Forward-backward multiplicity characteristics of particles produced in 60A GeV/c ^{16}O-AgBr-Collisions

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Introduction

Study of forward-backward characteristics of the particles produced in the hadron-nucleus(hA) and nucleus-nucleus (AA) collisions at relativistic energies has gained considerable interest of various workers[1-3] in the field of high-energy physicis in the past. Further, emission characteristics of particles produced in the forward hemisphere(FHS) is thoroughly studies[4-7], which can be generally described by the superposition models[4-5]. However, the production of relativistic particles in the backward hemisphere (BHS) has been of interest to the physicists because of the fact that emission of such particles i.e. pions in the backward direction, from the nuclei is kinematically restricted. Therefore, the emission of pions beyond the kinematical limit may be an evidence for some exotic production mechanism like production of particles in the form of clusters. Thus, the study of such hadrons produced in BHS may provide some useful information regarding nuclear effects such as interaction of hadrons from the primary interaction point with the surrounding nuclear matter and short-range correlation between nucleons.

Keeping the importance in view of the above, we present in this paper, some results on mean multiplicity, multiplicity distribution and multiplicity correlations amongst the secondary charged particles produced in 60A GeV/c ^{16}O-AgBr collisions. Furthermore, results of the present study are compared with those obtained for AMPT data.

Details of the data

An emulsion stack exposed to 60A GeV/c ^{16}O beam at SPS, CERN has been used for the present study. A random sample of 422 interactions from AgBr collisions are selected by using usual emulsion criteria. In order to compare the experimental results, a sample of events with similar characteristics at 60A GeV/c ^{16}O-AgBr collisions are generated using AMPT model and has also been analyzed.

Results and discussion

Mean multiplicities of relativistic charged particles produced in the forward and backward hemispheres are calculated for 60A GeV/c ^{16}O-AgBr collisions for experimental as well as AMPT data and are presented in the Table 1. It may be noted from the table that probability of emission of particles in the forward hemisphere (FHS) is much higher than that of the backward hemisphere (BHS). This result is in well agreement with the result obtained from AMPT data. Similar results have also been reported by other workers[1-3], which also show a significant increase in the value of mean multiplicity of relativistic charged particles produced in the BHS, $< n_s^b >$ with increasing the mass number of incident projectile. The values of the $< n_s^b >$ and $< n_s^f >$ with in the limit of experimental errors are nearly same for both the data samples.

Table 1. **Mean multiplicities of the relativistic charged particles produced in the BHS and FHS in 60A GeV/c ^{16}O-AgBr collisions**.

Mean multiplicities	Experimental data	AMPT data
$< n_s^b >$	3.32 ± 0.13	3.29 ± 0.17
$< n_s^f >$	26.01± 2.55	23.02± 2.43

Table 2. **Mean multiplicities of relativistic charged particles produced in the FHS for 60A GeV/c ^{16}O-AgBr collisions**.

Interaction type	$< n_s^f >$	
	Experimental data	AMPT data
$n_s^b=0$	15.91± 0.13	16.32± 1.24
$n_s^b=1$	20.71± 2.04	19.63 ±2.14
$n_s^b\geq 2$	31.75 ± 3.21	31.48 ± 3.22

Mean multiplicities of relativistic particles, $< n_s^f >$ for the interactions having $n_s^b = 0$, 1 and ≥ 2 are also calculated and tabulated in the Table 2. From the table, it is clear that $< n_s^f >$ increases rapidly as the number of relativistic hadrons produced in the BHS increases. This result is nicely reproduced by the AMPT model.

Fig.1 represents the multiplicity distribution of relativistic charged particle produced in the BHS for both the experimental as well as AMPT data on 60A GeV/c ^{16}O-AgBr collisions. The distributions are consistent with those as reported in reference[1]. It is interesting to mention that the multiplicity distribution of relativistic charged particles in the BHS almost same for all the projectiles. This leads to conclude that mechanism of particle production in the BHS is independent of projectile mass.

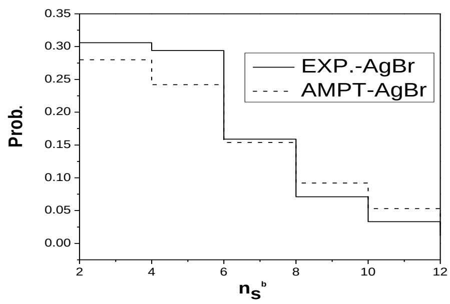

Fig. 1 n_s^b distributions for the experimental and AMPT data in 60A GeV/c ^{16}O-AgBr collisions.

The dependence of mean multiplicity of relativistic charged particles in the BHS and FHS in 60A GeV/c^{16}O-AgBr collisions for the experimental as well as AMPT generated data are shown in figs. 2 and 3. It is clear from the figures that $< n_s^b >$ and $< n_s^f >$ are strongly correlated with n_s^f and n_s^b respectively. Straight lines in the figures are the best fits to the data and are obtained using least-square fits of the following form:

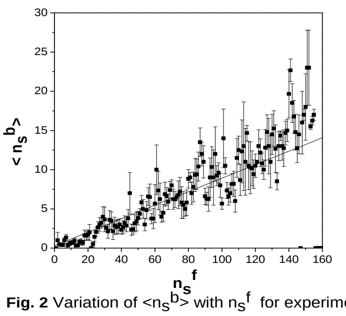

Fig. 2 Variation of $<n_s^b>$ with n_s^f for experimental data in 60A GeV/c ^{16}O-AgBr collisions.

$< n_s^f > = (45.32 \pm 5.40) + (7.27 \pm 0.52) \; n_s^b$ for Experimental and

$< n_s^f > = 25.56 \pm 3.33) + (6.37 \pm 0.29) \; n_s^b$ for AMPT data

$< n_s^b > = (0.903 \pm 0.246) + (0.035 \pm 0.003) \; n_s^f$ for the experimental and

$< n_s^b > = (0.590 \pm 0.030) + (0.086 \pm 0.006) \; n_s^f$ for the AMPT data.

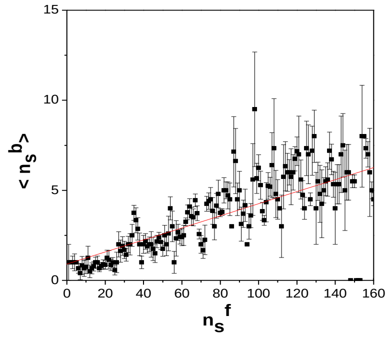

Fig. 3 Variation of $<n_s^b>$ with n_s^f for AMPT data in 60A GeV/c ^{16}O-AgBr collisions.

Conclusions

Based on the present study on the forward-backward characteristics in 60A GeV/c ^{16}O-AgBr collisions, we may conclude the following:

The mean multiplicity of the relativistic charged particles in the FHS, $< n_s^f >$ is strongly dependent on the projectile mass number, while the $< n_s^b >$ has a very weak dependence on the projectile mass number.

Mean multiplicities of the particles produced in the BHS and FHS for the experimental data are consistent with their corresponding values for the AMPT simulated data.

Mean multiplicity of relativistic charged particles produced in the FHS, $< n_s^f >$ is found to depend strongly on the produced hadrons in the BHS and the values obtained for the experimental data are in good agreement with their corresponding values obtained for AMPT data.

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