FERMILAB PROPOSAL No. 329

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The Interactions of Protons in Nuclear Emulsion at 400 (or 500) GeV/c

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A PROPOSAL OF THE EXPERIMENT AT THE NAL ACCELERATOR (BATAVIA,USA). THE INTERACTIONS OF PROTONS IN NUCLEAR EMULSION AT 400(OR 500)GEV/c.

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

Introduction

The Sovjet collaboration on investigation of multiple production of charged particles at the interaction of protons accelerated up to 200 Gev/c at NAL(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 distribution of multiplicity and angular distributions.

This analysis gives interesting results:

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

2) The data about a multiplicity in a fragmentation region as 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 pionisation processes take place, while at a high multiplicity there is mainly the process of pionisation.

4) A distribution of intervals of the rapidity containing K-1 particles (K=1,2...n-1,n-multiplicity) for n mixed [5,6] . It has been obtained that the distribution of maximum intervals as 4-8 particles in jets is narrower in comparison with a statistically independent production. The comparison of the distribution of maximum gaps between particles shows that experimental distribution shifted to the region of small values 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 increases in comparison with the data at 67 Gev/c, but it increases slower than for the reaction induced by π^--mesons [7-8] .

6) The data about the multiple production in proton-nucleus interactions [9]. It is obtained that in a projectile fragmentation region and pionisation region (for $n_s \leq 2 < n_s >$) the rapidity distributions are the same as in proton-nucleon interactions. The analysis shows that the increase of multiplicity at big angles, perhaps, is caused by fragmentation of few nucleons, but not by a development of the nuclear cascade.

The Sovjet collaboration has investigated the similar problems at 67 Gev [10-11] at Serpukhov. It is interesting in connection with it 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] in a region of the increase of the total proton-proton cross section.

The proposed experiments at 400(or 500)Gev

1. The investigation of mentioned processes we propose to carry out by the emulsions irradiated by a proton beam at 400 Gev(or 500 Gev). 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^o mesons by finding the electron-positron pairs and in this way to obtain a full information about the events with a low multiplicity.

2. The requirements to the photoemulsion stacks exposure.

We need three emulsion stacks each has 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 has to be of no more than 5.10^{-3}). The density of the beam is within $(2-4).10^4$ protons/cm^2. On the condition that the beam angle dispersion will not be more that $0.5.10^{-3}$ it is desirable to take some control irradiation of the same stacks perpendicular to the emulsion plane for the estimate of the distortion level. The particles density must be about 10^5 protons/cm^2.

3. The development of emulsions.

For the control of the development quality it is necessary to have some possibility to develop a small number of the photoemulsion layers during the preparation and exposures at Batavia. All the stacks will be processed in the USSR.

4. We ask to consider Dr.V.A.Zarev attached at NAL during 1974 (or Dr.M.I.Adamovich) from P.N.Lebedev Physical Institute as persons responsible for the emulsion exposure at NAL.

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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