Energy dependence of charged particle correlation in ^{16}O-AgBr collisions

N. Ahmad*
Deptartment of Physics,
Aligarh Muslim University, Aligarh, U.P. -202002, INDIA
* *email: nazeerahmadna@gmail.com*

Introduction

The information regarding the dynamics of multiparticle production in relativistic nuclear collisions may be obtained by studying the angular characterisitcs of the relativistic charged particles produced in these collisions. It is commonly believed [1-4] that relativistic charged particle produced through formation of some intermediate stage, like fireball, cluster, etc. It has also been reported [5-7] that clusters of different sizes are formed which finally decays into real physical particles. The idea of particle production in high-energy hadronic and nuclear collisions through the decay of clusters has gained a good degree of acceptibility [1-7] in the last three decades. Correlation and clusterization amongst produced charged particles may be investigated by examining the features of pseudorapidity and pseudorapidity spacing spectra in the frame work of multiperipheral model [4]. An attempt is, therefore, made to examine the correlation and clusterization amongst produced relativistic chatged particles in ^{16}O-AgBr collisions at 60A and 200A GeV.

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Experimental Details

In the present analysis, two emulsion stacks exposed to oxygen beams at 60A and 200A GeV from EMU01collaboration are used. Two samples of 391 and 212 interctions of ^{16}O with AgBr at 60A and 200A GeV respectively were selected using standard emulsion criteria [6].

Results and Discussion

The rapidity differences between two- and three-charged partilcles prouced in ^{16}O-AgBr collisions at 60A and 200A GeV are calculated for each event and arranged in decreasing order. According to Sinder [2], which is two channel generalization of Chew- Pignotti [4] multiperipheral cluster model has the rapidity gap distribution of the following form:

$$dn/dr = A\exp(-Br_i) + C\exp(-Dr_i) \quad [1]$$

where A, B, C and D are contants and r_i is the rapidity gap between the n^{th} nearest neighbours. It may be mentioned that first and second terms of the Eq. 1 respectively represents the contribution of short-range (SR) and long-range (LR) correlations. Furthermore, parameters B and D may help to glean out information about the size of cluster and cluster density respectively.

Rapidity gap distributions of two- and three-particles produced in ^{16}O-AgBr collisions at 60A GeV are displayed in Figs.1-2. It may be noted from the figures that clear peaks are observed to occur at relatively smaller values of rapidity gaps (r_i), indicating therebye the persence of two- and three-particle correlations. The solid curves in the figures are the best fits to the data obtained using Eq.1. Values of the constants A, B, C and D obtained for these distributions along with their chi-square are listed in Table 1 The two broken lines in the figures represents the contributions of two exponential terms appearing in the Eq.1. It may be mentioned that major contribution comes from the first term whilst second term contribution seems to be negligible. It is interesting to note from the table that parameter, B decreases with increasing size of cluster and found to be insensitive to the beam energy. However, parameter, D remain same with respect to the number of particle constituting a cluster and the beam energy.

. **Table 1(a)** Values of constants appearing in Eq. (1) obtained for 60A GeV ^{16}O-nucleus collisions.

Fit parameters	Correlation type	
	Two-particle	**Three-particle**
A	3.20±0.31	3.32±0.40
B	4.80±0.22	4.10±0.28
C	0.31±0.03	0.18±0.02
D	0.98±0.04	1.20±0.08
χ^2/D.F.	0.24	0.16

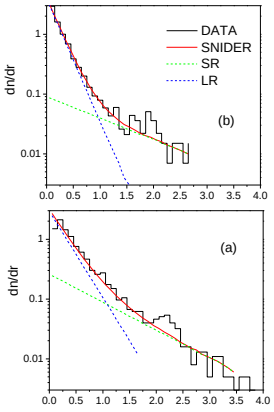

Fig. 1 Two- particle (a) and Three-particle (b) gap distributions in ^{16}O-AgBr collisions at 60A GeV

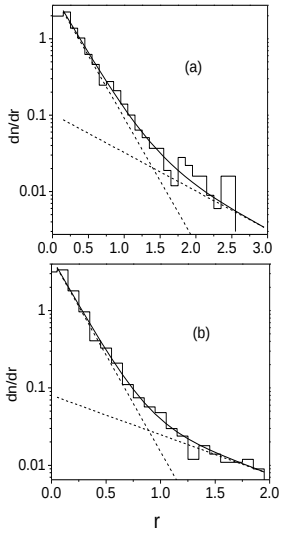

Fig.2 Two- particle (a) and Three-particle (b) gap distributions in ^{16}O-AgBr collisions at 200A GeV.

Table 1(b) Values of constants appearing in Eq. (1) obtained for 200A GeV ^{16}O-nucleus collisions.

Fit parameters	Correlation type	
	Two-particle	Three-particle
A	3.40±0.36	3.70±0.36
B	6.40±0.31	5.40±0.32
C	0.28±0.02	0.30±0.04
D	0.80±0.03	0.97±0.06
χ^2/D.F.	0.18	0.22

Conclusions

On the basis of results obtained in the present study, it may be concluded that in the relativistic nucleus-nucleus collisions, the maximum number of relativistic charged particle constituting a cluster is three. However, it is observed that this number is four for higher multiplicity events. This result, therefore indicates a strong dependence of cluster size on multiplicity of relativistic charged particles at both the beam energies. Furthermore, the cluster size is found to almost independent of the beam energy.

References

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