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FNAL Proposal

A search for charmed particles produced by 300 GeV/c negative pions in Nuclear Emulsion

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I. The purpose of the experiment

In the course of studying 205 (Ref.1) and 400 GeV/c proton interactions (FNAL proposal No.156 and No.243), we discovered and studied the short lived particles in emulsion. In order to discover more short lived particles, we wish to make an experiment using pion beams of 300 GeV/c.

II. Detectors

1. Construction

The construction of the charmber is shown in the Fig. 1.

They consist of producing layer and analysing layer. The producing layer are piles of emulsion films coated 300 μm on both sides of polystyrene base with thickness of 150 μm. The analysing layer are sandwich of emulsion films and thin lead of 0.5 mm plated with silver of 5 μm.

In the analysing layer the momenta of secondary charged particles will be estimated by means of the relative scattering method which is calibrated making use of the beam pions, and the energy of neutral pions will be estimated by usual cascade method applyed to gamma rays.

2. Size of chamber

9.5 cm x 12.0 cm x 9 cm (See fig. 1)

III. Exposures desired

1. Number of detecter 3

2. Vertical exposure of the pion beams to the emulsion plane.

3. Beam intensity $7.5 \times 10^3/cm^2$

IV. Expected number of charmed particles

The total number of pion interactions expected are 5000 in each chamber.

Of these ~10,000 are analysed in several months, and the total number of short lived particles expected are 2~10.

V. Merit of pion beams in charmed particles search

1. According to the theory by A. Donnachie and P.V. Landshoff (Ref.2), charmed particle production cross section of pion-proton interactions is higher than that of proton-proton interactions. For example,

$$\frac{6_{\pi p \to D\bar{D}}}{6_{pp \to D\bar{D}}} \Big|_{300\ GeV/c} \sim 2.6 \quad .$$

2. Total cross sections of pion-proton and proton-proton

interactions are 25 mb and 40 mb respectively at 300 GeV/c.

Therefore, pion beams are baout four times effective to search new short lived particles than proton beams.

References

1. K. Hoshino et al., Prog. Theor. Phys., 53, 1859 (1975)
2. A. Donnachie and P.V. Landshoff, Nuclear Phys. B112, 233 (1976).

Emulsion Chamber

Figure 1