Mean transverse momentum fluctuations in pp collisions at √s = 13 TeV using ALICE detector at LHC

Bushra Ali, for the ALICE Collaboration
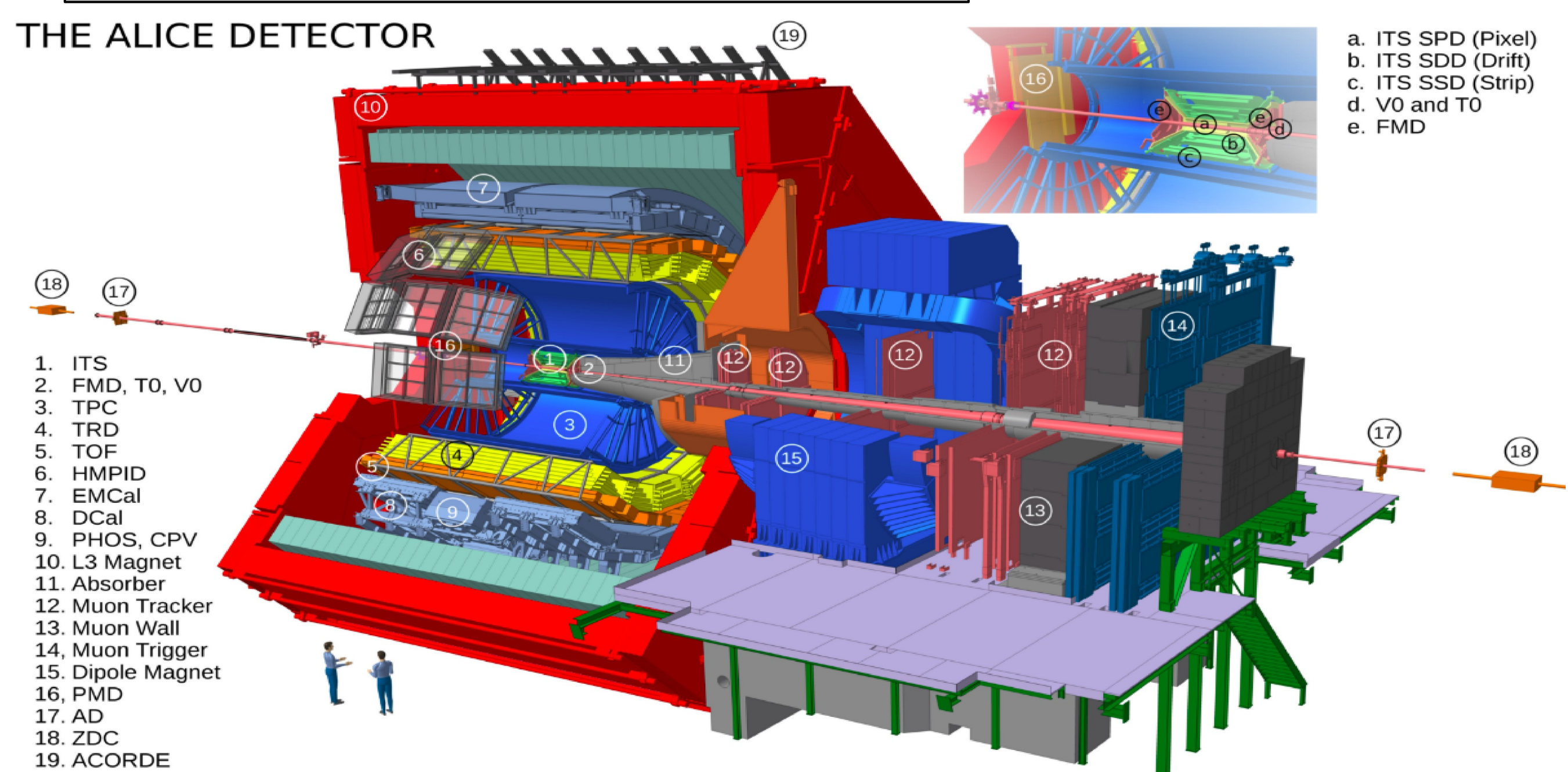### Department of Physics, Aligarh Muslim University, Aligarh, India

Motivation

- Presence of collectivity in high-multiplicity pp events[1][2], traces of deconfinement in hadronic collisions at TeV energies[3] and the observation of strangeness production to a value similar to those observed in Pb–Pb collisions[4][5] has drawn considerable attention towards the studies involving smaller collision systems, such as pp and p–Pb collisions.

- To search for collectivity, event-by-event (EbyE) mean p_T fluctuations are regarded as one of the important tools. These fluctuations may appear as a consequence of various types of correlations arising due to the resonance decays, jets, quantum correlations, etc.[6].

- A reduction in the dynamical mean p_T fluctuations with charged particle density in pp and Pb-Pb collisions has been reported by ALICE Collaboration[6]. The observed reduction is weaker than expected from independent particle emission.

- It is, therefore, considered worthwhile to undertake a study of fluctuations in mean p_T in high-multiplicity events produced in pp collisions at √s = 13 TeV using the two-particle correlator[7][8].

The data

THE ALICE DETECTOR

a. ITS SPD (Pixel)
b. ITS SDD (Drift)
c. ITS SSD (Strip)
d. V0 and T0
e. FMD

1. ITS
2. FMD, T0, V0
3. TPC
4. TRD
5. TOF
6. HMPID
7. EMCal
8. DCal
9. PHOS, CPV
10. L3 Magnet
11. Absorber
12. Muon Tracker
13. Muon Wall
14. Muon Trigger
15. Dipole Magnet
16. PMD
17. AD
18. ZDC
19. ACORDE

- Data set used: pp collisions at √s = 13 TeV collected by ALICE detector.
- Events analysed: 2 Billion (Minimum Bias) + 0.8 Billion (High-multiplicity triggered)
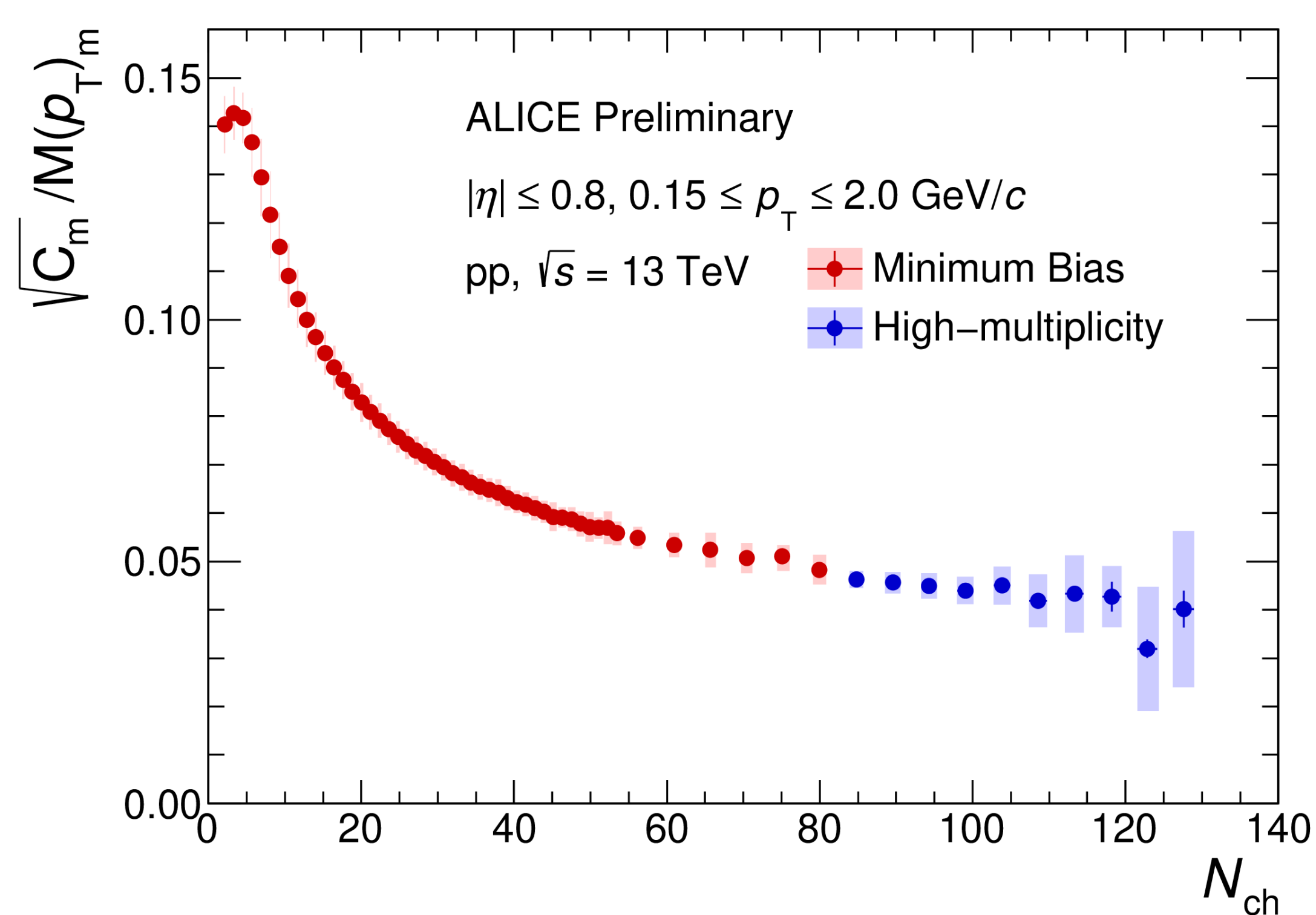
Observable

- Two-particle correlator[6][7][8], C_m is taken as a measure of dynamical component of mean p_T fluctuations.

$$C_m = \frac{1}{\sum_{k=1}^{n_{evt,m}} N_k^{pairs}} \sum_{k=1}^{n_{evt,m}} \sum_{i=1}^{N_{acc,k}} \sum_{j=i+1}^{N_{acc,k}} \left(p_{T,i} - M(p_T)_m \right) * \left(p_{T,j} - M(p_T)_m \right)$$
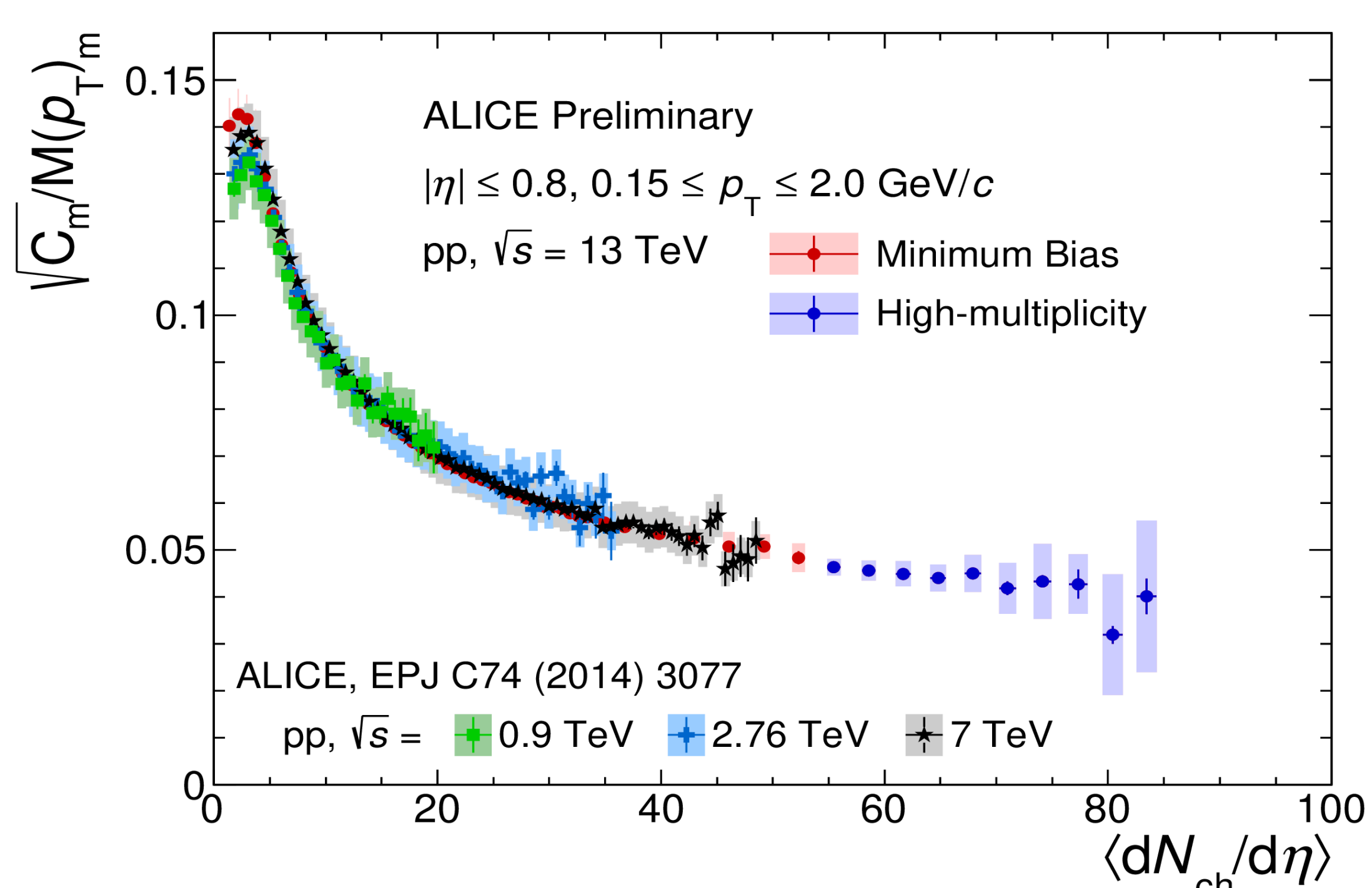
where, $n_{evt,m}$ denotes the number of events in multiplicity class m,

$N_k^{pairs} = 0.5 * N_{acc,k} * (N_{acc,k} - 1)$ is number of pairs in an event k, and

$M(p_T)_m$ is the mean p_T of all tracks of all events in a given multiplicity class, evaluated as:

$$M(p_T)_m = \frac{1}{\sum_{k=1}^{n_{evt,m}} N_{acc,k}} \sum_{k=1}^{n_{evt,m}} \sum_{i=1}^{N_{acc,k}} p_{T,i}$$

Results

ALICE Preliminary
$|\eta| \leq 0.8$, $0.15 \leq p_T \leq 2.0$ GeV/c
pp, √s = 13 TeV
- Minimum Bias
- High–multiplicity

ALI-PREL-550691

ALICE Preliminary
$|\eta| \leq 0.8$, $0.15 \leq p_T \leq 2.0$ GeV/c
pp, √s = 13 TeV
- Minimum Bias
- High-multiplicity

ALICE, EPJ C74 (2014) 3077
pp, √s =
- 0.9 TeV
- 2.76 TeV
- 7 TeV
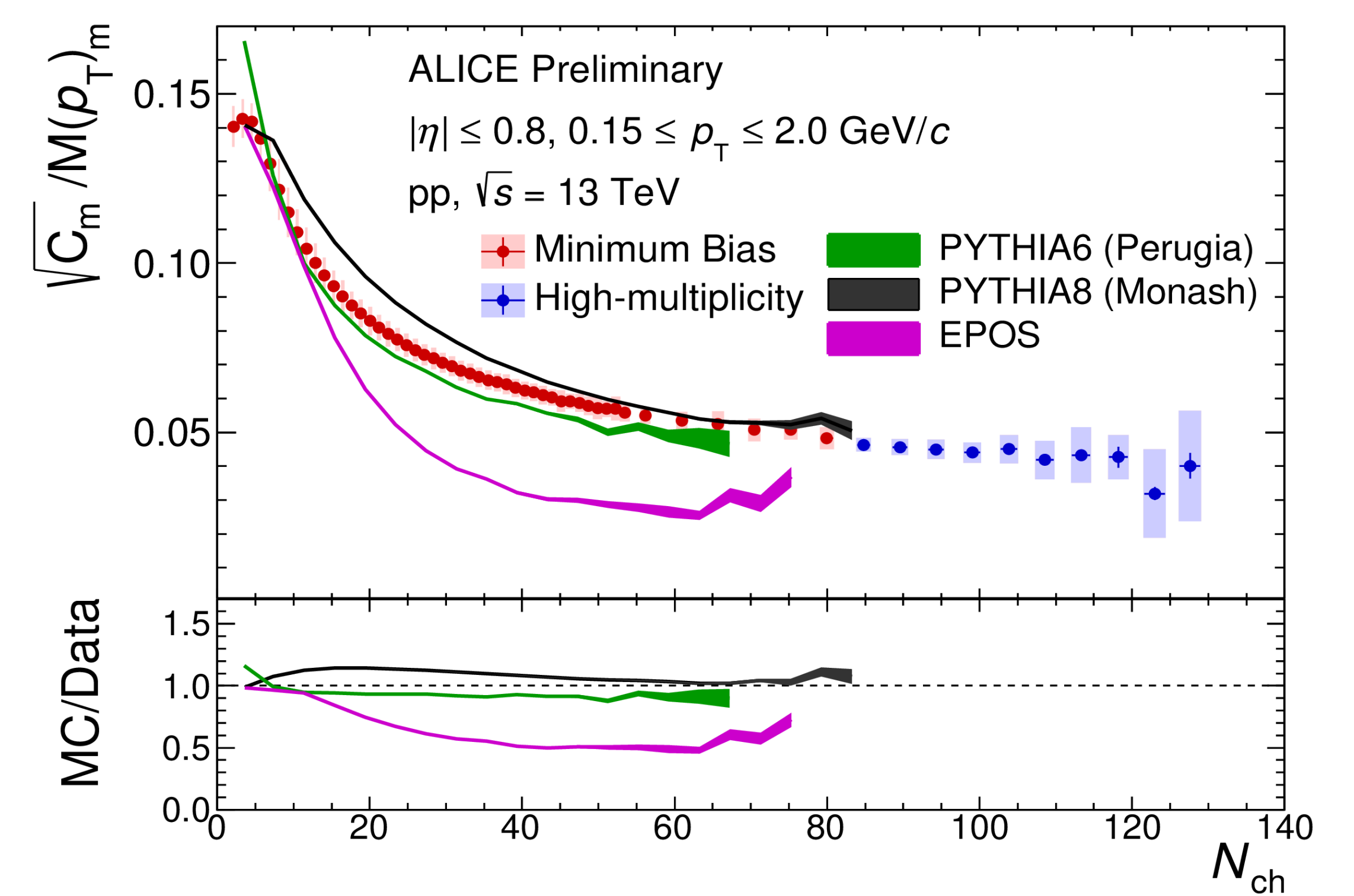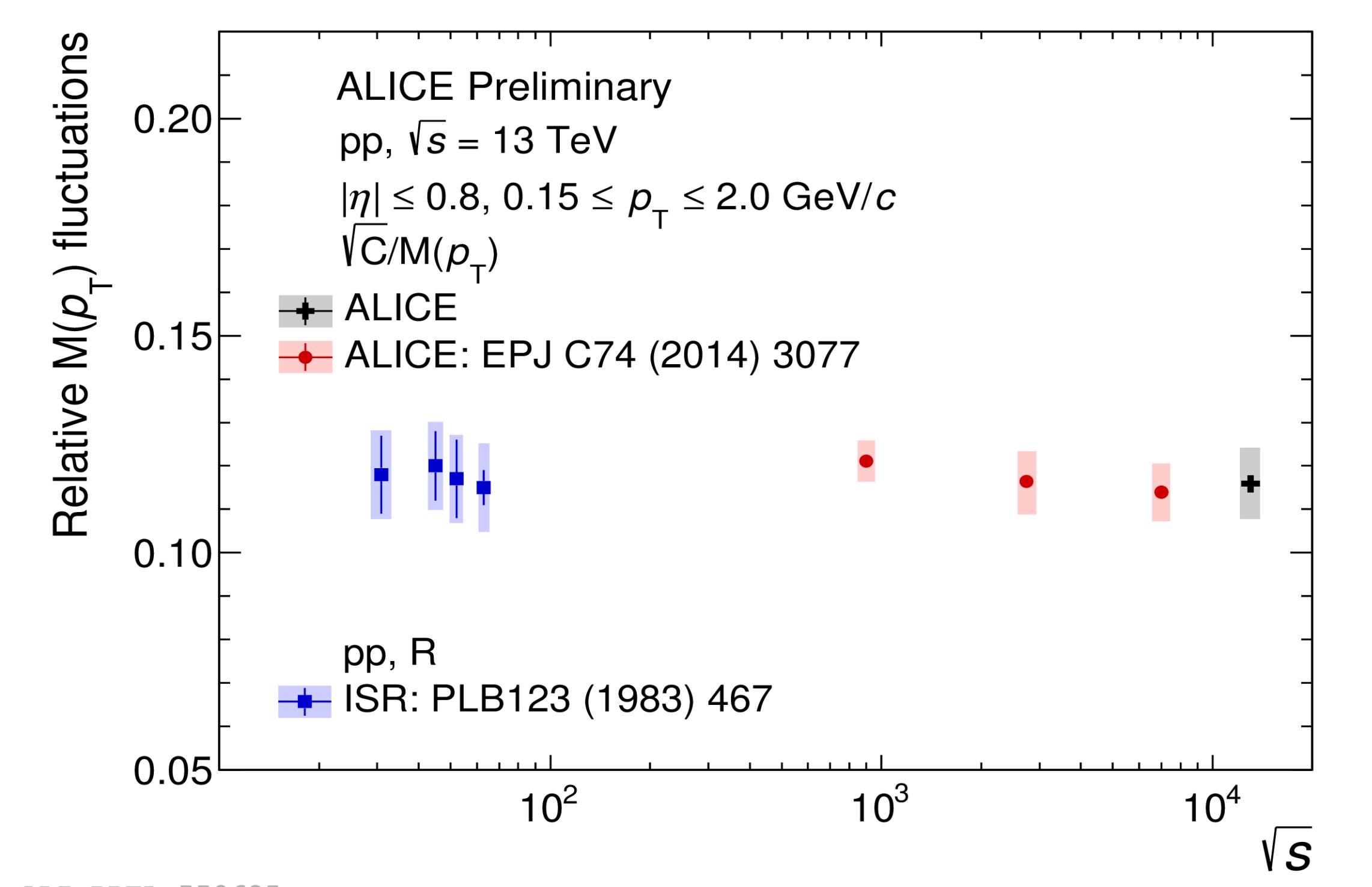
ALI-PREL-550688

- A decreasing trend of the correlator values with increasing multiplicity is observed up to high-multiplicity events.
- PYTHIA model qualitatively reproduces the trend of the data, while the EPOS model gives significantly lower values of correlator as compared to the data.
- Comparison of the present results with those reported at lower LHC energies suggests that the correlator acquires energy-independent values against multiplicity, except in the region of very low multiplicities.
- Comparison of inclusive correlator values with those reported for ISR and LHC energies further supports the energy independence of correlator values.

ALICE Preliminary
$|\eta| \leq 0.8$, $0.15 \leq p_T \leq 2.0$ GeV/c
pp, √s = 13 TeV
- Minimum Bias
- High-multiplicity
- PYTHIA6 (Perugia)
- PYTHIA8 (Monash)
- EPOS

MC/Data

ALI-PREL-550694

ALICE Preliminary
pp, √s = 13 TeV
$|\eta| \leq 0.8$, $0.15 \leq p_T \leq 2.0$ GeV/c
$\sqrt{C}/M(p_T)$
- ALICE
- ALICE: EPJ C74 (2014) 3077
- ISR: PLB123 (1983) 467

pp, R

ALI-PREL-550685

Summary

- Second-order mean p_T fluctuations in pp collisions at √s = 13 TeV energies are studied.
- Decreasing mean p_T fluctuations with increasing particle multiplicity are observed.
- Similar studies for identified particles are being carried out.

References

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[7] STAR Collaboration, Phys. Rev. C72 (2005) 044902.
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