CERN/TC/COM 61-46
31.10.1961

PROPOSAL FOR A π^+ EXPOSURE OF THE 80 cm HBC AT 4 GeV/c

In a document sent to the Chairman of the "Track Chamber Committee" on 3.3.1961 (referred to as I) the groups at Birmingham, Imperial College, Aachen, Munich and Bonn, submitted a proposal for an exposure of the 80 cm HBC to a medium energy pion beam. In the conclusions of that document it was requested that, as first priority, an equal number of π^+ and π^- photographs should be obtained.

The π^- exposure is now scheduled for the week commencing the 7th November 1961 and will use the Van der Meer beam without the separators in place. We believe that the exposure to π^+ is sufficiently interesting to warrant a later exposure, when the separator will be in place, with a beam of π^+ in hydrogen before the Van der Meer beam is dismantled.

As already pointed out in I, the main purpose of the exposure to π mesons of this energy is to isolate contributions to the π–P interaction from peripheral collisions and to study the $\pi\pi$ interaction. For this purpose in itself π^- and π^+ are equally useful and the results can be combined. But if we have both π^+ and π^- it should be possible to isolate the contributions of the pure $T = 2, 1, 0$ isospin states of the $\pi\pi$ system, the π^+P system being, of course, in a pure $T = 3/2$ state.

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PROPOSAL BY THE BIRMINGHAM, IMP. COLLEGE AND OXFORD GROUPS FOR A MEDIUM ENERGY π^- and π^+ BEAM WITH THE ECOLE POLYTECHNIQUE 80 cm H_2 B C AT CERN.

The bubble chamber film analysis groups of Birmingham, Imperial College and Oxford, have recently completed a study of interactions of 16 GeV π^- particles in the 30 cm H_2 bubble chamber.

1. The experience gained in this work has lead to the conclusions outlined below, in which an experiment is proposed to study peripheral interactions i.e. π^+ - P interactions where one virtual pion is exchanged between the pion and the proton. In particular we hope to:

a) Check the dependence of $\frac{\partial \sigma}{\partial \Delta^2}$ on ^{2} (four momentum transfer squared) for a fixed value of the masses of the $\pi\pi$ system, ($W_{\pi\pi}$) and of the πP system ($W_{\pi p}$). Determine the relative frequency of production of a $T_{3/2}\pi$ - nucleon state with respect to that of a single nucleon (ref. F. Salzman and G. Salzman to be published in Phys. Rev. Lett.).

b) Compare the reactions $\pi^-P \longrightarrow \pi^-\pi^-\pi^+P$ with $\pi^+P \longrightarrow \pi^+\pi^-\pi^+P$ to determine the isospin dependence of $\sigma_{\pi\pi}$.

c) Examine the $Q_{\pi\pi}$ distribution for possible resonant states of the $\pi\pi$ system.

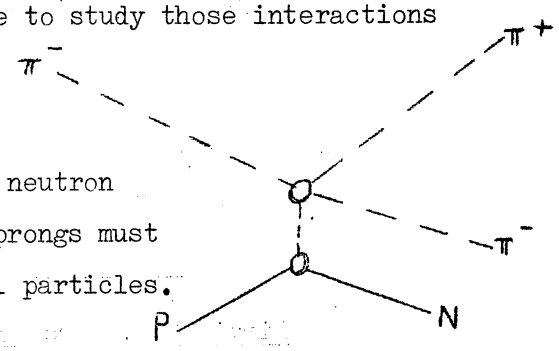
d) Use the Drell equation (Phys. Rev. Lett. 5, 342, 1960) to determine the $\sigma_{\pi\pi}$ energy dependence.

e) Derive the $_{\pi\pi}$ dependence on E using a Chew and Low extrapolation procedure; (We would like to point out here that except for point 1 b), all the others can be studied with either π^- or π^+ primaries).

2. In view of the above aims we propose to study those interactions which satisfy the following criteria:

a) $\Delta^2 \leq 10\ \mu_n^2$

b) Charged multiplicity 2 with an associated neutron or charged multiplicity 4 (one of the visible prongs must be an identified proton) wiht one or no neutral particles.



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3. Section 2 b) implies that it should be possible to measure the neutral mass with an accuracy better than 0.1 GeV in order to reject events with more than one neutral particle. This will limit our primary π momentum to a value not greater than P_p^{max} given by the equation

$$P_p^{max} = \left\{ \frac{\text{Max. Det. Mom.} < \text{GeV/c} >}{10} \right\}^{1/2} \text{GeV/c}$$

We do not as yet know the MDM for a typical track so we cannot specify P^{max}. However, with a reasonable value for the MDM the P_p^{max} will be limited to the range

MDM	P_p^{max}
300 GeV/c	6 GeV/c
100 GeV/c	3 GeV/c

4. A rough estimate of the cross section for interactions with characteristics specified in section 2 is approx. 0.7 mb; therefore, for 1000 interactions we require approx. 100,000 pictures containing approx. 20 tracks/picture. (In view of point 1 b), it would be desirable to have 50,000 pictures with π^- primaries and 50,000 with π^+ primaries).

5. Therefore, summarising, we would like to make the following request:

a) 1st. priority — 50,000 pictures with π^+ primaries and 50,000 pictures with π^- primaries.

b) 2nd. priority — 100,000 pictures with π^- primaries.

The energy of the primary should be:

6 GeV/c for MDM = 300 GeV/c

3 GeV/c for MDM = 100 GeV/c

c) If only 50,000 pictures will be available then 25,000 with π^+ primaries and 25,000 with π^- primaries would be preferable.

Birmingham, March 3rd, 1961. B. Tallini

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