PRELIMINARY RESULTS OF A STUDY OF INTERACTIONS OF 200 GeV PROTONS WITH EMULSION NUCLEI

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The main result of interaction of high-energy particles with nucleons is the multiple production of new particles in the hadron-hadron interaction.

The present report comprises the results of an investigation of interactions of 200 GeV protons with emulsion nuclei gathered by our laboratory within the framework of a collaboration with fourteen world laboratories*.

Ilford K-5 nuclear emulsions of a size of 20 x 5 x 0.06 cm^3 were exposed to protons at the National Accelerator Laboratory in Batavia, USA. The incidence direction of the protons was parallel to the surface of the 89.94 m was followed, and 263 interactions were found. The following value of the mean free path was obtained:

$$< \lambda > = (34.20 \pm 2.12) \text{ cm}$$

and it can be concluded that the value obtained at 200 GeV does not deviate considerably from those at lower energies (the geometric intaraction length is 27 cm).

We analyzed 190 interactions and found the following multiplicity of events according to the number of grey and black prongs of stars ($N_h = n_g + n_b$) and the nuber of charged shower particles n_s (Table 1).

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Table 1

	$N_h = 0$	$N_h = 1-5$	$N_h > 5$
Relative number of events (%)	22.1	32.6	45.2
$< N_h >$	-	2.6	13.4
$< n_s >$	7.2	9.05	16.8

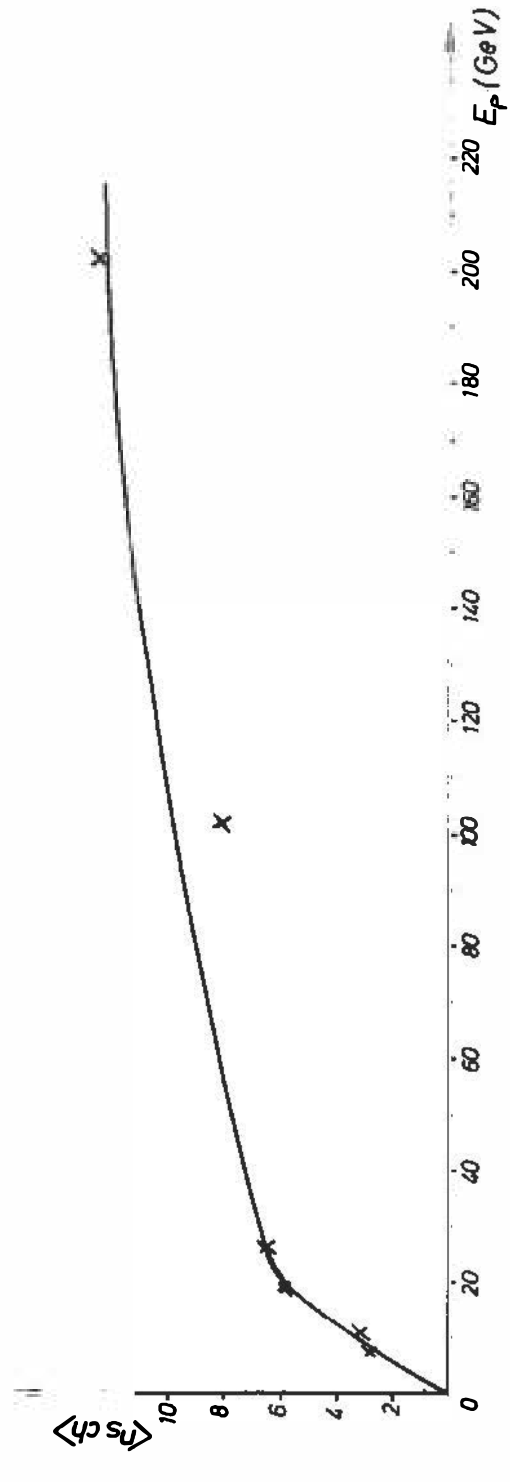
The maximum number of star prongs N_h was 30, while the maximum n_s was 47 (N_h = 30). Three cases of hammer tracks and two hyperfragments were found. For all the events the mean multiplicity $< N_h > \cong 7.13$ and $< n_s > = 12.4$. For white stars i.e. for $N_h = 0$ the mean multiplicity $< n_s > = 7.2$ is in agreement with the value $< n_s > = 7.6$ obtained in an investigation with a hydrogen bubble chamber [(1)]. However, this does not mean that all the events are due only to interactions of protons with the hydrogen nucleus, but they also arise from collisions with a nucleon at the periphery of heavy nuclei of the emulsion.

In Fig. 1 the mean production multiplicity of charged relativistic particles of E_p = 200 GeV is compared to experimental data obtained at lower energies of incident protons. It is seen that the multiplicity $< n_s >$ slowly increases with increasing energy. The low multiplicity and the relatively great number of events with N_h=0 and 1 (whixh amounts to 33.4%) point out that the leading particle is responsible for the production of secondary particles, and that the secondary particles have a small possibility to produce new particles and to impart a considerable energy to the target nucleus.

If only events with N_h = 0-5 are taken into consideration, then the mean multiplicity for charged particle production is given in Table 2.

Table 2

N_h	0	1	2	3	4	5
$< n_s >$	7.2	8.6	11.3	10.6	13.3	8



⟨ns ch⟩
10
8
6
4
2
0
20
40
60
80
100
120
140
160
180
200
220
Ep (GeV)

For events in Table 2 the angular distribution of relativistic particles was investigated. The polar angle (θ) of the prong of the secondary particle with respect to the incident particle was measured. The results of measurement are expressed in terms of $< u_L = \log_{10} \tan \theta >$ for $\theta < 90^o$ and are given in Table 3.

Table 3

N_h	n_s	$< u_L >$	θ
0	2.3	-1.75	1^o
0	$\geq$ 4	-1.04	5^o
1-5	all	-0.88	7^o

In the case of small stars the secondary particles are emitted in the forward direction, and this asymmetry decreases with increasing size of the star.

References

1. G.Charlton et al., Phys.Rev. Letters 29, 515 (1972).

2. I.Z.Artykov et al., Nuclear Physics B6, 11 (1968)