Forward backward multiplicity correlations in pp collisions in ALICE

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- Analysis details
- Results
- Summary

Motivation

The correlations over small range in rapidity are believed to be dominated by short-range Correlations due to resonance decays and those occurring over large rapidity range could be interpreted to be due to multiple parton interactions.
*W. D. Walker, Phys. Rev. D **69, 034007 (2004).***

Correlations that are produced across a wide range of rapidity are thought to reflect the earliest stages of the heavy-ion collisions, free from final-state effects.
*Y. V. Kovchegov, E. Levin, and L. McLerran, Phys. Rev. C **63,** 024903 (2001).*

STAR experiment has made a measurement between pp and AuAu collisions to claim the existence of a large long range correlation in central AuAu collisions.
PRL 103, 172301 (2009)

- Our work can provide the good baseline for this kind of study in PbPb collisions at LHC energies.

- Comparing with different event generators our study can give some insight into the particle production mechanism and could provides new constraints on the existing models.

Definition

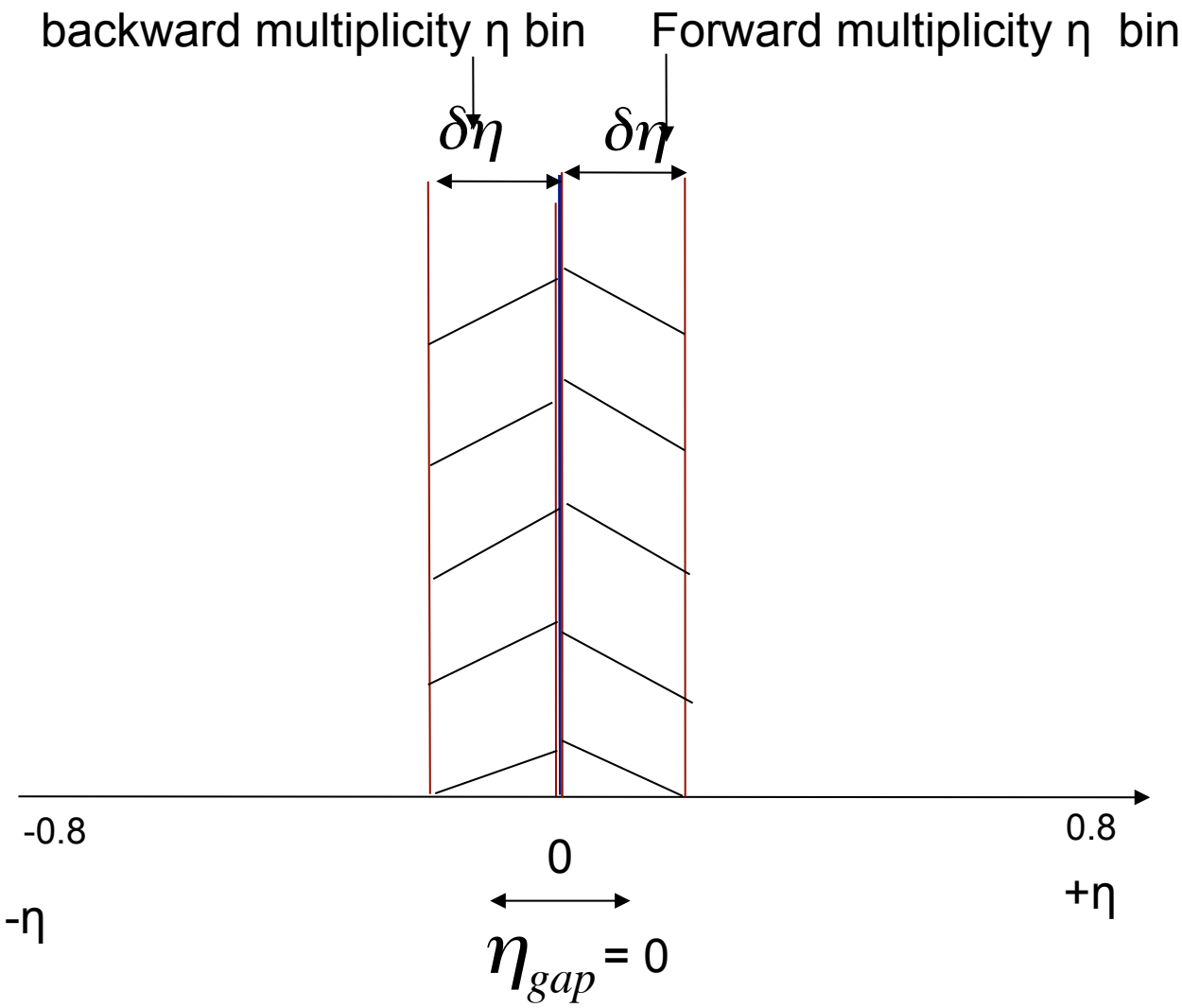
$$< N_b(N_f) >= a + b_{corr} N_f \longrightarrow 1$$

$$b_{corr} = \frac{< N_f N_b > - < N_f >< N_b >}{< N_f{}^2 > - < N_f >^2} \longrightarrow 2$$

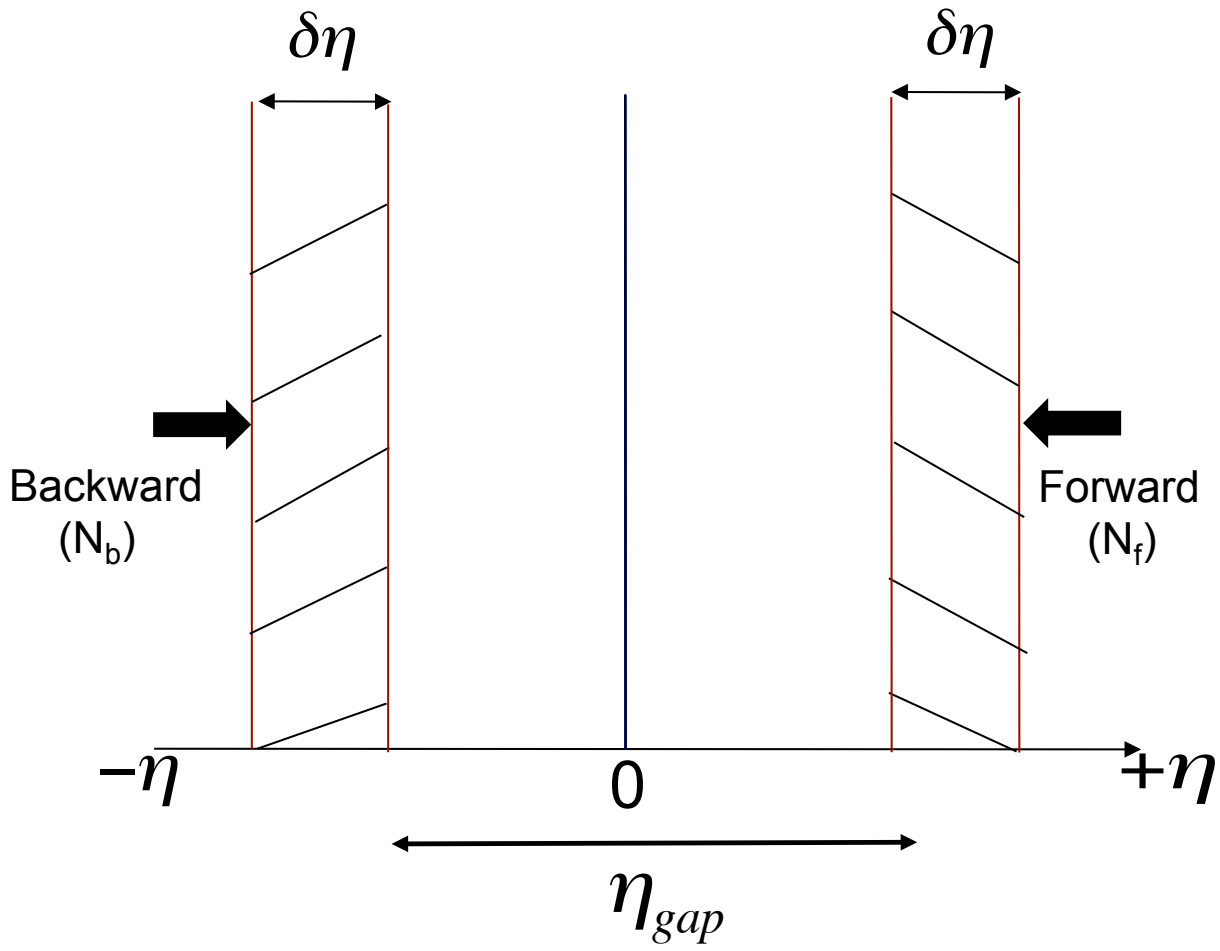
N_f ⟶ charged particle multiplicity in forward hemisphere ;

N_b ⟶ charged particle multiplicity in backward hemisphere ;

Definition


backward multiplicity η bin
Forward multiplicity η bin
$\delta\eta$
$\delta\eta$
-0.8
0
0.8
-η
+η
$\eta_{gap} = 0$

Definition



Calculation and Correction

- Calculation:
  1) by linear regression
  2) using correlator formula

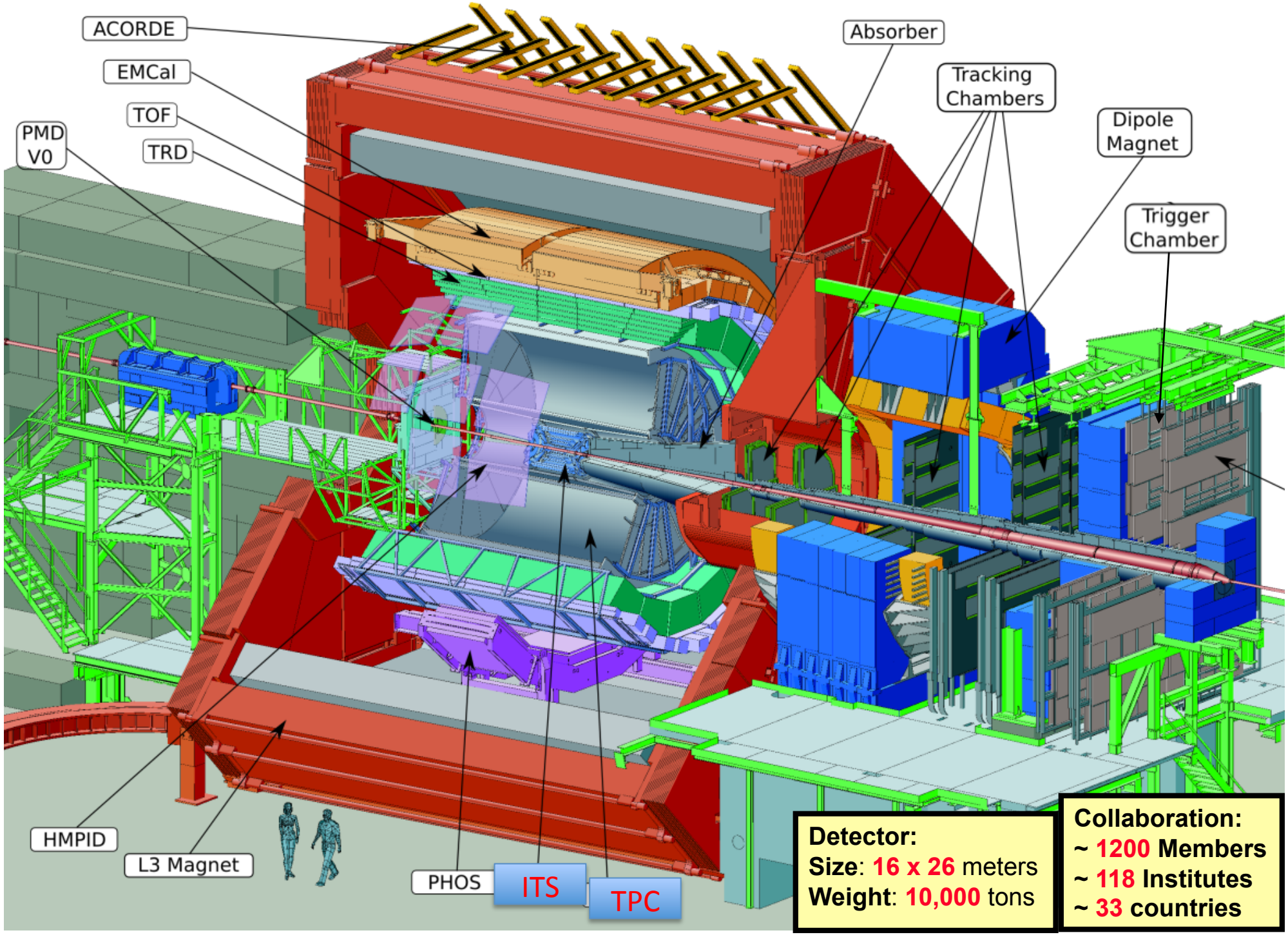
Calculation and corrections of coefficient b_{corr} were done for every configuration of η-windows pair.

- Corrections (three alternative procedures)
  1) by correcting b_{corr} *raw* value
  2) by correcting $\langle n_B n_F \rangle$, $\langle n_B \rangle$, $\langle n_F \rangle$ and $\langle n_F^2 \rangle$
  3) by extrapolation of b_{corr} to corrected $\langle n_F \rangle$ values

Calculations from all these procedures were combined to obtain resulting values and errors.

Correction factors are found to be of the order of *5-10%*

Systematic uncertainties are of the order of *2-5%*


ACORDE
EMCal
TOF
TRD
PMD
V0
Absorber
Tracking
Chambers
Dipole
Magnet
Trigger
Chamber
HMPID
L3 Magnet
PHOS
ITS
TPC
Detector:
Size: 16 x 26 meters
Weight: 10,000 tons
Collaboration:
~ 1200 Members
~ 118 Institutes
~ 33 countries

Analysis details

System: pp

Beam energy: 0.9, 2.76 and 7 TeV

No of analyzed events: 2M (0.9 TeV), 10M (2.76 TeV), 6.5M (7 TeV)

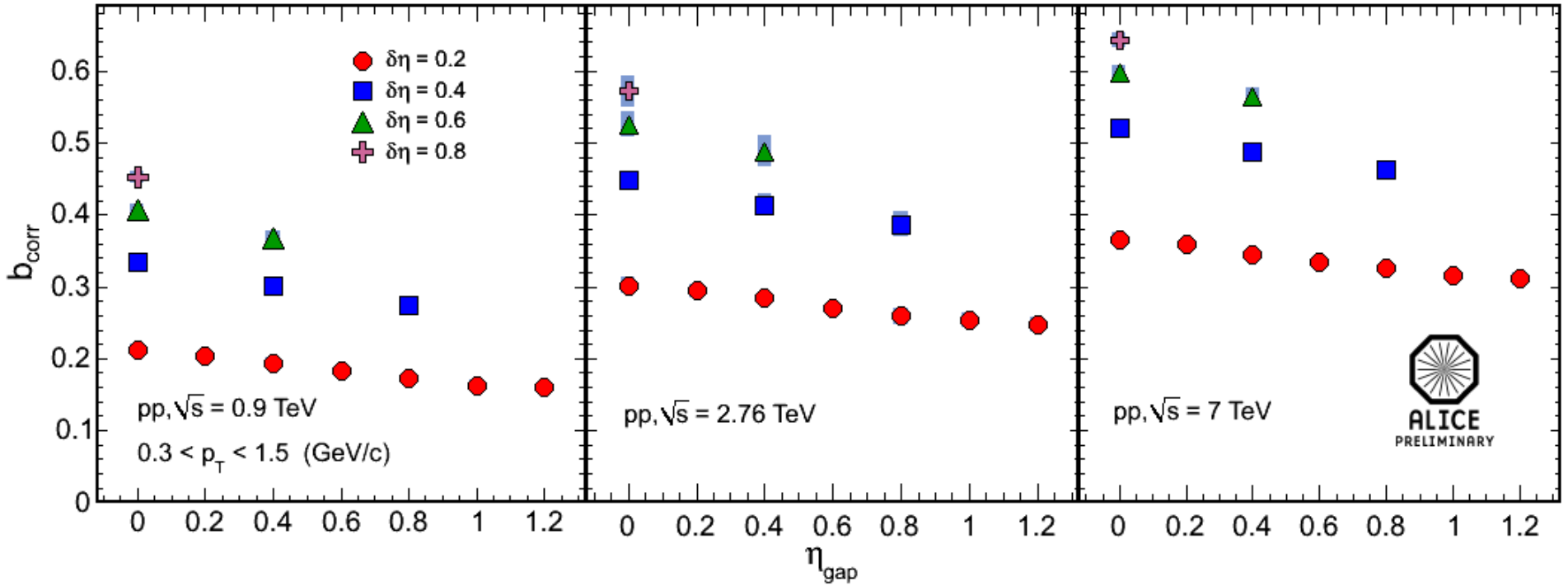
p_T cut: 0.3 to 1.5 GeV/c

η cut: $|\eta|<0.8$

Vertex cut: $|V_z|<10$ cm

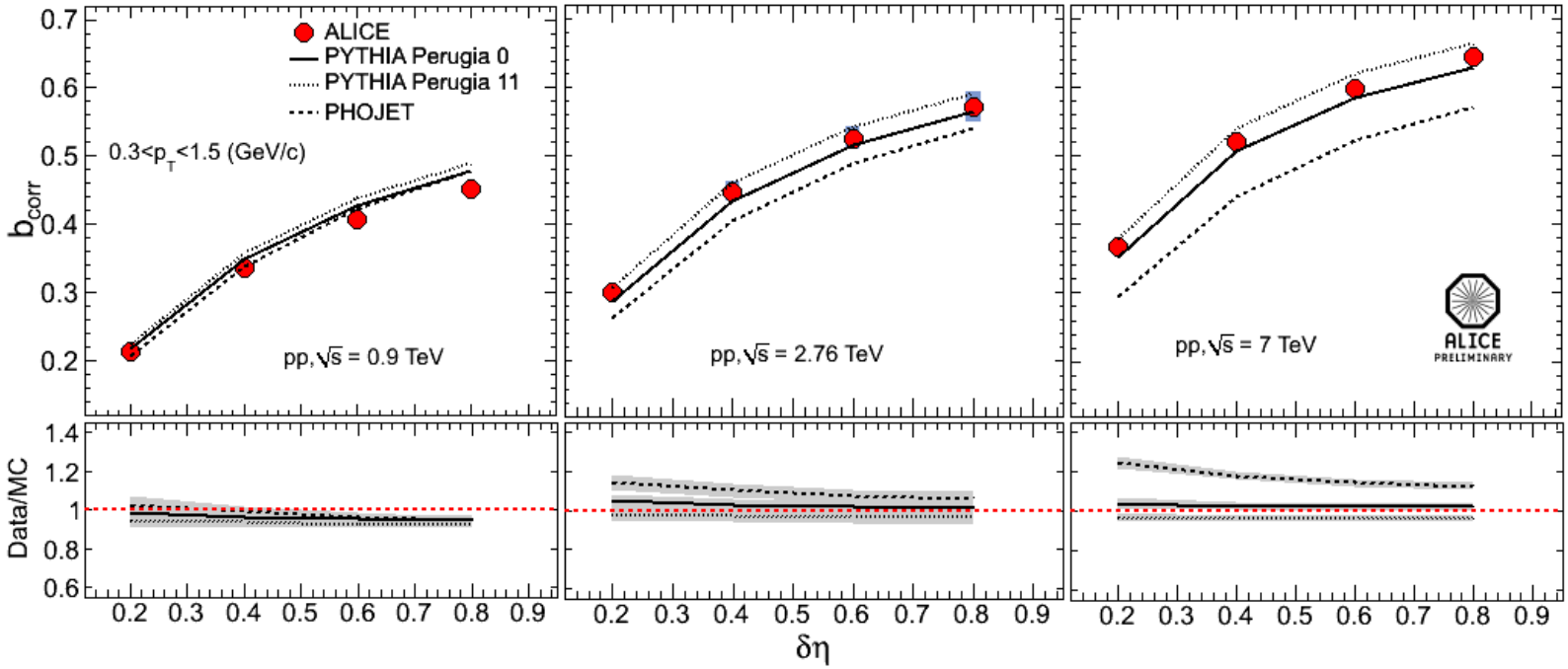
Event generators used: PYTHIA Perugia 0, PYTHIA Perugia 11, PHOJET

Results
Bin width dependence



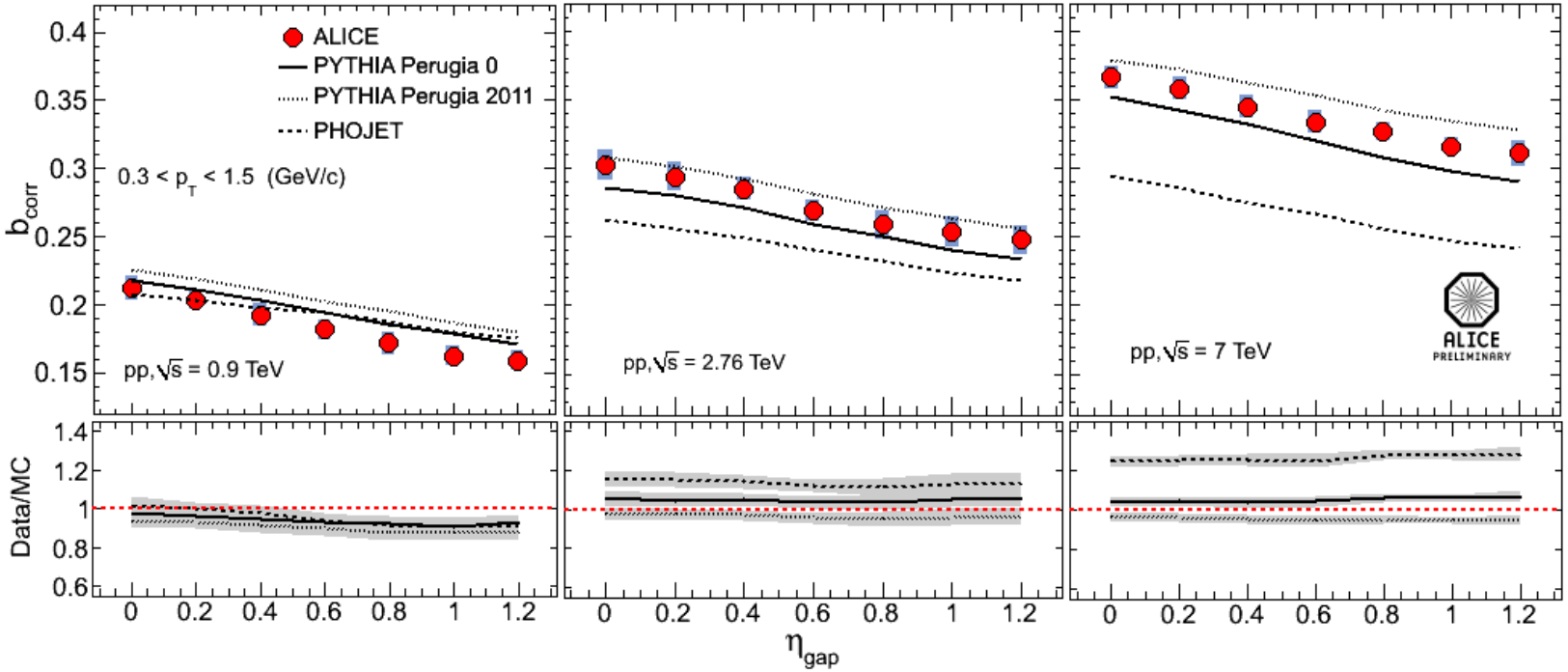
- correlation strength b_{corr} drops with η gap
- wider windows give higher b_{corr} values
- values of b_{corr} increase with the collision energy

Results
Bin-width dependence at $\eta_{gap} = 0$



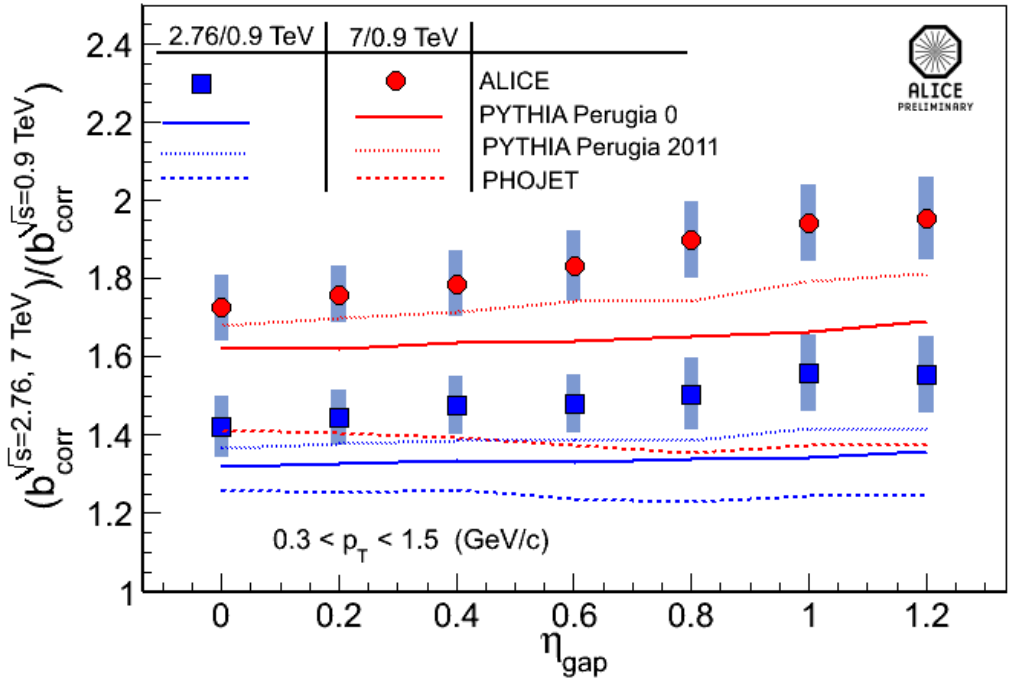
- b_{corr} increases with increasing bin-width and shows a tendency to saturate for higher bin-width.
- PYTHIA and PHOJET both show the similar trend as data
- The observed trend can be explained by simple model of random distributions of produced particles in pseudorapidty.

Results
Comparison with models



- Correlation strength with η_{gap} for three different energies is presented . Shaded region represent the systematic errors.
- Correlation strength increases significantly with beam energy.
- Data is compared with PYTHIA Perugia 0, PYTHIA Perugia 11 and PHOJET and it is observed that the trend is reproduced by MC but the b_{corr} values are deviated more for higher beam energies.

Results
Relative correlation



This is the ratio plot of 7 TeV and 2.76 TeV wrt 0.9 TeV

Red Points = Ratio between 7TeV and 0.9 TeV
Blue Point = Ratio between 2.76 TeV and 0.9 TeV

- Rate of increasing of correlation strength is higher than that of MC

Summary

- Forward backward multiplicity correlation strength (b_{corr}) as a function of increasing η_{gap} is presented for pp collisions at $\sqrt{s}$ = 0.9, 2.76 and 7 TeV.

- It is observed that b_{corr} decreases with increasing of η_{gap} and increases as a function of width of the η window.

- Relative correlations have been studied in terms of the ratio of the correlation strength at 7 TeV and 2.76 TeV with respect to 0.9 TeV and are found to increase significantly with beam energy.

- The results have been compared with the MC generators such as, PYTHIA Perugia 0, PYTHIA Perugia 11 and PHOJET. It is found that MC explains the data qualitatively.

- b_{corr} values are close to data at 0.9 TeV and deviated with increasing beam energy. It indicates different particle production mechanism at higher beam energies.