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بعض الخصائص المهمة للتعددية المركبة للجسيمات المنبعثة في تصادمات أنوية السيليكون مع أنوية المستحلب النووي عند $4.5\ GeV\ c^{-1}$

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A few Fascinating Highlights of compound variety with regards to silicon-nucleus impacts at 4.5 GeV c^{-1} for each nucleon

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الملخص:

جريت هذه الدراسة لمعرفه بعض خصائص التعددية المركبة للجسيمات المنبعثة في تصادمات أنوية السيلكون مع أنوية المستحلب النووي عند كمية الحركة 14.5-**GeVc**. تعرف التعددية المركبة بأنها مجموع تعددية الجسيمات الرذاذية والرمادية. النتائج على توزيعات التعددية المركبة اظهرت زيادة اتساع التوزيع بزيادة كتلة القذيفة و عدم اعتماد النسبة على كتلة القذيفة، علاوة على ذلك، لوحظ أن يزداد خطياً مع زيادة قيمة؛ كما أظهرت النتائج أن قيمة معامل الميل لا تعتمد على نوع المقذوف.

.الكلمات الدالة: اصطدام النواة النسبية، المستحلب النووي، تعدد الجسيمات المركبة والديناميكا اللونية الكمومية QCD)

Abstract

An endeavor was made to research a few intriguing qualities of compound variety with regards to silicon-nucleus impacts per nucleon. The quantity of dark and shower particles taken together is known as compound variety, Nc. It has been found that the compound assortment conveyances become more extensive with the expanding size of the struck nucleus nucleus. The worth of the proportion <Nc>/D(Nc) apparently remains free of the shot mass. Additionally, the scattering of the assortment circulation is seen to increment straightly with the expanding worth of <Nc>. Additionally, the outcomes show that the worth of the tendency coefficient doesn't depend upon the shot's sort.Nc=(Ng+Ns).

Keywords: Relativistic nucleus-nucleus Collision, nuclear emulsion, Compound Particle Multiplicity and Quantum Chromodynamics (QCD).

1 Introduction

Investigations of nucleus impacts at relativistic energies definitely stand out enough to be noticed of molecule physicists, because of the possibility that these examinations could give an extraordinary trial instrument to explore the Quantum Chromodynamics (QCD) stage chart and the properties of emphatically cooperating atomic matter under outrageous conditions(Sun et al., 2018, Luo, X et al., 2022). At the point when a vigorous nucleus slams into nucleus as an objective, various charged and uncharged particles are created. Lately, most of analyses on high energy nucleus crashes have been completed to explore the qualities of shower particles. The qualities of the dim particles delivered in these impacts are likewise being examined (Hebert, 1974, El-Daiem, 2010). It is fascinating to specify that the investigation of the discharge highlights of dark particles is of exceptional significance on the grounds that these particles are pictured to be made during or soon after the section of the main molecule and subsequently are supposed to recollect a piece of the historical backdrop of these impacts . Moreover, dark particles likewise viewed as an amazing proportion of the quantity of experiences made by the occurrence hadron inside the struck nucleus(Andersson et al., 1978, Jain et al., 1991).
To integrate the job of dim particles, a variable named compound variety, N_c=(N_g+N_s) was presented by the writers (Ghosh, D et al., 2009), and a few fascinating qualities of dim and shower particles taken together per cooperations were researched by a few authors(Ghosh et al., 1987, Abd-Allah and Mohery, 2001).
The principal legitimization for investigating compound assortment in high-energy significant molecule crashes is that the data on the effects may be used to refine the models of multiparticle creation put forth as a depiction of the hadronization pattern of the last state particles made in hadron and hadron-center collisions(El-Nadi et al., 2001). The exploratory information on compound arrangement spreads and their scatterings in the inelastic impacts of silicon focuses with the emulsion communities at the site of help force $4.5AGeVc^{-1}$ are talked about in this review.
Moreover, the investigation of variety connections was likewise explored. The examination assists us with understanding the systems of the hadronization of conclusive stage charged secondaries delivered in high energy weighty particle impacts. Hence, concentrating on certain attributes of compound multiplicities in more detail was thought of as beneficial.

2 Materials and Methods

Experimental details: The atomic emulsion heaps of NIKPI-BR2 of aspect (16.9x9.6x0.06 cm^3) with a printed lattice were utilized in this work. The stacks were presented to a silicon light emission $4.5AGeVc^{-1}$ at the Dubna Synchrophastron. In the deliberate connections, every one of the charged optional particles have been arranged into the accompanying groups(El-Naghy et al., 1994):
i) Shower particles: The amount of shower particles in an effect is limited by Ns. Shower particles have tolerably longer ranges in emulsion and have ionization under 1.4 g_o, where go addresses the base ionization of an independently charged atom.
ii) Grey particles: Grey particles: Tracks with ionization lying in the extent of 1.4 g_o to 10 g_o and having ranges in emulsion of, $R \geq$ 3mm are called dim tracks. Faint tracks are made by protons, deuterons, tritons and a couple of lazy mesons. The amount of faint tracks in a collaboration is portrayed by *Ng*.
iii) Black particles:
Follows ionization $g \geq 10g_o$ and having ranges in emulsion, R<3mm are named as dim tracks. Dark tracks are a result of slow particles and evaporated segments; their number in an affiliation is connoted by Nb. Grey and Black tracks are mutually alluded to as weighty tracks and their number in a connection is assigned by N_h (=N_g + N_b). To explore the discharge qualities of auxiliary particles created in silicon - nucleus crashes at $4.5AGeVc^{-1}$, an irregular example containing 636 occasions with $N_h \geq o$ was gathered.

3 Results and discussion

i) Compound Multiplicity distributions

Table 1 presents the mean worth, dispersions: $D(N_c) = [< N_c^2 > - < N_c >^2]^{\frac{1}{2}}$, and extent $< N_c > / D(N_c)$ of the compound assortment $<N_c>$. It is intriguing to see from the table that the extent's worth is autonomous of the mass of the shot.

Table 1. Mean Values and dispersions in nucleus-nucleus collision at 4.5 GeV c^{-1}

Projectile	$< N_c >$	$D(N_c)$	$< N_c >/D(N_c)$	Ref.
^{12}C	0.18 ±16.17	10.51±0.34	±0.051.54	(Khan et al., 1997)
^{12}C	0.25 ±12.07	0.24±07.50	±0.241.61	(Ghosh, et al., 1989)
^{24}Mg	0.47 ±23.63	0.50±15.34	±0.221.61	(Ghosh, et al., 1989)
^{24}Mg	±0.50 19.50	1.5016.80±	1.21±0.05	(Abd-Allah & Mohery, 2001)
^{28}Si	0.5018.20±	0.80±18.80	1.00±0.10	(Abd-Allah & Mohery, 2001)
^{28}Si	21.85±0.70	0.70±14.09	1.55±0.09	(Kailas & Singh, 1992)
^{28}Si	18.66±0.62	±0.4018.00	1.67±0.04	Present work

The dissemination of compound multiplicities in silicon-nucleus impacts at 4.5 GeV c^{-1} is displayed in figure 1. Likewise the figure presents an examination between the dissemination and the relating dispersions got for ^{24}Mg nucleus and ^{12}C nucleus. It very well may be seen obviously that the appropriations become more extensive and the pinnacle of the disseminations shifts toward higher upsides of N_c with expanding shot mass. This outcome is in concurrence with the outcomes announced in Refs. (El.Daiem, 2010).

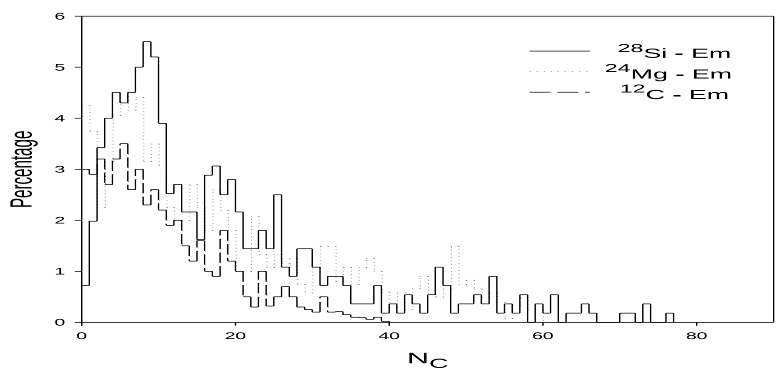

Figure 1. Compound multilicity distribution for ^{12}C,^{24}Mg and ^{28}Si interactions with emulsion at 4.5GeV c^{-1}

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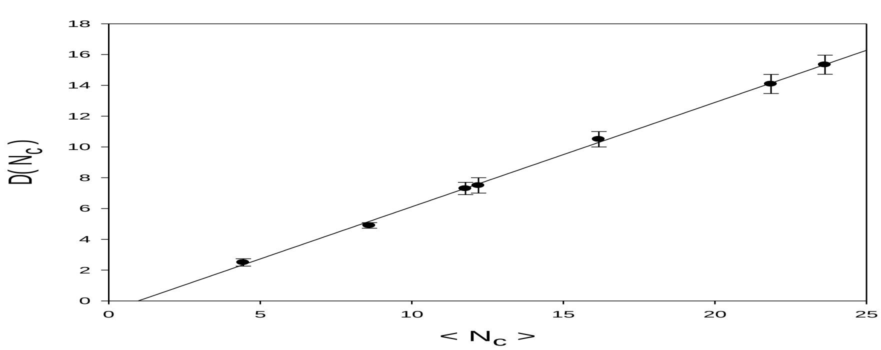

Figure 2. Dependence of $D(N_C)$ on $< N_C >$

Figure 2. Dependence of $D(N_c)$ on $< N_c >$

ii) Variation of $D(N_c)$ with $< N_c >$

The dispersion variation $D(N_c)$ as a function of $< N_c >$ is shown in Figure 2. The figure shows that the variation is linear with $< N_c >$. The exploratory information focuses are found to fit the accompanying connection:

$$D(N_c) = (0.67 \pm 0.09) < N_c > +(-0.66 \pm 0.15) \qquad (1)$$

iii) Dependence of <N $_C$> on the projectile and target mass

Figures 3 and 4 show the reliance of the typical compound multiplicity $< N_c >$ on the mass of the shot, A_p and the mass of the objective, A_t. From the figures, it very well might be seen that $< N_c >$ increment quickly with expanding the shot and target masses, which further affirm the consequences of (Khan et al., 1997). The focuses are the exploratory information while the ceaseless line is the aftereffect of fitting by the relations:

$< N_c >= \alpha A_p^{\beta}$ (2), $< N_c >= \gamma A_t^{\mu}$ (3)

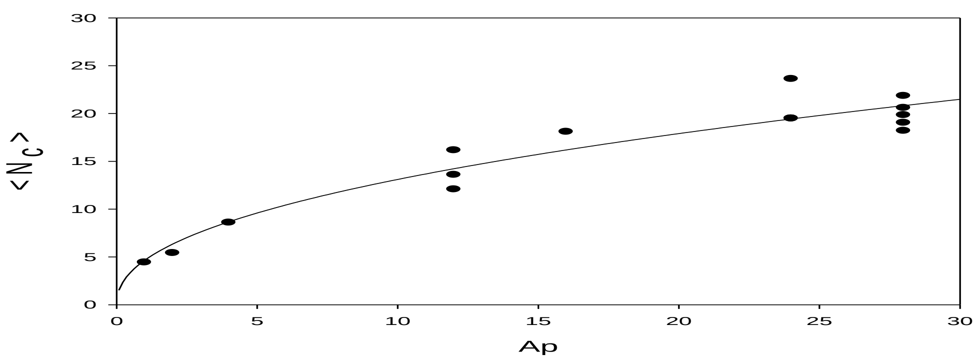

Figure 3. Dependence of < N$_C$ > on the mass projectile (Ap)

Figure 3. Dependence of $< N_c >$ on the mass projectile (A_p)

$$< N_c >= \alpha A_p^{\beta}$$
$$\alpha = (4.65 \pm 0.8) \quad , \beta = (0.44 \pm 0.05)$$

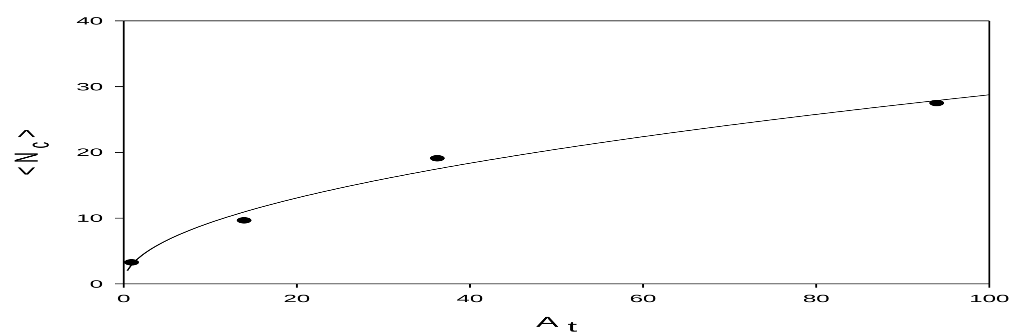

Figure 4. Dependence of < N$_C$ > on the mass target (A $_t$)

Figure 4. Dependence of $< N_c >$ on the mass target (A_t)

$$< N_c >= \gamma A_t^{\mu}$$
$$\gamma = (3.00 \pm 0.72) \quad , \mu = (0.49 \pm 0.06)$$

IV Correlations of compound multiplicity

Figure 5 shows the variety of the mean compound variety $< N_c >$ as a component of N_b, N_g, N_h and N_s. It tends to be seen from the figure that $< N_c >$ increments directly with N_b, N_g, N_h and N_s and these conditions imitate the information very well.

$< N_c > = a + b\, N_i$ (4) Where $N_i \, (N_b, N_g, N_h, N_s)$.

The values of the inclination coefficients obtained from heavy-ion collisions at 4.5 $GeV\ c^{-1}$ per nucleon are shown in Table 2. It is clear from the table that the inclination coefficients in the case of $< N_c > - N_b$ correlation are almost in the same order. It can also be observed that the dependence of $< N_c >$ on N_b is stronger in heavy-ion collisions as compared to proton-nucleus collisions.

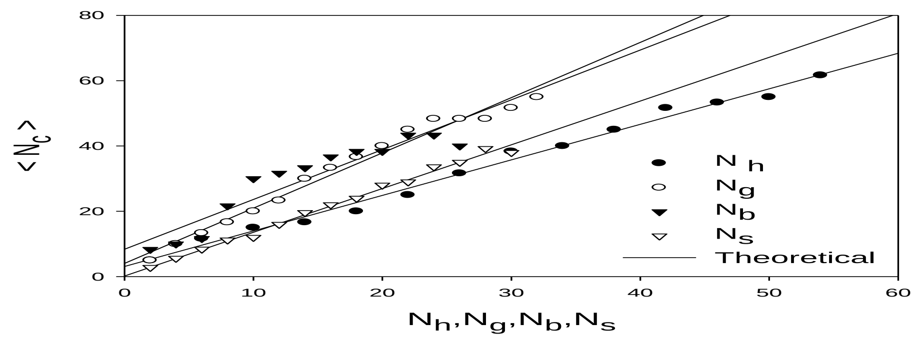

Figure 5. Variations of < N_c > with N_h,N_g,N_b and N_s for ^{28}Si - nucleus collision at 4.5 GeV c^{-1}

Figure 5. Variations of $< N_c >$ with N_h, N_g, N_b and N_s for ^{28} Si- nucleus collision at 4.5 GeVc^{-1}

Table 2. Values of slope for the average compound multiplicity using $<N_c>=a+bN_i$

Projectile	N_i	b	Ref.
^{12}C	N_g	1.51±0.07	(Khan et al 1997)
^{28}Si	-	1.69±0.06	Present work
P	N_b	0.32±0.04	(Ghosh, et al., 1989)
^{12}C	-	2.00±0.16	(Ghosh, et al., 1989)
^{24}Mg	-	2.10±0.12	(Ghosh, et al., 1989)
^{28}Si	-	1.52±0.17	Present work
P	N_h	0.32±0.23	(Ghosh, et al., 1989)
^{12}C	-	0.94±0.04	(Khan et al 1997)
^{28}Si	-	1.08±0.08	Present work
^{28}Si	N_s	1.33±0.03	Present work

4 Conclusions

The ongoing investigation of the nucleus crashes at $4.5 GeVc^{-1}$ for ^{28}Si prompts the accompanying essential ends:

1. The mass of the shot determines the transmission of confusing multiplicities and the usual complex variety < N_c >.
2. It is found that the dispersion $D(N_c)$ increases linearly with $< N_c >$.

3. 3. Due to the diversity intensification, the value of the direction parameter is independent of the shot mass.
4. 4. The mean worth of compound assortment is seen to rely firmly upon N_b on account of weighty -particle impacts while on account of proton-nucleus crashes is feeble ward at a similar energy of the shot.

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Conflict of interest: The authors declare that there are no conflicts of interest

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