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FNAL PROPOSAL

A STUDY OF ANGULAR DISTRIBUTIONS IN PROTON-NUCLEUS COLLISIONS USING NUCLEAR EMULSIONS

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Beam Energy; 400-500 GeV proton
Proton momentum as high as possible.

Beam Intensity; About 10^4- 6 x 10^5 protons/cm^2.

Detectors;
1) 20 pellicles, normal G5 emulsion each 15cm x 20cm x 0.06cm. The 20cm edge along the beam.
2) One emulsion chamber with carbon and paraffine producer (size of 10cm x 12cm x 10cm). The surface of 10cm x 12cm will be exposed vertically to the proton beam direction.

6pgs.

§ Summary

1. Objectives

   (i) Exclusive angular distribution of secondaries

   (ii) Identification of the recoil proton

   (iii) Effective target mass distribution

   (iv) Inelasticities K_M and K_γ

2. Techniques proposed

<u>Exposure details</u> Two types of chambers are exposed to the proton beam. One is the emulsion stack, and the other is the emulsion chamber with the producer layer. The emulsion stack should be exposed by the beam intensity of 6×10^5 protons/cm^2, and the emulsion chamber should be exposed by more feesible intensity in order to avoid the overlapping of cascade showers. The collision mean path of the producer part in the emulsion chamber is about 0.1, and so the chamber should be exposed by the intensity of 10^4 protons/cm^2. For this intensity, the number of interactions in the producer is expected to be about 2×10^4.

<u>Experimental details</u> As for the emulsion stack experiment, we firstly measure the collision mean free path of proton with emulsion nuclei by the along-the-track scanning, and then measure the emission angles of secondaries. We also specify the nature of secondaries within the backward

cone by measuring the momenta of secondaries with the use of the multiple scattering methd.

As for the emulsion chamber experiment, we firstly follow the incident beam by the beam tracer, and find the interaction point in the producer by the along-the-track scanning. We then carry out the area scanning of the coordinate-recorder made of pellicle for the corresponding of the horizontal locations (in the producer) to the vertical locations (in the emulsion chamber), and trace the tracks into the emulsion chamber. Further, in the producer part, the emission angle and momentum of each secondary particle with considerably large angle will be measured. Conversely, we find out the cascade showers by the naked-eye scanning in high sensitive X-ray films (Sakura N-type) in the emulsion chamber, and follow back. Emulsion chamber part consists of the sandwiches of Pb of the thickness 1mm and the emulsion plate based on the acrylic acid resin (plate) with the emulsion of 50 micron meter thick on the both surface of it, and is designed in order to use the relative scattering method by Pb.
In this part, we also measure the momenta of γ rays and charged particles emitted forward.

§ Physics Justification

Our main purpose of the experiment is to examine the exclusive structure of multiparticle production processes at high energy. To get proton-quasi-free nucleon reactions from those with the various target materials, namely, nuclear emulsion, carbon and paraffine, the effective target mass and the number of shower particles and heavy tracks are measured event by event. Our equipment will make possible to measure the emission angles of almost all secondaries, and we can measure the following quantities;

Momentum of the recoil proton   The backward particles with sufficiently large emission angles in the laboratory system are measured rather easily, so that we can examine the correlation between the momentum of the recoil proton and the angular distribution of the secondaries.

Effective target mass   The effective target mass is approximately estimated by using the emission angles of secondary particles, assuming the transverse momenta of secondaries to be nearly constant. Momentum measurement of secondaries provides more accurate value of the target mass. The relation between the effective target mass and the momentum of the recoil proton is examined.

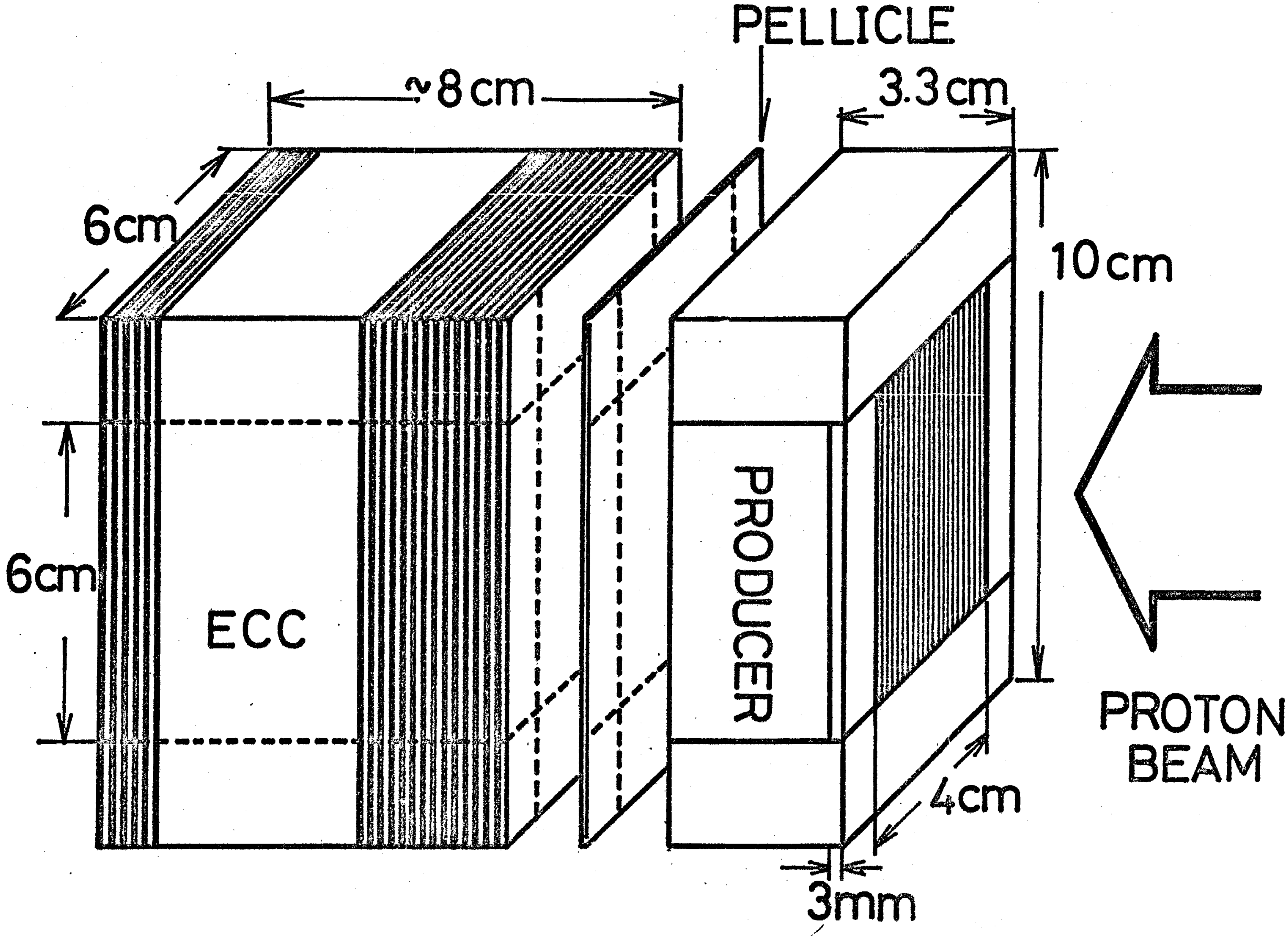
Inelasticities K_M and K_γ Inelasticity defined in the mirror system is derived from the effective target mass event by event. The distribution of inelasticities is deeply connected with the structure of the nucleon and the collision dynamics. While, energy fraction into radiation from total energy K_γ, which is an important quantity especially for the cosmic ray researches with the use of the emulsion chamber. They are to be measured directly in this experiment.

§ Apparatus Needed

The emulsion stack and the emulsion chamber should be aligned to the beam direction within 10^{-3}radian. Lead blocks are needed.

§ Scope of the Experiment

At least, one of us will attend this experiment at FNAL. Development of photo-sensitive materials must be carried out somewhere in USA. In our rough estimation, the total time needed for testing and data accumulation is about an hour, oncethe desired beam intensity is obtained.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6cm
10 cm
6cm
ECC
PRODUCER
PROTON
BEAM
4cm
3mm