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# COHERENT PRODUCTION OF PARTICLES BY PROTONS AT 200 Gev/c ON EMULSION NUCLEI

(Alma-Ata-Leningrad-Moscow-Tashkent collaboration).

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The coherent diffraction production process is characterized by a very narrow angular distribution of secondary particles that is caused by a small 4-momentum transferred to the nuclei. Besides, they have neither excitation of nuclei, nor desintegration. The quantum numbers of the coherently produced system are the same as those of the incident particle. For proton coherent interactions the number of charged particles must be odd. The following reaction can occur.

$$p+A \rightarrow \begin{cases} \text{one prong} \rightarrow p\pi^0(n\pi^+) + K\pi^0 + A \\ \text{three prong} \rightarrow p\pi^+\pi^-(n2\pi^+\pi^-) + K\pi^0 + A \\ \text{five prong} \rightarrow p2\pi^+\pi^-(n3\pi^+2\pi^-) + K\pi^0 + A \end{cases}$$

etc., where A is a target atom weight and K=0,1,2,3...

In this work are presented the data about a cross section for production of three, five and seven charged particles at 200 Gev/c, the energy dependence of these cross sections as angular characetristics of the secondary particles in coherent reactions.

## Experiment

Two stacks of nuclear emulsions BR-2 20 cmx10 cmx(100x0,06)cm in size were irradiated by 200 Gev/c protons at the NAL(Batavia) accelerator. On 3303 m of proton tracks the 9839 inelastic interactions by scanning along the track were found.

The coherent production reactions were detected according to the usual criteria [1,2].

## The cross section of coherent reactions

The method of selection of coherent event was described in detail elsewhere [1,2] and based on comparison of multiplicity

distribution as angular one in pp and pn-interactions. The preliminary results were reported in[3], the more complete data are presented in[4].

The numbers of events with the production of three, five and seven charge particles are $N_3 = 140 \pm 16$, $N_5 = 53 \pm 10$ and $N_7 = 7 \pm 3$, respectively; the lower bound of the number of events with one charged particles is $N_1 \geq 100$ (this is the lower bound because all events with $\theta_L < 2 \cdot 10^{-3}$ were treated as elastic ones).

A full number of coherent events at 200 Gev/c is $\sim 300$ that corresponds to $\sim 3{,}2\%$ of all inelastic events while at 67 Gev/c the coherent events were equal to only 2% of all events[2].

The cross sections for production of one, three, five and seven particles (on mean emulsion nuclei) are $\sigma_1 > 6{,}3$ mb, $\sigma_3 = (8{,}8 \pm 1)$ mb, $\sigma_5 = (3{,}4 \pm 0{,}6)$ mb and $\sigma_7 = (0{,}4 \pm 0{,}2)$ mb.

The estimation of the cross section for production of three charge particles only (excluding neutral ones) was performed: $\sigma_{p\pi^+\pi^-} = (4{,}3 \pm 1.0)$ mb[4]; this value became constant at 200 Gev/c. In fig.1 is shown an energy dependence of cross sections for coherent production of three, five charged particles.

It is seen that: 1) The cross section for production of three and five charge particles increases in an energy interval of 20-200 Gev.

2) The more is the multiplicity of the final state the more rapidly increases the cross section.

3) The cross section for reactions indu-

ced by protons increases slower than for that induced by pions.

## Multiplicity and angular distributions of secondary particles from coherent diffraction reactions

The coherent diffraction events are among those with odd prong number selected according to the criteria for quasinucleon interactions[1,2]. In this work we selected 1620 quasinucleon interactions, 630 of which are pp- and 990 pn- and coherent ones. A sum of pp- and pn- interactions we call pN- interactions, then quasinucleon interactions are the sum of pN and coherent events.

To obtain the angular characteristics of coherent events we compare angular distributions of produced particles(without leading ones with $\theta_L < 10^{-2}$; the number of such particles for pp- and quasinucleon interactions per event is 0,65 and 0,64, respectively from pp- and quasinucleon interactions).

In fig.2 is shown the relation $r = \frac{\langle n'_{ch} \rangle_{quasinucl.}}{\langle n'_{ch} \rangle_{pp}}$ per an interval of angles (in $\lambda = \lg \operatorname{tg} \theta_L$ or $y = -\ln \operatorname{tg} \theta_L/2$ scale). It is seen that at small angles ($y > 6$) $r \approx 5,0$ then decreases with increasing of angles and at $y = 4 \div 2$ $r = 2,05$ and became constant.

Assuming the identity of the forward cones in pp- and pn- interactions we obtain that the number of pN interactions is 2,05 times and pn- 1,05 times as much than that of pp; this gives the number of coherent events $N = 330$, which is not so far from the value $N = 300$ obtained by another method[4].

In region of $y > 2$ $r \approx 1,8$ that indicates the difference of proton and neutron fragmentation[5].

In Fig.3b is shown the angular distribution of the produ-

ced particles from all coherent reactions, it is obtained as a difference of distributions for quasinucleon and pN interactions. In this Figure is shown the distribution for pp-interactions also. Fig.3a shows the multiplicity distribution for coherent and pp-interactions. The comparison of both Fig.3a and 3b shows the significant difference of the characteristics of coherent and pp-interactions. A mean value of multiplicity for coherent interactions is $\langle n_{ch} \rangle = 2,7 \pm 01$ [6] (at 67 Gev/c $\langle n_{ch} \rangle = 2,6 \pm 0.1$) while for pp-interactions with n=2,4,6 and 8 this value is $\langle n_{ch} \rangle = 5,5 \pm 0,1$.

In conclusion we note that it is interesting to obtain the data about coherent interactions at higher energies for both incident protons and $\pi$ -mesons.

R E F E R E N C E S


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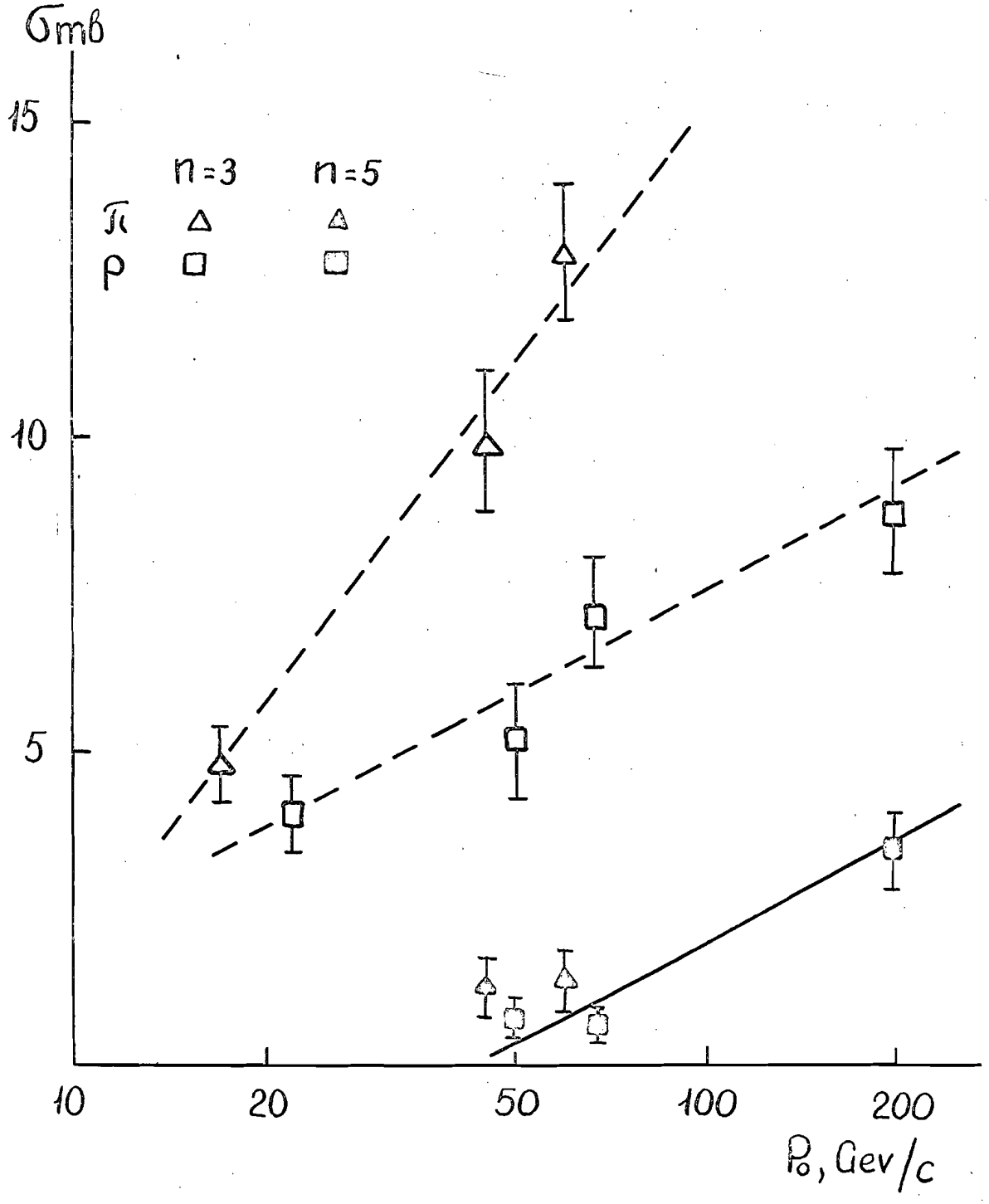


Fig.1. Energy dependence of the coherent production of three and five charded particles.

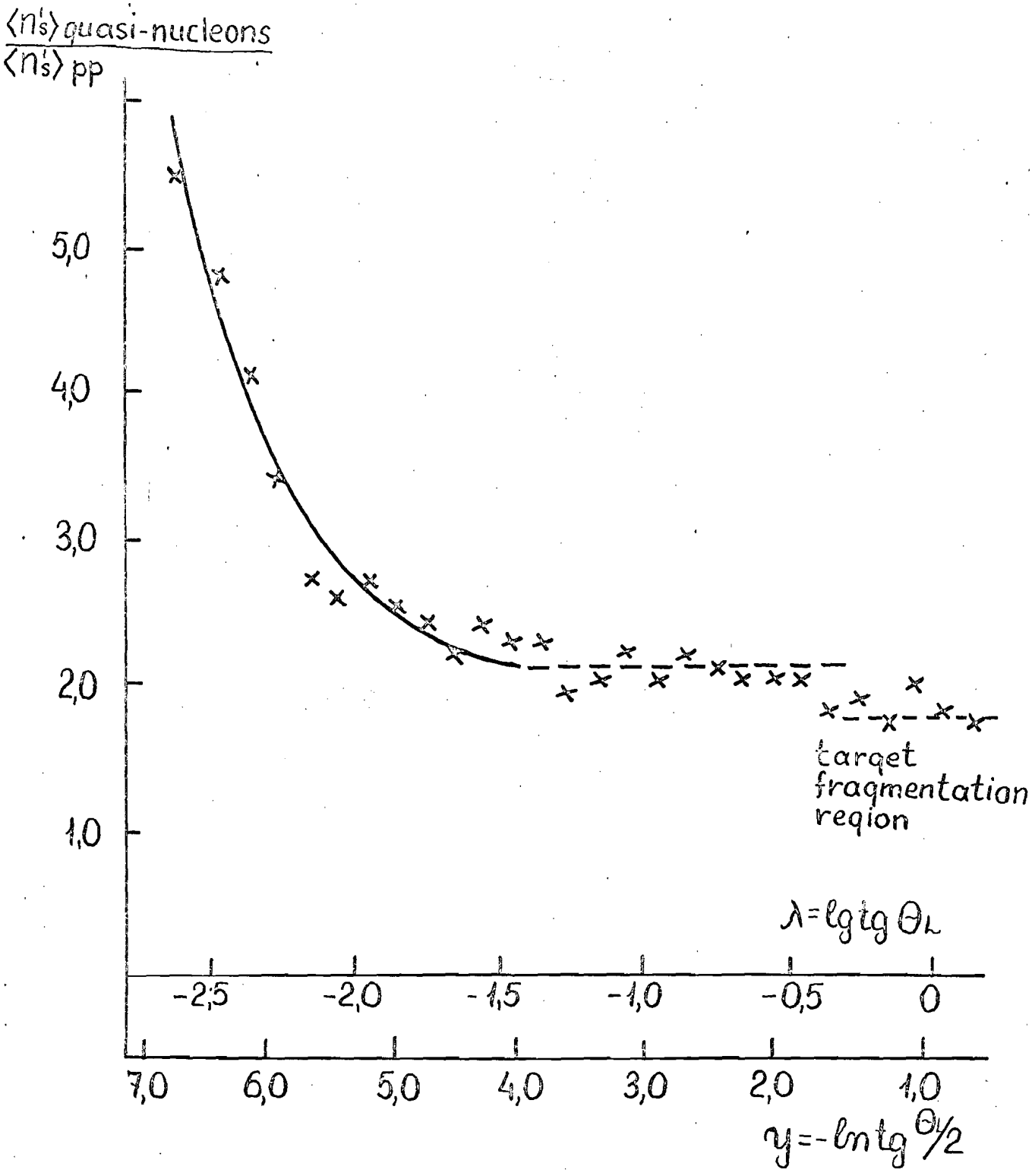


Fig.2. Relation of multiplicity of charged particles ( excluding a leading ones ) for quasinucleon and PP-interactions.

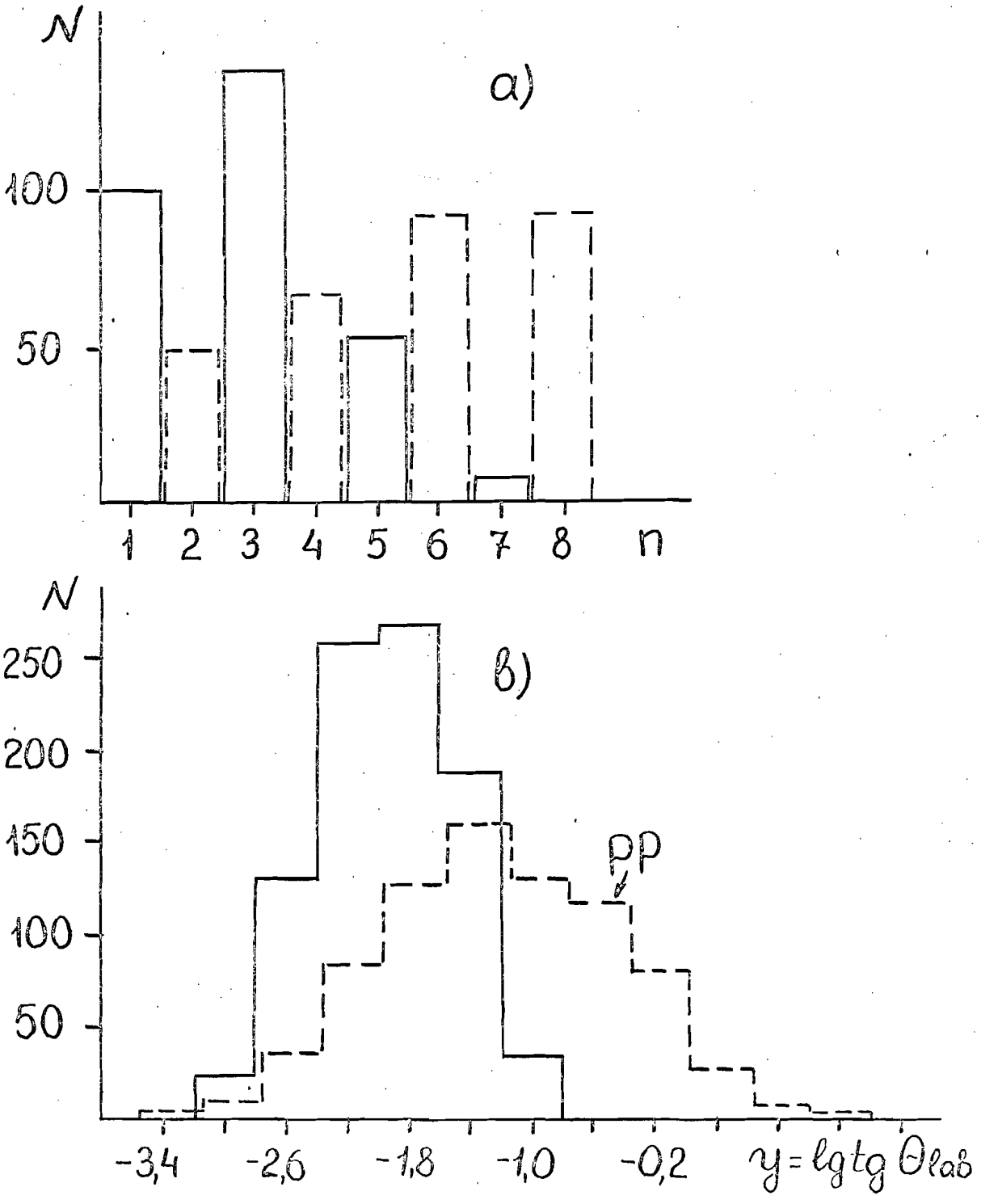


Fig.3. a) Distribution of the multiplicity for coherent and pp-interactions.

b) Angular distributions of charged particles from coherent and pp-interactions.