Production of Relativistic Charged Particles in ^{28}Si-Nucleus Interactions at 4.5 A GeV/c

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Introduction: In 1935 Japanese physicist Hideki Yukawa proposed the existence of One type of mesonic particle inside the Nucleus which might be sole responsible For binding together the nucleons (protons And neutrons) inside the Nucleus.

In 1947 British physicist Cecil Frank Powell of Bristol university of London with the help of High Energy Nuclear Emulsion technique discovered exactly the same mesonic particle which was Exactly proposed by Yukawa and it was named as pion in the name of Powell. So in 1949 Yukawa was awarded the Nobel prize for the theoretical prediction Of pion and in 1950 Cecil Frank Powell was awarded the Nobel prize for its experimental verification.

For the present work the samples of high energy emulsion plates were imported from Joint Institute of Nuclear Research (JINR),DUBNA,MOSCOW.

Experimental Results:
Study of the angular characteristics of secondary charged particles produced in ^{28}Si-nucleus interactions at 4.5 A GeV/c has been carried out in terms of pseudo rapidity variables, η (= $-$ ln tan $\theta/2$), where θ is the angle of relativistic charged particles in the laboratory system.
In order to investigate the dependence of angular characteristics on impact parameter ,b, the data are divided into three groups i.e. $N_h \geq 0$, $N_h \geq 8$ and $2 \leq N_h \leq 7$, where N_h denotes the number of heavily ionizing tracks in in an event,N_h=N_b+N_g.

The disintegrations having $2 \leq N_h \leq 7$ are admixture of interactions due to CNO group with average atomic mass,$\langle A \rangle$ =14 and peripheral collisions with Ag Br target nuclei, while the events with $N_h \geq 8$ are collisions with Ag Br nuclei with $\langle A \rangle$ = 94. However, the events with $N_h \geq 0$ are collisions with nuclei of nuclear emulsion with $\langle A \rangle$ = 73.

In the present work, the average number of relativistic charged particles, $\langle N_s \rangle$ produced in 4.5 A GeV/c ^{28}Si-nucleus interactions in different η–bins are listed in the table -1. It is clear from the table that the average number of relativistic charged particles per η–bins decreases much faster in the target fragmentation region ($\eta \leq 1$) as compared to that in the central region of η–spectra ($1 < \eta \leq 4.62$). However the value of average multiplicity of relativistic charged particles per η–bin decreases slowly with increasing value of N_h in the projectile fragmentation region ($\eta >$ 4.62). Similar results of $<N_s>$ in different η–bins are reported by Gill et al [2] for ^{139}La-nucleus interactions at 1.2 A GeV/c and ^{12}C-nucleus collisions at 4.5 A GeV/c by Saleem et al [1]. It is reported by Shukla et al [3] that the value of $<N_s>$ per η–bin increases with N_h in both target and central region of η–distribution, while this value is found to decrease with N_h in projectile fragmentation region. Moreover, the production of relativistic charged particles decreases with increasing atomic mass of the target nucleus in the projectile fragmentation region.

Conclusion:

On comparing the findings of the present work with those reported in reference 4, it may be concluded that the behavior of the production of $<N_s>$ in both hadron-nucleus and nucleus-nucleus reactions is almost the same.

References:

1.M.Saleem Khan et al : Can. J. Phys. 74, 651 (1996).
2.A. Gill et al : Int. J. Mod. Phys. A5, 755 (1990).
3.V.S. Shukla et al : Mod. Phys. Lett. A3, 1753 (1980).
4.H. Khushnood et al : Can. J. Phys. 60, 1523 (1982).

Table-1

Projectile	**N_h -interval**	**$<N_s>$**	**$<N_s>$**	**$<N_s>$**	**References**
		$\eta \leq 1$	$1<\eta\leq 4.62$	$\eta>4.62$	
^{12}C	$2 \leq N_h \leq 7$	0.59 ±0.05	4.50±0.14	0.36±0.04	1
^{28}Si	$2 \leq N_h \leq 7$	2.63±0.002	4.88±0.10	0.72±0.04	Present work
^{12}C	$N_h \geq 0$	1.49±0.06	6.56±0.12	0.37±0.03	1
^{28}Si	$N_h \geq 0$	2.97±0.001	4.97±0.15	0.64±0.002	Present work
^{12}C	$N_h \geq 8$	2.27±0.09	8.32±0.18	0.37±0.04	1
^{28}Si	$N_h \geq 8$	2.78±0.001	5.12±0.20	0.64±0.003	Present work