A Study of compound particles in pion-nucleus interactions

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Introduction

In this paper, the phenomenon of multiparticle production has been studied using the nuclear emulsion technique. Nuclear emulsion is a material which memorises the tracks of charged particles. When an incident particle interacts with the nuclei of the emulsion, secondary particles are produced. These secondary particles are classified into three categories viz., shower (N_s), grey (N_g) and black (N_b) particles. The investigation of particle-nucleus collisions is fundamental for understanding the nature of the interaction process. In such studies most of the attention was paid to the relativistic charged particles that is showers [1-3]. From the servey of literature it is found that slow particles (grey and black) are less studied in comparison to charged shower particles. Grey particles may provide some valuable information and it may be taken as good measure of number of collisions made by the incident particle [4].

For the present paper the data was collected using a stack of emusion exposed to negative pion beam of energy 340 GeV. In the study of multiparticle production process, multiplicity is regarded as one of the most important parameters. This parameter may help in explaining many aspects of particle production process. Jurak and Linscheid [5] studied proton-nucleus interactions taking shower and grey particles together without making any distinction between them. The number of shower and grey particles taken together in an event was termed as compound multiplicity (N_c=N_s+N_g).

Results and discussions

To study the target size dependence of compound multiplicity disrtribution, the data has been divided into diffetrent N_h ensembles.

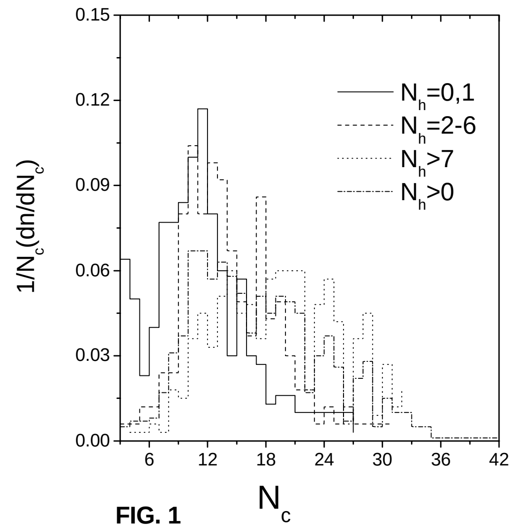

FIG. 1

It can be seen from Fig.1 that as target size increases, the compound multiplicity distribution becomes broader and broader and the peak shifts towards the higher value of N_c , similar results have been obserbed by other workers [6,7] also. In order to study different multiplicity correlations, the variation of mean number of compound multiplicity, $\langle N_c \rangle$ with N_g, N_h and N_s are presented in Fig. 2.

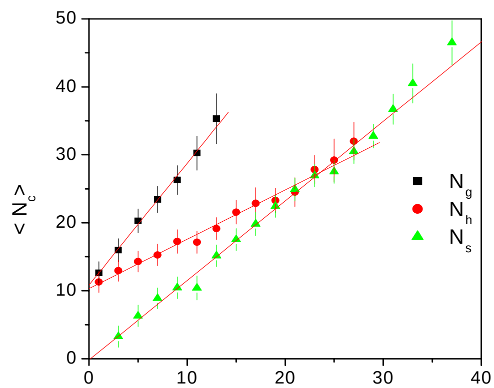

FIG.2 N$_x$(x=g,h and s)

It is observed from the figure that $\langle N_c \rangle$ increases linearly with N_g, N_h and N_s. Least square fits to the data have been performed and the following equations were obtained:

$<Nc> = (10.82\pm1.39) + (1.79\pm0.21)\ N_g$
$<Nc> = (10.33\pm0.89) + (0.72\pm0.06)\ N_h$
$<Nc> = (-0.18\pm0.89) + (1.17\pm0.04)\ Ns$

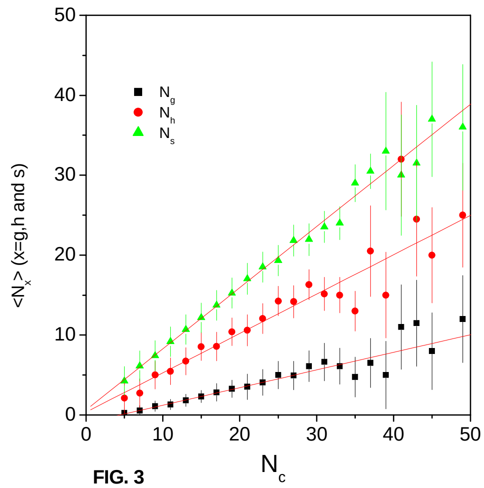

FIG. 3

Fig.3 shows the variation of $<N_g>$, $<N_h>$ and $<N_s>$ with Nc. We again find that the dependence is linear one. Here also least squares fittings are performed and the equations obtained are as under:

$<N_g> = (-0.95\pm0.48) + (0.21\pm0.03)\ N_c$
$<N_h> = (0.34\pm1.04) + (0.49\pm0.04)\ N_c$
$<N_s> = (0.63\pm1.06) + (0.76\pm0.04)\ N_c$

Another parameter, which is used to understand the multiparticle production process is mean normalised multiplicity, R_A. It is defined as $R_A = <N_s>/<N_{ch}>$ where $<N_s>$ represents the avereage number of relativistic charged particles observed in poin- nucleus collisions and $<N_{ch}>$ is the mean number of charged particles produced in pion-nucleon interactionsat almost the same energy. In the present case $<N_s>$ has been taken as $<N_c>$ that is mean number of compound particles.

The variation of R_A with Ng, N_h and Ns are displayed in Fig.4. Least square fits to the data are given in form following equation:

$R_A = (1.02\pm0.05) + (0.17\pm0.01)\ N_g$
$R_A = (-0.01\pm0.03) + (0.11\pm0.01)\ N_h$
$R_A = (1.02\pm0.07) + (0.06\pm0.01)\ N_s$

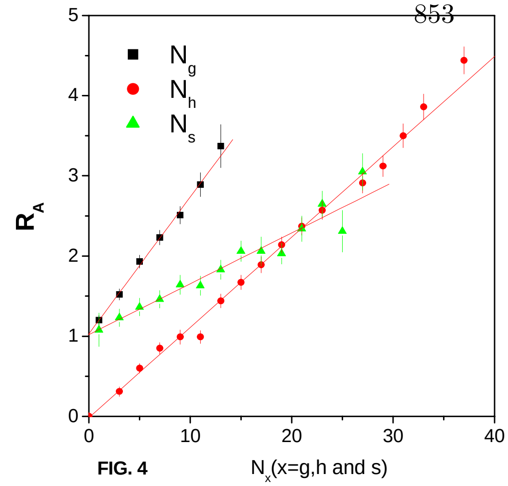

FIG. 4

Conclusions

It is found that the compound multiplicity distribution is target size dependent. Regarding the correlations between different particle multiplicities a linear relationship is observed. R_A is also found to depend almost linearly on different particle multiplicities.

References

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