Forward-backward multiplicity correlations in Pb-Pb collisison at $\sqrt{S_{nn}} = 2.76$ TeV

A. Ahmed[1], N. Subba[1], A.N. Tawfik[2], and P.K. Haldar[1*]
[1] *Department of Physics, Cooch Behar Panchanan Barma University, Panchanan Nagar, Vivekananda Street, Cooch Behar- 736101, West Bengal, India and*
[2] *Nile University, Egyptian Center for Theoretical Physics (ECTP), Juhayna Square of 26th-July-Corridor, 12588 Giza, Egypt*

Introduction

The evaluation of space-time of hot and dense matter during heavy-ion collision at RHIC and LHC can be well described by relativistic viscuss hydrodynamics [1]. Since the density fluctuations in the initial state based on event-by-event condition, so the final state of the produced matter also fluctuates event to event. At the early state of high energy collisison the density fluctuation generates long-range correlation which is appears as correlations of the multiplicities densities of produced particles separated in pseudorapidity (η). Many Studied have been revealed a significat information about the about the forward backward correlation among the produces particles [2].

Two particle correlation and the transverse momentum have been studied in Pb-Pb collisison at $\sqrt{S_{nn}} = 2.76$ TeV. For the study purpose we use simulated data based on Ultra-relativistic Quantum Molecular Dynamics (UrQMD). It is one of the most reliable and transport models to study the simulation of heavy-ion collisions is the Ultra Relativistic Quantum Molecular Dynamics (UrQMD) model [3]. It operates well in the energy range between SIS to RHIC. It runs on various UNIX–based computing platforms. UrQMD is designed as a multipurpose tool for studying a wide variety of heavy-ion related effects ranging from multifragmentation and collective flow to correlations and particle production.

*Electronic address: prabirkrhaldar@gmail.com

Methodology

Forward-backward correlation

For the calculation of Forward-backward correlation in the multiplicity of Pb-Pb interaction at 2.76 TeV. Here we consider two pseudorapidity windows having width $\Delta\eta$ along the both positive and negetive η-axis about the origin in pseudorapidity space which is also termed as forward backward window.

Let n_f be the number of charged particles in the position of forward window and n_b is the same but for backward window then the exact long-range correlation must follow the equation

$$\langle n_b(n_f)\rangle = a + bn_f \tag{1}$$

Where b is the slop of the straight line, it is also known as correlation strength & a is the intercept. The expression for correlation strength(b) is

$$b = D_{fb}/D_{ff} \tag{2}$$

where

$$D_{fb} = \langle n_f n_b\rangle - \langle n_f\rangle \langle n_b\rangle \tag{3}$$

Another important parameter is roughness parameter which is expressed as

$$\gamma_k^2 = \sum_{i=1}^{m} \left(n_{ik} - \frac{n_k}{\langle n_k\rangle} \right) /\sigma_{ik}^2 \tag{4}$$

where m denotes the number of bins in the pseudorapidity space and $\sigma_{ik} = \sqrt{n_{ik}}$ is the statistical error.

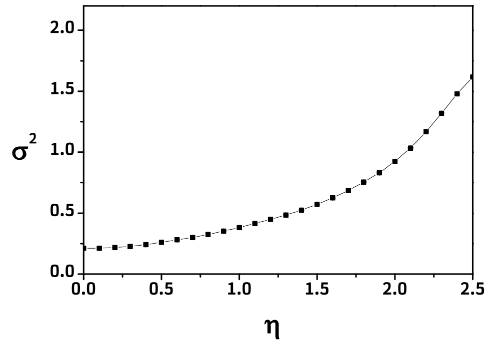

FIG. 1: Represents the variation of correlation fluctuation (σ^2) with η.

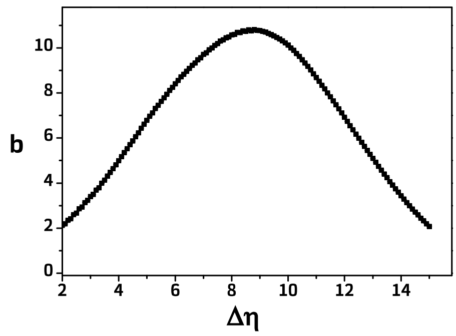

FIG. 3: Represents the variations of correlation strength (b) with $\Delta\eta$.

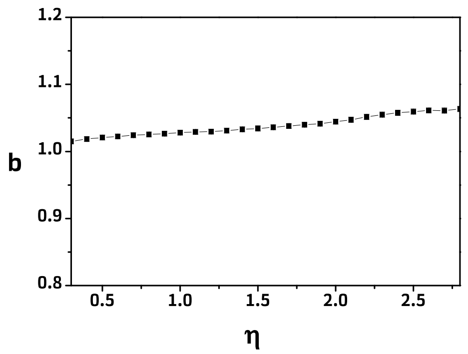

FIG. 2: Represents the variations of correlation strength (b) with η.

Discussions

To know the existence of multiplicity correlation between the charged particle, we have considered Pb-Pb collision at incident energy 2.76 TeV. Fo the study purpose we have only considered UrQMD simulated values. Fig. 1 shows the variations of the correlation fluctuations (σ^2) with η having constant bin size $\Delta\eta$. It has been observed that the variation of σ^2 increases with increasing the values of η. In Fig. 2, we have observed the variation of correlation strength b with η at constant bin size $\Delta\eta$. We noticed that the correlation strength remains constant with η value which implise that there are no correlation present between the particle. Fig. 3 represents the variation of b with $\Delta\eta$. It is observed from the figure that the value of b increases upto a certain value of $\Delta\eta$ and then it again decreases with increasing of $\Delta\eta$ value, which implise the presence of correlation among the produced particles.

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