Run16 J/ψ update

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Data set and cuts

- RUN16 Au+Au@200GeV
- Dimuon trigger 1679M events after event cut

Vertex Cuts
- $|Vz_{TPC}|<100cm$
- $|Vz_{TPC} - Vz_{VPD}|<3cm$
- $|Vr_{TPC}|<1.8cm$

Muon PID cuts
- fire trigger
- $-1 < n\sigma_{\pi} < 3$
- $\triangle y$ & $\triangle z$

  $\leq 2\sigma$ if $p_T < 3$ GeV/c

  $\leq 2.5\sigma$ if $p_T > 3$ GeV/c
- $\triangle tof < 0.2$ ns

Track quality cuts
- primary track
- $p_T > 1.3$ GeV/c
- $|\eta| < 0.8$
- dca < 1cm
- nHitsFit ≥ 15
- nHitDedx ≥ 10
- nHitsFit/nHitPoss ≥ 0.52

Pair cut
- $|y|<0.5$

Effect of including HFT in the tracking

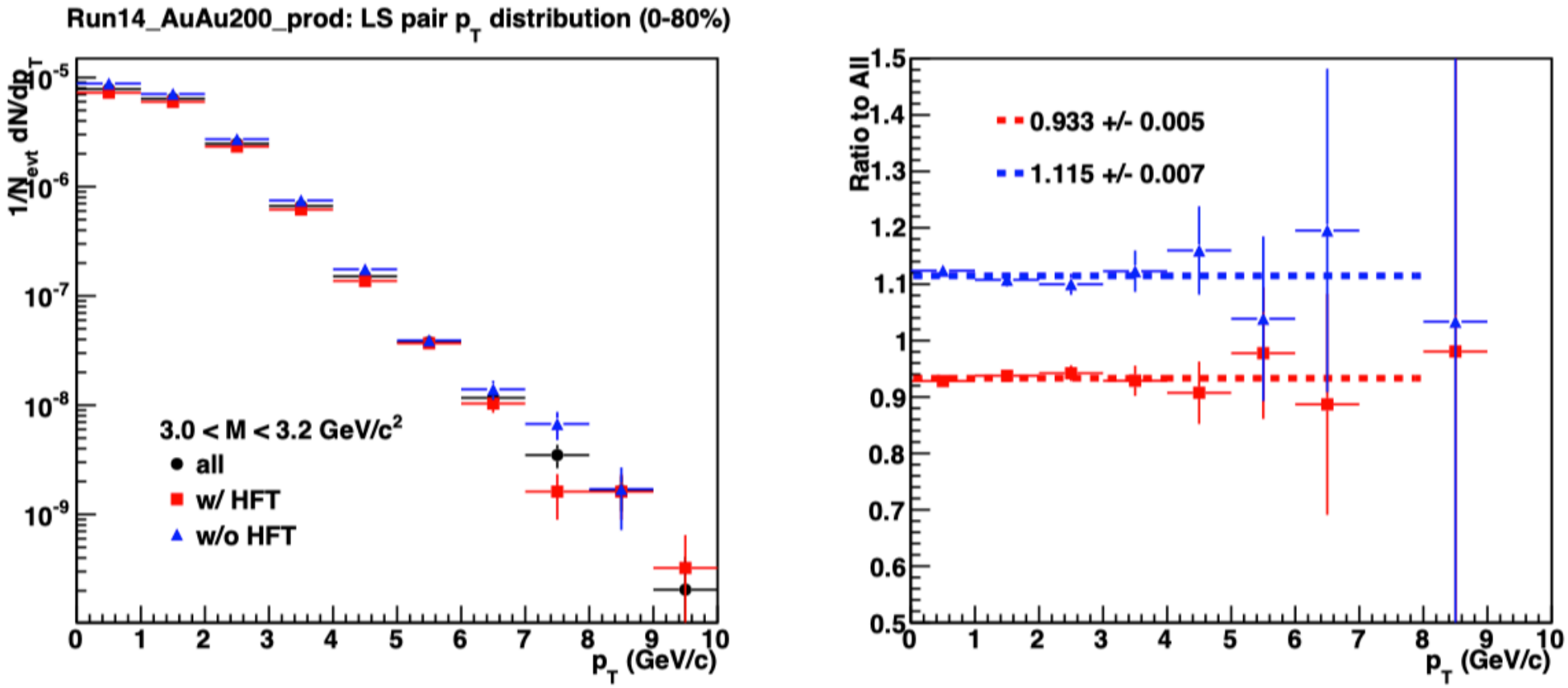


Figure 67: Raw yields of like-sign muon pairs in events with and without HFT readout (left), and their ratios to the inclusive sample (right).

HFT in Run16

AuAu 200GeV, run 2016 data production

next deterctors are on: tpx (tpc with daq1000 electronics), tof, VPD, emc, eemc, bsmd, esmd, mtd, pxl, ist, sst, gmt ; set of detectors varies with run numbers
Corrections included in TPC reconstruction: Shorted Ring correction, sectors alignment for TPC, ExB correction, ExB 2D shape correction, ExB twist correction, clock correction, padRow 13 distortion, Field Cage correction, Space Charge and Grid Leak 3D corrections;

Trigger sets

- **AuAu_200_production_2016;**
- **AuAu200_production2_2016;**

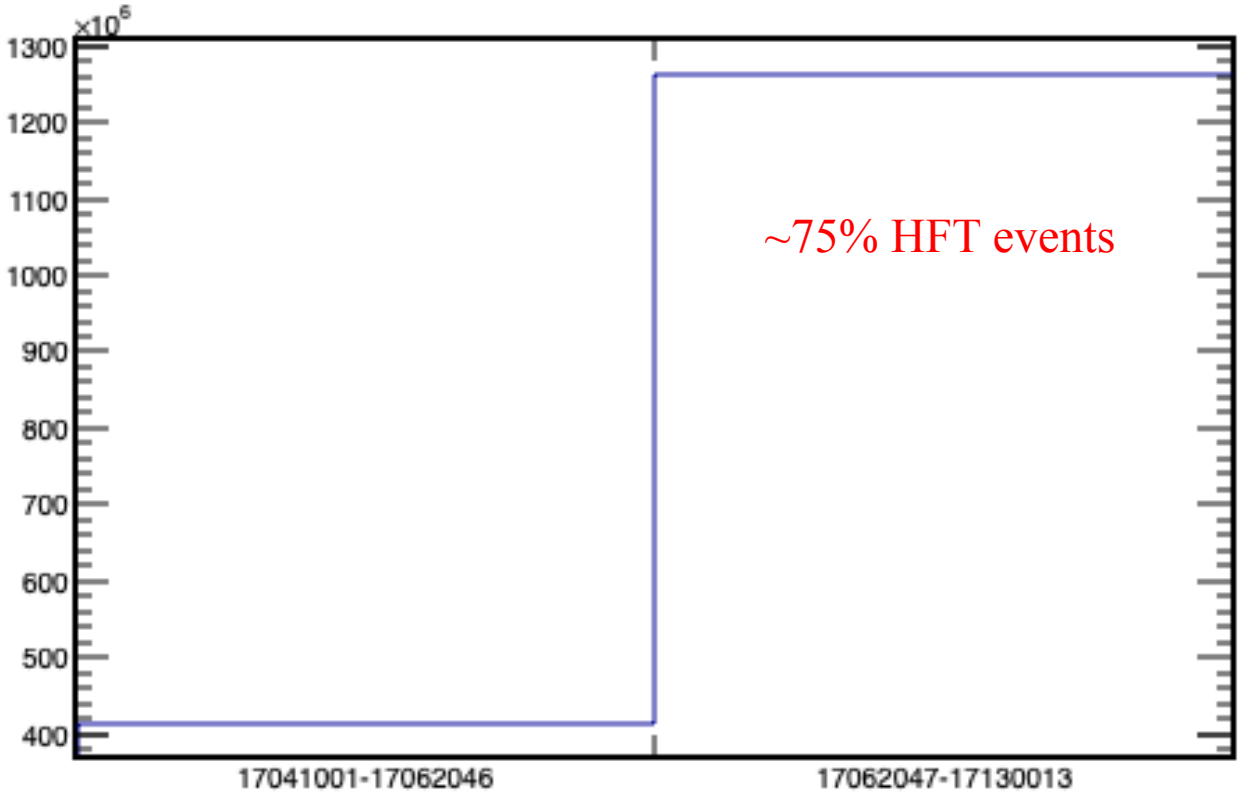
next stream data are processed;
st_physics, st_mtd, st_WB, st_hlt, st_upc,
st_sst, st_nosst, st_fms, st_zerobias

Trigger set and stream data description could be found on Trigger 2016 Web page.

Production Series

- **P17if production of st_upc stream data with library SL17f . StiCA tracking has been used for tracks reconstruction.**
  Data taken before run number 17062047 were processed without HFT tracking due to firmware issue with HFT detectors. Data taken after runnumber 17062047 were processed with HFT tracking.
  "VFPPVnoCTB, beamline, VFStoreX" options have been used for vertex finding with default PPV cut vertex cut: DcaZMax = 3cm, RImpactMax = 3cm, MinTrack = 2, nHitFit/nHitPoss > 0.7 . "VFStoreX" used to save at least 100 vertices in MuDst.
- **P16ij production of st_hlt, st_physics, st_mtd, st_WB, st_nosst, st_sst, st_fms, st_zerobias stream data with library SL16j . StiCA tracking has been used for tracks reconstruction.**
  Data taken before run number 17062047 were processed without HFT tracking due to firmware issue with HFT detectors. Data taken after runnumber 17062047 were processed with HFT tracking.
  "VFMinuit" option has been used for vertex finding with default cut: DcaZMax = 3cm, RImpactMax = 1.5cm, MinTrack = 5.
  st_physics data are using updated/improved dEdx calibrations; for st_hlt stream data it is possible to recalculate dEdx nSigma distribution using the improved calibration parameters in the database but it could be applyed only for MuDst data format;
  st_mtd and st_WB stream data are processed without HFT tracking by request of PWG;
- **P16ik production of st_hlt stream data for runnumber >= 17062047 without HFT tracking for comparison with data reconstructed with HFT tracking. Library used for reconstruction is SL16k . There are no difference in tracking codes with SL16j library. The rest of parameters are the same as in P16ij production.**

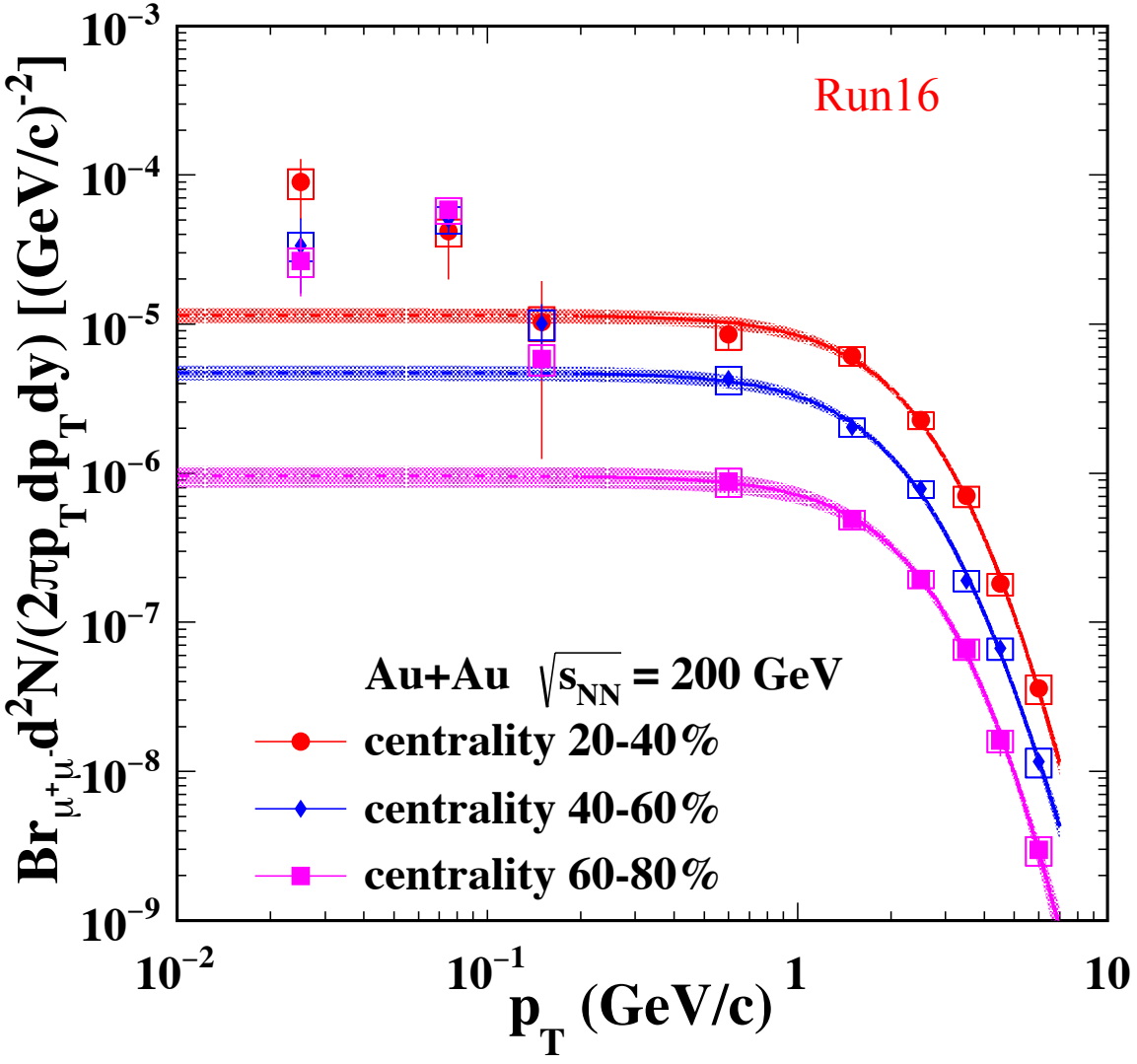
HFT events in run16

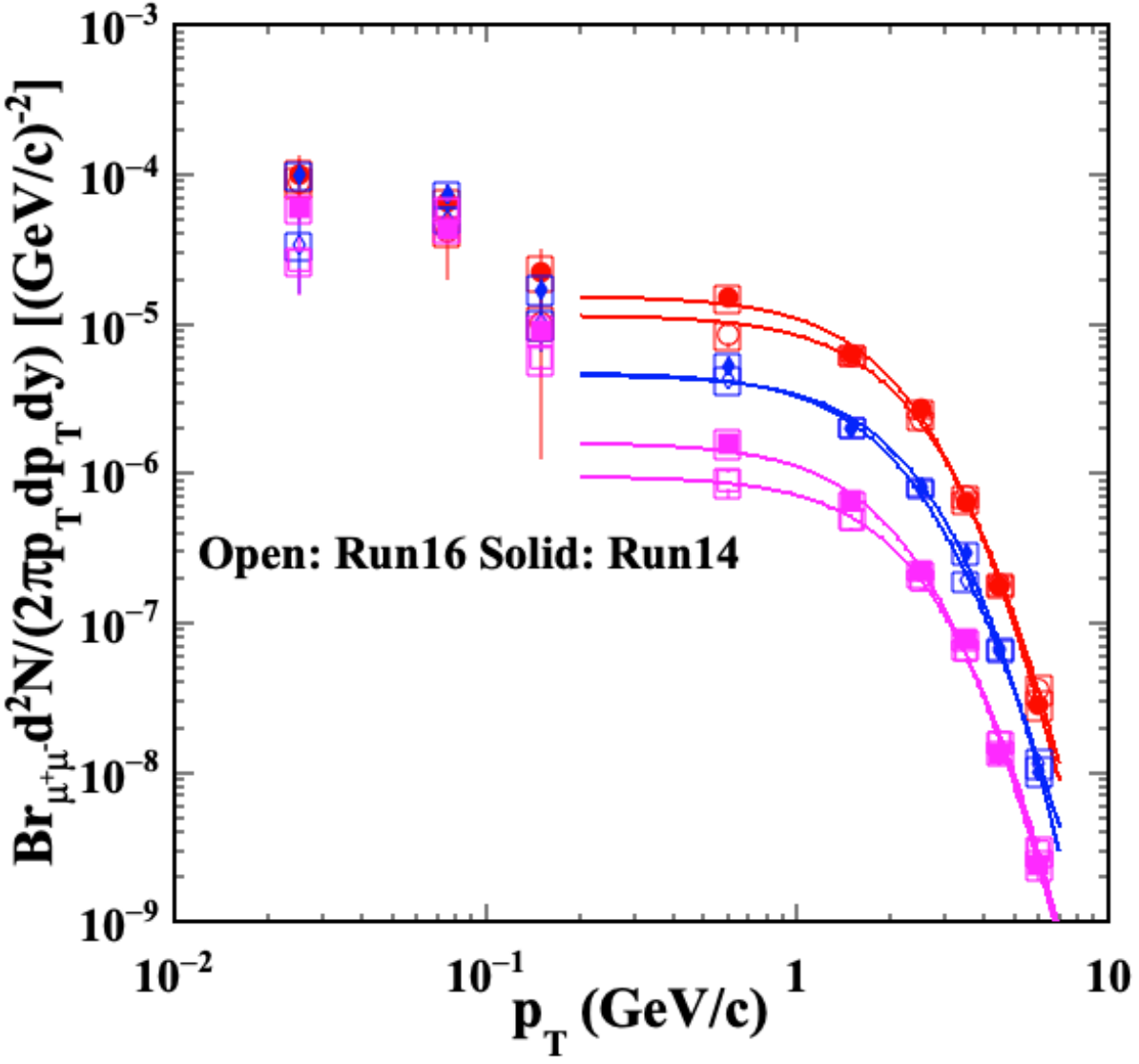


If the influence of HFT events in run16 is similar with run14 (about 18%) , the efficiency loss will be 13.6%

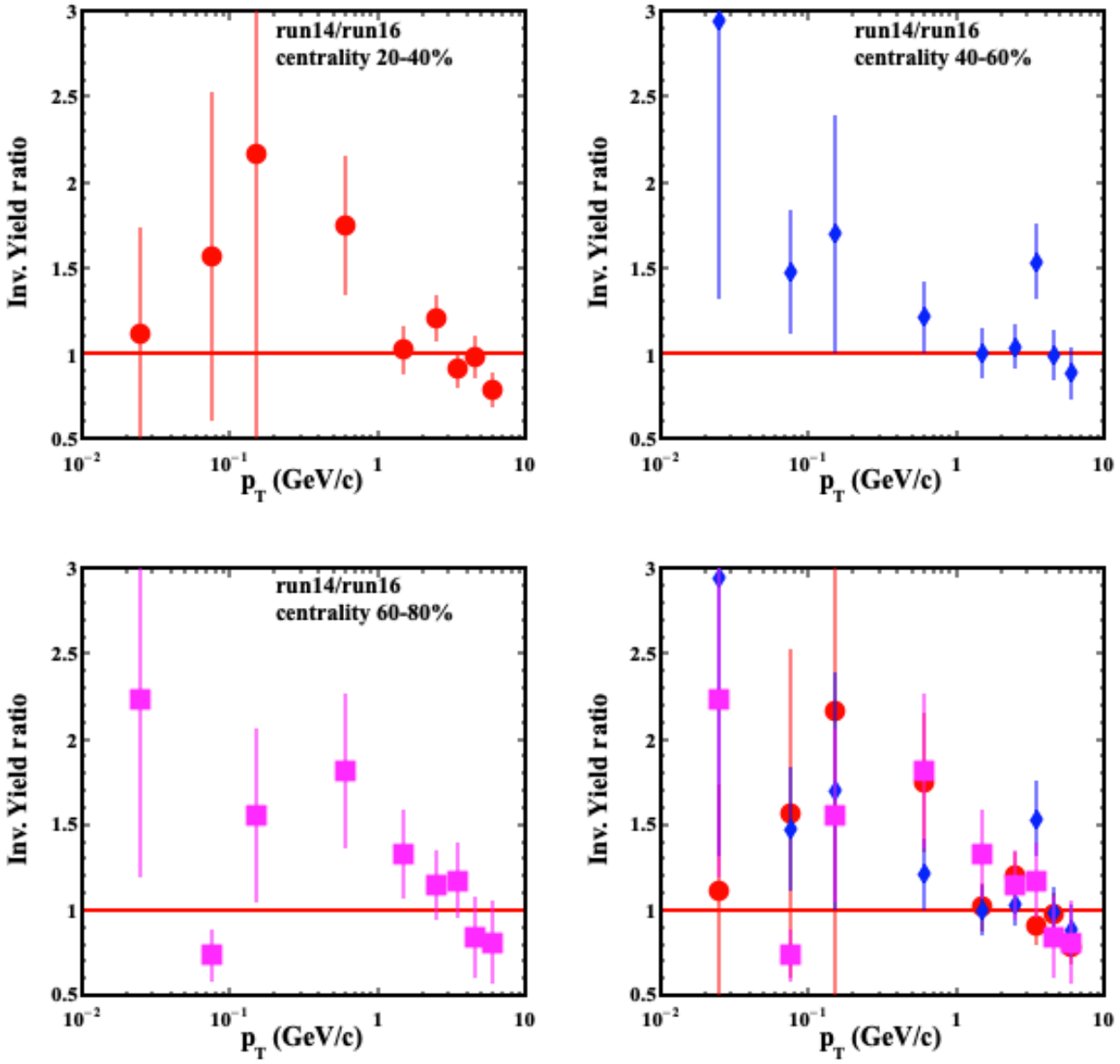
Will check this effect in run16

Inv. Yield compare with run14

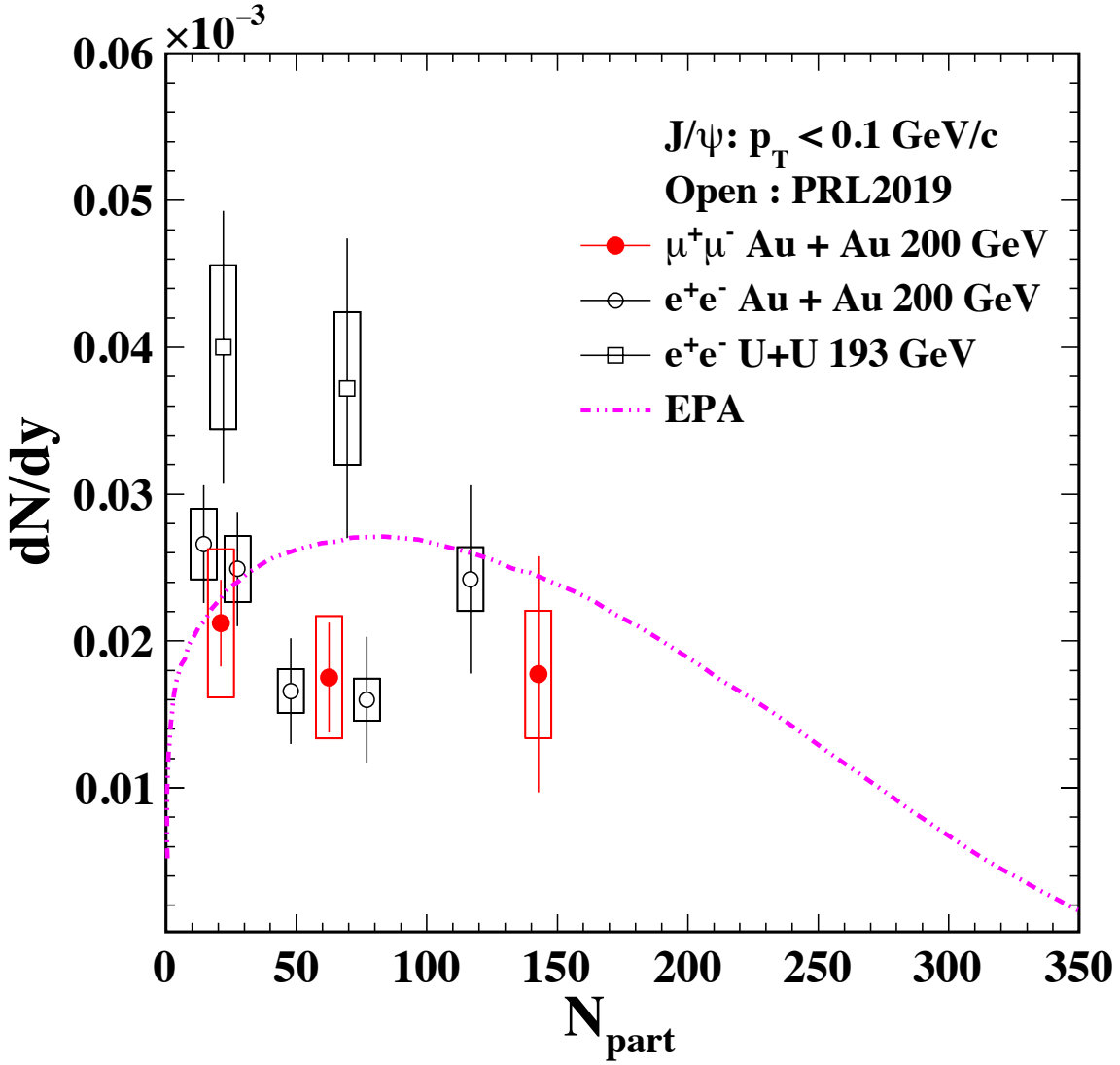


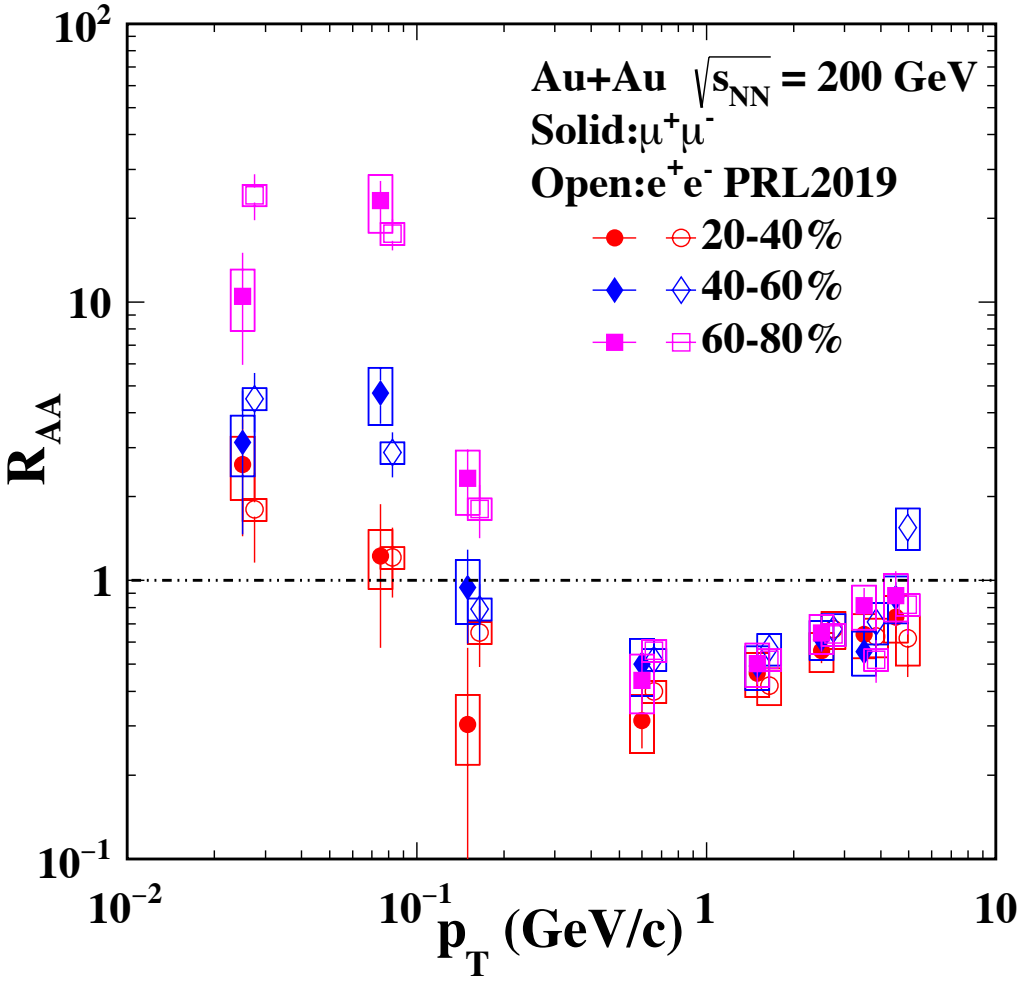


Ratio of inv. yield



Excess yield and R_{AA} (run16) compare with di-electron

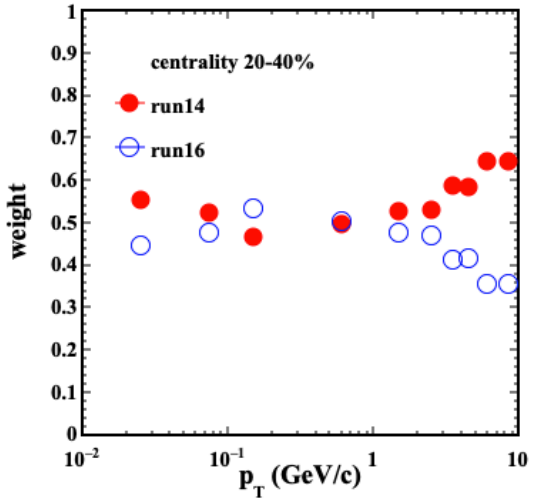


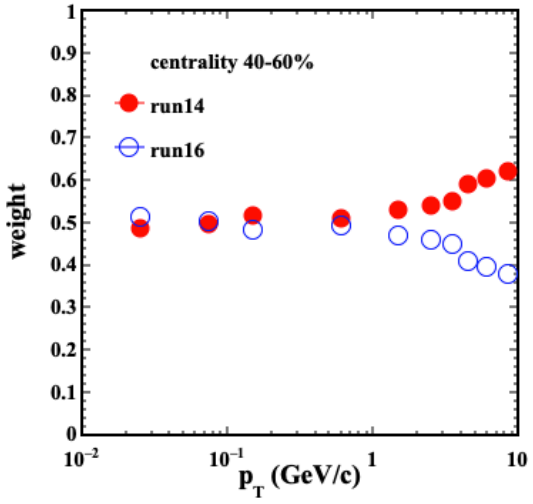


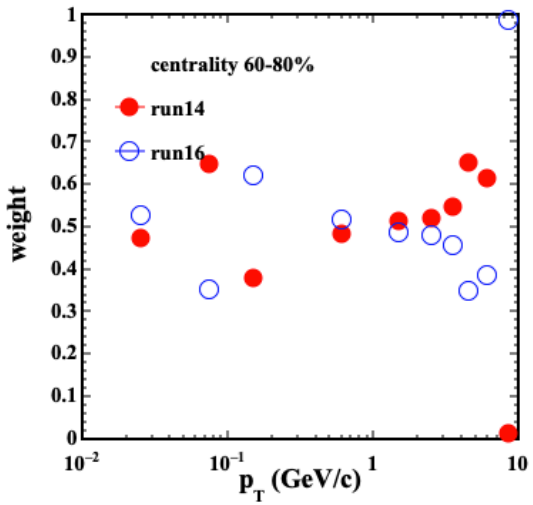
Combine run14 and run16

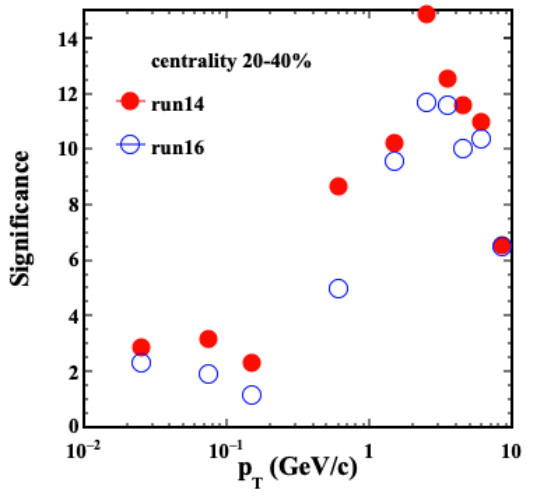
- $weight1 = \frac{1}{stat.err1^2} \div (\frac{1}{stat.err1^2} + \frac{1}{stat.err2^2})$
- $weight2 = \frac{1}{stat.err2^2} \div (\frac{1}{stat.err1^2} + \frac{1}{stat.err2^2})$
- $stat.err.combine^2 = (weight1 \times stat.err1)^2 + (weight2 \times stat.err2)^2$
- Signal_combine = weight1*Signal1+weight2*Signal2
- Sys.err.combine = weight1*Sys.err1+weight2*Sys.err2

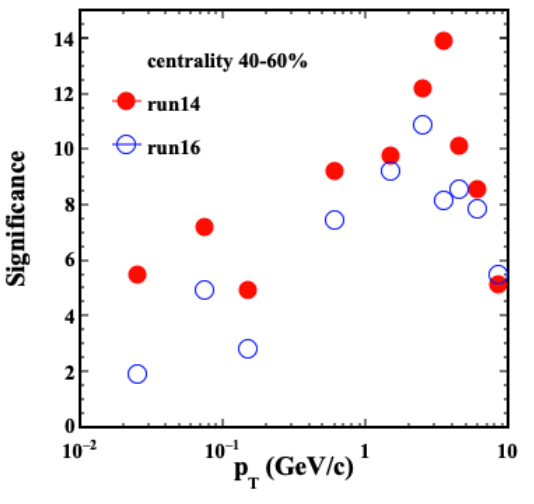
Weight and significance in pT bin

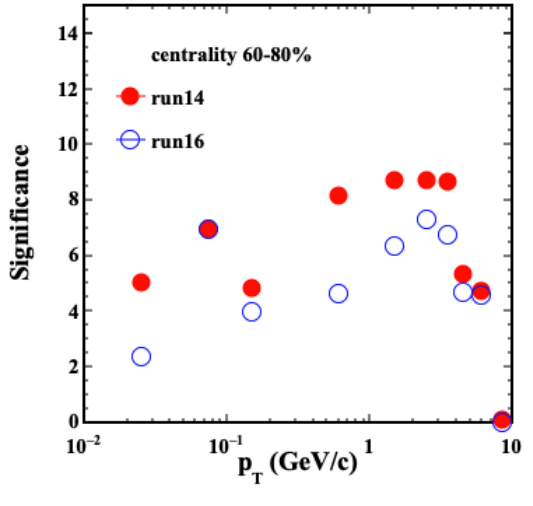




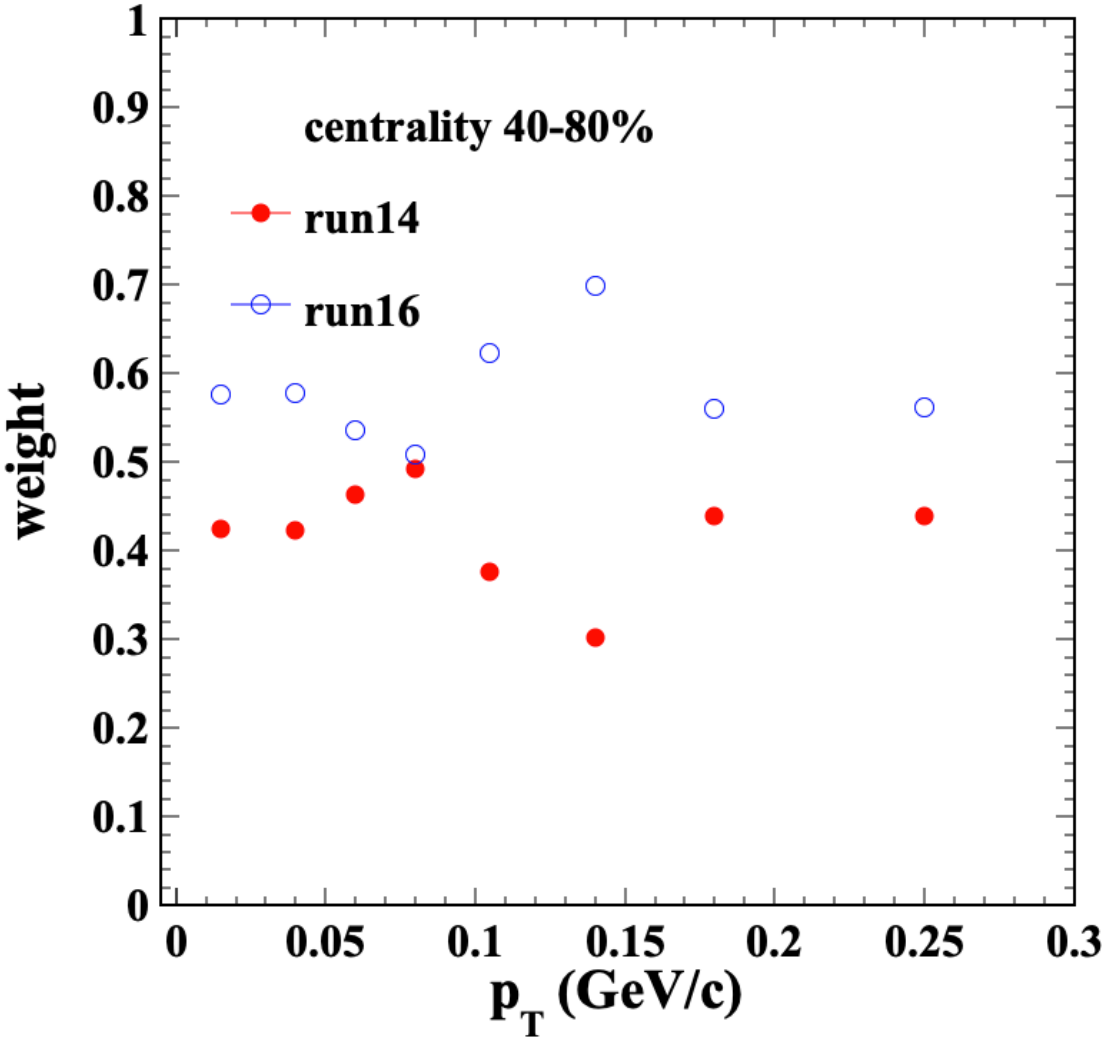


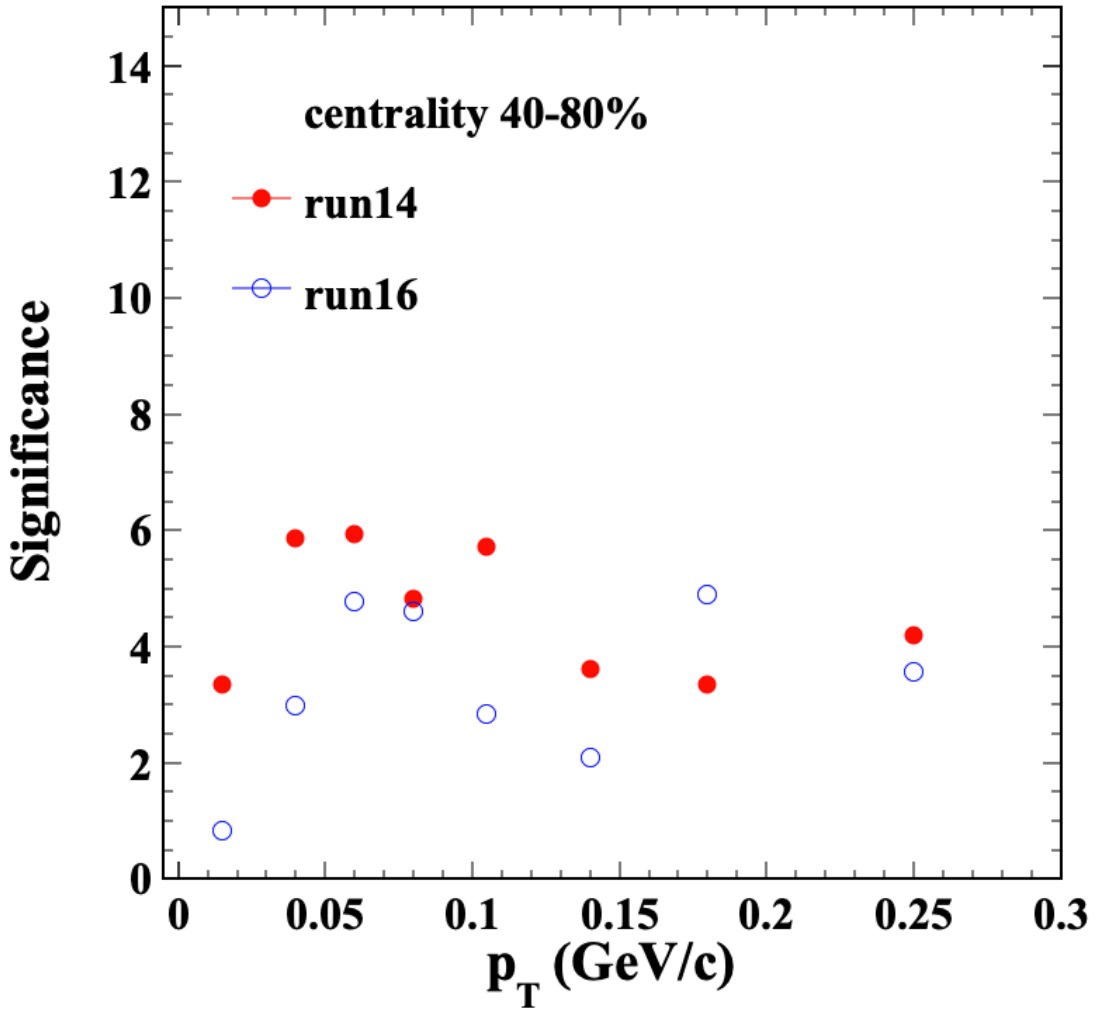




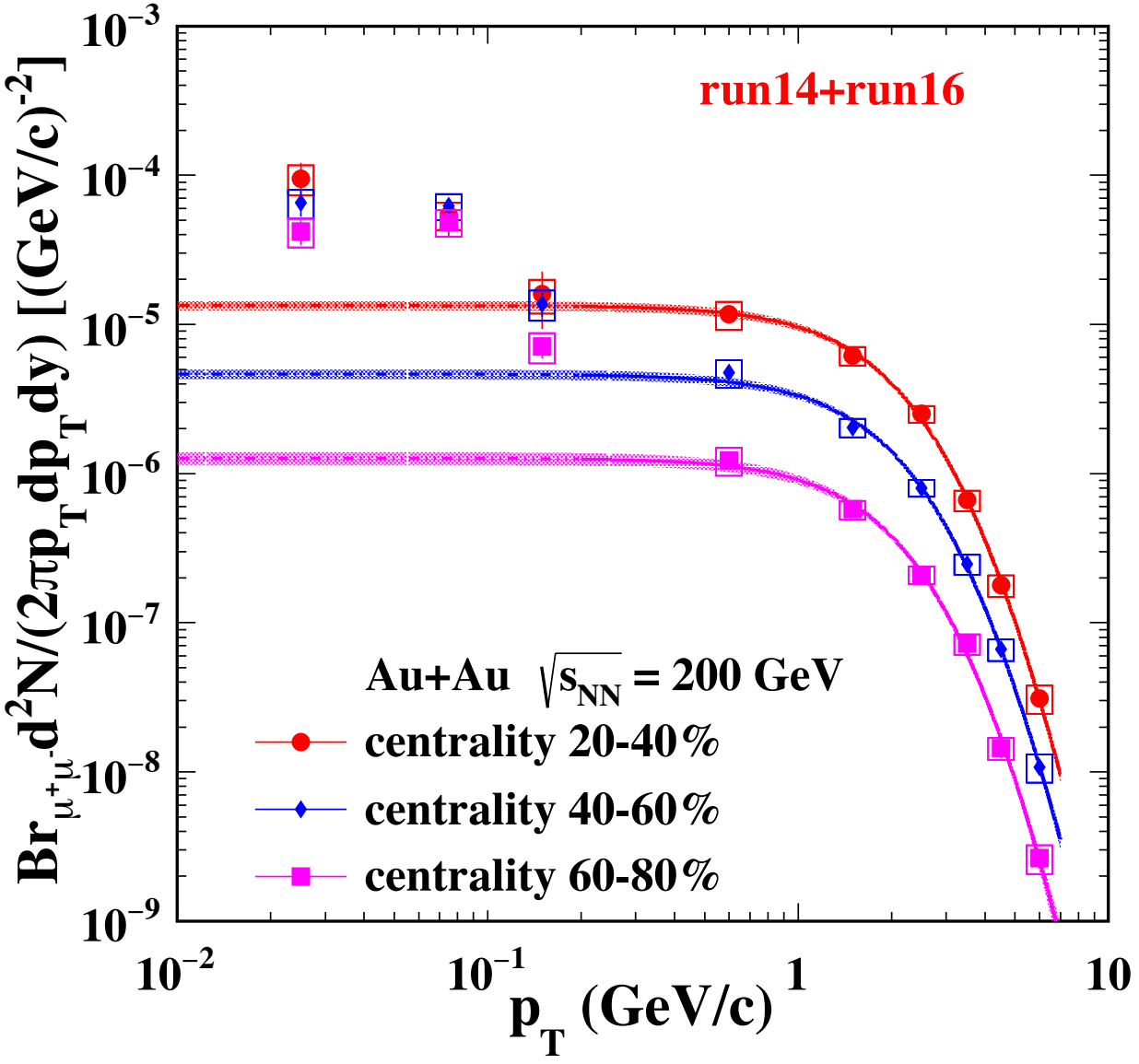


Weight and significance in t bin





Inv.Yield

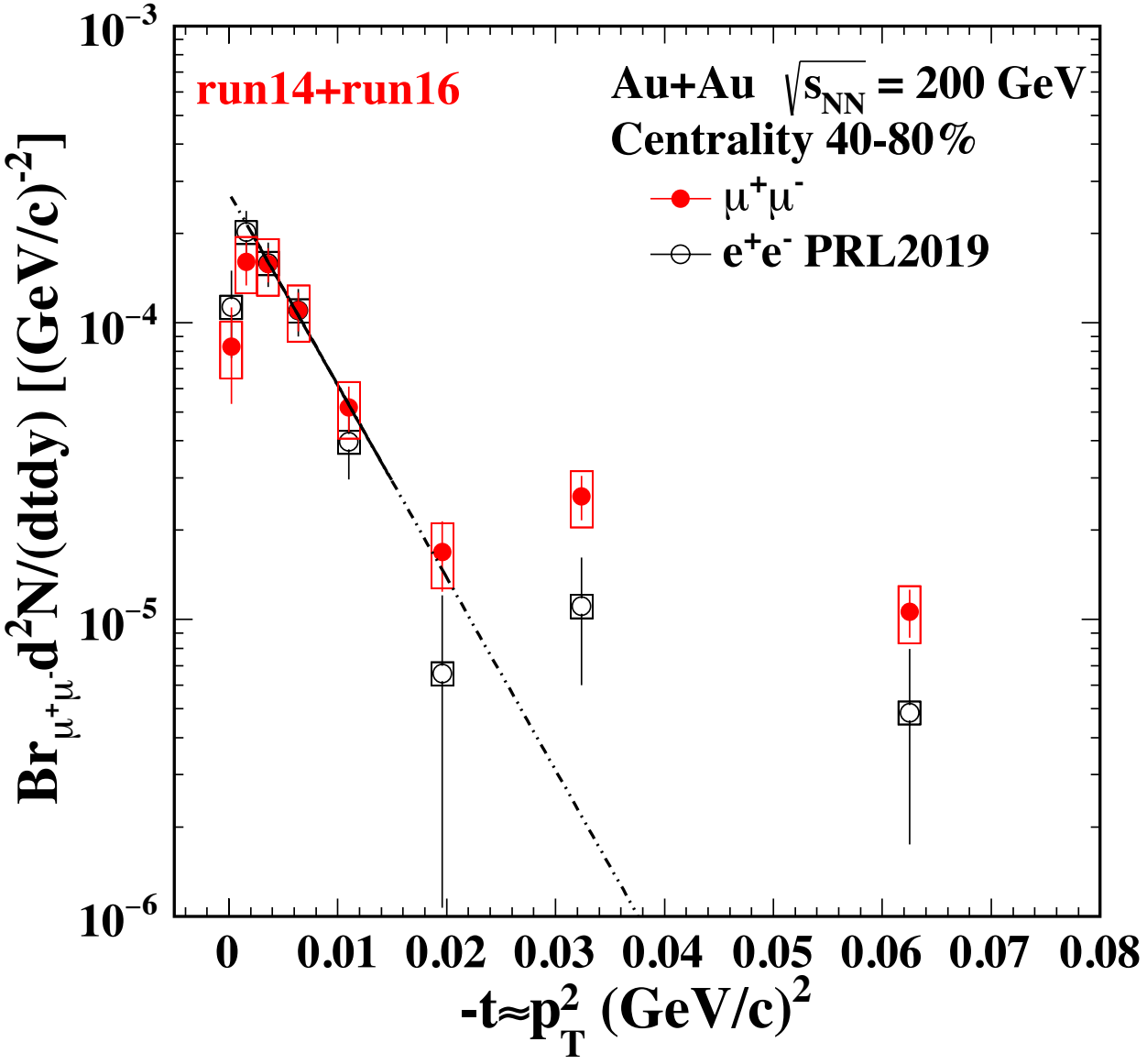


Invariant yield as function of p_T for different centrality

$p_T > 0.2$ GeV fitted by Tsallis function

$$\frac{d^2N}{2\pi p_T dp_T dy} = \frac{1}{2\pi}\frac{dN}{dy}\frac{(n-1)(n-2)}{nC(nC+m_0(n-2))}\left(1+\frac{m_T-m_0}{nc}\right)^{-n}$$

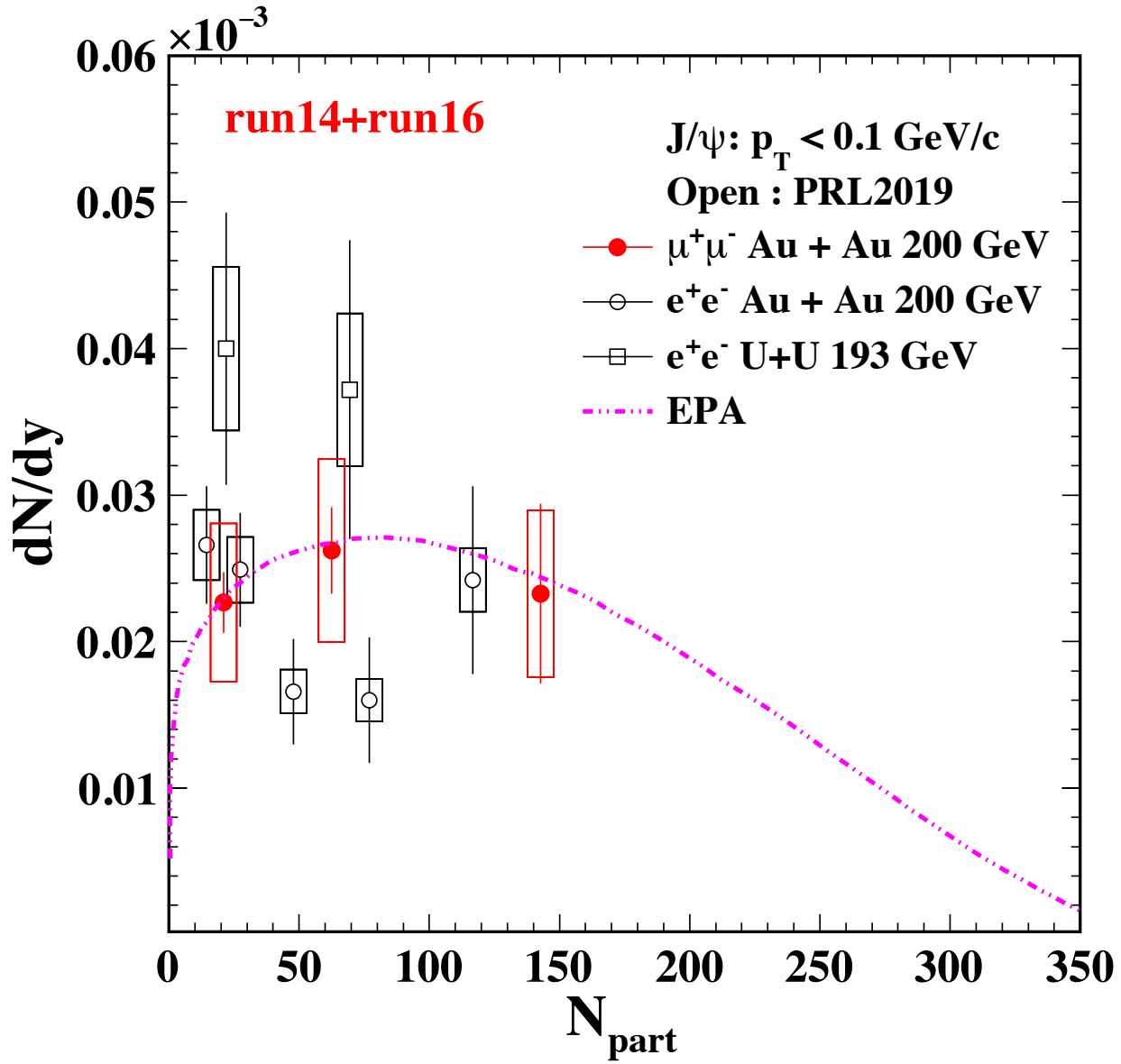
t distribution



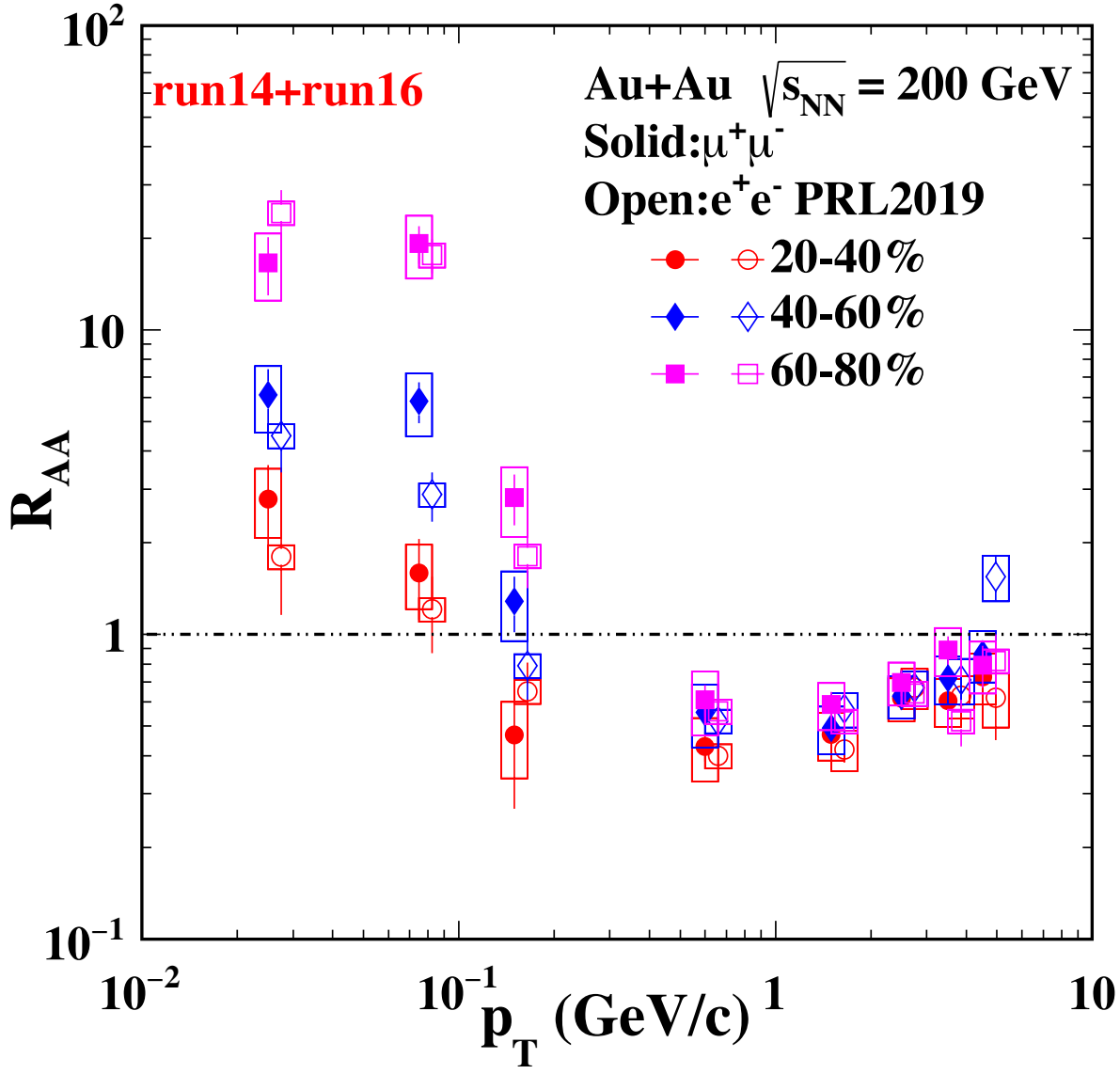
Fitted by an exponential function at
$0.001 < -t < 0.015$ (GeV/c)^2

The extracted slope paramter is 149 ± 28 (GeV/c)$^{-2}$
Which is 177 ± 23 (GeV/c)$^{-2}$ in dielectron

Excess yield



R_{AA}

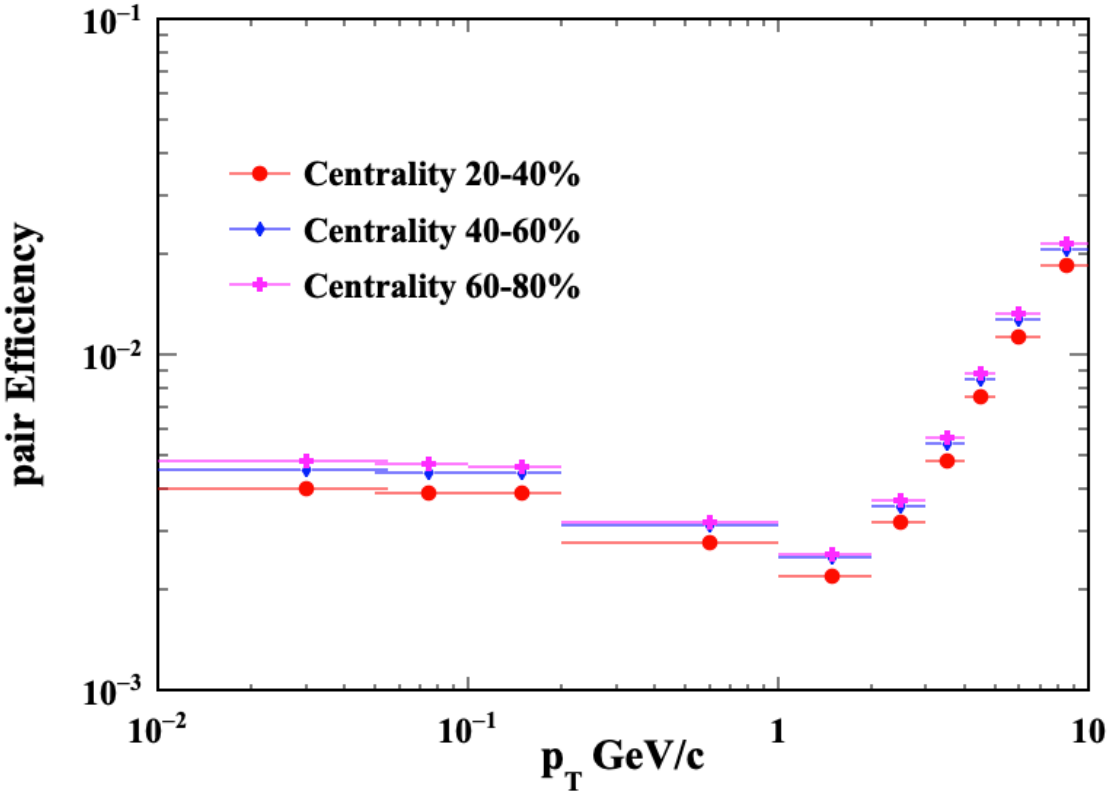

run14+run16
Au+Au $\sqrt{s_{NN}}$ = 200 GeV
Solid:$\mu^+\mu^-$
Open:e^+e^- PRL2019
20-40%
40-60%
60-80%
R_{AA}
p_T (GeV/c)
10^2
10
1
10^{-1}
10^{-2}
10^{-1}
1
10

Pair efficiency

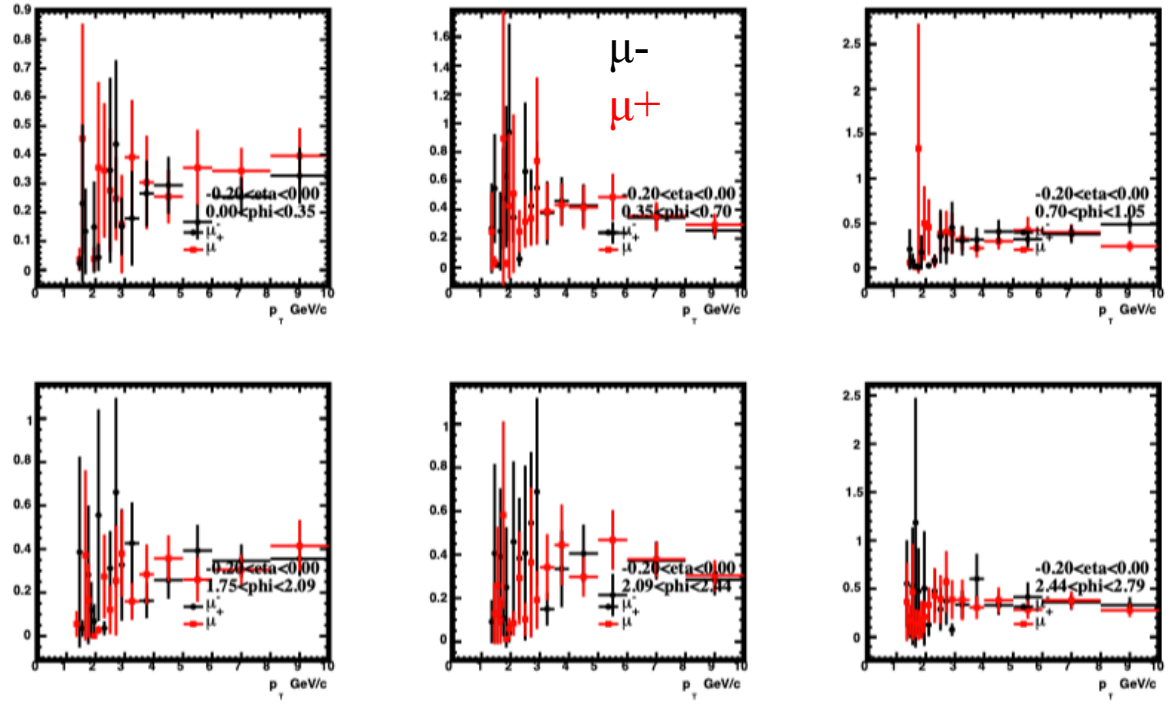
I. Pair efficiency is applied 3-D method

II. Set toyMC input J/ψ configuration: flat distributions in $|y| < 0.5$ and $0 < \phi < 2\pi$, Tsallis Blast Wave p_T distribution

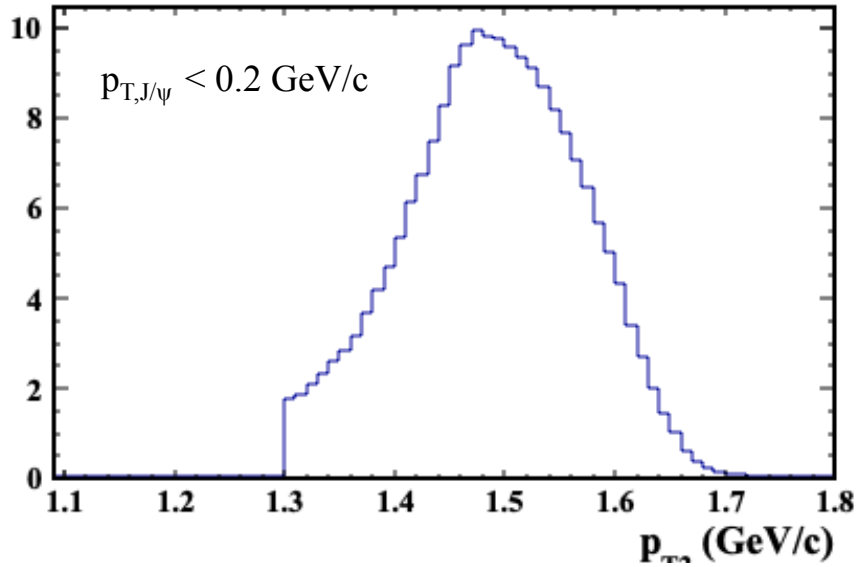
III. Apply 3-D single track efficiency (p_T, η, ϕ)



Muon tracking efficiency of different η,φ bins



3-D method in a narrow p_T range



Works well in normal p_T range

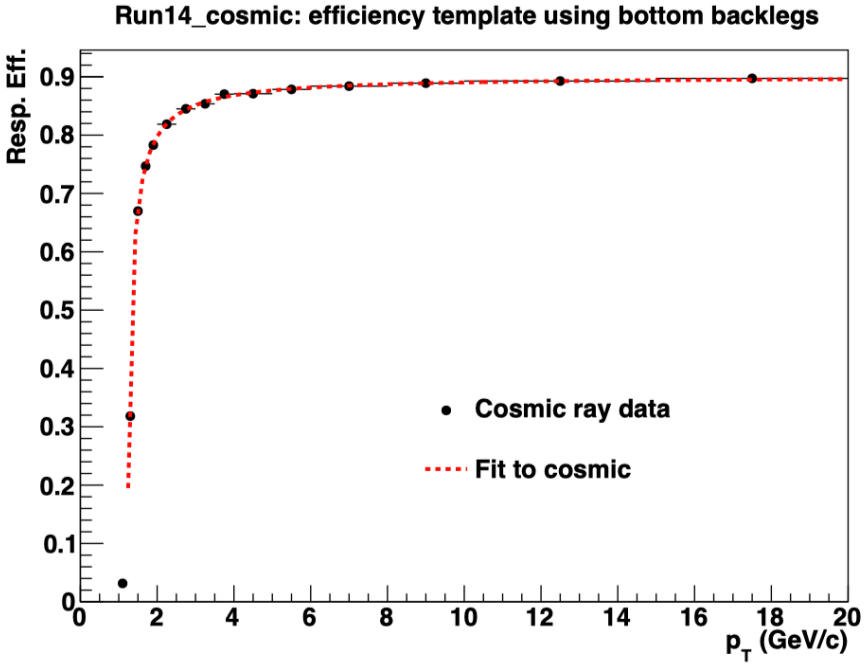
$$\epsilon_{\text{total}} = \frac{N^{\text{reco},J/\psi}}{N^{\text{true},J/\psi}} = \frac{\sum_i N_i^{\text{reco},J/\psi}}{\sum_i N_i^{true,J/\psi}} = \frac{\sum_i N_i^{\text{true},J/\psi} \times \epsilon_{\text{total}}^i}{\sum_i N_i^{true,J/\psi}} = \sum_i w_i \epsilon_{\text{total}}^i$$

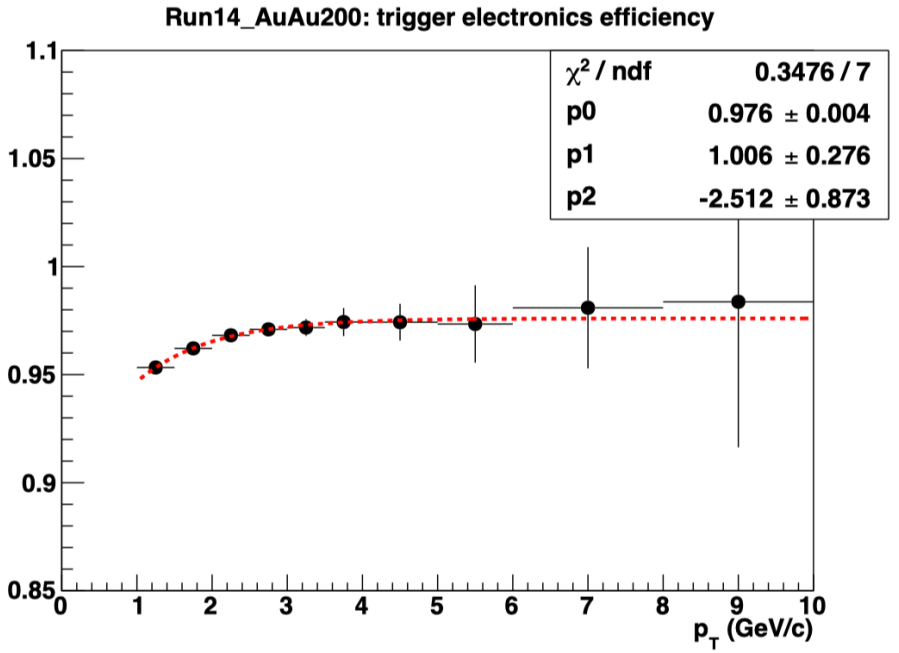
$$N_i^{true,J/\psi} \propto N_{\text{MB,i}}^{\text{cent}} \times N_{\text{coll}} \times R_{\text{AA}}^{J/\psi}$$

or $N_i^{true,J/\psi} \propto N_{\text{MB,i}}^{\text{cent}}$ (for coherent J/ψ)

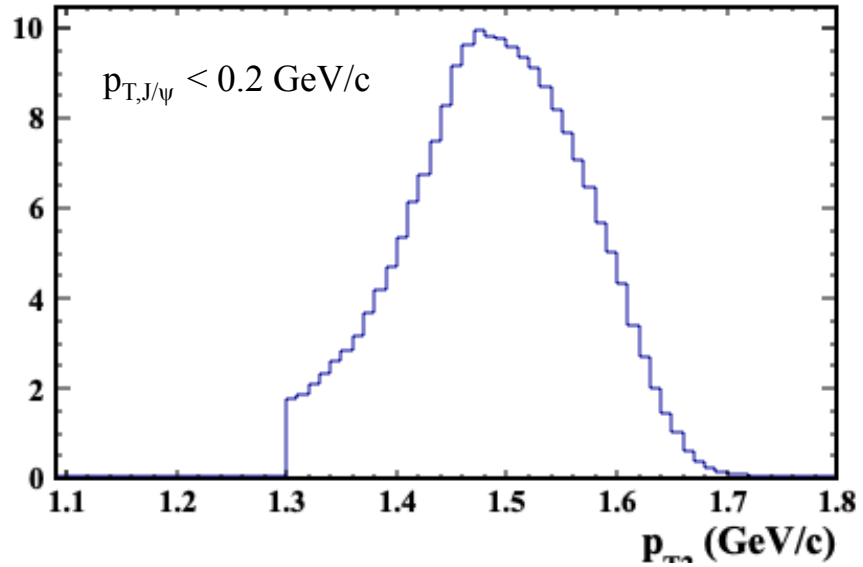
$$\epsilon_{total}^i = \epsilon_{total}^{all} \times \frac{\epsilon_{\text{TPC}}^i}{\epsilon_{\text{TPC}}^{all}}$$

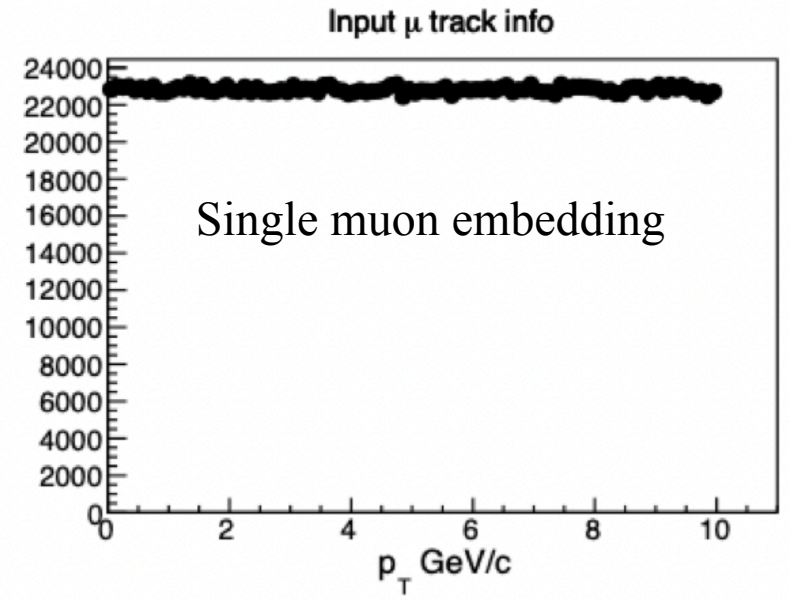
1-D TPC tracking efficiency

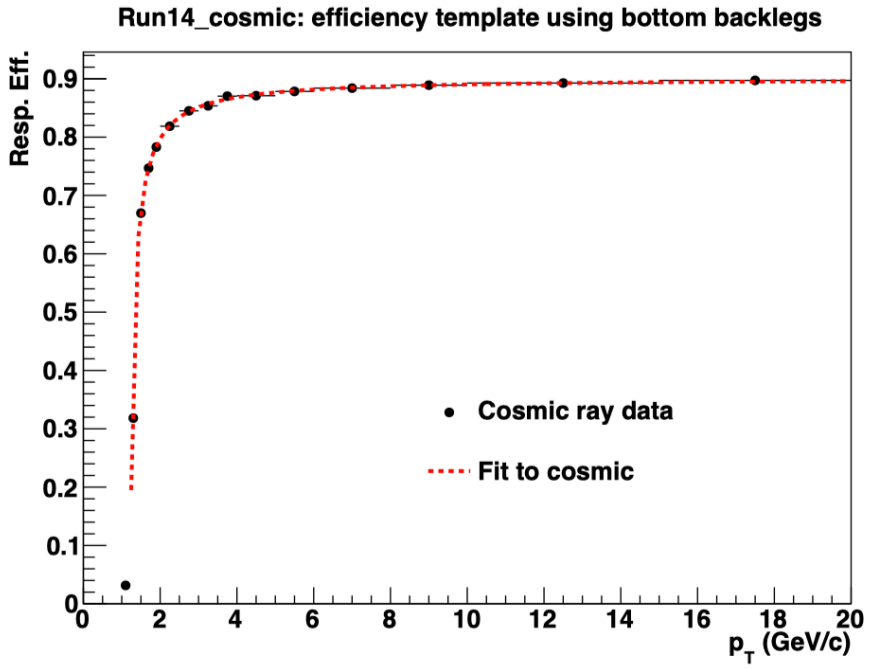


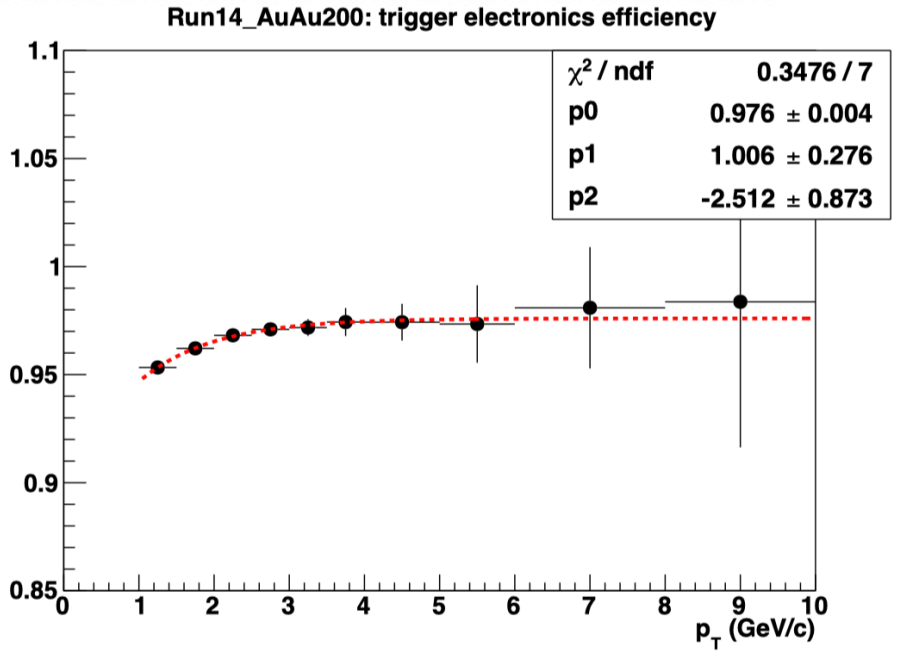


3-D method in a narrow p_T range







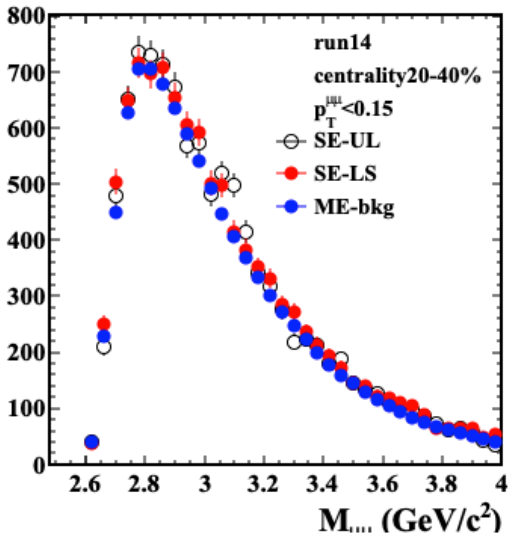


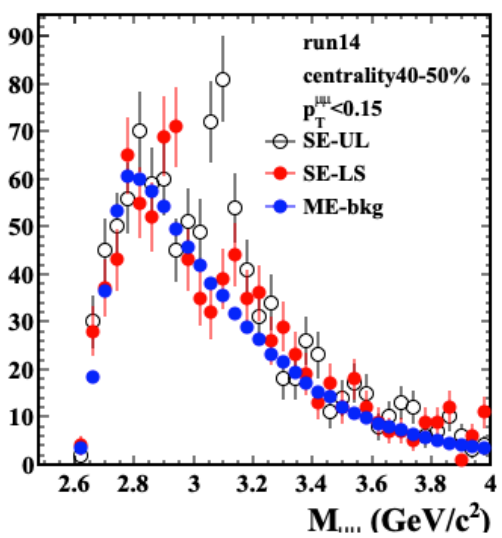
Summary

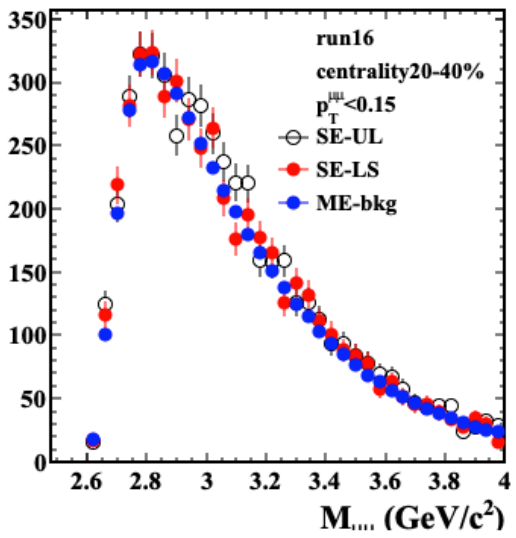
- Calculate combined results.
- Need to confirm the performance of pair efficiency with 3-D method

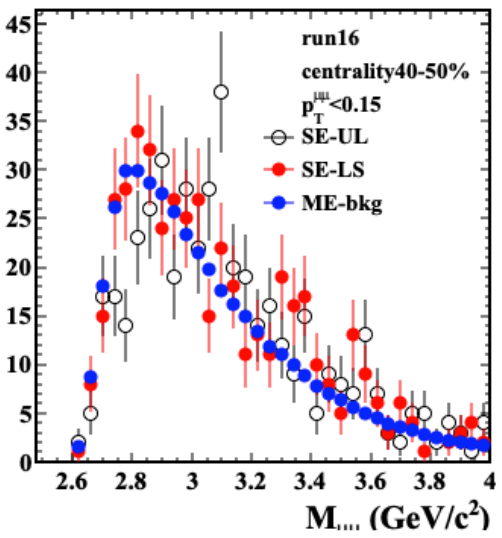
Back up

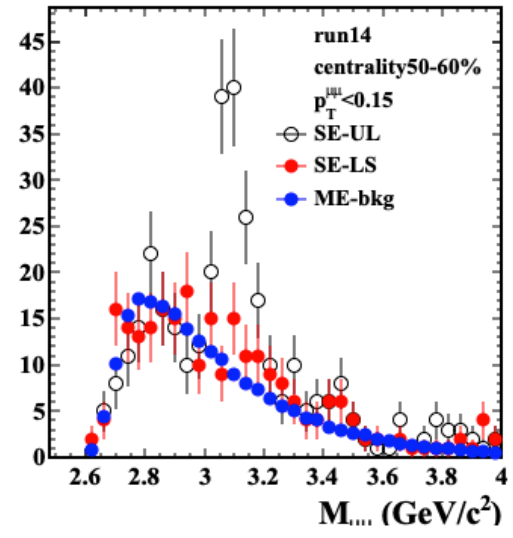
Mass distribution for run14 and run16

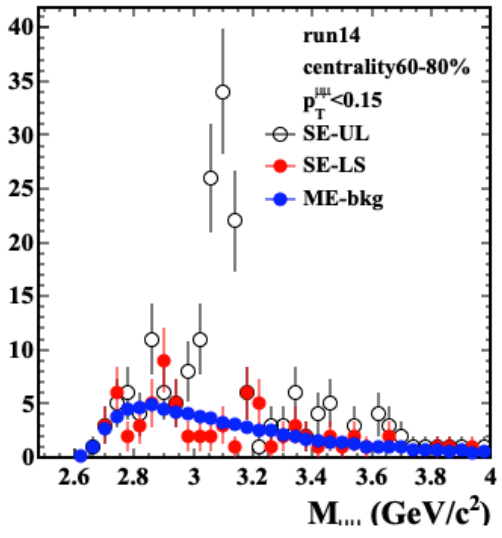


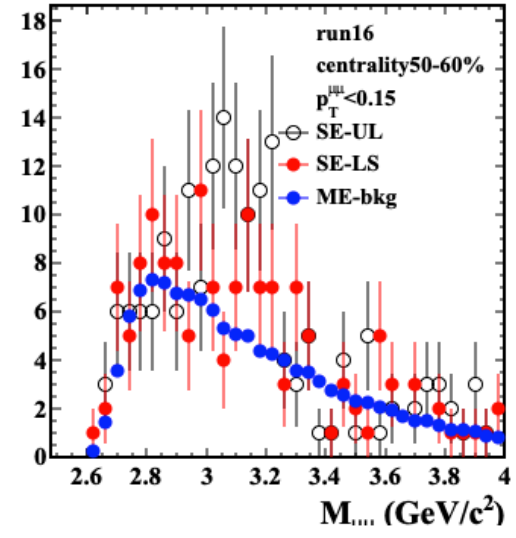


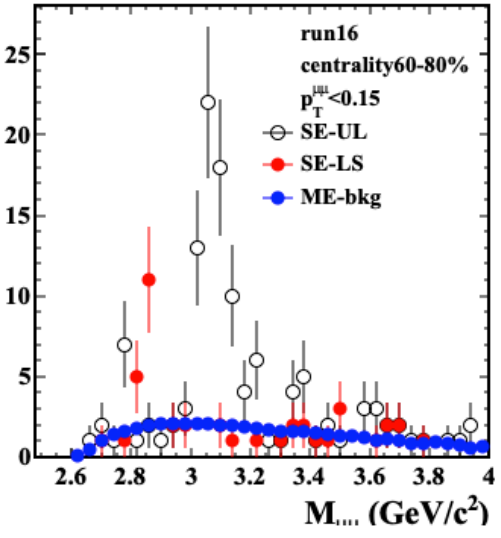




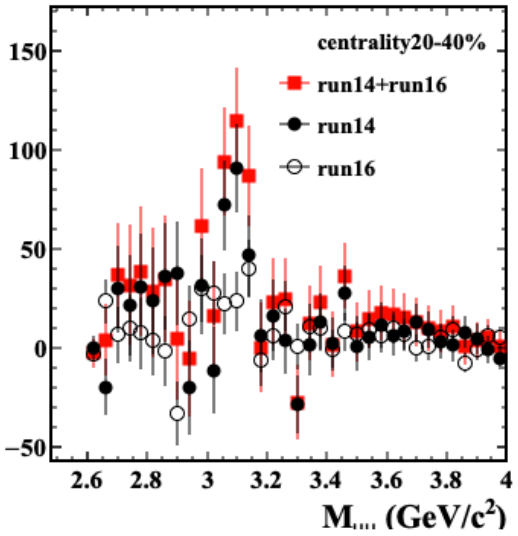


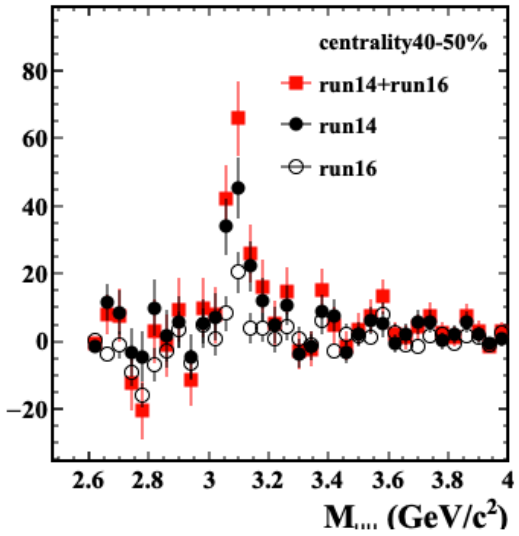


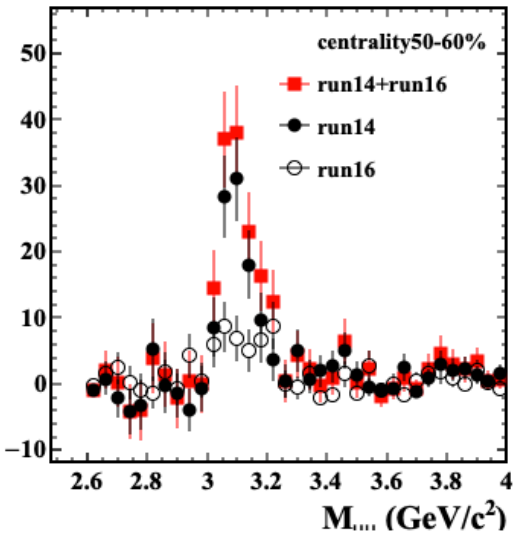


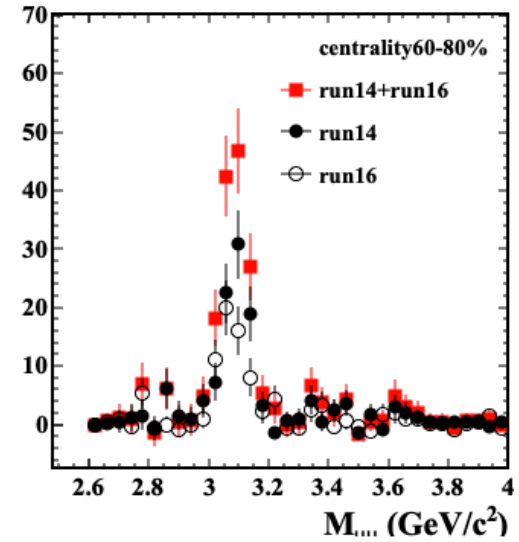


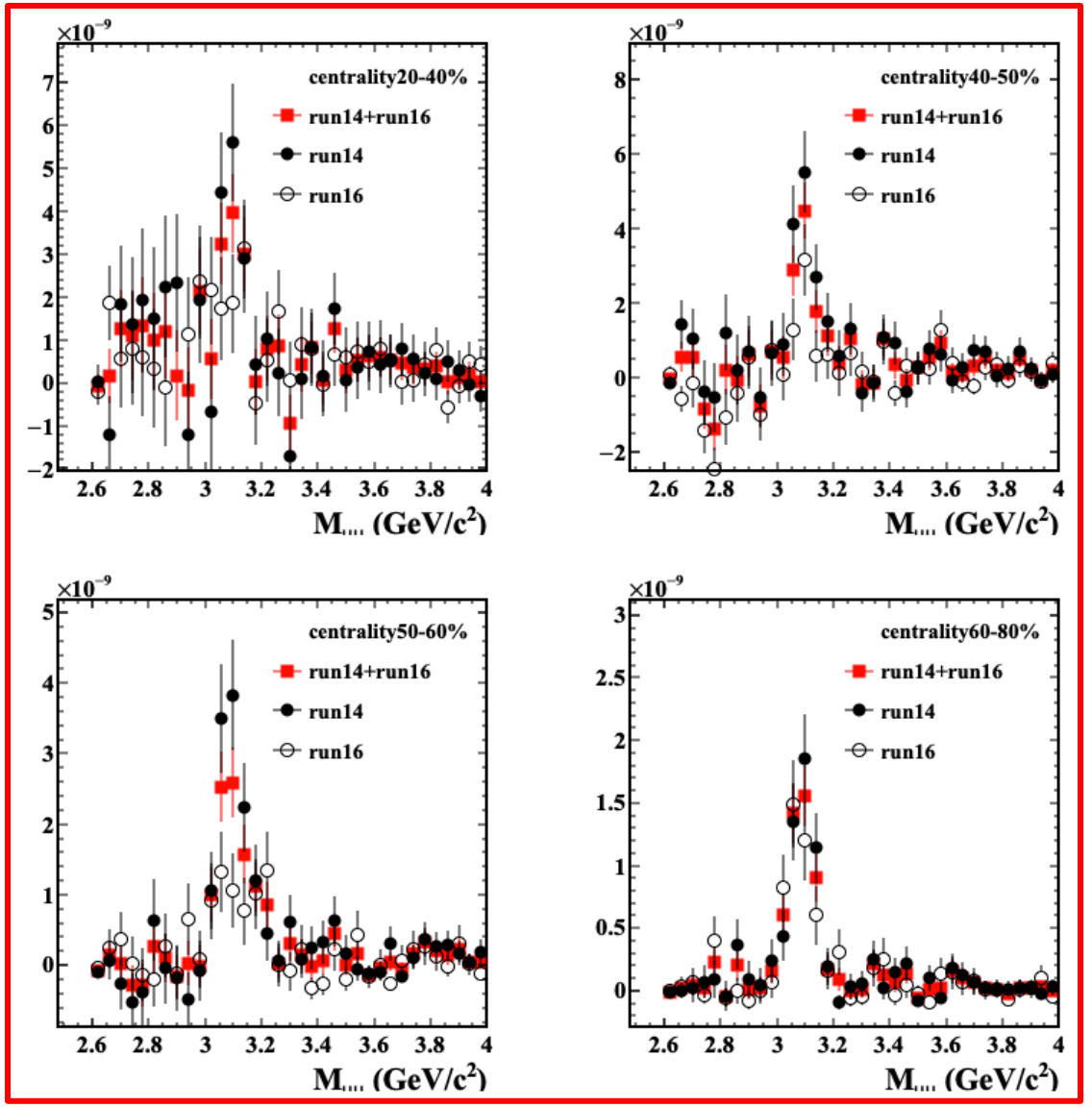
SE UL – ME UL distribution





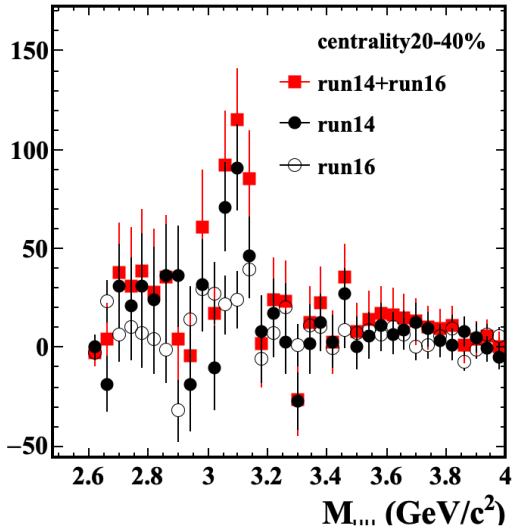


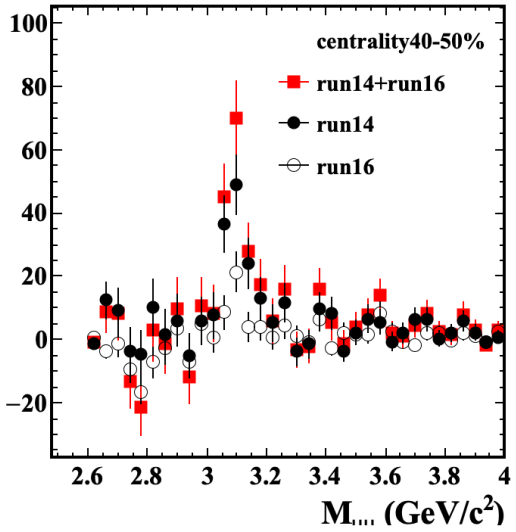


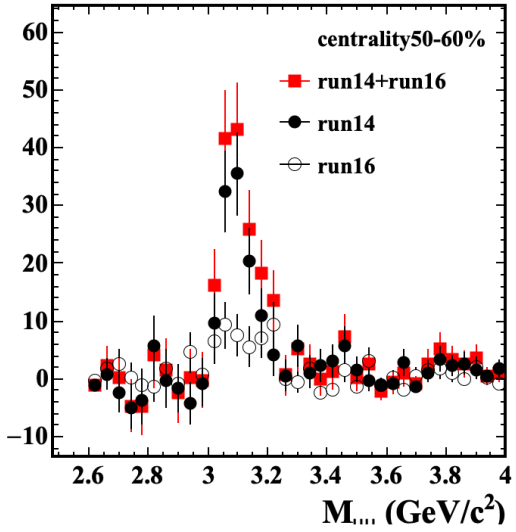


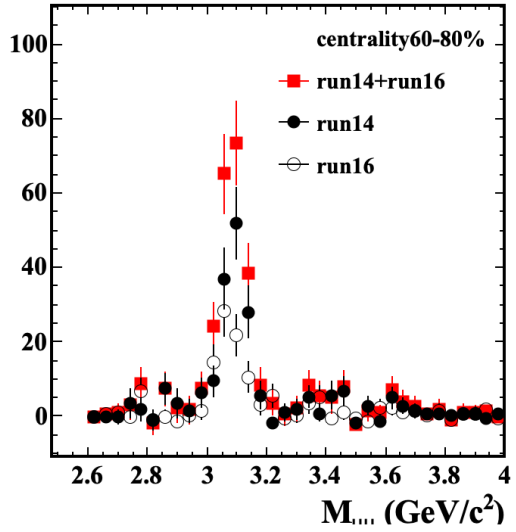
N_{MB} weighted

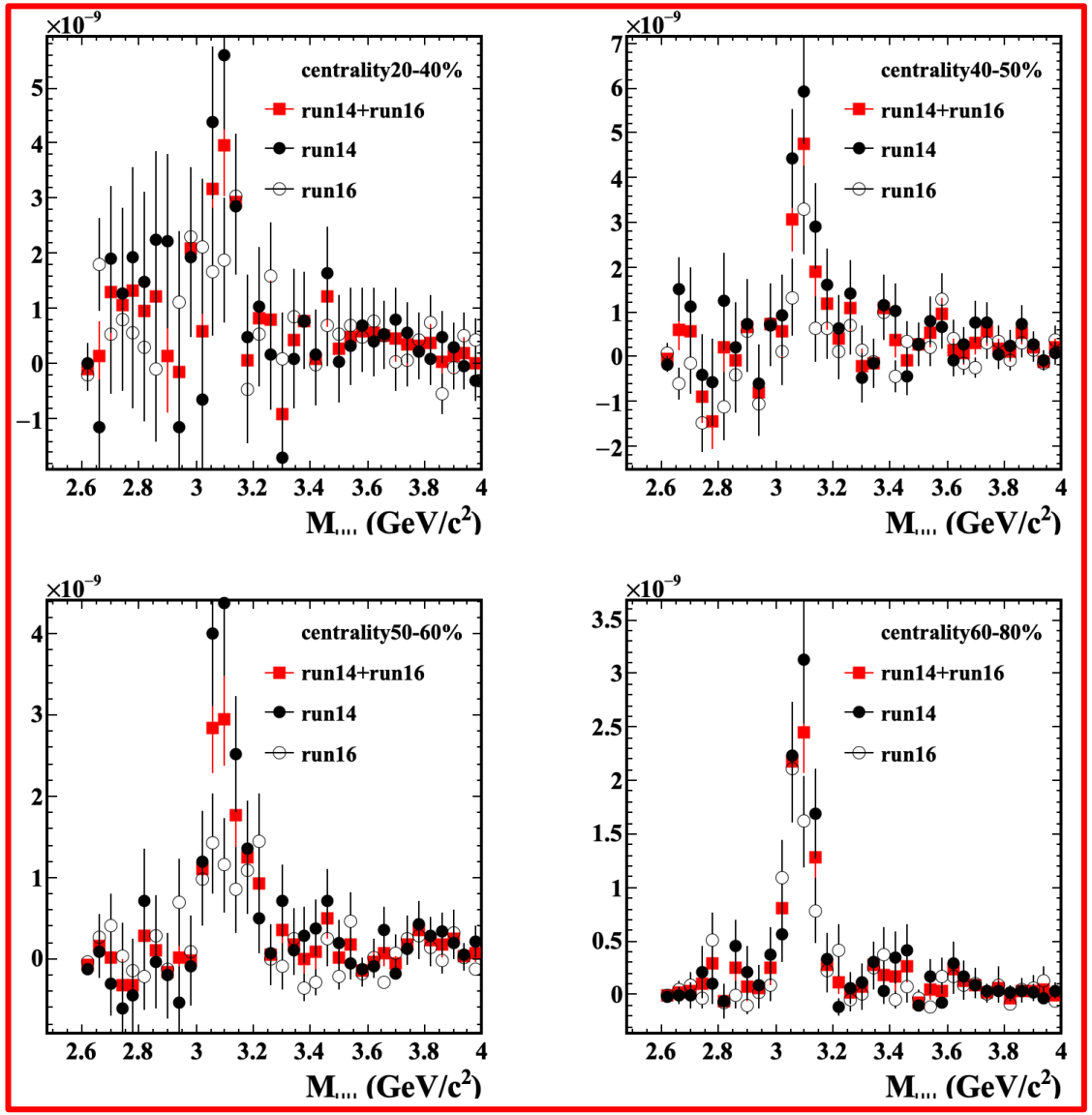
SE UL – ME UL distribution (with reWeight)





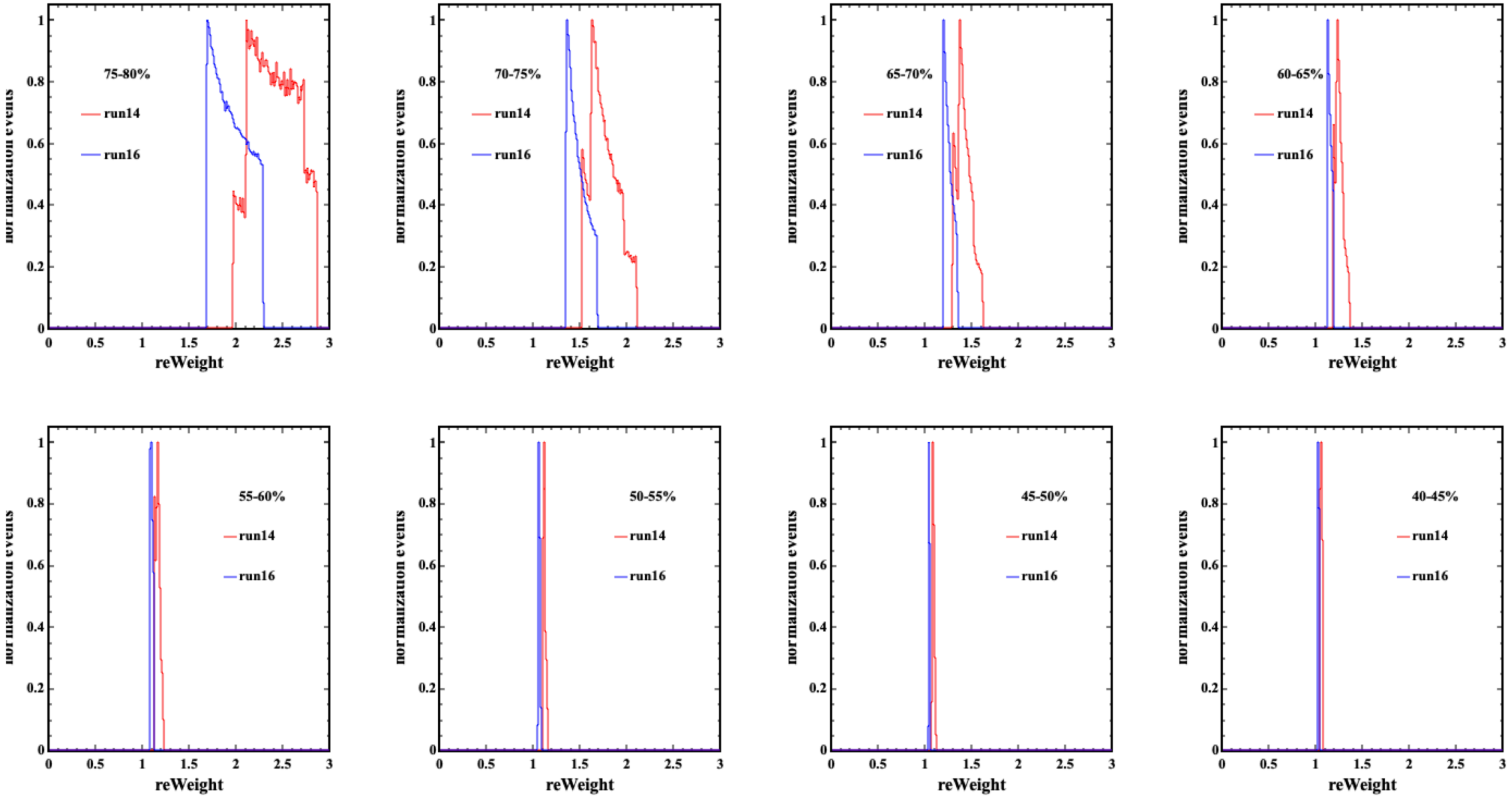




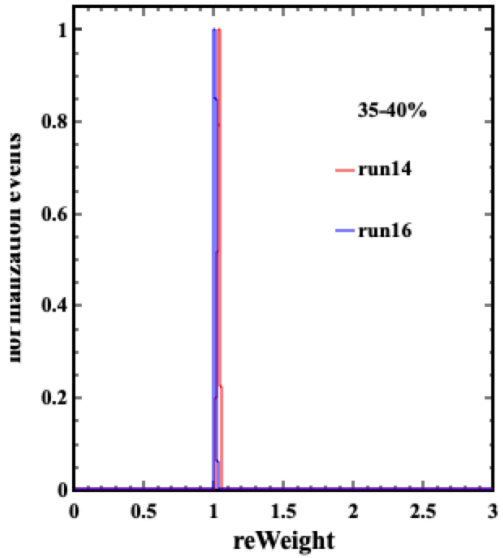


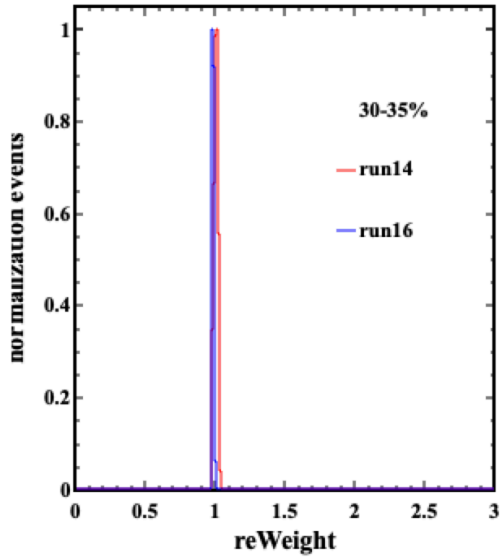
N_{MB} weighted

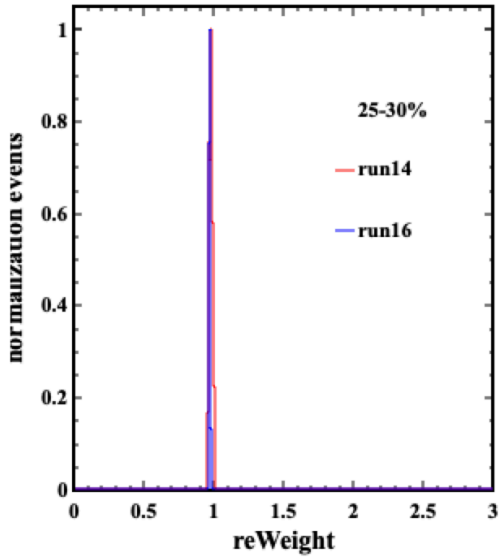
reWeight distribution

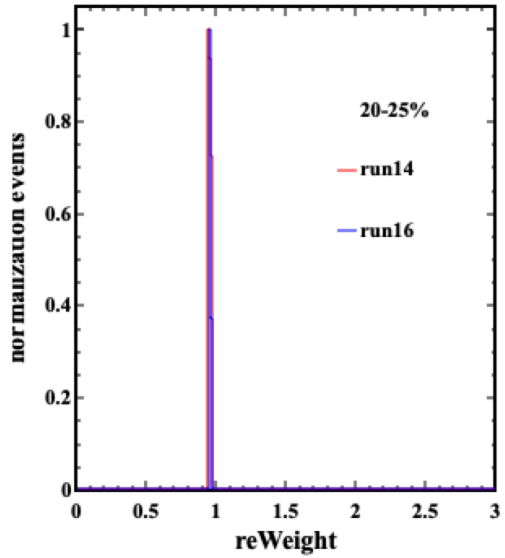


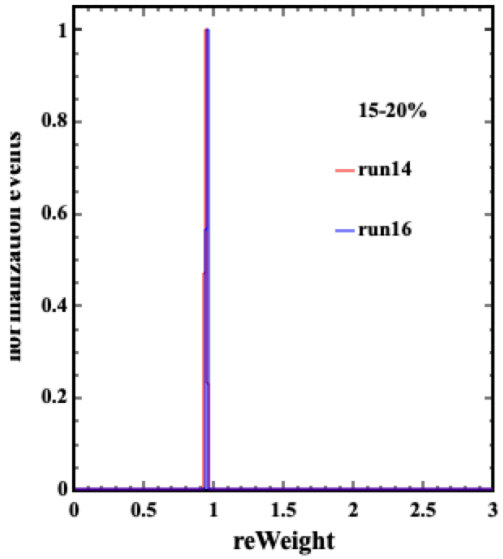
reWeight distribution

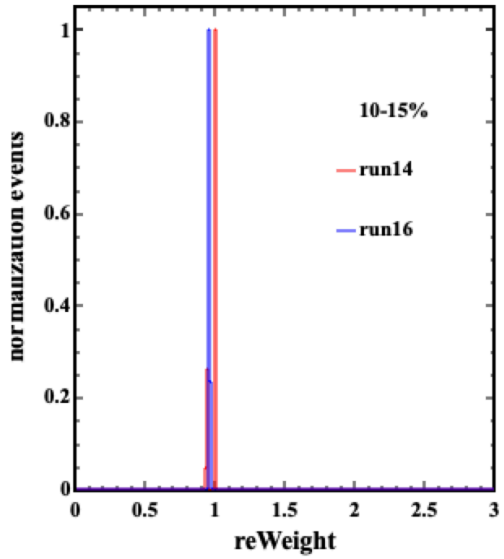


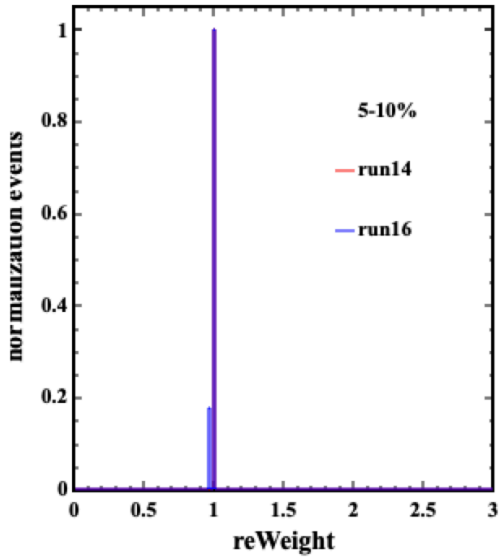


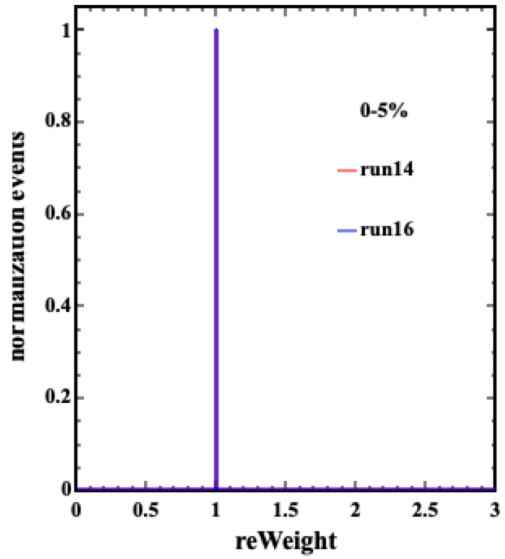


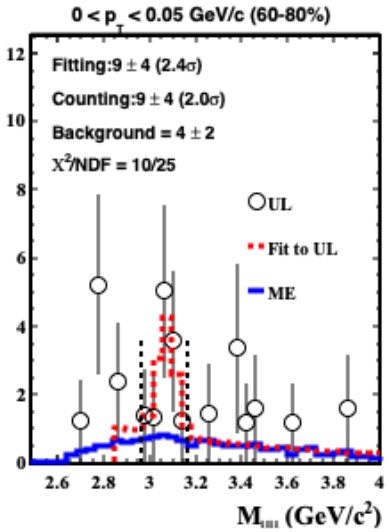


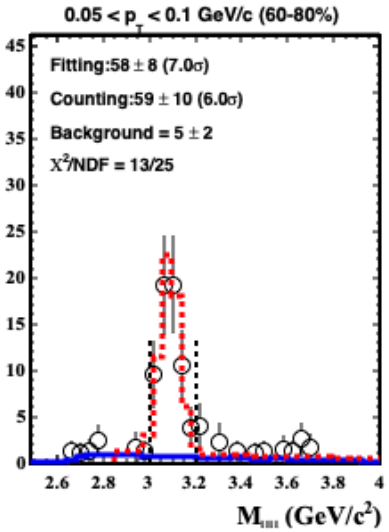


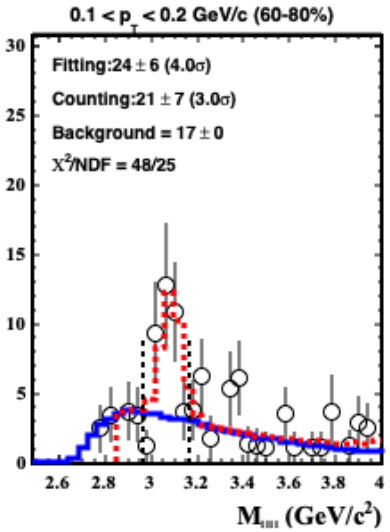


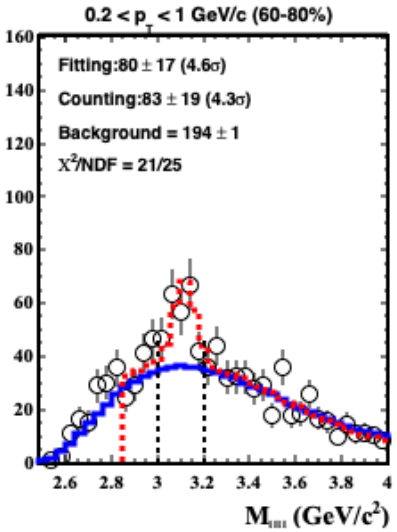


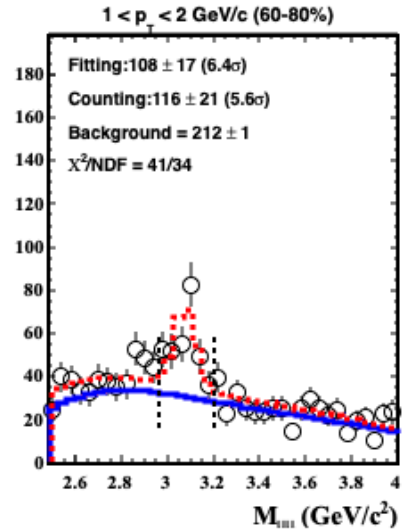



0 < p_T < 0.05 GeV/c (60-80%)
Fitting:9 ± 4 (2.4σ)
Counting:9 ± 4 (2.0σ)
Background = 4 ± 2
X²/NDF = 10/25
UL
Fit to UL
ME
M_inv (GeV/c²)

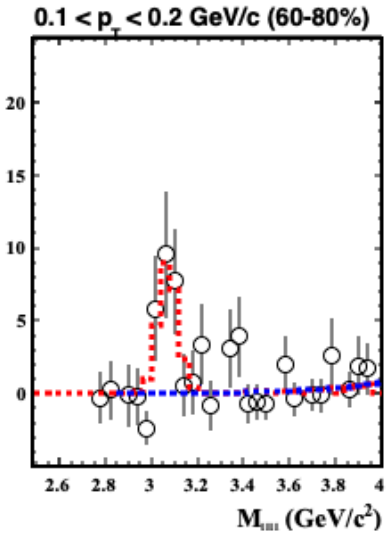

0.05 < p_T < 0.1 GeV/c (60-80%)
Fitting:58 ± 8 (7.0σ)
Counting:59 ± 10 (6.0σ)
Background = 5 ± 2
X²/NDF = 13/25
M_inv (GeV/c²)

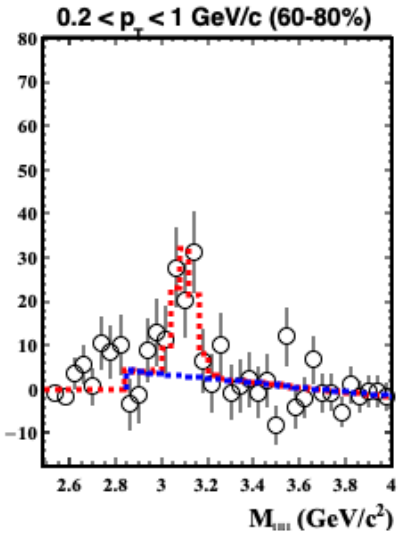

0.1 < p_T < 0.2 GeV/c (60-80%)
Fitting:24 ± 6 (4.0σ)
Counting:21 ± 7 (3.0σ)
Background = 17 ± 0
X²/NDF = 48/25
M_inv (GeV/c²)

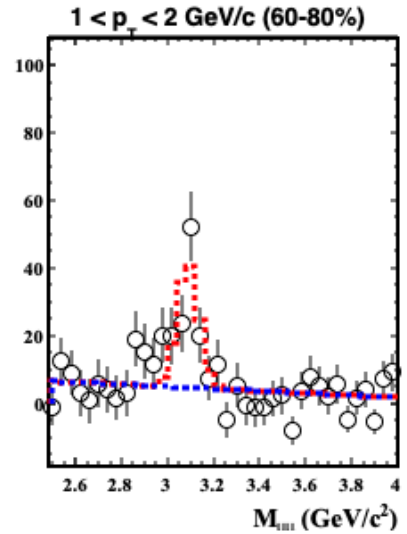

0.2 < p_T < 1 GeV/c (60-80%)
Fitting:80 ± 17 (4.6σ)
Counting:83 ± 19 (4.3σ)
Background = 194 ± 1
X²/NDF = 21/25
M_inv (GeV/c²)

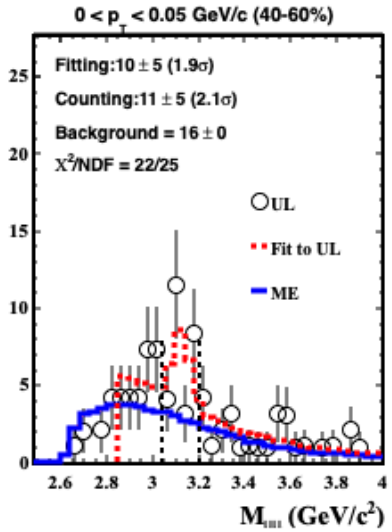

1 < p_T < 2 GeV/c (60-80%)
Fitting:108 ± 17 (6.4σ)
Counting:116 ± 21 (5.6σ)
Background = 212 ± 1
X²/NDF = 41/34
M_inv (GeV/c²)

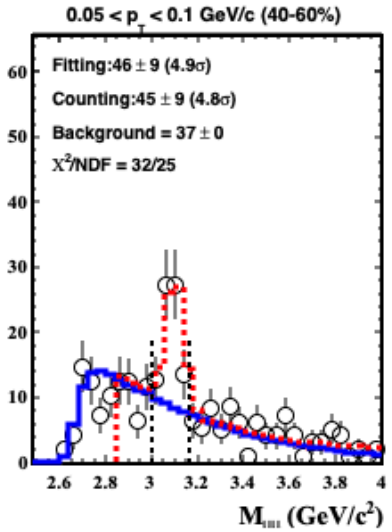

UL - ME
Fit - ME
Res. Bkg.

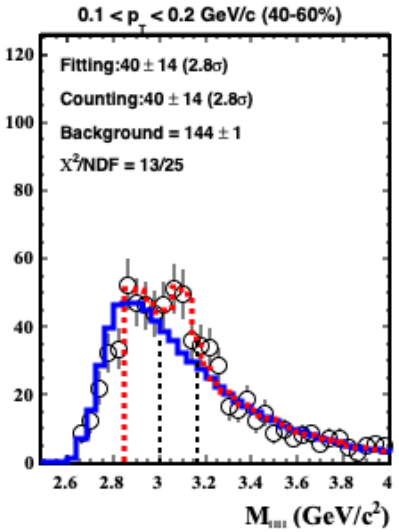

0.1 < p_T < 0.2 GeV/c (60-80%)
M_inv (GeV/c²)

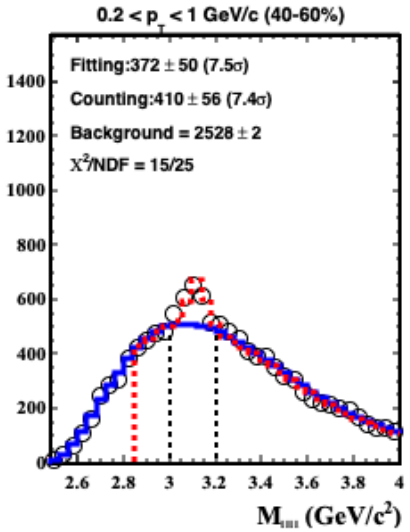

0.2 < p_T < 1 GeV/c (60-80%)
M_inv (GeV/c²)

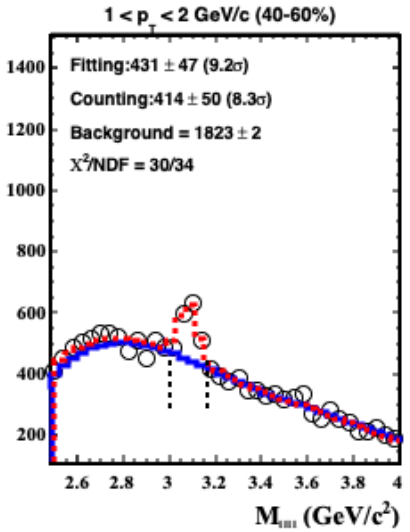

1 < p_T < 2 GeV/c (60-80%)
M_inv (GeV/c²)

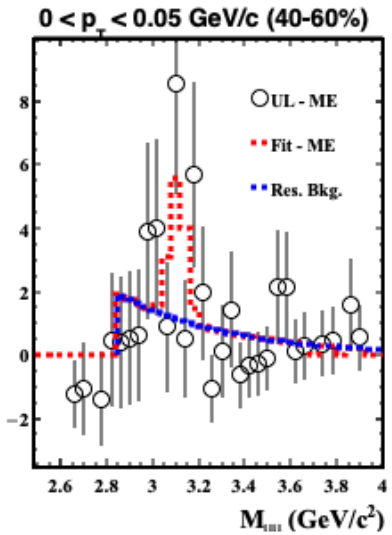

0 < p_T < 0.05 GeV/c (40-60%)
Fitting:10 ± 5 (1.9σ)
Counting:11 ± 5 (2.1σ)
Background = 16 ± 0
X²/NDF = 22/25
UL
Fit to UL
ME
M_inv (GeV/c²)

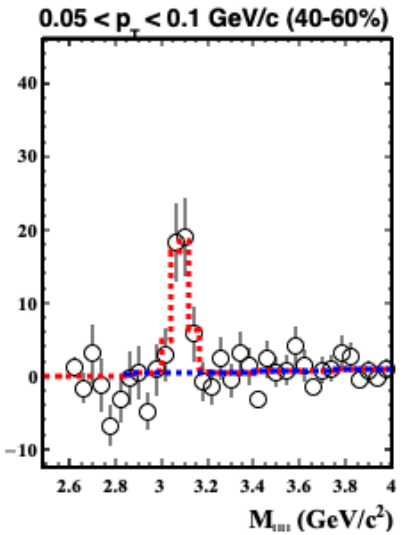

0.05 < p_T < 0.1 GeV/c (40-60%)
Fitting:46 ± 9 (4.9σ)
Counting:45 ± 9 (4.8σ)
Background = 37 ± 0
X²/NDF = 32/25
M_inv (GeV/c²)

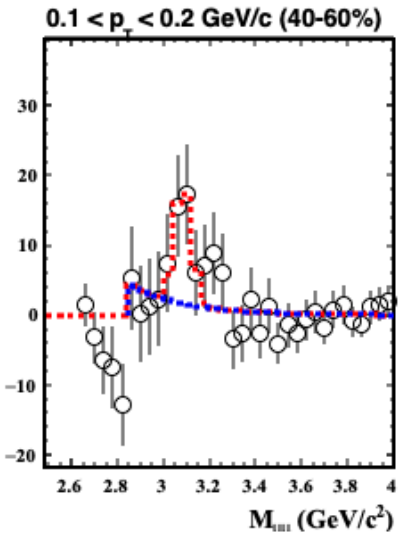

0.1 < p_T < 0.2 GeV/c (40-60%)
Fitting:40 ± 14 (2.8σ)
Counting:40 ± 14 (2.8σ)
Background = 144 ± 1
X²/NDF = 13/25
M_inv (GeV/c²)

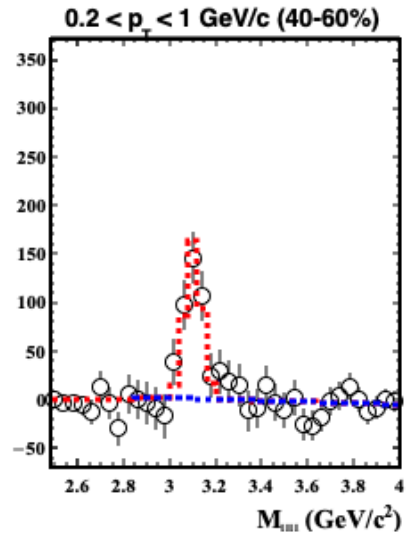

0.2 < p_T < 1 GeV/c (40-60%)
Fitting:372 ± 50 (7.5σ)
Counting:410 ± 56 (7.4σ)
Background = 2528 ± 2
X²/NDF = 15/25
M_inv (GeV/c²)

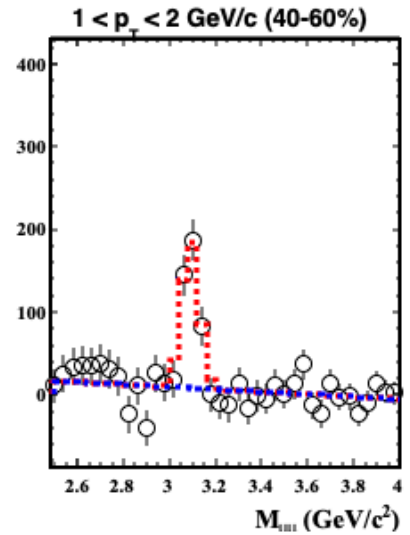

1 < p_T < 2 GeV/c (40-60%)
Fitting:431 ± 47 (9.2σ)
Counting:414 ± 50 (8.3σ)
Background = 1823 ± 2
X²/NDF = 30/34
M_inv (GeV/c²)

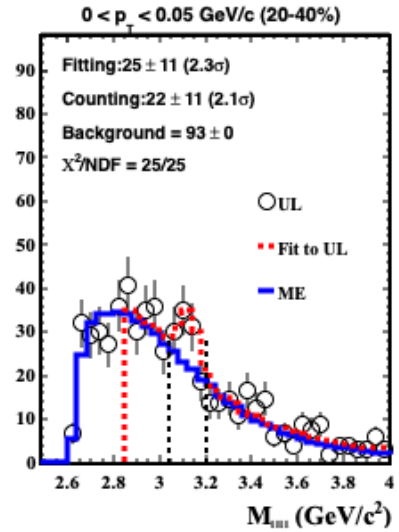

0 < p_T < 0.05 GeV/c (40-60%)
UL - ME
Fit - ME
Res. Bkg.
M_inv (GeV/c²)

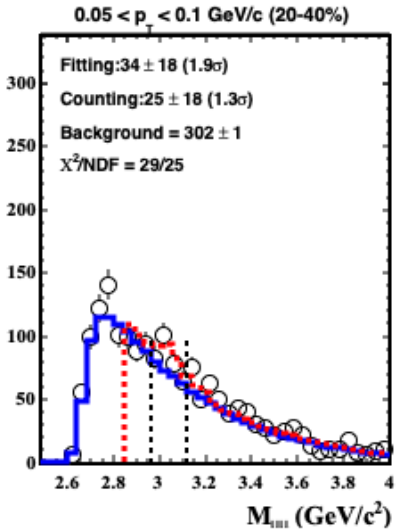

0.05 < p_T < 0.1 GeV/c (40-60%)
M_inv (GeV/c²)

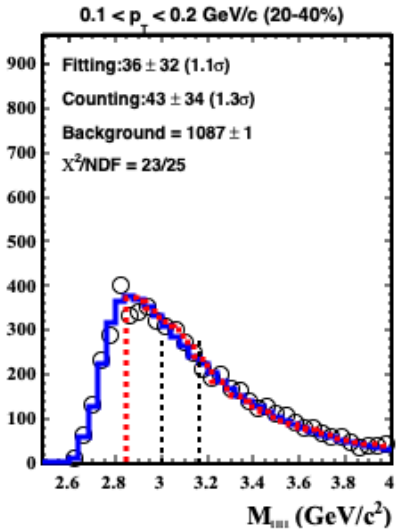

0.1 < p_T < 0.2 GeV/c (40-60%)
M_inv (GeV/c²)

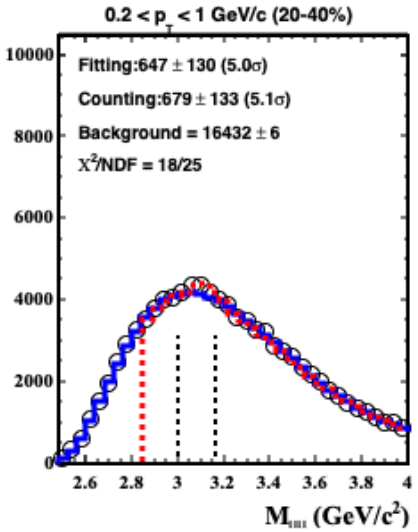

0.2 < p_T < 1 GeV/c (40-60%)
M_inv (GeV/c²)

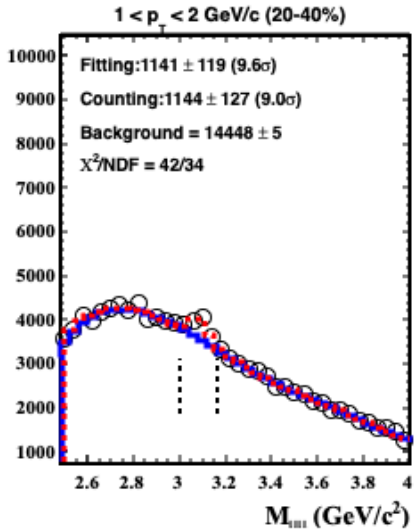

1 < p_T < 2 GeV/c (40-60%)
M_inv (GeV/c²)

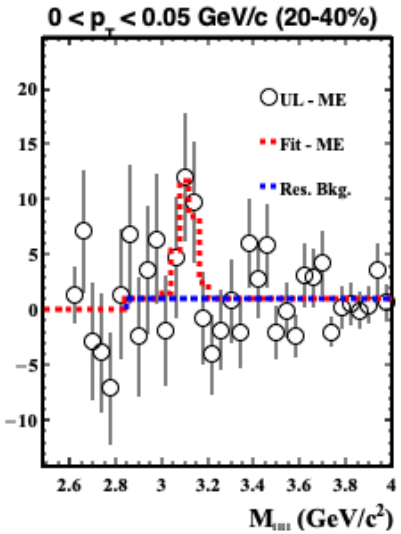

0 < p_T < 0.05 GeV/c (20-40%)
Fitting:25 ± 11 (2.3σ)
Counting:22 ± 11 (2.1σ)
Background = 93 ± 0
X²/NDF = 25/25
UL
Fit to UL
ME
M_inv (GeV/c²)

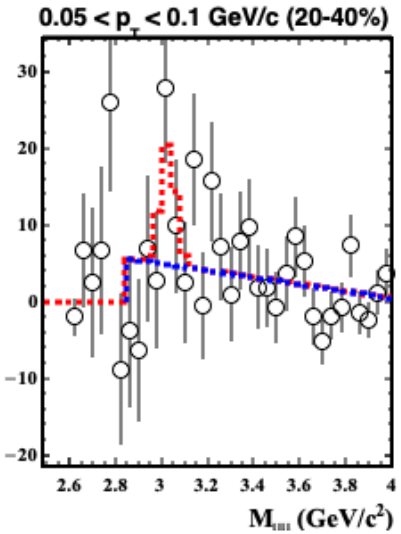

0.05 < p_T < 0.1 GeV/c (20-40%)
Fitting:34 ± 18 (1.9σ)
Counting:25 ± 18 (1.3σ)
Background = 302 ± 1
X²/NDF = 29/25
M_inv (GeV/c²)

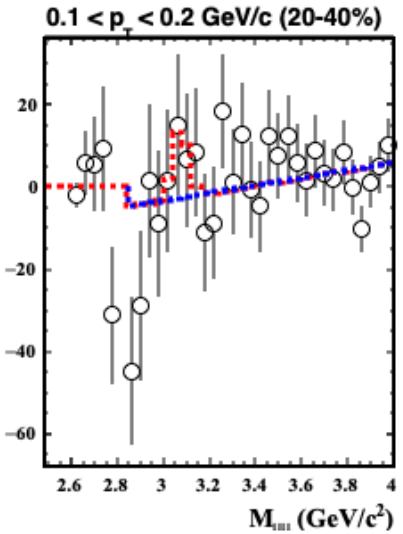

0.1 < p_T < 0.2 GeV/c (20-40%)
Fitting:36 ± 32 (1.1σ)
Counting:43 ± 34 (1.3σ)
Background = 1087 ± 1
X²/NDF = 23/25
M_inv (GeV/c²)

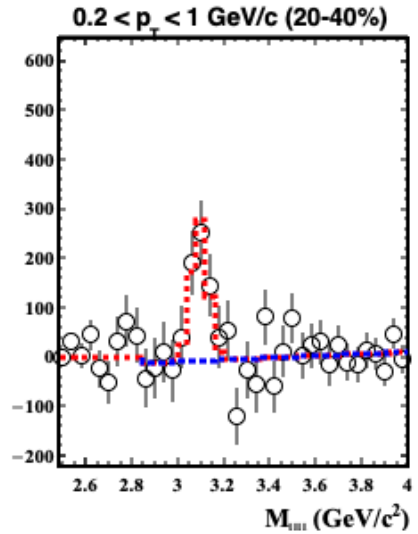

0.2 < p_T < 1 GeV/c (20-40%)
Fitting:647 ± 130 (5.0σ)
Counting:679 ± 133 (5.1σ)
Background = 16432 ± 6
X²/NDF = 18/25
M_inv (GeV/c²)

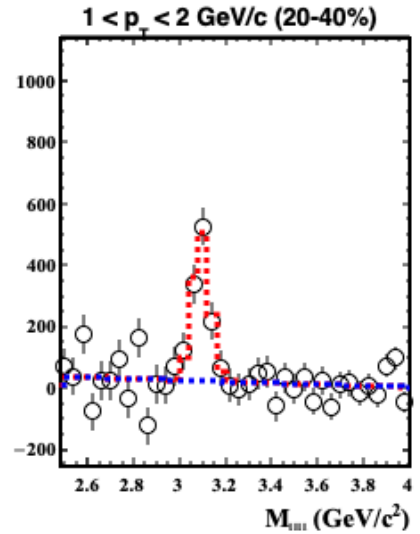

1 < p_T < 2 GeV/c (20-40%)
Fitting:1141 ± 119 (9.6σ)
Counting:1144 ± 127 (9.0σ)
Background = 14448 ± 5
X²/NDF = 42/34
M_inv (GeV/c²)


0 < p_T < 0.05 GeV/c (20-40%)
UL - ME
Fit - ME
Res. Bkg.
M_inv (GeV/c²)


0.05 < p_T < 0.1 GeV/c (20-40%)
M_inv (GeV/c²)


0.1 < p_T < 0.2 GeV/c (20-40%)
M_inv (GeV/c²)


0.2 < p_T < 1 GeV/c (20-40%)
M_inv (GeV/c²)


1 < p_T < 2 GeV/c (20-40%)
M_inv (GeV/c²)