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A proposal of the experiment at
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THE INTERACTIONS OF PROTONS IN NUCLEAR EMULSION AT 400 GEV/C (OR 500 GEV/C)

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/Alma-Ata - Leningrad - Moscow - Tashkent -
collaboration/

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Summary

A request is made for an exposure of two or three emulsion stacks to a beam of 400 Gev/c (or 500 Gev/c) protons at FNAL. The interest in this exposure is based on the following:

1. A study of high energy proton-proton and proton-nucleus interaction and comparison with predictions from a theoretical model.
2. Measuring the energy dependence of the cross sections for production of one or more charged particles in proton-nucleon and proton-nucleus interactions.
3. A study of distribution of intervals of the rapidity, containing K-1 particles (k=1, 2...n-1,n-multiplicity) for a fixed n.

Similar analysis has originated from exposures by this group at Serpukhov and FNAL and there is important to compare the results with the higher energy data.

A PROPOSAL OF THE EXPERIMENT AT THE FNAL ACCELERATOR

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THE INTERACTIONS OF PROTONS IN NUCLEAR EMULSION AT

400 (OR 500) GEV/c.

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Introduction

The Sovjet collaboration on investigation of multiple production of charged particles at the interaction of protons accelerated up to 200 Gev/c at FNAL (Batavia) has scanned 3303 meters of proton tracks and detected 9339 inelastic interactions. A part of these events are pp- and pn- interactions, another part are coherent and incoherent interactions of protons on nuclei. There has been obtained a distributions of multiplicity and angles.

This analysis gives essential results:

1. Multiplicity distribution and angular characteristics of the secondary particles in pp- and pn-collisions [1-3].

2. The data on the multiplicity in a fragmentation region and in a pionisation one [4].

The distribution in a fragmentation region is a Poisson type, but in a pionisation region it is wider than the Poisson one.

3. A multiplicity in a forward and backward direction

in a center of mass system.

These data indicate that at a low multiplicity both the fragmentation and pionosation processes take place, while at a high multiplicity there is mainly the process of pionosation.

4. A distribution of the rapidity intervals containing K-1 particles (K=1, 2...n-1,n-multiplicity) for a fixed n. [5,6] .

For K=5÷ 9 and K-1 it has been obtained narrower experimental distribution in comparison with a statistically independent production. The comparison of the distribution of maximal gaps between particles with the distribution obtained from calculations in which exchange of pomeron was taken into account, shows that experimental distribution shifted to the region of small velues of intervals.

5. The data about a coherent production of charged particles on nuclei shows that a cross section for production of one, three, five and seven particles in p-A-coherent-interactions increases in comparison with the data at 67 Gev/c, but it increases slower than for the reactions induced by π^--mesons [7-8] .

6. The data about the multiple production in proton-nucleus interactions [9] .

It was obtained that in a projectile fragmentation region and pionisation region for $n \lesssim 2 < n_s >$ the rapidity distributions are the same as in proton-nucleon interactions. The analysis shows that the increase of multiplicity at large angles, perhaps, is caused by fragmentation of few

nucleons, but not by a development of the intranuclear cascade.

The Sovjet collaboration has investigated the similar problems at 67 Gev [10-11] at Serpukhov. In connection with it, it is interesting to investigate the characteristics of multiple production at 400 Gev(or, if possible, at 500 Gev). This will give a possibility to obtain the energy dependence of the characteristics of multiple production mentioned in [1-6], to study question about scaling and to obtain results about proton-proton and proton-nucleus interactions in a region of the increase of the total proton-proton cross section.

1. <u>The proposed experiments at 400(or 500) Gev</u>

We propose to carry out the investigation of mentioned processes by the emulsions irradiated by a proton beam at 400 Gev(or 500Gev). As it is known the emulsion has a very high spatial resolution which is of great importance at the investigation of the processes at a high multiplicity. Besides, the emulsion has a small radiation length that enables to detect effectively the π^0-mesons by finding the electron-positron pairs and in this way to obtain a full information about the events with a low multiplicity.

2. <u>The requirements to the exposure of the protoemulsion stacks.</u>

We need two or three emulsion stacks each with a volume of 1 liter irradiated by protons at 400 (or 500)Gev/c. The proton beam must be parallel to the emulsion plane (the dip angle must be no greater than 5.10^{-3}). The density of the beam must be within $(2-4).10^4$ protons/cm^2. The beam

angle dispersion must be no greater than $0,5.10^{-3}$. In addition to it, it is desirable the same stacks irradiation perpendicular to the emulsion plane for the estimate of the distorsion level. The particles density for the perpendicular beam must be about 10^5 protons/cm^2.

3. The develompent of emulsions.

For the control of the irradiation quality it is necessary to have some possibility to develop a small number of the protoemulsion layers during the exposures at Batavia. The stacks will be processed in the USSR.

4. We ask to consider Dr.P.S.Baranov and Dr.A.S.Belousov attached at FNAL during 1975 or Dr.M.I.Adamovich from P.N. Lebedev Physical Institute as persons responsible for the emulsion exposure at FNAL.

5. Please send all the information about the performing of this experiment to Dr.M.I.Tretjakova. Laboratory of Cosmic rays P.N.Lebedev Physical Institute,Leninsky prospect, 53, Moscow, USSR.

R E F E R E N C E S

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