[HIN-14-009]
muID check &
Z vertex weighting

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lab meeting
10th October 2014

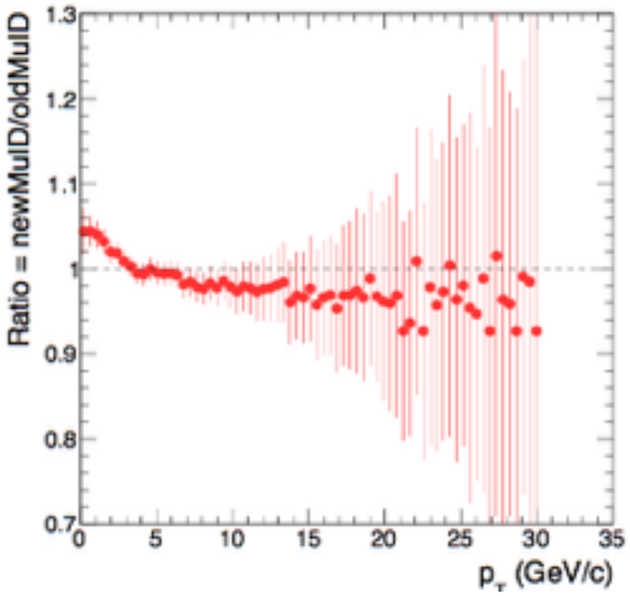
Contents

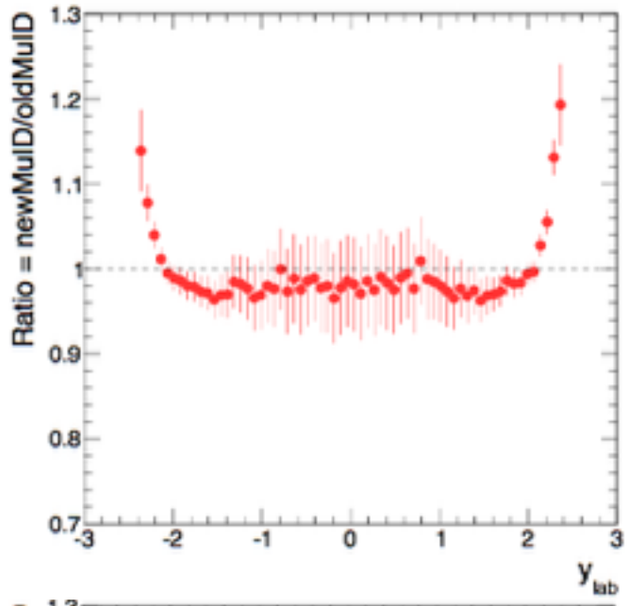
- **muon ID check**
- **Z vertex weighting**

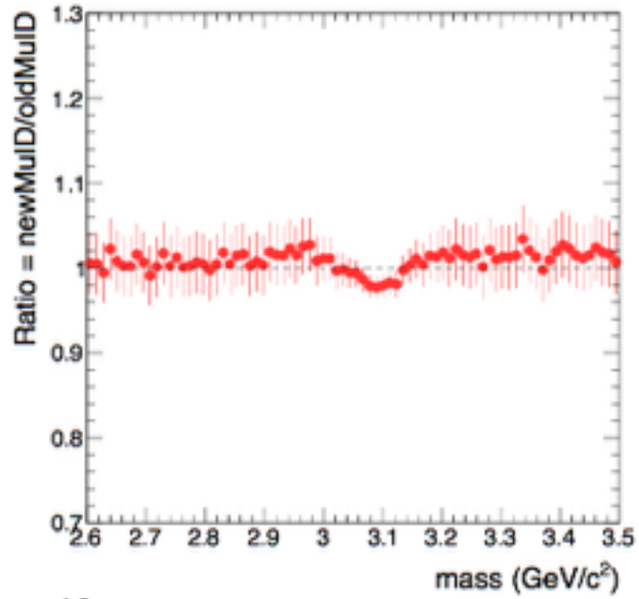
muID : new vs old

- **Dimuon variables (new muID/ old MuID)**

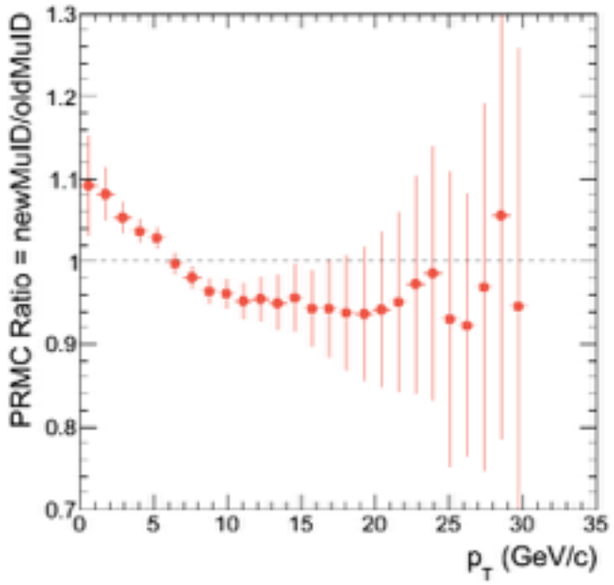
Data

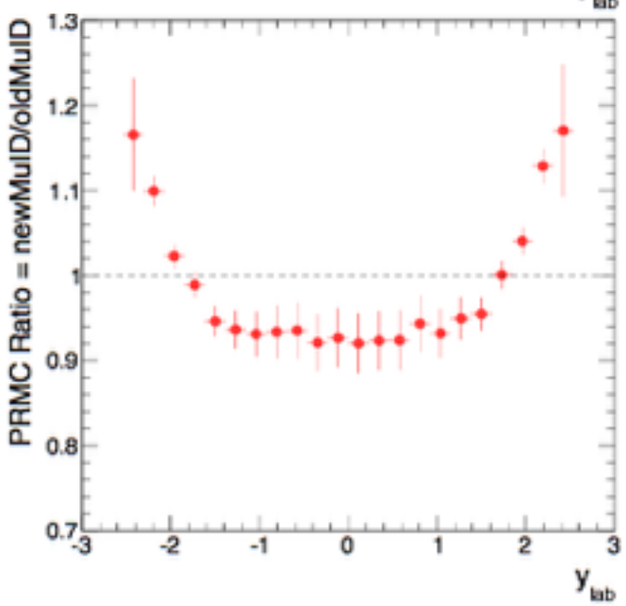


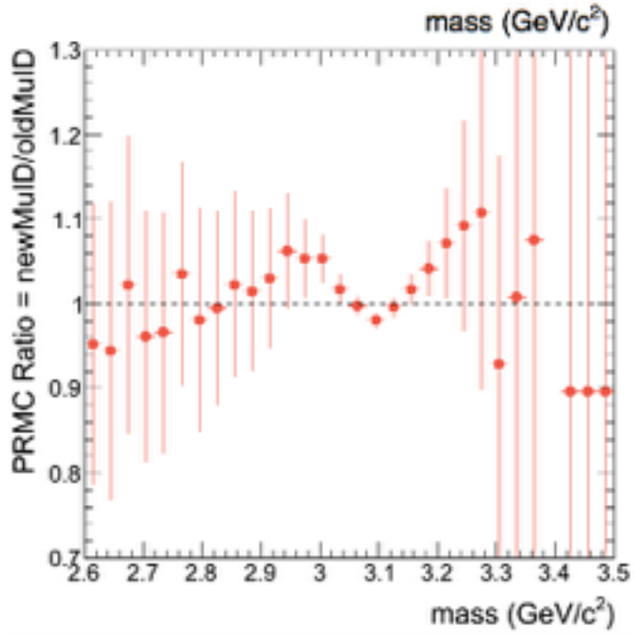




MC







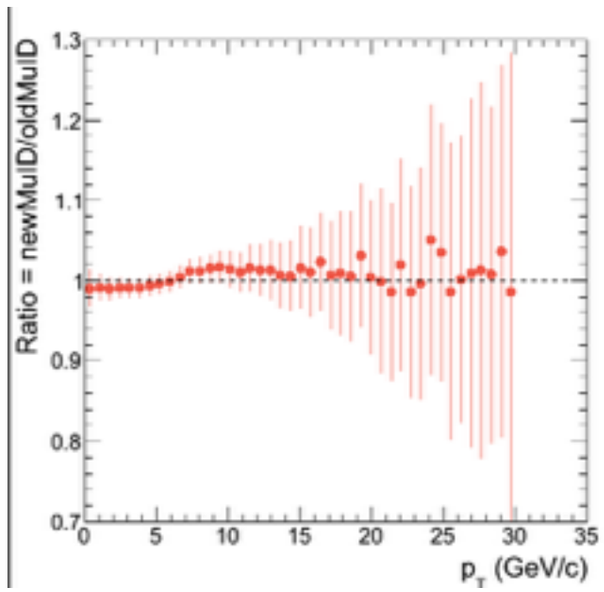
- The difference mainly comes from nPixLayer cut (old > 1, new > 0)
- More low pT muons pass the cut
  -> more muons in forward or backward rapidity
  -> Peaks becomes wider in mass plots

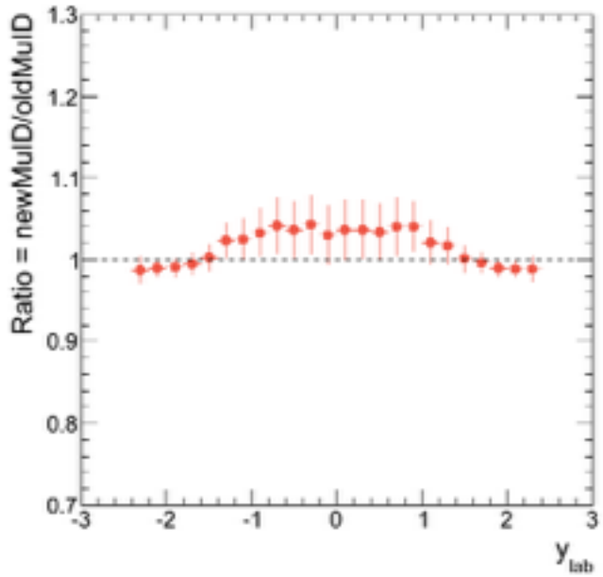
muID : new vs old

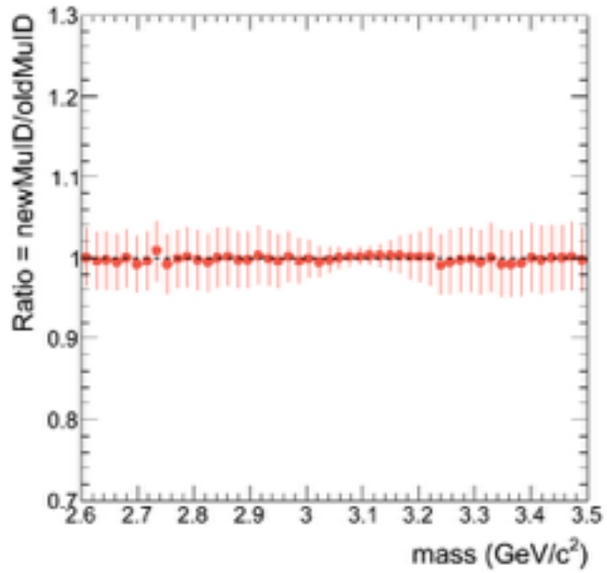
- **Check A**

nPixLayer > 1
for new ID

Data







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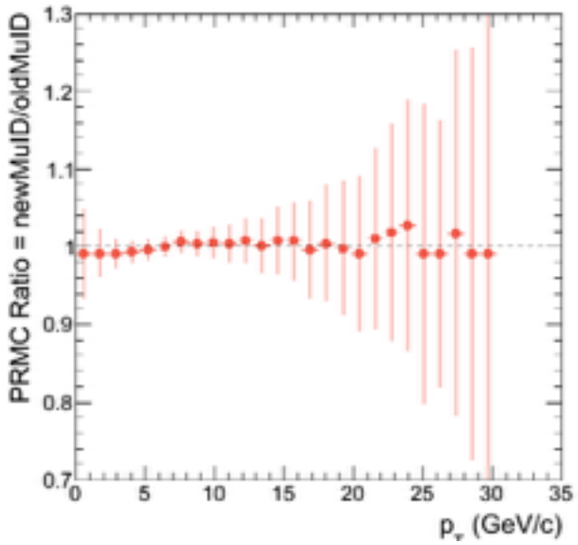
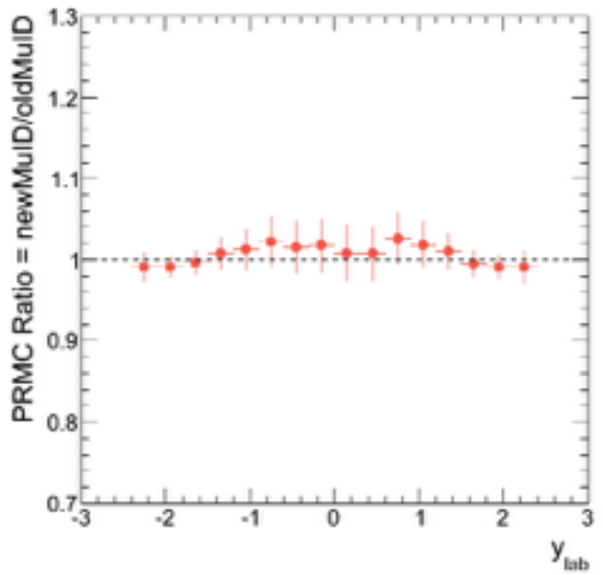
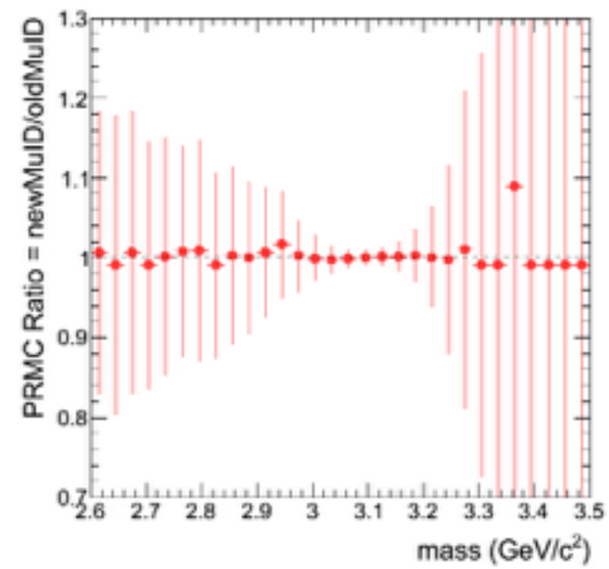






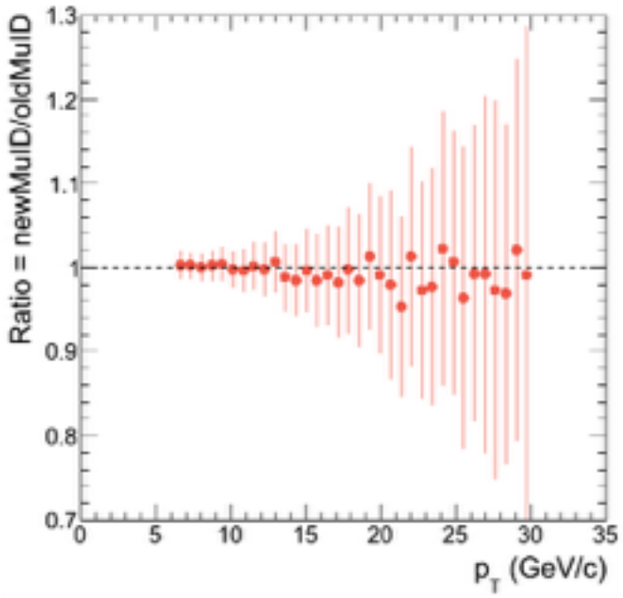
- Effect of new muID is similar for DATA and MC.
- maybe stronger for MC? but agree within uncertainties

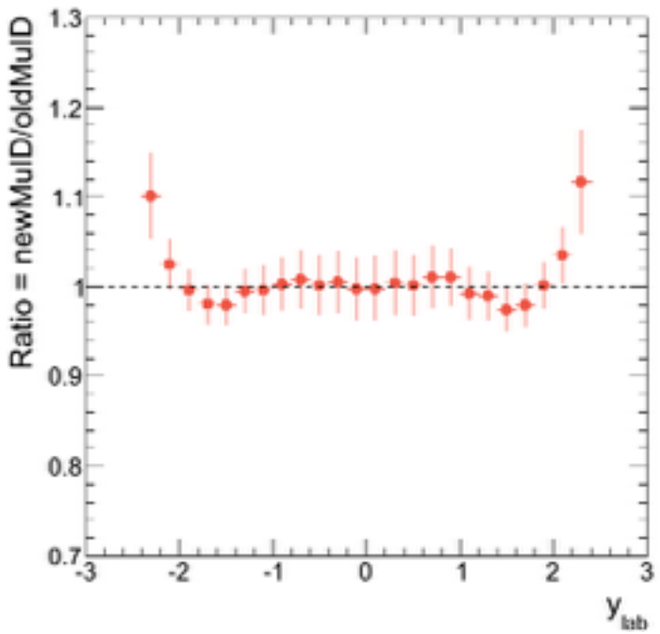
muID : new vs old

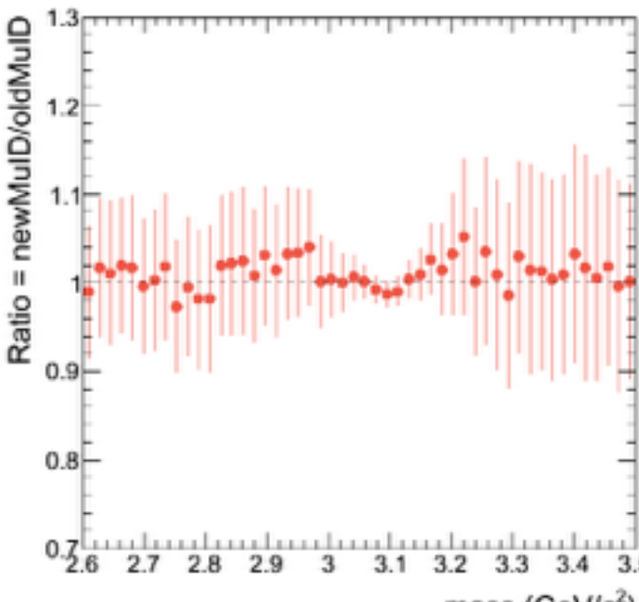
- **Check B**

pT > 6.5 GeV only

Data







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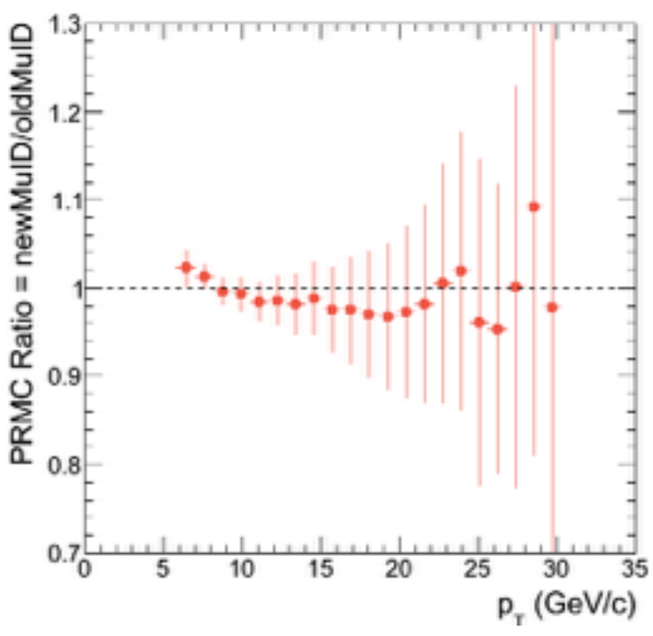
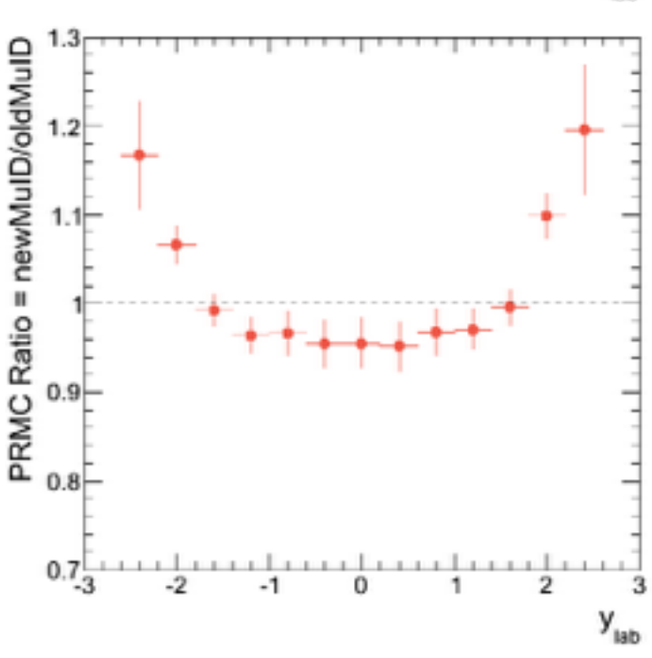
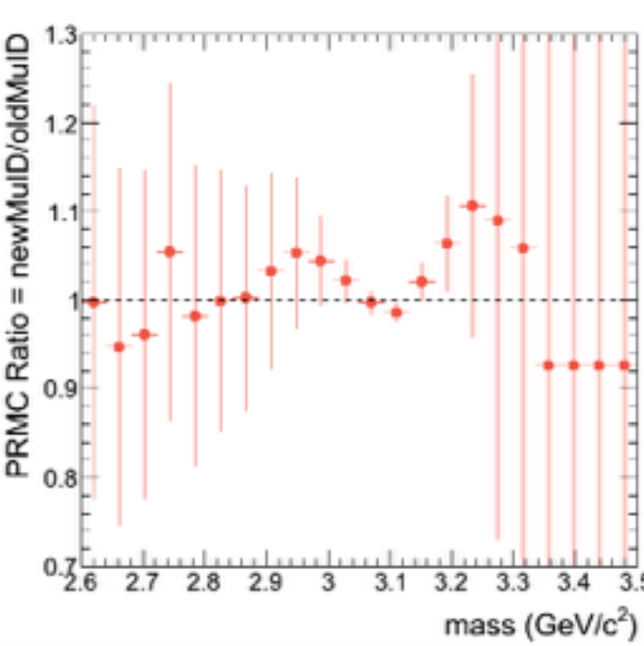






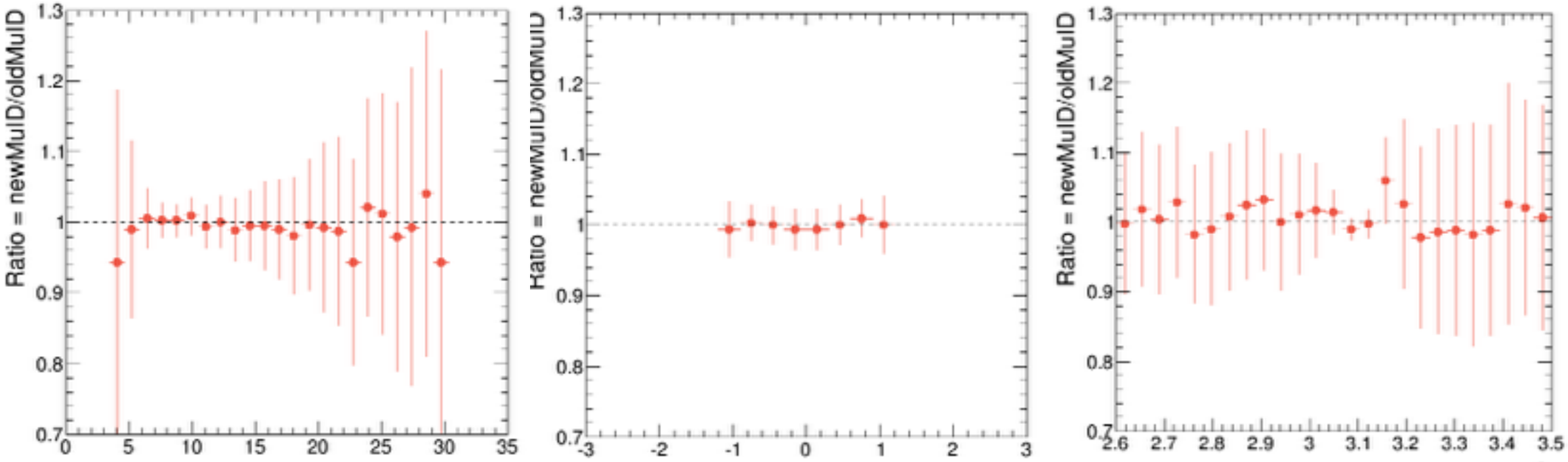
- Higher pT region (> 6.5 GeV/c) still show differences in forward/backward regions

muID : new vs old

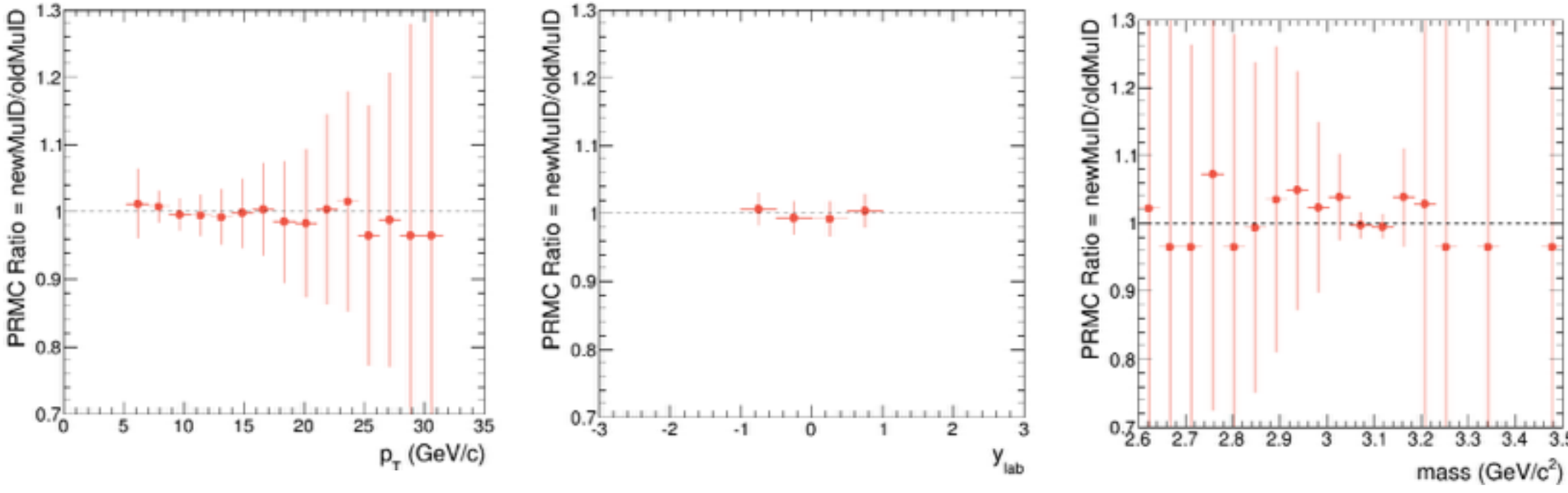
- **Check C**

y_lab < 1 only

Data



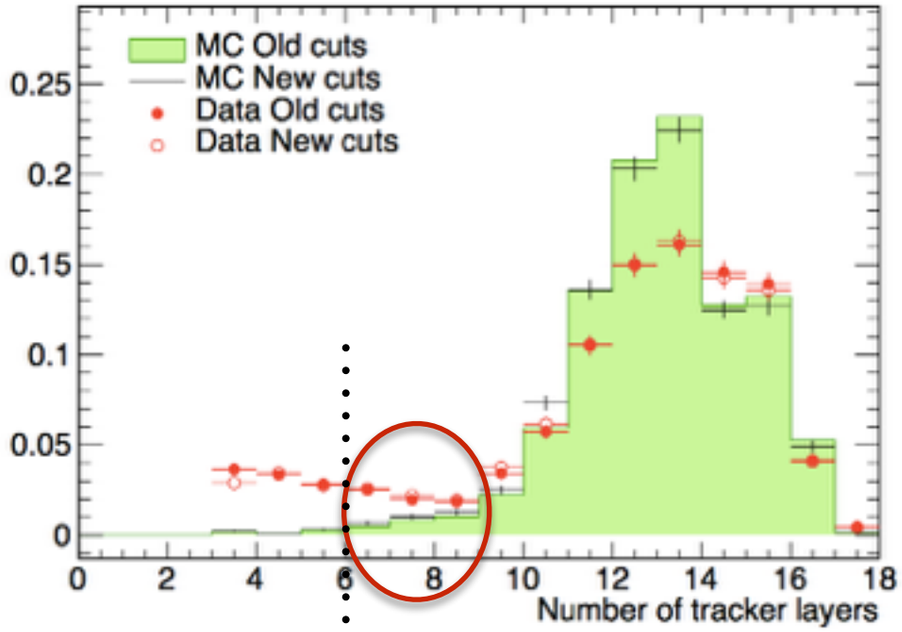
MC

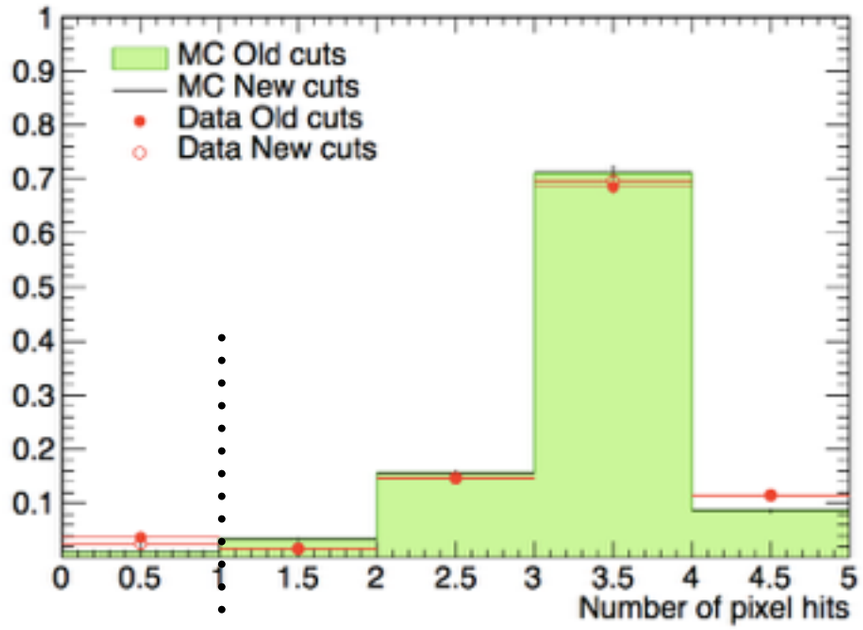


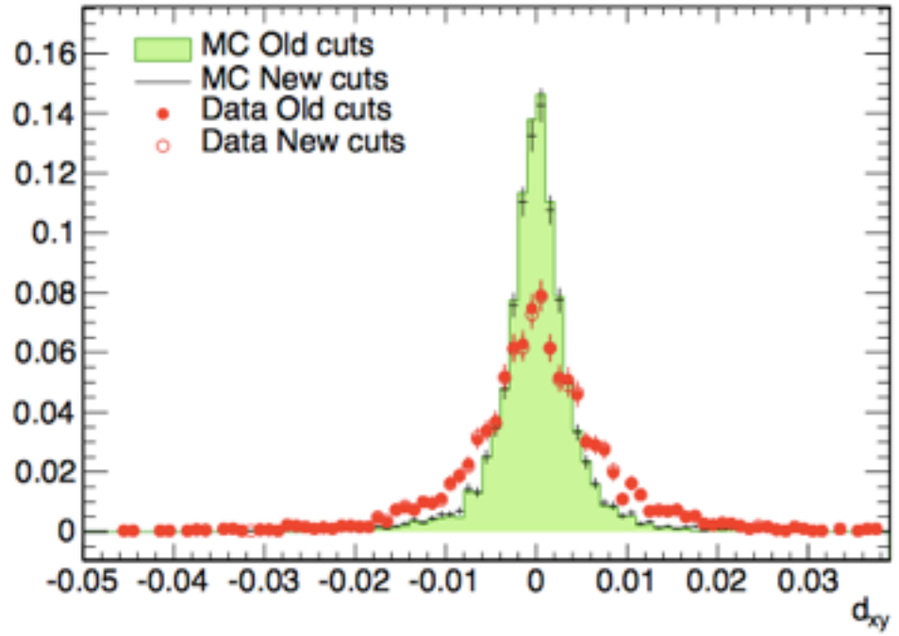
- Distributions agree in mid-rapidity regions
- nPixLayer affects endcap more than barrel?

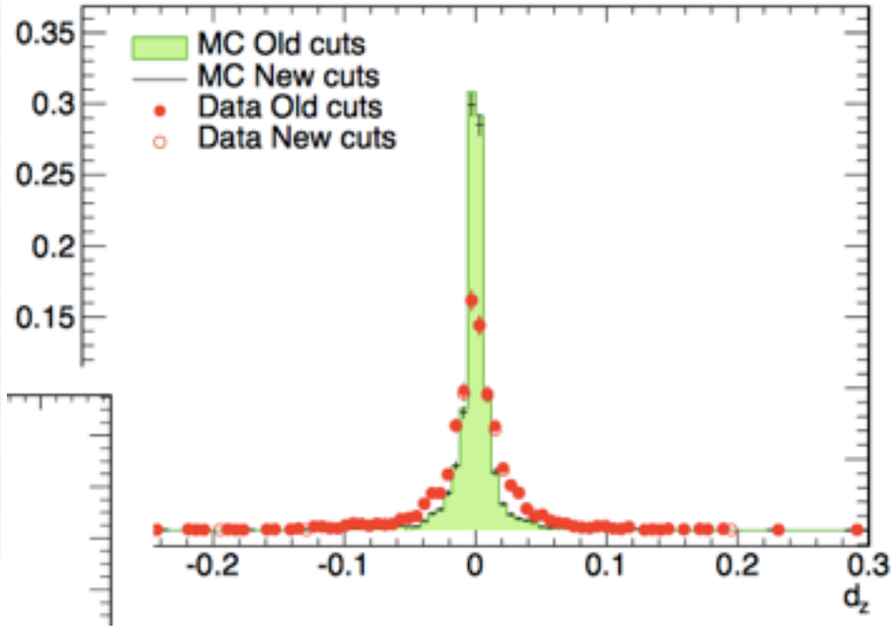
muID : Data vs MC

Lamia





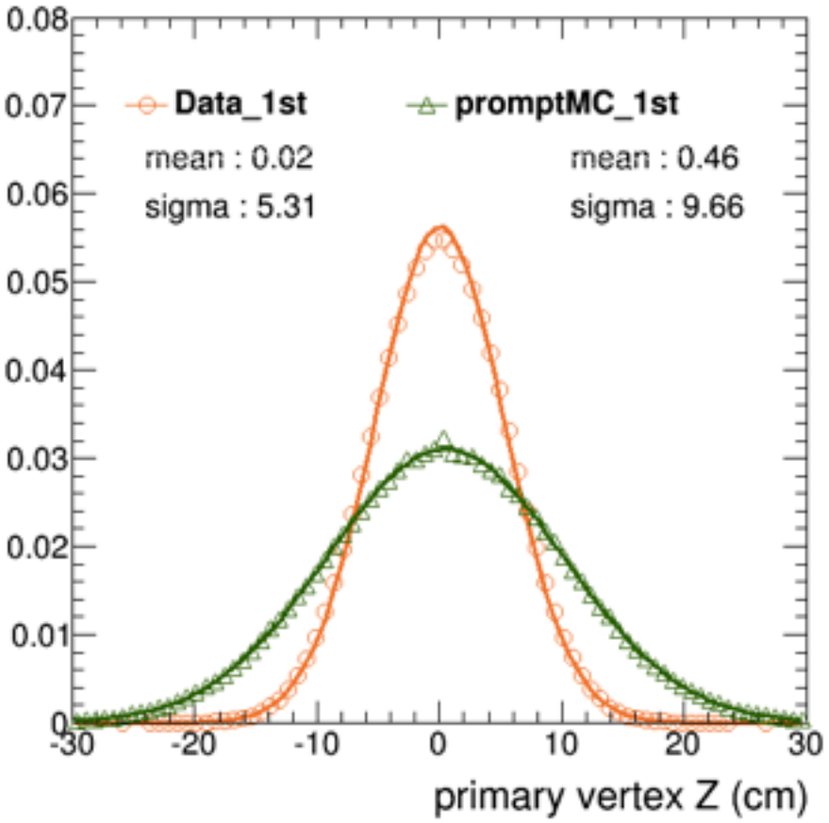


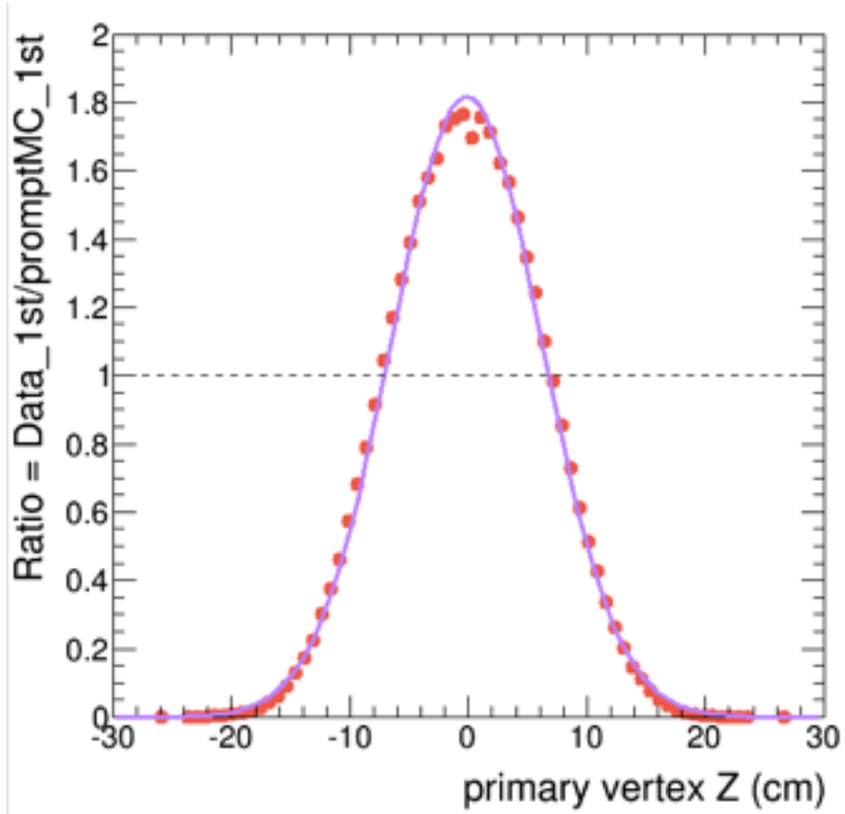


- Need to check if $\int_{cut} MC / \int_{cut} Data$ ~ 1 with new muID.
- Check the distribution of sideband region in DATA
  to confirm if discrepancies are mainly from backgrounds.

z vertex weighting

- **Primary Z vertex distributions in MC and Data**





[Option 1]

- Fit the distributions by Gaussian separately (orange, green)
- Take the ratio of two functions (violet line)

[Option2]

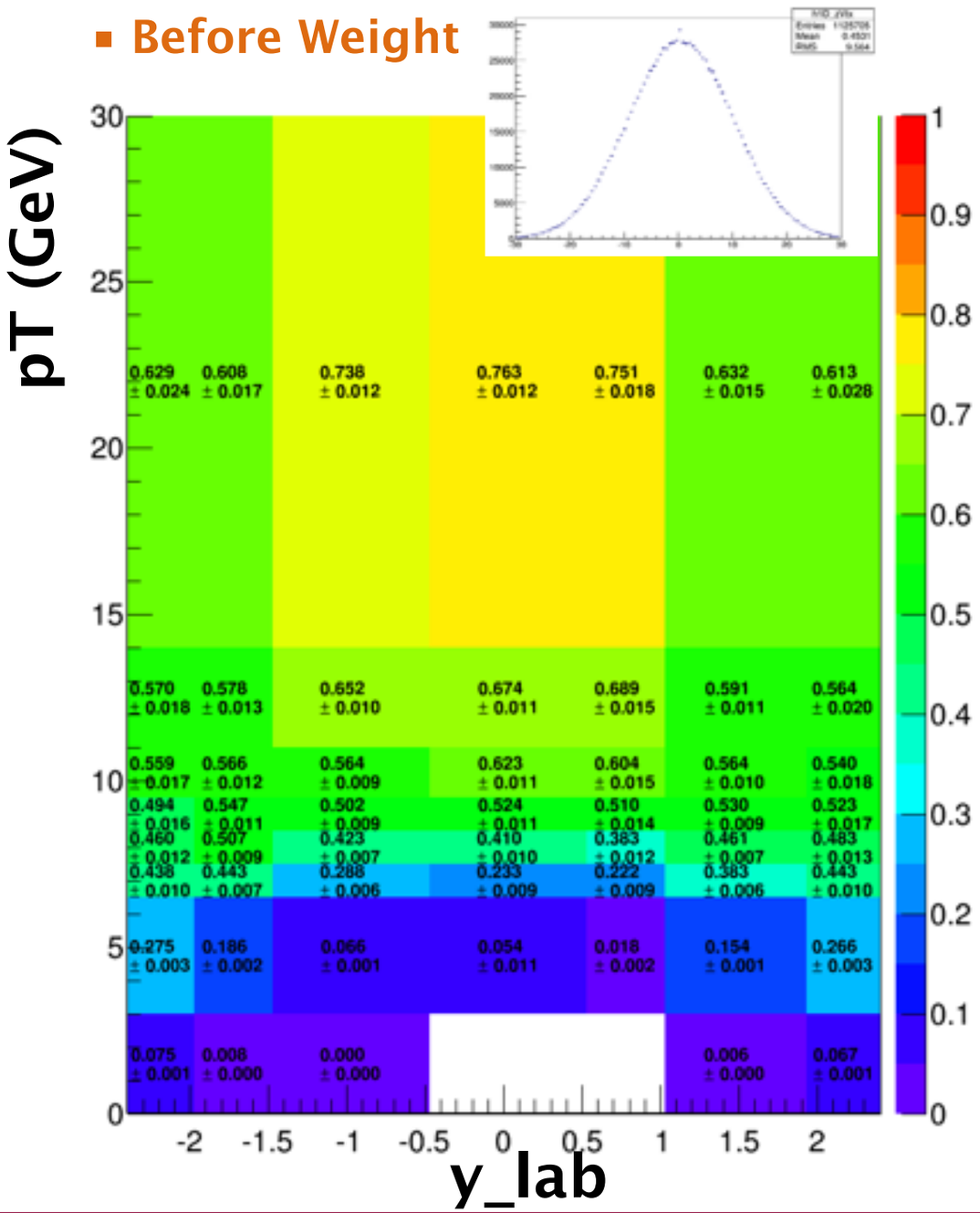
- Take the ratio of distributions first (red points)
- Fit the ratio by Gaussian -> fitting is worse than opt.1 (in backup p21)

- **Using [option 1], reweight Z vertex distributions in MC samples**

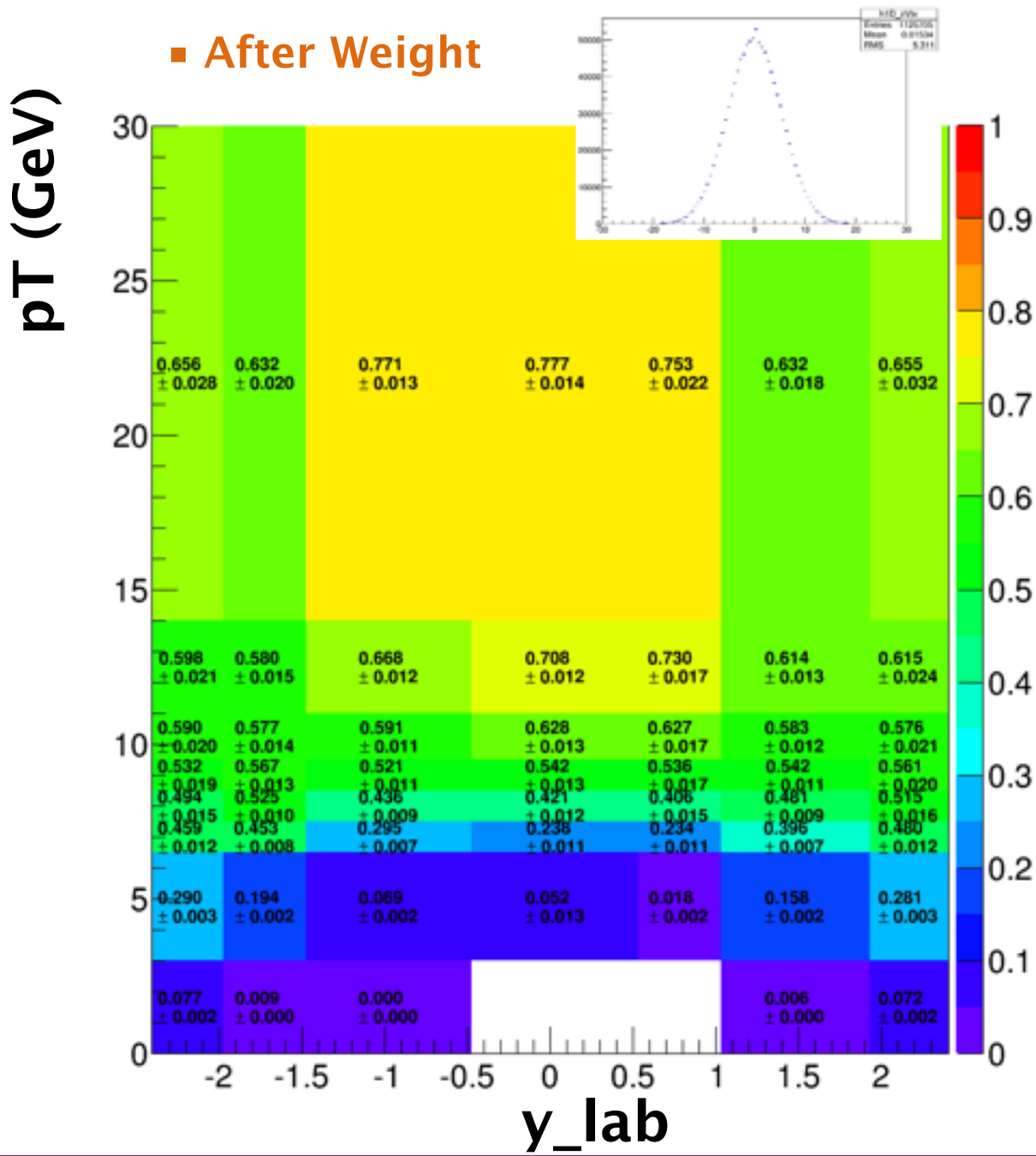
Efficiency

- **e.g. Prompt J/psi, 1st run period**
  - Efficiency values become higher over the whole bin after weighting

- **Before Weight**



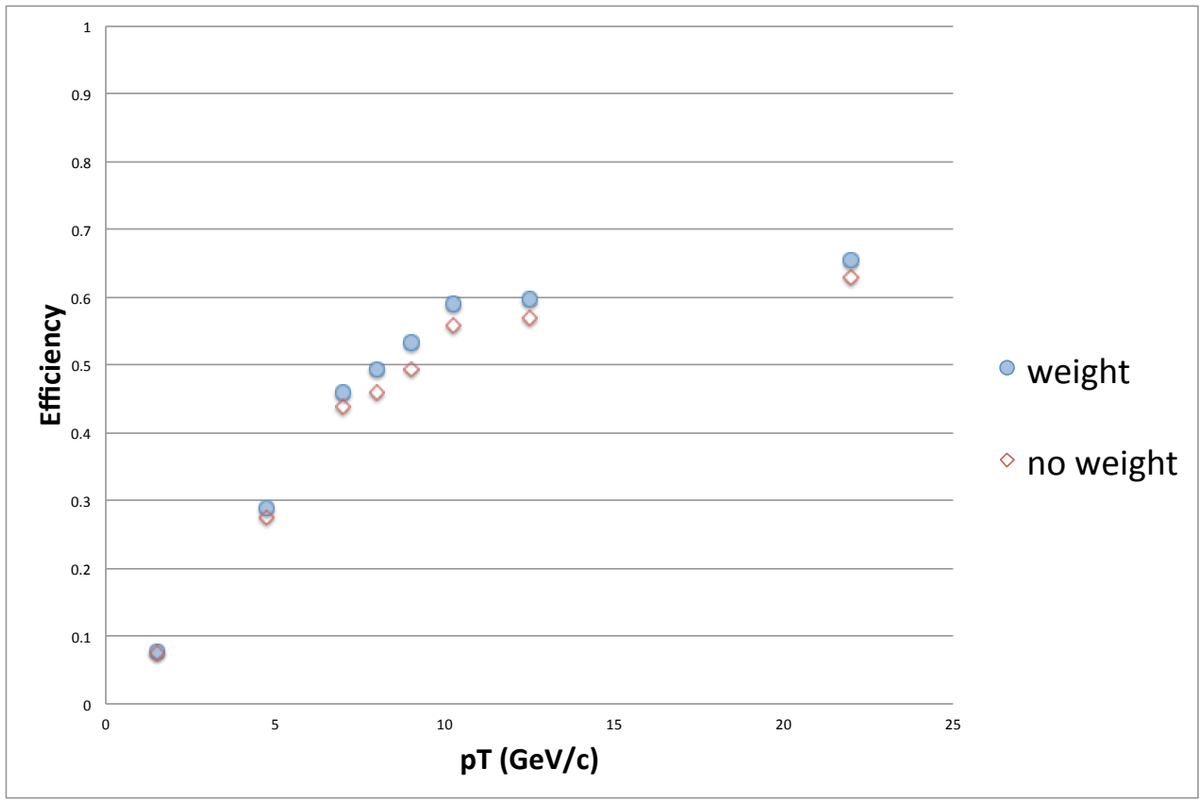
- **After Weight**

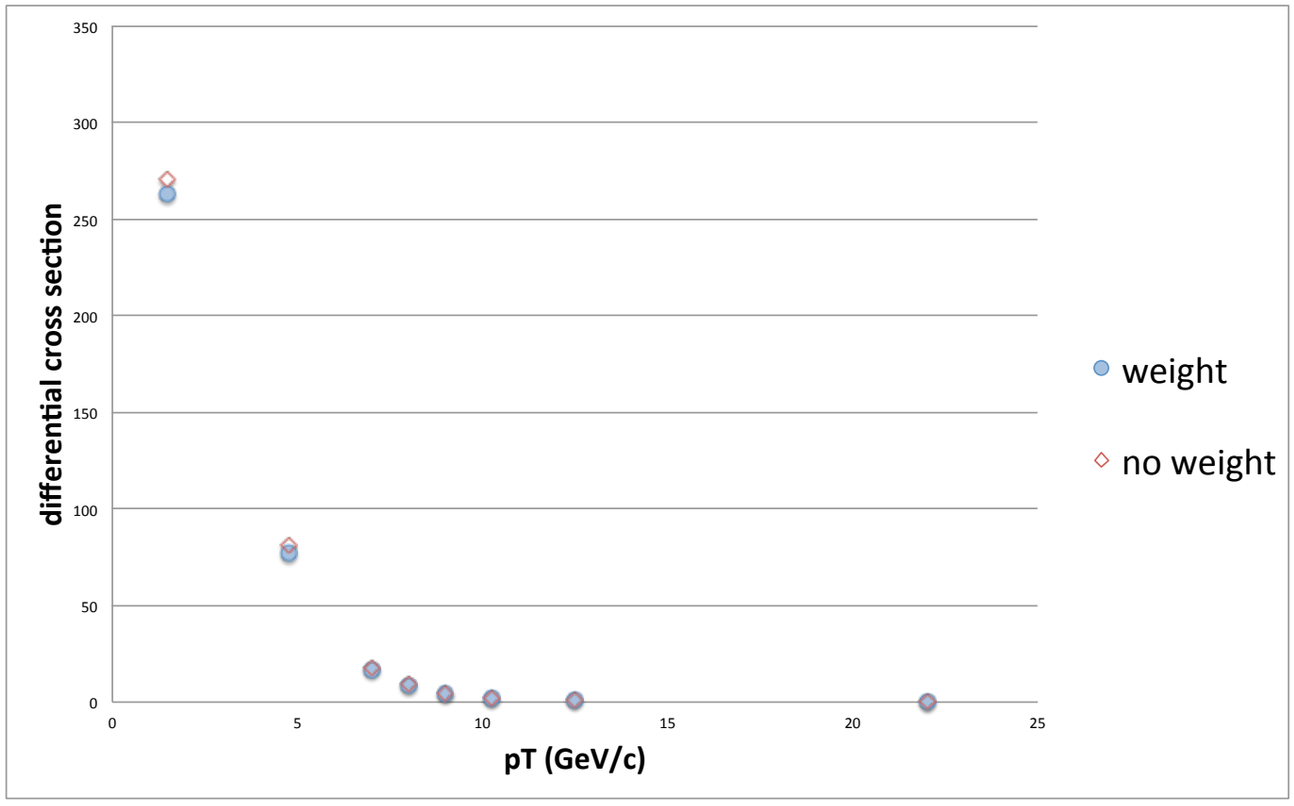


Results

- **e.g. Prompt J/psi, 1st run period, $1.5 < y_{CM} < 1.93$**

SF NOT applied

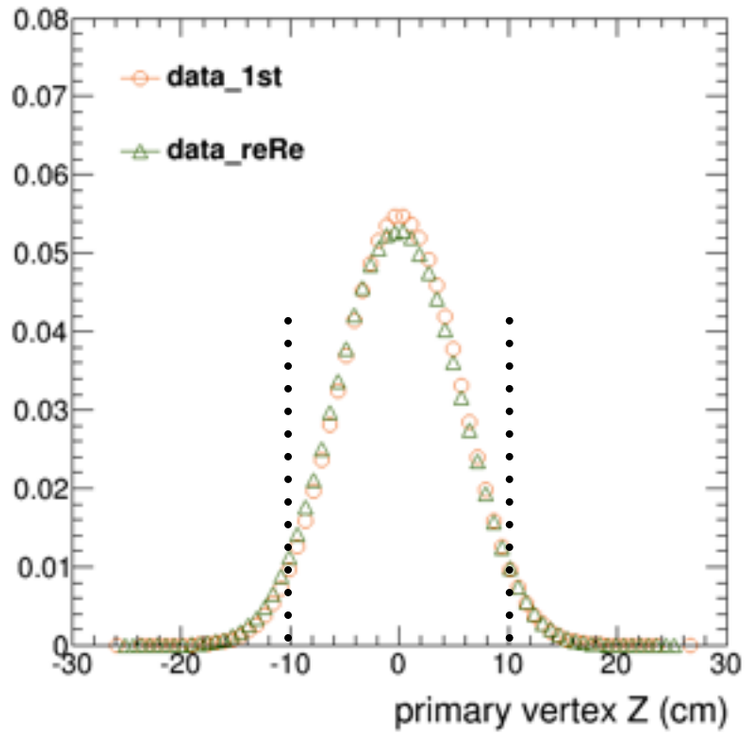


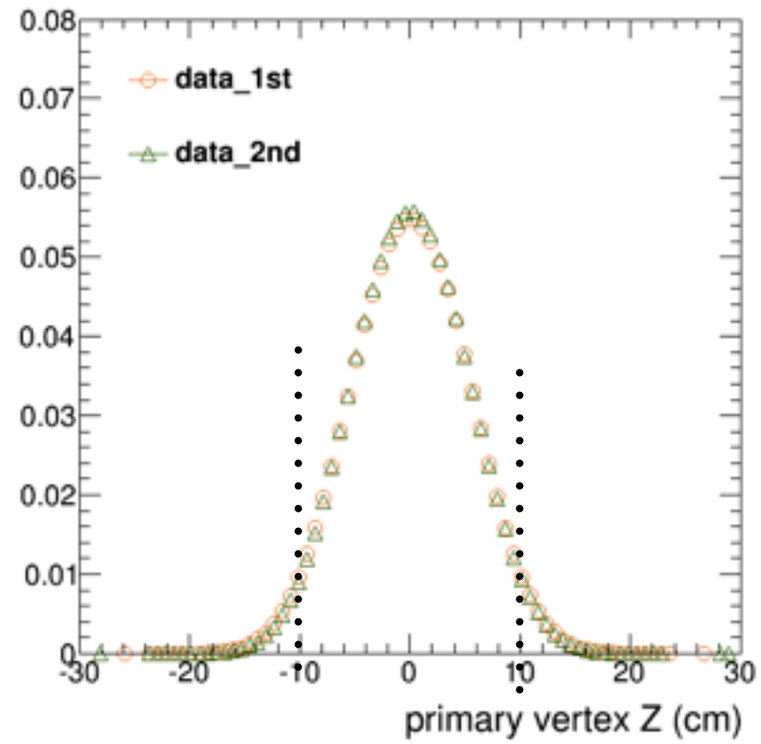


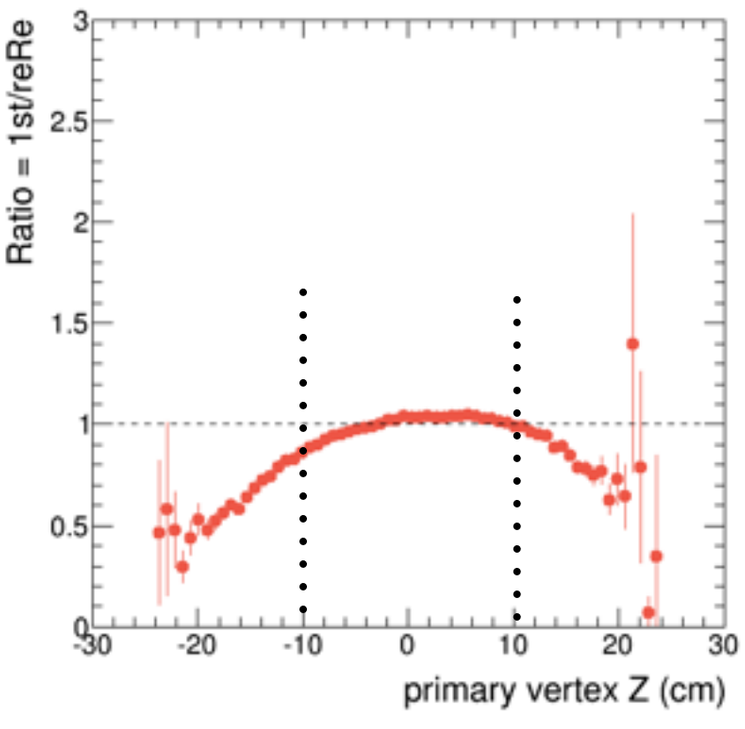
- Efficiency values become higher after weighting -> Good news?!

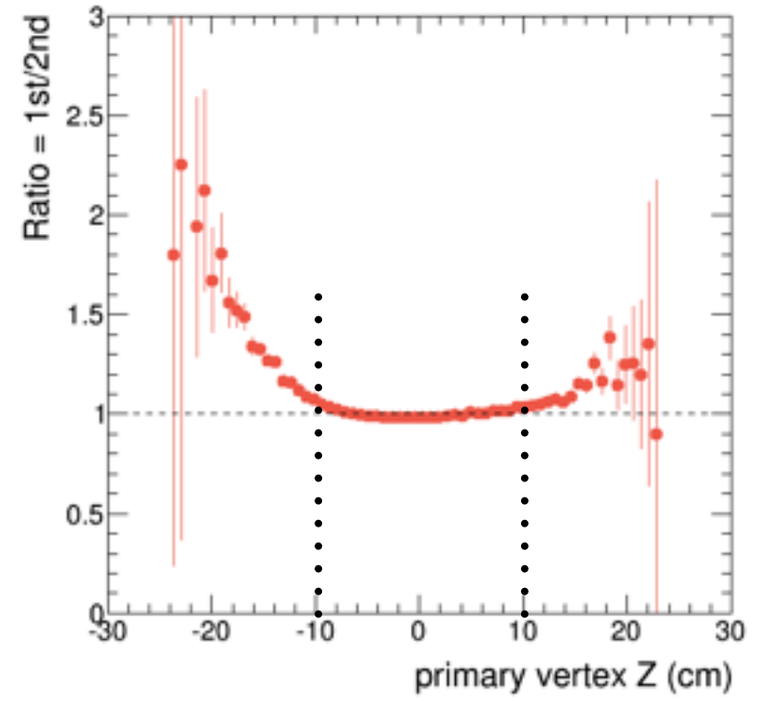
Next step

- **cf) Comparison b/w Data (ReReco & 1st run & 2nd run period)**









- Cut in |Zvtx| < 10cm
  - exclude poor quality events
  - select where distributions match

Plan and summary

- **official MC request (Songkyo & Mihee)**
  - Good new : Request is finalized last week !
  - Bad new : It will take more time than expected
  - We need to re-do every step again when MC are ready,
    but prepare machineries with private samples

- **MuID variables & acceptance systematics (Lamia)**

- **TNP (Kisoo & Yongsun)**
  - After discussing with muon POG, there was some change in definition of tag & probes.
  - Priority : debugging and validate macro in slc6.

- **Vertex weighting (Songkyo & Yongsun)**
  - |Zvtx| cut
  - Need to check x, y vertices also (Not included in Tree at the moment)
  - Check efficiency vs z vtx

Back up

Plan and summary

Songkyo To-do!

- General : muon RECO study (note & codes) : every two days

[Friday]

- embedded sample RECO!! – hiGenParticles including, & 5_3_19 compile again
- zVtx cut < 10 cm : also check ratio of entries before and after cut
- Reco_QQ x, y vtx quick check instead of primary vtx

[Weekend] : **prepare korea quarkonium workshop slide + 토 방정리, 병원, 헤어 or 네일? + 일요일 제사**

- Fitting study
  - finalize binning with quick tuning (only for Bfrac at the moment)

[Monday~]

- 0-3 GeV/c
  : add more function for lifetime
  : 0-1 GeV will be hard due to MC stat? e.g. ctauTrue

[Wednesday~ (Don't update in the meeting soon)]

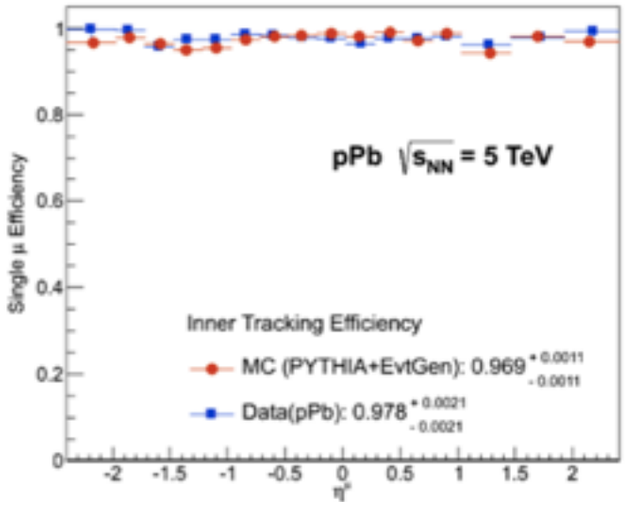
- R_FB quick check
  : DONE -> not much differences after 3-6.5 -> 5-6.5 GeV/c :)
  : higher pT bin check
- Event activity check
- self norm. cross-section (finer bins and compare with ALICE pPb, pp)

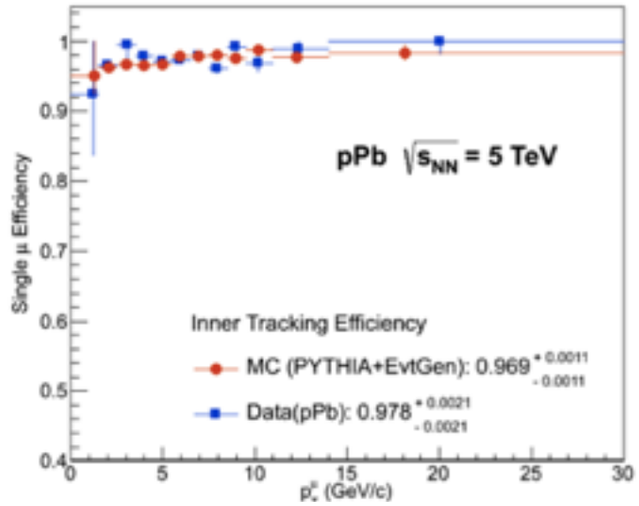
- Unfolding matrix check

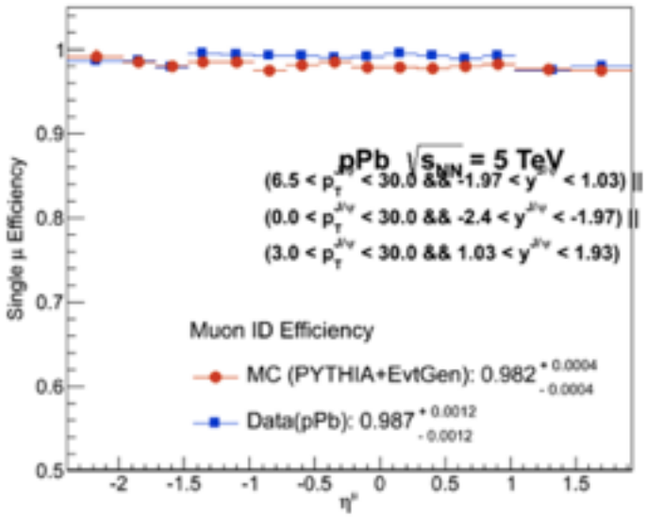
- After TNP finalized
  - scale factor (erf fit if needed ?)
  - efficiency uncertainty study

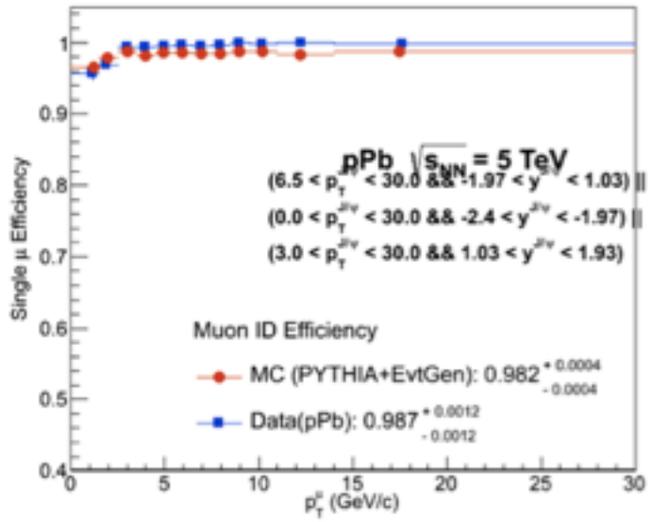
T&P

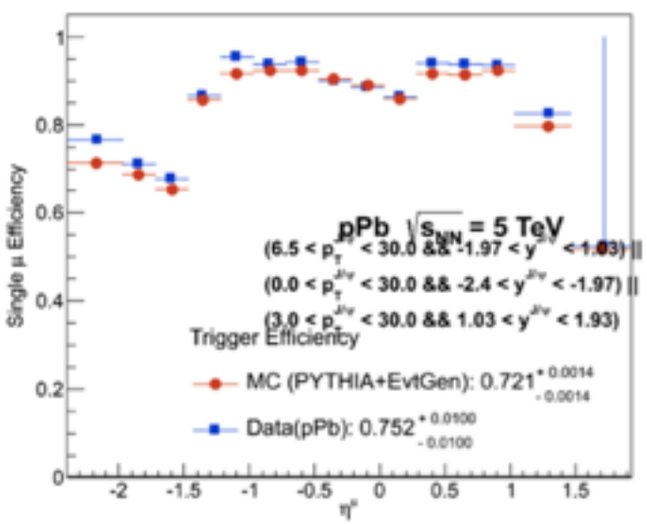
Kisoo

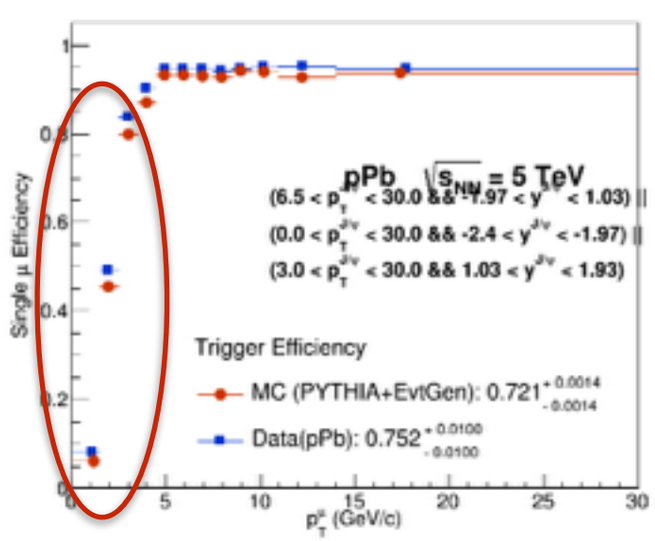






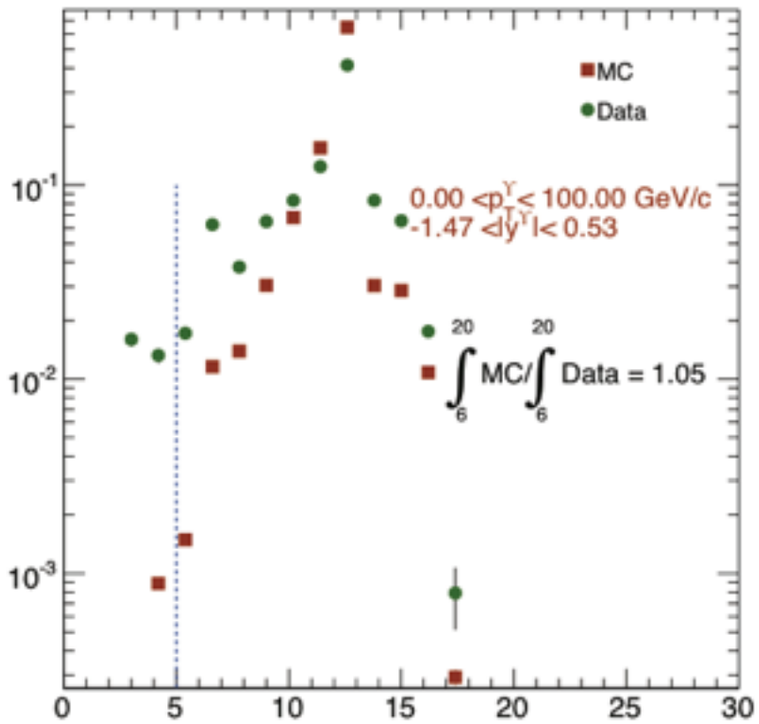


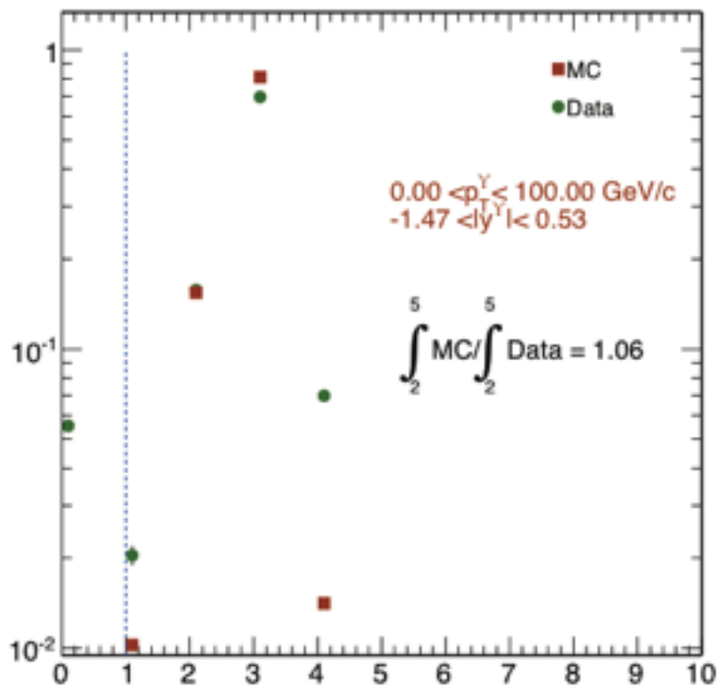


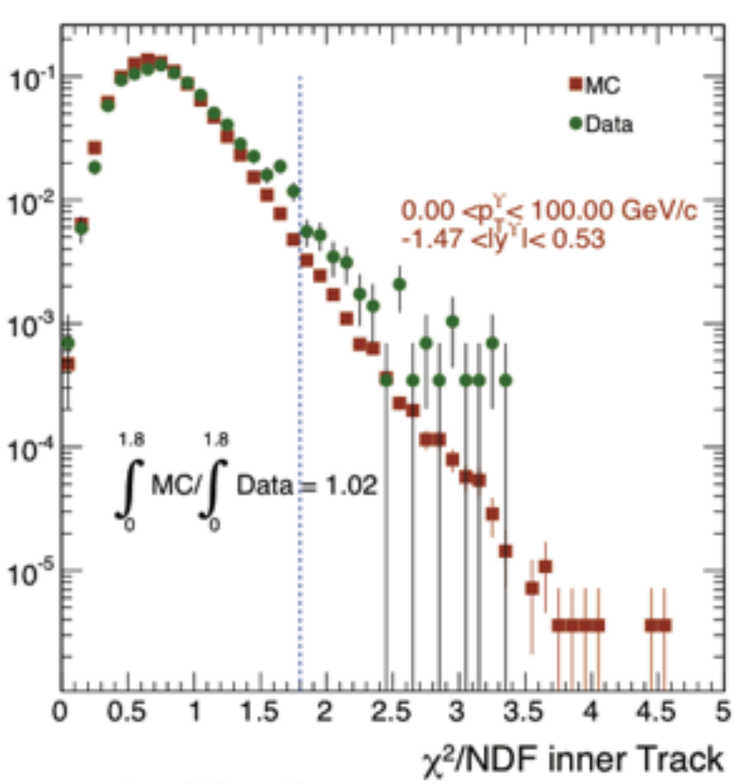


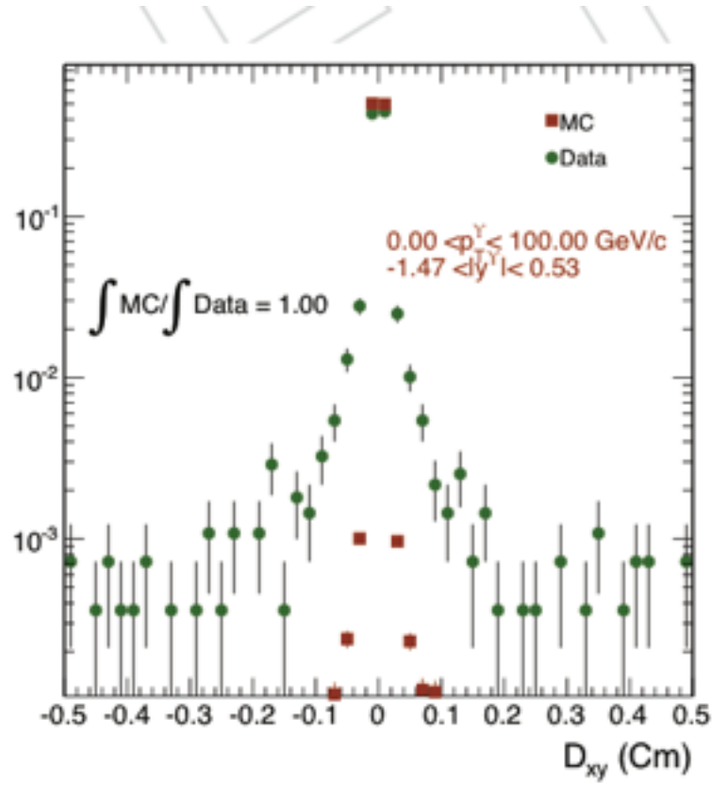
- largest SF will be ~ 10% ?

muID in pPb bottomonia

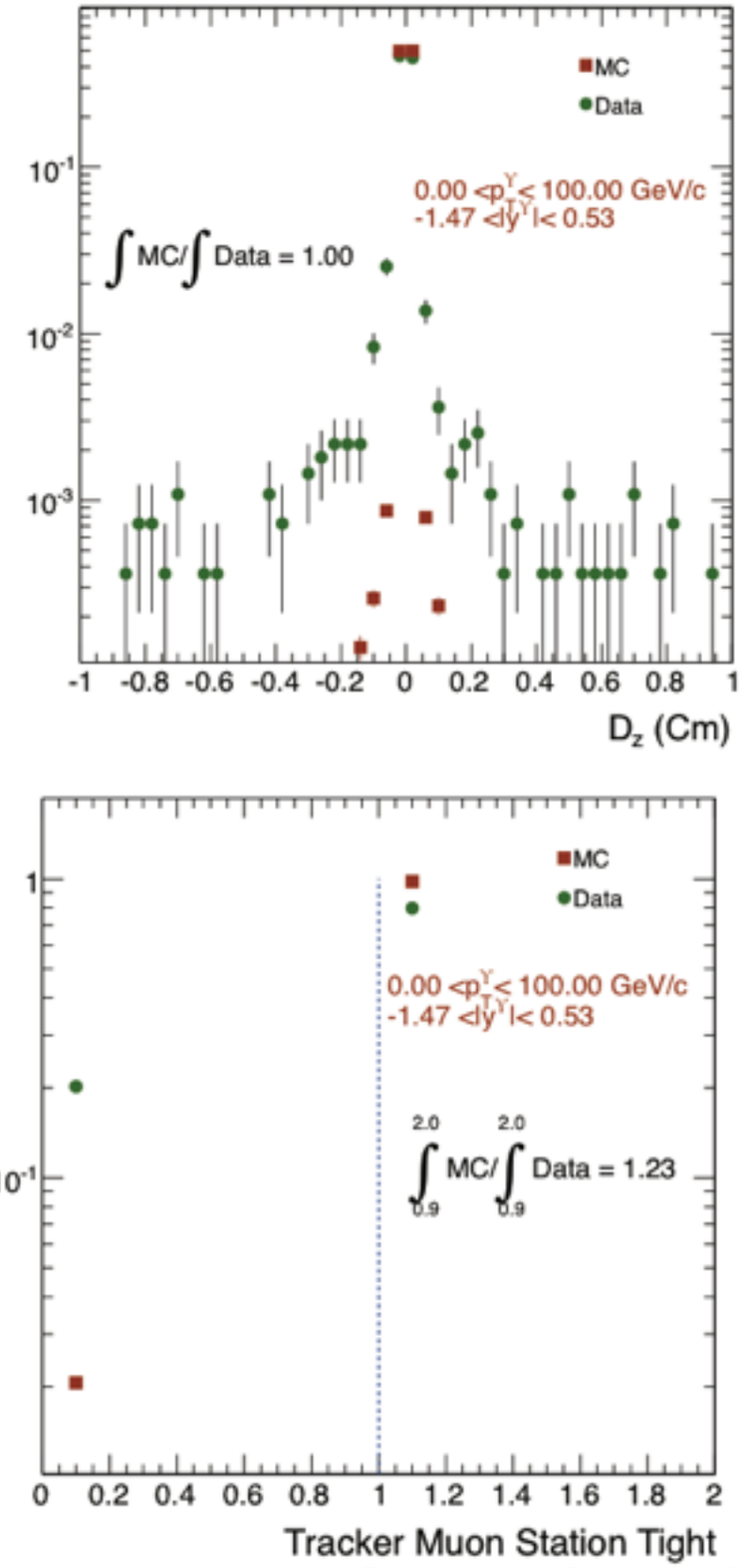


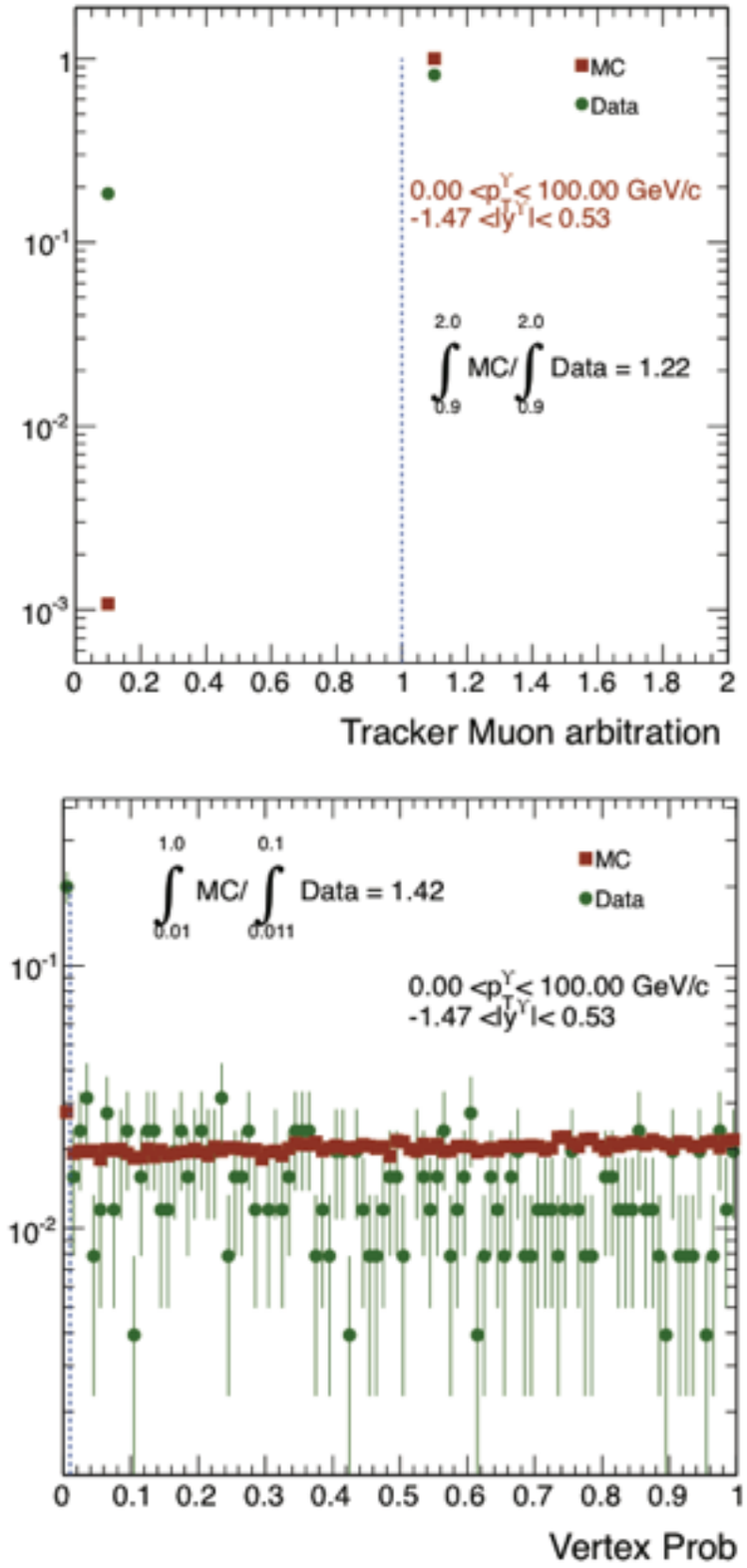






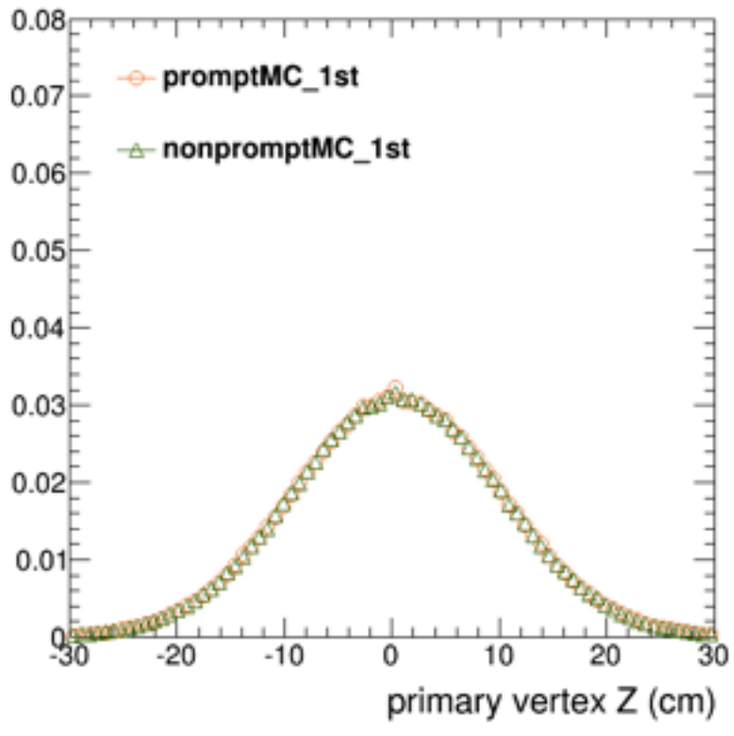
muID in pPb bottomonia

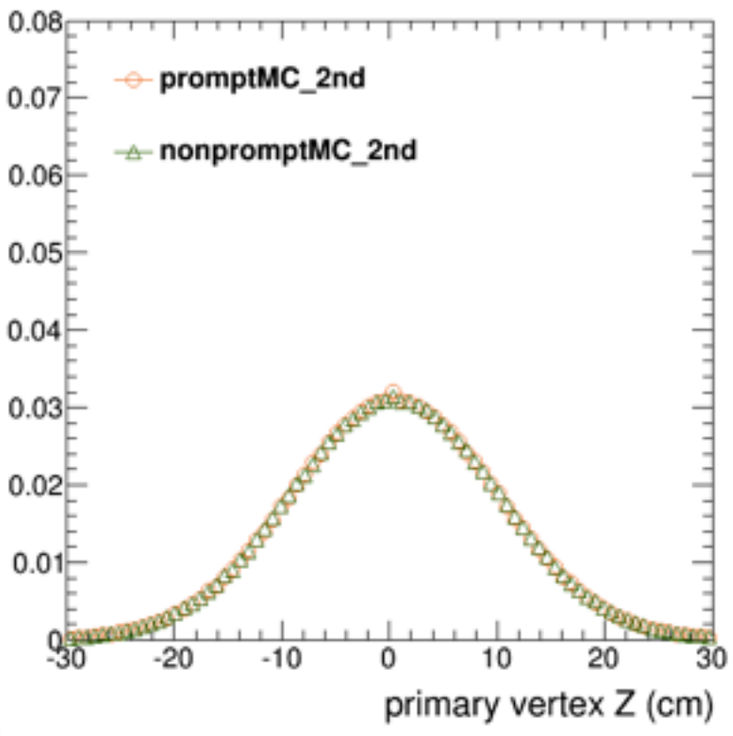


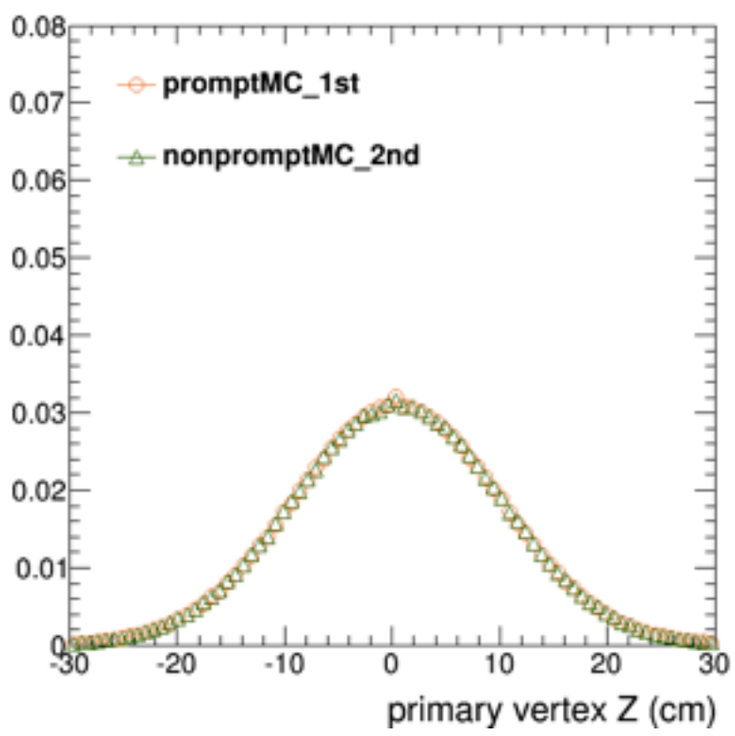


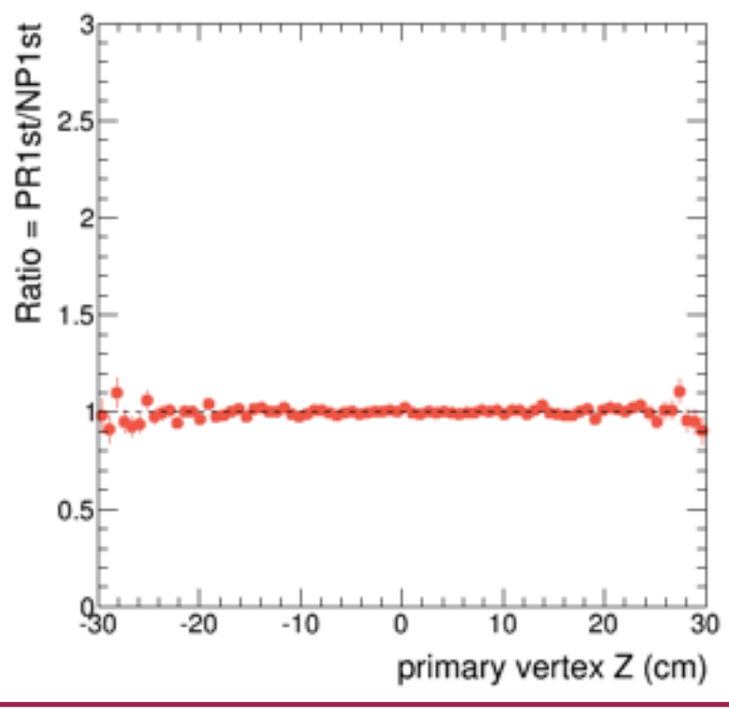
z vertex

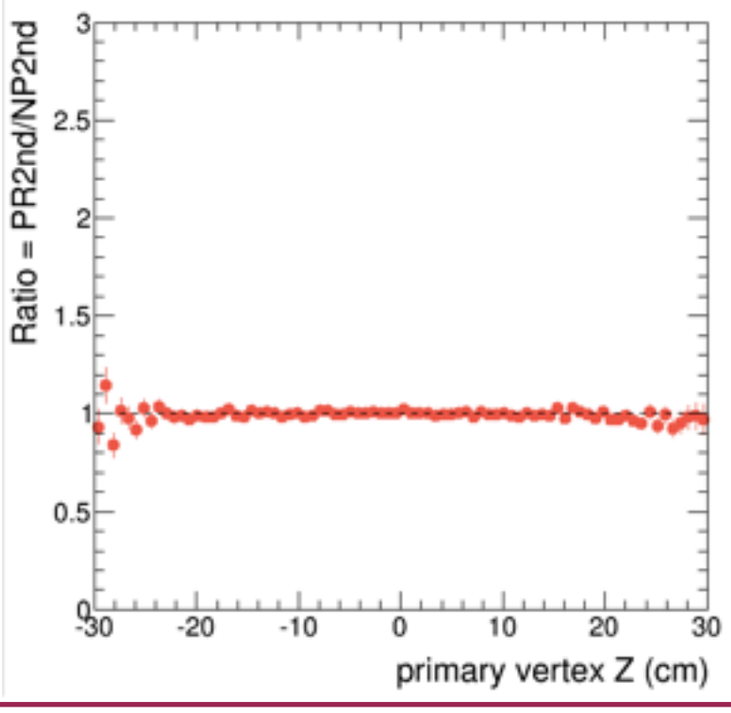
- **cf) Comparison b/w MC (PR 1st, 2nd, Np 1st, 2nd)**

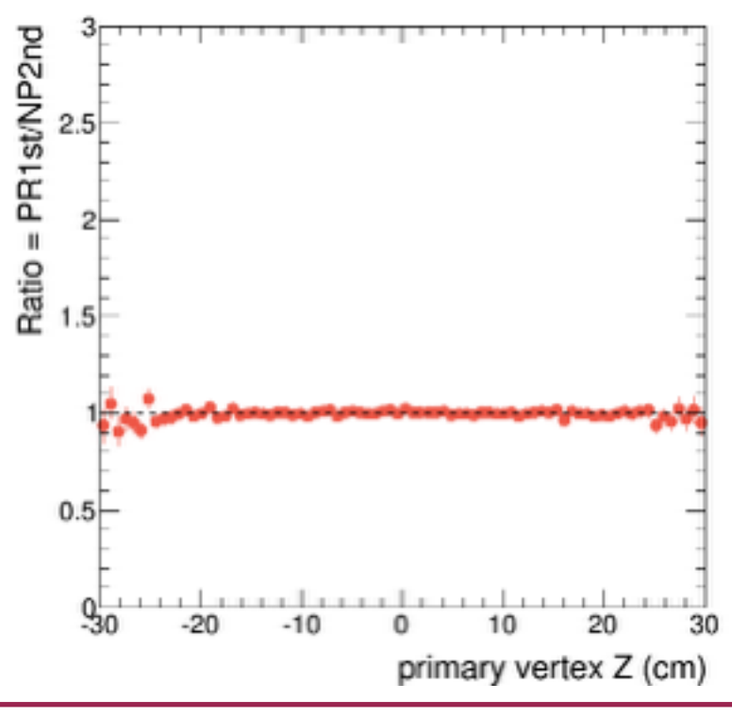






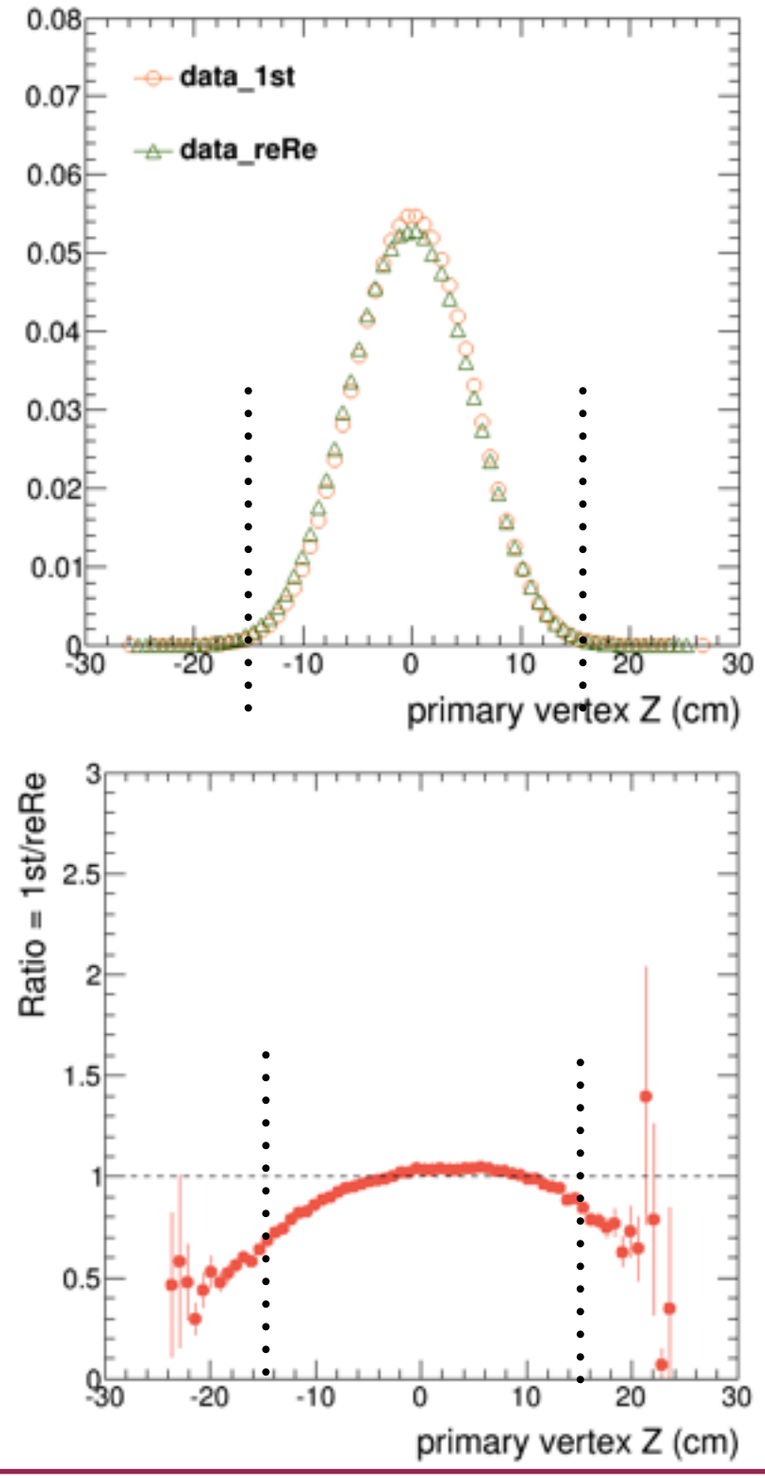


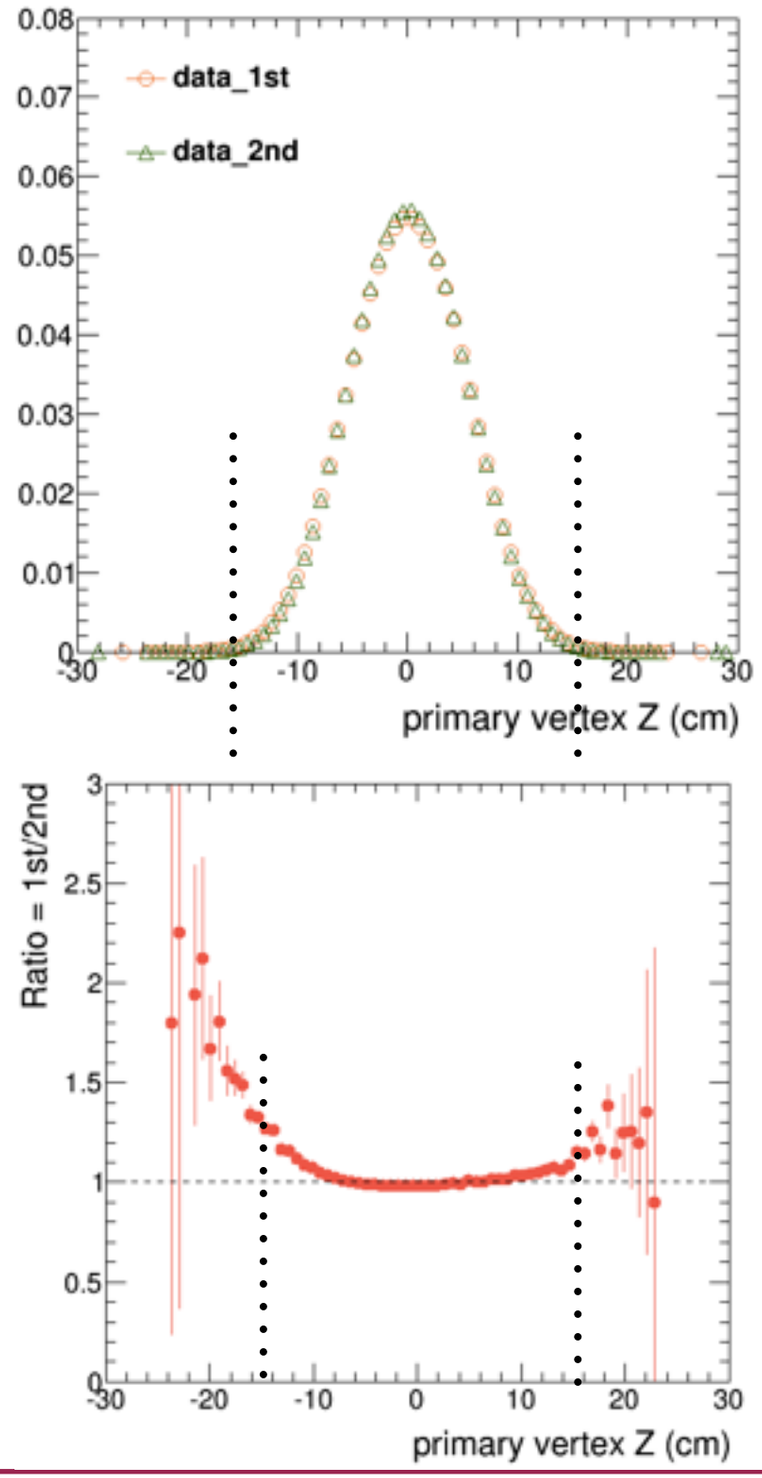




z vertex

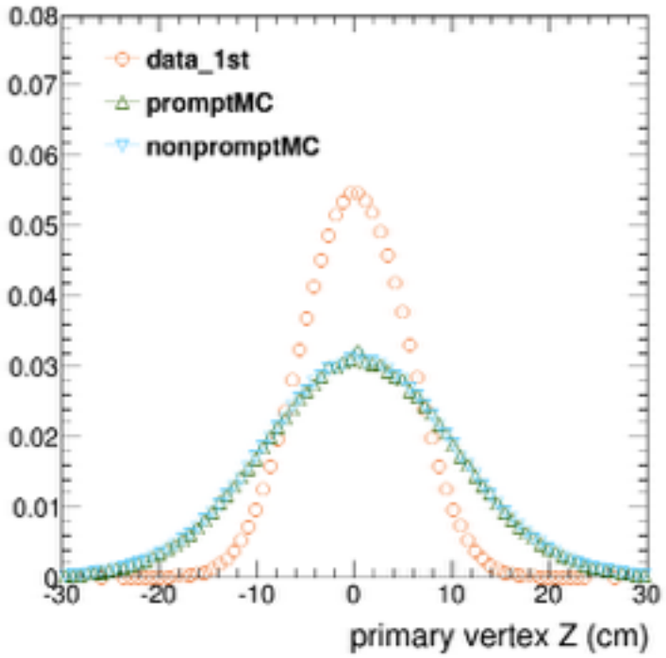
- cf) Comparision b/w Data (ReprocessedReco, 1st, 2nd)

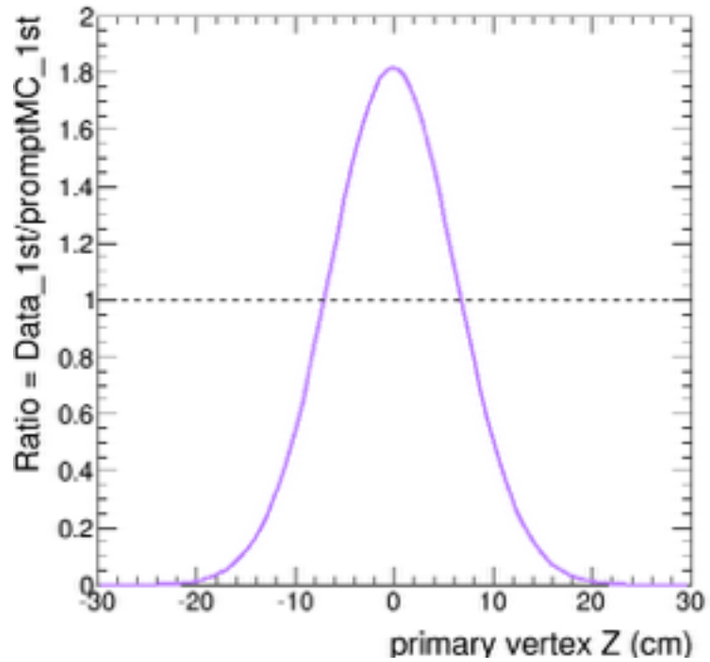




z vertex : parameters

- **primary Z vertex distributions**

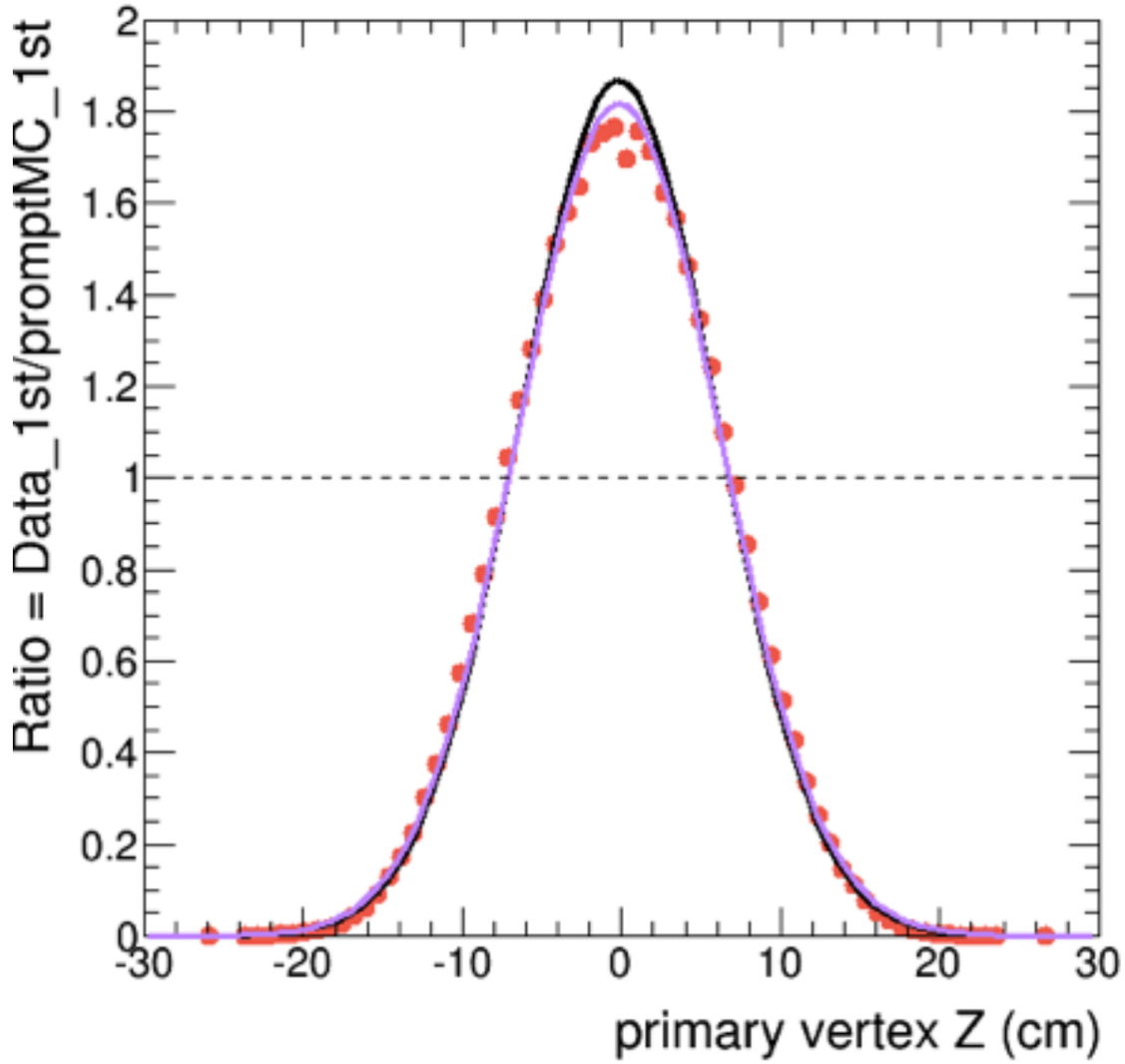





```
                EDM=1.15479e-08    STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                                   STEP         FIRST
  NO.   NAME      VALUE            ERROR          SIZE      DERIVATIVE
   1  p0           5.62625e-02   2.84424e-05   1.17933e-04   4.46129e-02
   2  p1           1.50483e-02   2.25792e-03   1.11277e-02   4.64033e-04
   3  p2           5.30830e+00   1.41665e-03   5.89157e-03   5.81147e-04
Error in ROOT::Math::ParameterSettings>: Invalid lower/upper bounds - ignoring the bounds
Error in ROOT::Math::ParameterSettings>: Invalid lower/upper bounds - ignoring the bounds
Error in ROOT::Math::ParameterSettings>: Invalid lower/upper bounds - ignoring the bounds
 FCN=146.398 FROM MIGRAD    STATUS=CONVERGED     134 CALLS         135 TOTAL
                EDM=1.88215e-07    STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                                   STEP         FIRST
  NO.   NAME      VALUE            ERROR          SIZE      DERIVATIVE
   1  p0           3.10179e-02   3.62279e-05   1.73471e-05  -2.33579e-02
   2  p1           4.62137e-01   7.96229e-03   5.46210e-03   6.62083e-04
   3  p2           9.66361e+00   6.28096e-03   3.25169e-03  -7.93966e-05
Info in <TCanvas::Print>: pdf file zVtxFit_hand_zVtx_2014fit.pdf has been created
```

z vertex

- **primary Z vertex distributions**



[Option 1]

- Fit the distributions by Gaussian separately
- Take the ratio of two functions **(violet line)**

[Option2]

- Take the ratio of distributions first
- Fit the ratio by Gaussian **(black line)**

Comparison

- **e.g. Prompt J/psi, 1st run period, $1.5 < y_{CM} < 1.93$**

pT (GeV/c)
0--3
3-6.5
6.5-7.5
7.5-8.5
8.5-9.5
9.5-11
11-14
14-30

old muID
wrong filter

Eff Pbp	err
0.076	0.001
0.267	0.002
0.376	0.007
0.394	0.009
0.454	0.012
0.452	0.013
0.48	0.014
0.465	0.018

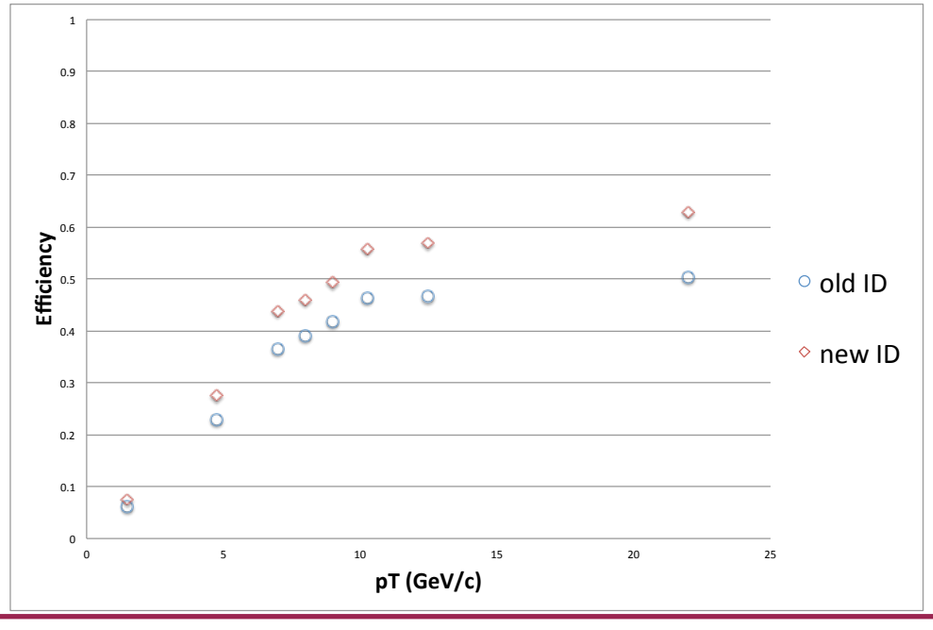
old muID
correct filter

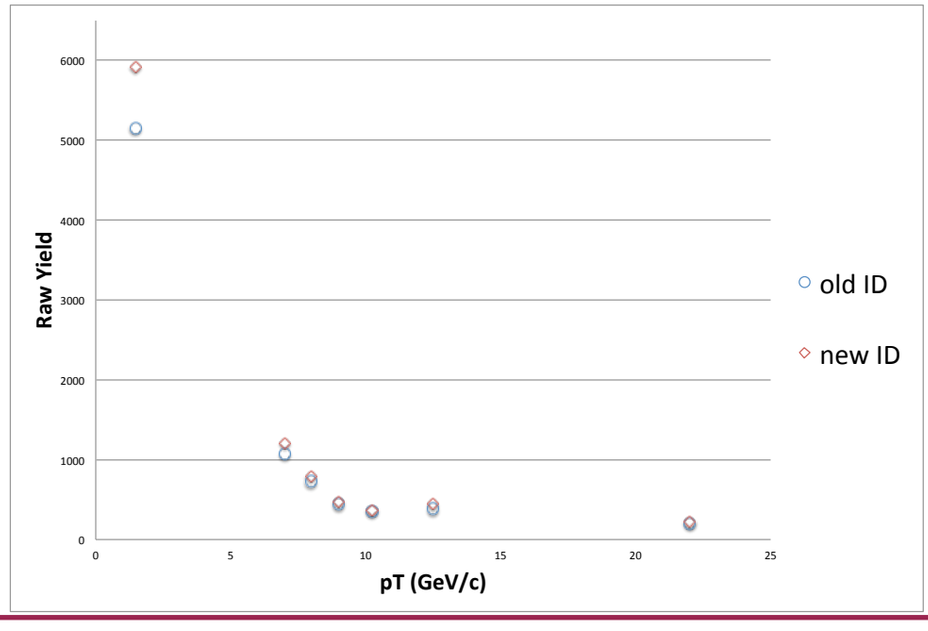
Eff Pbp	err	yield Pbp
0.061	0.001	5161.12
0.229	0.003	7261.88
0.365	0.01	1070.66
0.39	0.012	727.837
0.418	0.015	448.342
0.465	0.017	347.446
0.466	0.018	385.286
0.503	0.025	203.91

new muID
correct filter

Eff Pbp	err	yield Pbp
0.075	0.001	5910.21
0.275	0.003	8103.91
0.438	0.01	1199.92
0.46	0.012	782.763
0.494	0.016	475.264
0.559	0.017	368.098
0.57	0.018	437.496
0.629	0.024	223.354

- Both yields and efficiency increased when new muID applied



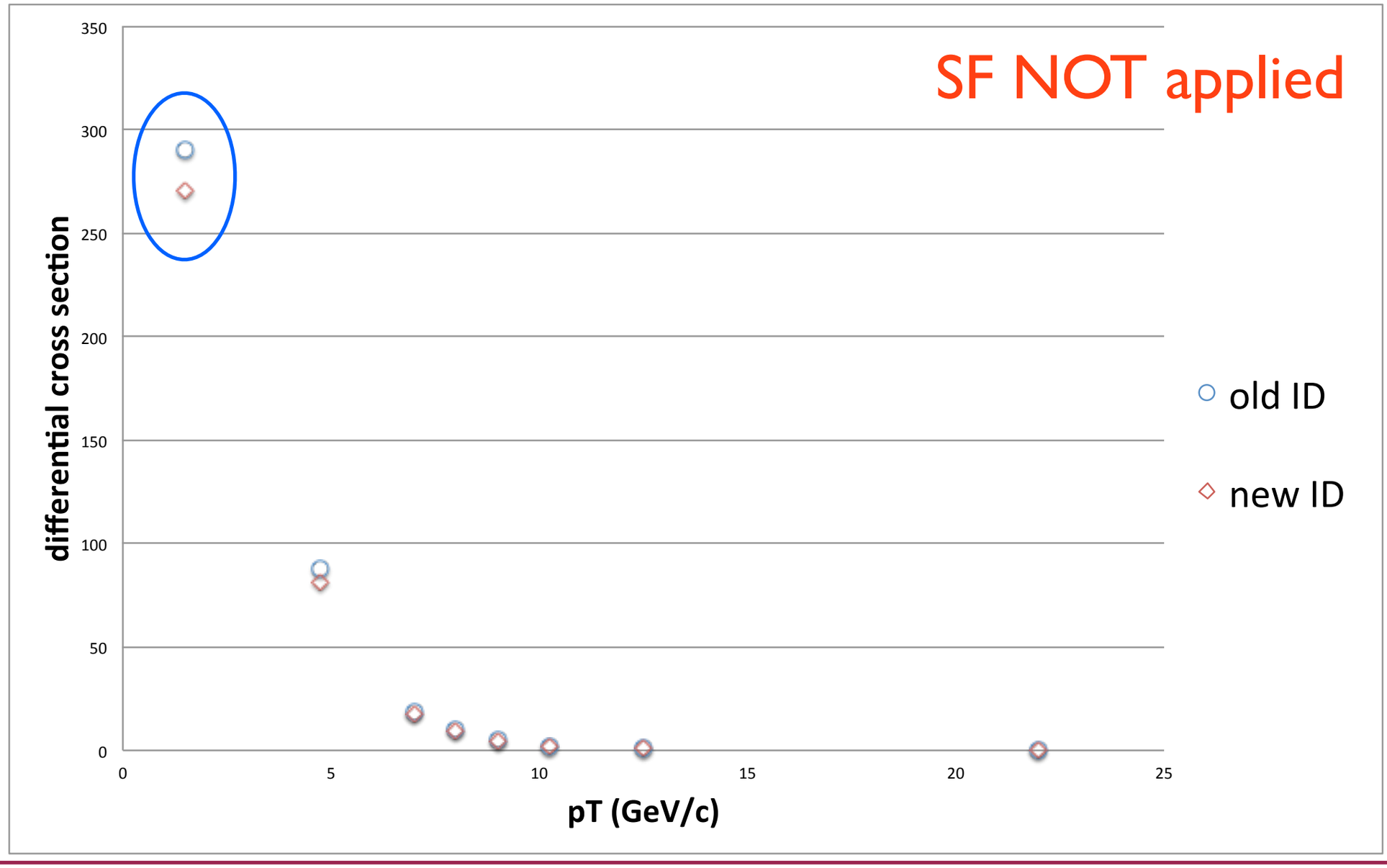


Quick check for results

Double differential cross section

$$\frac{d^2\sigma}{dp_T dy} = \frac{N_{fit}^{J/\psi} / (A \cdot \varepsilon)}{L_{int} \times B(J/\psi \to \mu^+\mu^-) \times \Delta p_T \Delta y}$$

- Quick check from the previous slide ($1.5 < y_{CM} < 1.93$)
- Cross-section values (corrected yield) becomes <u>smaller</u> with new muID applied
- Need to apply "scale factors" from TNP results



soft muon ID

soft muon ID cut

[Old version]

- TMOneStationTight
- TrackerLayersWithMeasurement >5
- PixelLayersWithMeasurement >1
- $|d_z|$ < 30 cm , $|d_{xy}|$ < 3 cm
- track.normalizedChi2 < 1.8

[New version]

- TMOneStationTight
- TrackerLayersWithMeasurement >5
- PixelLayersWithMeasurement >0
- $|d_z|$ < 20 cm , $|d_{xy}|$ < 0.3 cm
- track high purity tag

More details

- muon selection wiki : https://twiki.cern.ch/twiki/bin/view/CMSPublic/SWGuideMuonId
- HiOniaAnalyzer with new muID : https://github.com/CmsHI/pPbJPsiAnalysis/blob/master/HiOniaAnalyzer.cc

New datasets in EOS

- 1st 7 run :

/store/caf/user/lamia/merged_pPbData_1st_ntuple_ReprocessedReco-v1_GR_P_V43F_pileupRej_muID_tot.root

- 1st run period (7 run excluded) :

/store/caf/user/lamia/merged_pPbData_1st_ntuple_PromptReco-v1_GR_P_V43D_pileupRej_muID_tot.root

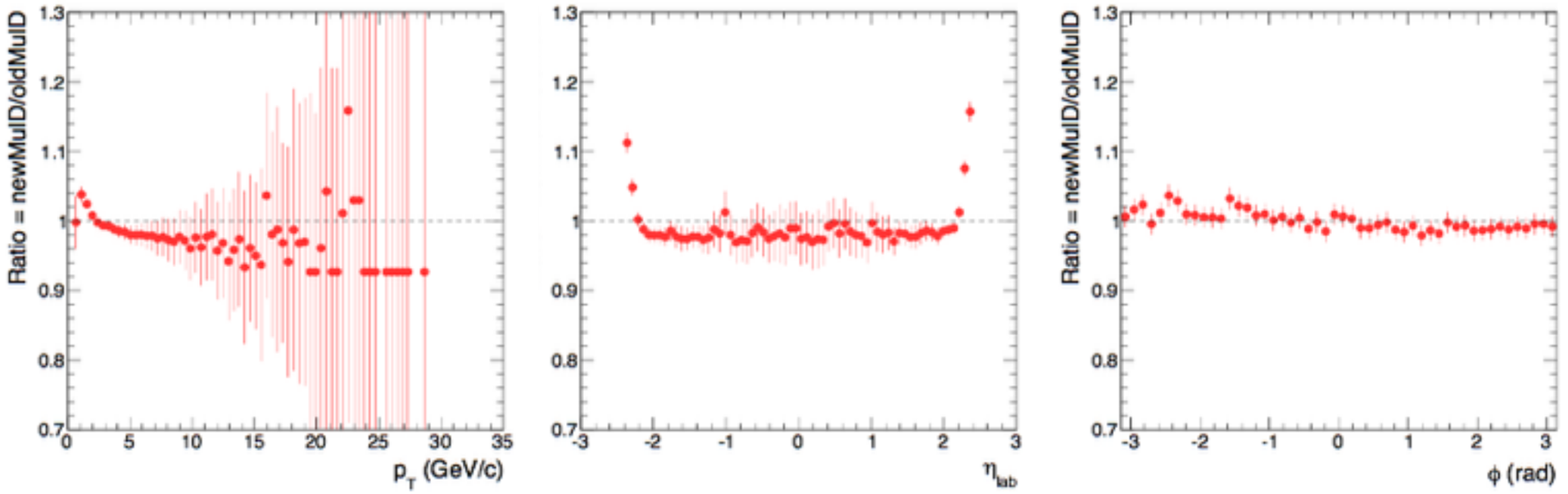
- 2nd run period :

/store/caf/user/lamia/merged_pPbData_2nd_ntuple_PromptReco-v1_GR_P_V43D_pileupRej_muID_tot.root

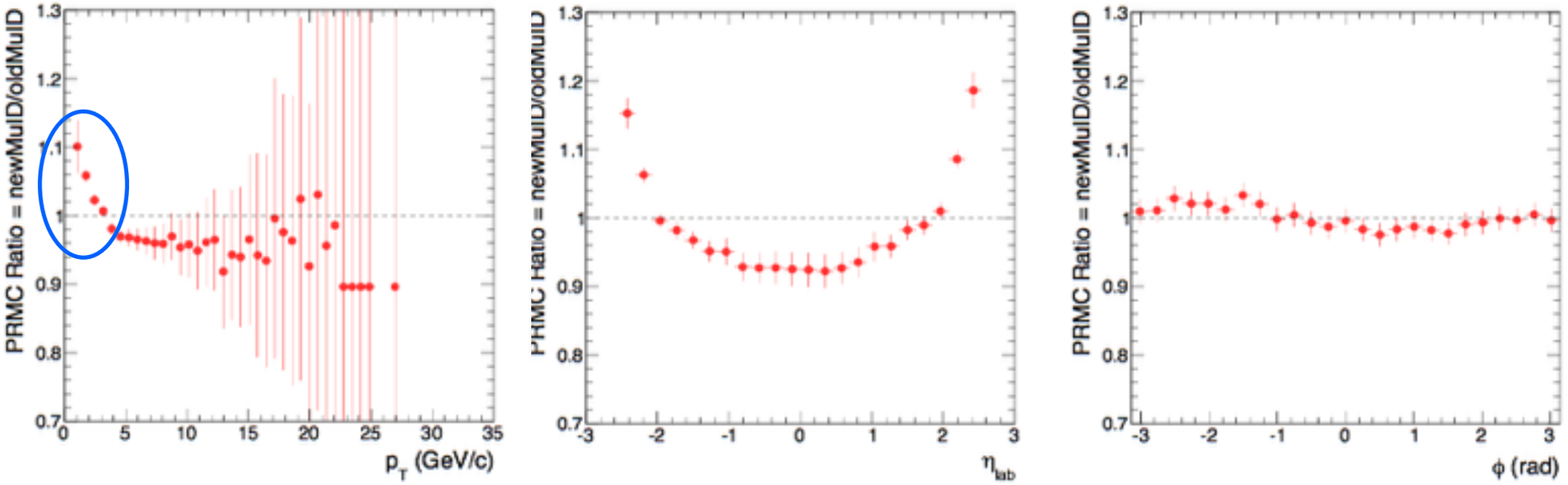
soft muon ID

- **<u>Single muon</u> variables (new muID/ old MuID)**

Data



MC



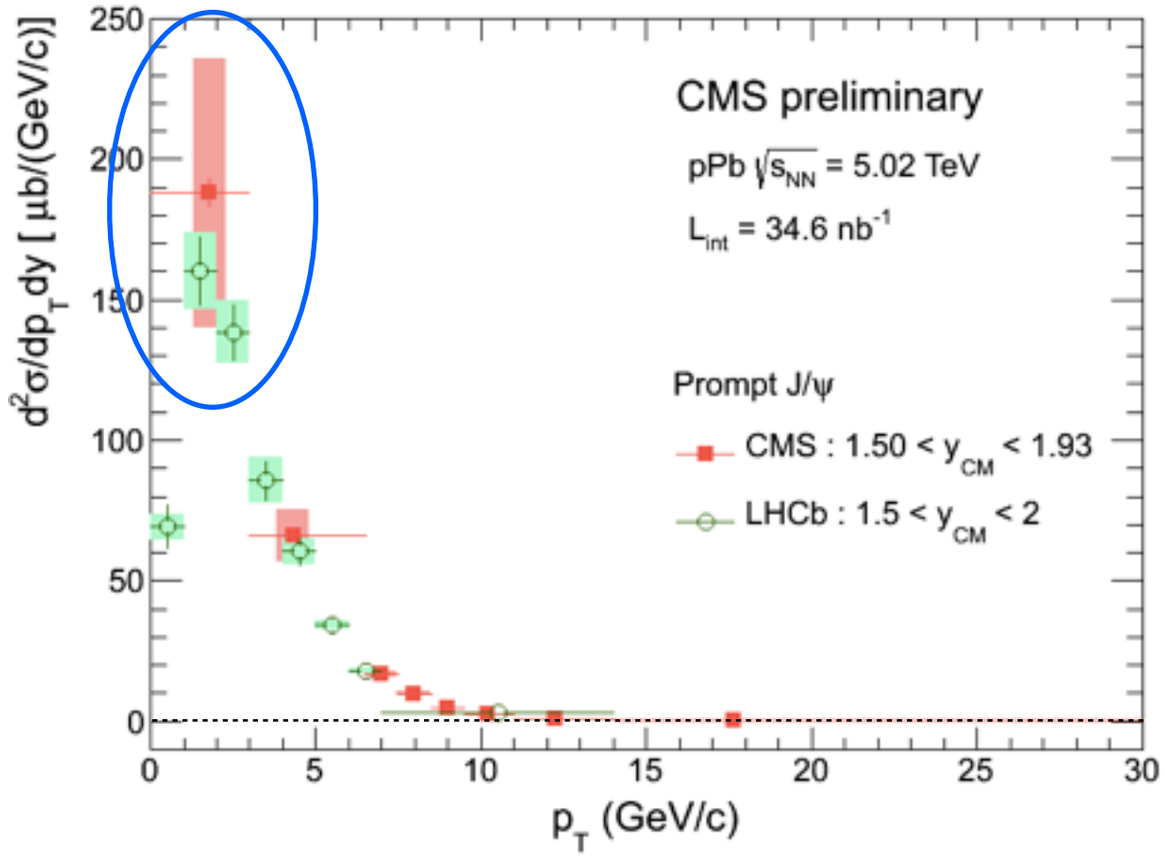
- Effect of new muID is similar for DATA and MC.
- maybe stronger for MC? **-> lower pT region -> need to look at muID variable's distributions**

New sample

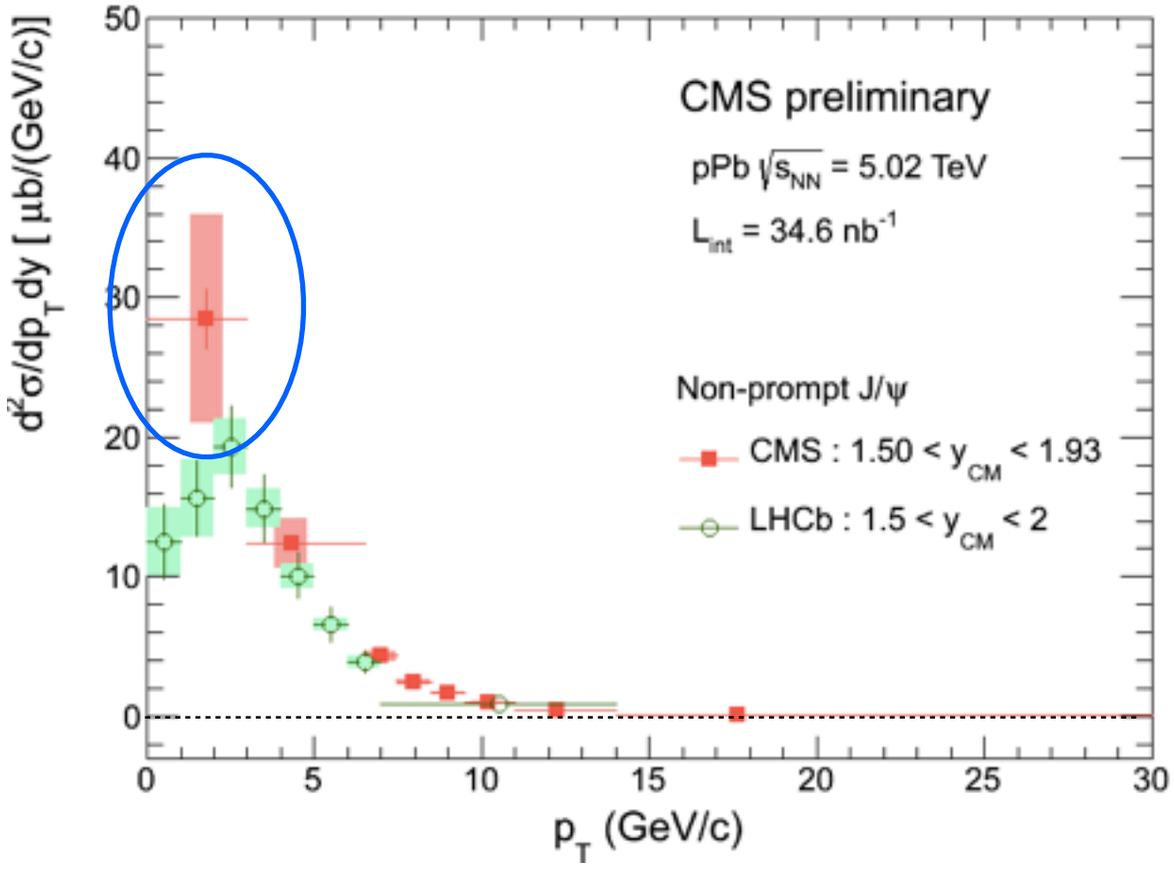
- **Double differential cross section**
  - LHCb points plotted at the center of the bin
  - Our points plotted at < p_T >

$$\frac{d^2\sigma}{dp_T dy} = \frac{N_{fit}^{J/\psi} / (A \cdot \varepsilon)}{L_{int} \times B(J/\psi \to \mu^+\mu^-) \times \Delta p_T \Delta y}$$

[Prompt]



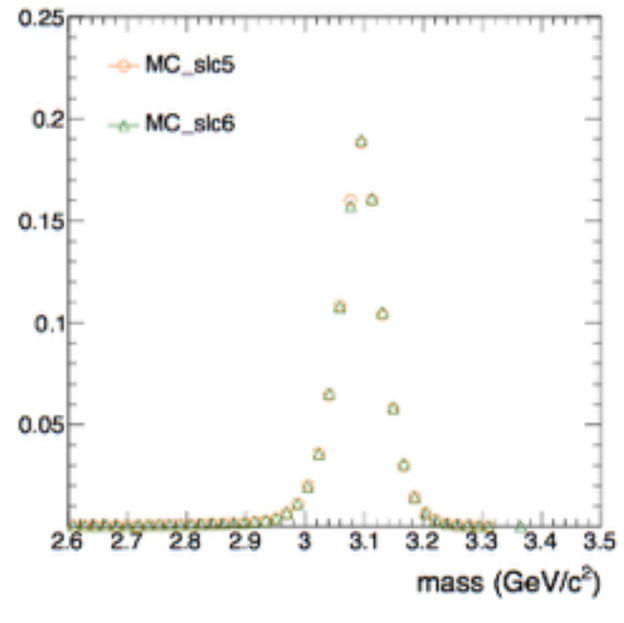
[Non-prompt]

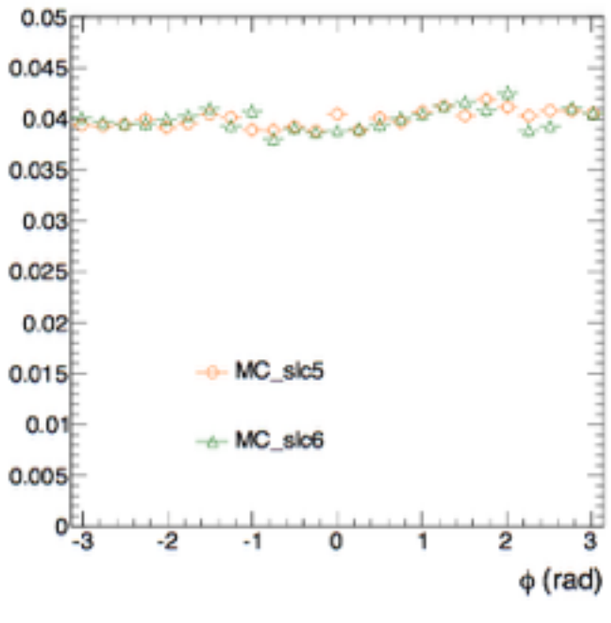


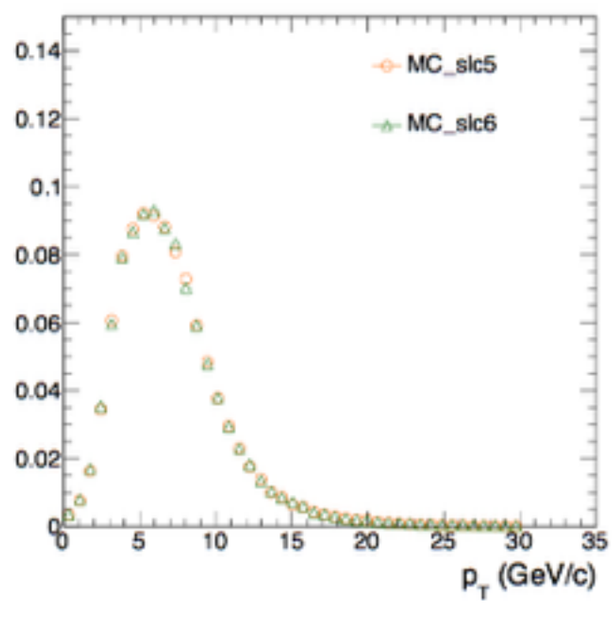
- **Large discrepancies at lower p_T < 3 GeV/c**
  - **acceptance or efficiency underestimated?**

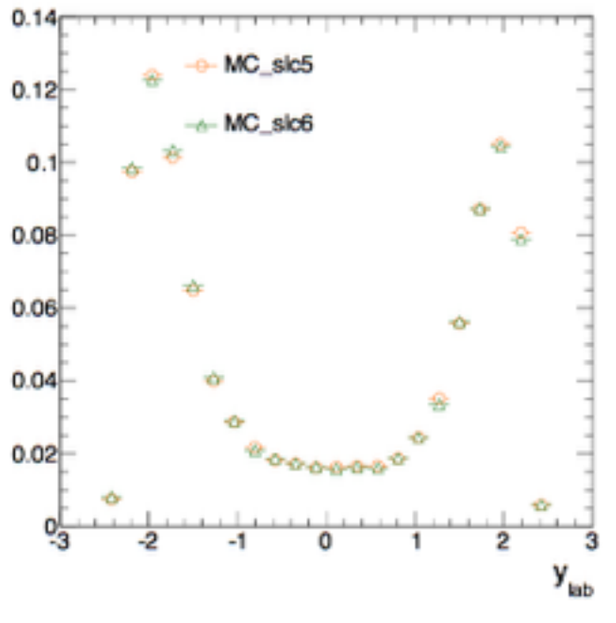
MC 5_3_8_HI vs 5_3_19

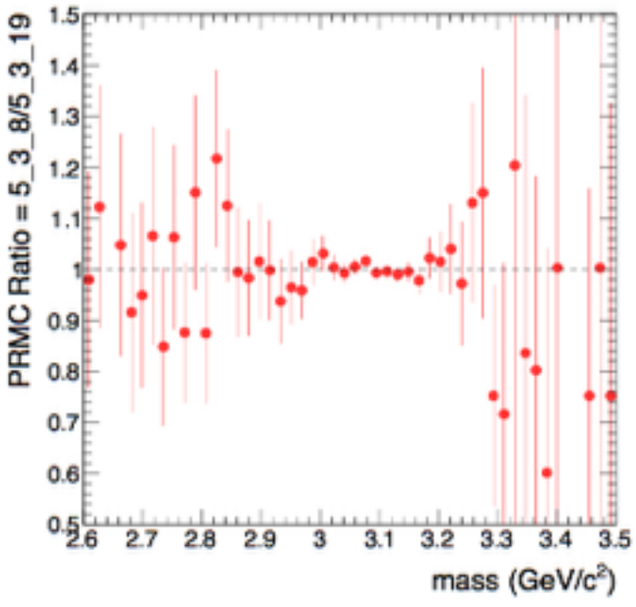
- **cf) Whole process (GEN-RECO) in different machine**

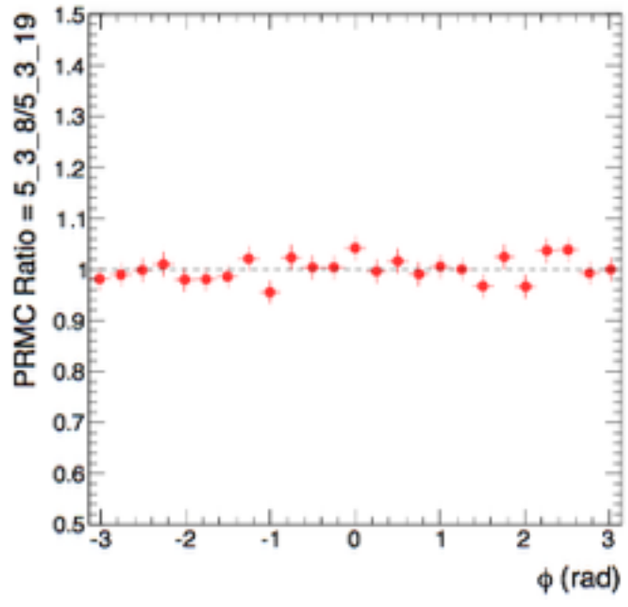


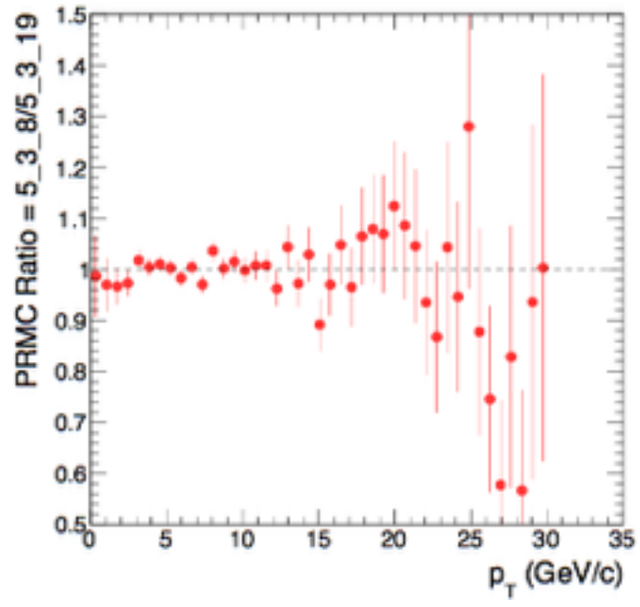


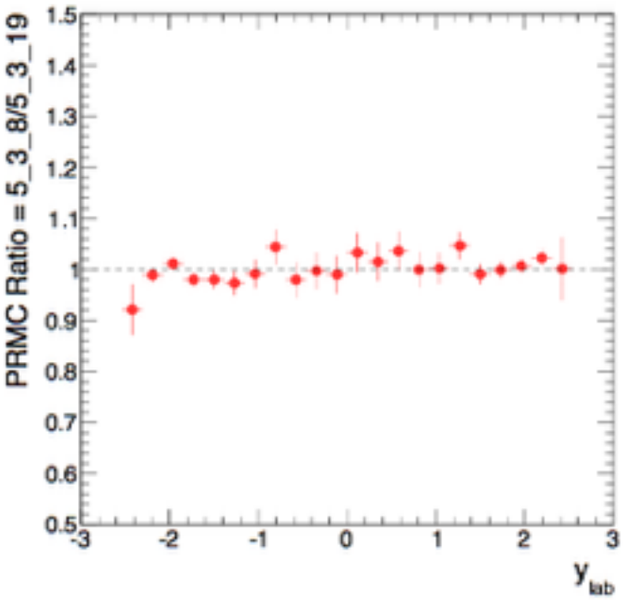












soft muon ID

- **Acceptance (SetShowProjectionX)**