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EXPERIMENTAL STUDY OF THE PION-XENON NUCLEUS COLLISIONS WITHOUT PARTICLE PRODUCTION AT 3.5 GeV/c MOMENTUM:

Asymmetry in Proton Emission

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1. INTRODUCTION

It was already pointed out [1-4] that when a high energy hadron, of kinetic energy much higher than the threshold for pion production, passes through a massive atomic nucleus it may undergo deflection only accompanied by nucleon emission, but without particle production. The passage through the layers of nuclear matter thick enough, without causing the particle production, is always accompanied by the emission of many fast nucleons [2,4] of kinetic energy from about 20 to about 400 MeV; usually neutrons are not observed simply, but protons are observed without difficulties almost in all experiments. We have investigated such events in the 180 litre xenon bubble chamber [5] exposed to negatively charged pion beams; there were collision events of the type

$$\pi^- + Xe \to \pi^- + n_p + f, \qquad (1)$$

where $n_p \geq 0$ is the number of the protons emitted, f denotes residual nuclear fragments.

In a sample of events of this type (1) the pion deflection plane, P_H - in which the incident pion and the deflected pion straight-line courses lie, is a naturally distinct plane among other planes in which incident pion course lies. Two other planes related to the incident hadron deflection plane, to the incident pion deflection plane in the case, are of great importance and are naturally distinct as well; both these planes are perpendicular to the P_H plane. One of these planes P_V, we call it the vertical plane, we define as the plane normal to the deflection plane P_H and containing the incident hadron straight-line course; the second plane P_A, we call it the azimuth plane, we define as normal to both the planes P_H and P_V and containing the point at which the incident and deflected hadron courses intersect.

The natural distinction of the three planes (P_H, P_V, P_A) in the collision events of the type (1) provides a possibility to look experimentally for asymmetries in nucleon emission, relative to these planes; occurrence of some asymmetries cannot be excluded a priori.

The subject matter in this paper is to present results of our experimental study of asymmetries in proton emission in pion-xenon nucleus collision events of the type (1) at 3.5 GeV/c momentum.

2. EXPERIMENT

The characteristics of the 180 litre xenon bubble chamber[5] used as an apparatus in which the collisions occur and emitted protons and produced neutral pions, charged pions, and other particles were detected, and a detailed information about the experimental procedure can be found in our previous works[1,4,6,7]; we limit ourselves here, therefore, to the presentation of the most important information about the experiment, just for the case in question.

The class of hadron-nucleus collision events of the type (1) could have been discovered[1,2] when all the secondary pions, charged and neutral, and the emitted protons were registered with an efficiency of about 100%; the 180 litre xenon bubble chamber as the detector satisfying these conditions has been used therefore.

The sample under analysis consists of 876 collision events of the type (1) with various proton multiplicity $n_p \geq 0$.

Any sharp change in the straight-line track of any beam pion was considered in the chamber photographs scanning to be an indication that this pion underwent the interaction with a xenon nucleus; the deflection point of any beam pion track was accepted to be the point of impact. We were able to detect the collision events in which the incident pion deflects at an angle of no less than 2 degrees, accompanied or not by any number of proton tracks.

In any of the events the deflection angle θ_{π^-} of the incident pion track, the number n_p of the protons emitted, the emission angle θ_p and the azimuth angle ϕ_p, the kinetic energy E_{kp}, the longitudinal momentum P_{Lp}, and the transverse momentum P_{Tp} of each of the protons emitted were determined; the azimuth angle of the proton emission direction is defined as the angle between the pion deflection plane and the proton emission plane. The accuracy in measuring of the pion deflection angle is about 1 degree; the accuracy in measuring of the proton emission direction angle is about 3 degrees, on the average. Energies of the protons were measured, using the range-energy relation[8], with an accuracy of about 3%.

In addition to the proton emission direction azimuth angle ϕ_p and zenith angle θ_p, two projections of the zenith angle on the hadron deflection plane θ_{pH} – we call it the horizontal projection, and on the vertical plane θ_{pV} – we call it the vertical projection, are here in use; we define these projections more accurately.

The azimuth angle horizontal projection θ_{pH} we define as:

$$\theta^{+-}_{pH} = \mathrm{arctg}\,a^{+-}, \qquad (2)$$

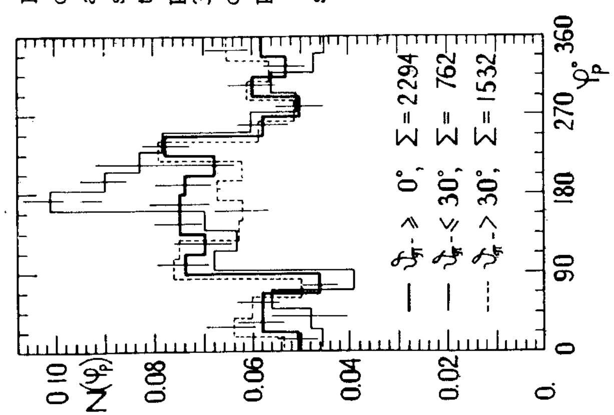

Fig.1. Distributions, $N(\phi_p)$, of the azimuth proton emission angles, ϕ_p, in pion-xenon collisions without particle production of the type (1) with proton multiplicity $n_p \geq 1$, at 3.5 GeV/c momentum, in samples of events with various incident pion deflection angles θ_{π^-}. Σ - numbers of protons in the sample.

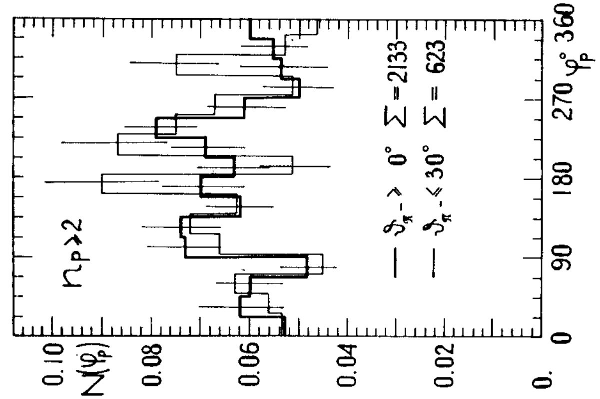

Fig.2. Distributions, $N(\phi_p)$, of the azimuth proton emission directions, ϕ_p, in pion-xenon collision events of the type (1) without particle production and with proton multiplicities $n_p \geq 2$, at 3.5 GeV/c momentum; in samples of events with different values of the incident pion deflection angle θ_{π^-}. Σ - numbers of protons in the sample.

where $tg\alpha^{+-} = P^{+-}_{px}/P^{+-}_{ph}$ and P^{+}_{px} or P^{-}_{px} are the positive or negative component of the proton momentum P_p on the x-axis perpendicular to the incident hadron course lying in the hadron deflection plane, P^{+}_{ph} or P^{-}_{ph} are the negative or positive projections of the proton momentum P_p on the hadron course;

$$\theta^{+-}_{pV} = \mathrm{arc\,tg}\,\beta^{+-}, \qquad (3)$$

where $tg\,\beta^{+-} = P^{+-}_{py}/P^{+-}_{ph}$ and P^{+}_{py} or P^{-}_{py} are the positive or negative component of the proton momentum P_p along the y-axis perpendicular to the hadron deflection plane.

3. EXPERIMENTAL DATA

The data obtained in the analysis of 876 events of the type (1) are presented in fig.1 and fig.2, and in tables 1-5.

Frequency distributions presented in fig.1 and in fig.2, and in tables 1 and 2 characterize the azimuth asymmetry in the proton emission; frequency distributions presented in table 3 and in table 4 characterize the asymmetry in proton emission zenith angle vertical projection distributions; frequency distributions presented in table 5 characterize the asymmetry in proton emission zenith angle horizontal projection distributions.

4. CONCLUSIONS AND REMARKS

In result of a review of the experimental data presented in foregoing section 3, it can be concluded that:

1) An azimuth asymmetry in proton emission exists; stronger asymmetry is observed in events with smaller pion deflection angles, $\theta_\pi < 30$ degrees, fig.1; the asymmetry exists in both samples of events of the type (1), when $n_p \geq 1$ and when $n_p \geq 2$, fig.1 and fig.2.

2) Does not exist any asymmetry in distributions $N(\Delta\theta_{pV})$ of the proton emission angle vertical projections θ_{pV}, table 3 and table 4.

3) An asymmetry exists in distributions $N(\Delta\theta_{pH})$ of the proton emission angle horizontal projection θ_{pH}, table 5.

The observed azimuth and horizontal asymmetries will be a subject matter of an additional accurate analysis.

Table 1

Proton emission azimuth angle, ϕ_p degrees, distributions, $N(\Delta\phi_p)$, in the samples of pion-xenon nucleus collision events at 3.5 GeV/c momentum, without particle production and with the number of emitted protons $n_p \geq 1$, of the type (1), in which incident pions are deflected at various deflection angles, θ_π degrees. ΣN - total number of events in a sample, $<\phi_p>$ - mean value of the azimuth angle, r.m.s. - the root-mean-square deviation

Low edge $\Delta\varphi_p$ degrees	$N(\Delta\varphi_p) \pm \Delta N(\Delta\varphi_p)$ $\vartheta_\pi \leq 180$	$\vartheta \leq 30$	$\vartheta \leq 60$	$\vartheta > 30$	$\vartheta > 60$
0	0.027 0.003	0.030 0.007	0.027 0.004	0.026 0.004	0.029 0.007
11.25	0.024 0.003	0.016 0.004	0.020 0.004	0.028 0.005	0.032 0.007
22.50	0.028 0.003	0.024 0.005	0.028 0.004	0.031 0.005	0.029 0.007
33.75	0.030 0.003	0.024 0.005	0.024 0.004	0.033 0.005	0.041 0.008
45.00	0.024 0.003	0.026 0.005	0.022 0.004	0.023 0.004	0.029 0.007
56.25	0.034 0.004	0.030 0.007	0.035 0.005	0.037 0.005	0.034 0.007
67.50	0.025 0.003	0.022 0.005	0.025 0.004	0.027 0.004	0.025 0.005
78.75	0.021 0.003	0.017 0.005	0.022 0.004	0.023 0.004	0.020 0.005
90.00	0.037 0.004	0.034 0.007	0.037 0.005	0.038 0.005	0.035 0.007
101.25	0.037 0.004	0.034 0.007	0.040 0.005	0.038 0.005	0.030 0.007
112.50	0.033 0.004	0.024 0.005	0.031 0.005	0.038 0.005	0.037 0.007
123.75	0.037 0.004	0.039 0.007	0.039 0.005	0.037 0.005	0.034 0.007
135.00	0.026 0.003	0.029 0.007	0.027 0.004	0.025 0.004	0.025 0.005
146.25	0.039 0.004	0.041 0.008	0.039 0.005	0.038 0.005	0.039 0.007
157.50	0.033 0.004	0.042 0.008	0.036 0.005	0.028 0.004	0.026 0.005
168.75	0.042 0.004	0.059 0.009	0.044 0.005	0.034 0.005	0.039 0.007
180.00	0.040 0.004	0.049 0.008	0.043 0.005	0.036 0.005	0.034 0.007
191.25	0.034 0.004	0.041 0.008	0.034 0.005	0.031 0.005	0.034 0.007
202.50	0.037 0.004	0.049 0.008	0.043 0.005	0.031 0.005	0.025 0.005
213.75	0.031 0.003	0.034 0.007	0.031 0.005	0.030 0.005	0.033 0.007
225.00	0.041 0.004	0.041 0.008	0.038 0.005	0.042 0.005	0.049 0.008
236.25	0.037 0.004	0.037 0.007	0.038 0.005	0.037 0.005	0.035 0.007
247.50	0.027 0.003	0.031 0.007	0.029 0.005	0.025 0.004	0.025 0.005
258.75	0.031 0.003	0.029 0.007	0.033 0.005	0.033 0.005	0.029 0.007
270.00	0.027 0.003	0.026 0.005	0.027 0.004	0.027 0.004	0.025 0.005
281.25	0.024 0.003	0.025 0.005	0.023 0.004	0.024 0.004	0.028 0.007
292.50	0.030 0.003	0.026 0.005	0.027 0.004	0.032 0.005	0.035 0.007
303.75	0.030 0.003	0.030 0.007	0.029 0.005	0.029 0.005	0.030 0.007
315.00	0.031 0.003	0.022 0.005	0.029 0.005	0.035 0.005	0.034 0.007
326.25	0.022 0.003	0.025 0.005	0.025 0.004	0.021 0.004	0.017 0.005
337.50	0.031 0.003	0.024 0.005	0.030 0.005	0.035 0.005	0.033 0.007
348.75	0.027 0.003	0.021 0.005	0.025 0.004	0.030 0.005	0.030 0.007
ΣN	**2294**	**762**	**1532**	**1532**	**762**
<φp>	**180.5**	**181.6**	**181.5**	**179.9**	**178.5**
r.m.s.	**98.9**	**93.3**	**97.2**	**101.5**	**102.2**
skewness	**0.03**	**-0.05**	**-0.02**	**0.02**	**-0.01**
kurtosis	**-1.05**	**-0.86**	**-1.01**	**-1.13**	**-1.14**

Table 2

Proton emission azimuth angle distributions, $N(\Delta\phi_p)$, in pion-xenon nucleus collisions at 3.5 GeV/c momentum without particle production, of the type (1), when the number of emitted protons $n_p = 1$ or $n_p \geq 2$ and incident pions are deflected at various deflection angles θ_π degrees. ΣN - total number of protons in a sample, $<\phi_p>$ - the mean value of the azimuth angle, r.m.s. - the root-mean-square deviation

a) $n_p = 1$

Low edge $\Delta\varphi_p$ degrees	$N(\Delta\varphi_p) \pm \Delta N(\Delta\varphi_p)$					
	$\vartheta_\pi \leq 180$		$\vartheta_\pi \leq 30$		$\vartheta_\pi \leq 60$	
0	0.019	0.009	0.014	0.007	0.020	0.013
11.25	0.006	0.006	0.000	0.000	0.000	0.000
22.50	0.006	0.006	0.007	0.007	0.007	0.007
33.75	0.000	0.000	0.000	0.000	0.000	0.000
45.00	0.025	0.012	0.014	0.007	0.020	0.013
56.25	0.019	0.012	0.015	0.007	0.020	0.013
67.50	0.012	0.006	0.007	0.007	0.007	0.007
78.75	0.012	0.006	0.007	0.007	0.013	0.007
90.00	0.025	0.012	0.021	0.007	0.020	0.013
101.25	0.056	0.019	0.058	0.021	0.059	0.020
112.50	0.025	0.012	0.014	0.007	0.026	0.013
123.75	0.006	0.006	0.007	0.007	0.007	0.007
135.00	0.043	0.019	0.043	0.014	0.039	0.013
146.25	0.068	0.019	0.072	0.021	0.065	0.020
157.50	0.056	0.019	0.065	0.021	0.058	0.020
168.75	0.087	0.019	0.086	0.021	0.092	0.026
180.00	0.106	0.025	0.122	0.029	0.111	0.026
191.25	0.118	0.025	0.137	0.029	0.124	0.026
202.50	0.050	0.012	0.050	0.021	0.052	0.013
213.75	0.012	0.006	0.014	0.007	0.013	0.007
225.00	0.037	0.012	0.043	0.014	0.039	0.013
236.25	0.043	0.019	0.043	0.014	0.046	0.013
247.50	0.025	0.012	0.014	0.007	0.020	0.013
258.75	0.012	0.006	0.014	0.007	0.013	0.007
270.00	0.019	0.012	0.014	0.007	0.020	0.007
281.25	0.037	0.012	0.036	0.014	0.039	0.013
292.50	0.012	0.006	0.014	0.007	0.013	0.007
303.75	0.006	0.006	0.007	0.007	0.007	0.007
315.00	0.012	0.006	0.007	0.007	0.007	0.007
326.25	0.012	0.006	0.014	0.007	0.013	0.007
337.50	0.012	0.006	0.014	0.007	0.013	0.007
348.75	0.019	0.012	0.021	0.007	0.020	0.007
ΣN	161		139		153	
$<\varphi_p>$	182.8		188.3		185.2	
r.m.s.	73.0		68.3		71.0	
skewness	0.01		0.13		0.03	
kurtosis	0.15		0.54		0.32	

Table 2 (continued)

b) $n_p \geq 2$

Low edge $\Delta\varphi_p$ degrees	$N(\Delta\varphi_p) \pm \Delta N(\Delta\varphi_p)$					
	$\vartheta_\pi \leq 180$		$\vartheta_\pi \leq 30$		$\vartheta_\pi \leq 60$	
0	0.028	0.004	0.034	0.008	0.028	0.004
11.25	0.025	0.003	0.019	0.005	0.022	0.004
22.50	0.030	0.004	0.027	0.006	0.030	0.004
33.75	0.032	0.004	0.029	0.006	0.029	0.004
45.00	0.024	0.003	0.029	0.006	0.022	0.004
56.25	0.036	0.004	0.034	0.008	0.036	0.005
67.50	0.026	0.003	0.026	0.006	0.028	0.004
78.75	0.022	0.003	0.019	0.005	0.022	0.004
90.00	0.038	0.004	0.037	0.008	0.039	0.005
101.25	0.035	0.004	0.029	0.006	0.038	0.005
112.50	0.034	0.004	0.026	0.006	0.032	0.005
123.75	0.040	0.004	0.046	0.008	0.043	0.005
135.00	0.025	0.003	0.026	0.006	0.025	0.004
146.25	0.037	0.004	0.034	0.008	0.036	0.005
157.50	0.031	0.004	0.037	0.008	0.033	0.005
168.75	0.039	0.004	0.053	0.009	0.038	0.005
180.00	0.035	0.004	0.032	0.006	0.036	0.005
191.25	0.028	0.004	0.019	0.005	0.024	0.004
202.50	0.036	0.004	0.048	0.008	0.042	0.006
213.75	0.033	0.004	0.040	0.006	0.033	0.005
225.00	0.042	0.004	0.039	0.006	0.038	0.005
236.25	0.037	0.004	0.035	0.008	0.037	0.005
247.50	0.028	0.004	0.035	0.008	0.030	0.004
258.75	0.033	0.004	0.032	0.006	0.035	0.005
270.00	0.027	0.004	0.029	0.006	0.028	0.004
281.25	0.023	0.003	0.022	0.006	0.021	0.004
292.50	0.027	0.004	0.029	0.006	0.029	0.004
303.75	0.027	0.004	0.045	0.008	0.032	0.005
315.00	0.032	0.004	0.026	0.006	0.032	0.005
326.25	0.023	0.003	0.027	0.006	0.026	0.005
337.50	0.032	0.004	0.026	0.006	0.032	0.005
348.75	0.028	0.004	0.020	0.006	0.026	0.005
ΣN	2133		623		1379	
$<\varphi_p>$	180.3		180.1		181.1	
r.m.s.	100.6		98.0		99.7	
skewness	0.05		-0.03		0.07	
kurtosis	-1.11		-1.04		-1.09	

Table 3

Distribution, $N(\Delta\theta_{pV})$, of the proton emission angle vertical projections, θ_{pV} degrees, in pion-xenon nucleus collisions events at 3.5 GeV/c momentum without particle production, when $n_p \geq 1$ protons are emitted and incident pions are deflected at any angle $\theta_\pi \leq 180$ degrees; θ_{pV} is defined by formula (3). $<\theta_{pV}>$ - mean value of the proton emission angle vertical projection, r.m.s. - the root-mean-square deviation, ΣN - total number of the protons distributed.

Low edge $\Delta\vartheta_{pV}$ degrees	$N(\Delta\vartheta_{pV})$	$\pm\ \Delta N(\Delta\vartheta_{pV})$
0	0.054	0.005
11.25	0.043	0.004
22.50	0.052	0.005
33.75	0.037	0.004
45.00	0.045	0.004
56.25	0.036	0.004
67.50	0.031	0.003
78.75	0.031	0.003
90.00	0.030	0.003
101.25	0.024	0.003
112.50	0.024	0.003
123.75	0.020	0.003
135.00	0.017	0.003
146.25	0.022	0.003
157.50	0.015	0.003
168.75	0.018	0.003
180.00	0.021	0.003
191.25	0.018	0.003
202.50	0.023	0.003
213.75	0.017	0.003
225.00	0.023	0.003
236.25	0.022	0.003
247.50	0.024	0.003
258.75	0.028	0.003
270.00	0.031	0.003
281.25	0.034	0.004
292.50	0.035	0.004
303.75	0.041	0.004
315.00	0.044	0.004
326.25	0.047	0.004
337.50	0.040	0.004
348.75	0.052	0.005
$<\vartheta_{pV}>$	179.4	
r.m.s	119.0	
skewness	0.02	
kurtosis	-1.51	
ΣN	2294	

Table 4

Characteristics of the distributions, $N(\Delta\theta_{pV})$ of the proton emission angle vertical projection, θ_{pV}, in pion-xenon nucleus collision events at 3.5 GeV/c momentum without particle production, when the number of protons emitted is $n \geq 1$ and incident pions are deflected through a certain angle θ_π degrees. $<\theta_{pV}>$ - mean value of the θ_{pV}, r.m.s. - the root-mean-square deviation, ΣN - the number of protons in a sample.

Quantity	ϑ_π			
	≤ 180	≤ 60	> 60	> 30
$<\vartheta_{pV}>$	179.4	179.8	178.8	178.8
r.m.s.	119.0	119.4	118.2	118.1
skewness	0.002	0.006	-0.007	0.011
kurtosis	-1.510	-1.514	-1.488	-1.490
ΣN	2294	1532	762	1532

Table 5

Distributions, $N(\Delta\theta_{pH})$, of the proton emission angle horizontal projections, θ_{pH} degrees, in pion-xenon nucleus collision events at 3.5 GeV/c momentum without particle production in which incident pion is deflected at various deflection angles, θ_π degrees, and when the numbers of emitted protons are $n_p \geq 1$ or $n_p \geq 2$; θ_{pH} is defined by formula (2). $<\theta_{pH}>$ - mean value of the proton emission angle horizontal projection, r.m.s. - the root-mean-square deviation, ΣN - total number of the protons distributed.

a) $n_p \geq 1$

Low edge $\Delta\vartheta_{pH}$ degrees	$N(\Delta\vartheta_{PH}) \pm \Delta N(\Delta\vartheta_{PH})$							
	$\vartheta_\pi \leq 180$		$\vartheta_\pi \leq 60$		$\vartheta_\pi > 30$		$\vartheta_\pi > 60$	
0	0.045	0.004	0.046	0.005	0.046	0.005	0.043	0.008
11.25	0.035	0.004	0.037	0.005	0.034	0.008	0.031	0.007
22.50	0.037	0.004	0.035	0.005	0.039	0.005	0.043	0.008

1	2	3	4	5
33.75	0.036 0.004	0.034 0.005	0.040 0.005	0.041 0.008
45.00	0.034 0.004	0.033 0.005	0.040 0.005	0.037 0.007
56.25	0.038 0.004	0.036 0.005	0.041 0.005	0.043 0.008
67.50	0.027 0.003	0.026 0.004	0.028 0.004	0.030 0.007
78.75	0.023 0.003	0.021 0.004	0.028 0.004	0.028 0.007
90.00	0.020 0.003	0.014 0.003	0.020 0.003	0.030 0.007
101.25	0.024 0.003	0.026 0.004	0.024 0.004	0.018 0.005
112.50	0.021 0.003	0.020 0.003	0.022 0.004	0.025 0.005
123.75	0.023 0.003	0.020 0.004	0.023 0.004	0.028 0.007
135.00	0.021 0.003	0.022 0.004	0.022 0.004	0.020 0.005
146.25	0.018 0.003	0.017 0.003	0.018 0.003	0.020 0.005
157.50	0.013 0.002	0.013 0.003	0.014 0.003	0.012 0.004
168.75	0.020 0.003	0.020 0.004	0.021 0.003	0.021 0.005
180.00	0.020 0.003	0.023 0.004	0.020 0.004	0.014 0.004
191.25	0.018 0.003	0.018 0.003	0.018 0.003	0.017 0.005
202.50	0.019 0.003	0.015 0.003	0.021 0.003	0.026 0.005
213.75	0.019 0.003	0.020 0.004	0.020 0.003	0.017 0.004
225.00	0.026 0.003	0.027 0.004	0.024 0.003	0.025 0.005
236.25	0.025 0.003	0.023 0.004	0.027 0.004	0.028 0.007
247.50	0.027 0.003	0.027 0.004	0.026 0.004	0.026 0.005
258.75	0.032 0.004	0.037 0.005	0.030 0.005	0.024 0.005
270.00	0.041 0.004	0.042 0.005	0.038 0.005	0.038 0.007
281.25	0.042 0.004	0.049 0.006	0.033 0.005	0.028 0.007
292.50	0.051 0.005	0.055 0.006	0.045 0.005	0.045 0.008
303.75	0.056 0.005	0.057 0.006	0.046 0.005	0.052 0.008
315.00	0.039 0.004	0.037 0.005	0.044 0.005	0.043 0.008
326.25	0.050 0.005	0.047 0.005	0.051 0.006	0.056 0.009
337.50	0.045 0.004	0.052 0.006	0.043 0.006	0.031 0.007
348.75	0.053 0.005	0.050 0.006	0.054 0.006	0.059 0.009
$\langle \vartheta_{pH} \rangle$	194.7	197.9	189.2	188.2
r.m.s.	116.7	116.3	117.3	117.3
skewness	-0.22	-0.28	-0.13	-0.10
kurtosis	-1.44	-1.40	-1.47	-1.49
ΣN	2294	1532	1532	762

b) $n_p \geq 2$

Low edge $\Delta\vartheta_{pH}$ degrees	$N(\Delta\vartheta_{PH}) \pm \Delta N(\Delta\vartheta_{PH})$		
	$\vartheta_\pi \leqslant 180$	$\vartheta_\pi \leqslant 30$	$\vartheta_\pi > 30$
0	0.047 0.005	0.050 0.006	0.046 0.005
11.25	0.035 0.004	0.037 0.008	0.034 0.005
22.50	0.038 0.004	0.035 0.008	0.038 0.005
33.75	0.036 0.004	0.032 0.006	0.041 0.005
45.00	0.034 0.004	0.019 0.005	0.040 0.005
56.25	0.040 0.004	0.037 0.008	0.042 0.005
67.50	0.028 0.004	0.029 0.006	0.028 0.004
78.75	0.025 0.003	0.016 0.005	0.028 0.004
90.00	0.021 0.003	0.024 0.006	0.020 0.004

Table 5 (continued)

1	2	3	4
101.25	0.025 0.003	0.027 0.006	0.025 0.004
112.50	0.023 0.003	0.024 0.006	0.022 0.004
123.75	0.024 0.003	0.026 0.006	0.023 0.004
135.00	0.021 0.003	0.021 0.006	0.021 0.004
146.25	0.018 0.003	0.019 0.005	0.018 0.004
157.50	0.014 0.002	0.013 0.005	0.014 0.004
168.75	0.022 0.003	0.022 0.006	0.021 0.004
180.00	0.022 0.003	0.026 0.006	0.021 0.004
191.25	0.019 0.003	0.021 0.006	0.019 0.004
202.50	0.020 0.003	0.016 0.005	0.021 0.004
213.75	0.019 0.003	0.018 0.005	0.020 0.004
225.00	0.026 0.003	0.032 0.006	0.024 0.004
236.25	0.025 0.003	0.021 0.004	0.027 0.004
247.50	0.027 0.004	0.029 0.006	0.026 0.004
258.75	0.030 0.004	0.032 0.006	0.030 0.005
270.00	0.040 0.004	0.043 0.008	0.038 0.005
281.25	0.037 0.004	0.047 0.008	0.032 0.004
292.50	0.045 0.005	0.045 0.008	0.046 0.005
303.75	0.051 0.005	0.061 0.008	0.046 0.005
315.00	0.038 0.004	0.024 0.006	0.043 0.005
326.25	0.051 0.005	0.050 0.008	0.051 0.005
337.50	0.044 0.004	0.048 0.008	0.043 0.005
348.75	0.054 0.005	0.056 0.008	0.053 0.005
$\langle \vartheta_{pH} \rangle$	191.1	195.8	189.2
r.m.s.	116.7	115.7	117.0
skewness	-0.16	-0.24	-0.13
kurtosis	-1.45	-1.38	-1.47
ΣN	2133	623	1510

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ТЕМАТИЧЕСКИЕ КАТЕГОРИИ ПУБЛИКАЦИЙ ОБЪЕДИНЕННОГО ИНСТИТУТА ЯДЕРНЫХ ИССЛЕДОВАНИЙ

Индекс	Тематика
1.	Экспериментальная физика высоких энергий
2.	Теоретическая физика высоких энергий
3.	Экспериментальная нейтронная физика
4.	Теоретическая физика низких энергий
5.	Математика
6.	Ядерная спектроскопия и радиохимия
7.	Физика тяжелых ионов
8.	Криогеника
9.	Ускорители
10.	Автоматизация обработки экспериментальных данных
11.	Вычислительная математика и техника
12.	Химия
13.	Техника физического эксперимента
14.	Исследования твердых тел и жидкостей ядерными методами
15.	Экспериментальная физика ядерных реакций при низких энергиях
16.	Дозиметрия и физика защиты
17.	Теория конденсированного состояния
18.	Использование результатов и методов фундаментальных физических исследований в смежных областях науки и техники
19.	Биофизика

Стругальский З., Павляк Т., Плюта Я. E1-82-719

Экспериментальные исследования столкновений пион-ксенон без рождения частиц при 3,5 ГэВ/с: асимметрии в испускании протонов

В адрон-ядерных столкновениях без рождения частиц, когда налетающие адроны лишь отклоняются при прохождении через ядра-мишени в сопровождении интенсивного испускания нуклонов, можно естественным образом выделить три плоскости - плоскость рассеяния налетающего адрона и две плоскости, сопряженные с ней; сопряженные плоскости расположены перпендикулярно к плоскости рассеяния. Обнаружены асимметрии в испускании протонов по отношению к двум из этих плоскостей. Приводятся экспериментальные данные, характеризующие эти асимметрии.

Работа выполнена в Лаборатории высоких энергий ОИЯИ.

Сообщение Объединенного института ядерных исследований. Дубна 1982

Strugalski Z., Pawlak T., Pluta J. E1-82-719

Experimental Study of the Pion-Xenon Nucleus Collisions without Particle Production at 3.5 GeV/c Momentum: Asymmetry in Proton Emission

In hadron-nucleus collision events without particle production, when the incident hadrons are deflected only in their passage through the target-nuclei accompanied by intensive target-nucleon emission, three planes can be naturally distinct - the hadron deflection plane and two planes simply related to it; the related planes are vertically situated to the deflection plane. Asymmetries in proton emission, relatively to two of these planes are found. Experimental data characterizing these asymmetries are presented.

The investigation has been performed at the Laboratory of High Energies, JINR.

Communication of the Joint Institute for Nuclear Research. Dubna 1982