



Speaker: Mintu Halder (SRF)

Supervisor: Dr. Sidharth Kumar Prasad

**Department of Physical Sciences
Bose Institute, Kolkata**

“ALICE-STAR-India Collaboration Meeting”

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Study of Two Particle Azimuthal Correlation in pp and pPb Collisions at 5.02 TeV in ALICE



Mintu Haldar (SRF, Bose Institute)

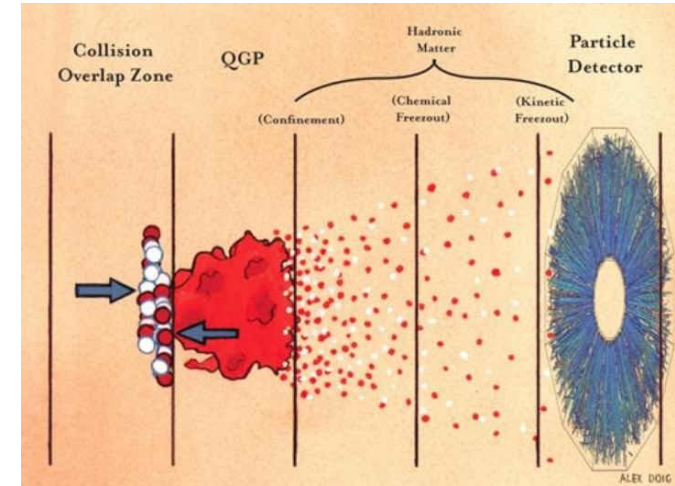
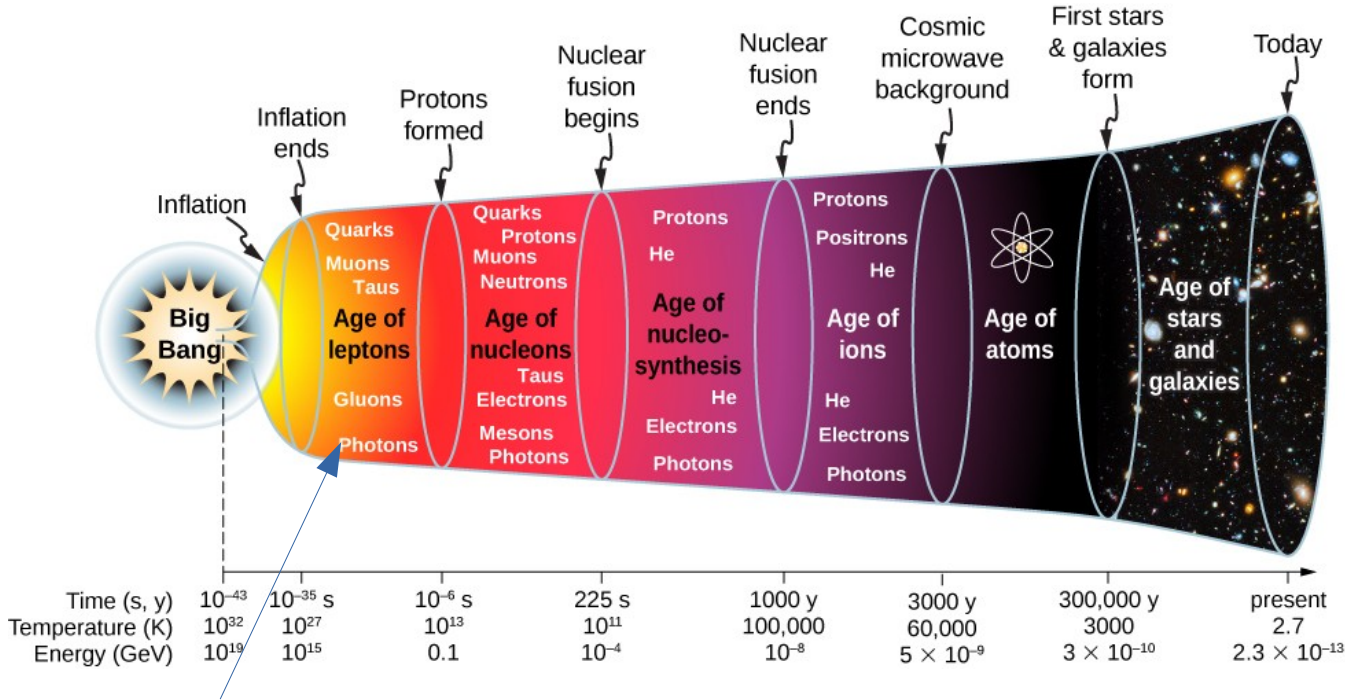
**Collaborators: Sanchari Thakur,
Subikash Choudhuri, Sidharth Kumar
Prasad**



Outline

- Introduction
- Motivation
- Analysis Details
- Some Preliminary Results
- Future Plan
- Summary

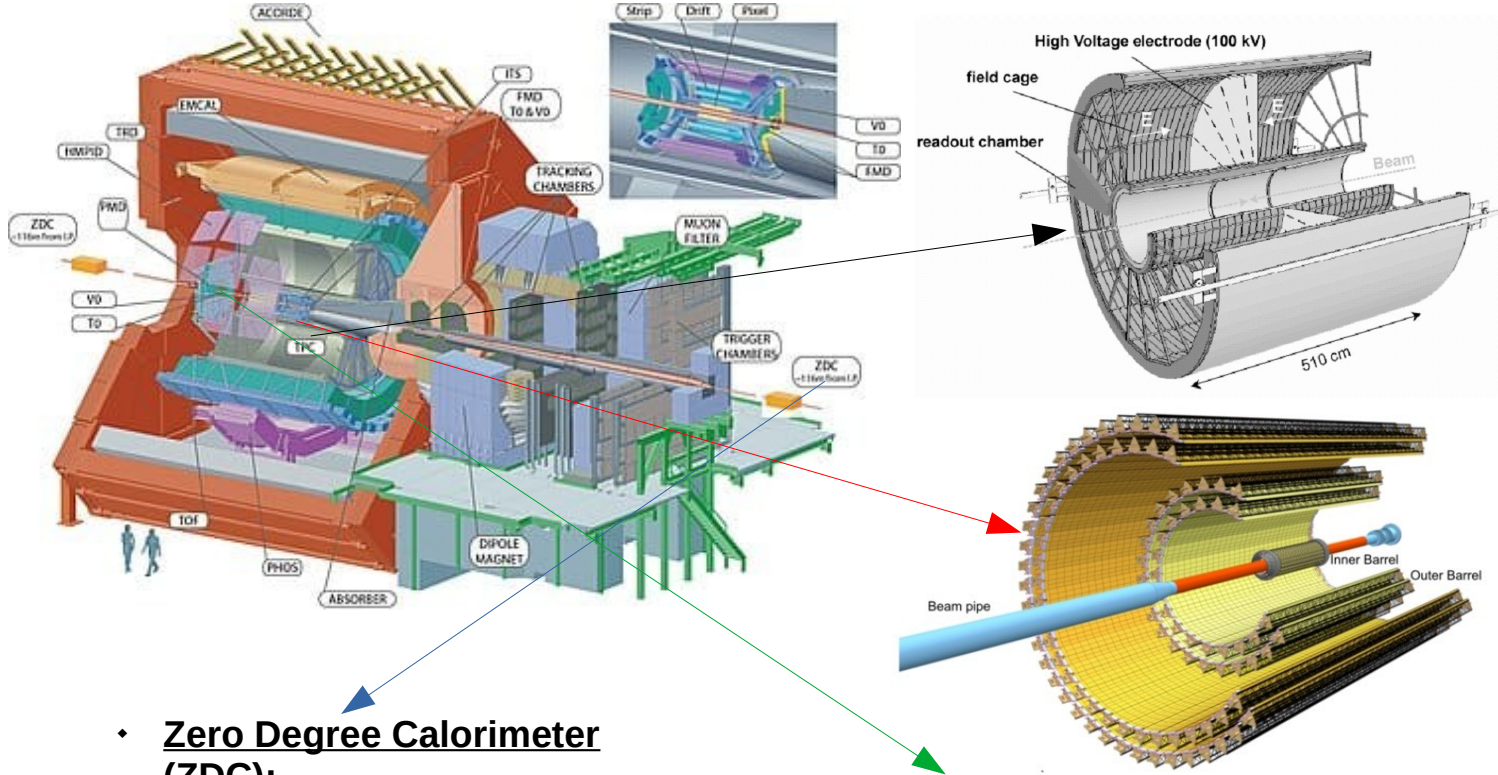
Introduction



Quark Gluon Plasma (QGP):

1. Deconfined state of quarks and gluons
2. Thermally equilibrated state of matter

A Large Ion Collider Experiment (ALICE)



- **Time Projection Chamber (TPC):**

It is a gas detector and used for particle identification and tracking through momentum and energy loss measurement

- **Inner Tracking System (ITS):**

ITS is silicon detector and used for-

1. Primary vertex reconstruction
2. Particle identification
3. Tracking and standalone reconstruction of low p_T particles

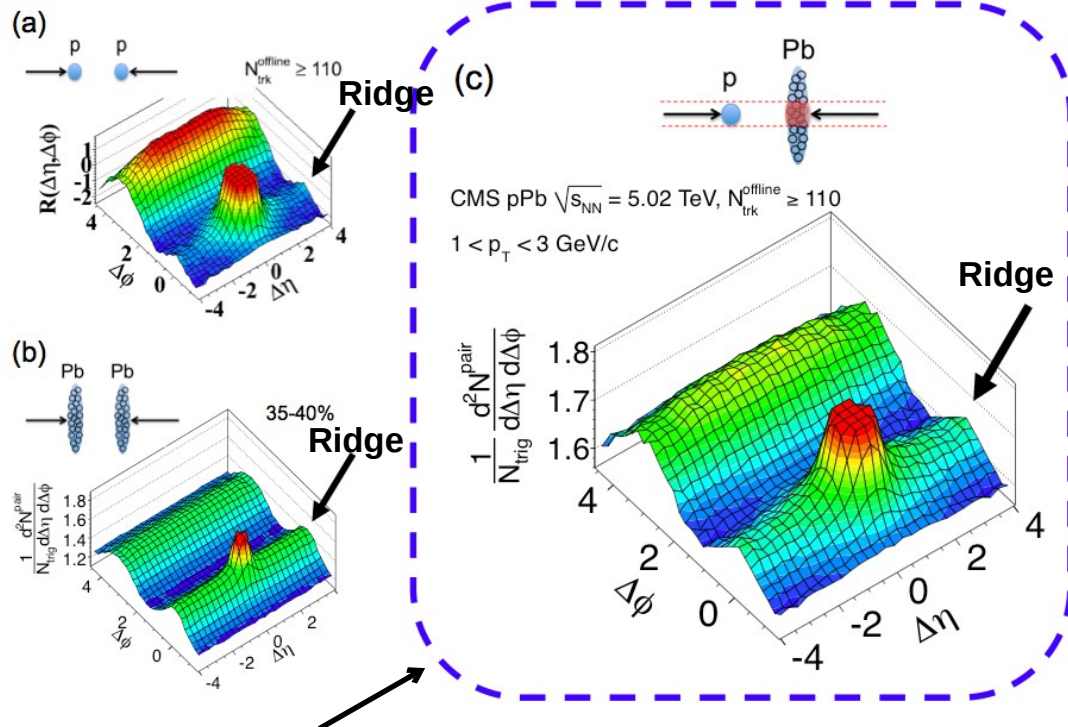
- **Zero Degree Calorimeter (ZDC):**

It is a Calorimeter and it is used for centrality estimation through deposited energy of spectators

- **Vertex Zero (V0):**

It is a scintillator detector used for centrality estimation using produced particles

Motivation

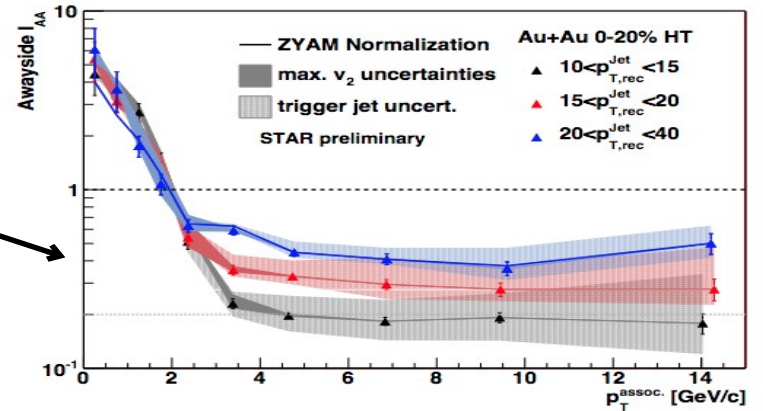
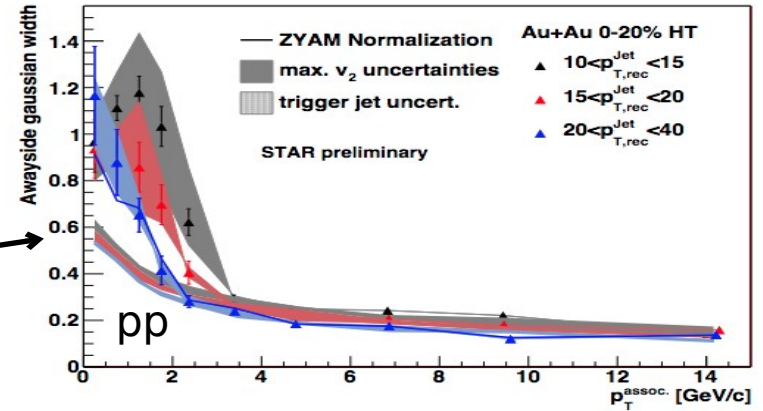


QGP like
behaviour in
pPb

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

My main motivation is to investigate
the mechanism of QGP like
behaviour through hadron-hadron
correlation in pp and pPb collisions

- 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



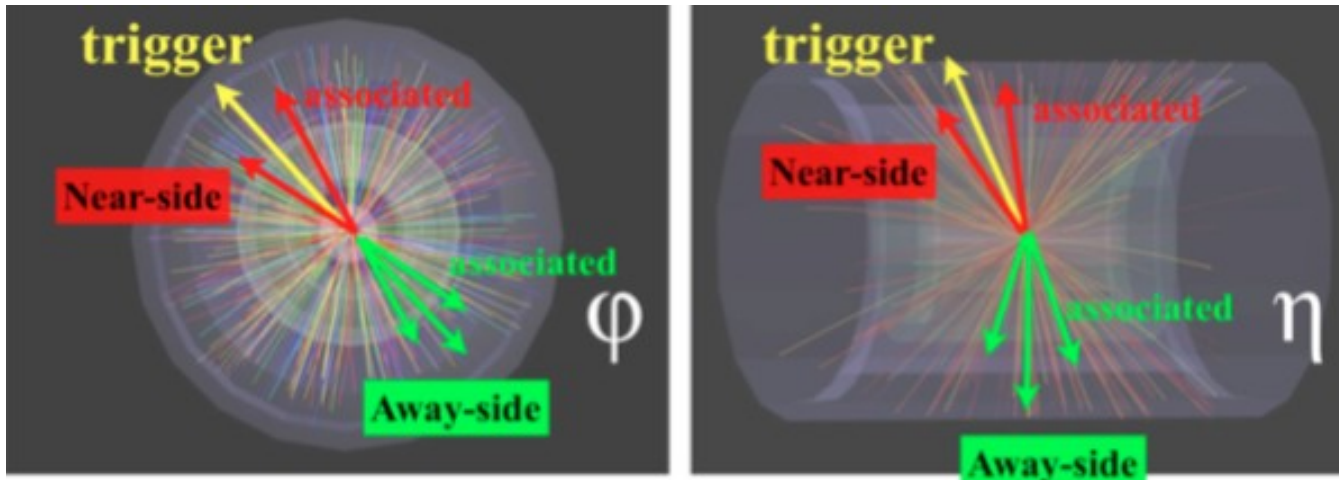
We are probing the modification of jet-like yields and widths in pp and pPb collisions

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 $\Delta\eta$ - $\Delta\phi$ space is defined as,

$$C(\Delta\phi, \Delta\eta) = \frac{1}{N_{trigger}} \frac{d^2 N_{asso}}{d\Delta\phi d\Delta\eta}$$

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



The Same Event (SE):

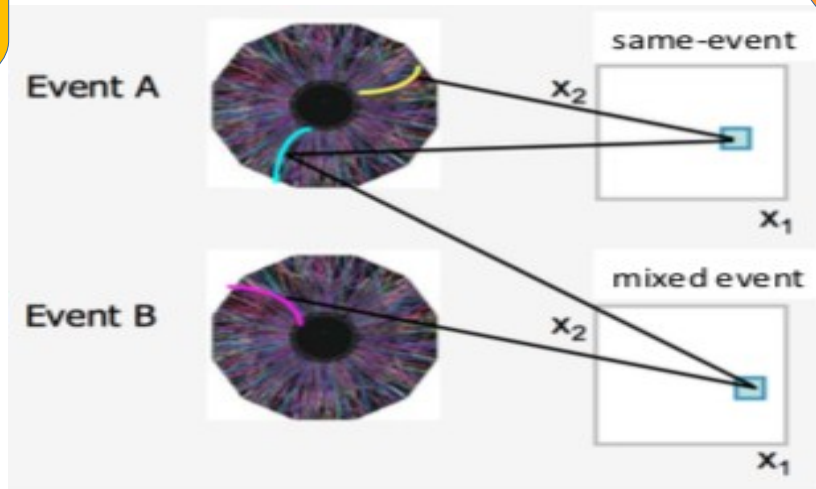
$$S(\Delta\phi, \Delta\eta) = \frac{1}{N_{\text{trigger}}} \frac{d^2 N_{\text{same}}}{d\Delta\phi d\Delta\eta}$$

Physics correlation
+ finite detector
acceptance effect +
background due to
uncorrelated pairs

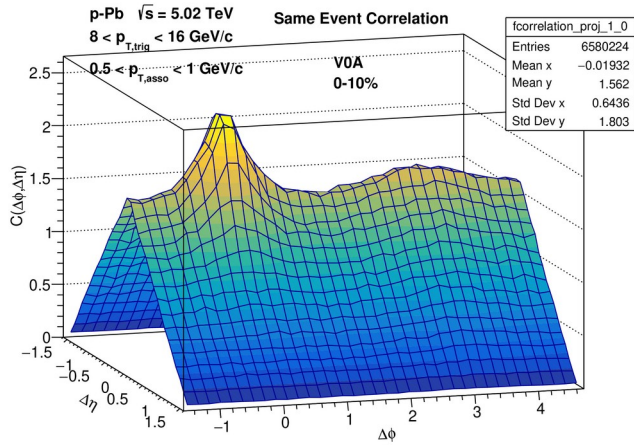
The Background (ME):

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

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

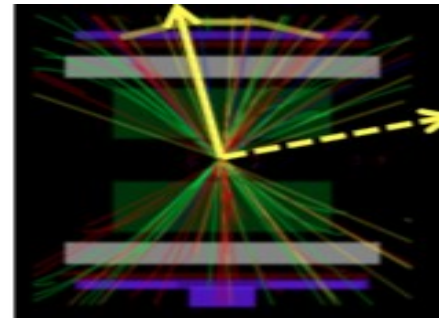
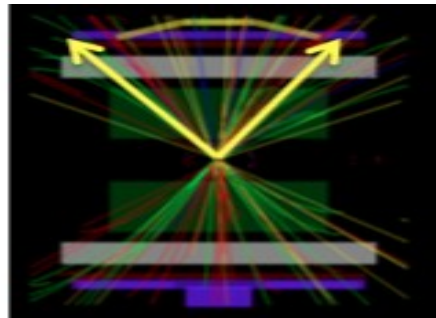
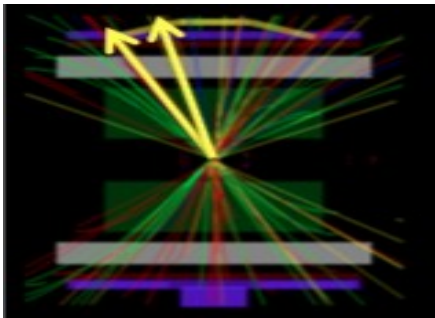
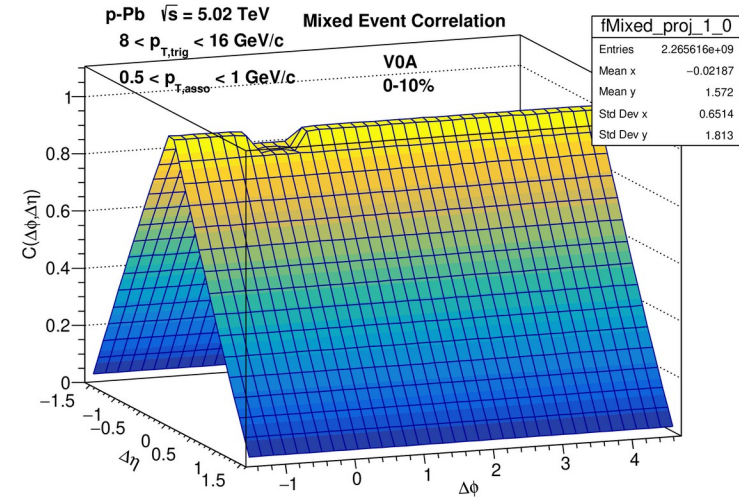


Same Event



Due to the finite acceptance in η the probability of reconstructing pairs in small $\Delta\eta$ is large (triangular shape) Pair acceptance

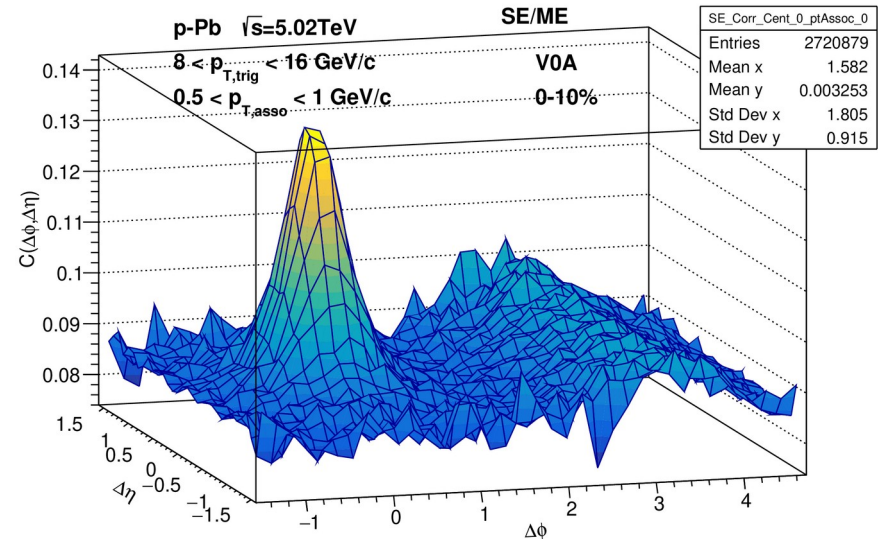
Mixed Event



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

$$C(\Delta\eta, \Delta\phi) = B(0, \pi) \frac{S(\Delta\eta, \Delta\phi)}{B(\Delta\eta, \Delta\phi)}$$

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



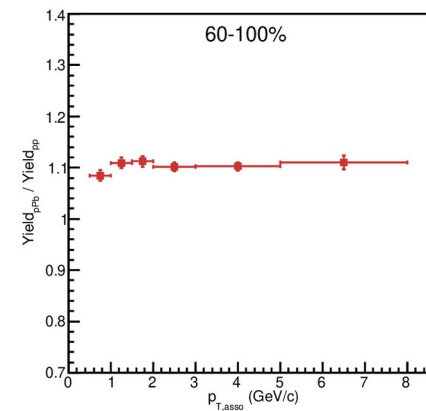
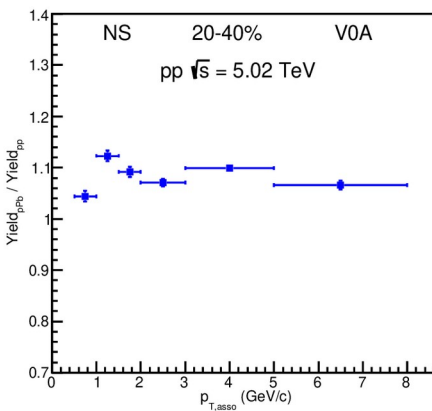
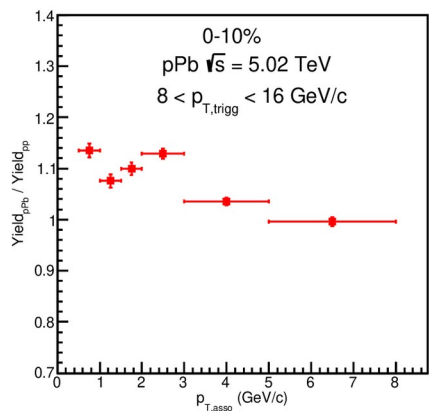
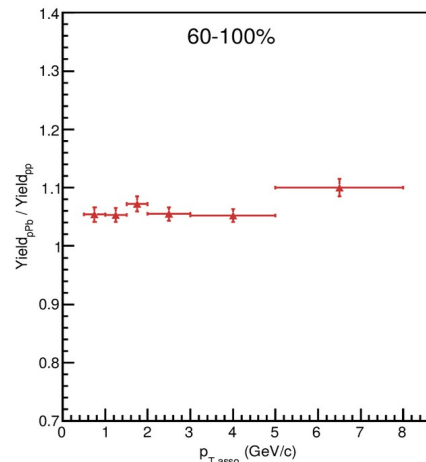
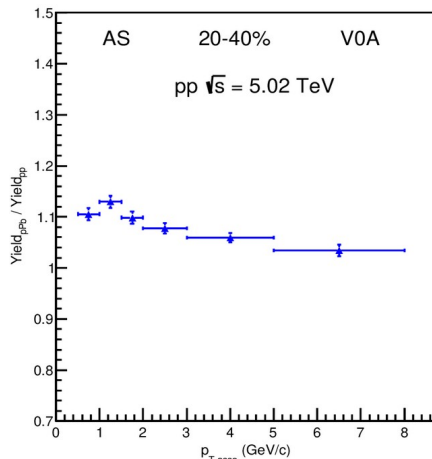
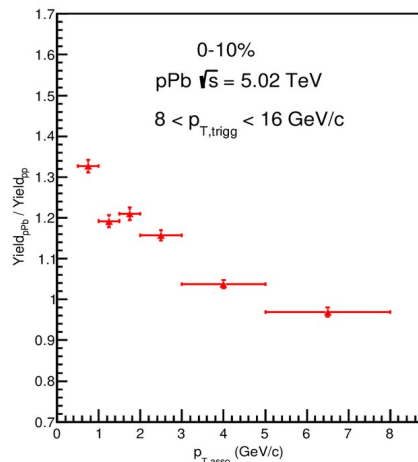
Analysis details

- Dataset : LHC16q pass2 dataset is used for pPb
LHC17p_pass1 for pp
- MC : LHC17f2b for pPb
LHC17l4_fast_lastG4fix, LHC17l4_cent_lastG4fix,
LHC17l4_cent_woSDD_lastG4fix for pp
- Event cuts: **Trigger kINT7** (V0AND, hit in both V0A and V0C): Minimum bias trigger and rejection of background events, $|Z\text{-Vertex}| < 10$ cm, **Physics selection Task** is used to select collision candidates in data and reject background and poor quality events
- Track cuts:
 - $|\eta| < 0.8$
 - Filterbit96
 - **Trigger** p_T : $8 < p_T < 16$ GeV/c,
 - **Associate** p_T : $0.15 < p_T < 8$ GeV/c
 - **Track merging** correction is included
 - **Centrality estimator**: V0A is used for pPb

Preliminary Results

Raw Data

Overview of the last meeting



→ Ratio of yields of p-Pb w.r.t the yield of pp as a function of associated transverse momentum

→ In central collision, a significant enhancement in NS and AS yield is observed for low p_T^{asso}

Efficiency correction

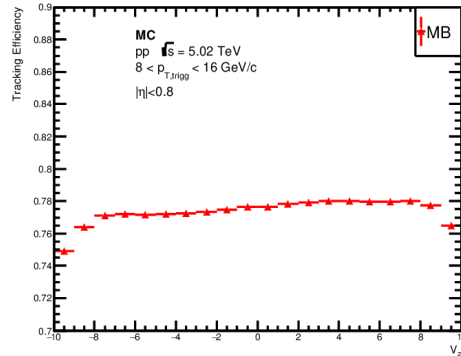
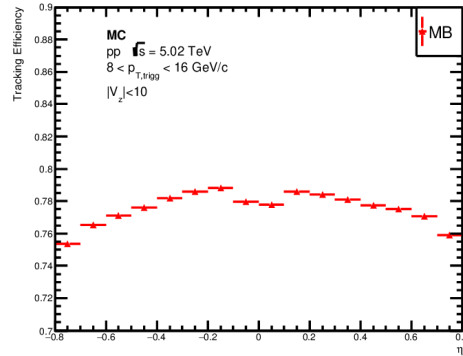
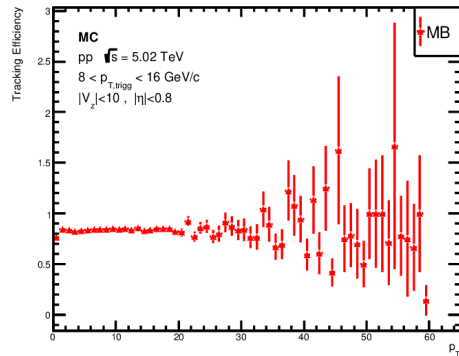
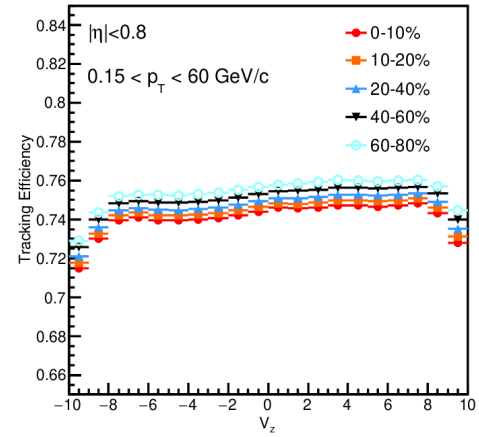
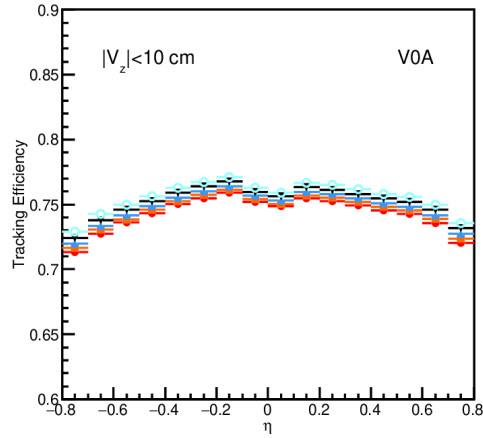
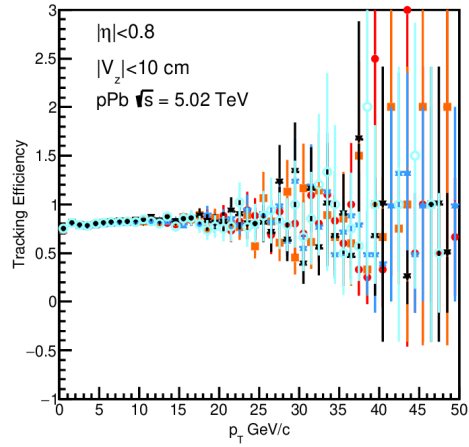
Definition of Efficiency: $\epsilon = \frac{\text{No. of reconstructed primary hadrons}}{\text{No. of generated primary hadrons}}$

Tracking Efficiency

Why do we need efficiency correction?

- We do not get actual correlation function from raw data in order that we need correction to get actual correlation function
- Detector do not have 100% efficiency for that we lose particles and that also varies detector to detector. So, to get actual yield we need to correct them
- We can compare with different results

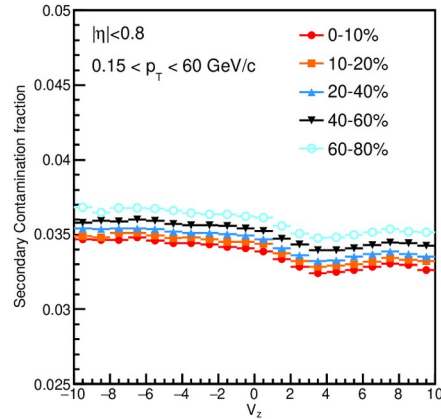
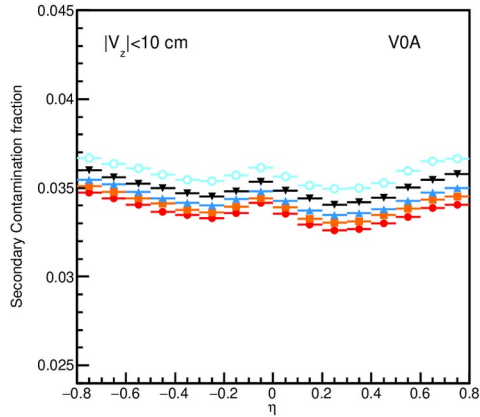
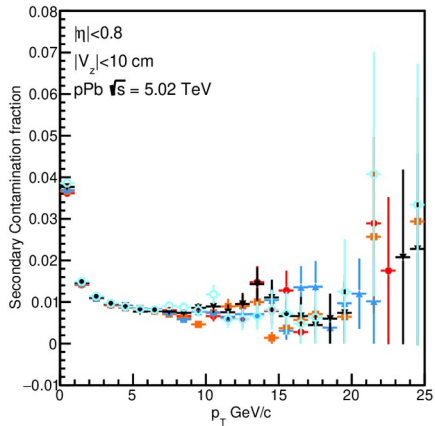
Efficiency correction



Tracking Efficiency:

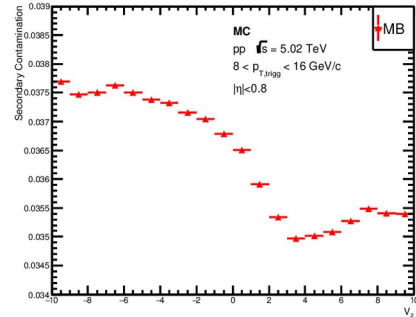
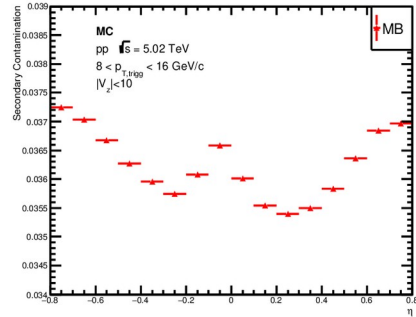
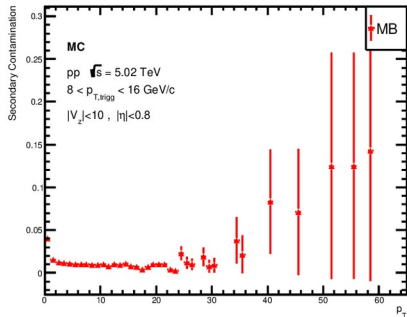
$$\epsilon = \frac{\text{No. of reconstructed primary hadrons}}{\text{No. of generated primary hadrons}}$$

Secondary Contamination and correction factor



Correction factor:

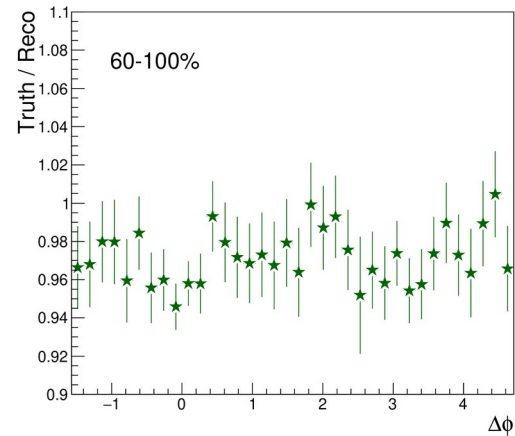
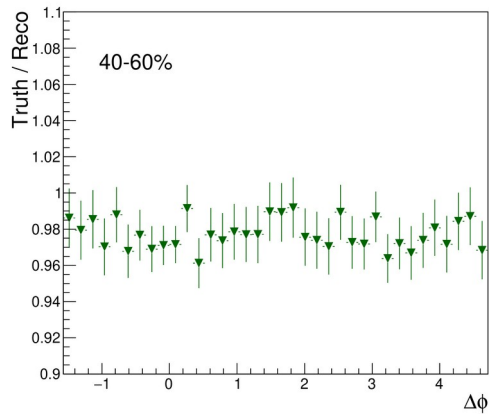
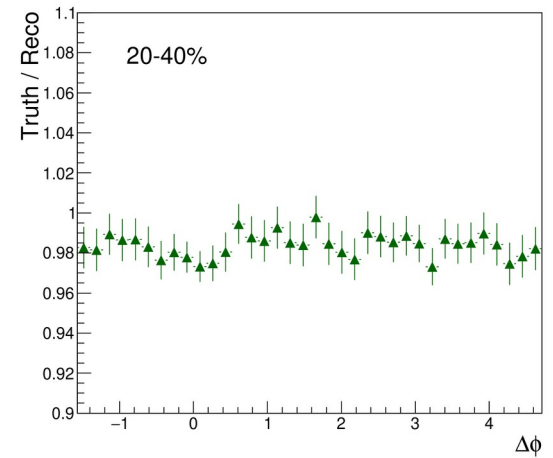
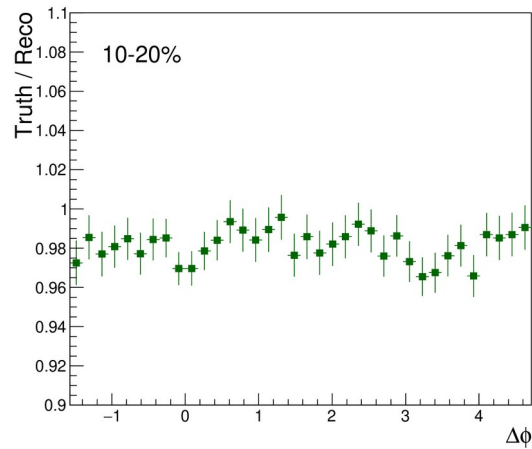
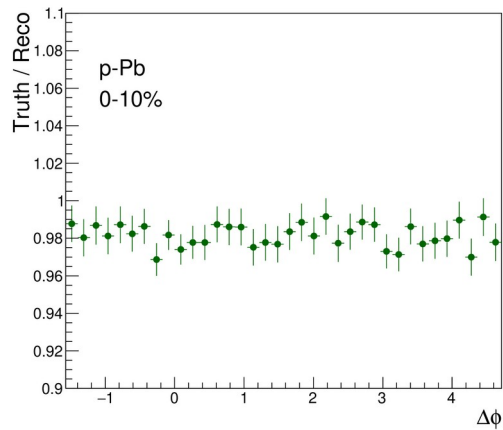
$$f_h = \frac{1 - C_h}{\epsilon_{tracking,h}}$$



Secondary Contamination:

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

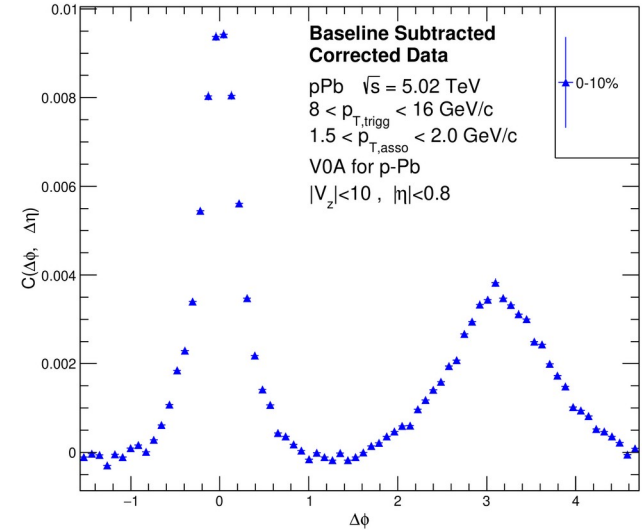
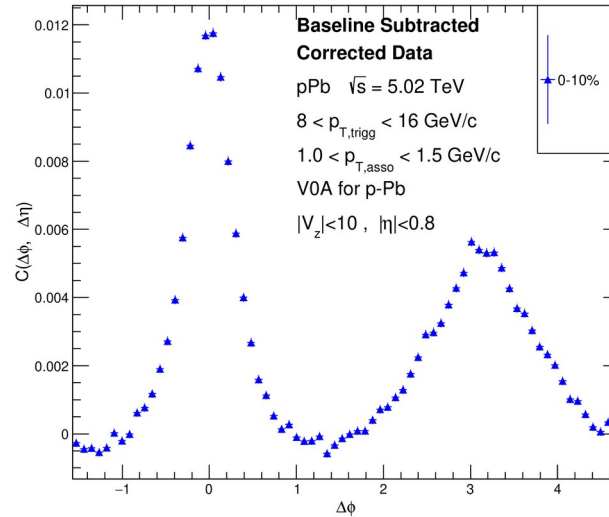
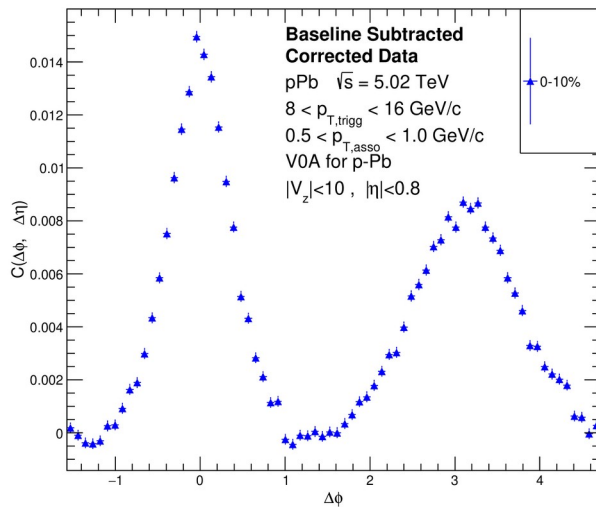
MC Closure test for p-Pb



Delta-phi projection for p-Pb

Corrected Data

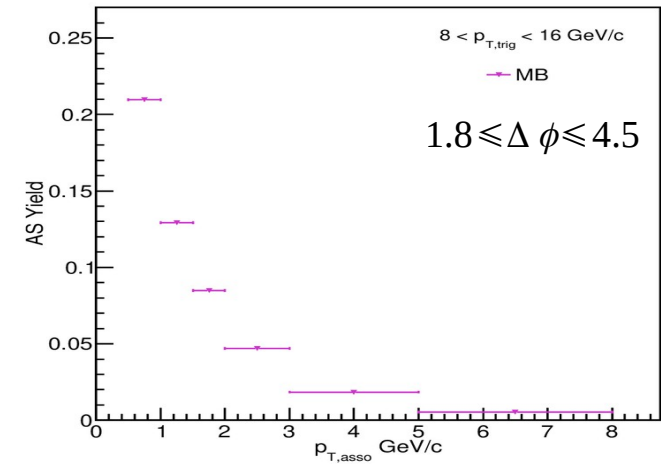
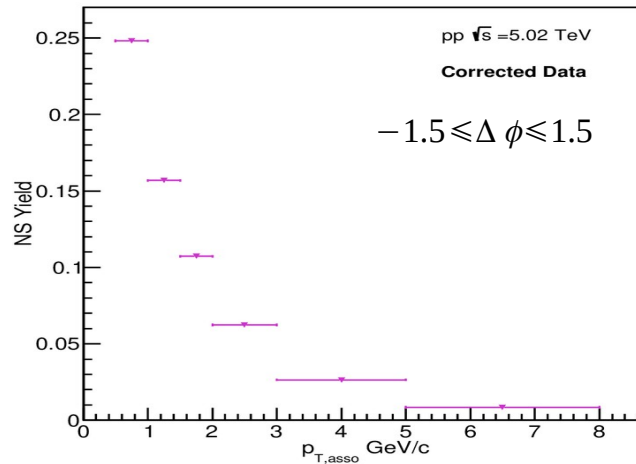
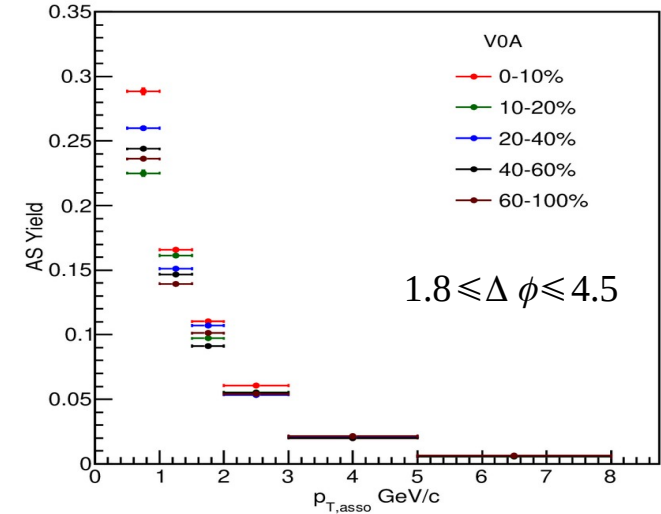
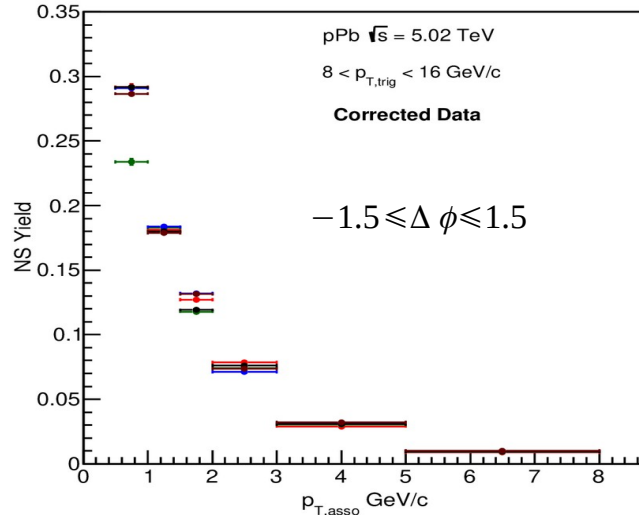
$\Delta \eta$ is integrated from -1.2 to 1.2



Near Side and Away Side Yield for corrected data

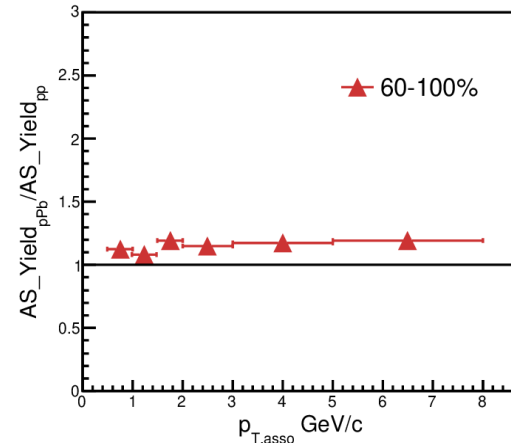
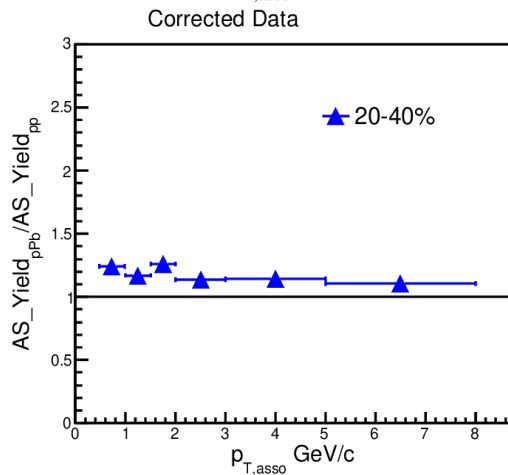
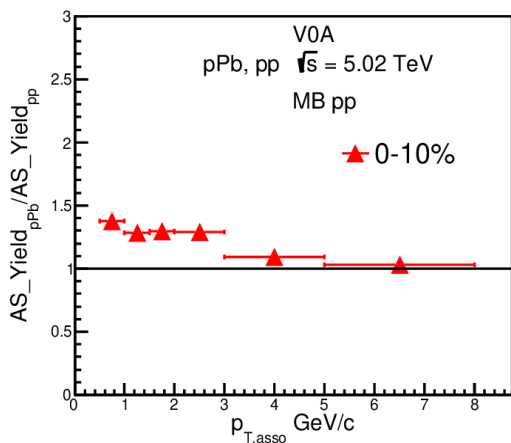
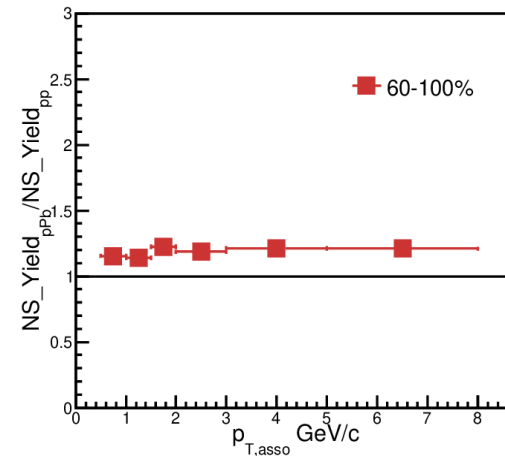
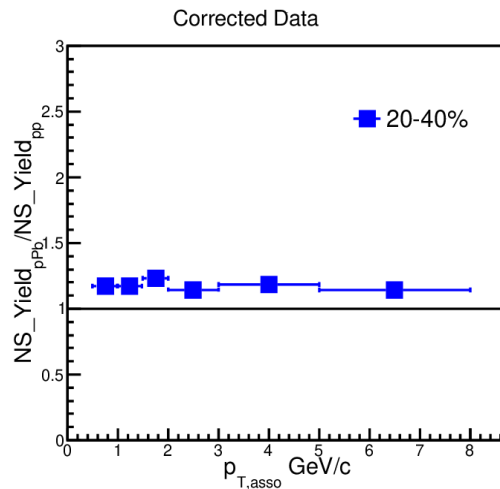
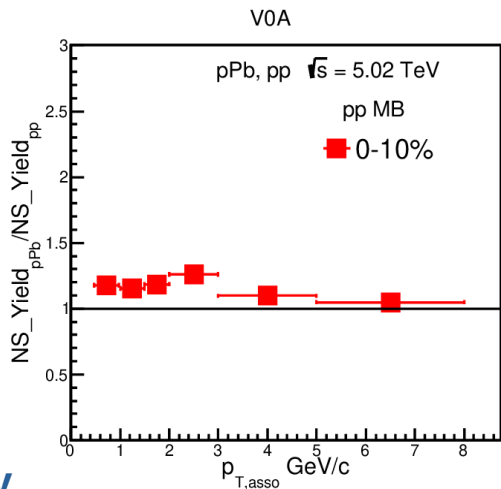
Corrected Data

Normalized
by Bin Width



Corrected Data

Ratio of Yield



Normalized by
Bin Width

Summary

- Efficiency and secondary contamination correction using MC are done
- Correction factor has been calculated
- $\Delta \phi$ projection of correlation function is shown using corrected data
- Near side and away side yields have been estimated by using corrected data
- Ratio of yields for different centrality classes has been measured by using corrected data

Future Plan

- **Systematic uncertainties will be measured**
- **Model comparison will be done**

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Thank You