Multiparticle production in 4.5A GeV/c ^{28}Si-nucleus interactions

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Introduction

Currently the main motivation behind the investigations of high energy nuclear collisions is to study quark-gluon substructure of nuclear matter and possibility of occurrence of a phase transition from a hadronic matter to quark-gluon plasma [1] at high energy densities. So, search of a clear evidence of QGP formation and a deep and thorough understanding of the background will help understand QGP formation. Some useful and interesting information about multiparticle production in high energy nuclear interactions are available. These information are considered to be very important for explaining certain aspects of high energy nuclear interactions such as multiplicity correlations, multiplicity distribution and pseudorapidity distribution of various secondary charged particles. These are expected to provide very useful information about the formation of quark-gluon plasma in relativistic nucleus-nucleus collisions.

In this investigation, results on various types of multiplicity correlations amongst secondary charged particles produced in ^{28}Si-nucleus collisions at 4.5A GeV/c are analyzed.

Experimental Details

Analysis of 530 events produced in ^{28}Si-nucleus interactions at 4.5A GeV/c is carried out. Secondary charged particles produced in these collisions are separated into shower, grey, black and highly ionizing particles (target fragments) in accordance with their specific ionization, velocity and range. The multiplicities of shower (s), grey (g), black (b) and heavily ionizing (h) tracks produced in an interaction are represented by n_s, n_g, n_b and n_h respectively.

Result and discussion:

In order to understand the nature of the multiplicity correlations [2-4], an attempt is made to investigate multiplicity correlations between $\langle n_s\rangle - n_b$, $\langle n_s\rangle - n_h$ and $\langle n_g\rangle - n_b$. For this purpose, correlations of the type: $n_i - \langle n_j\rangle$, where i, j = b, g, s and h with $i \neq j$ are studied. The variations of $\langle n_s\rangle$ with n_b and n_h and $\langle n_g\rangle$ with n_b are shown in Figs 1-3. In the present analysis, multiplicity correlations obtained in ^{28}Si-nucleus collisions may be represented by the least squares fittings of the type:

$$\langle n_j\rangle = b + a\, n_i$$

where 'a' and 'b' represent slope and intercept of the linear relation respectively.

Figure 1 shows the variation of $\langle n_s\rangle$ with n_b for ^{28}Si-nucleus interactions. From Fig. 1, it is seen that the variation of $\langle n_s\rangle$ with n_b is linear. The correlation between $\langle n_s\rangle$ and n_b can also be fitted well by the following linear fit having positive slope:

$$\langle n_s \rangle = 4.89 + (1.04 \pm 0.07)\, n_b$$

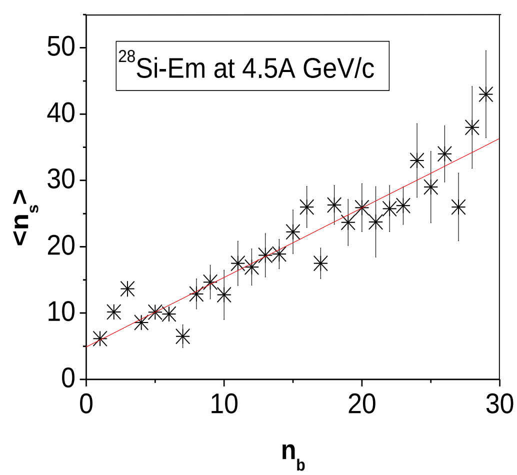

Fig. 1 Variation of $\langle n_s\rangle$ with n_b

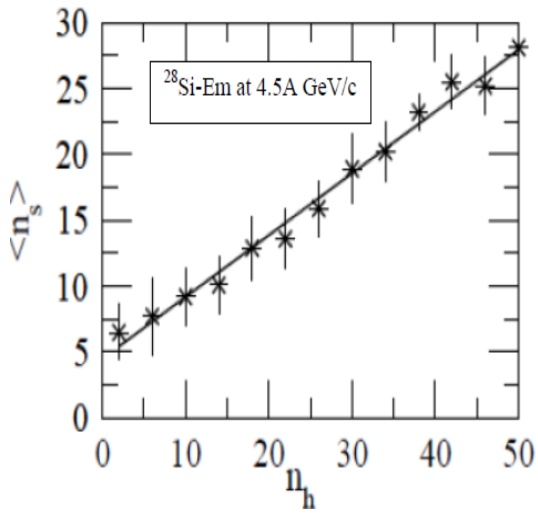

Fig. 2 Variation of $<n_s>$ with n_h

From Fig. 2 it is clear that the experimental data can be nicely fitted by the following linear relation:

$$< n_s > = 4.50 + (0.44 \pm 0.03)\, n_h$$

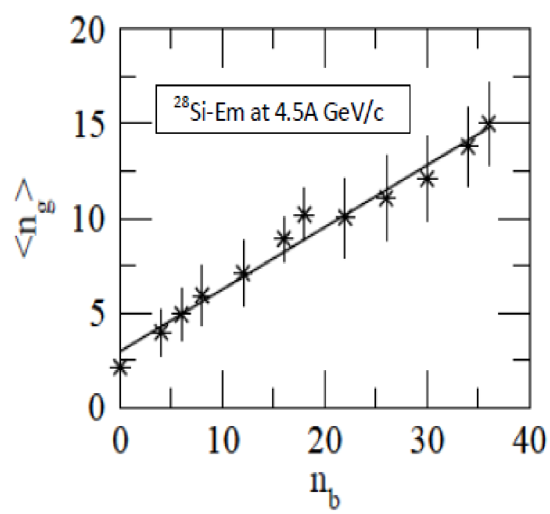

Fig. 3 Variation of $<n_g>$ with n_b

Fig. 3 shows multiplicity correlation between $<n_g>$ and n_b. This can be fitted by the following linear relationship:

$$< n_g > = 2.96 + (0.33 \pm 0.01)\, n_b$$

From all these figures, there is a clear evidence indicating the existence of strong correlations amongst various types of secondary charged particles produced in high energy nucleus-nucleus collisions.

Conclusion:

On the basis of the present study following conclusions can be arrived at:

1. The multiplicity correlations between $<n_s> - n_b$, $<n_s> - n_h$ and $<n_g> - n_b$ are linear and are represented quite well by the linear fits to the data.
2. A linear dependence between the mean multiplicity of relativistic charged particles and multiplicity of heavily ionizing ones are observed.
3. All the correlations are very well fitted by straight lines with positive slopes.

The above observations help understand the mechanism of multiparticle production in high energy nuclear collisions.

References

[1] H.R. Schmidt and J. Schukraft, J. Nucl. Phys.G19, (1993) 1705.

[2] M. Tariq, M. Zafar, A. Tufail and S. Ahmad: IJMPE4, No.2, (1995) 347.

[3] M. Saleem Khan, H. Khushnood, A. R. Ansari and Q.N. Usmani: Nuovo Cim., A108, No.2,(1995) 147.

[4] Tauseef Ahmad and M. Irfan: Nuovo. Cim. A106, No.2, (1993) 171.