Production of Relativistic Charged Particles in 28Si-Nucleus Interactions at 4.5 A GeV/c

H.Khushnood[1]* and Sheikh Sarafarz Ali[2]
[1]University Polytechnic,Jamia Millia Islamia,New Delhi-110025,INDIA
[3] Department of Physics,,Jamia Millia Islamia,New Delhi-110025,INDIA
* email: khushnoodhusain@gmail.com

Introduction

The study of relativistic nucleus-nucleus collisions is attracting a great deal of attention during the recent years[1-6] with a great hope that such studies might provide a chance to investigate the collective properties of nuclear matter at high density and high temperature. Since the existing information on the behavior of the angular characteristics of relativistic charged particles produced in nucleus-nucleus interactions is quite meager, we have carried out a detailed study of the angular characteristics of relativistic charged particles produced in 4.5 A GeV/c 28Si-nucleus collisions.

The angular characteristics of secondary charged particles produced in heavy ion collisions might provide some useful information regarding the dynamics of particle production in nucleus-nucleus collisions.Thus, an attempt has been made to investigate the angular characteristics of relativistic charged particles produced in 28Si-nucleus interaction at 4.5 A GeV/c.

Experimental Techniques

The present work is carried out using the emulsion stacks of NIKFI-BR2 of dimensions 16.9cmX9.6cmX0.06cm (undeveloped emulsion) exposed to 4.5 A GeV/c 28Si-nuclei at Dubna Sychrophostron, Russia. In order to investigate the characteristics of secondary charged particles, a random sample of 498 events produced in 4.5 A GeV/c 28Si-nucleus interactions, have been analyzed. All the relevant information regarding the emulsions stacks, methods of measurement selection criteria etc.may be found in our earlier publication[5].All the secondary charged particles produced in these interactions may be classified in the following categories;

1. Black Particles:- The tracks having relative velocity, β <0.3 are termed as black track. The nature of these tracks in an event is denoted by Nb.They are generally alpha particles,helium nuclei etc.
2. Grey Particles:-The tracks with $0.3\leq\beta\leq0.7$ are referred as grey particles. The number of grey particles in an integration is denoted by Ng.They are generally protons with a very little admixture of slow pions.
3. Heavily Ionizing Particles:-The black and grey tracks taken together are treated as heavily ionizing particles and denoted by Nh (=Nb+Ng).
4. Relativistic Charged Particles:-The tracks having β>0.7 are considered as relativistic charged particles. The number of these particles in a star is represented by Ns.They are generally charged pions.

Experimental Results

Study of the angular characteristics of secondary charged particles produced in 28Si-nucleus interactions at 4.5 A GeV/c has been carried out in terms of pseudo rapidity variables, η (=-ln tan $\Theta/2$), Where Θ is the angle of relativistic charged particles in the laboratory system. In order to investigate the dependence of angular characteristics on impact parameter, the data are divided into three groups i.e. Nh≥0, Nh≥8and 2≤Nh≤7,where Nh denotes the number of heavily ionizing tracks in an event.

The disintegration having 2≤Nh≤7 are admixture of interactions due to CNO group with average atomic mass, <A>=14 and peripheral collisions with AgBr target nuclei, while the events with Nh≥8 are collisions with AgBr nuclei with <A>=94.However, the events with Nh≥0 are collisions with nuclei of nuclear emulsions with <A>=73.

In the present work, the average number of relativistic charged particles,<Ns> produced in

4.5 A GeV/c 28Si-nucleus interactions in different η-bins are calculated and are listed in the table.

Table

Projectile	Nh intervals	<Ns>		
		η≤1	1<η≤4.62	Η>4.62
12C	2≤Nh≤7	0.59±0.05	4.50±0.14	0.36±0.04
28Si	2≤Nh≤7	2.63±0.002	1.49±0.06	0.72±0.04
12C	Nh≥0	1.49±0.06	6.56±0.12	0.37±0.03
28Si	Nh≥0	2.97±0.001	4.97±0.15	0.64±0.002
12C	Nh≥8	2.27±0.09	8.32±0.18	0.37±0.04
28Si	Nh≥8	2.78±0.001	5.12±0.20	0.64±0.003

It is clear from the table that the average number of relativistic particles per η-bins decreases much faster in the target fragmentation region(η≤1) as compared to that in the central region (1< η<4.62) of η-spectra.However the value of average multiplicity of relativistic charged particles per η-bin decreases slowly with the increasing value of Nh in the projectile fragmentation region(η>4.62).Similar results of <Ns> in different η-bins are reported by Gill et al [2] for 130La-nucleus interactions at 1.2 A GeV/c and 12C-nucleus collisions at 4.5 A GeV/c by Saleem et al[1].It is reported by Shukla et al[3] that the value of <Ns> per η-bin increase with Nh in both target and central region of η-distribution, while this value is found to decrease with Nh in projectile fragment region.Moreover,the production of relativistic charged particles decreases with increasing atomic mass of the target nucleus in the projectile fragment region.

Conclusion

On comparing the findings of the present work with those reported in [4],it may be concluded that the behavior of the production of <Ns> in both hadron-nucleus and nucleus-nucleus reactions is almost the same.

References

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