The Study of Compound Multiplicity for $^{84}Kr_{36}$ with Emulsion Detector at Relativistic High Energy

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Introduction

The Nuclear Emulsion Detector (NED) is one of the oldest detector technologies and has been in use from the birth of the experimental nuclear and astroparticle physics. The investigation of final state particles produced through nucleus - nucleus (A-A) and nucleon - nucleus (h-A) interactions at relativistic high energy is an active research area [1–4]. The recoil target nucleons are emitted shortly after the passage of the hadrons. Therefore, it is important to study the compound multiplicity of the recoil target nucleon as well as freshly produced particles.

Experimental Details

NED is composed of silver halide crystals immersed in a gelatin matrix [1–4] consisting mostly of hydrogen, carbon, nitrogen, oxygen, silver and bromine while a small percentage of sulfur and iodine are also present [1–4]. In this study we have used a stack of high sensitive NIKFI BR-2 nuclear emulsion pellicles having the dimensions of 9.8×9.8×0.06 cm^3, which is exposed horizontally to $^{84}Kr_{36}$ ion at relativistic energy [1–4]. The exposure has been performed at Gesellschaft fur Schwerionenforschung (GSI) Darmstadt, Germany [1–4].

There are two standard methods employed in scanning for the events of interest. One of them is volume scanning and other one is line scanning. In volume scanning method we scan events or interactions in NED volume by volume, where as line scanning is to scan the detector along the particle tracks i.e. along the incident beams till they interact, stop or escape from any surface of the detector. in this study we used both methods [1–4].

Classification of Secondary Charged Particles

The charged particles produced in an interaction are classified with following their ionization in terms of normalized grain density, range as well as velocity in the following categories as per bellow [1–3],

Shower Particle (N_s)

These particles having normalized grain density $g^* < 1.4$ and relative velocity $\beta > 0.7$ [1–4].

Black Particle (N_b)

These particles having normalized grain density $g^* > 6.8$, range L < 3 mm and relative velocity $\beta < 0.3$ [1–4].

Grey Particle (N_g)

These particles having normalized grain density $1.4 < g^* < 6.8$, range L > 3 mm and relative velocity 0.3$> \beta < 0.7$ [1–4].

The number of heavily ionizing charged particles ($N_h = N_b + N_g$) depends upon the target breakup [1–4].

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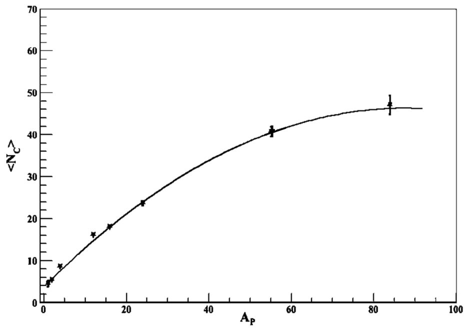

FIG. 1: Dependence of N_c on the mass number Ap of different projectile in nucleus - nucleus collisions [1].

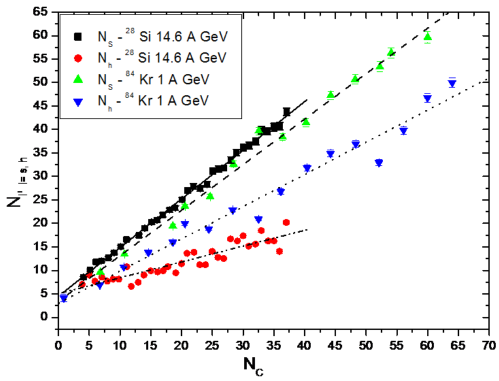

FIG. 2: Dependence of N_c on N_i (i = s, h) for ^{84}Kr and ^{28}Si with emulsion at 1 A GeV and 14.6 A GeV [1, 6].

Results and Discussion

In order to refine the models for multi-particle production in nucleus-nucleus and hadron-nucleus collisions, a new variable termed as compound multiplicity ($N_c = N_g + N_s$), was introduced by Jurak and Linscheid in year 1977[5]. Figure 1 shows the variation of the average compound multiplicity $< N_c >$ versus mass number of the beam nucleus A_p [1–4]. The points represent the experimental data while the fitting are by the relation $< N_c > = K_\beta^\alpha$ explain briefly in Ref. [1]. Figure 2 represent the correlations between $< N_c >$ and N_s, N_h for ^{84}Kr and ^{28}Si - emulsion collisions at relativistic high energy [1, 6]. This study reveals that the compound multiplicity distribution increases with increasing in mass number of the projectile [1, 6].

Acknowledgments

Authors are thankful to all the technical staff of GSI, Germany for exposing nuclear emulsion detector with $^{84}Kr_{36}$ beam and Department of Science and Technology (DST), New Delhi, for their financial support.

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