Characteristics of correlation peak with multiplicity using di-hadron correlation in pp collisions at 13 TeV in ALICE

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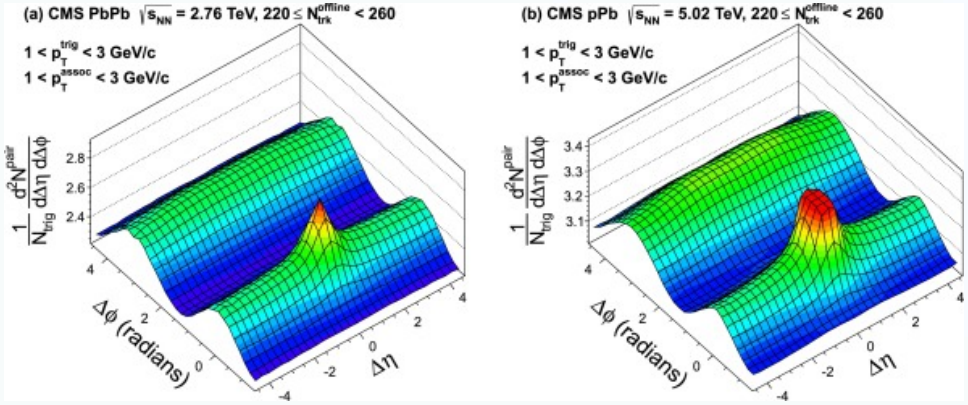
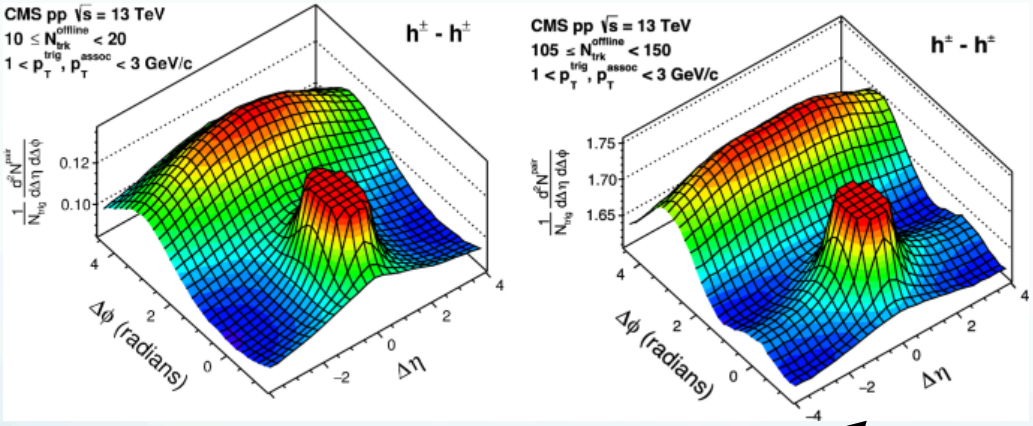
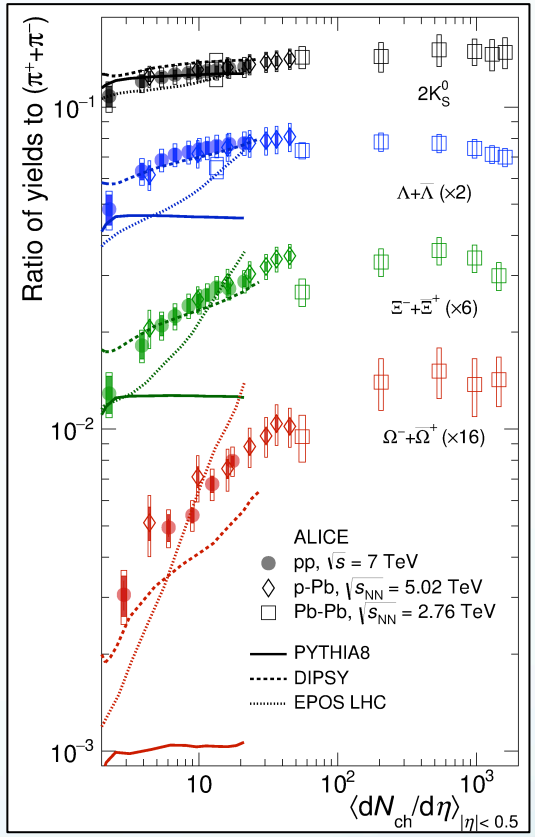
Motivation

QGP like behaviour in pp



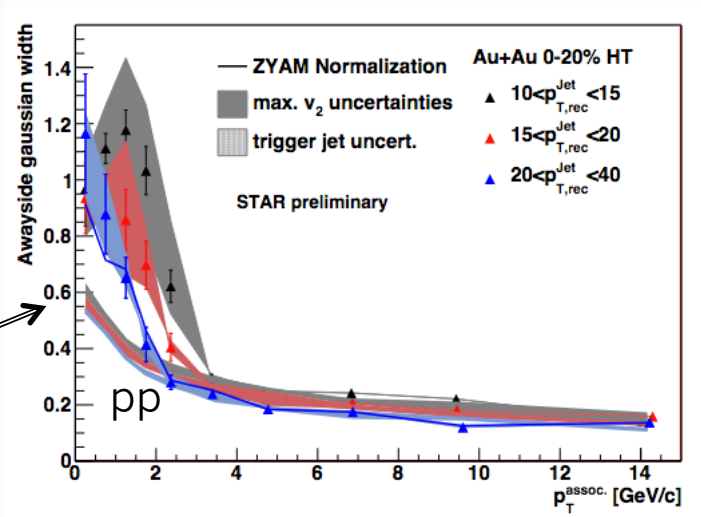


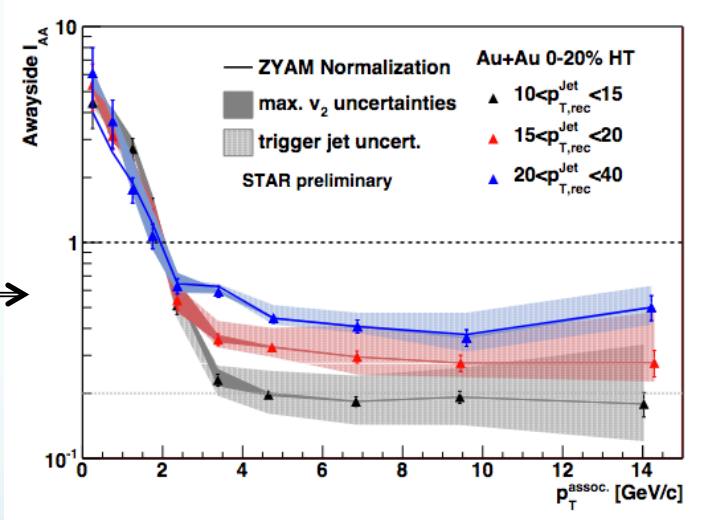


pp (High Multiplicity) unexpectedly shows ridge like structure and strangeness enhancement similar to Pb-Pb in Run-1 and Run-2 LHC

Reason is under investigation

- We know, in heavy-ion collisions, partons lose energy in the medium
- What should we see in angular correlation studies? **Softer and broader distribution of hadrons around the jet axis than seen in pp**
- The widths of the heavy-ion jet appear broader
- Effect is more in awayside as the recoiled parton travels through a significant amount of the medium
- Significant softening of the awayside jets has been observed in heavy-ion [1]





We are probing the modification of jet-like yields and widths in pp collision

[1] A. Ohlson [STAR], "Jet-hadron correlations in STAR," J. Phys. Conf. Ser. 316 (2011), 012015, arXiv:1106.6032 [nucl-ex]

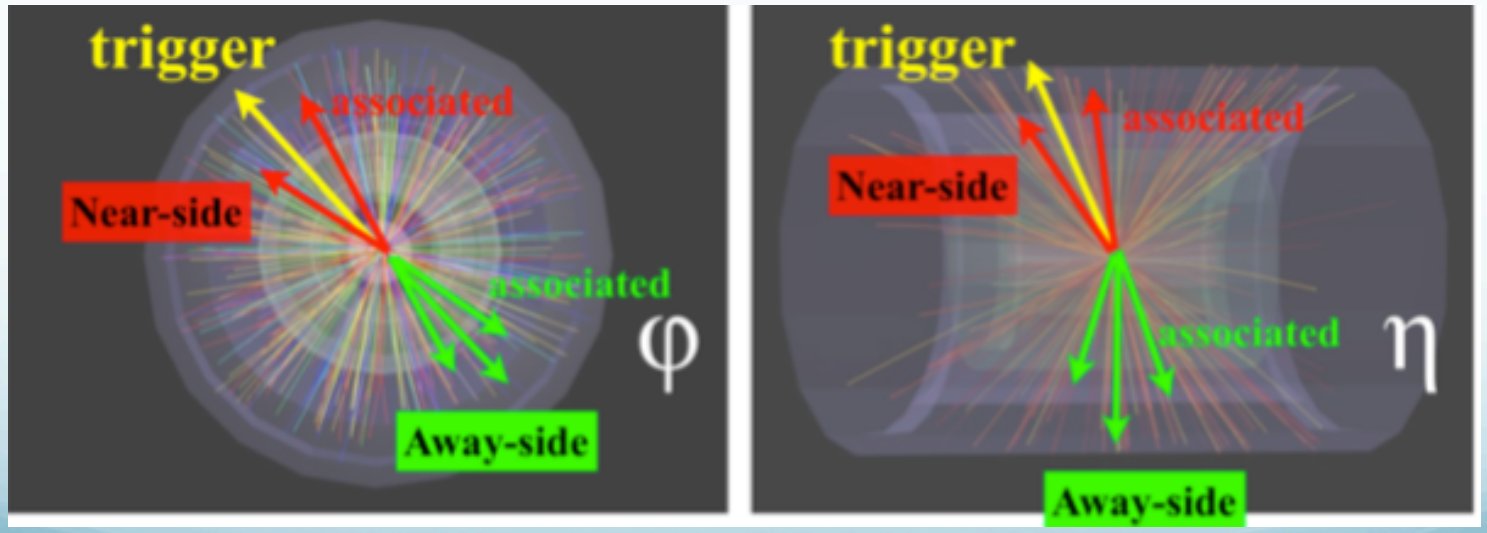
Measurement of correlation in data

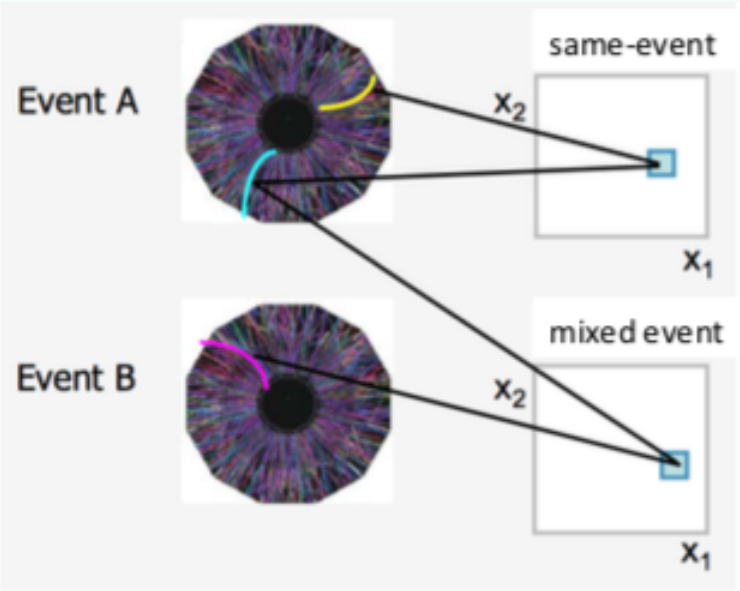
- **What is Correlation ?** Given a particle (trigger), what is the probability of finding another particle (associated) at a relative angle

- Two particle correlation between pairs of triggers and associate hadrons in Δη-Δϕ space is defined as,

$$C(\Delta\eta,\Delta\phi)=\frac{1}{N_{trig}}\frac{d^2N_{asso}}{d\Delta\eta\Delta\phi}=B(0,0)\frac{S(\Delta\eta,\Delta\phi)}{B(\Delta\eta,\Delta\phi)}$$

$$\Delta\phi=\phi_{trig}-\phi_{asso},\Delta\eta=\eta_{trig}-\eta_{asso}$$

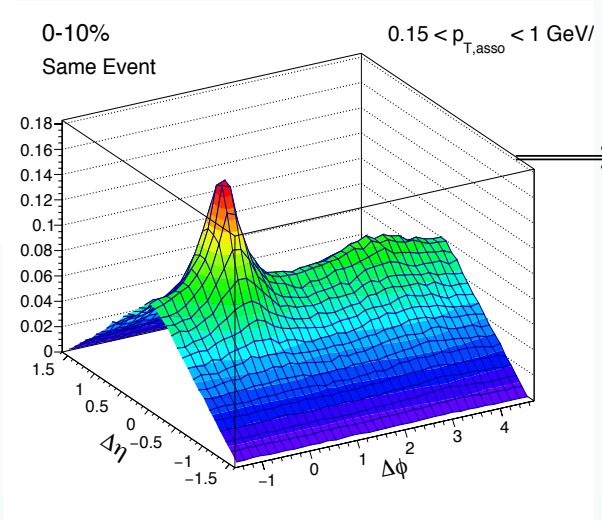




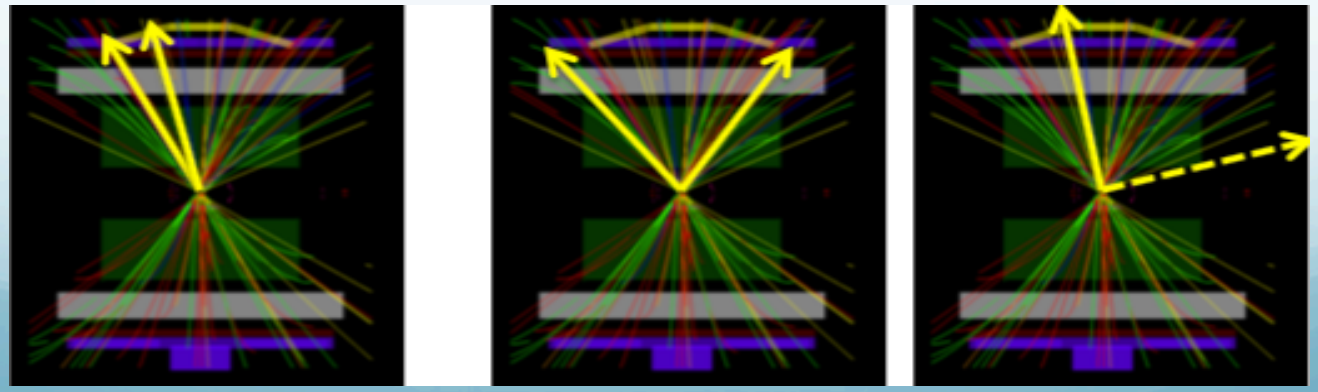
The signal (SE):

$$S(\Delta\phi,\Delta\eta)=\frac{1}{N_{trig}}\frac{d^2N_{same}}{d\Delta\phi\Delta\eta}$$

- True physics correlation + finite detector acceptance effect + background due to uncorrelated pairs



- Due to the finite acceptance in η --- the probability of reconstructing pairs in small Δη is large (triangular shape) --- Pair acceptance

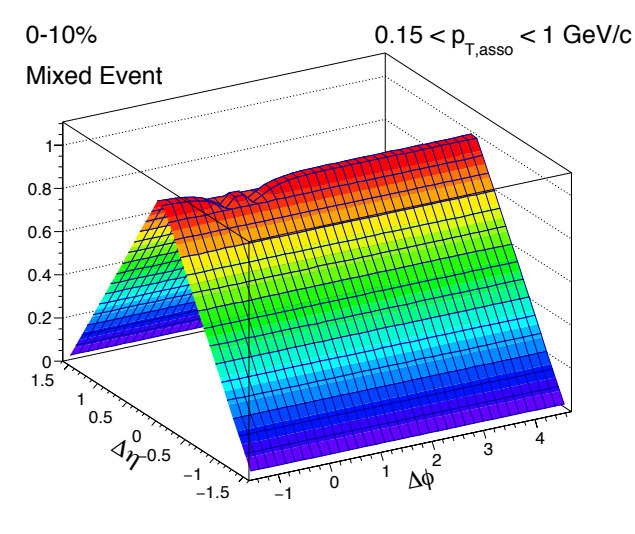


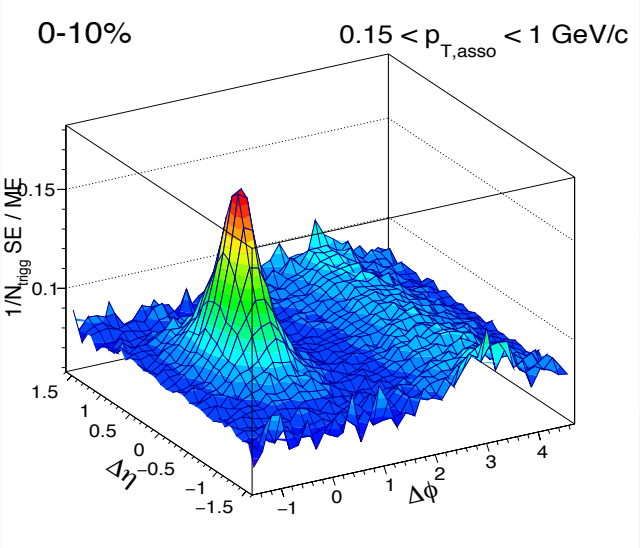
To correct for this pair acceptance and to remove background due to uncorrelated pairs : mixed event method is used

The Background (ME):

$$B(\Delta\phi,\Delta\eta)=\frac{d^2N_{mixed}}{d\Delta\phi\Delta\eta}$$

- No physics correlation - only finite detector acceptance effect + background due to uncorrelated pairs





- *We divide correlation functions of the Signal with mixed event to extract the true physics correlation*
- The pair counts in the mixed event are normalized with the value at (0,0) to make it 1

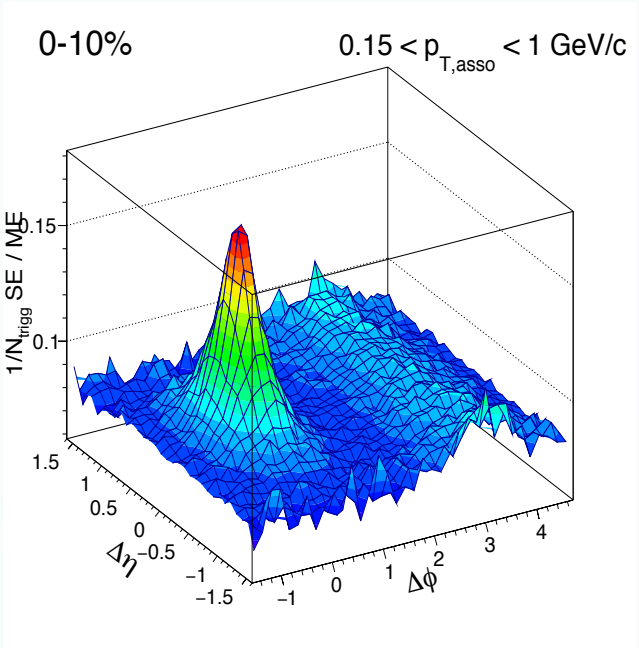
Analysis details

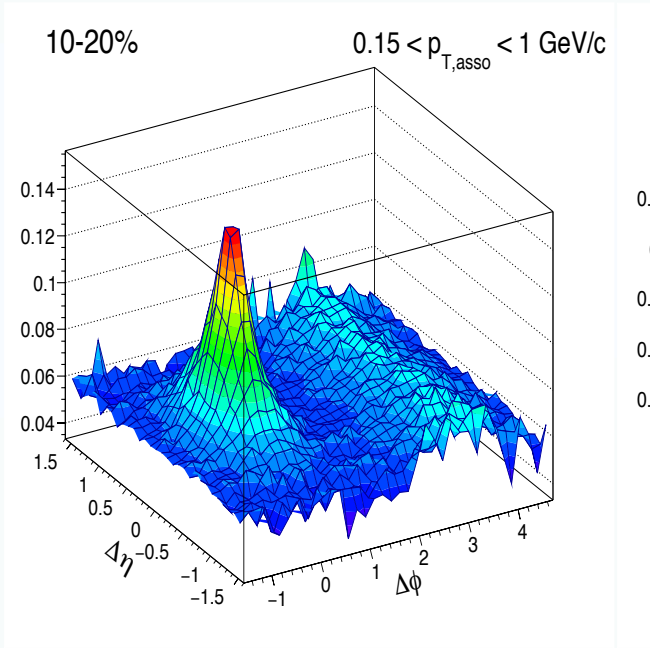
- Dataset : LHC17 and LHC18 all dataset
- MC dataset: All sets anchored to LHC17 and LHC18

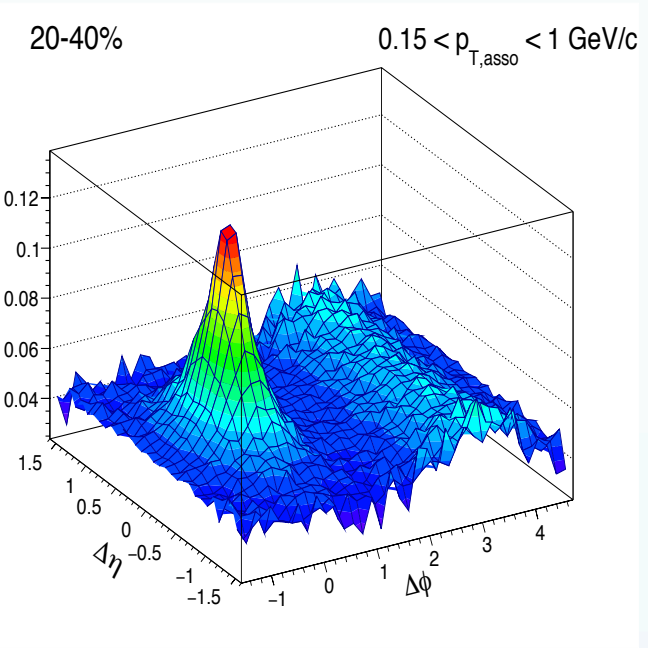
- Event cuts: Trigger kINT7 (V0AND, hit in both V0A and V0C): Minimum bias trigger and rejection of background events, |Z-Vertex| < 10 cm, Physics selection Task is used to select collision candidates in data and reject background and poor quality events

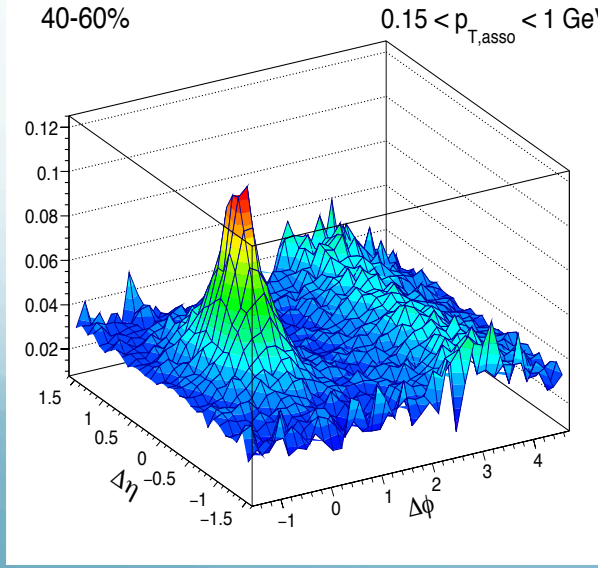
- Track cuts:
  - Filter Bit 768 (hybrid tracks with tighter DCA cut)
  - $|\eta| < 0.8$
  - Trigger p_T : $p_T > 10$ GeV/c, Associate p_T : $0.15 < p_T < 10$ GeV/c
  - Track merging correction is included
  - Centrality estimator: V0M

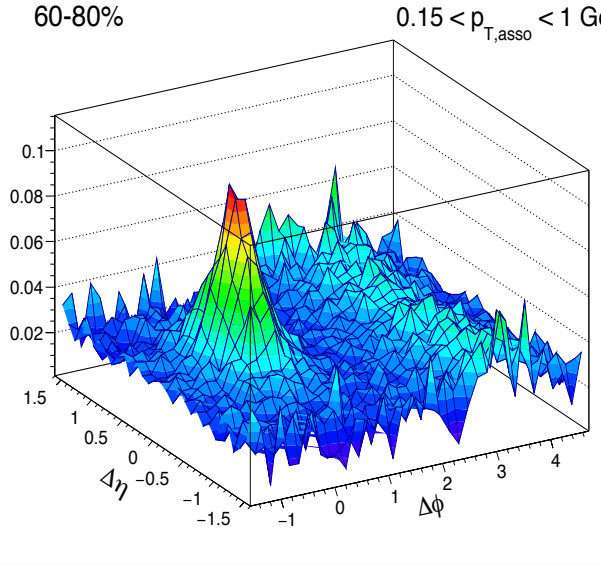
Raw correlation function







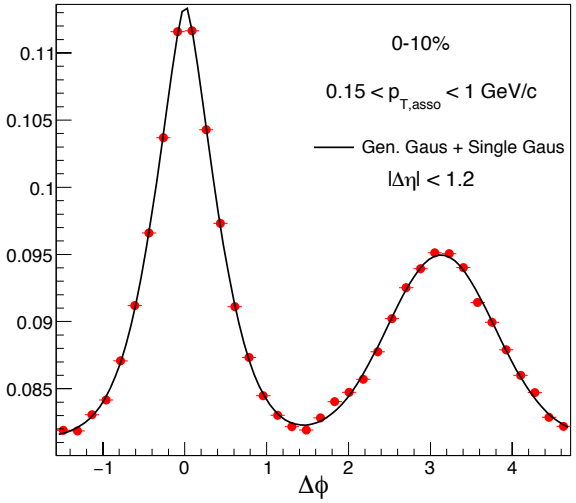


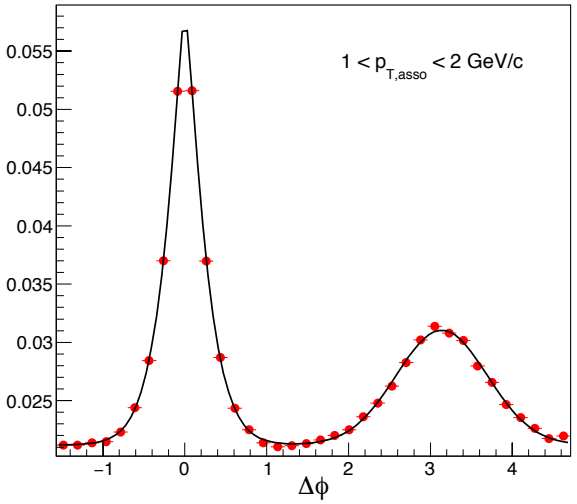


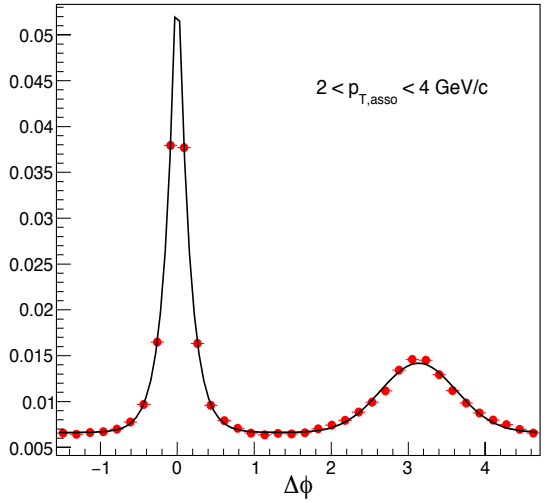
$p_{T,trigg} > 10$ GeV/c

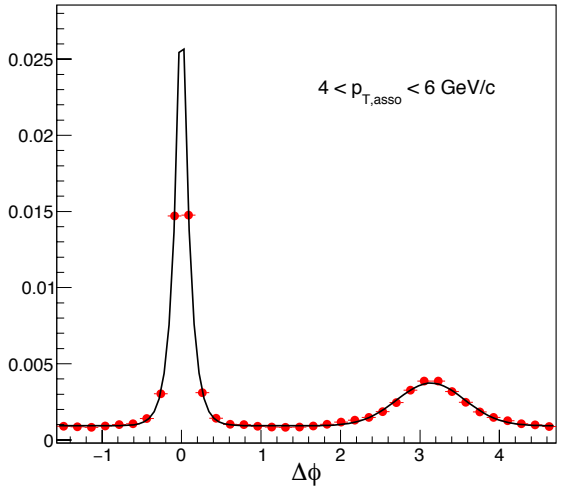
$0.15 < p_{T,asso} < 1$ GeV/c

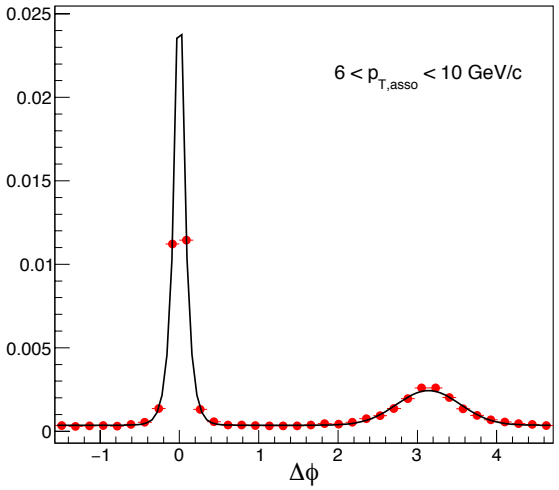
Δϕ projection of correlation function







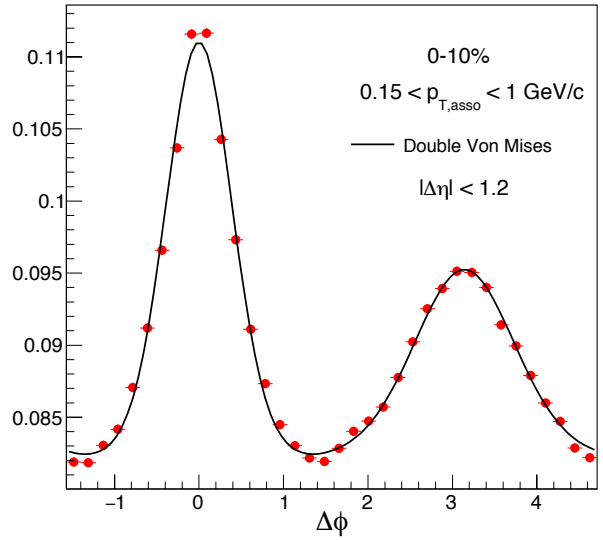


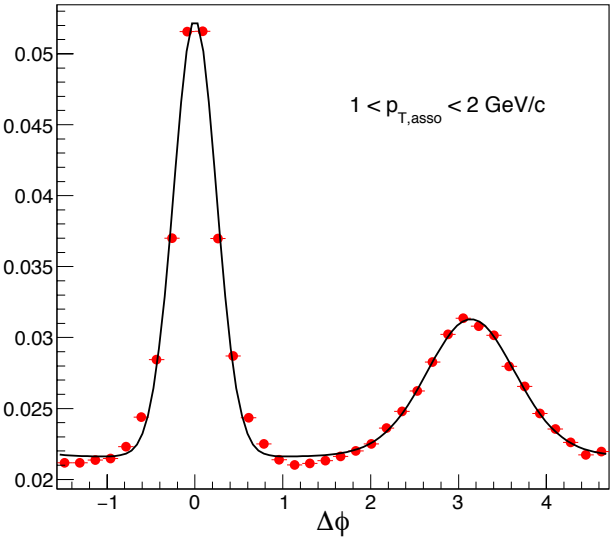


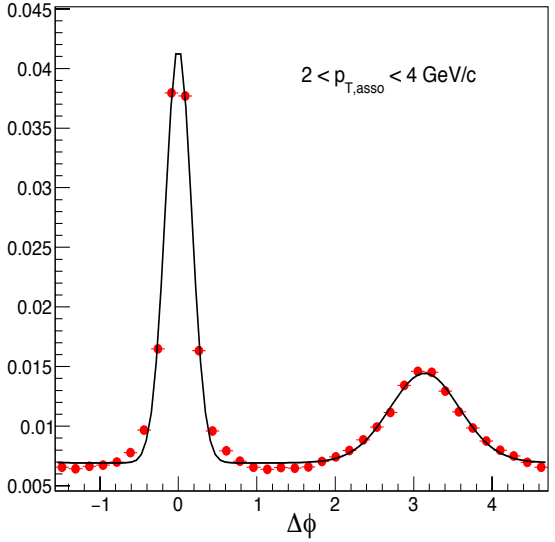
$$f = \frac{A}{2\sigma\Gamma(1/\alpha)} e^{-\left(\frac{x-\mu}{\sigma}\right)^{\alpha}}$$

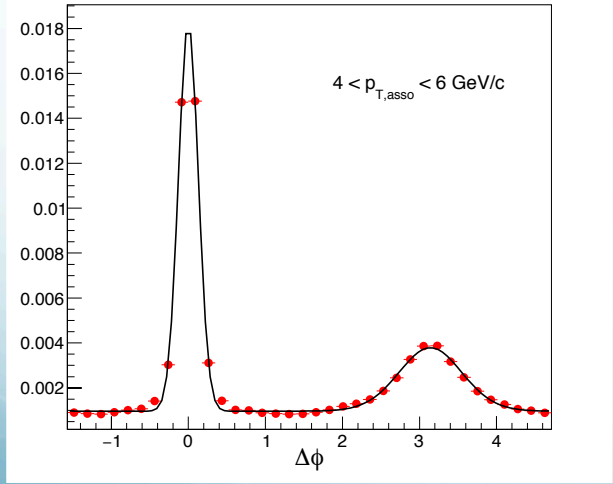
Generalized Gaus (NS) + Std. Gaus (AS)

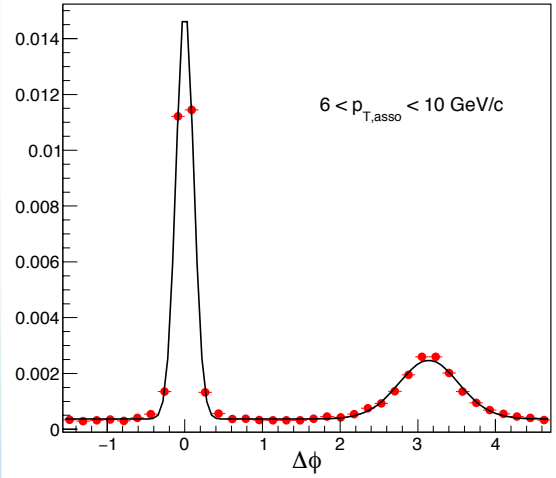
Δϕ projection of correlation function









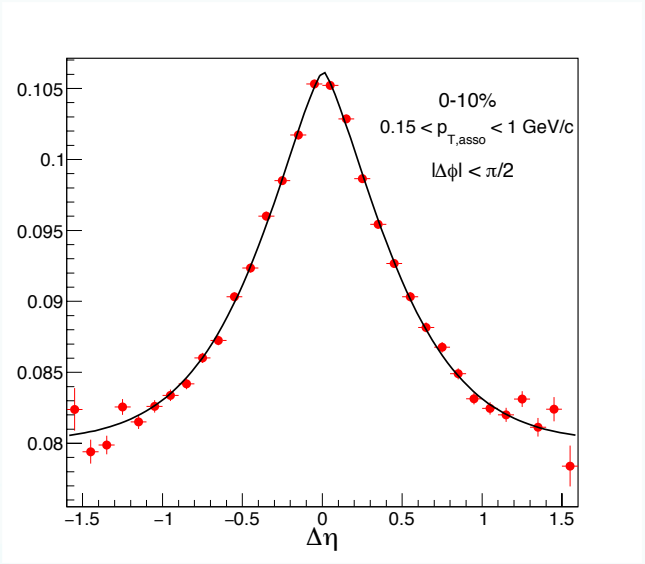


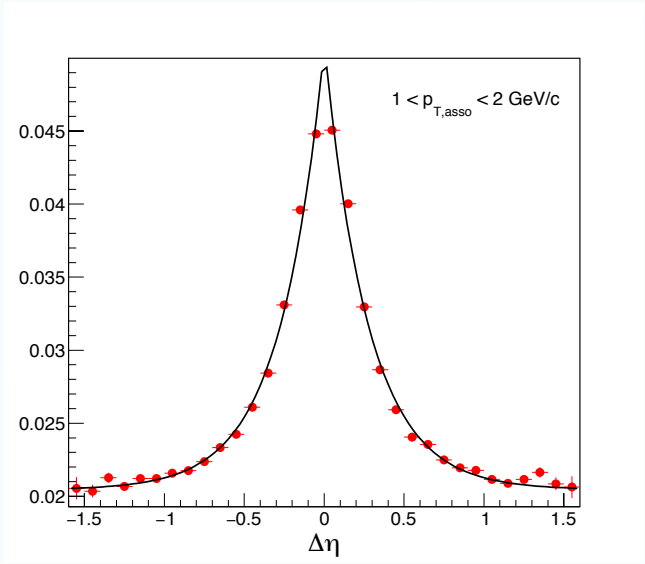
$$f = \frac{A}{2\pi I_0(\kappa)} e^{\kappa Cos(x-\mu)}$$

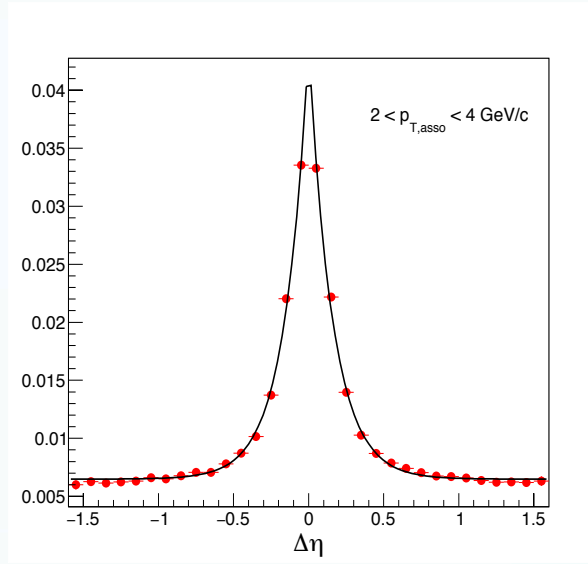
$$1/\kappa \approx \sigma^2$$

Von Mises function

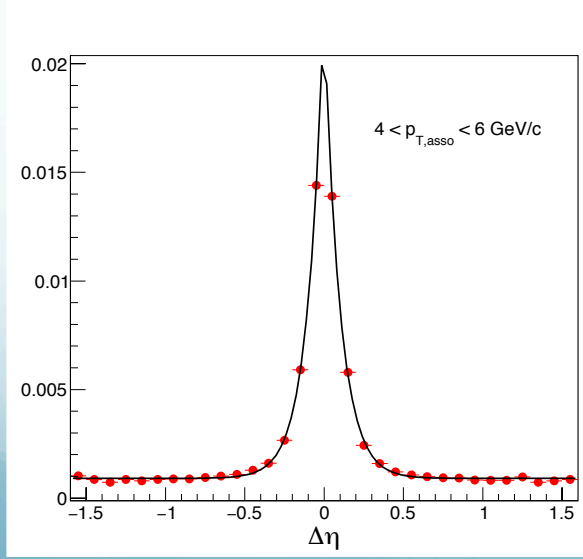
Δη projection of correlation function

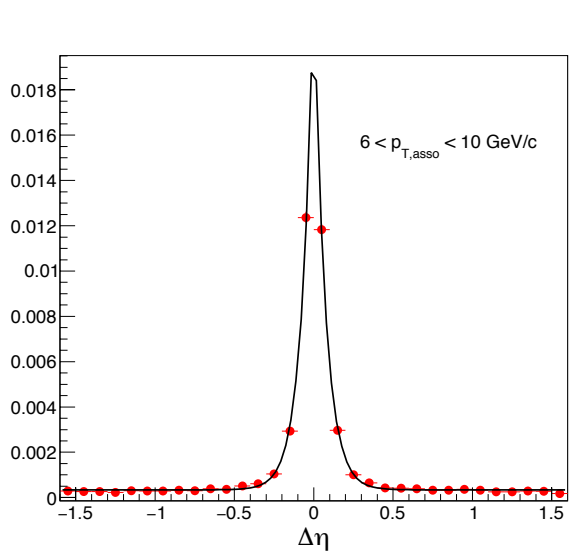




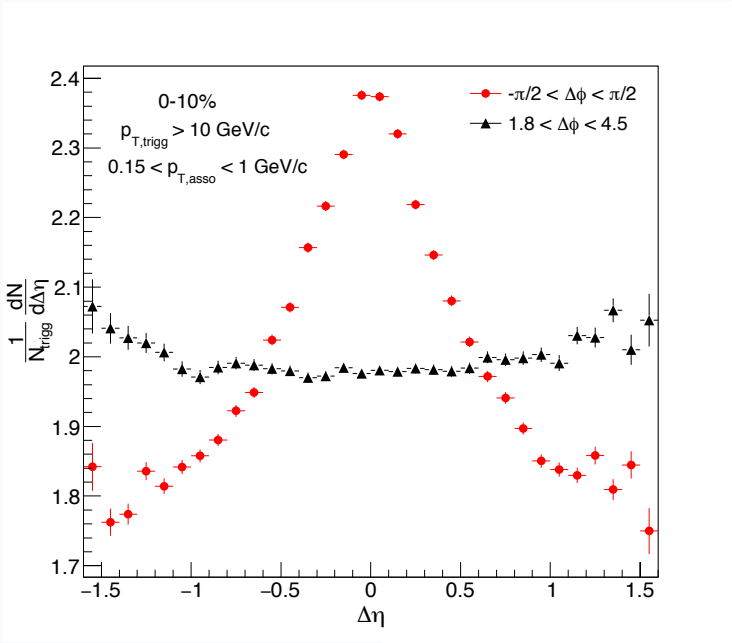


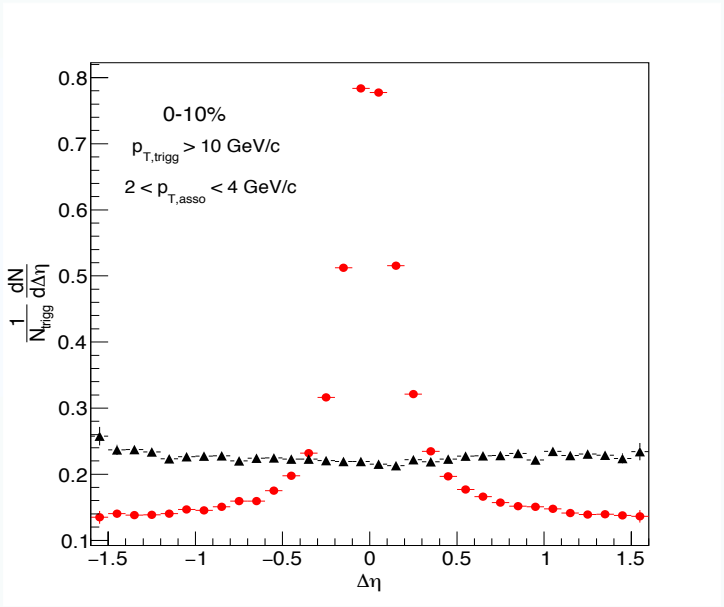
Generalized Gaus

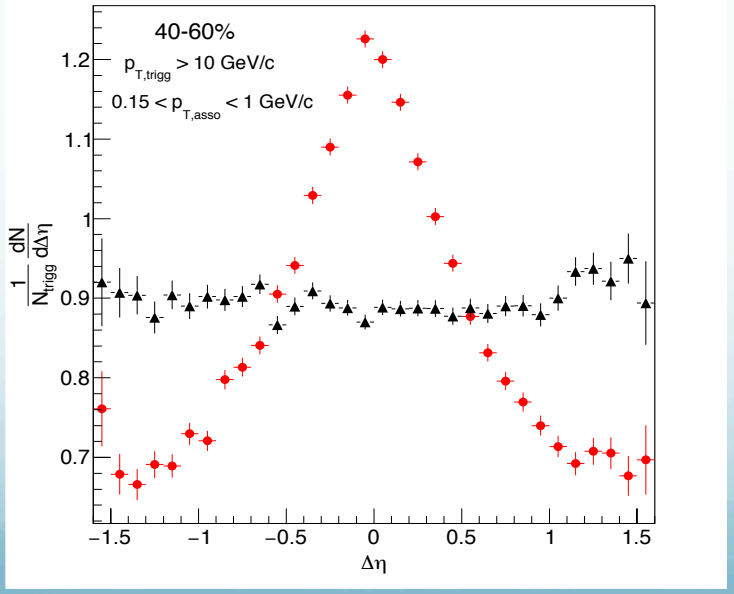




Δη projection of correlation function

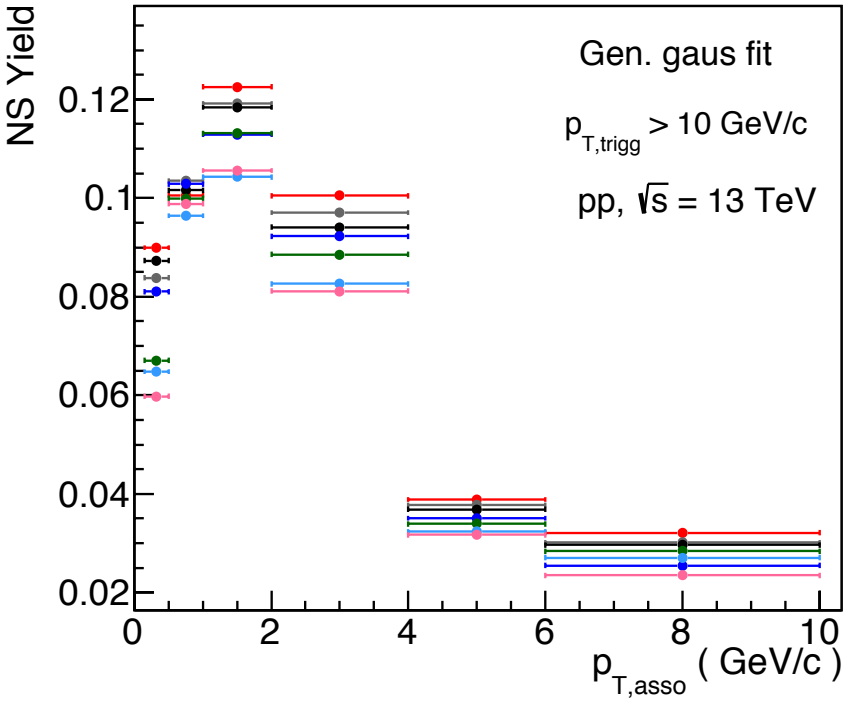


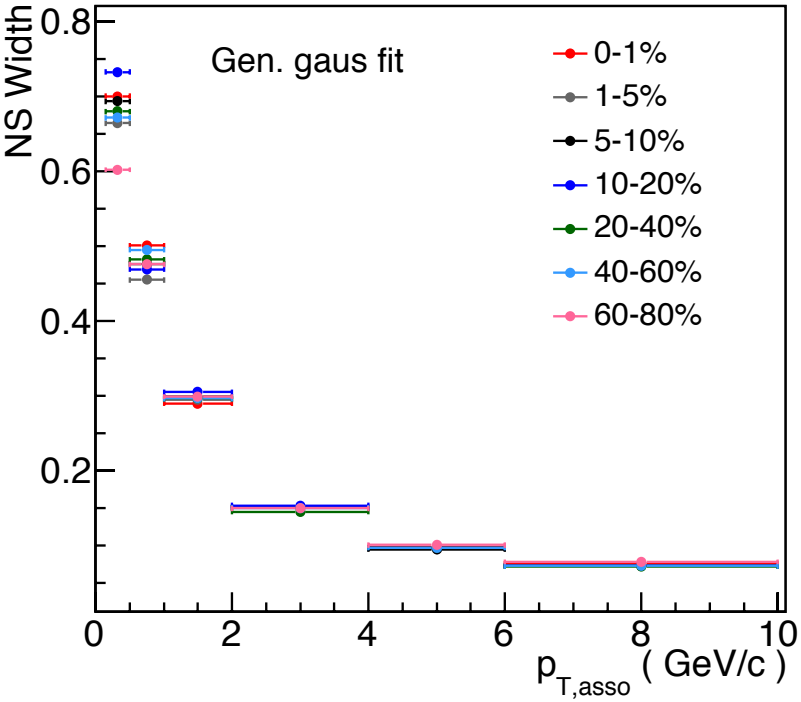




Nearside yield and width from Gen. Gaus

Raw data



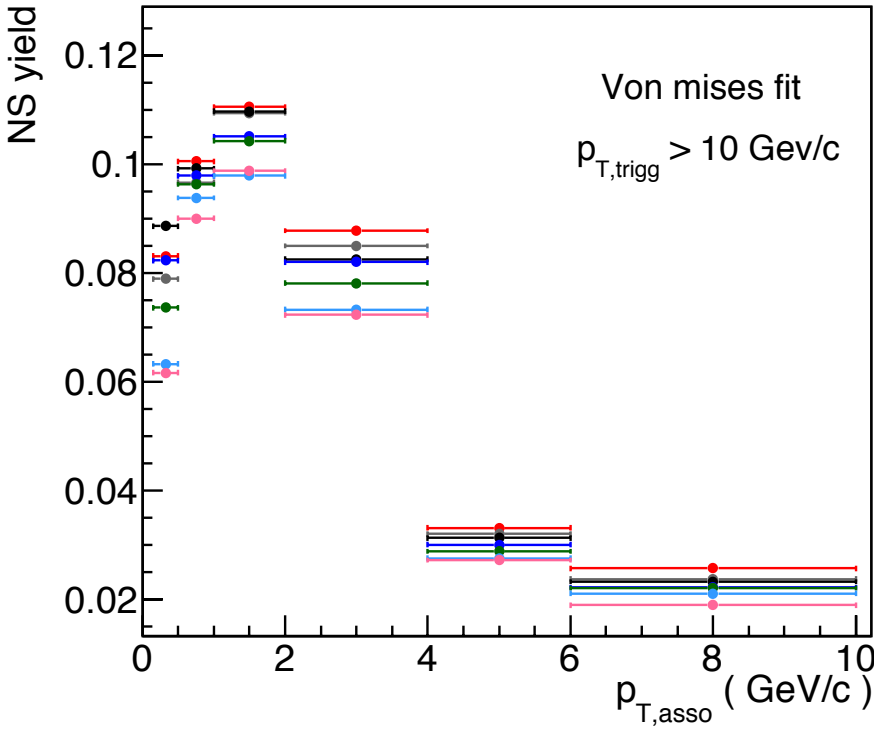


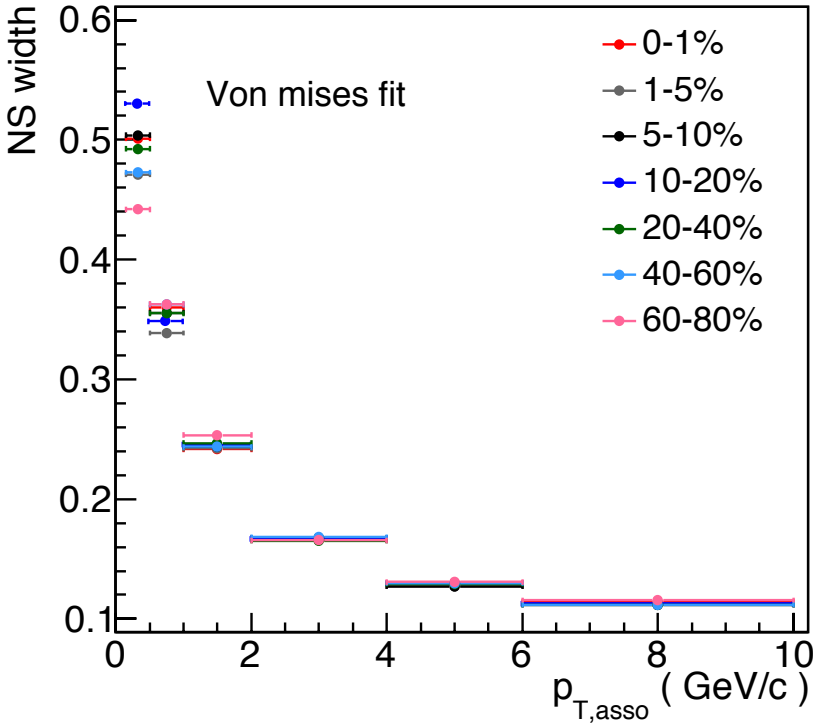
$-\pi/2 \leq \Delta\phi \leq \pi/2$

Yield and width decrease with increasing p_T

Nearside yield and width from Von mises

Raw data

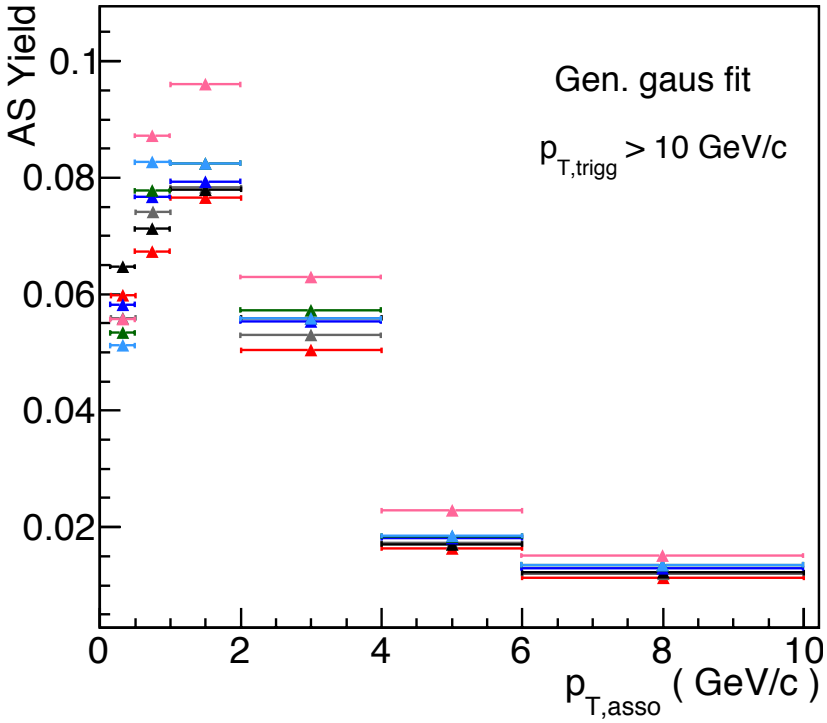


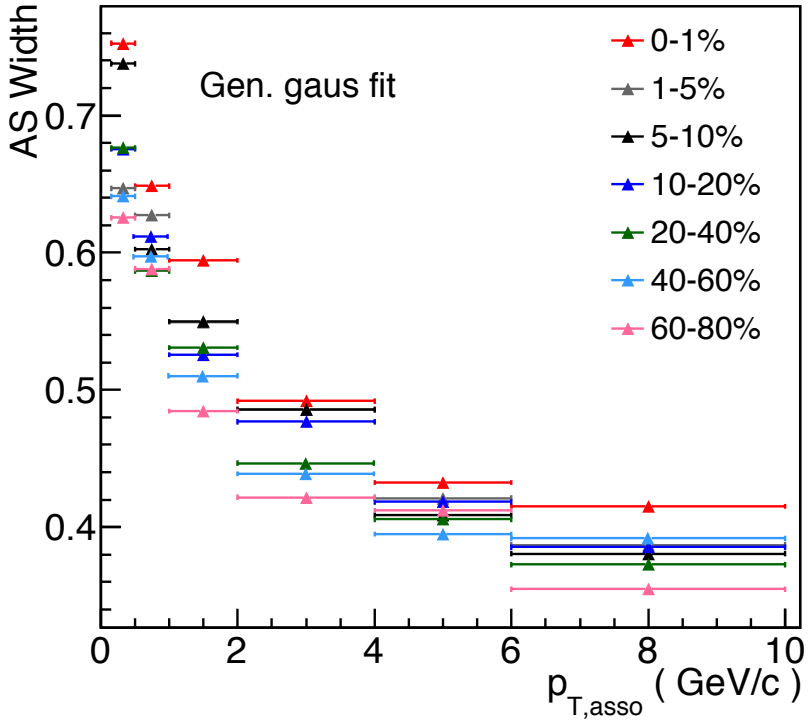


$-\pi/2 \leq \Delta\phi \leq \pi/2$

Awayside yield and width from Gaussian

Raw data



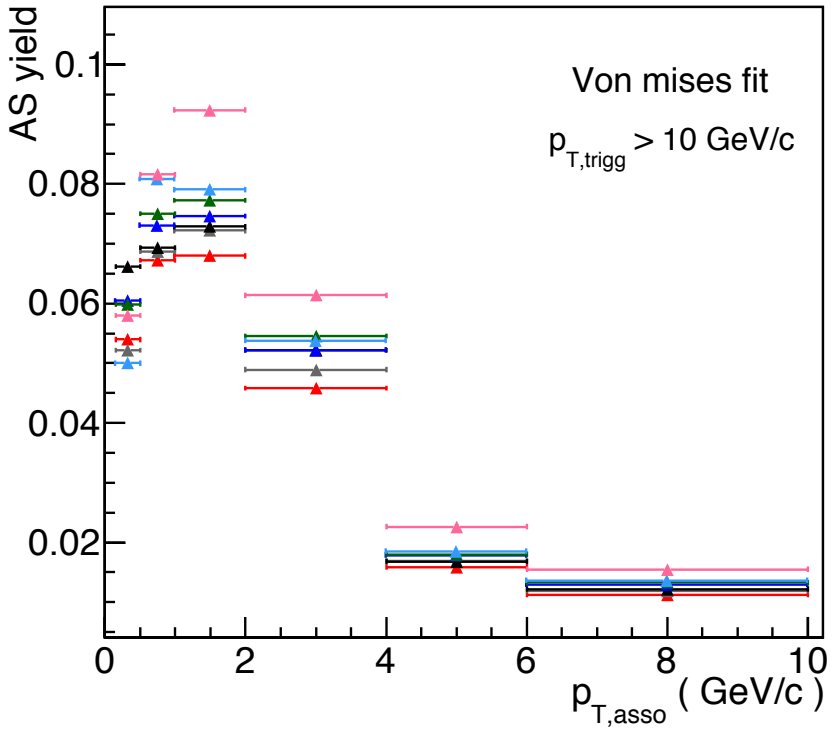


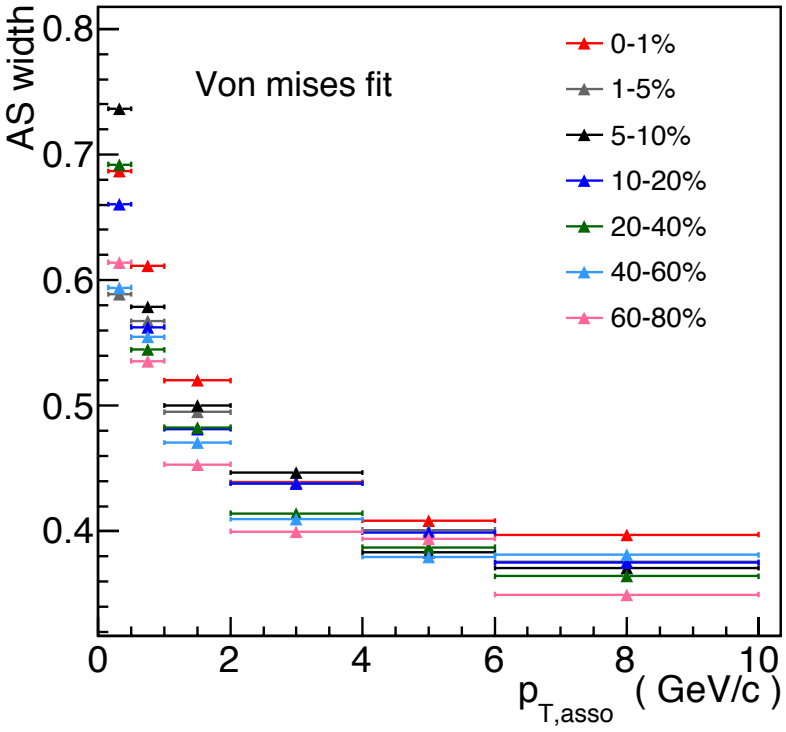
$1.8 \leq \Delta\phi \leq 4.5$

Yield and width decrease with increasing p_T

Awayside yield and width from Von Mises

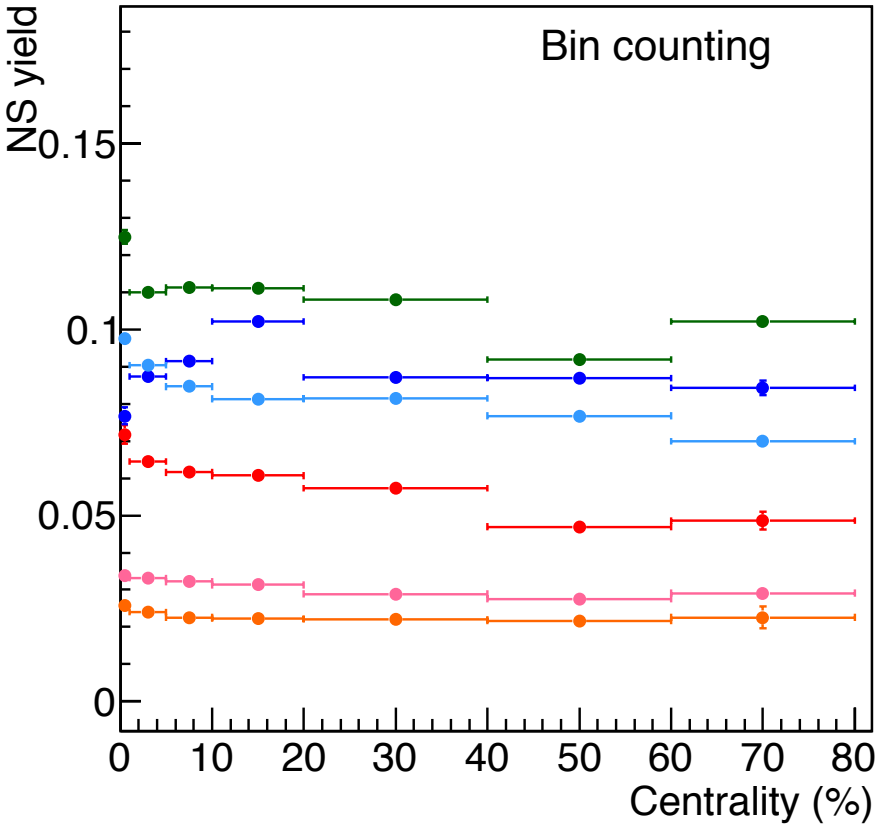
Raw data

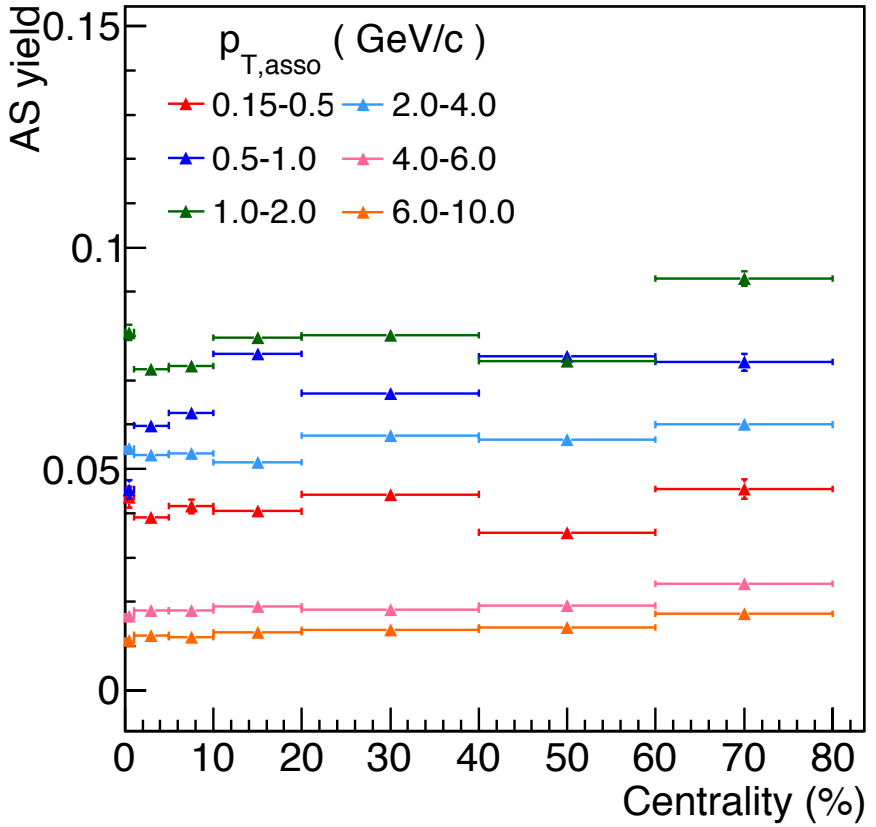




$1.8 \leq \Delta\phi \leq 4.5$

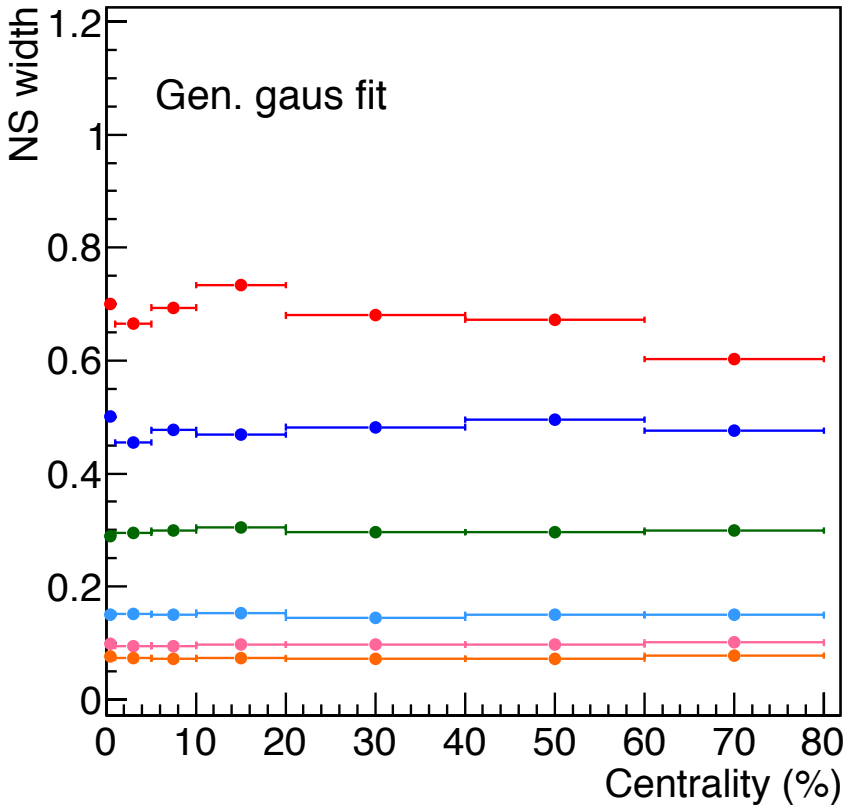
Nearside and awayside yield vs centrality

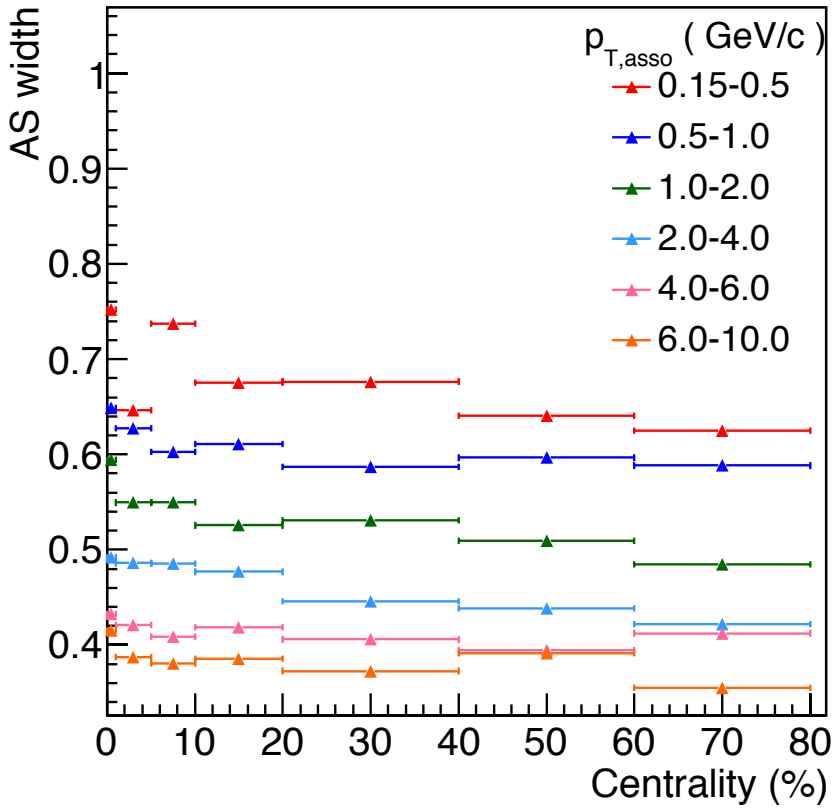




No significant multiplicity dependence – ratio needs to be taken

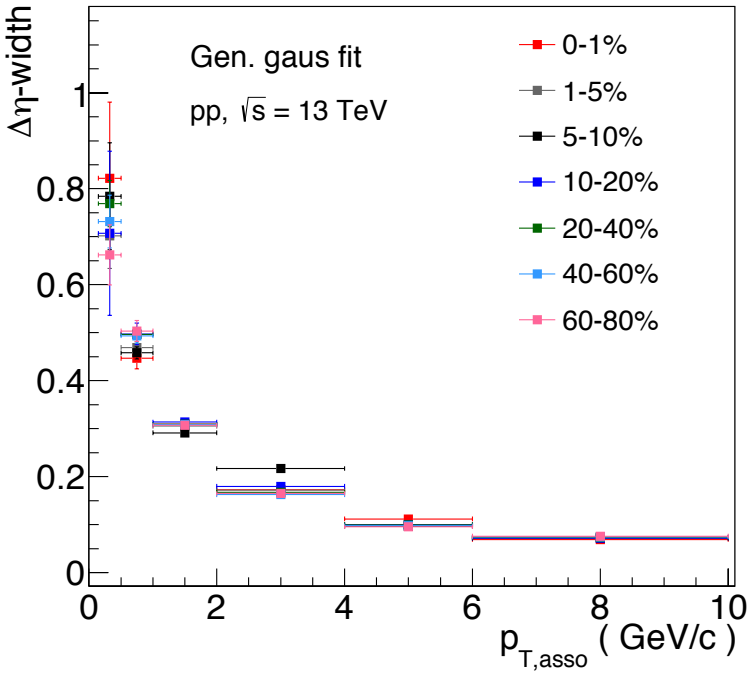
Nearside and awayside width vs centrality

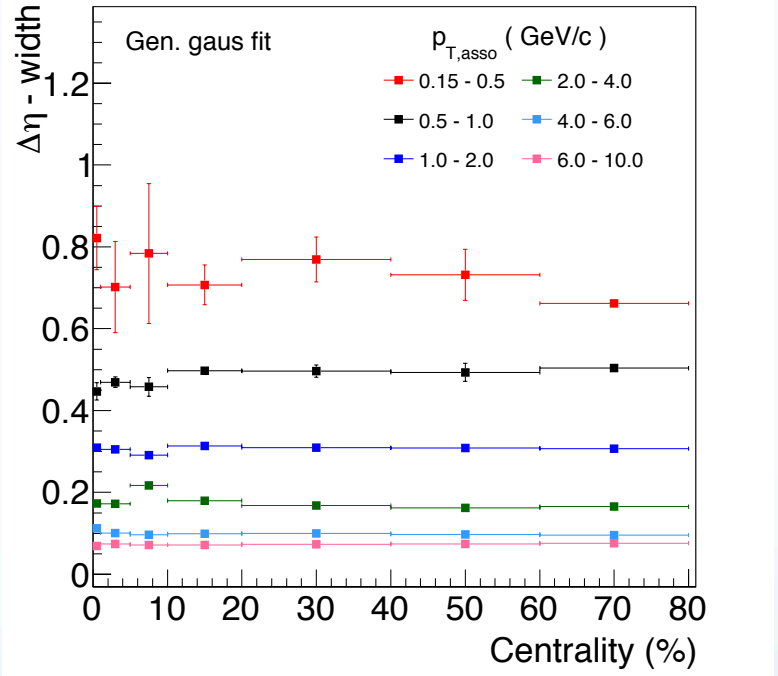




Δη-width of correlation function

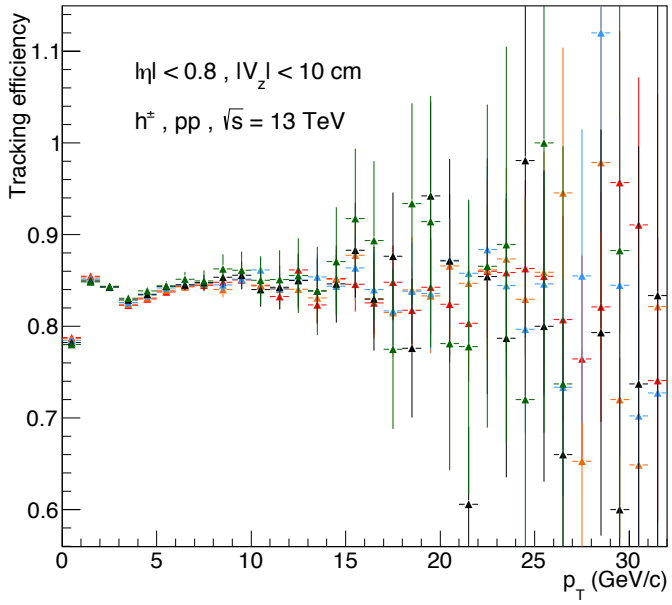
$-\pi/2 \leq \Delta\phi \leq \pi/2$

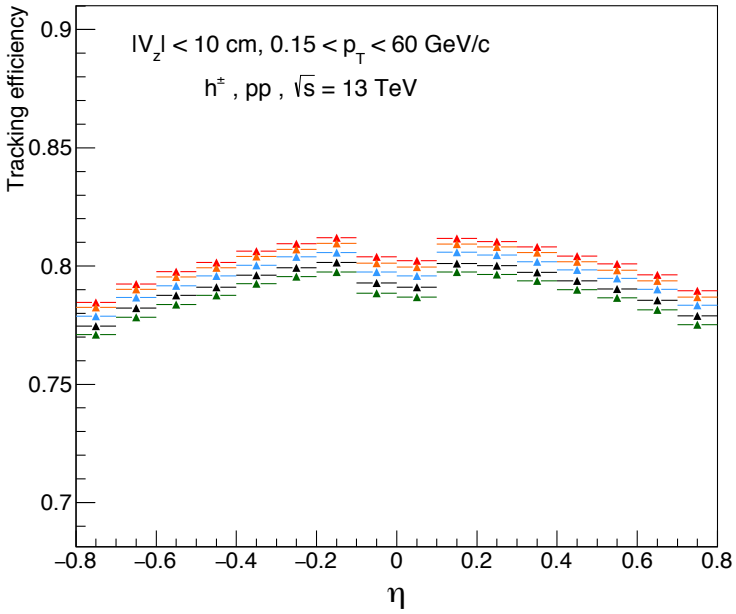


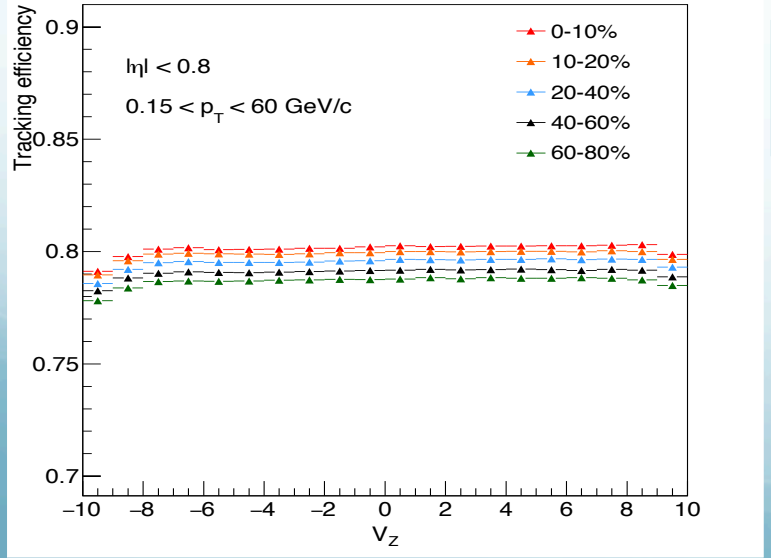


- Width in **Δη** decreases with increasing p_T
- No significant multiplicity dependence – need to take ratio

Efficiency correction



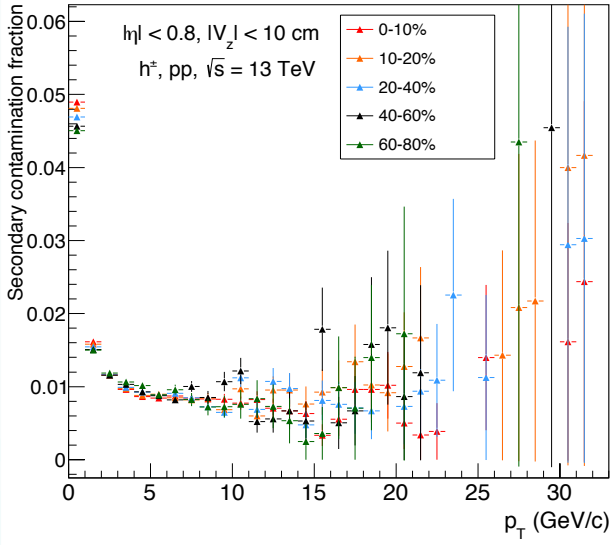


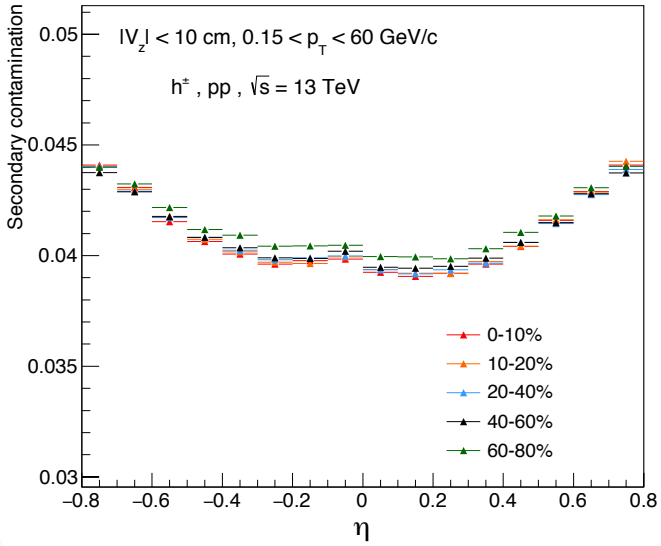


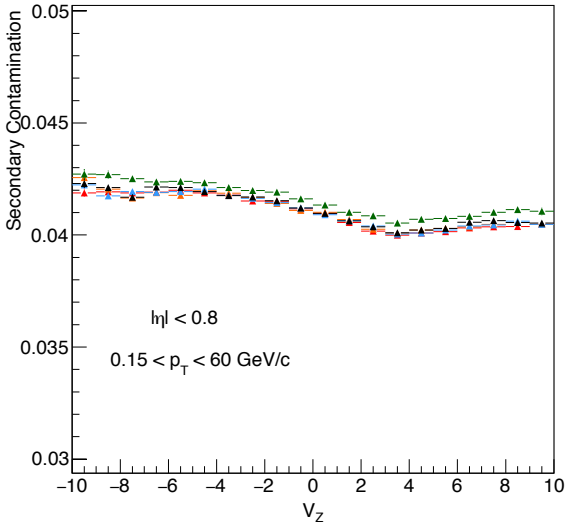
$$\epsilon = \frac{No.\ of\ reconstructed\ primary\ hadrons}{No.\ of\ generated\ primary\ hadrons}$$

Tracking Efficiency

Secondary Contamination and correction factor







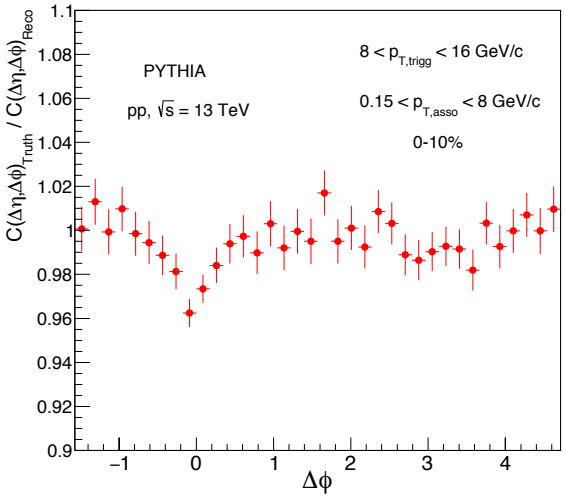
Secondary Contamination:

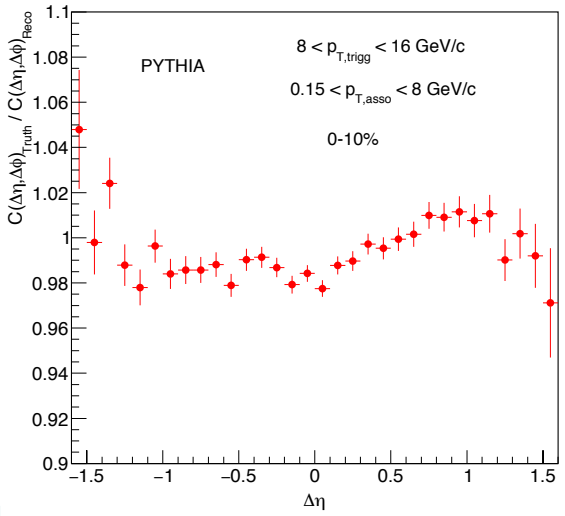
$$C = \frac{No.\ of\ rec.\ sec.\ hadrons}{No.\ of\ rec.\ prim.\ hadrons + rec.\ sec.\ hadrons}$$

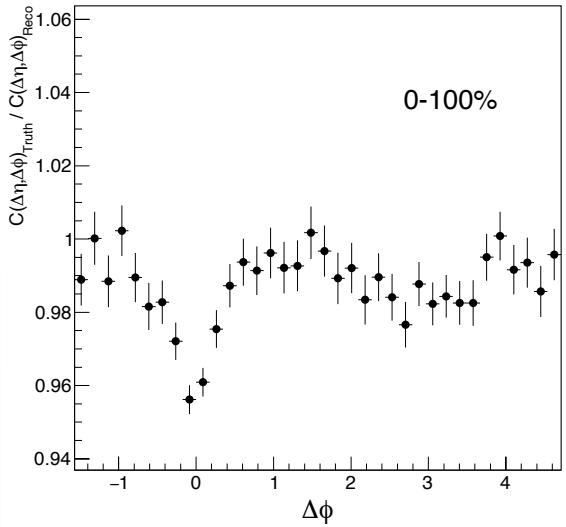
Correction factor:

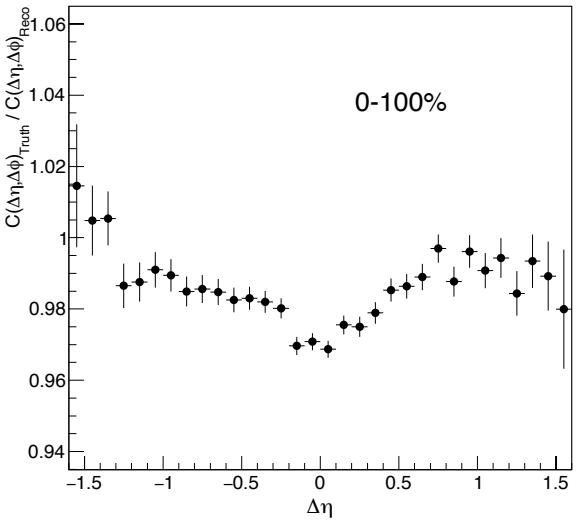
$$f_h = \frac{1 - C_h}{\epsilon_{tracking,h}}$$

Validation of closure test









Efficiency corrected reconstructed correlation function:

- Correction factor for trigger – c_1
- Correction factor for associated – c_2
- Then fill the correlation function with weight factor $c_1 * c_2$

❖ Outlook:

- ❖ Efficiency corrected correlation yields and widths
- ❖ Systematics study
- ❖ Analysis note submission and paper proposal

THANK YOU