Angular Characteristics of Relativistic Charged Particle Produced in 4.5 A GeV ^{12}C-Nucleus Interactions

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1. Introduction

Angular characteristics of relativistic charged particles produced in total disintegration of heavy emulsion nuclei in nuclear emulsion at high-energy particle-nucleus collisions have been extensively studied by several workers [1,2]. In recent years some attention has been paid to study such characteristics for relativistic charged particles produced in central heavy-ion interactions at relativistic energies [3-5]. Since the existing information on the behavior of the angular characteristic of relativistic charged particles for the case of nucleus-nucleus interactions is quite meager, we have carried out a detailed study of the angular characteristic of relativistic charged particles produced in catastrophic destruction of Ag and Br nuclei by the carbon nuclei of momentum 4.5 A GeV/c.The rapidity variable, Y, may be defined as:

$$Y = \tfrac{1}{2}\ \ln\,[E+Pl\ /\ E-Pl] \qquad (1)$$

Where E and P_l denote the energy and longitudinal momentum respectively of a relativistic charged particle. Since the majority of relativistic charged particles are pions with a mean transverse momentum ~ 0.4 GeV/c with P_l »Pt » m, where Pt and m are respectively a mean transverse momentum and mass of the secondary particle, hence eq.(1) reduces to the form

$$Y \approx \eta = -\text{In} \tan(\theta/2) \qquad (2)$$

Where θ is the angle of relativistic charged particle in the lab system.

2. Experimental details

All the experimental details regarding the emulsion stack, scanning procedure, measurement, selection criteria and classification of tracks may be found in ref.6

3. Experimental results and discussion

The angular distribution of relativistic charged particles produced in totally disintegrated nuclei at 4.5 A GeV has been analyzed in terms of pseudo rapidity variable, η.

The η-distribution of relativistic charged particles for both, central, ($N_h \geq 28$) and inclusive events ($N_h < 27$) produced in 4.5 A GeV ^{12}C-nucleus collisions are shown in the figure. It may be possible out that N_h denotes the number of heavily ionizing tracks in an event with relative velocity,$\beta \leq 0.7$. It may be seen in the figure that the maxima of η-distribution shifts towards the higher values of η with decreasing impact parameter. It may also be noted in the figure that width of η-distribution decreases with decreasing impact parameter.

The average number of relativistic charged particles per η bin are estimated for different region of η distribution and are listed in the table.

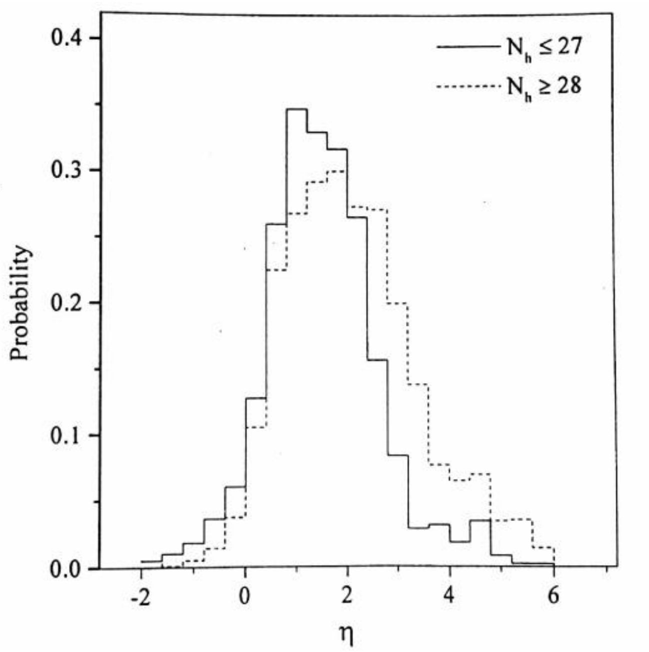
It is evidently clear from the table that the average multiplicity of relativistic charged particles per η bin increases with increasing value of N_h in the target fragmentation region. (η ≤ 1). However, in the projectile fragmentation region, (η > 4.62) as well as in central fragmentation region, (1 ≤ η ≤4.62), the average multiplicity of relativistic charged particles per η bin decreases with increasing value of N_h. It is reported [7] that the average multiplicity of relativistic charged particles per η bin increases much faster in the target

Table:

$N_{h\ interval}$	η≤1	1≤η ≤4.62	η >4.62
$N_{h\geq28}$	31.03±0.25	66.25±0.34	1.56±0.04
$N_{h\leq27}$	20.95±0.43	74.31±0.41	4.71±0.11

fragmentation region as well as in central fragmentation region. They [7] have also reported that average multiplicity of relativistic charged particles per η bin remains essentially constant in 1.2 A GeV ^{139}La-nucleus interactions. However, in ref.8 it is reported that the average multiplicity per η bin increases with increasing values of N_h in both target and central region of η-distribution, while this value is observed to decrease with increasing value of N_h in the projectile region.

The results also indicates that the height of the central plateau is higher in the case of events of inclusive collisions than the totally disintegrated events. This fact is reflected in the figure. This observation reveals that the field responsible for particle production is stronger in the case of heavier target than in the lighter target. Furthermore, the production of relativistic charged particles decreases with increasing target size (larger N_h in) the projectile fragmentation region. This result suggests that the η-spectrum of leading particle depends on the target size (impact parameter) and that target is not fully transparent to the Carbon projectile at 4.5 A GeV. This also suggests that the nuclear matter is partially opaque to all the components of wave function of projectile at 4.5 A GeV



4. Conclusions

On comparing our results with those obtained in high-energy particle-nucleus collisions [9], it may conclude that the characteristics of η-spectra are almost similar in both nucleus-nucleus and hadron-nucleus interactions.

5. References

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