pPb 8TeV Upsilon v2 status

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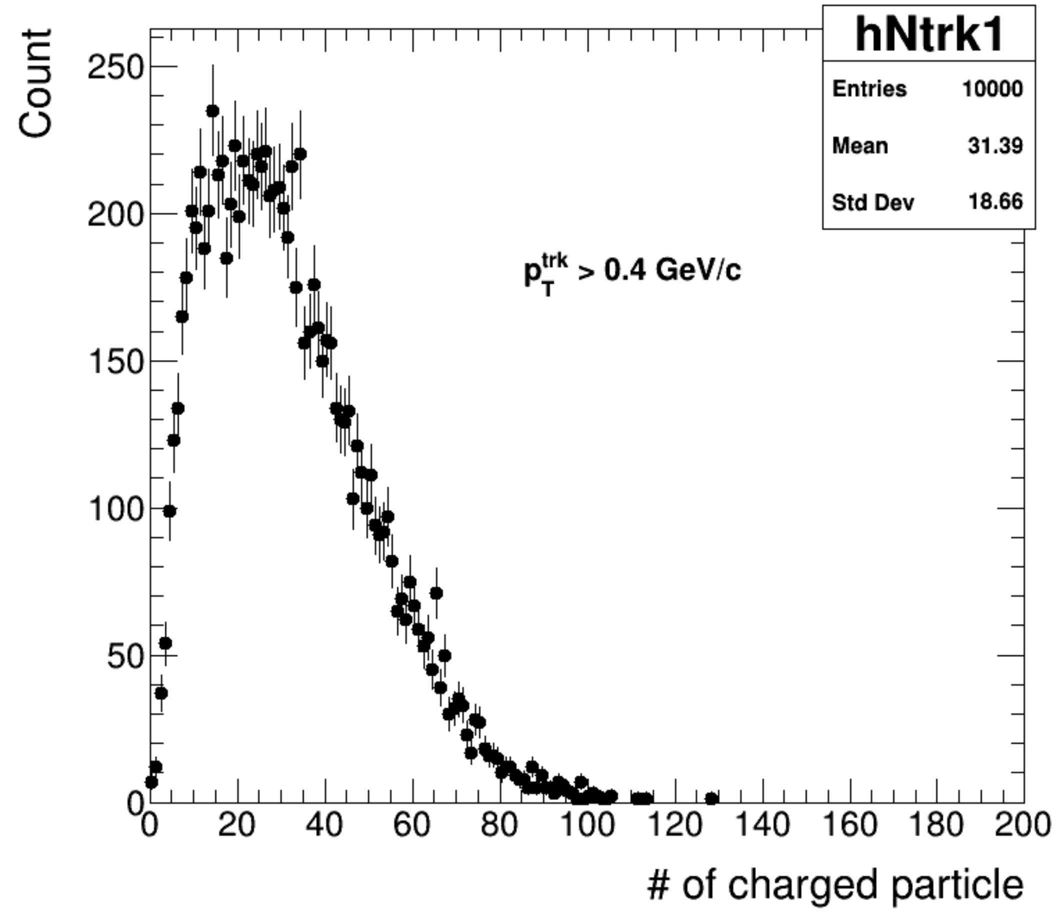
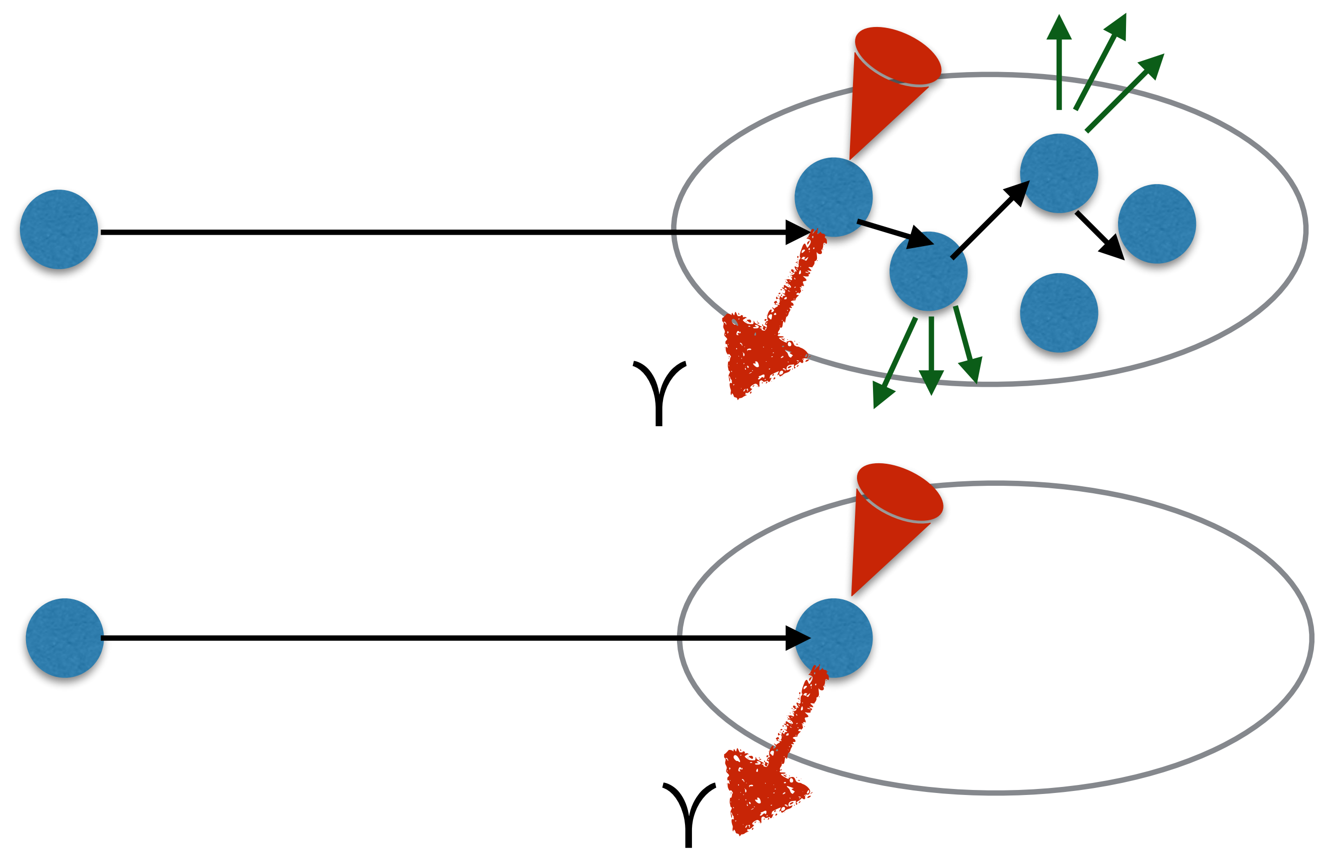
Idea of MC study for low-multiplicity



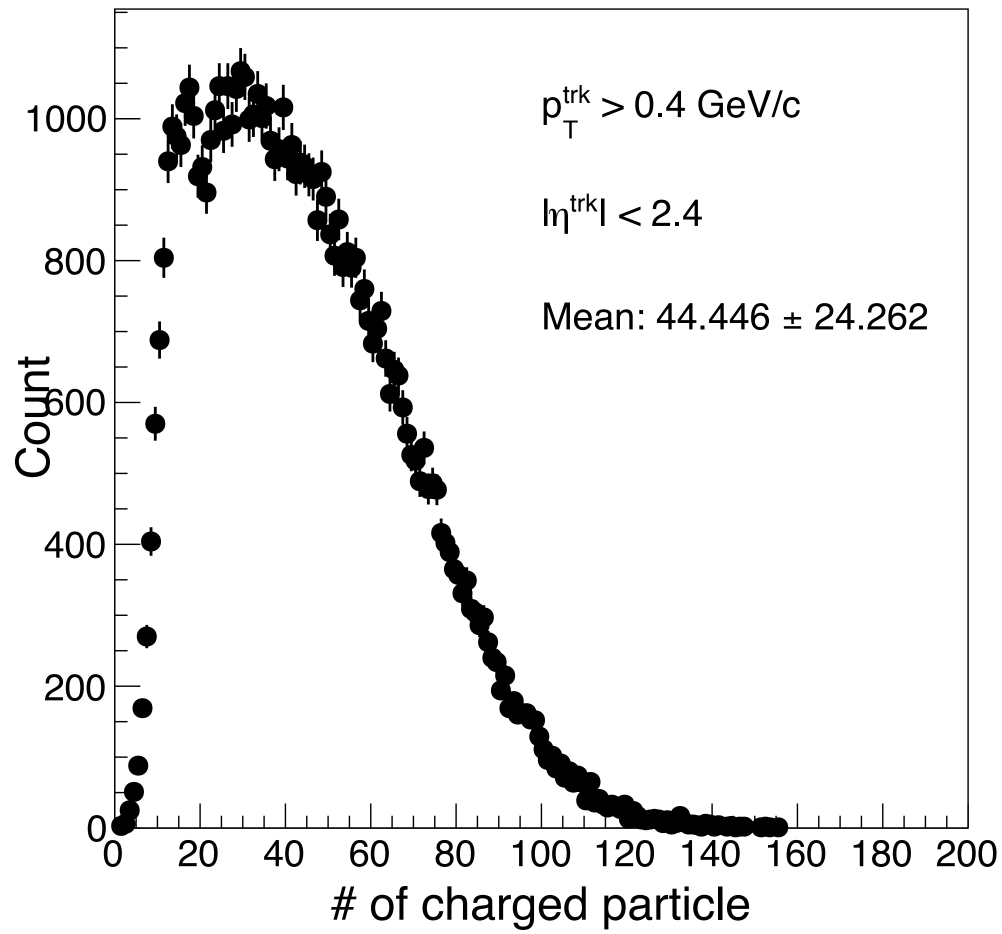


- Low-multiplicity range also need to retain enough ϒ
- Low-multiplicity subtraction is needed to estimate residual contribution from back-to-back jet correlations
- Ncoll == 1 is back-to-back jet correlation case
- Multiplicity 50 (31±18) was tentative multiplicity range

MC dataset

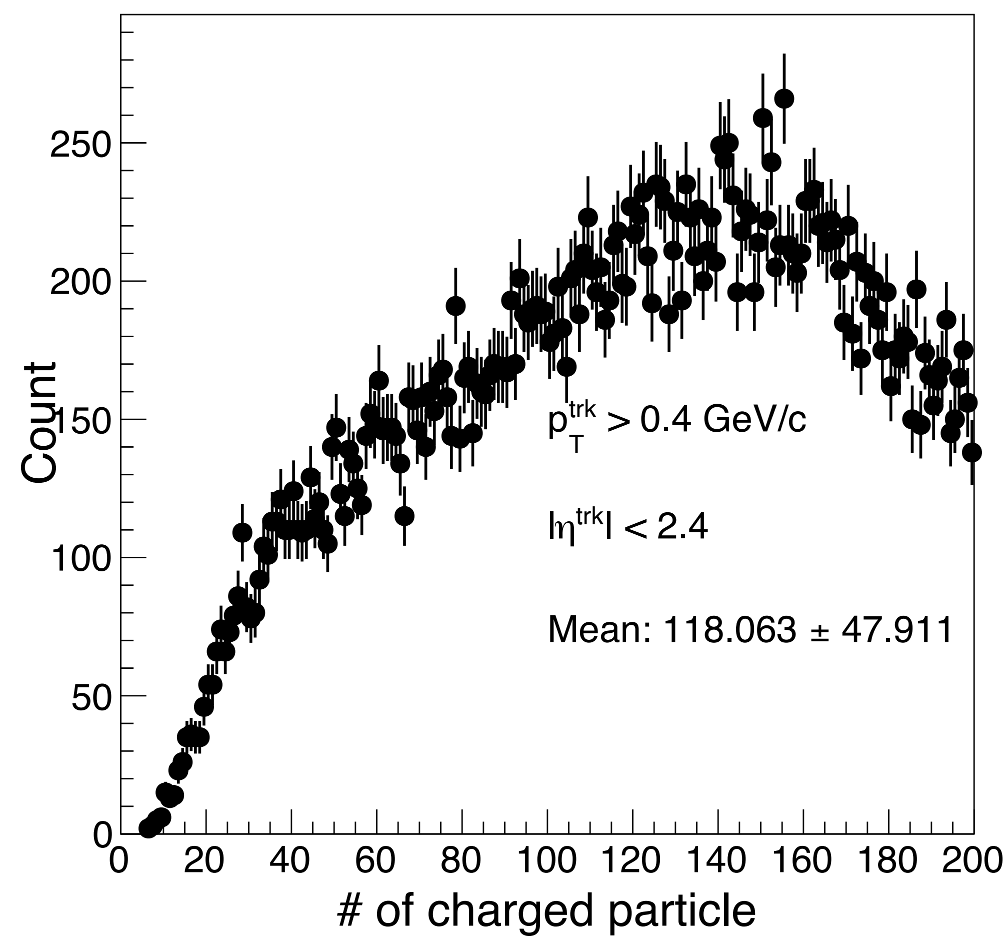
- 1. Check Υ event with GENonly file
  - Contains tracks in the Υ events for Ncoll==1 case
- 2. Check Υ event with EPOS embedded file
  - Contains tracks in the Υ events for Ncoll==1 case
  - Effect of Pb-ion also included from EPOS embedding
- 3. Check with MB EPOS file
  - Contains all Ncoll case
  - Advantage to calculate portion of Ncoll==1 case as function of multiplicity

GENonly sample



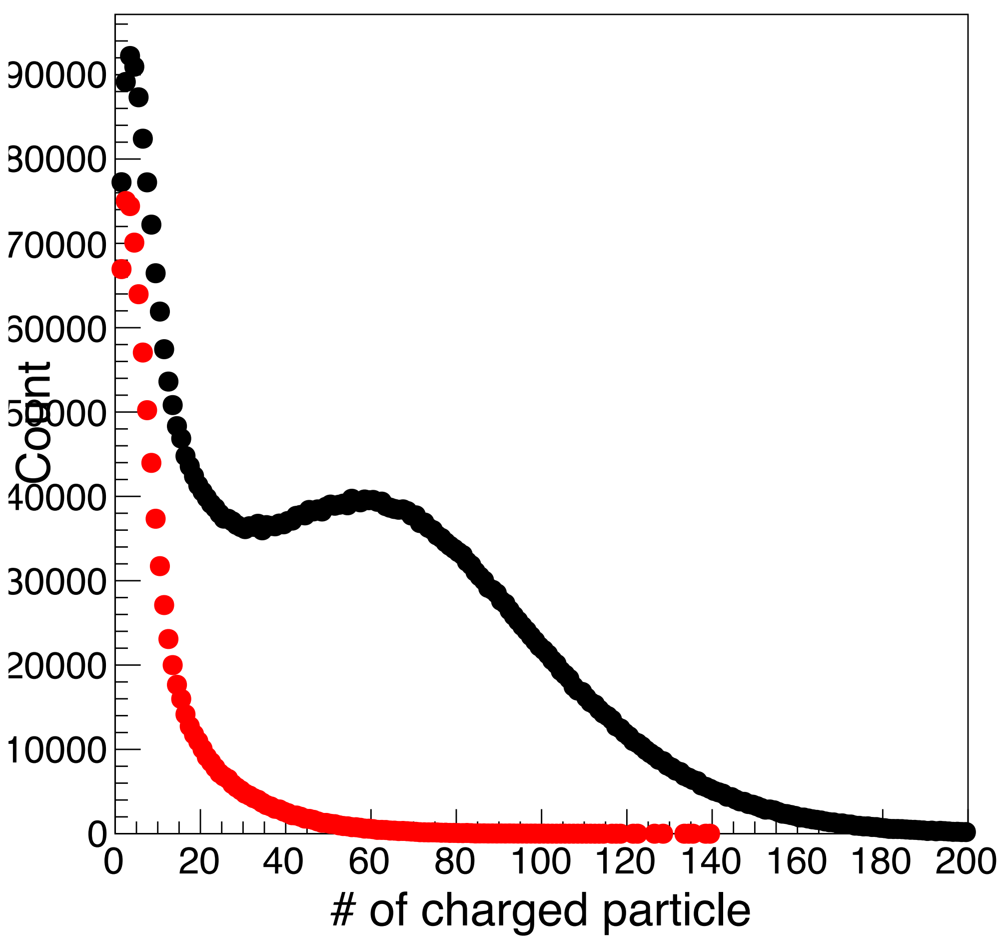
- Unembedded sample does not contain Pb effect
- Mean is 44 but peak position is around 30
  - Any function to describe this shape?
- No Ncoll information
  - Can not determine the range which is the Ncoll==1 is dominant

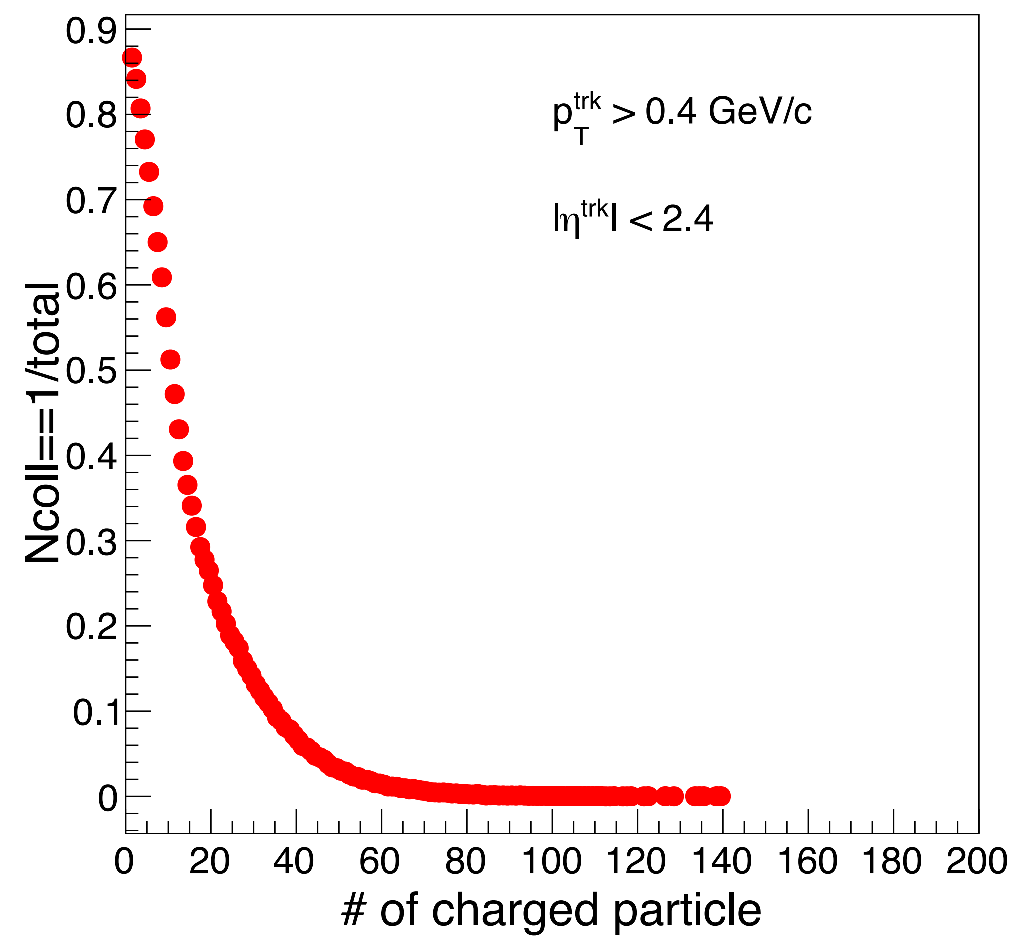
Embedded sample



- Pythia does not produce collision but particle
  - Genonly, embedded sample are both do not have Ncoll information
  - Even if embedded with EPOS, just tracks are added based on pythia
  - All Ncoll cases are integrated in the embedded sample

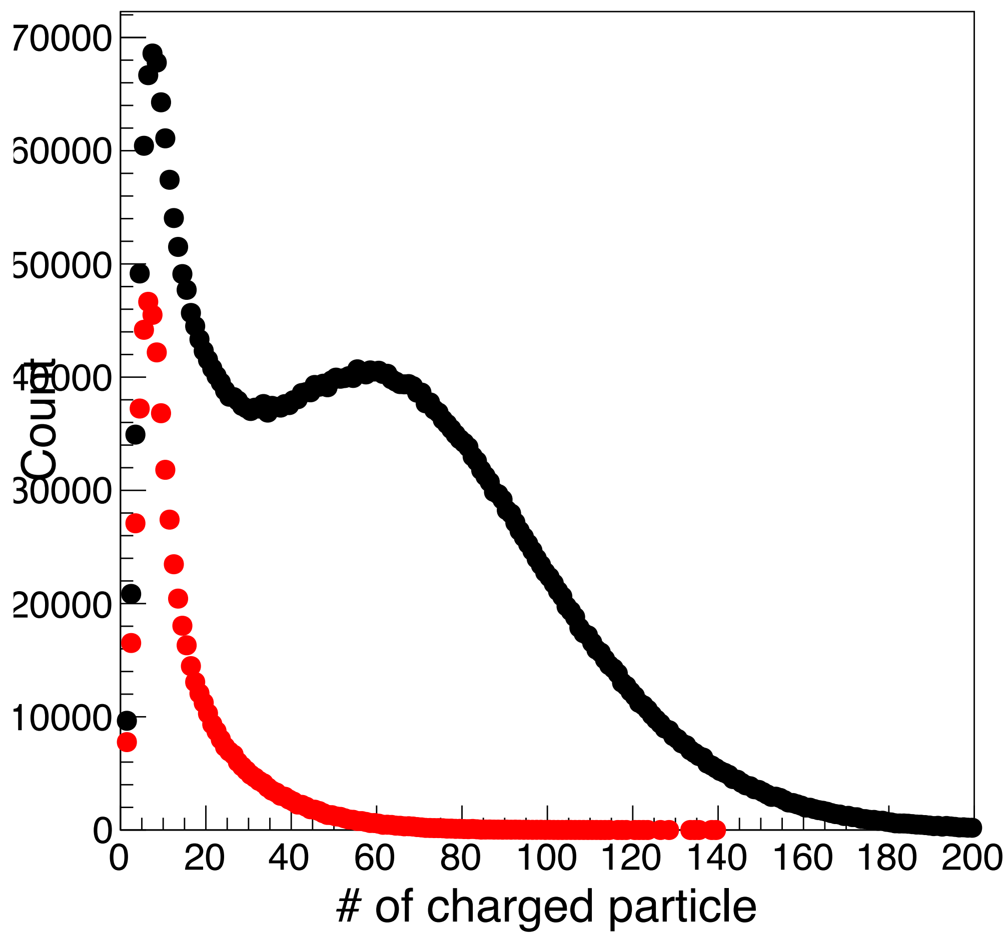
Minimum Bias

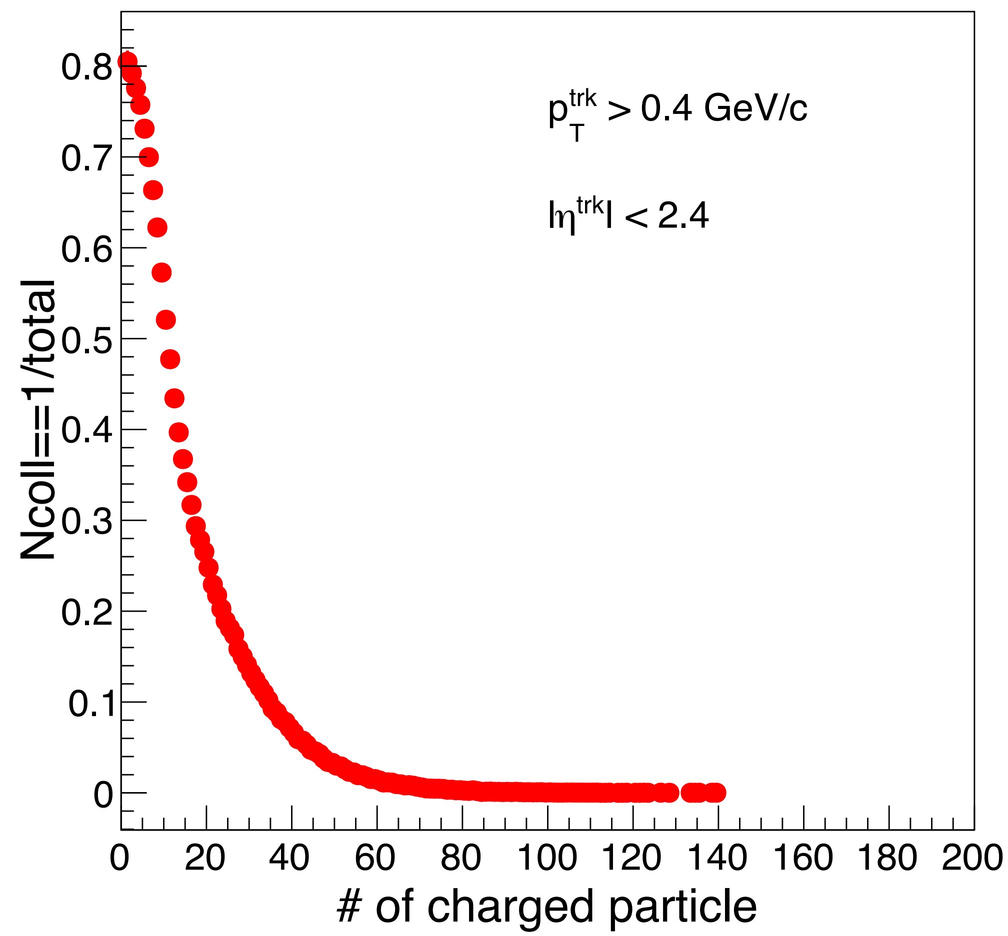




- EPOS MB sample has Ncoll information
- Portion of Ncoll==1 is very low even in multiplicity 20
- MB sample contains almost no ϒ due to low cross-section
  - Multiplicity distribution is different from that of ϒ
  - The event containing ϒ produce more tracks

Minimum Bias(hard collision)





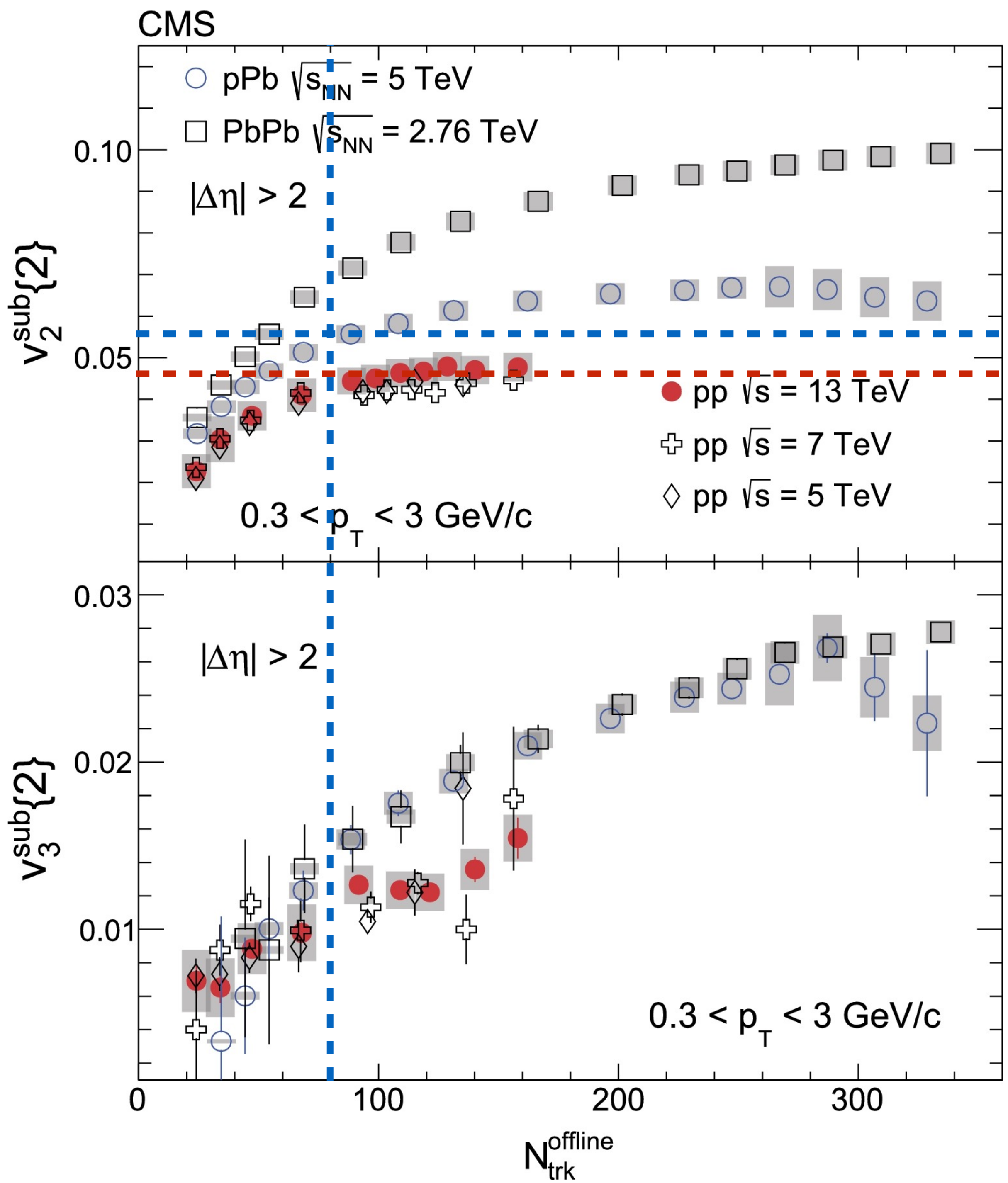
- One the collision should be hard scattering to produce ϒ
- Hard scattering case also similar to soft scattering
- Even if the collision is hard scattering ϒ can not be produced due to cross-section

Summary of MC study

- 1. GEN only sample can show Υ events for Ncoll==1 case
  - Can not describe pPb multiplicity
  - Can not determine Ncoll==1 dominant range
  - Need fitting function rather than mean of histogram
- 2. EPOS embedded sample
  - Can not distinguish high-and low multiplicity due to embedded tracks
- 3. MB sample
  - Almost no Υ events due to low cross-section
  - Ncoll==1 multiplicity is lower than actual Υ events multiplicity

From the other study

PLB 765, 193(2017)



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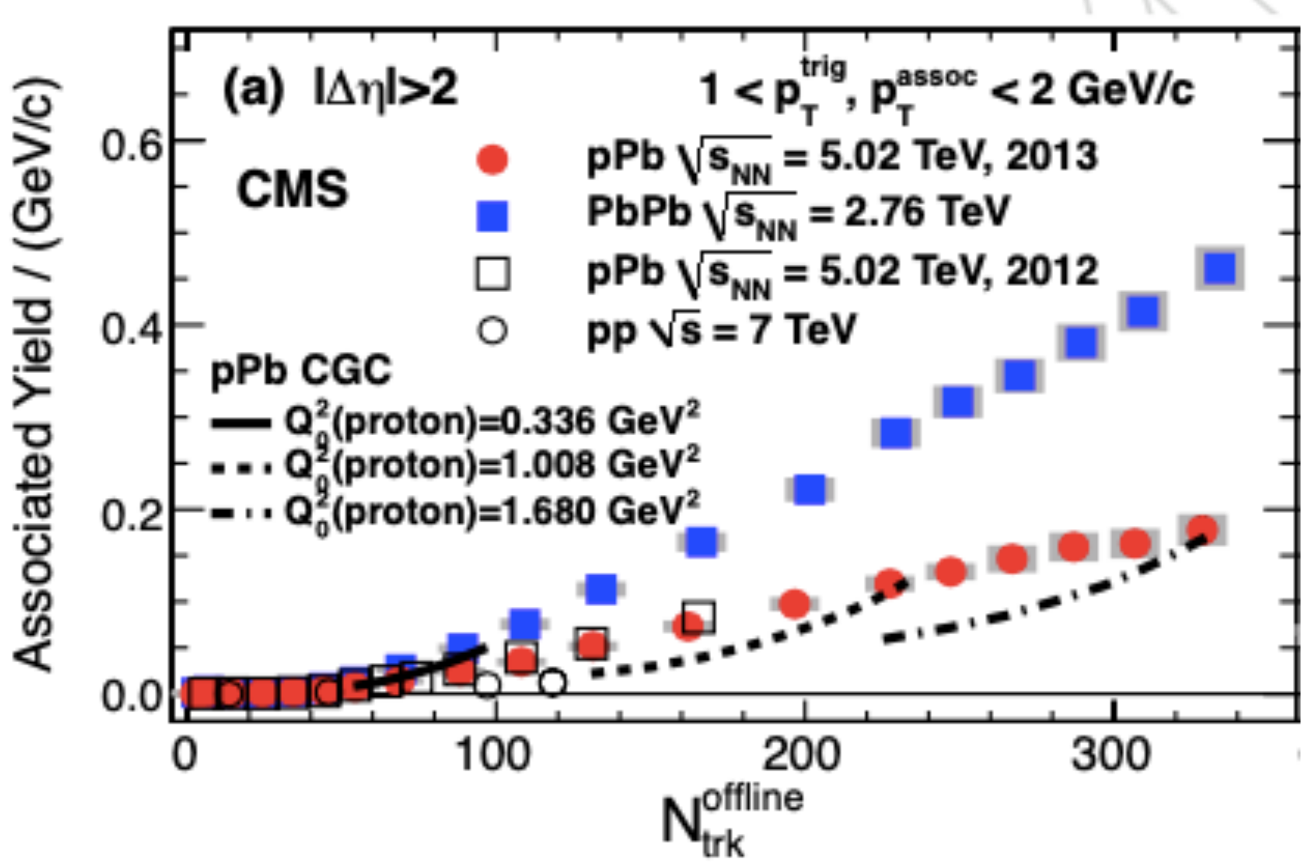
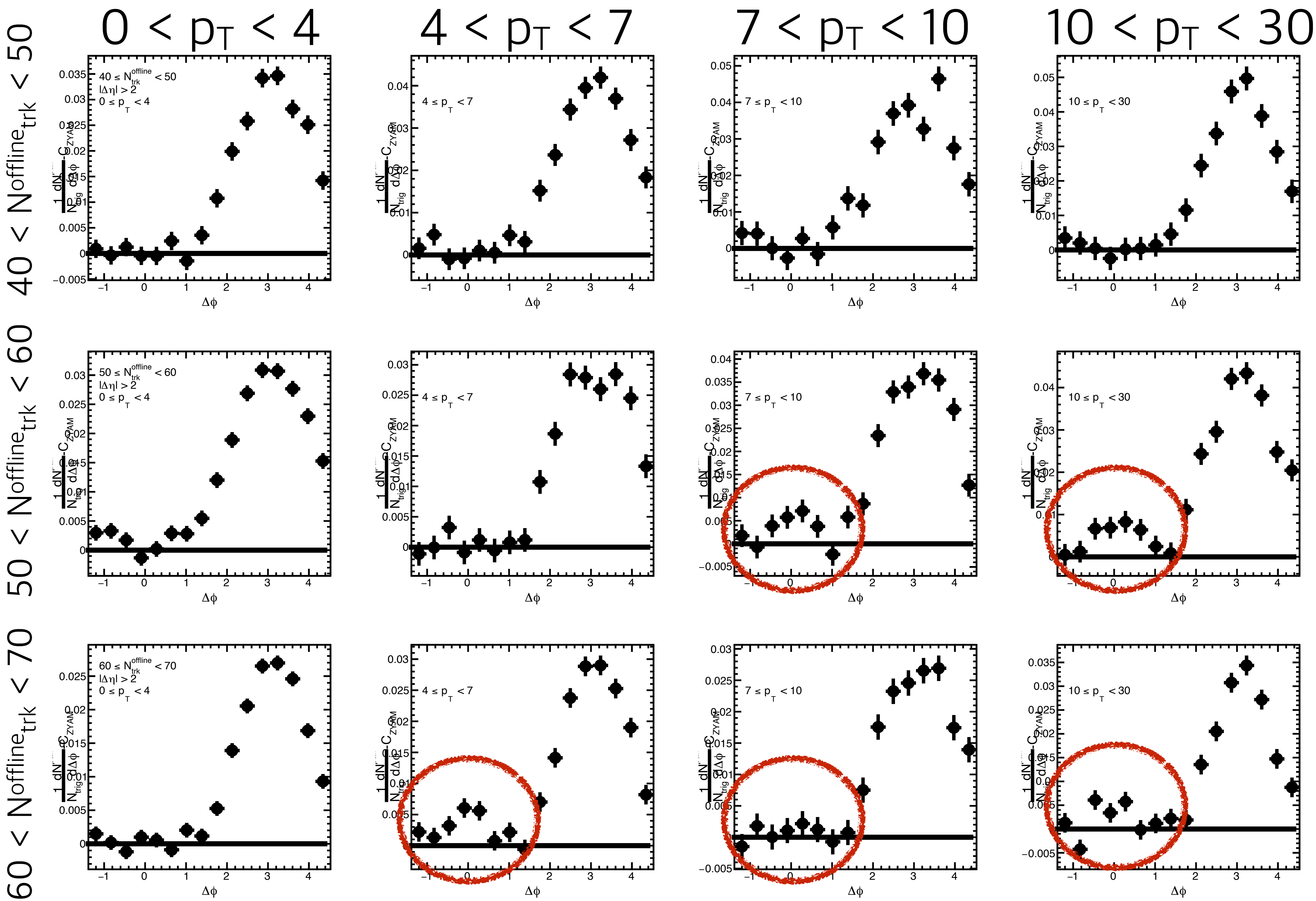


- High-multiplicity range determined from the pp and pPb charged hadron v_2
- Long-range associated yield is 0 until multiplicity 40 regardless of system

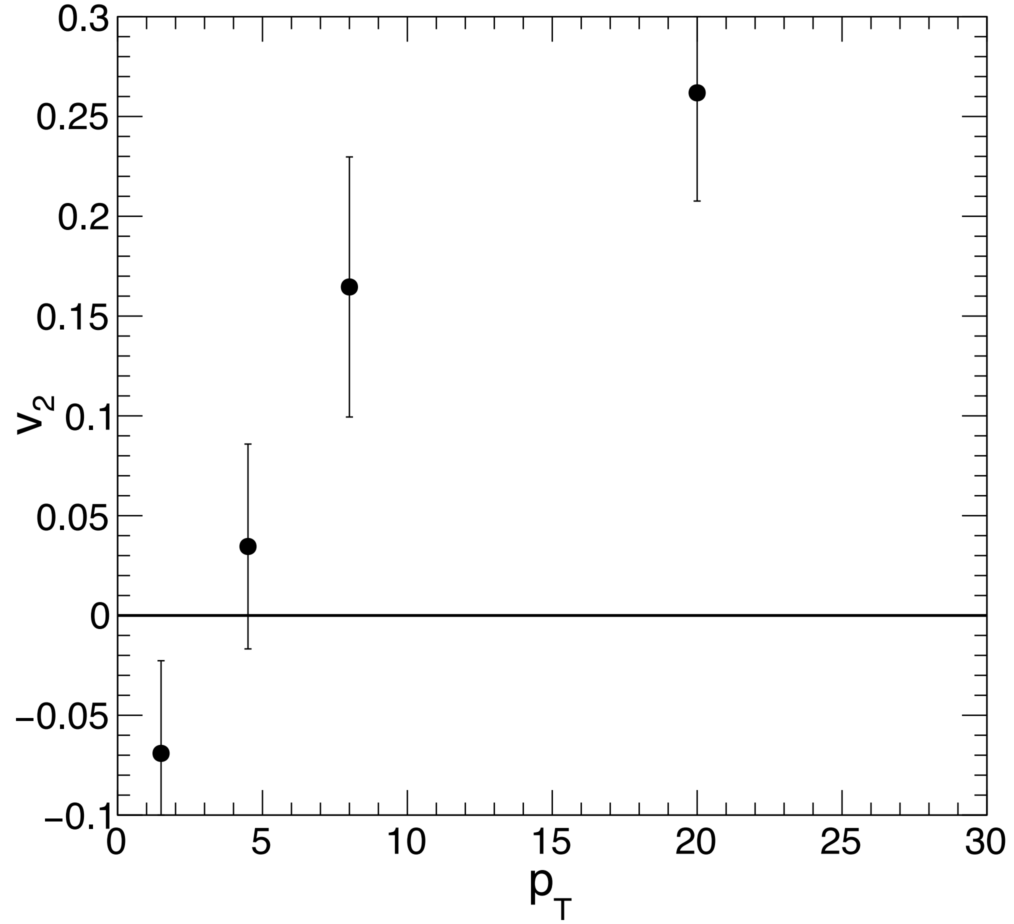
Long-range associated yield



Low-multiplicity range

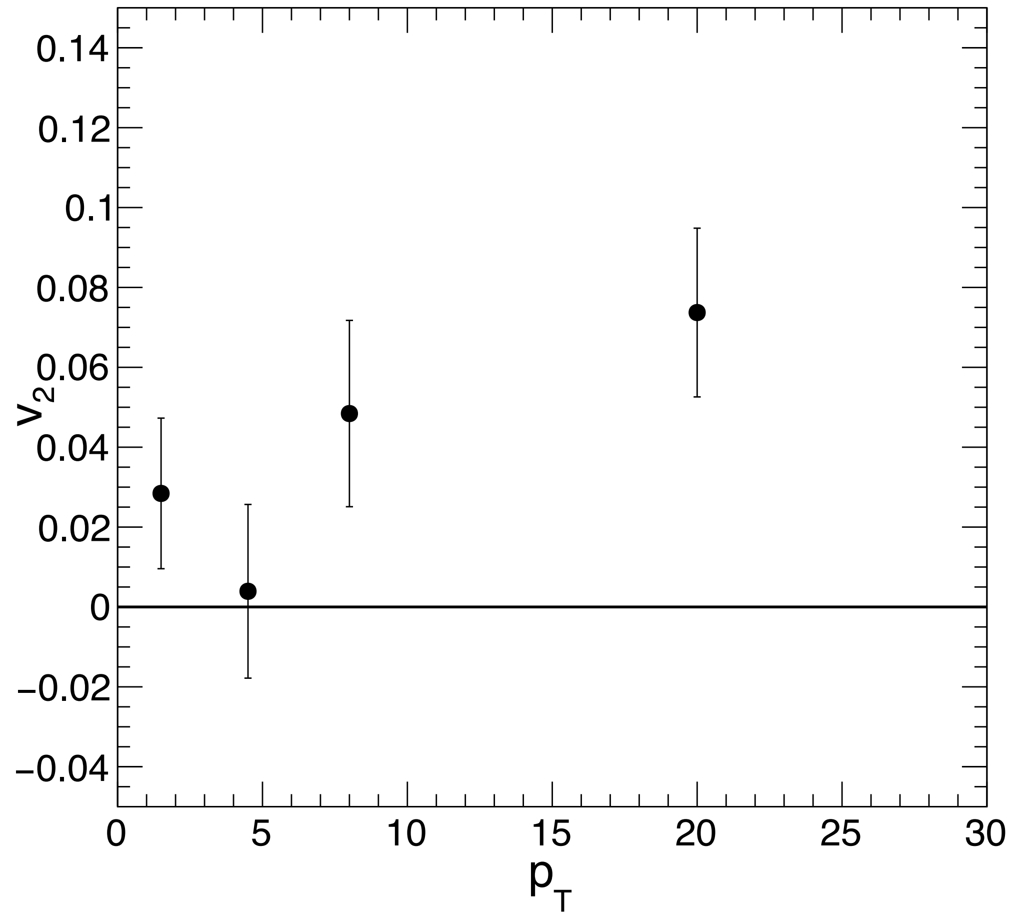
- By correlating associators which is correlated with ϒ, back-to-back jet dominant range could be extracted
- Associators in the ϒ mass range ($9 < m < 10$) di-muon events are correlated
- Track-track long-range ($|\Delta\eta| > 2$) associated yield is non-zero at the higher multiplicity than 50
- At the higher than multiplicity 50, there are more correlation except back-to-back jet
- At the lower than multiplicity 50, almost events are back-to-back jet correlation
- Multiplicity 0~50 can be used as low-multiplicity range to subtract residual back-to-back correlation

Low-multiplicity v_2



- Previous issue about simultaneous fitting is resolved with p_T binning
- [0, 4, 7, 10, 30] → [0, 3, 6, 10, 30]
- Yield was too poor for $7 < p_T < 10$

High-multiplicity v_2 with new p_T bin

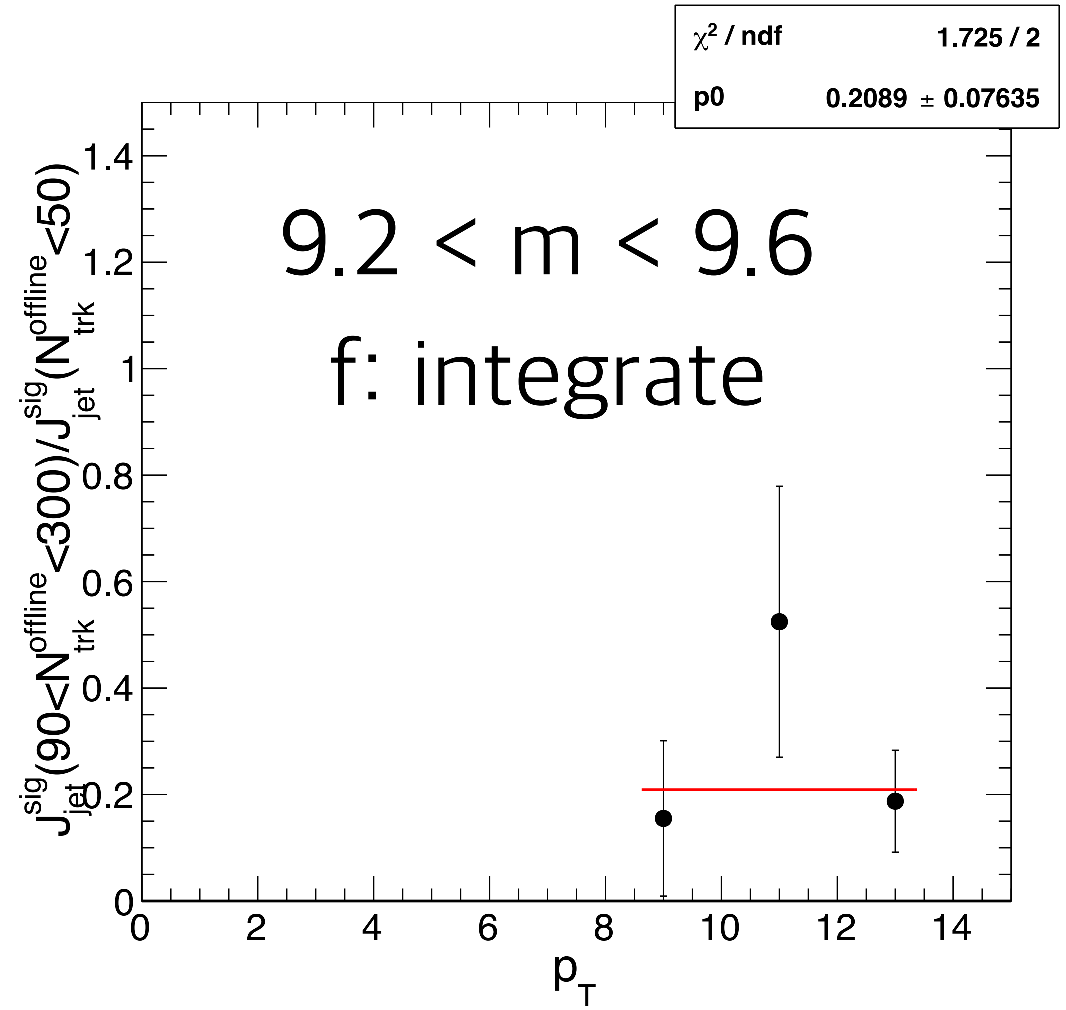


- High-multiplicity v_2 also calculated with new p_T binning
- One bin in the ϒ mass range is very low
- v_2 at $3 < p_T < 6$ was lowest in the PbPb

Low-multiplicity subtraction

- Low-multiplicity subtraction is needed to estimate residual contribution from back-to-back jet correlation
- $v_2^{sub} = v_2(high) - v_2(low) \times \frac{N_{assoc}(low)}{N_{assoc}(high)} \times \frac{Y_{jet}(high)}{Y_{jet}(low)}$
- $Y_{jet}^{sig} = \frac{Y_{jet}^{peak} - (1-f)Y_{jet}^{bkg}}{f}$
- $Y_{jet} = Y_{jet}(|\Delta\eta| < 1) - Y_{jet}(|\Delta\eta| > 2)$

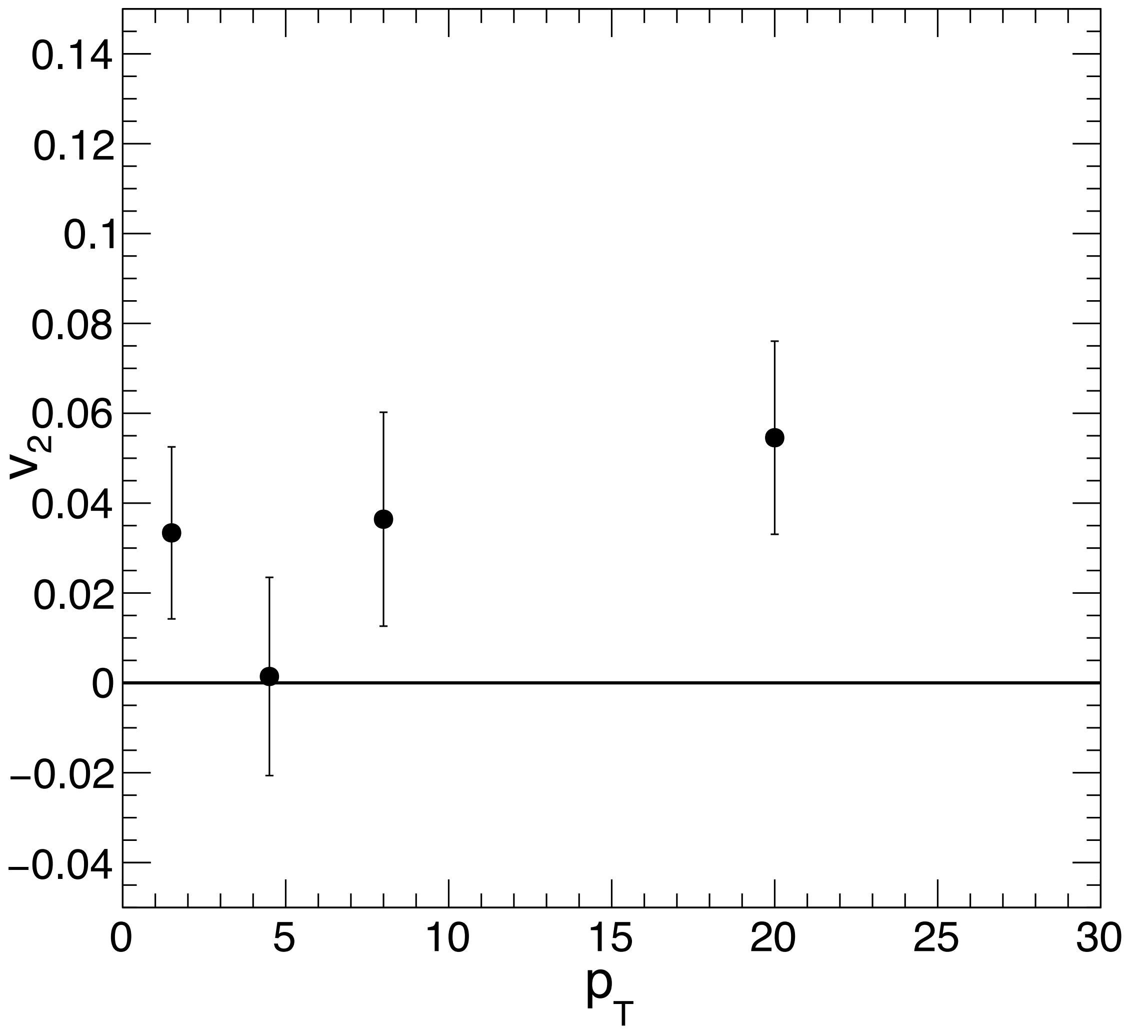
Jet yield ratio

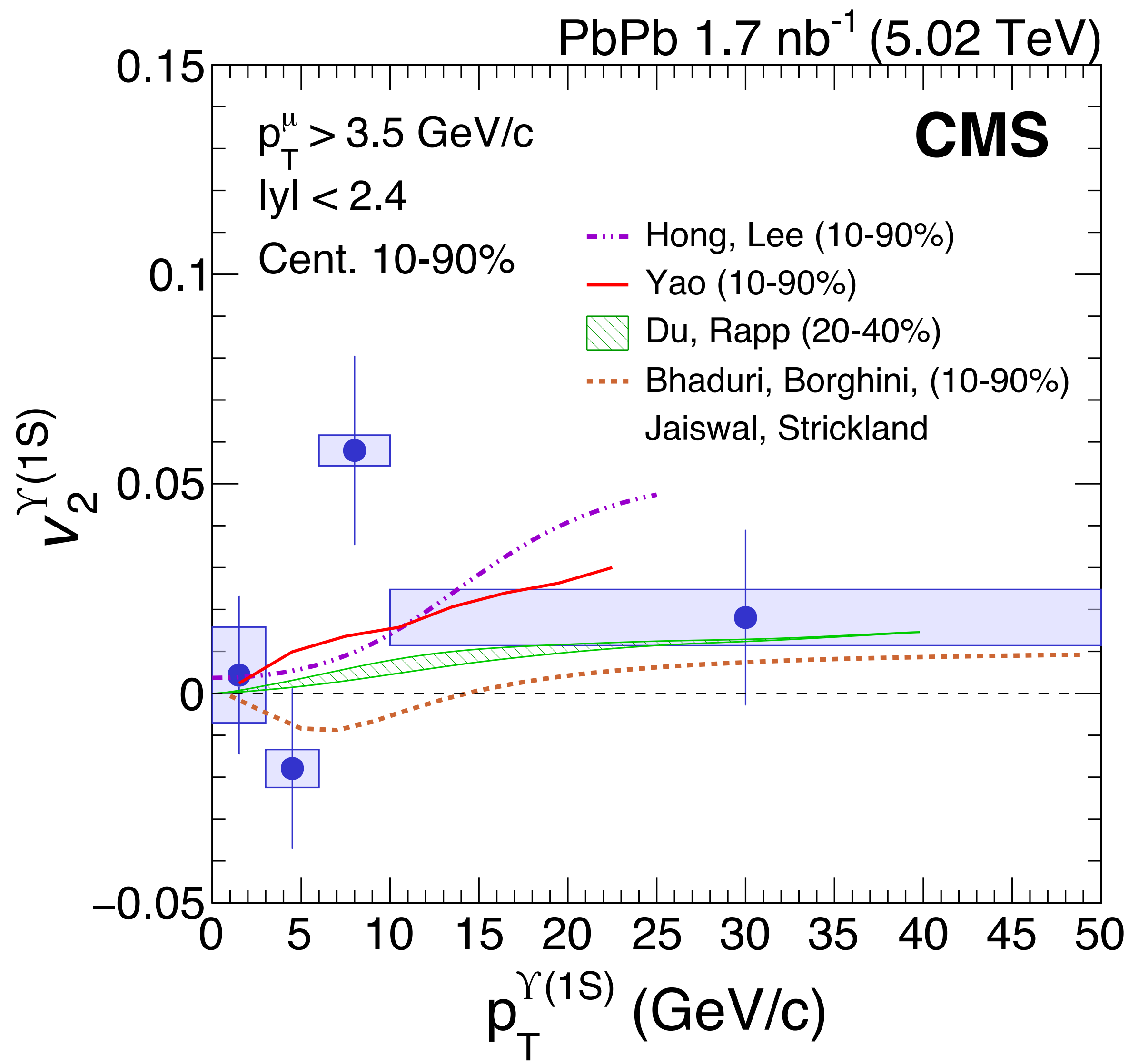


- $$Y^{sig}_{jet} = \frac{Y^{peak}_{jet} - (1-f)Y^{bkg}_{jet}}{f}$$
- Signal fraction of each mass point is different
- Integrated Sig/(Sig+Bkg) is used as fraction

Low-multiplicity subtracted result

pPb 8 TeV





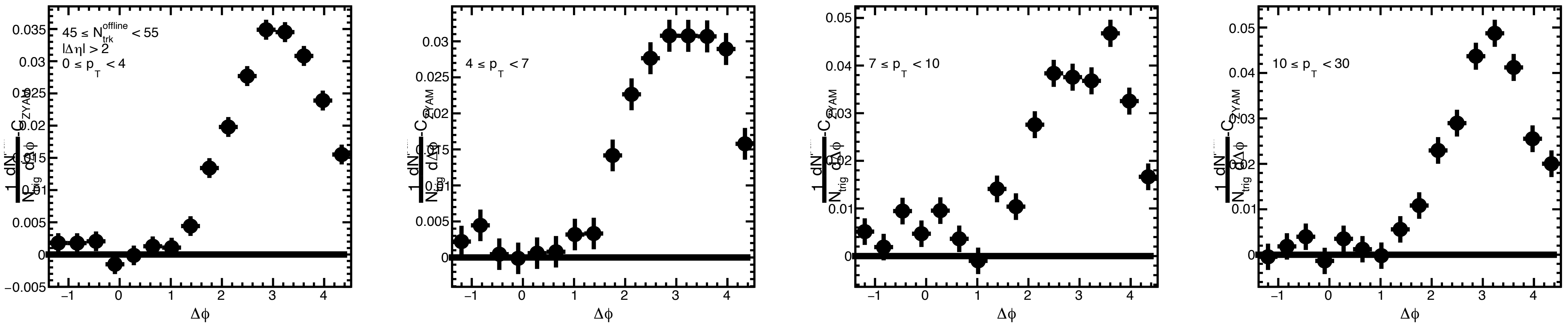
- Similar result at $6 < p_T < 10$ but error bar is large
- At $10 < p_T < 30$, pPb v2 is still higher than 0

Summary & plan

- Low-multiplicity range is defined as 0~50 from associator study
- Υ p_T bin has changed: [0, 4, 7, 10, 30] → [0, 3, 6, 10, 30]
- Need to understand jet yield ratio (low-multiplicity is higher than high-multiplicity)
- Low-multiplicity subtracted v2 is smaller than 0.06
  - Non-zero at high p_T
- Private MC is ready
  - Same amount with official (2 M)
- Presentation in di-lepton meeting (7/15 Wed.)
- Working meeting (7/17 Fri.)
- Presentation in flow meeting (7/20 Mon.)
- Request CADI in di-lepton meeting (7/21 Tue.)

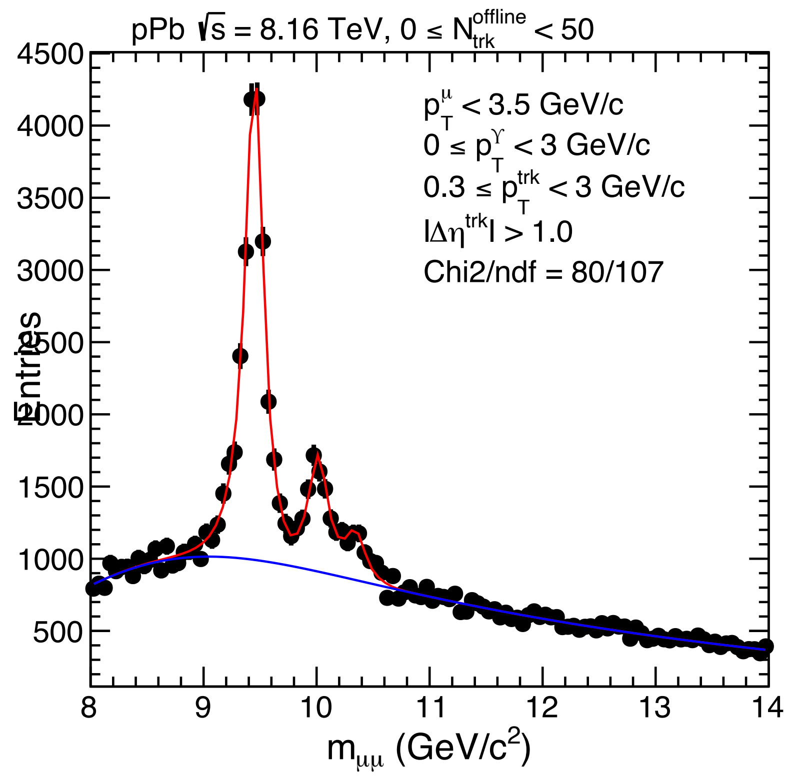
Back up

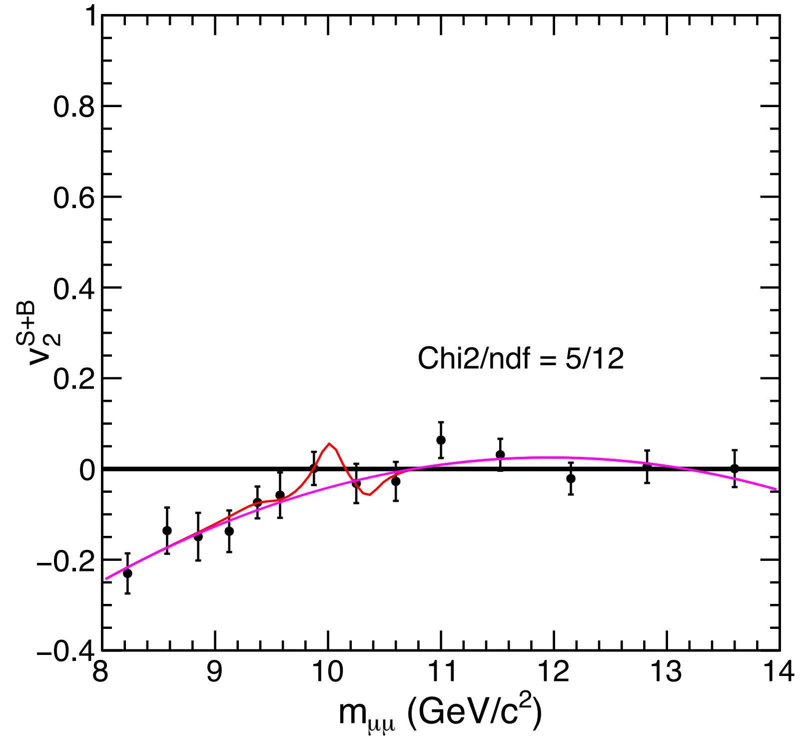
Long-range at 45 < multiplicity < 55

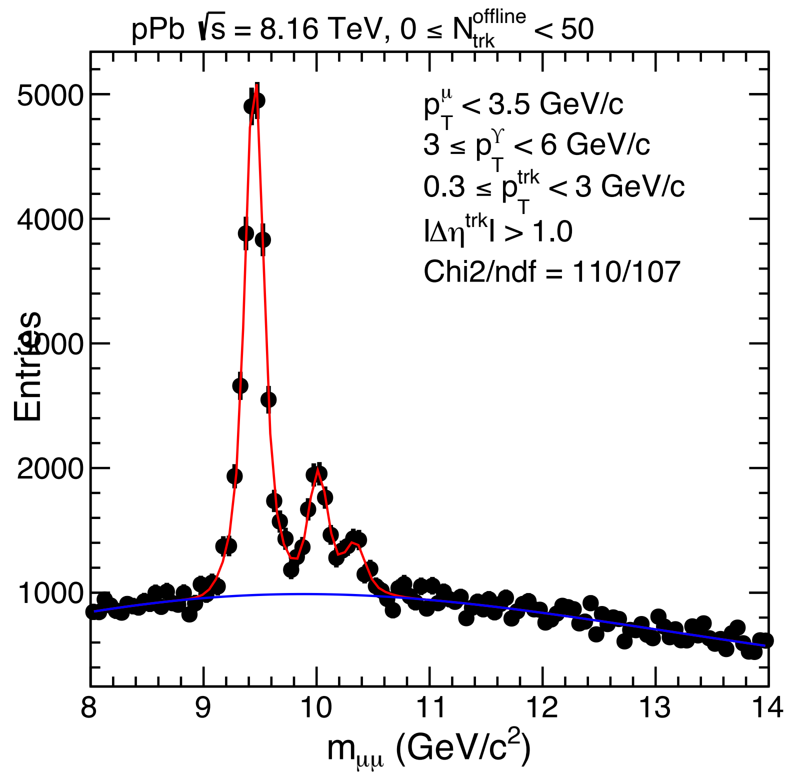


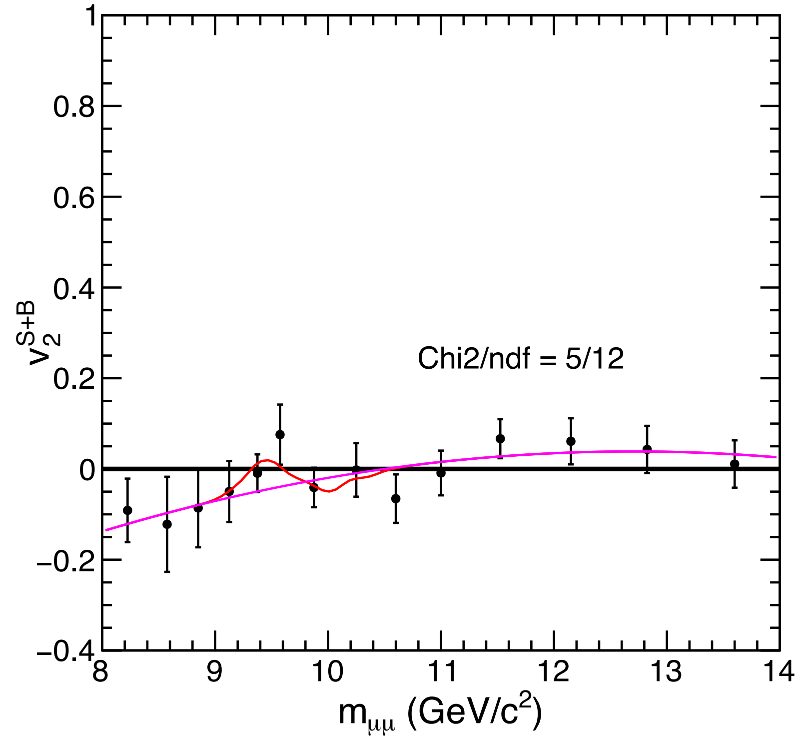
- At the p_T higher than 7 GeV/c track-track long-range near-side yield is non-zero
- 0~50 is the maximum range as low-multiplicity

Simultaneous fit (0 < mult. < 50)

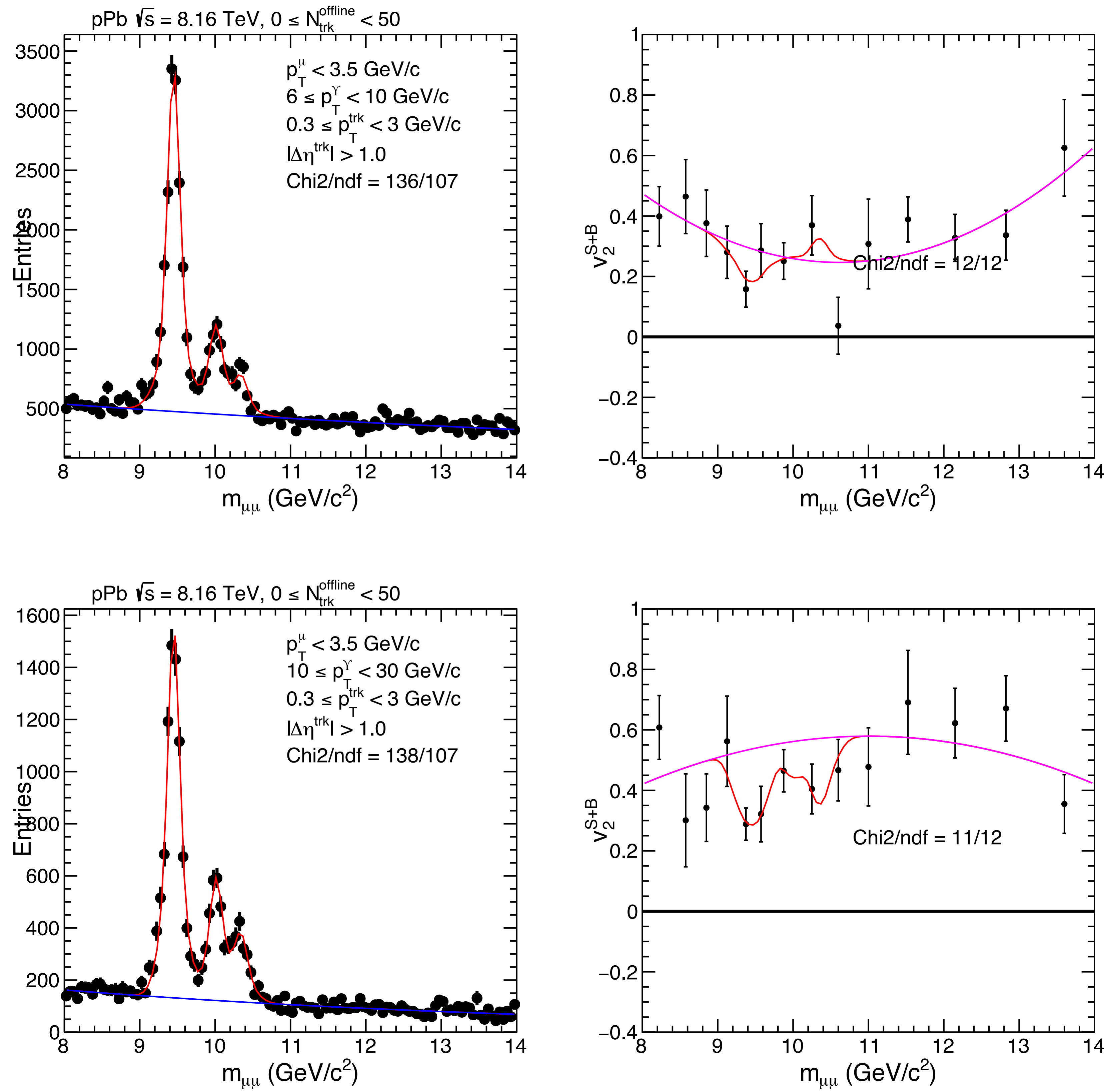




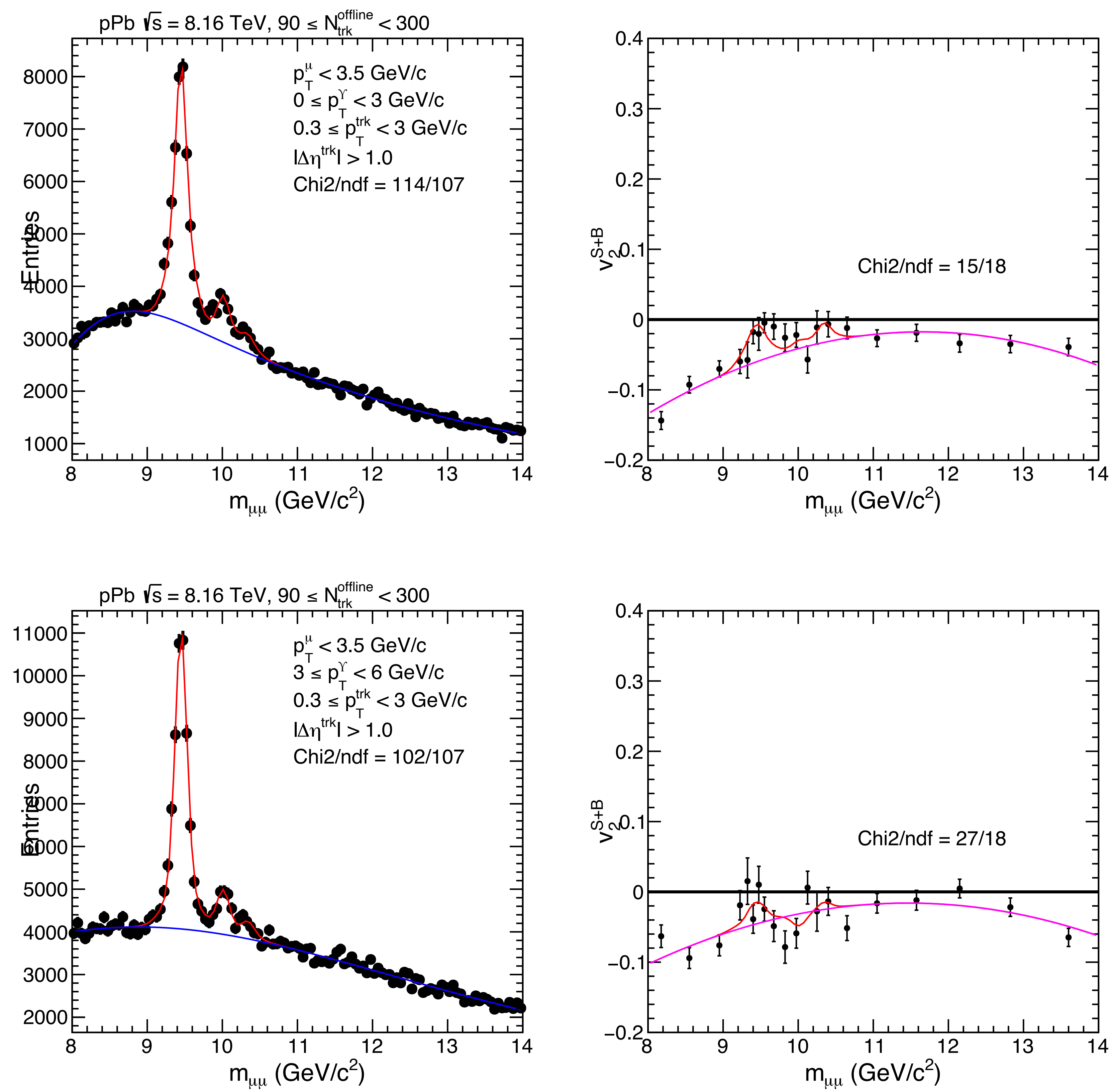




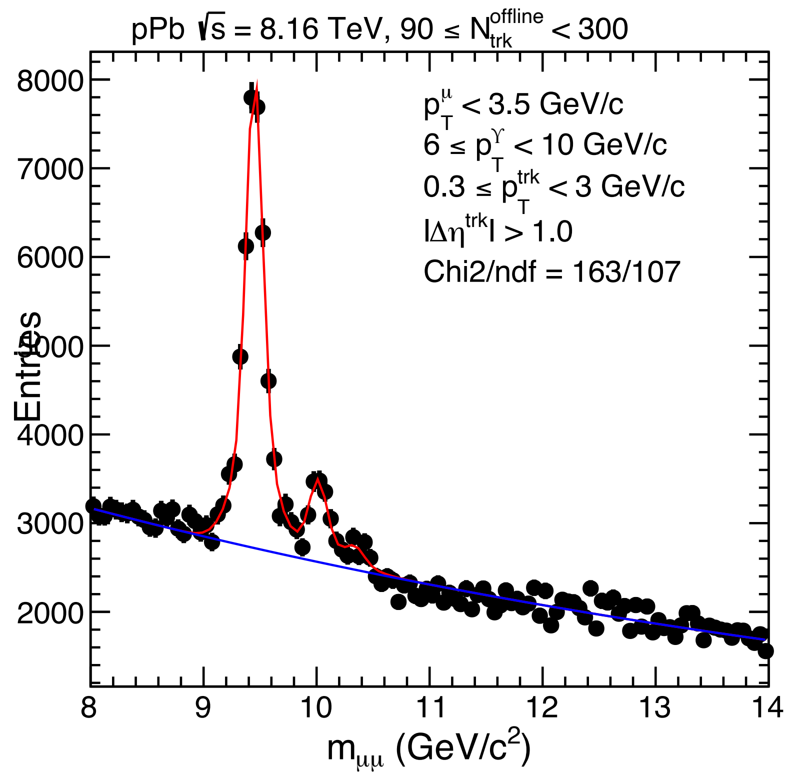
Simultaneous fit (0 < mult. < 50)

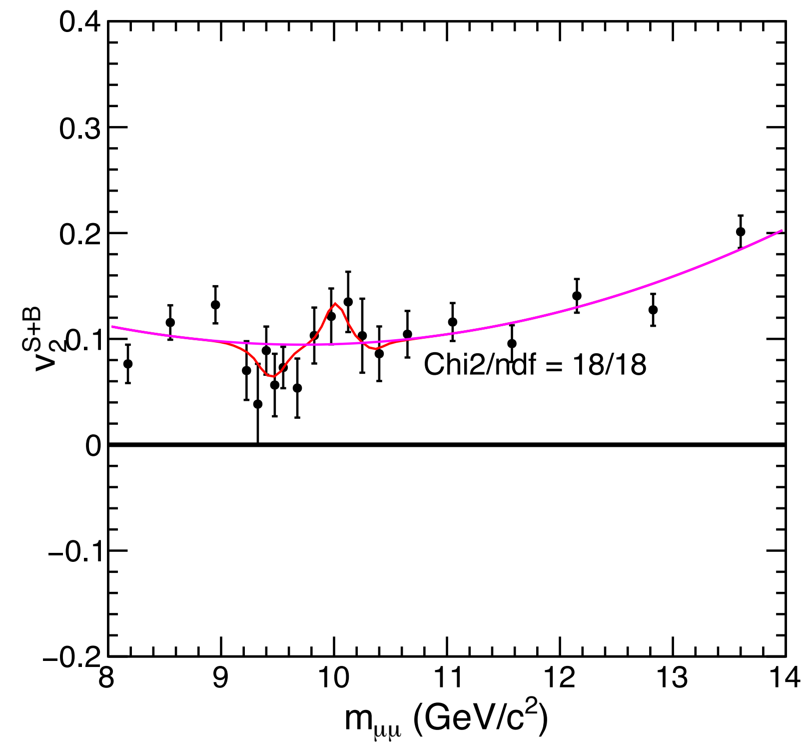


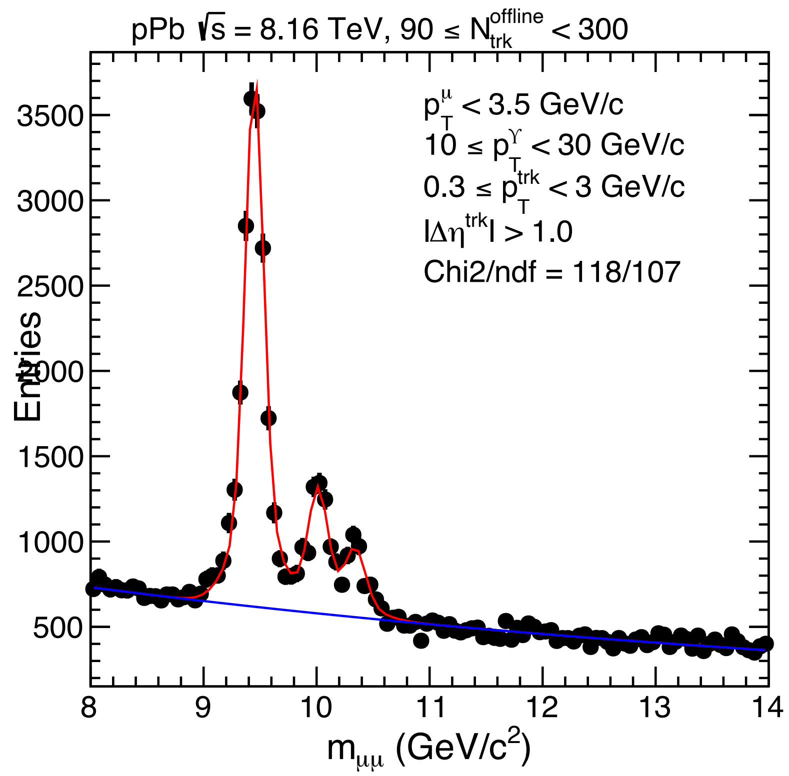
Simultaneous fit (90 < mult. < 300)

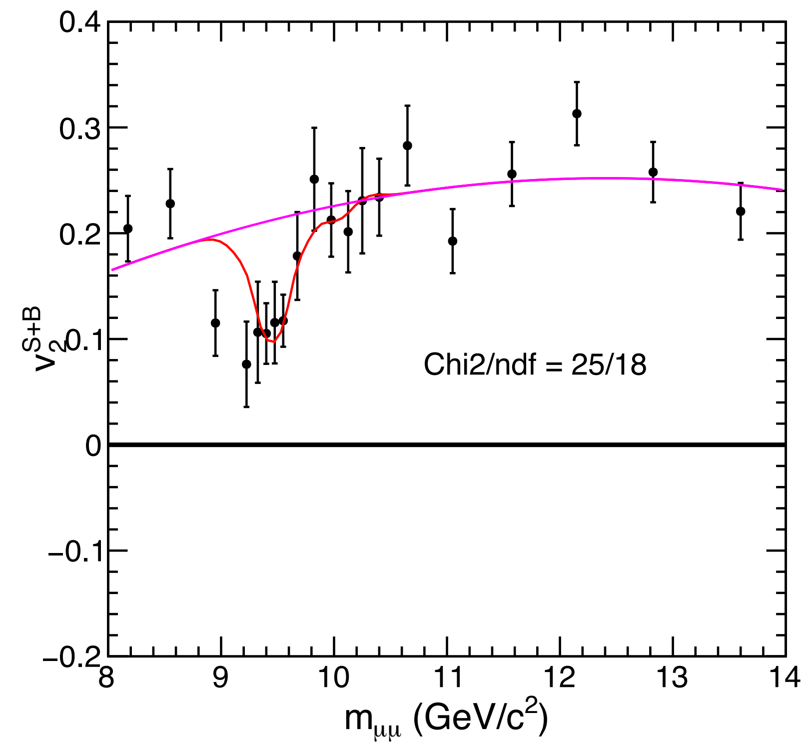


Simultaneous fit (90 < mult. < 300)

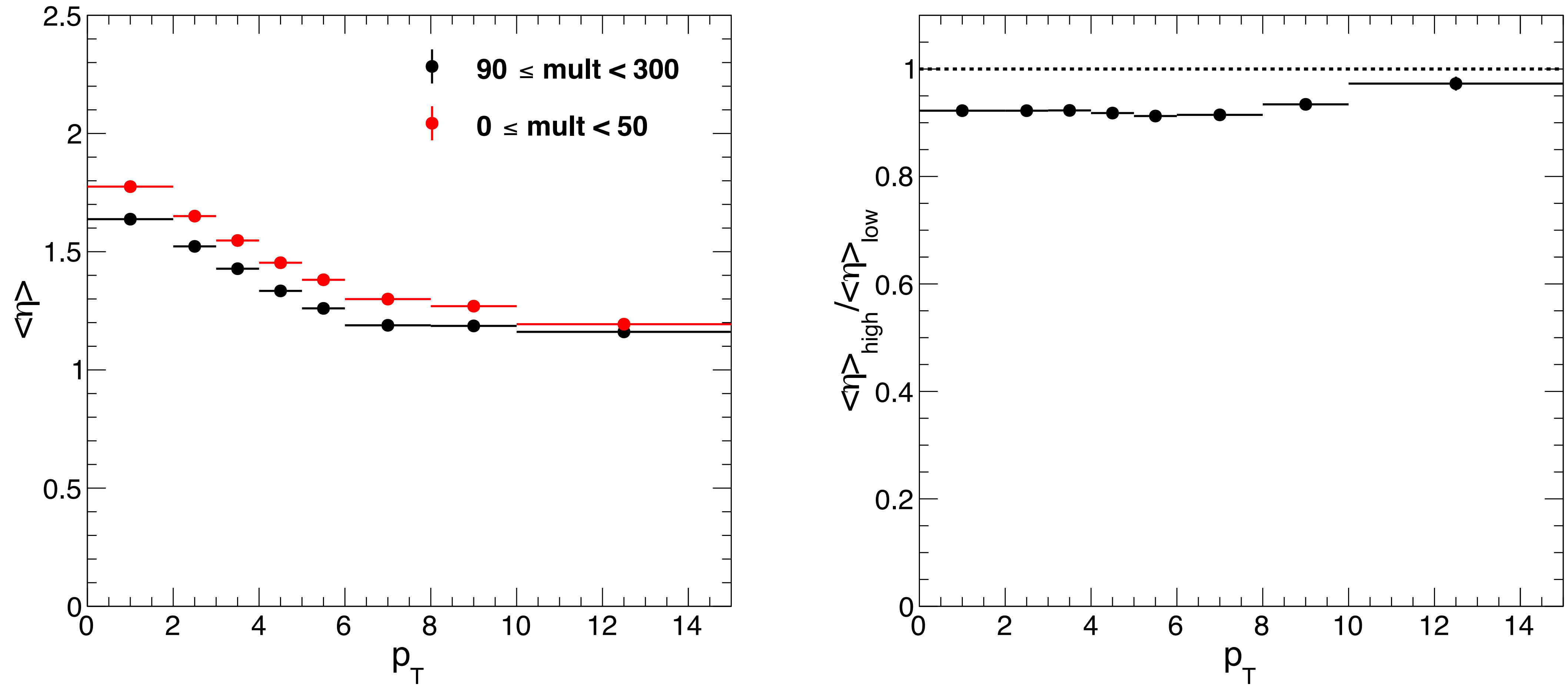






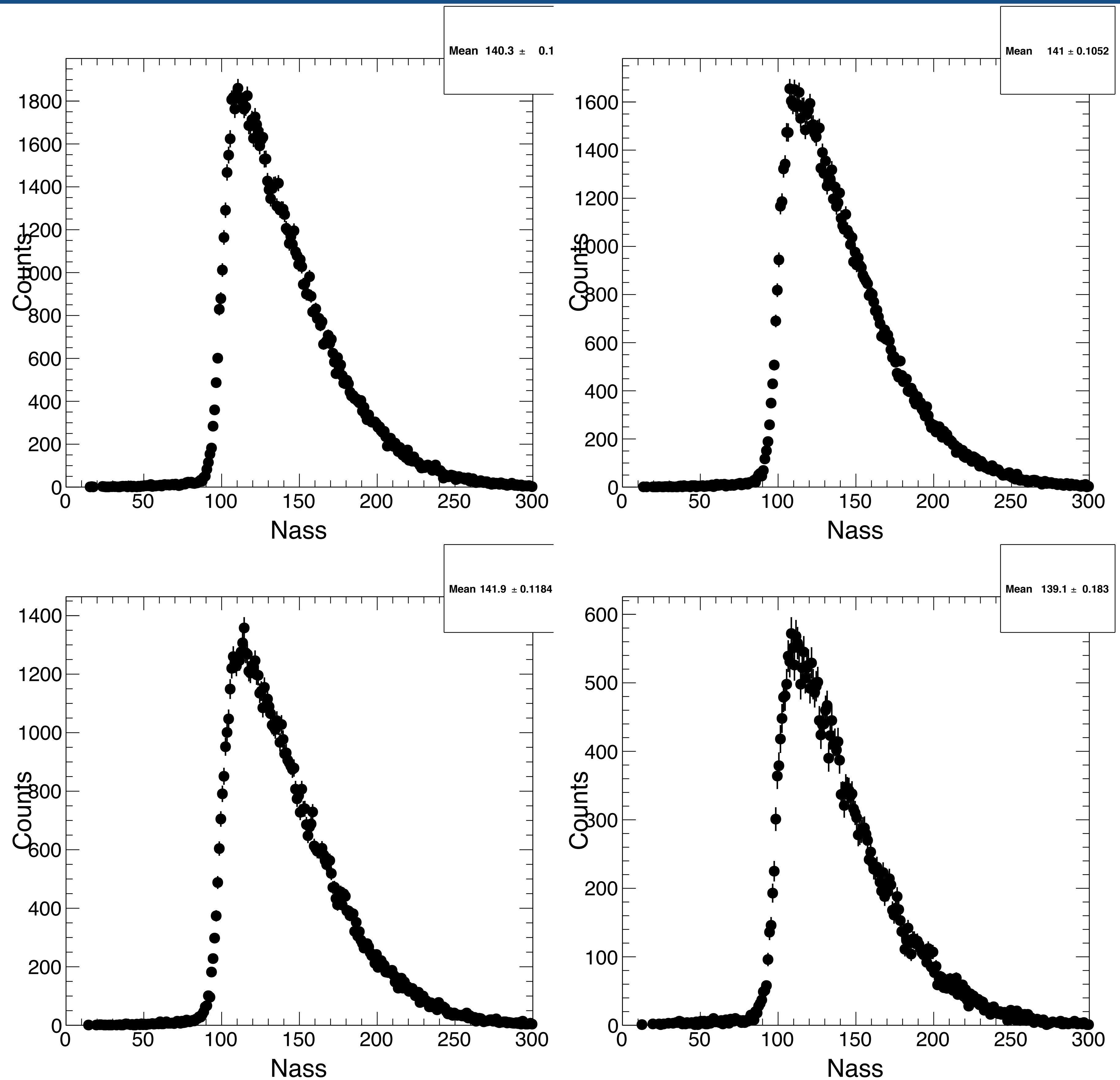


mean η of ϒ

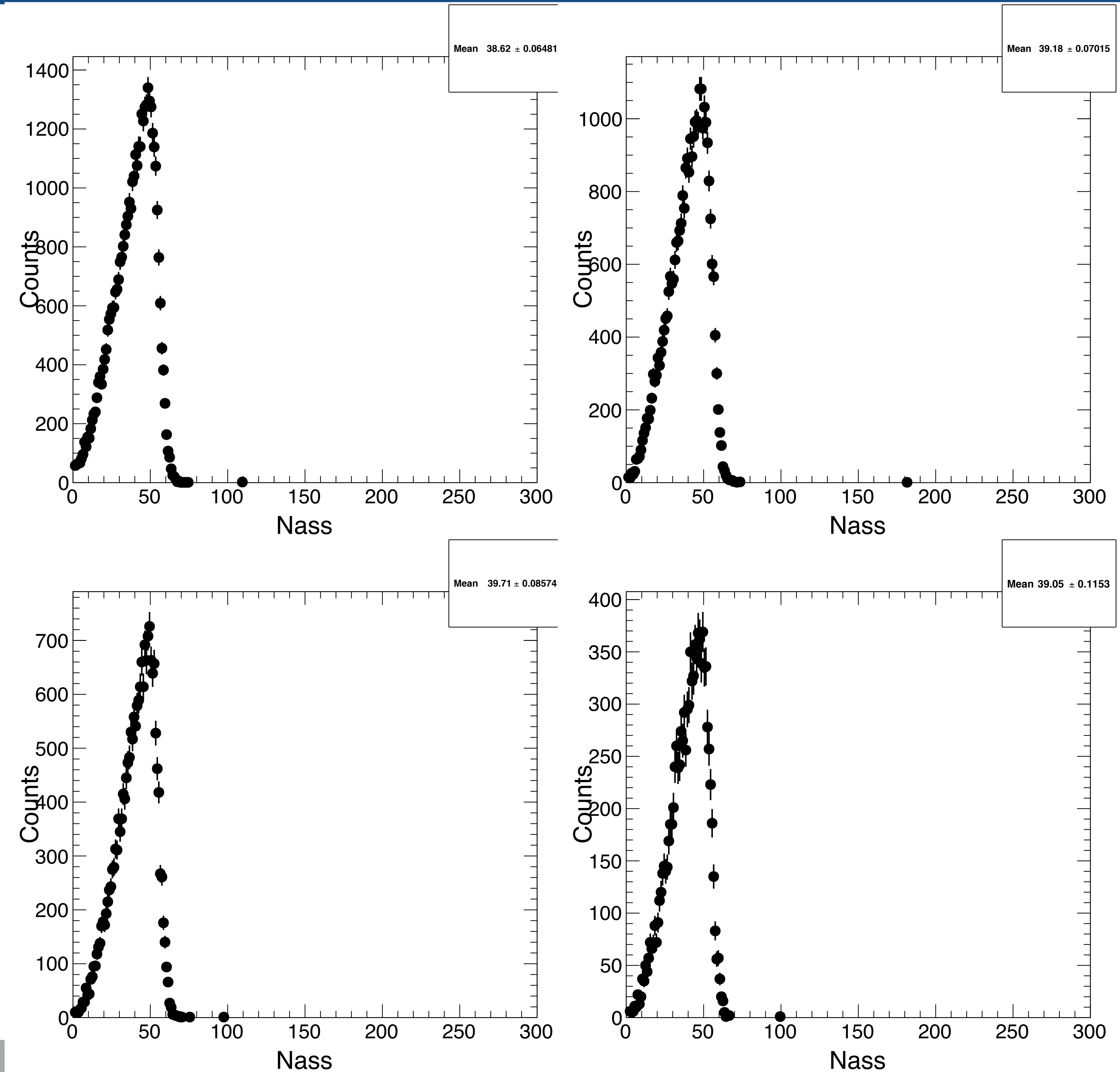


- Mean value of histogram is used as <η>
- Lower than J/ψ because J/ψ used only forward events
- Trend is different from J/ψ but ratio between high and low shows no strong multiplicity dependence as J/ψ
- ϒ case also can say that the effect from truncation are largely cancelled

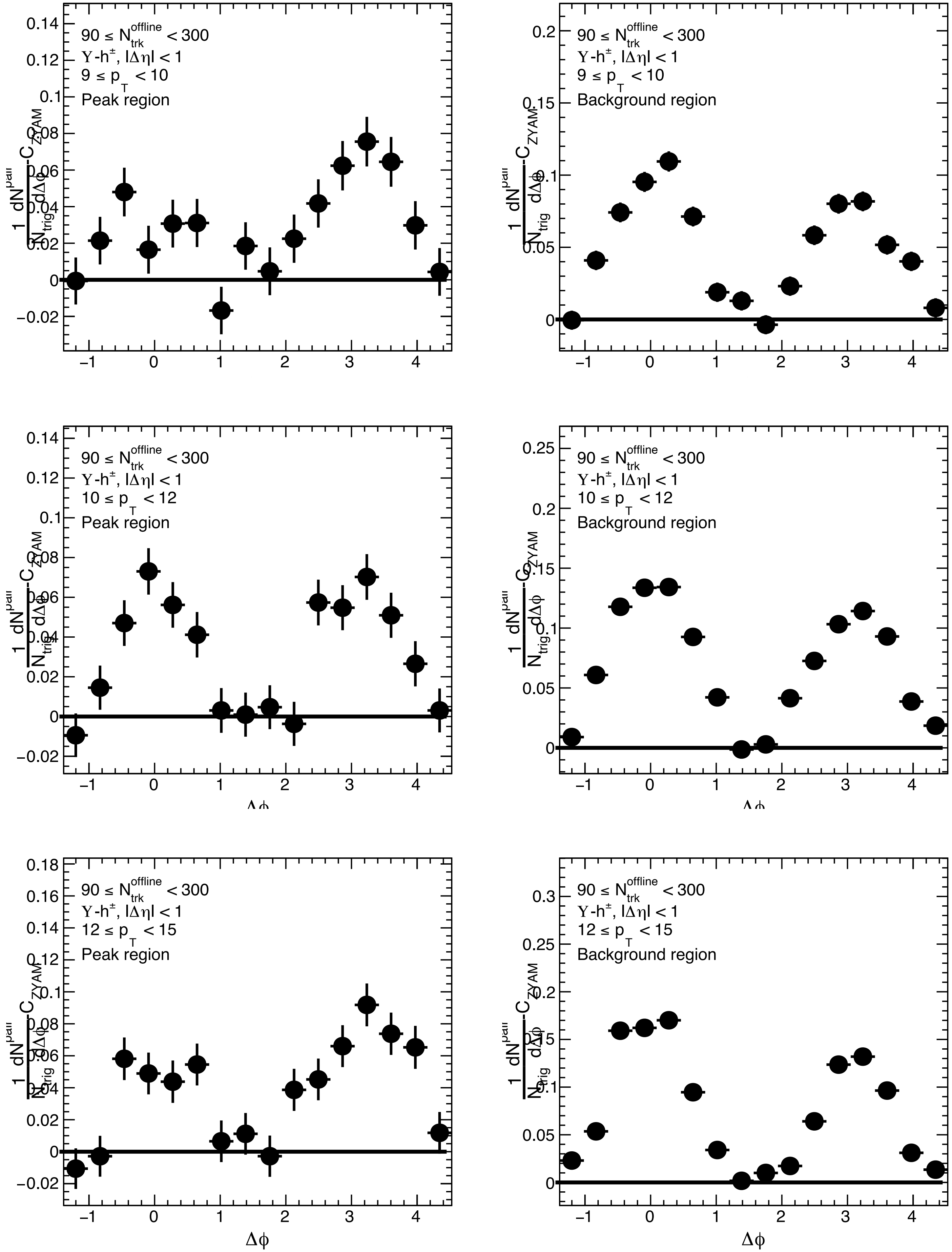
Number of associator (90 < mult. < 300)



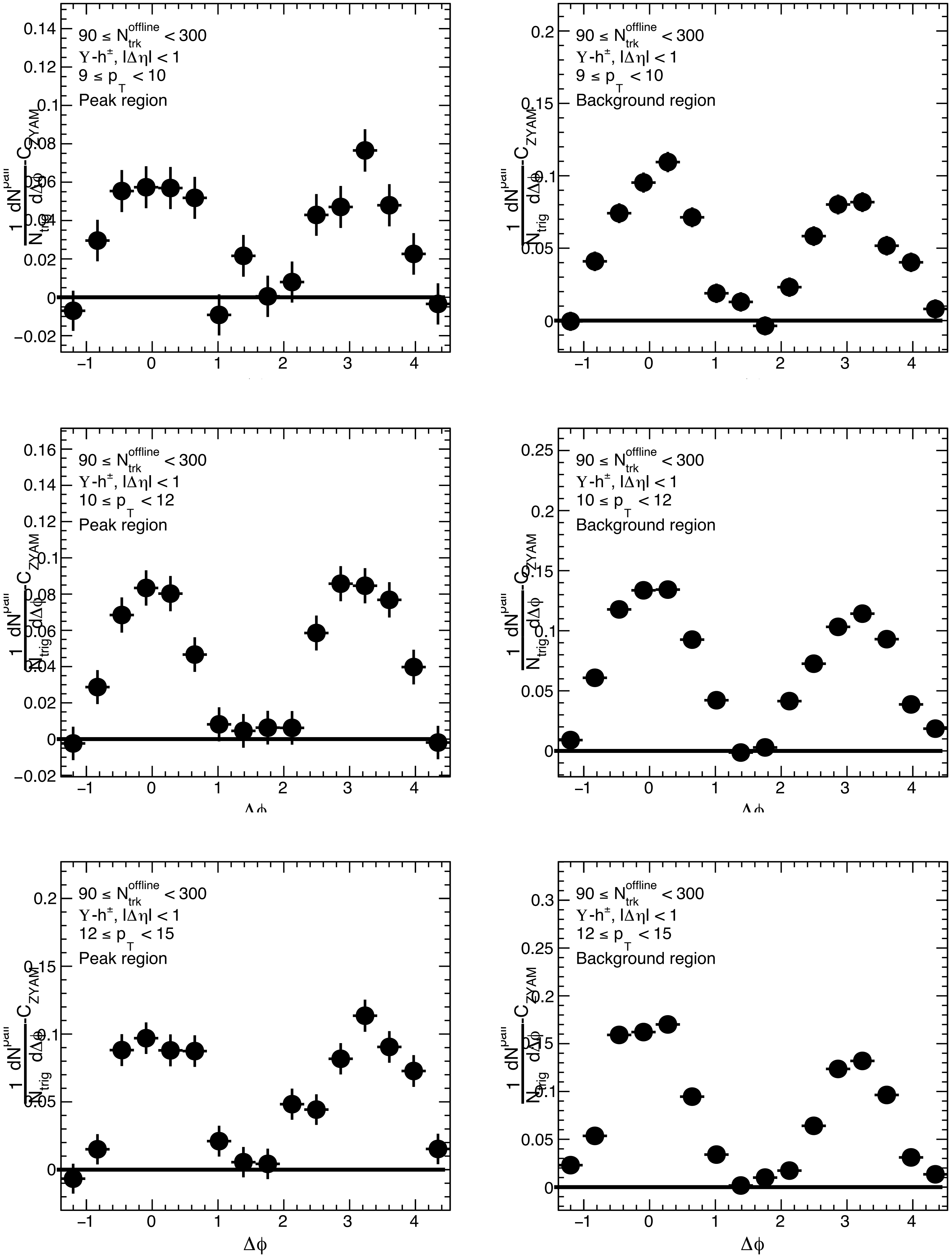
Number of associator (0 < mult. < 50)



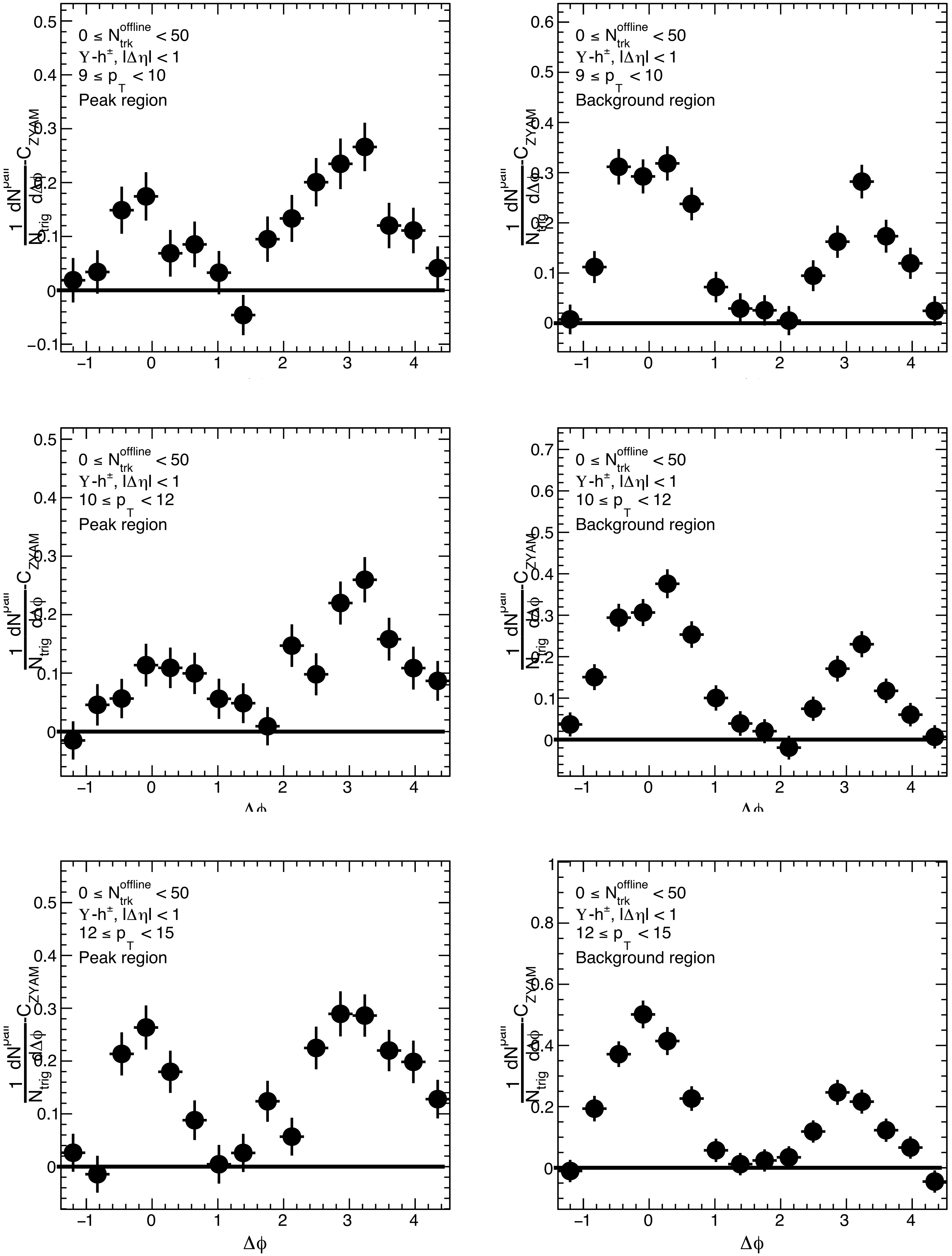
High-multiplicity 9.2 < m < 9.6



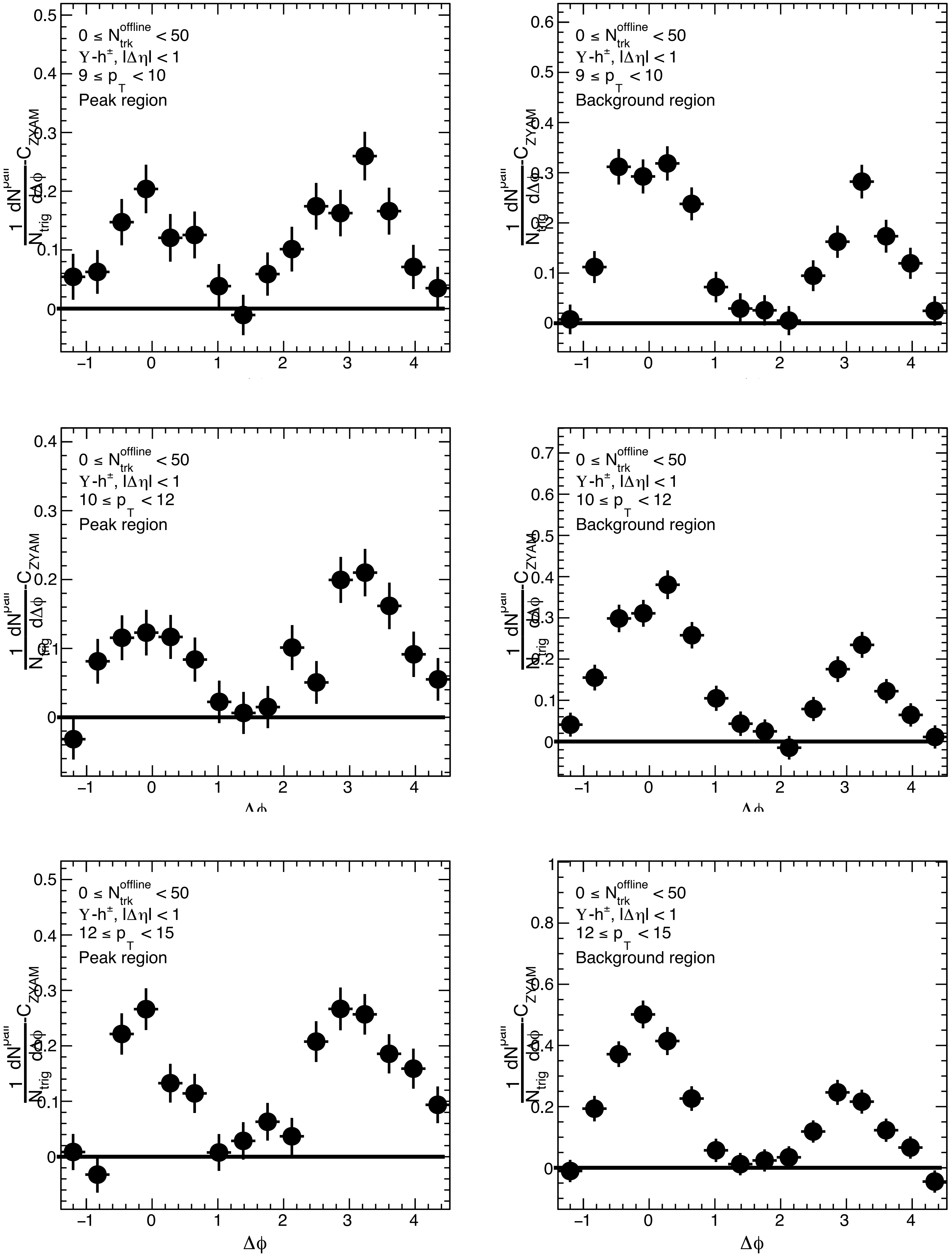
High-multiplicity 9.0 < m < 9.8



Low-multiplicity 9.2 < m < 9.6



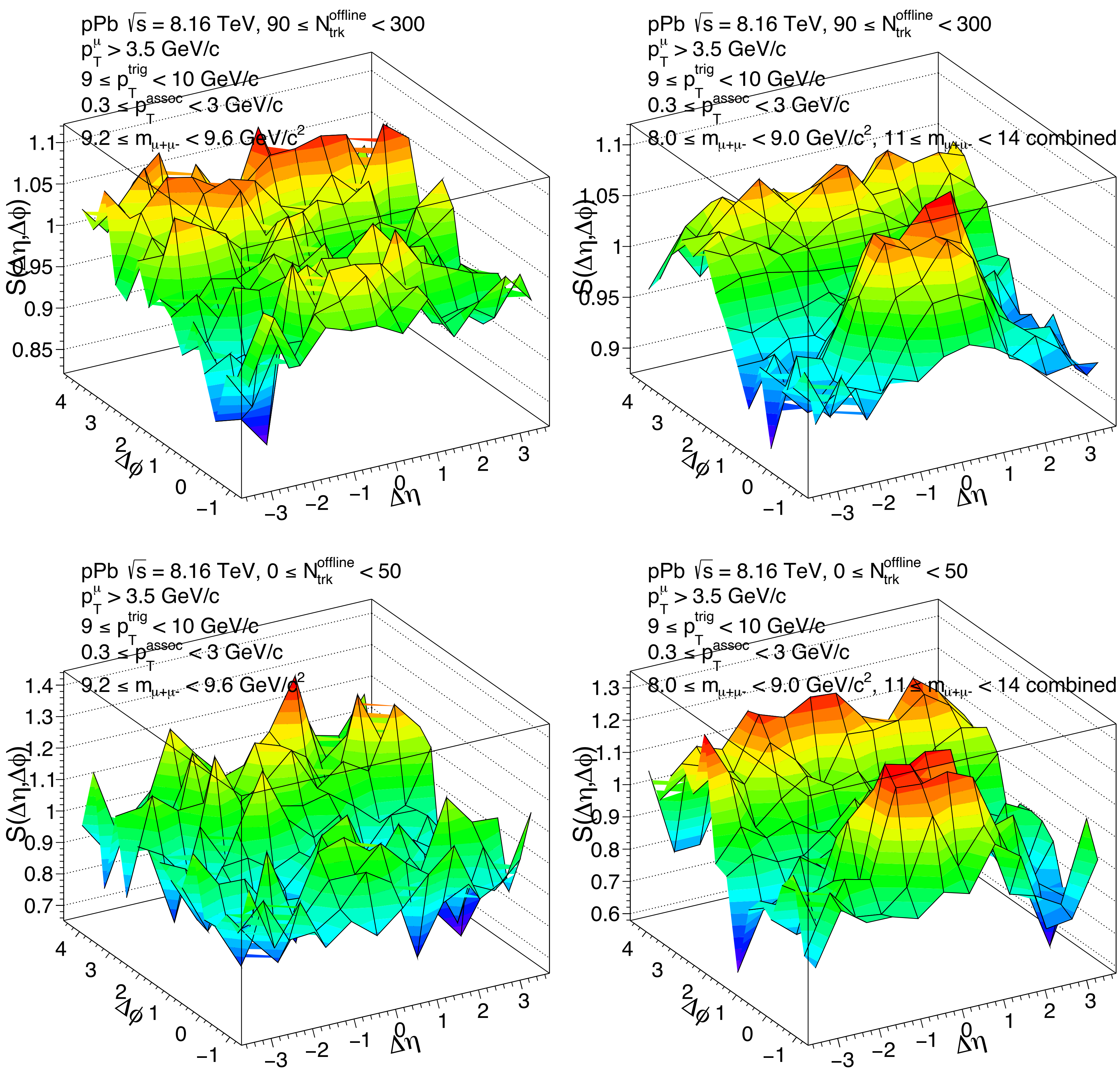
Low-multiplicity 9.0 < m < 9.8



Error propagation of Jet ratio

- $$Y_{jet}^{sig} = \frac{Y_{jet}^{peak} - (1-f)Y_{jet}^{bkg}}{f}$$
- $$\sigma_{sig} = \sqrt{\left(\frac{\sigma_{peak}}{f}\right)^2 + \left(\frac{(1-f)\sigma_{bkg}}{f}\right)^2}$$
- $$ratio = \frac{Y_{jet}^{high}}{Y_{jet}^{low}}$$
- $$\sigma_{ratio} = \frac{Y_{jet}^{high}}{Y_{jet}^{low}} \times \sqrt{\left(\frac{\sigma_{sig}^{high}}{Y_{jet}^{high}}\right)^2 + \left(\frac{\sigma_{sig}^{low}}{Y_{jet}^{low}}\right)^2}$$

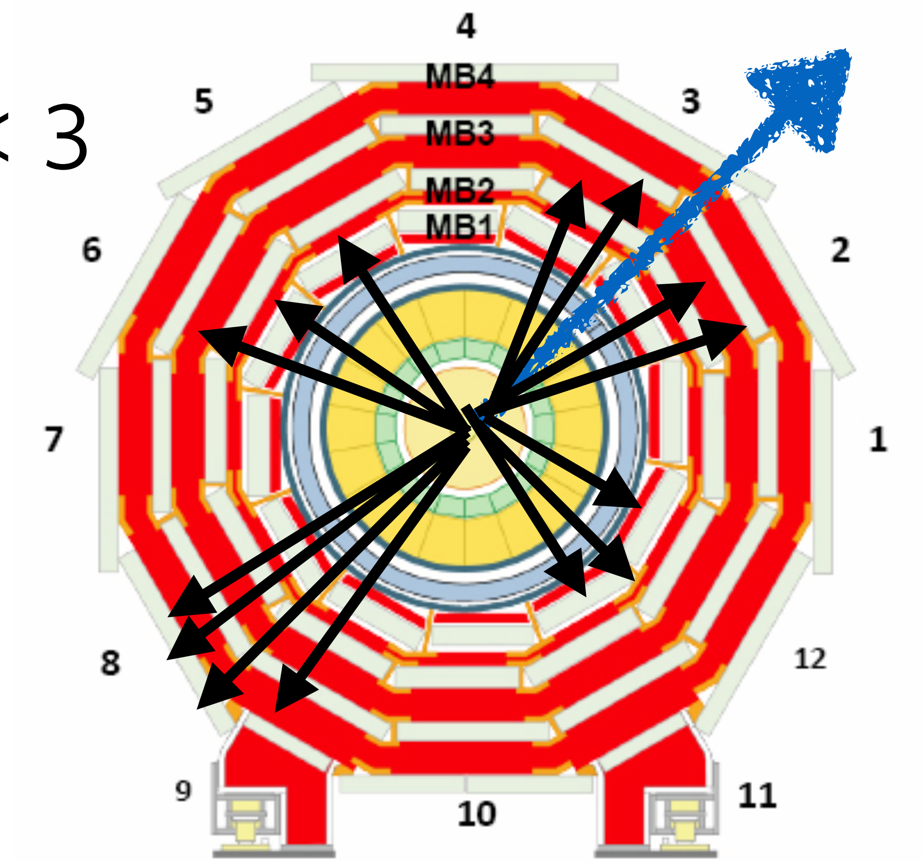
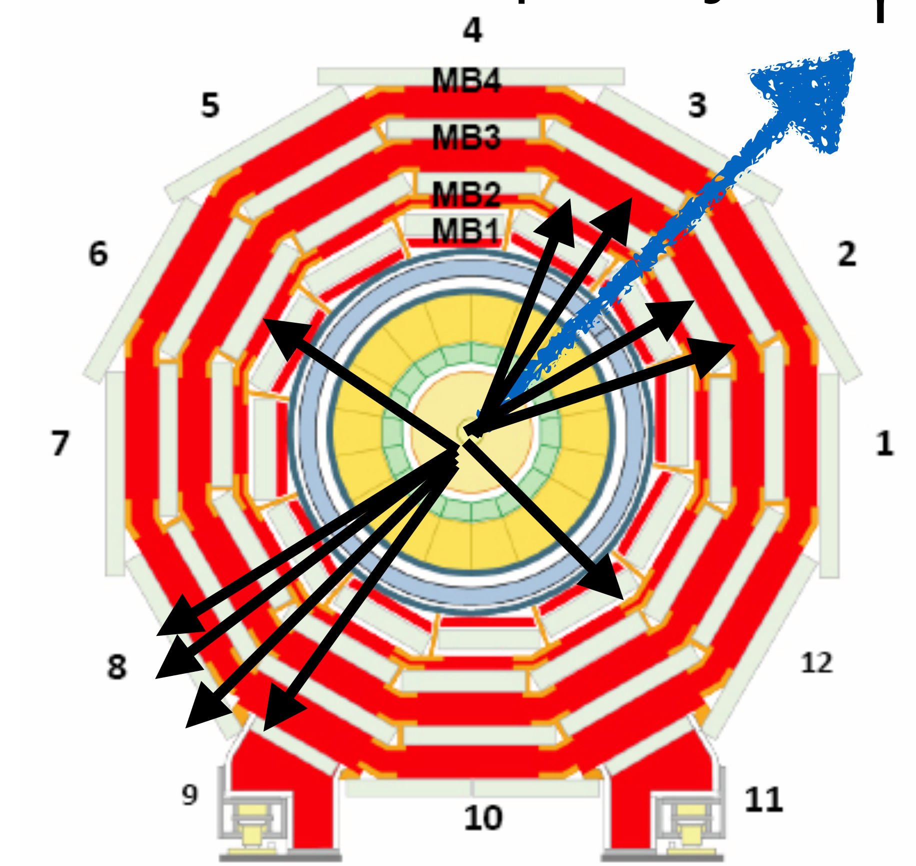
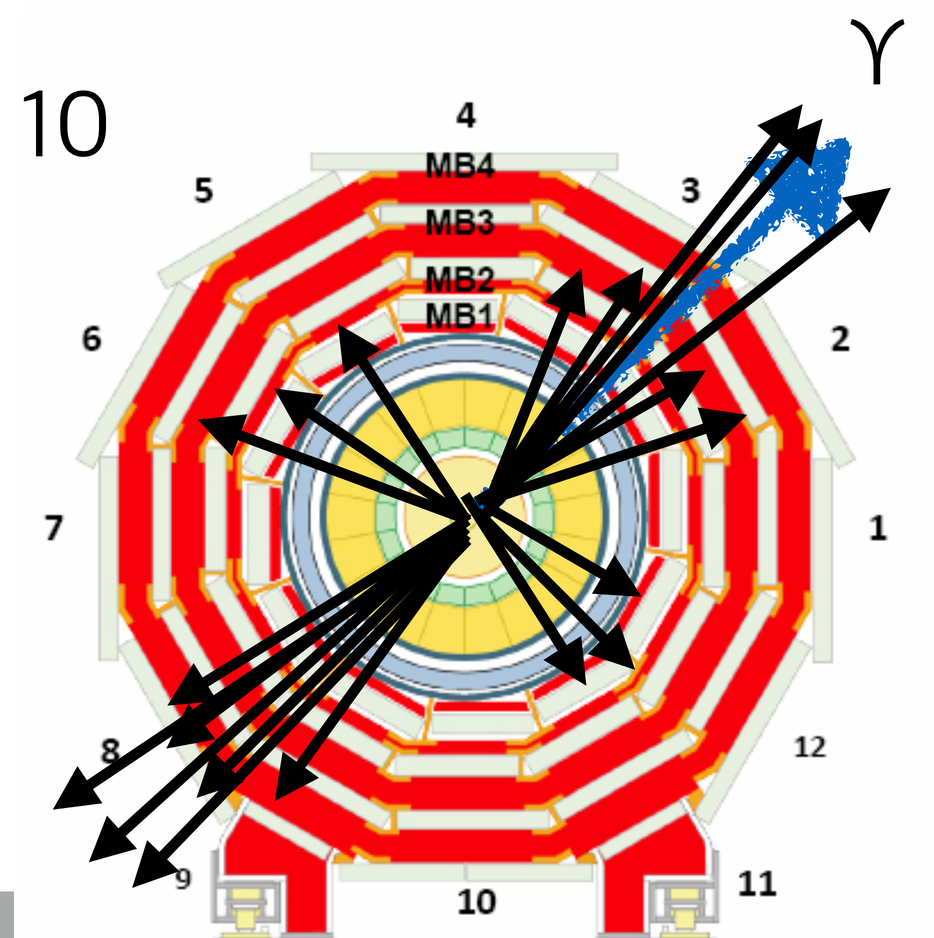
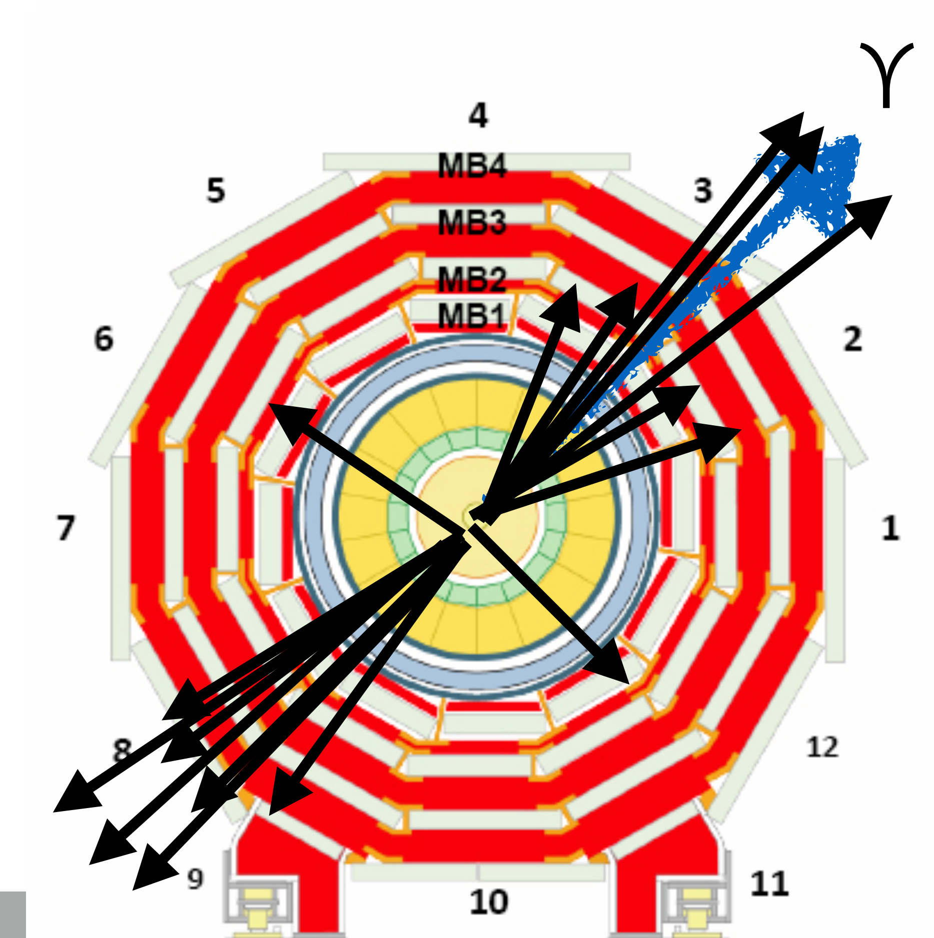
Multiplicity jet comp. 9.2 < m < 9.6



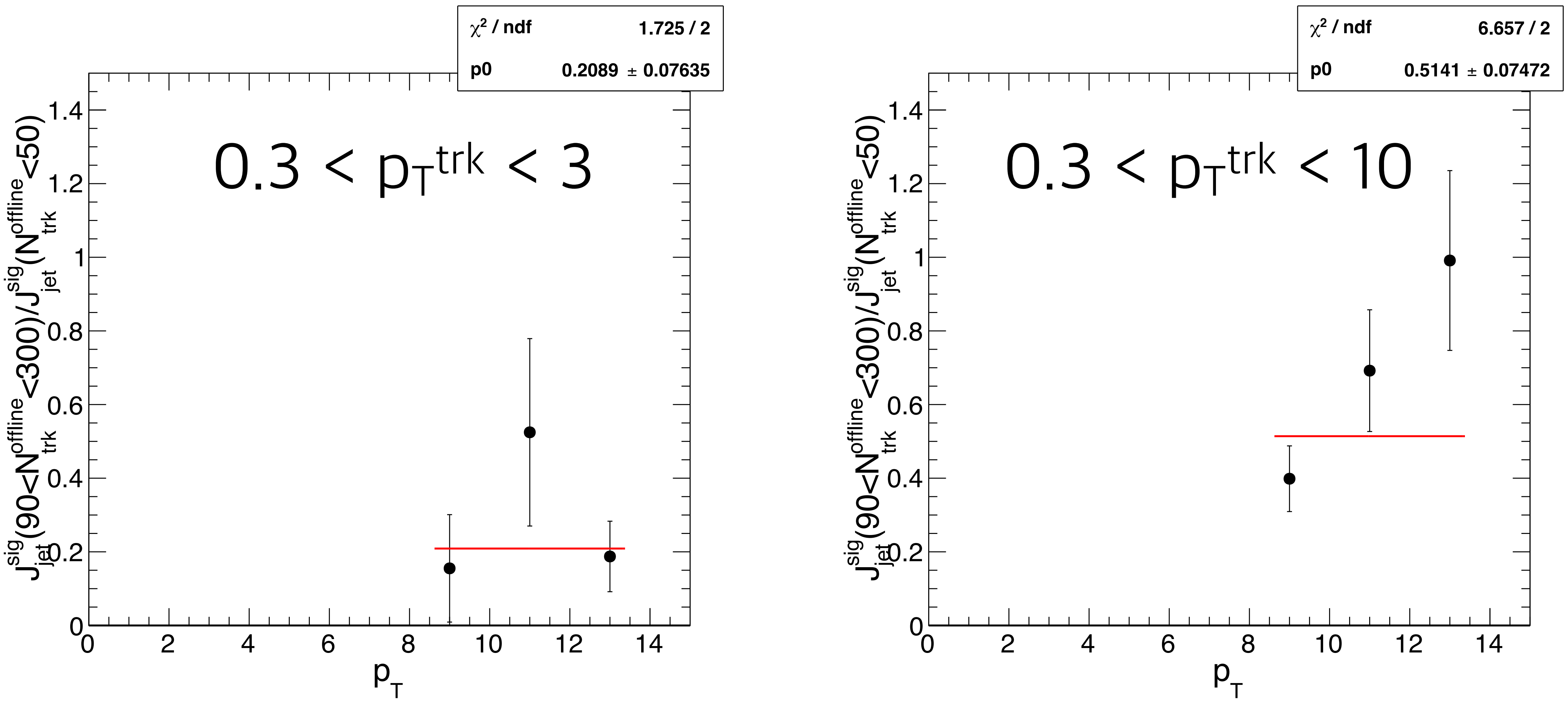
- Shape is clear for high-multiplicity
- Difference between Maximum and Minimum is higher at the low-multiplicity
- If $\Delta\phi$==1 is high, relative jet yield should be reduced

Track p_T effect

- In the low-multiplicity event, almost tracks are in the jet
- In the high-multiplicity event, there are more tracks not included in the jet region
- For the v2 analysis, associator track p_T is lower than 3 GeV/c
- If many tracks inside jet are rejected by 3 GeV/c cut, low p_T non-jet tracks are getting more dominant in the high-multiplicity
- But low-multiplicity does not affect much from the track pT cut because the non-jet tracks are rare
- Definition of jet ratio is jet portion comparison between high and low multiplicity

	High-multiplicity	Low-multiplicity
$0.3 < p_T^{trk} < 3$		
$0.3 < p_T^{trk} < 10$		

Track p_T effect



- Jet ratio increases as track p_T maximum cut increases
- Tracks inside jet portion is increased with the p_T cut in the high-multiplicity