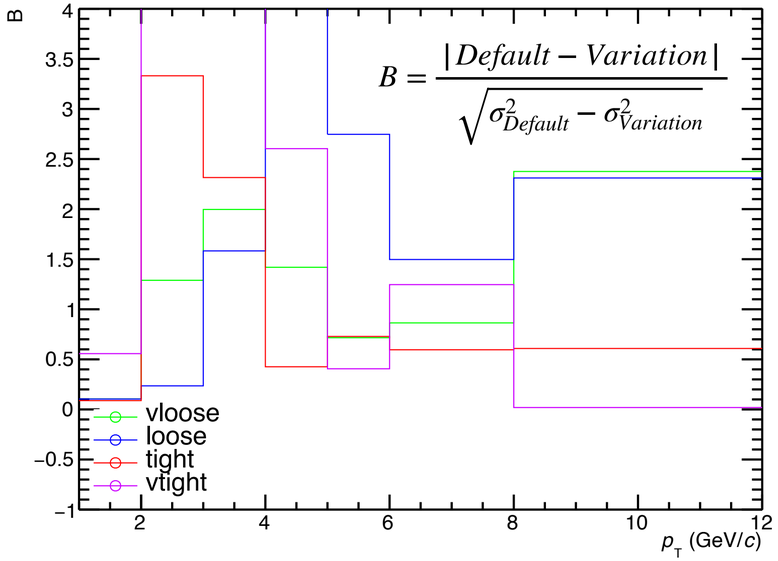
- **Xi PID (OLD)**
  - The Xi topology cut is varied to study the uncertainties on V0 and cascade reconstruction.

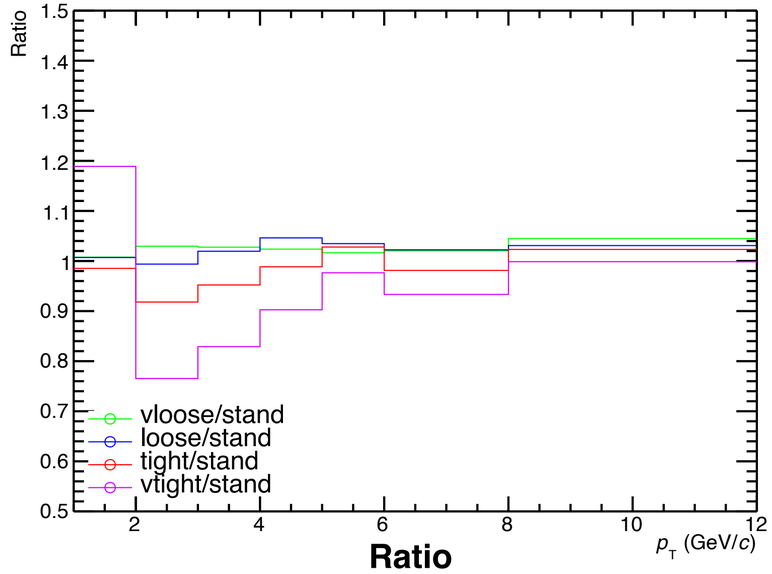
| Cut variables | VeryLoose | Loose | Standard | Tight | VertTight |
|---|---|---|---|---|---|
| Λ Mass tolerance ($MeV/c^2$) | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 |
| Ξ Mass tolerance ($MeV/c^2$) | 8 | 8 | 8 | 8 | 8 |
| DCA of V0 to PV (cm) | >0.05 | >0.05 | >0.05 | >0.1 | >0.15 |
| DCA of V0 daughters to PV (cm) | >0.05 | >0.061 | >0.073 | >0.088 | >0.102 |
| V0 cosine of pointing angle to Ξ vertex | >0.98 | >0.981 | >0.983 | >0.9839 | >0.985 |
| DCA of bachelor track to PV (cm) | >0.05 | >0.05 | >0.05 | >0.05 | >0.1 |
| V0 decay length (cm) | >1.1 | >1.55 | >2.67 | >3.6 | >4.39 |
| Ξ decay length (cm) | >0.5 | >0.5 | >0.5 | >0.53 | >0.72 |



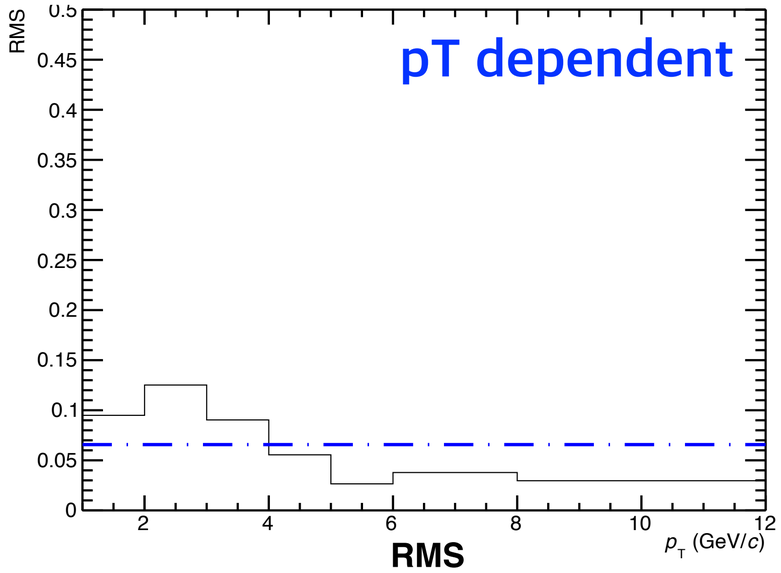
Cross section



Ratio

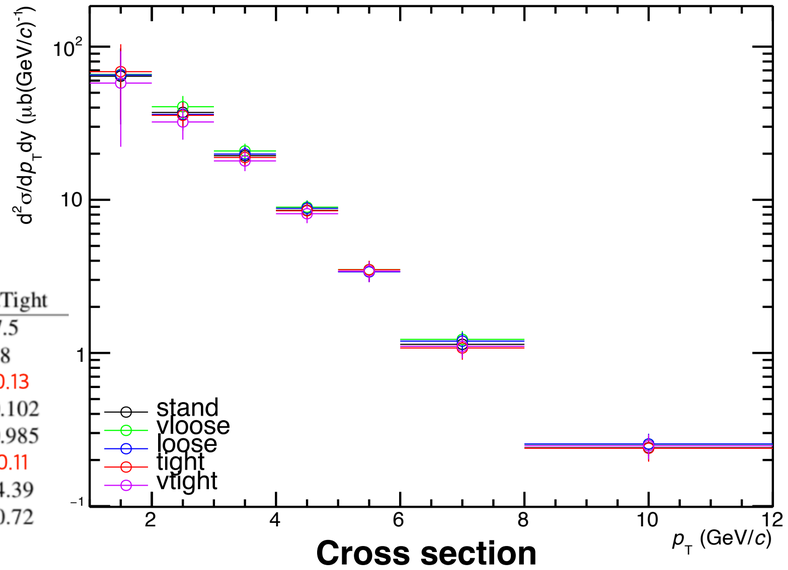


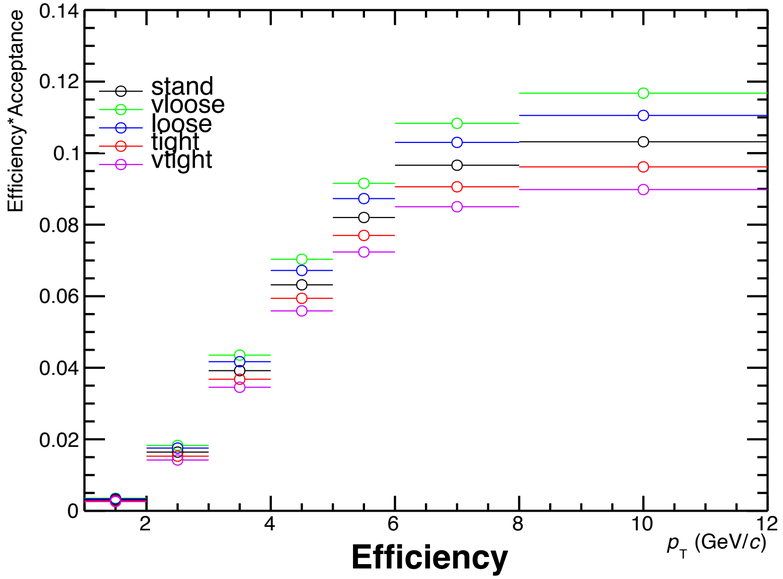
RMS

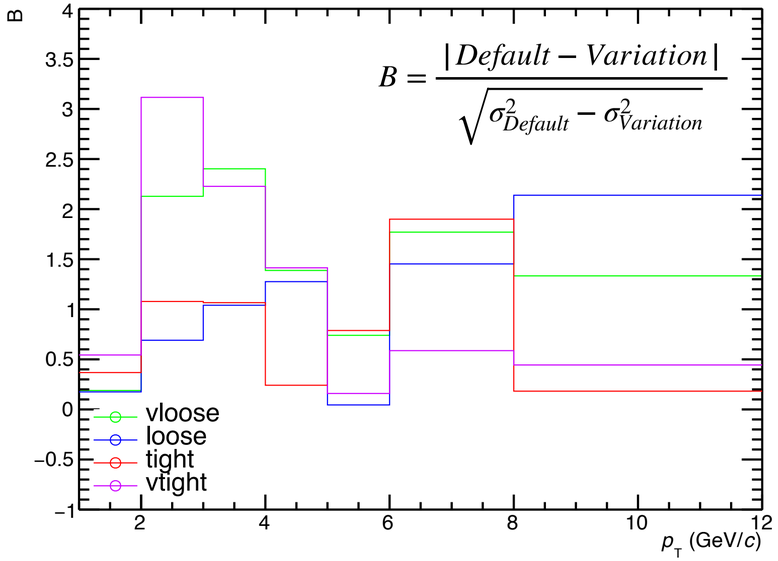
# - Systematic study

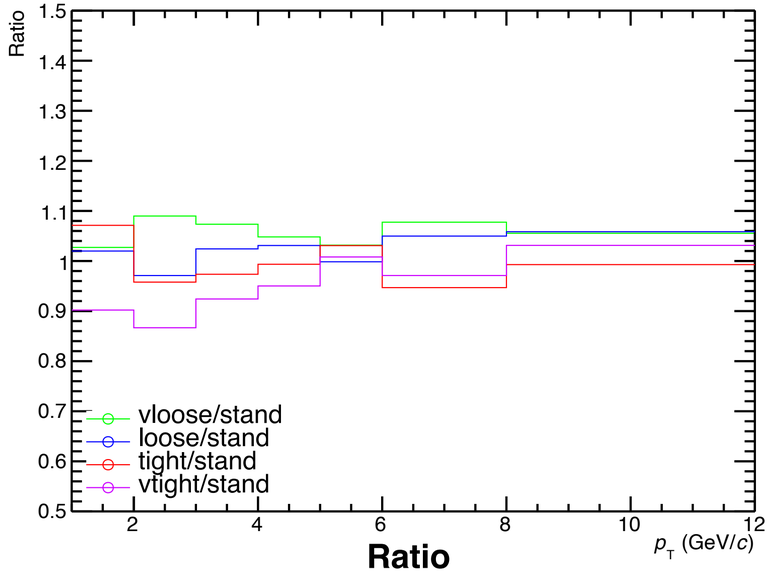
- **Xi PID**
  - The Xi topology cut is varied to study the uncertainties on V0 and cascade reconstruction.

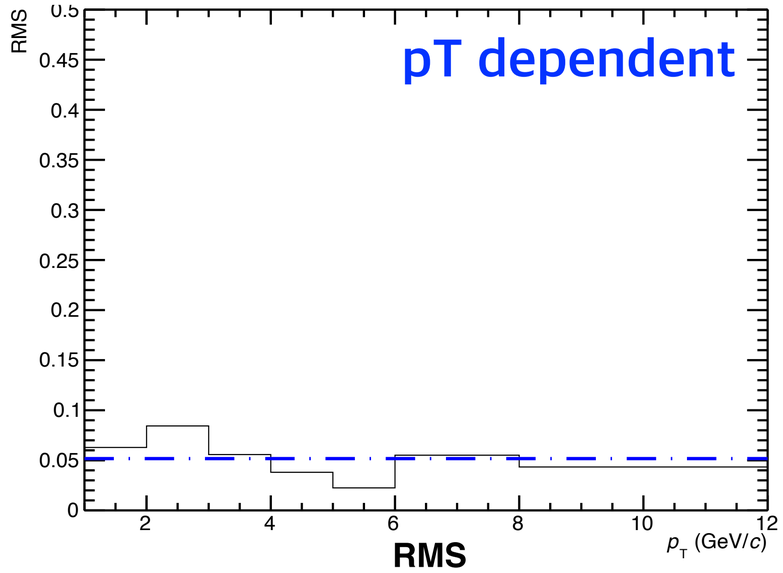
| Cut variables | VeryLoose | Loose | Standard | Tight | VertTight |
|---|---|---|---|---|---|
| Λ Mass tolerance ($MeV/c^2$) | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 |
| Ξ Mass tolerance ($MeV/c^2$ ) | 8 | 8 | 8 | 8 | 8 |
| DCA of V0 to PV (cm) | >0.05 | >0.07 | >0.09 | >0.11 | >0.13 |
| DCA of V0 daughters to PV (cm) | >0.05 | >0.061 | >0.073 | >0.088 | >0.102 |
| V0 cosine of pointing angle to Ξ vertex | >0.98 | >0.981 | >0.983 | >0.9839 | >0.985 |
| DCA of bachelor track to PV (cm) | >0.05 | >0.05 | >0.07 | >0.09 | >0.11 |
| V0 decay length (cm) | >1.1 | >1.55 | >2.67 | >3.6 | >4.39 |
| Ξ decay length (cm) | >0.5 | >0.5 | >0.5 | >0.53 | >0.72 |



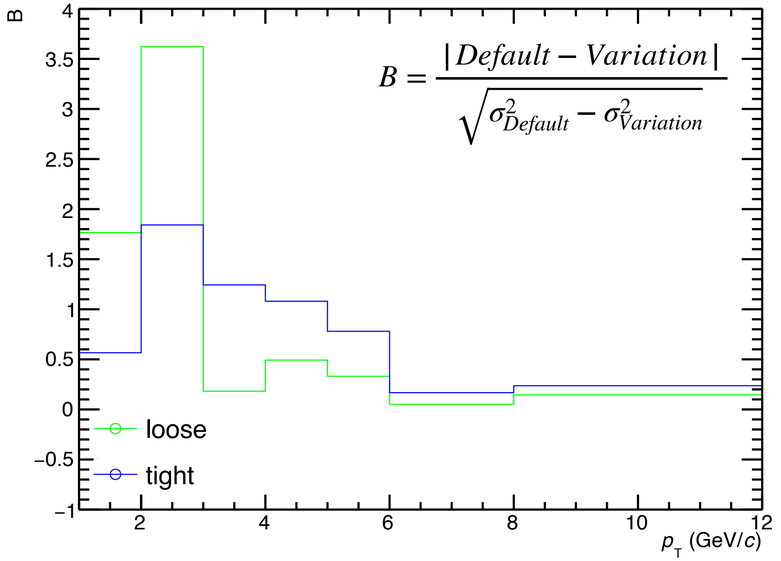



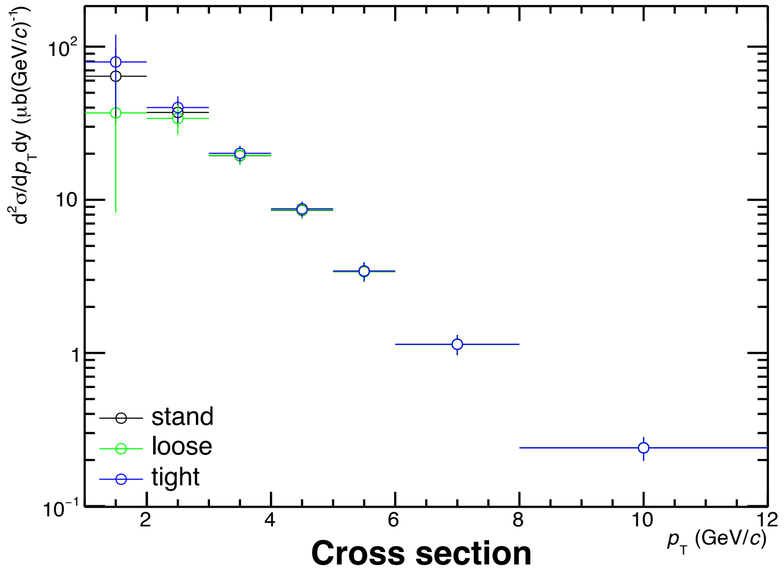



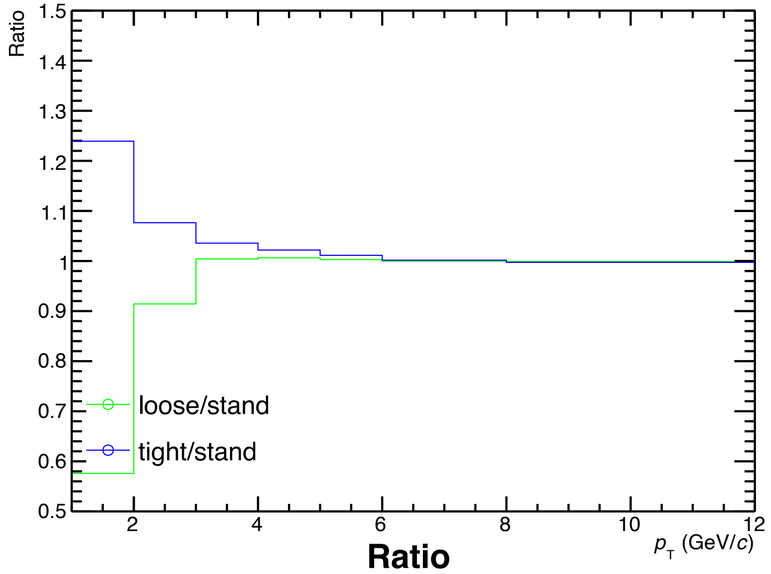
# - Systematic study (NEED TO DISCUSS)

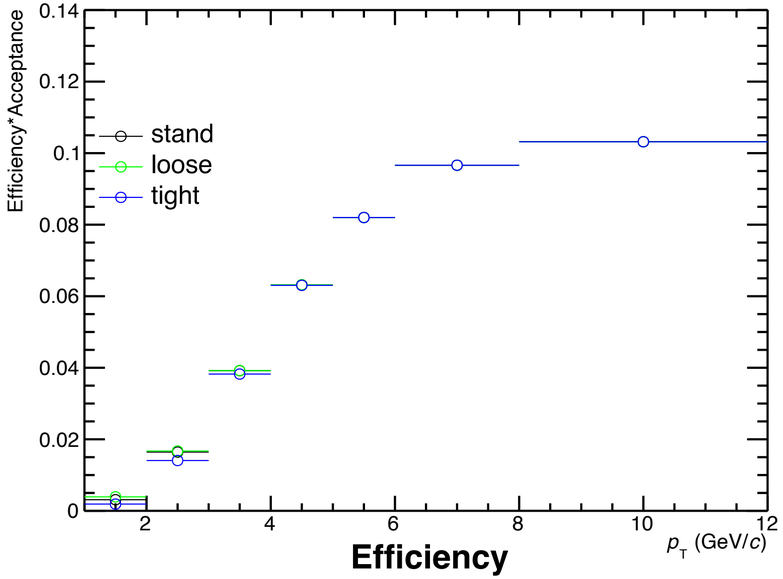
- **Opening angle**
  - The opening angle cut is varied to study the uncertainties on eXi pair opening angle.

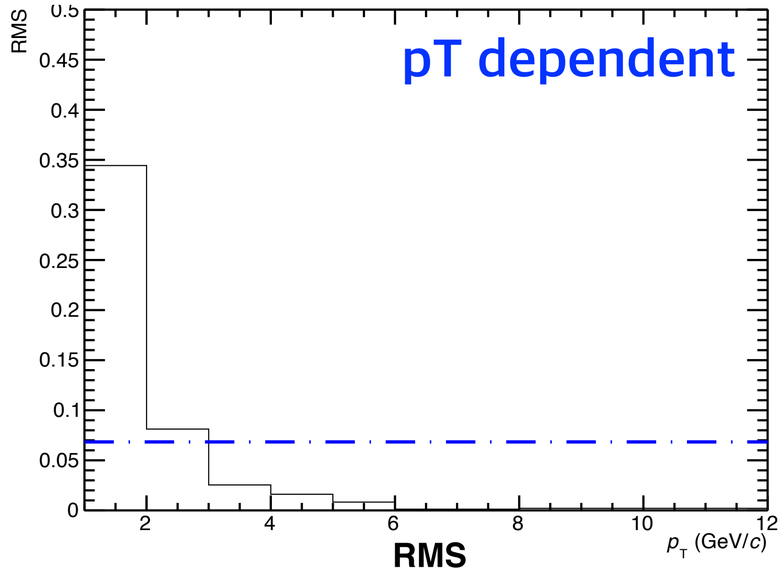
| Cut variables | Loose Cuts | Standard cut | Tight cut |
|---|---|---|---|
| Opening angle (degree) | 110 | 90 | 70 |



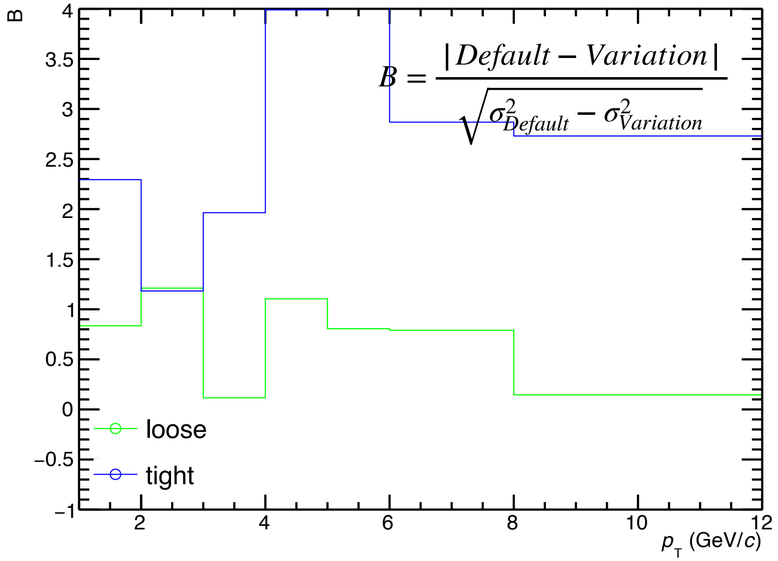



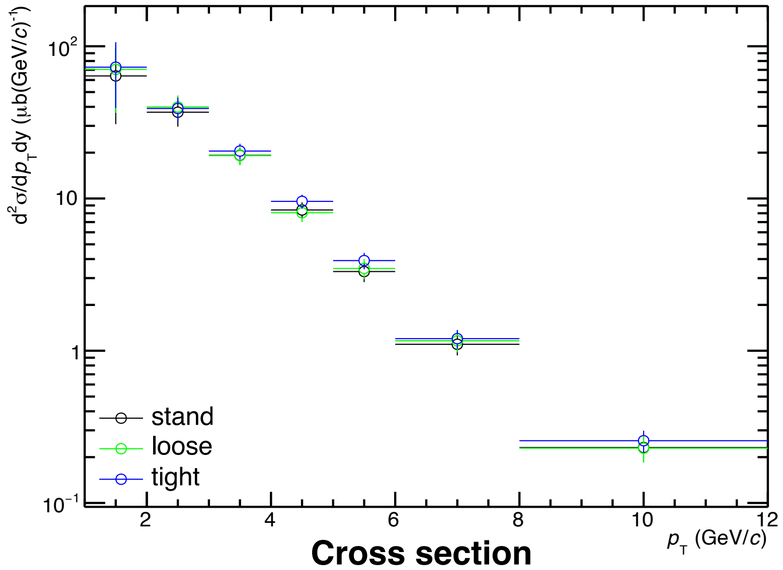



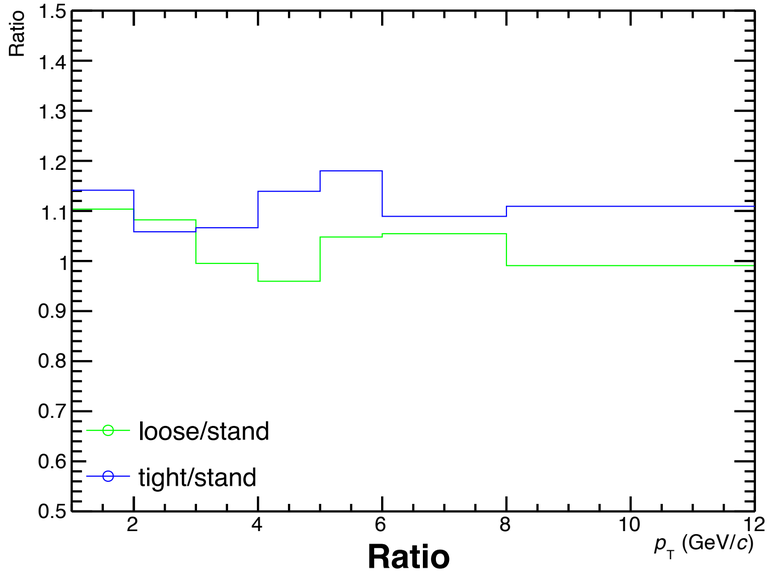
# - Systematic study

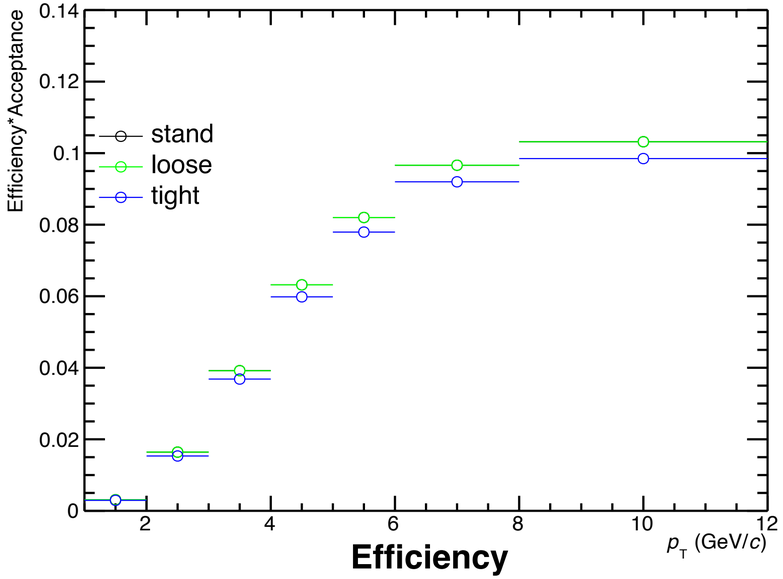
- **Invariant mass**
  - The invariant mass cut is varied to study the uncertainties on eXi pair invariant mass.

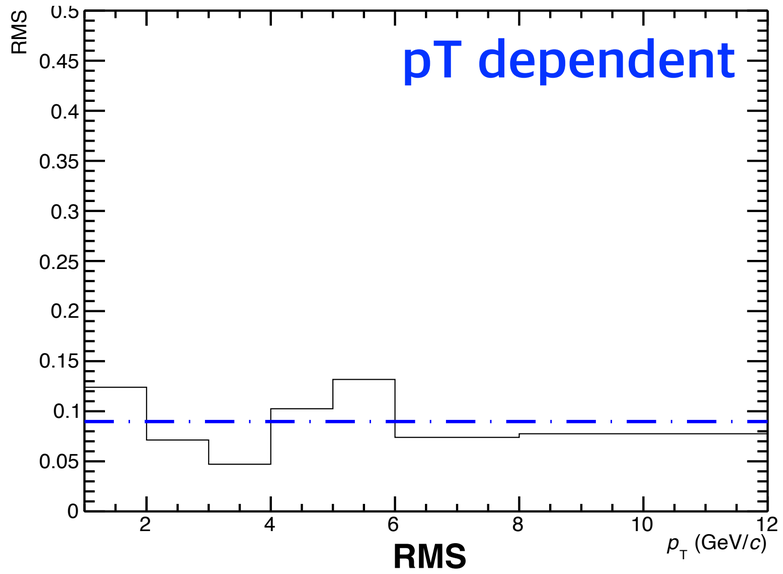
| Cut variables | Loose Cuts | Standard cut | Tight cut |
|---|---|---|---|
| Invariant mass ($GeV/c^2$) | <2.7 | <2.5 | <2.3 |



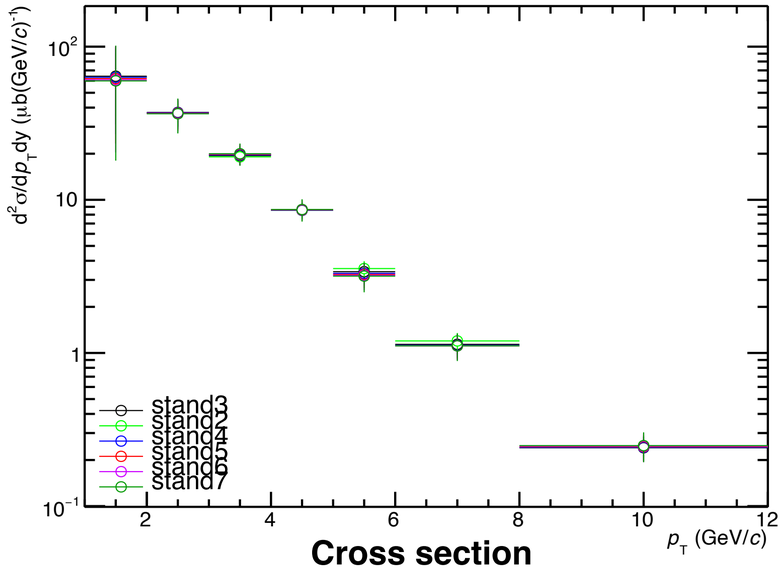



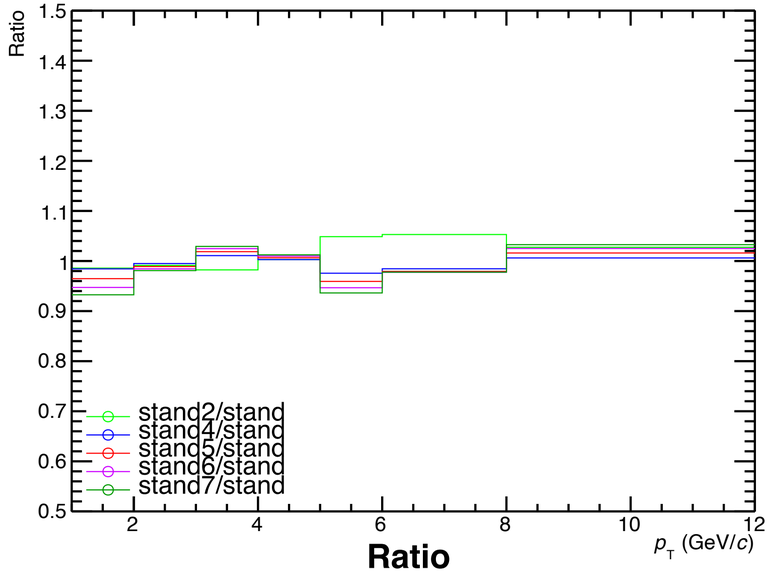



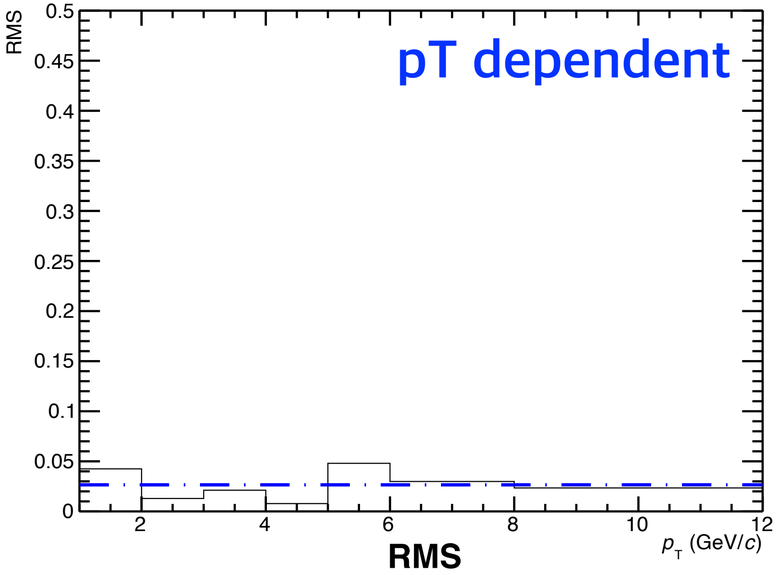



# - Systematic study

- **Bayesian Unfolding**
  - The unfolding method and the number of iterations are varied to study the uncertainties of the unfolding procedure.
  - Bayesian with 3 iterations is default.
  - Due to large statistics of MC, the number of iteration is not critical to unfolded spectrum.



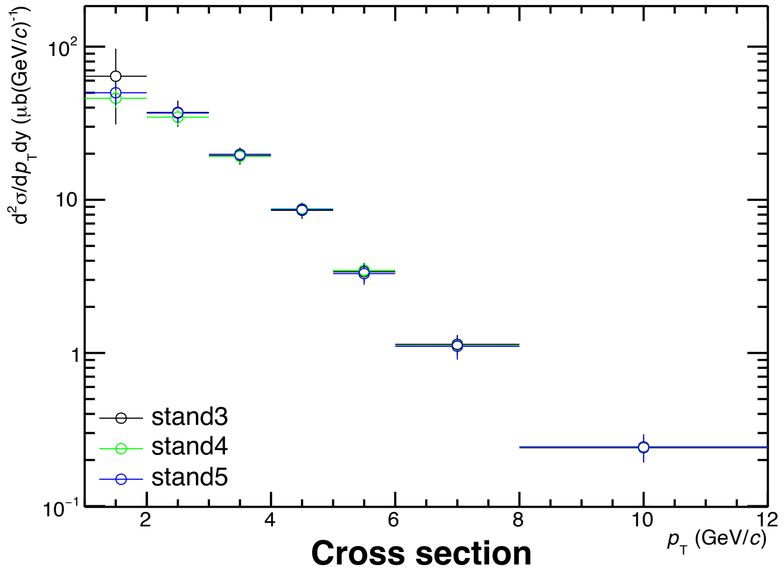



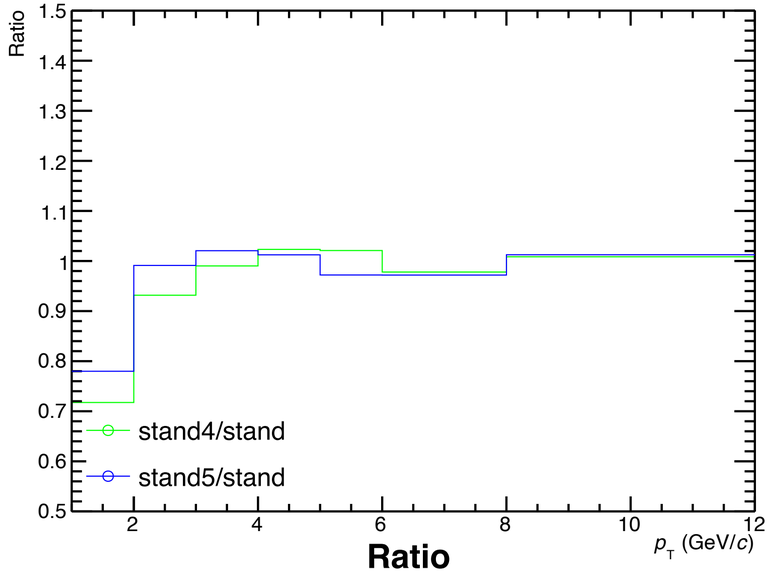



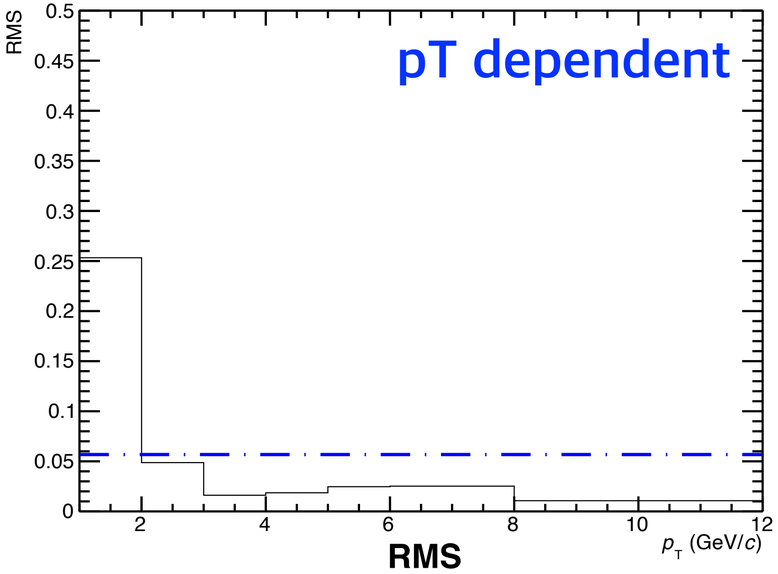
# - Systematic study

- **SVD Unfolding**
  - The unfolding method and the number of iterations are varied to study the uncertainties of the unfolding procedure.
  - Bayesian with 3 iterations is default.
  - D vector

```
1 : 13.0744
2 : 7.71148
3 : 2.94854
4 : 0.741504
5 : 0.525418
6 : 0.182362
7 : 0.525431
8 : 0.267351
9 : 0.303222
```

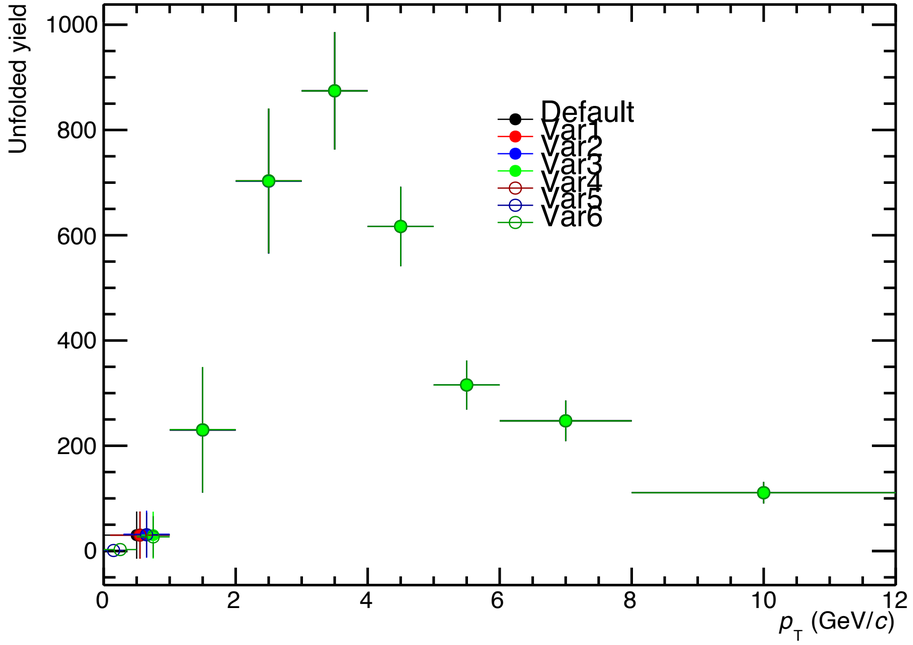


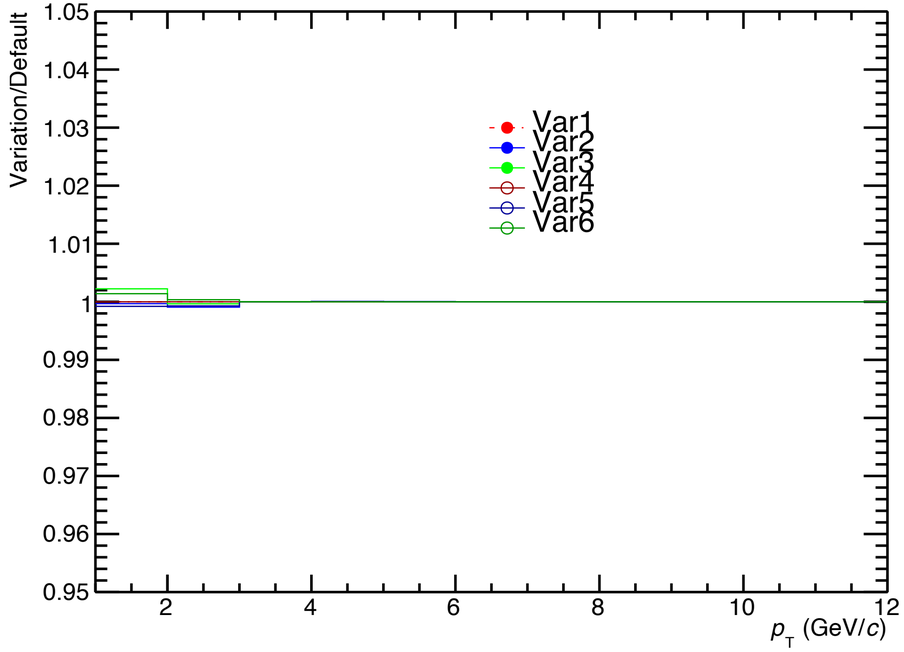



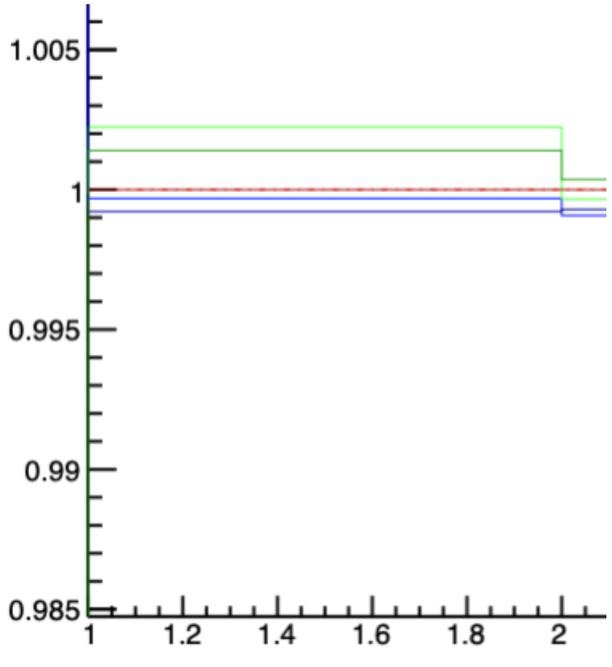



# - Systematic study

- **The low limit of response matrix**
  - Unfolded spectrum is sensitive to the binning of matrix, especially low $p_{T.}$
  - **Default** : {0,1,2,3,4,5,6,8,12} Bayesian method, 3 iterations
  - **Variation 1** : {0.1,1,2,3,4,5,6,8,12}, **Variation 2** : {0.3,1,2,3,4,5,6,8,12}, **Variation 3** : {0.5,1,2,3,4,5,6,8,12} →Change low limit
  - **Variation 4** : {0,0.1,1,2,3,4,5,6,8,12}, **Variation 5** : {0,0.3,1,2,3,4,5,6,8,12}, **Variation 6** : {0,0.5,1,2,3,4,5,6,8,12} →Split the first bin
  - Default binning is fine, and no systematic uncertainty is assigned for binning.

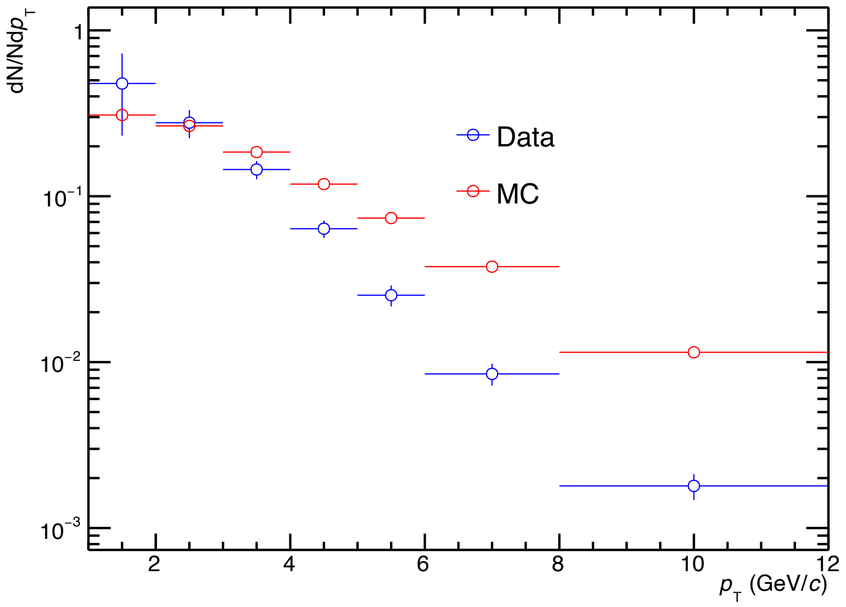


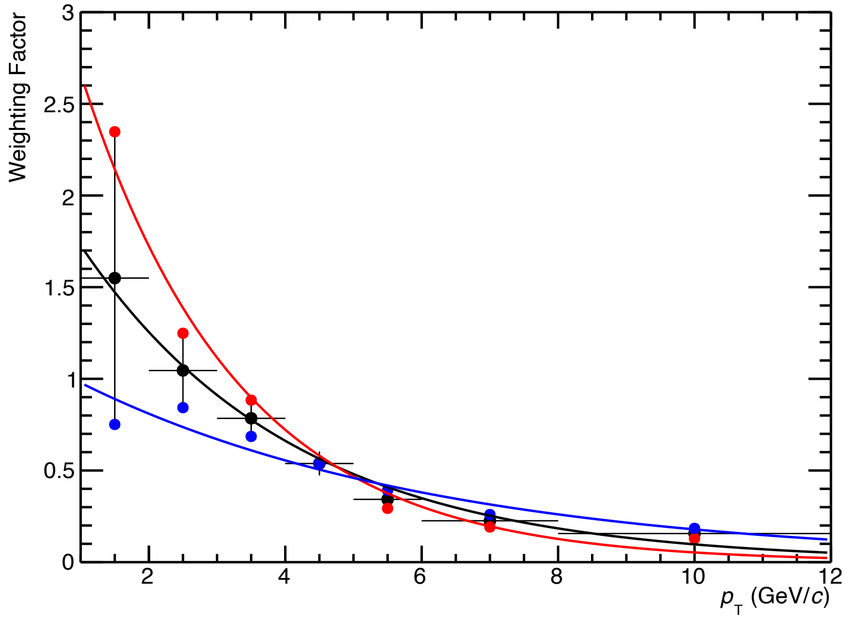



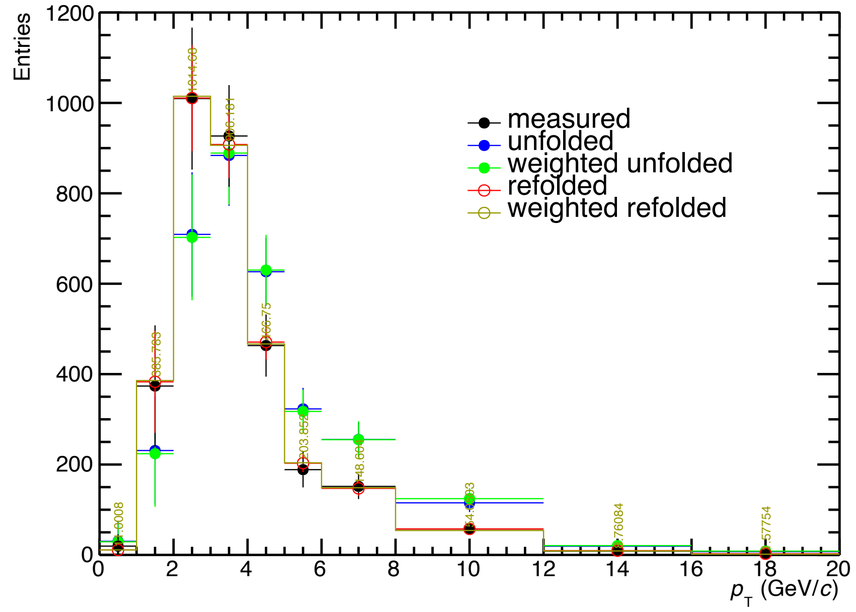



# - Systematic study (TO DO)

- **Weigting the pT spectrum**
  - **Default** : “expo” function, central points
  - **Variation 1** : “expo” function, upper limit in low pT and lower limit in high pT
  - **Variation 2** : “expo” function, lower limit in low pT and upper limit in high pT



# Back up

# - Status

- **Finalize the Xic0 analysis**
  - Almost done! Just remain minor systematics.

- **etc**
  - KPS?
  - CS50 certification

CERTIFICATE of
LECTURE

boostcourse

입문

모두를 위한 컴퓨터 과학 (CS50 2019)

서진주

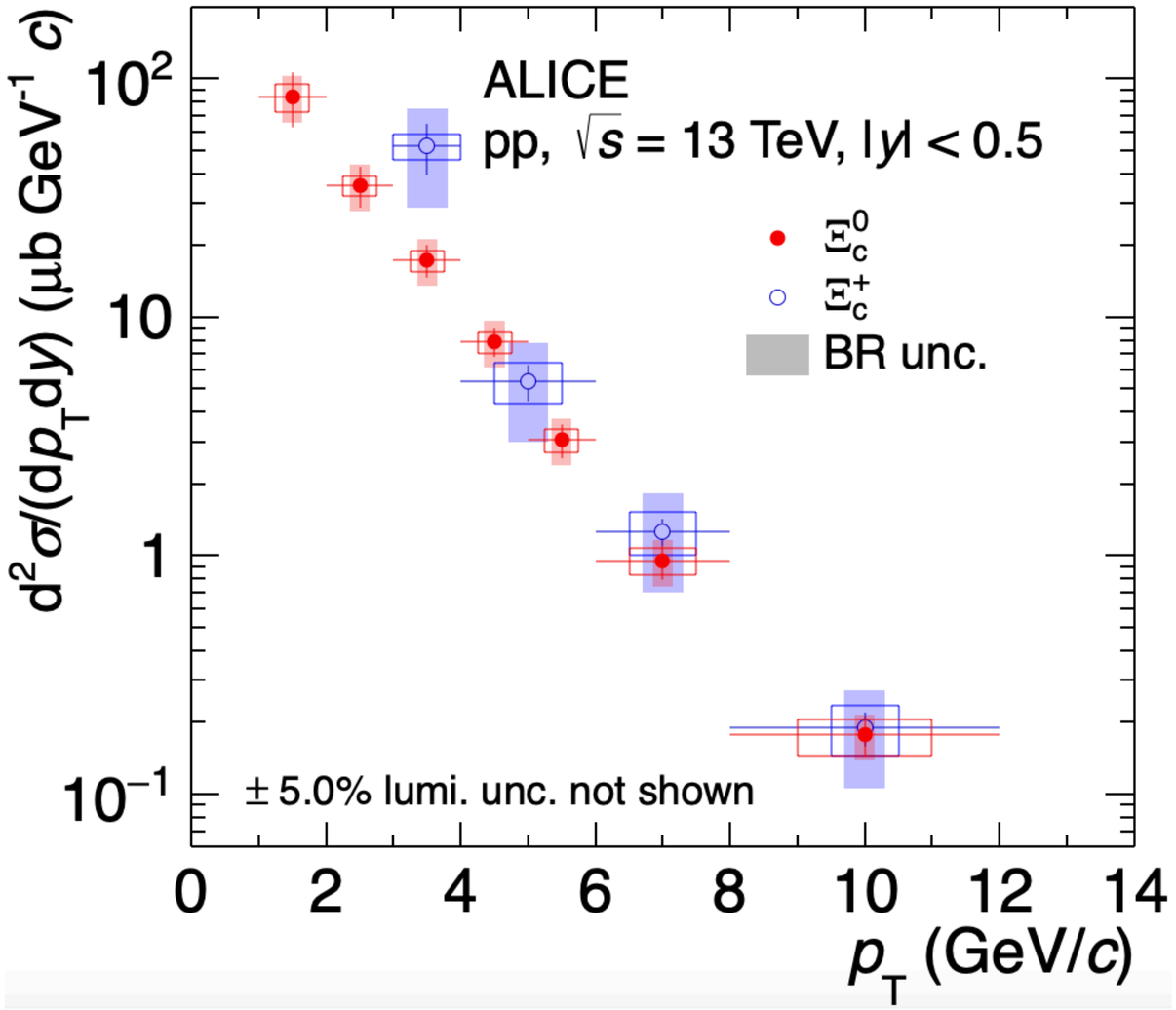
위 사람은 부스트코스에서 운영하는 본 코스를 이수하였기에
이 증서를 수여합니다.

수료일 2021.02.24.

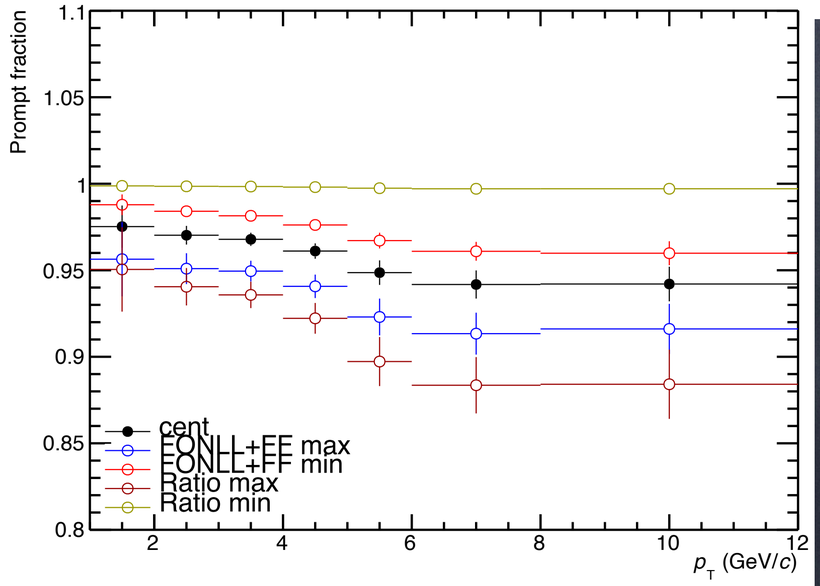
발급일
2021.02.24.

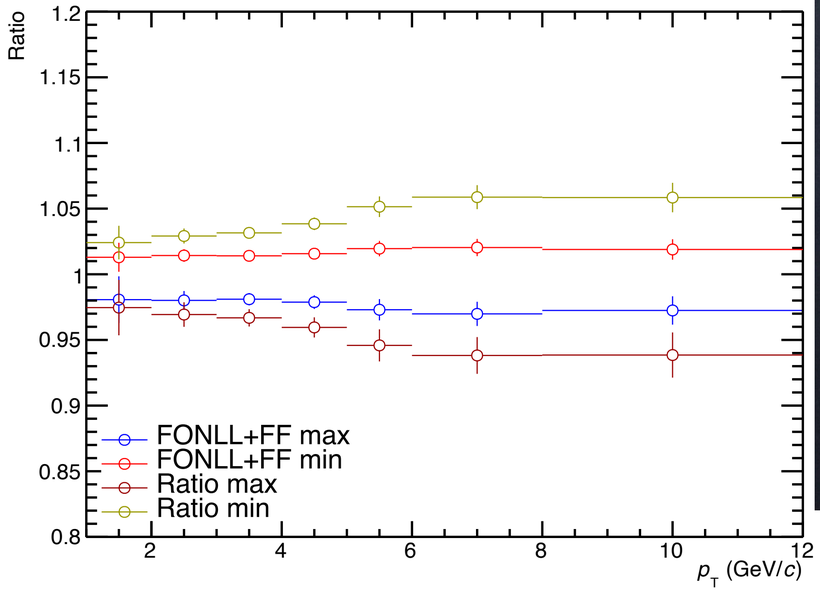
발급번호
A20210224-012280
실명 인증된 수료증입니다.

네이버 커넥트재단



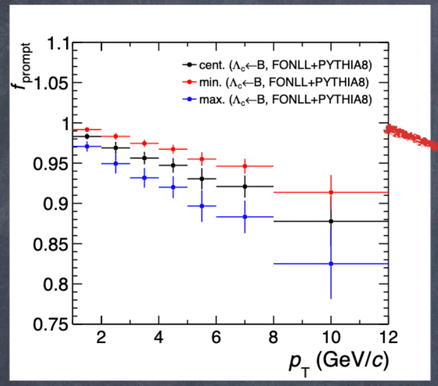
# - Systematic study (TO DO)

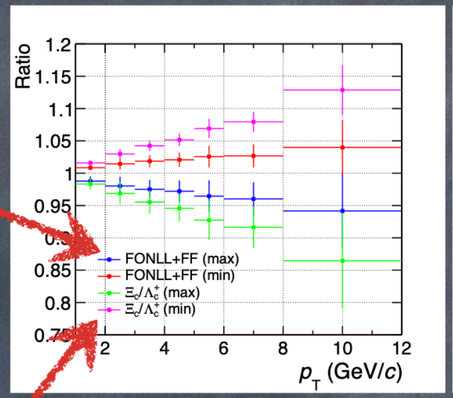


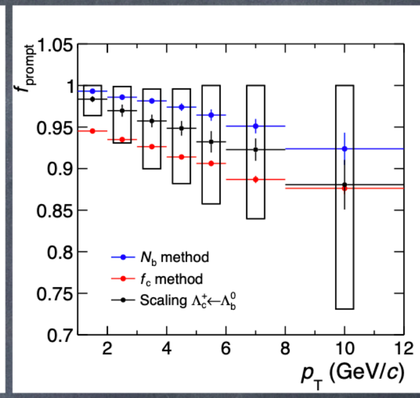




1) FONLL + FF:

➡ Max. and min. value of FONLL and fragmentation function

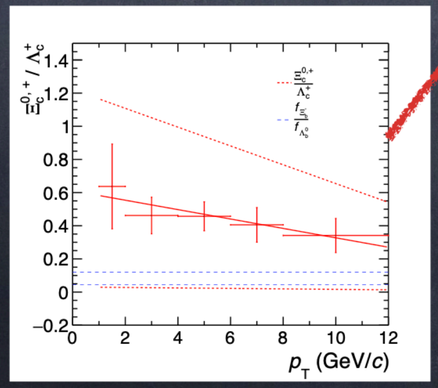



2) $\Xi_c/\Lambda_c$:

➡ Scale function with factor 2 (max.) and 0.05 (min.)

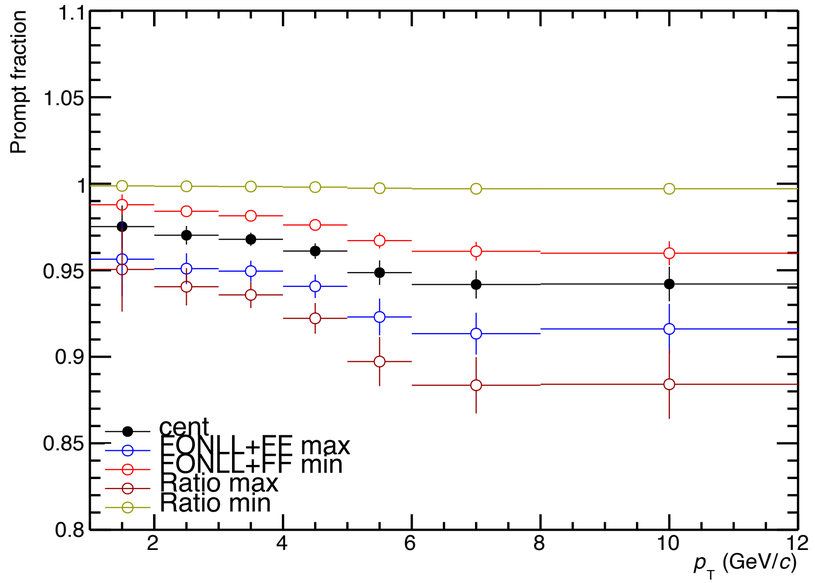


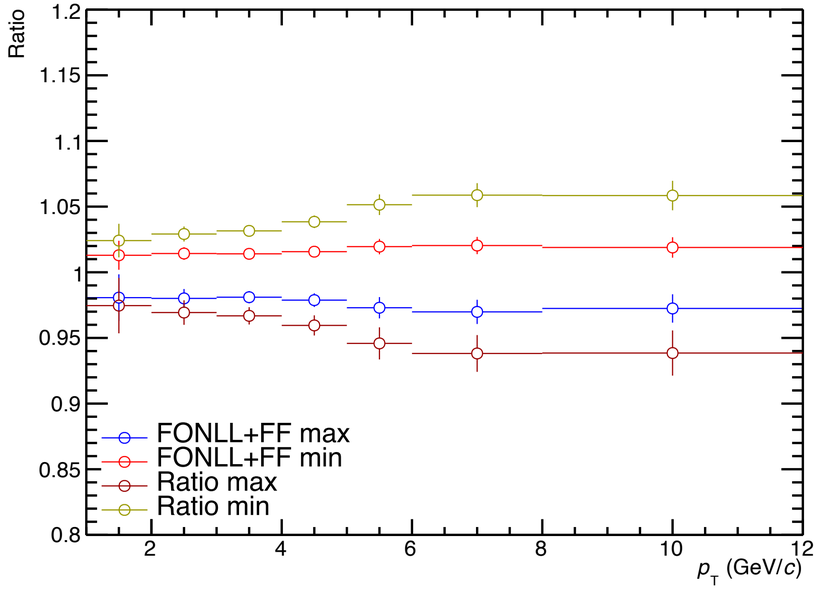

| $p_T(\Xi_c^0)$ (GeV/c) | | (1, 2) | (2, 3) | (3, 4) | (4, 5) | (5, 6) | (6, 8) | (8, 12) |
|---|---|---|---|---|---|---|---|---|
| FONLL + FF | up | 1% | 1% | 2% | 2% | 3% | 3% | 4% |
| | down | 1% | 2% | 3% | 3% | 4% | 4% | 6% |
| $\Xi_c/\Lambda_c$ | up | 2% | 3% | 4% | 5% | 7% | 8% | 13% |
| | down | 2% | 3% | 5% | 6% | 7% | 8% | 16% |
| Total | up | 2% | 3% | 4% | 5% | 8% | 9% | 14% |
| | down | 2% | 4% | 6% | 7% | 8% | 9% | 17% |

$\frac{f_{\Xi_b^-}}{f_{\Lambda_b^0}} = (8.2 \pm 0.7 \pm 0.6 \pm 2.5) \times 10^{-2}$ **measured in** $2 < \eta < 6$ **and** $p_T < 20$ GeV/$c$ **with LHCb**

[Phys. Rev. D 99, 052006 (2019)]

## - Systematic study (TO DO)




### Reason of large syst. of $\Xi_c/\Lambda_c$ at high $p_T$

1) Larger BR $\Lambda_b \to \Lambda_c + X$ (from PDG $\sim 30\,\%$ to PYTHIA $\sim 80\,\%$)
   - ➡ The factor [New(FONLL)/Old(FONLL)=1.73] caused a larger slope in $f_{\rm prompt}$
2) Syst. of $\Xi_c/\Lambda_c$ correlated with the value of $(1 - f_{\rm prompt})$
   - ➡ Smaller $f_{\rm prompt}$ -> larger $(1 - f_{\rm prompt})$ -> larger syst. of $\Xi_c/\Lambda_c$

$$f_{\rm prompt}(\text{old}) = 1 - \frac{N_{\Xi_c^0 \text{ from b}}}{N_{\Xi_c^0,\text{ raw}}} = 1 - \frac{1}{N_{\Xi_c^0,\text{ raw}}} \cdot \frac{\mathrm{d}\sigma^{\Xi_c^0 \text{ from b}}_{\text{scaling } \Lambda_c^+ \leftarrow \Lambda_b^0}(\text{old})}{\mathrm{d}p_T \mathrm{d}y} \cdot 2 \cdot (Acc \times \varepsilon)_{\text{feed-down}} \cdot \Delta p_T \cdot \Delta y \cdot BR \cdot L_{\rm int}$$

$$f_{\rm prompt}(\text{New}) = 1 - \frac{N_{\Xi_c^0 \text{ from b}}}{N_{\Xi_c^0,\text{ raw}}} = 1 - \frac{1.73}{N_{\Xi_c^0,\text{ raw}}} \cdot \frac{\mathrm{d}\sigma^{\Xi_c^0 \text{ from b}}_{\text{scaling } \Lambda_c^+ \leftarrow \Lambda_b^0}(\text{old})}{\mathrm{d}p_T \mathrm{d}y} \cdot 2 \cdot (Acc \times \varepsilon)_{\text{feed-down}} \cdot \Delta p_T \cdot \Delta y \cdot BR \cdot L_{\rm int}$$