Intermittency Analysis of charged particles generated in Xe-Xe collisions at $\sqrt{s_{NN}}$ = 5.44 TeV using AMPT Model

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MOTIVATION

The Multiplicity fluctuations are sensetive to the QCD phase transition and to the presence of the critical point in QCD phase diagram

At the critical temperature, the system undergoes a phase transition is characterised by lager fluctuations in the observables.

Thus multiplicity fluctuation study is one of the important technique

- to characterize QGP
- and hence to add to information about the QCD phase diagram/particle production mechanism [1].

Here a study of scaling properties of multiplicity fluctuations over wide range of bin sizes using Normalized Factorial Moments referred to as Intermittency analysis is presented.

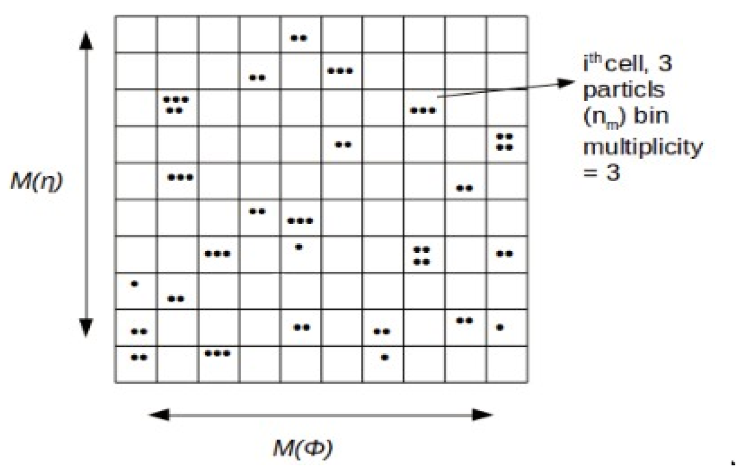
PREDICTION

ν_{GL} = 1.304 in Ginzburg Landau formalism for second-order phase transition [2].

METHODOLOGY

- Two dimensional event by event intermittency analysis in performed
- Eta-phi phase space of an event is binned into M ×M bins
- |η| ≤ 0.8, 0 ≤ φ ≤ 2π , p_T ≤ 1.0 GeV/c
- Charged particles are mapped onto this 2D matrix so that
- number of particles that go in each cell defines the bin multiplicity(nie)
- For multiplicity (n_{ie}), the NFM F_q is

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



- If F_q has power law dependence on M as, (M-scaling)

$$F_q(M) \propto (M)^{\phi_q}$$

then, it is termed as intermittency.

ϕ_q: known as intermittency index

F_q has power law dependence on F_2 as, (F-scaling)

$$F_q \propto F_2^{\beta_q}$$

Where $\beta_q = (q - 1)^\nu$

ν : known as scaling exponent [2]

A MULTIPHASE TRANSPORT MODEL(AMPT)

- AMPT model is a mixed model based on both hadronic and partonic phase[3]. It exists in two versions: the default AMPT and the AMPT with string melting version.
- Using the String melting (SM) version, 500K minimum biased Xe-Xe events at $\sqrt{s_{NN}}$ = 5.44 TeV generated.
- Analysis is performed for central events with impact parameter 0 ≤ b ≤ 3.5 fm.

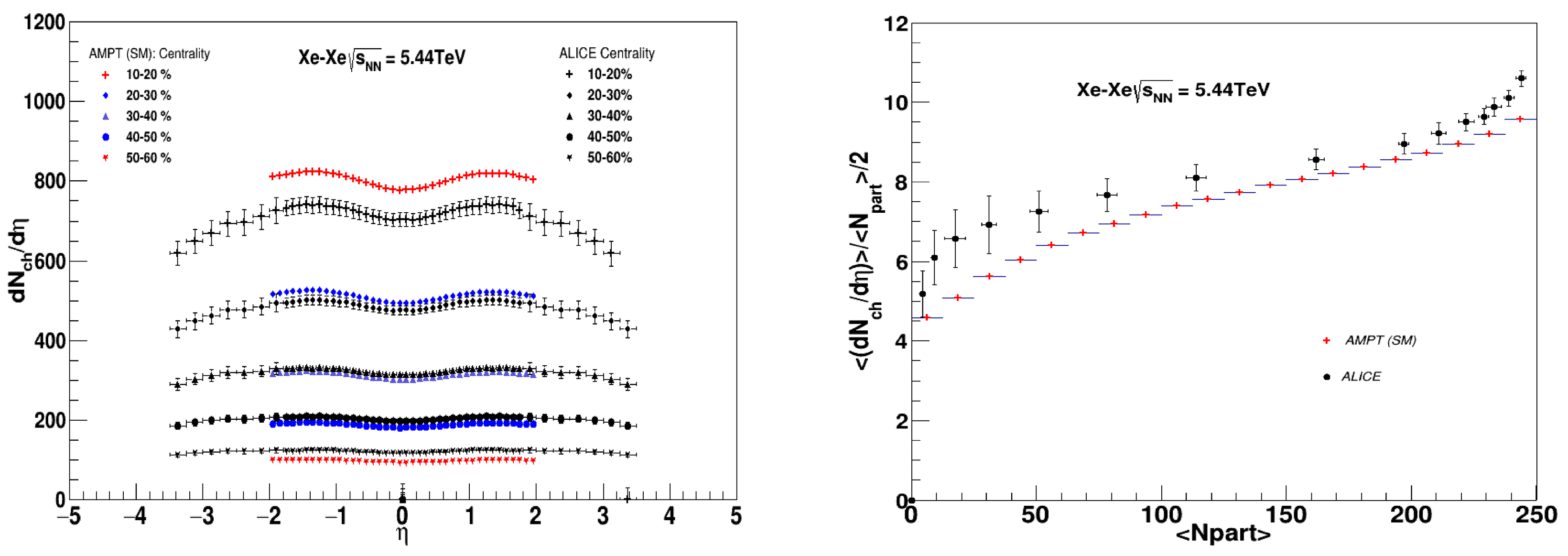
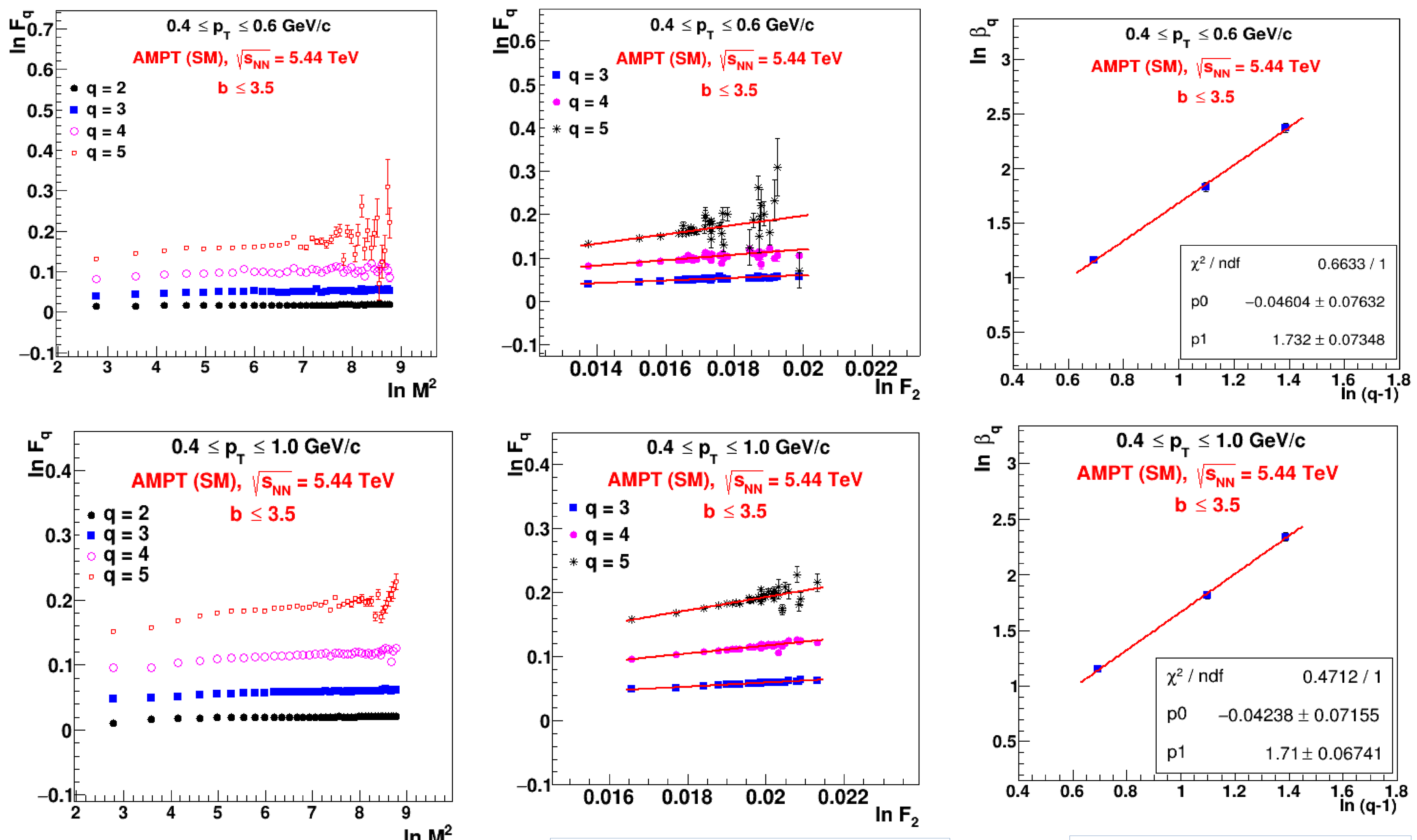


Fig .1.(left) Pseudorapidity density distribution of charged particles for various centralities and (right) charged particle density vs number of participants from the generated events is given and compared with the ALICE data for Xe-Xe collision at $\sqrt{s_{NN}}$ = 5.44 TeV [4].

OBSERVATION AND RESULTS

The M-scaling (left) and F-scaling (middle) behaviour of the NFM (F_q) is observed for two different p_T bins and the scaling exponent (right) values are calculated for the same.



$F_q(M) \propto (M)^{\phi_q}$ $F_q \propto F_2^{\beta_q}$ $\beta_q = (q - 1)^\nu$

Fig .2. Scaling and scaling exponent in [0.4 – 0.6, 0.4-1.0] p_T bin

- To study dependence of scaling exponent on p_T bins and p_T bin width, analysis of the scaling behaviour is carried in various p_T bins. Results given below along with the comparison of results from other system and energies.

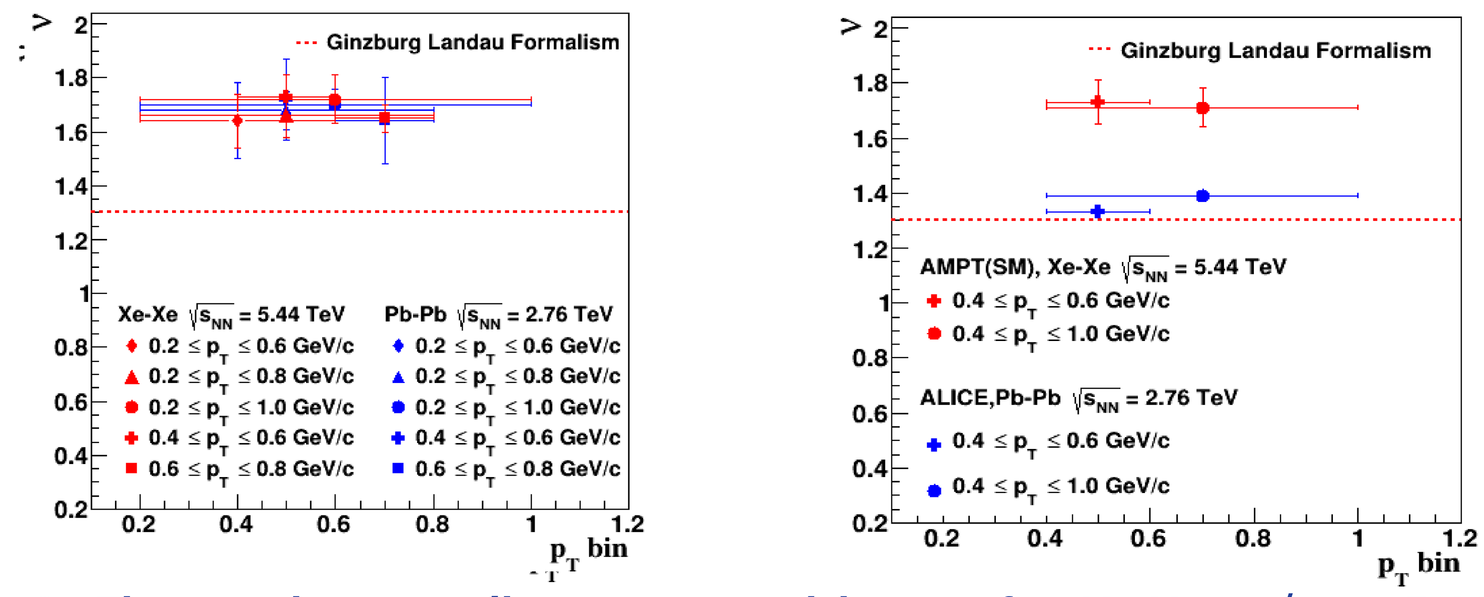


Fig .3. Figures shows scaling exponent (ν) vs p_T for Xe-Xe at $\sqrt{s_{NN}}$ = 5.44 TeV. ν value obtained for Pb-Pb collision at $\sqrt{s_{NN}}$ = 2.76 TeV from AMPT(SM) model [5] (left panel) and ALICE experiment [6] (right panel) are also given.

SUMMARY

- Intermittency analysis of the charged particles generated in the mid rapidity region in Xe-Xe collisions at $\sqrt{s_{NN}}$ = 5.44 TeV have been studied .
- A power-law growth of NFM (F_q) with M is observed to be absent at high M values in all the p_T bins.
- However F-scaling is observed.
- With no phase transition physics implemented in (SM) AMPT model
  - Scaling behaviour in line with intermittency is absent.
  - Scaling exponent different from value predicted by theory for second order phase transition.

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