Characteristics of the charged particle production in interaction of ^{84}Kr$_{36}$ with nuclear emulsion detector at relativistics energy

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Introduction

Nuclear emulsion detector played important role in the studies of high energy interactions during the twentieth century. After the prediction of new phase of matter (QGP) the investigations of final state particles produced in nucleus-nucleus / nucleon-nucleus interactions at relativistic high energy became an active research area [1-3]. The various concepts of nuclear physics can be extrapolate with the study of heavy-ion collisions. According to the participant spectator model the interacting systems are divided into three regions, projectile spectator region, target spectator region and participant region. In participant region nuclear matter interacts violently with each other and a large number of new particles are produced. The particles which produced from the participant regions are mostly mesons, photons, lepton pairs etc. The nuclear emulsion detector has several unique features such as high position resolution, 4π detection capability, large range of ionization sensitivity as well as compactness of the size [1,2]. The high resolution of the detector make it useful for the detection of the short-lived particles. In this report we focus on the characteristics of the shower particles produced in the interaction of ^{84}Kr with nuclear emuslsion detector at relativistics energy.

Experimental Details

The data are taken from the highly sensitive NIKFI-BR2 nuclear emulsion plate of dimentions $9.8{\times}9.8{\times}0.06$ cm^3 having initial thickness of 600 μm. The exposure of nuclear emulsion plate has been performed at Gesellschaft fur Schwerionenforschung (GSI) Darmstadt, Germany. In the exposure ^{84}Kr ion at incident kinetic energy around 1 A GeV is used as projectile source/ beam. The Olympus BH-2 transmitted-light-binocular microscope is used for the collection of the events from the nuclear emulsion plates. To obtain the primary interactions, line and volume scanning methods are used. In line scanning method the beam tracks is picked up at 4mm from the edge of emulsion plate and followed carefully till they interact or escape / stopped from any surface of nuclear emulsion plate. While in volume scanning method, the event information was collected strip-by-strip scanning [1,2]. All the secondary charged particles emitted from the primary interactions are divided into the following categories as below;

Projectile fragments

The projectile fragments are classified according to their charges in three main categories as, singly ($N_{z=1}$), doubly ($N_{z=2}$) and multiply ($N_{z>2}$) charged projectile fragments [2].

Shower particle (N_s)

Shower particles are singly charged relativistic particles having normalized grain den-

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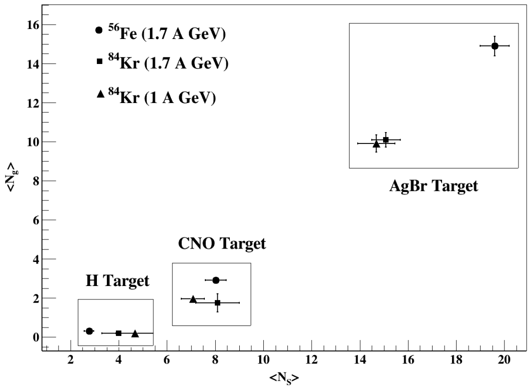

FIG. 1: The variation of average multiplicity of $< N_S >$ with $< N_g >$ for ^{84}Kr (1.7 A GeV) [4], ^{56}Fe (1.7 A GeV) [5] and ^{84}Kr (1 A GeV) [Present work] for H-target, CNO-target and AgBr target events.

sity $g^* < 1.4$ and relative velocity $\beta > 0.7$. The number of such particle represents the degree of destruction and depends on collision geometry as well as the impact parameter of the events [2].

Black particle (N_b)

Black particles are slow evaporated target fragments having normalized grain density g^* > 6.8, range L < 3 mm and relative velocity $\beta < 0.3$ [2].

Grey particle (N_g)

Grey particles are fast evaporated target fragments having normalized grain density 1.4 $< g^* < 6.8$, range L > 3 mm and relative velocity 0.3> $\beta < 0.7$ [2].

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

Target separation

The target separation are achieved by applying restrictions on the number of heavily ionized charged particles and residual range of black particles emitted in each event [2].

AgBr Target Events

The events which have $N_h \geq 8$ and at least one track with R < 10 μm [2].

CNO Target Events

The events which have $2 \leq N_h \leq 8$ and no tracks with R < 10 μm [2].

H Target Events

The events which have $N_h \leq 1$ and no tracks with R < 10 μm [2].

Result and Discussions

Figure 1 show the variation of $< N_S >$ with $< N_g >$ for the events of interaction of ^{84}Kr (1 A GeV), ^{84}Kr (1.7 A GeV) [4] and ^{56}Fe (1.7 A GeV) [5] with H-target, CNO-target and AgBr target of nuclear emulsion detector. From figure 1 it is clear that as we move from lighter target (H-target) to heavier target (AgBr-target) the variation of $< N_S >$ with $< N_g >$ for ^{84}Kr are changing with respect to interaction from different target as well as incident energy. Which show that the emission of shower particle and grey particle depends on both incident energy as well as the interaction of the projectile beam with different target. The variation of $< N_S >$ with $< N_g >$ for ^{56}Fe [5] show that the interaction probability of heavier target is more as compared to the ^{84}Kr having same incident energy. This study show that the emission probability of shower and grey particle increases as we move from the lighter to heavier target interaction and it also depend strongly on the incident kinetic energy of the projectile beam [1-3].

Acknowledgments

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