Study of Forward-Backward Multiplicity Correlations in 14.5A GeV/c ^{28}Si-AgBr Collisions

N. Ahamd[1*], Hushnud[1], M. M. Khan[2], A. Kamal[#] and M. Irfan[1]
[1]Department of Physics, Aligarh Muslim University, Aligarh -202002, INDIA
[2]Deptartment of Applied, Aligarh Muslim University, Aligarh -202002, INDIA

** email: nazeer_ahmad_na@rediffmail.com*

Introduction

Mechanism of multiparticle production in high energy hadronic and nuclear collisions has been extensively investigated by several workers [1-3]. However, correlations among particles produced in such collisions in different rapidity regions, which are expected to provide invaluable information about the underlying mechanism of particle production in nuclear collisions have not been investigated thoroughly. Short-range correlations (SRC) have been observed [1] in hadron-hadron (hh) collisions, indicatiing clustering over a region of pseudorapidity $\sim\pm1$. It was, therefore, considered worthwhile to study forward-backward multiplicity correlations of charged particles in symmetric rapidity bins, which may provide some insight into the dynamics of the particles produced in these collisions. Forward-backward multiplicity correlations are investigated thoroughly [1-3] using the data mainly on hh collisions. However, studies involving RHIC data suggest that in high energy pp collisions, multiparticle correlations would extend over a long range. Furthermore, long-range correlations (LRC) may be present in nucleus-nucleus (AA) collisions at high energies. The observed long-range correlations in these collisions may be a signal of multipartonic interactions in highly dense nuclear matter [2,3]. An attemmpt is, therefore, made to investigate forward-backward multiplicity correlation in AA collisions by anlyzing data on 14.5A GeV/c ^{28}Si-AgBr collisions. The results of the study are also compared with the corresponding results obtained for Monte Carlo HIJING and FRITIOF generated events of the same description. The behaviour of correlated production of particles due to dynamical reasons, are checked by analyzing the mixed events.

An observable, $C = \dfrac{N_f - N_b}{\sqrt{N_f + N_b}}$, which measures charged particle asymmetry in the forward and backward regions is used to study forward-backward multiplicity correlations. For this purpose, two symmetric η regions of equal width $\Delta\eta$ about $\pm\eta$ ($\eta = \eta_{cm}$) are considered. The number of charged particles in the forward and backward regions respectively, N_f and N_b are counted and the variance of C, σ_c^2 may be calculated using:

$$\sigma_c^2 = \frac{D_{ff} - D_{bb} - 2D_{fb}}{\langle N_f + N_b \rangle} \qquad (1)$$

where $D_{ff} = \langle N^2_f \rangle - \langle N_f \rangle^2$,

$D_{bb} = \langle N^2_b \rangle - \langle N_b \rangle^2$ and

$D_{fb} = \langle N_f N_b \rangle - \langle N_f \rangle\langle N_b \rangle$.

Parameter b, which measures the strength of correlation, is defined as: $b = \dfrac{D_{fb}}{D_{ff}}$ (2)

Results and discussions

Variations of σ_c^2 with $\Delta\eta$ for the experimantal and simulated data sets are dispalyed in Fig.1 alongwith the data involving mixed events. It is clear from the figure that σ_c^2 increases with increasing bin width for all the data sets considered in the present study except for the mixed events. However, the values of σ_c^2 obtained for simulated data are higher than those of the experimental ones. It is also observed from Fig. 1 that $\sigma_c^2\sim1$ for smallest windows and increases with increasing

[#] Presently in Macca, KSA

pseudorapidity windows. This may be attributed to the fact that with increasing window size probability of finding more than one particle in the forward and backward regions increases. This would tend to indicate existence of forwrad-backward multiplicity correlations in the experimental as well as Monte Carlo generated events. However, correlation amongst the produced particles disappears after mixing the events.

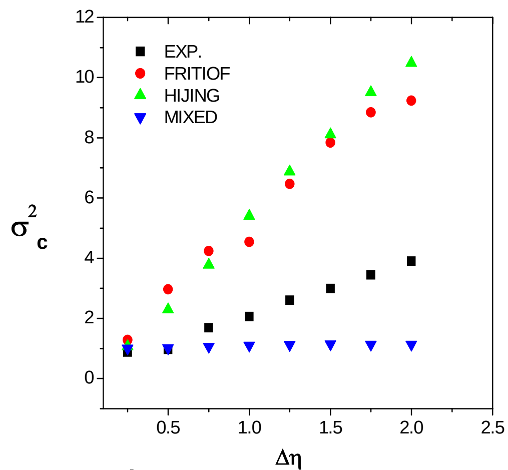

Fig. 1

The strength of the correlation for the LRC measured by parameter, b is plotted against $\Delta\eta$ in Fig. 2 for the experimental as well as simulated events. The magnitude of the LRC is observed to be quite large for the particles lying in the interval, $\Delta\eta \geq 0.5$. However, HIJING and FRITIOF generated events both show that LRC occurs with a large value of b. It may be noted that the value of b saturates for $\Delta\eta \geq 2.0$. It is believed[2,3] that the experimental observation of the LRC is due to the fluctuations in the number of elementary inelastic collisions.

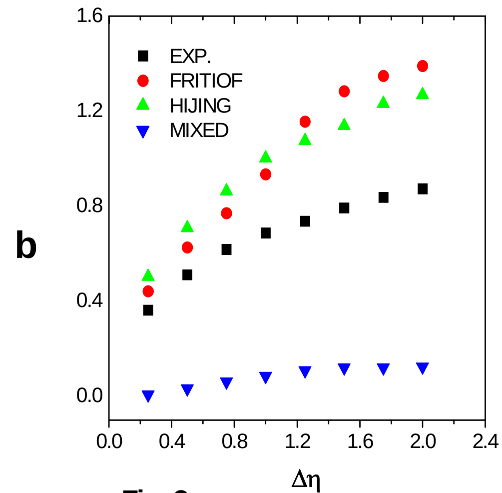

Fig. 2

Conculsions

Study of parameters $\sigma_c^{\ 2}$ and b for 14.5A GeV/c ^{28}Si-AgBr collisions reveals occurrence of charged particle multiplicity fluctuations in the pseudorapidity space. Long-range correlations are observed in all the sets of data for $\Delta\eta \geq 0.5$.

References

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