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**MOMENTUM AND ANGULAR DISTRIBUTIONS
OF CHARGED SECONDARIES IN 40 GeV/c
 π^- A INTERACTIONS
WITH SINGLE PARTICLE HIGH P_{\perp} TRIGGER**

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INTRODUCTION

Investigation of processes with high P_1 particle production in hadron-hadron and hadron-nucleus interactions is of big interest for high-energy physics because a new information about hadron structure and space-time picture of hadron formation is expected to be obtained. As yet almost all the data are inclusive or semiinclusive. Bubble chamber results refer to the P_1 -region below 1.2 GeV/c. However, it is for $P_1 \geq 1$ GeV/c where the change in the dependence of differential cross section versus transverse momentum is observed^{1,2/} (transition from exponential-like behaviour to power-like one). Furthermore the anomalous growth of cross section with mass number A has been found for P_1 -region of 2-3 GeV/c in hadron-nucleus interactions (Cronin effect)^{3/}. It has no satisfactory theoretical explanation as yet. New experimental data of exclusive nature are needed to continue detailed study of high P_1 processes.

EXPERIMENTAL SET-UP

The experiment has been performed with RISK-spectrometer^{4/} where interactions are detected in a 5-meter streamer chamber. The streamer chamber technique allows us to investigate rare processes (cross sections below $1 \mu\text{b}$) at nearly 4π geometry with high multitrack efficiency.

The sketch of experimental set-up is shown in Fig.1. Unseparated 38 GeV/c beam of negatively charged particles (98% π^- , 1.7% K^- and 0.3% \bar{p}) produced from internal target of 70 GeV proton synchrotron (Serpuhov) was focussed onto the target placed inside the sensitive volume of the streamer chamber. H_2 , D_2 , C, Cu, and Pb targets were used. Charged high P_1 particles were detected with telescope of three two-coordinate multiwire proportional chambers. Dimensions of sensitive areas of chambers were $1.0 \times 0.5 \text{ m}^2$ (horizontal and vertical, respectively). The chamber telescope has been placed above the streamer chamber in non-zero magnetic field region and covered the polar angle interval $12^\circ < \theta < 22^\circ$ for particles originating from the target (it corresponds to $85^\circ < \theta^* < 120^\circ$ in πN c.m.s.). Fast processor, using MWPC-information, selected events with charged particle having P_1 above predetermined threshold. This threshold has been varied from 1.0 GeV/c to

	π^-		π^+		$\langle P_{\perp} \rangle$, MeV/c	$\langle y \rangle$	$D(y)$	$\langle P_{\perp} \rangle$, MeV/c
	$\langle y \rangle$	$D(y)$	$\langle y \rangle$	$D(y)$				
π^- -C	inelastic /5/	2.46±0.01	1.75	1.45	354±1	2.05±0.01	1.45	378±1
	$P_{\perp} \geq 1.3$ GeV/c	2.07±0.04	1.05	0.96	380±7	1.84±0.03	0.96	408±7
π^- -Pb	inelastic	-	-	-	303±26	-	-	392±25
	$P_{\perp} \geq 1.3$ GeV/c	1.58±0.03	0.98	0.93	318±9	1.42±0.03	0.93	392±7

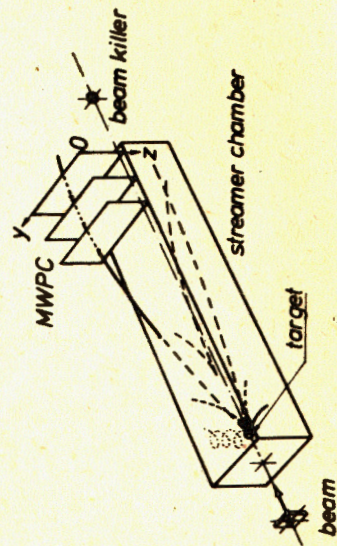


Fig. 1. Layout of the experiment.

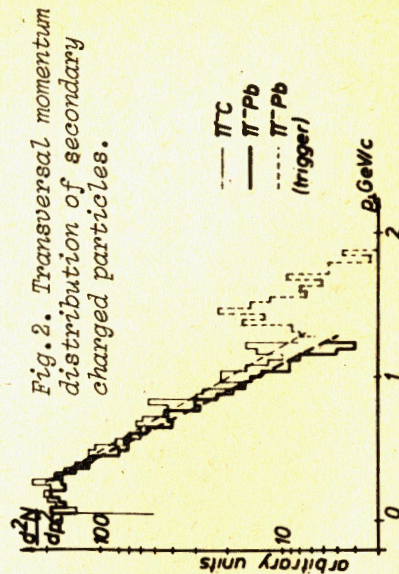


Fig. 2. Transversal momentum distribution of secondary charged particles.

1.5 GeV/c. Trigger acceptance was ~6% in P_{\perp} -range from threshold to ~2.5 GeV/c.

RESULTS AND THEIR DISCUSSION

In this paper the data obtained from full reconstruction of 1500 π^- -C and 500 π^- -Pb events are presented. Target thicknesses were 1.9% and 0.7% of nuclear absorption length for carbon and lead respectively. Events to be measured were selected by film scanning with MWPC-information taken into account. During the scan procedure tracks of highly ionizing particles are registered visually. All secondary tracks were measured in selected events and reconstruction of momenta and emission angles was performed by a computer program. Highly ionizing positive particles with momenta below 500 MeV/c were identified as protons. Some characteristics of events with triggering particle having transverse momentum above 1.3 GeV/c are shown below.

In Fig. 2 transverse momentum distributions of secondary charged particles are demonstrated with identified protons being excluded. The slope of P_{\perp} -spectra of associated particles is steeper for Pb-target than for C-target. Hence, the average transverse momentum, $\langle P_{\perp} \rangle$, of these particles is less in π^- -Pb than in π^- -C events. Comparison with non-biased inelastic π^- -C /5/ and π^- -Pb interactions (see the Table) showed that $\langle P_{\perp} \rangle$ of particles associated with high- P_{\perp} trigger is higher for carbon-target and do not differ for lead-target.

One can see also the difference between rapidity distributions of π^- -C and π^- -Pb events with high- P_{\perp} trigger (Fig. 3): the number of particles produced in the target fragmentation region is larger on Pb-target than on C-target while in projectile fragmentation region the relation between numbers of secondaries from two targets is reversed. The center of rapidity distribution for π^- -C-interaction is shifted toward the target fragmentation side in comparison with non-biased inelastic events and the rapidity spectrum is more narrow for high P_{\perp} events.

The excess of positive charge of fast ($P_{lab} \geq 0.7$ GeV/c) particles, $Q_F = n^+ - n^-$, differs significantly for Pb- and C-target. Within statistical errors Q_F is 0.0 for carbon while for lead it equals 2.9±0.3.

All these facts appear to indicate that multiple scattering of hadron constituents or of entire hadron in nuclear matter contributes significantly to high P_{\perp} particle production on heavy nucleus. Within such model transverse momentum of triggering particle can be compensated by a few particles with relatively low P_{\perp} . Hence, the average P_{\perp} of associated

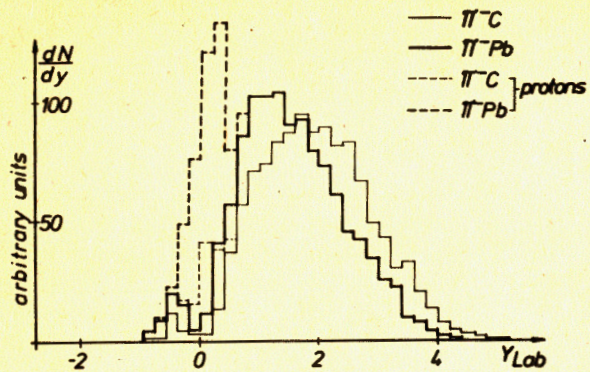


Fig. 3. Rapidity (Y_{lab}) distribution. (--- protons). Triggering particle rapidity is equal to -2 .

Fig. 4. Azimuthal correlations between triggering particles ($P_{\perp} \geq 1.5$ GeV/c) and all associated secondaries for π^-C interaction in three Δy intervals (Δy - difference of the rapidities of associated secondary and triggering particle). 4a - the central region $-1 \leq \Delta y \leq 1$; x - like (+, +); ■ - unlike (+, -); 4b - the fragmentation region of incident π^- $\Delta y \geq 1$; 4c - the target fragmentation region $\Delta y < -1$.

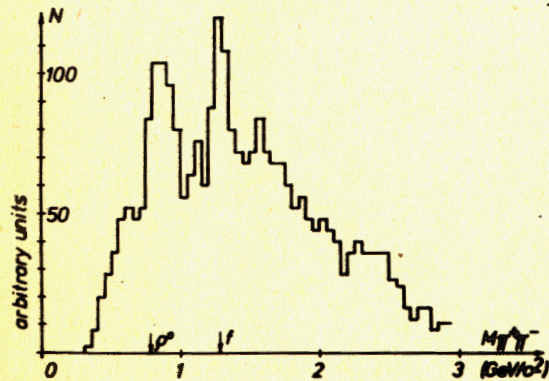
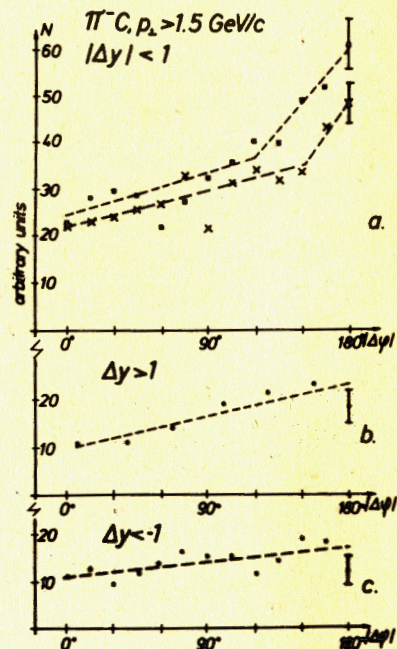


Fig. 5. Spectrum of effective masses $\pi^+\pi^-$ in the combination of triggering particle and associated secondaries.

particles should not increase in comparison with non-biased inelastic collisions and the excess of positive charge of fast particles appears. For light nucleus such mechanism should be less important.

Due to larger statistics of selected π^-C interactions it was possible to study events where triggering particle had higher P_{\perp} -momentum (>1.5 GeV/c). One can expect that some interaction features should appear in such events more clearly.

In Fig. 4 distributions of azimuthal angles between triggering particle and all associated secondaries are shown. An increase of azimuthal correlations is observed at $\Delta\phi \sim 180^\circ$ in the central interaction region ($|\Delta y| \leq 1$, Δy - difference of rapidities of associated and triggering particle) whereas in the target and projectile fragmentation regions no such correlation is presented.

The contribution of pionic resonances to high P_{\perp} particle production was estimated in π^-C events with triggering particle having $P_{\perp} \geq 1.5$ GeV/c. Peaks of ρ^0 and f -mesons are clearly seen in the spectrum of $\pi^+\pi^-$ combinations of triggering and associated particles (Fig. 5). About 25% and 15% of triggering particles with $P_{\perp} \geq 1.5$ GeV/c origin from ρ and f decay respectively. Similar spectra for triggering particles with $P_{\perp} \geq 1.3$ GeV/c on Pb and C targets do not show resonances clearly. It can be expected that increasing of statistics will allow one to study multiple resonance production.

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Импульсные и угловые характеристики заряженных частиц
в π^-A -взаимодействиях при 40 ГэВ/с в событиях с рождением адрона
с большим поперечным импульсом

Получены угловые и импульсные спектры, распределения по быстротам и эффективным массам вторичных заряженных частиц в π^-C - и π^-Pb -взаимодействиях при импульсе 38 ГэВ/с с триггерной частицей, имеющей поперечный импульс $P_{\perp} \geq 1$ ГэВ/с и вылетающей в системе центра масс πN системы под углами $\theta^* = 85^\circ - 120^\circ$. Показано, что средние поперечные импульсы вторичных адронов в неупругих π^-Pb - и π^-C -взаимодействиях и ассоциированных адронов в процессах с образованием частицы с большим поперечным импульсом совпадают для свинца и несколько различаются для углерода. В событиях с образованием частицы с большим поперечным импульсом на мишени из свинца наблюдается увеличение избытка положительно заряженных частиц с импульсом $P_{\perp} \geq 0,7$ ГэВ/с по сравнению с данными на мишени из С. Эти факты свидетельствуют в пользу механизма образования частиц с большим P_{\perp} за счет нескольких перерассеяний внутри ядра. Показано, что в π^-C -взаимодействиях значительная доля частиц с большим поперечным импульсом происходит от распада $\rho^0 \rightarrow \pi^+\pi^-$.

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Momentum and Angular Distributions of Charged Secondaries
in 40 GeV/c π^-A Interactions with Single Particle
High P_{\perp} Trigger

Momentum and angular spectra as well as rapidity and effective masses distributions of charged secondaries in 38 GeV/c π^-C and π^-Pb interactions triggered on a single particle emitted at πN c.m.s. angles $85^\circ \pm 120^\circ$ with transversal momentum $P_{\perp} \geq 1$ GeV/c are obtained. It is shown that the average transversal momenta of secondary pions for inelastic interactions and pions associated to the high P_{\perp} particle coincide for the Pb-target and are slightly different for the C-target. Increase of the excess of positively charged particles having momentum above 0.7 GeV/c in high P_{\perp} processes on the Pb-target in comparison with the C-target is observed. These facts suggest the multiple scattering mechanism of the high P_{\perp} particle production on nuclei. It is shown that a considerable part of triggering particles in π^-C interactions originates from $\rho^0 \rightarrow \pi^+\pi^-$ decay.

The investigation has been performed at the Laboratory of Nuclear Problems, JINR.

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