Study of multiplicity fluctuations of charged particles produced at the LHC energies (O2 framework)

Balwan Singh

Supervisor : Prof. Ramni Gupta

Department of Physics,
University of Jammu,
Jammu, India

ALICE- STAR INDIA MEET 23-12-2023

OUTLOOK

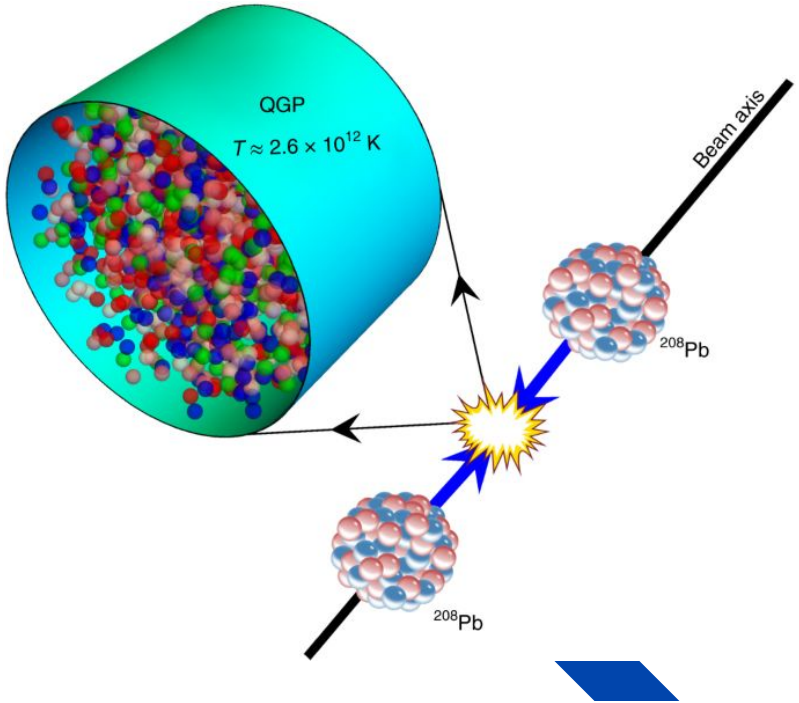
1. MOTIVATION
2. METHODOLOGY
3. DATA SET
4. OBSERVATIONS
5. SUMMARY

Motivation

As the system approaches critical temperature, tension between the collective interactions and thermal randomization increases leading to formation of clusters.

Fluctuations study of the observables is an important tool to understand the dynamics of the particle production and phase changes

These fluctuations are characterized by the moments of the distribution of particle density in the collision within some phase space.

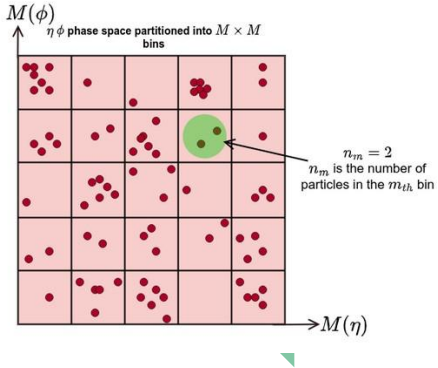


Methodology

Scale-invariance over a range of bin sizes is given by Normalized Factorial Moments (NFM).

$$\mathbf{F_q(M)} = \frac{\frac{1}{\mathbf{N}}\sum_{\mathbf{e=1}}^{\mathbf{N}}\frac{1}{\mathbf{M}}\sum_{\mathbf{i=1}}^{\mathbf{M}}\mathbf{f_q(n_{ie})}}{\left(\frac{1}{\mathbf{N}}\sum_{\mathbf{e=1}}^{\mathbf{N}}\frac{1}{\mathbf{M}}\sum_{\mathbf{i=1}}^{\mathbf{M}}\mathbf{f_1(n_{ie})}\right)^{\mathbf{q}}}$$

$$f_q(n_{ie}) = \langle n_{ie}(n_{ie}-1)\ldots(n_{ie}-q+1)\rangle_h$$



"In a scale-invariant pattern, the properties of normalized factorial moments (NFM) change according to the number of phase space bins, M.

M-scaling $F_q \propto M^{\phi_q}$

F-scaling $F_q \propto F_2(M)^{\beta_q}$

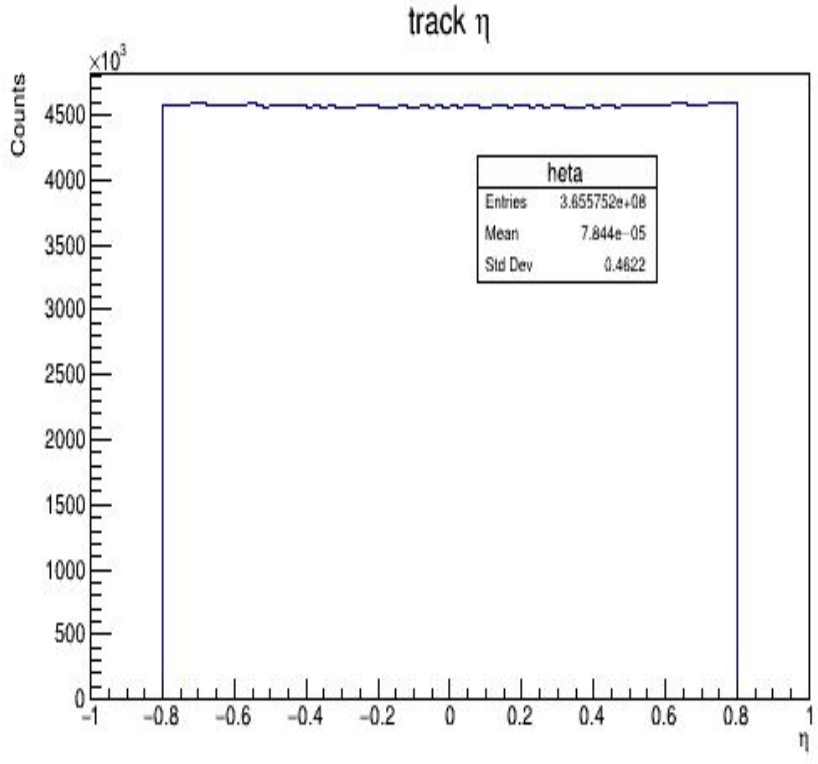
DATA SET

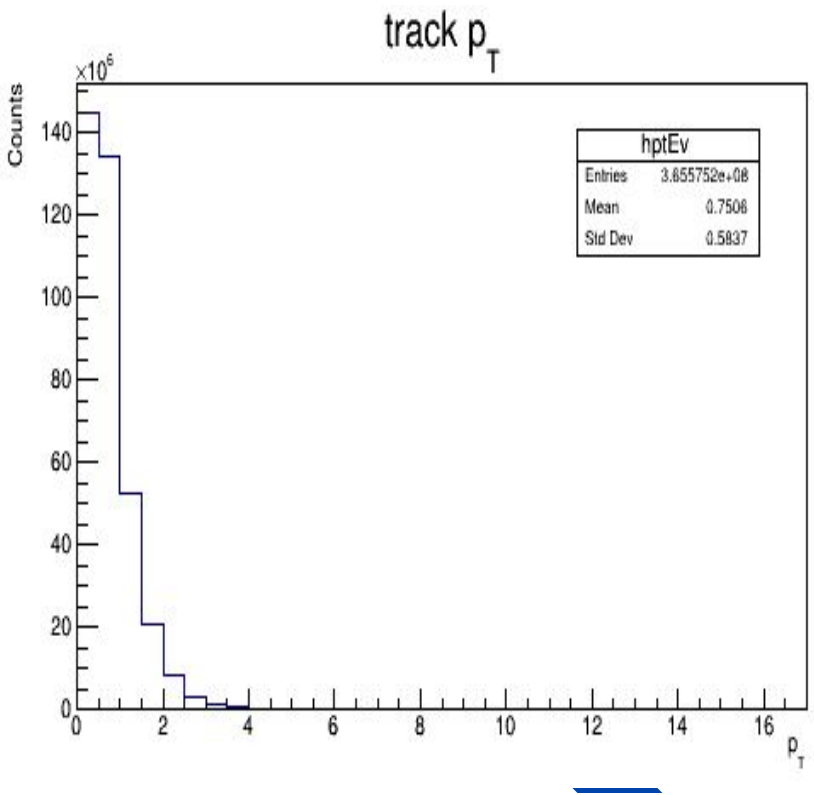
AO2D.root file for (pp at √s = 13.6 TeV)

Data sample: LHC22m_pass3

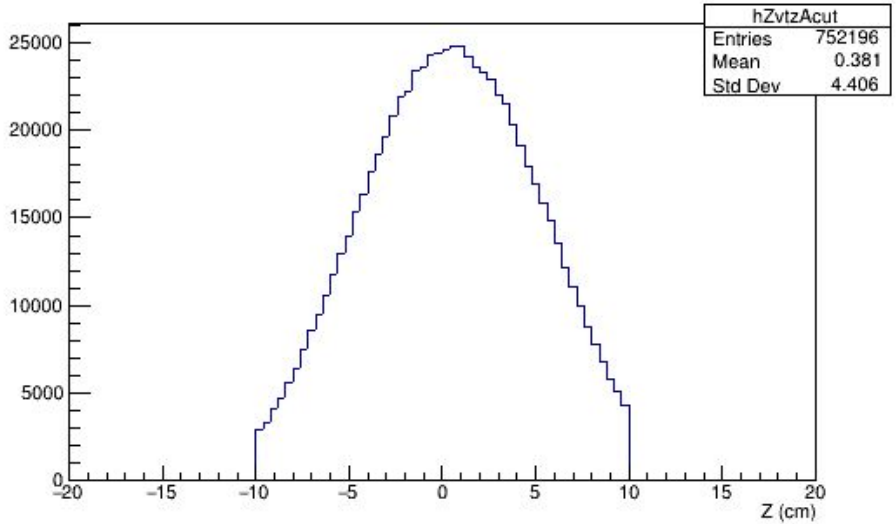
Run no. 523308

OBSERVABLES

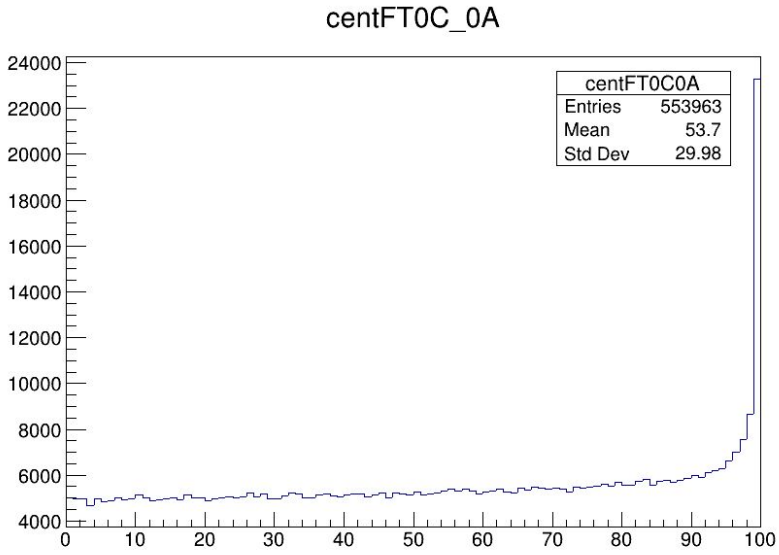




OBSERVABLES

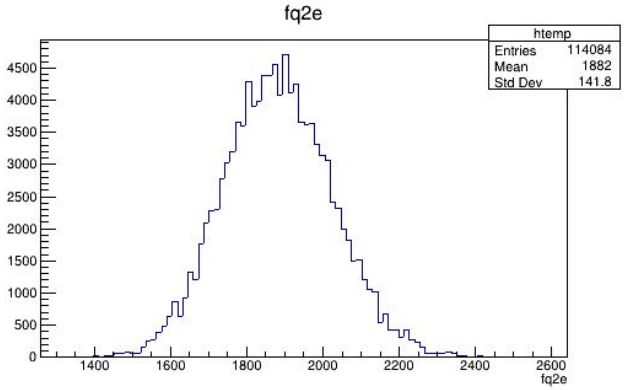


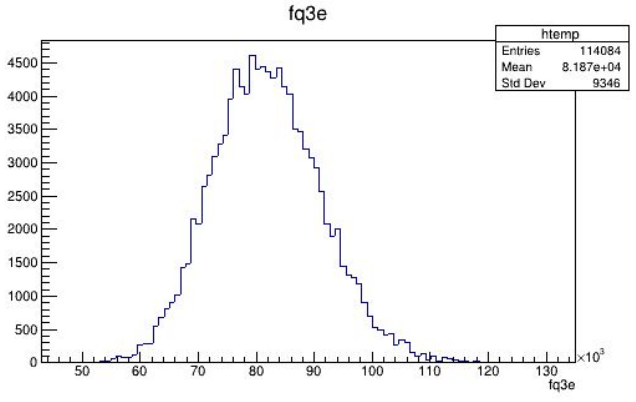
|Vz| < 10

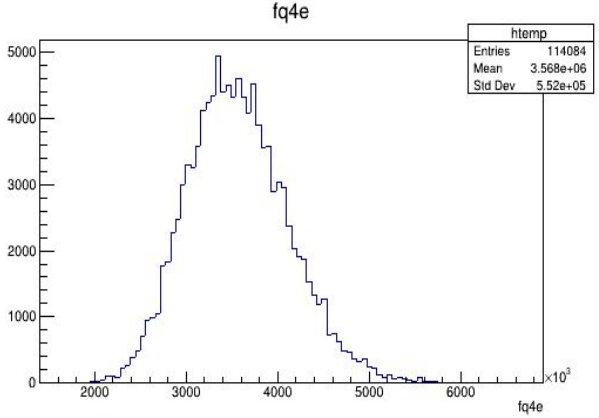


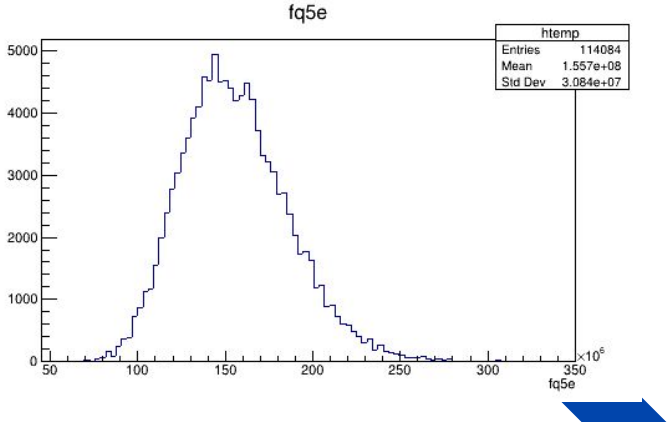
Centrality distribution for Charged Particles

Fq Distribution for ($0.4 < p_T < 1.0$)









Summary

1. **Developing O2 code for the study of fluctuations as was done at 2.76 TeV and 5.02 TeV data for the RUN3 analysis.**
2. **O2 code for basic histograms is ready**
3. **Observable calculations in O2 are done**
4. **Results in the dataframes. Developing codes to read the data frames**

Thank you!