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## MEMORANDUM ON T 16 EXPERIMENT

(CERN, TC Division)

It is the purpose of this note to outline a further point of interest in the T 16 experiment, of 7 GeV/c π^- in the Ecole Polytechnique H.L.B.C. with internal hydrogen target[1].

The proposal centres round the study of the radiative decay of the ρ - meson. Apart from establishing the branching ratio (r) for the decay in $\pi\gamma$ and $\pi\pi$ channels respectively, there is the possibility of making an estimate of the width of the ω-meson. The ratio, R, ($= \dfrac{\Gamma(\omega \longrightarrow \pi\gamma)}{\Gamma(\rho \longrightarrow \pi\gamma)}$), of the widths of the ω and ρ mesons for radiative decay can be calculated reliably[2]. Then $\Gamma(\omega_\gamma)$ is determined from

$$\Gamma(\omega_\gamma) = \frac{r}{R} . \Gamma(\rho \longrightarrow \pi\pi)$$

Thus a measurement of the branching ratio of the $\rho \longrightarrow \pi\gamma$ and $\rho \longrightarrow \pi\pi$ channels together with the width of the ρ - meson in the pion channels, (where the measurement error is a small fraction of the real width), determines the width of the ω - meson.

Secondly, the measurement of the branching ratio of $\rho \longrightarrow \pi\gamma$ and $\rho \longrightarrow \pi\pi$ allows some clarification of the problems in low energy pion photoproduction. There exists a large discrepancy between the theoretical predictions and experimental results in the threshold region for the process, even when allowance is made for the large direct interaction between the γ ray and pion fields at these low energies. This discrepancy has been attributed to a vertex
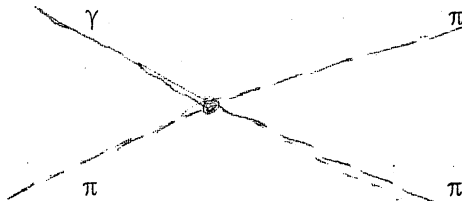
playing an important part in the ordinary photoproduction process

$$\gamma + p \longrightarrow \pi^+ + n.$$

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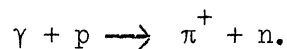
(1) CERN/TC/COM 63-28   18 April 1963
   62-49   19 Nov. 1962
     W.B. Fretter   2 April 1962

(2) Kobyarev, I. Yu. Private Communication.

It is difficult to make a good estimate of the strength of this vertex from the photoproduction experiments themselves, but in an investigation on the branching ratio discussed above, the strength of the $(\gamma \rho \pi)$ vertex may be directly evaluated.

Feasibility

The feasibility of such an experiment depends largely on the value of the branching ratio under examination. The theoretical estimates range from a few percent to 0.5 o/o, depending on the model under consideration[3]. The only experimental evidence is due to Pevsner et al[4] who examined the reaction

$$\pi^- + n \longrightarrow p + X^0$$
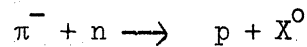
looking at the missing mass to define X^0. An analysis of their results yields an upper limit of a few percent on the ratio.

The T 16 experiment (at 7 GeV/c only) should yield around 8.000 ρ-meson in the reaction

$$\pi^- + p + \rho^- + p$$
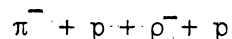
thus some 50 - 100 events of $\rho \longrightarrow \pi \gamma$ should be detected if the branching ratio (r) is of the order of 1 o/o.

The range and angle of the proton determines the missing mass, and should permit selection of events within the ρ peak. The $\rho \longrightarrow \pi\gamma$ decay kinematics are defined by the angle and energy of the π^-, and line of flight of the materialised γ ray.

We would scan for events with

$$\pi^- + p \longrightarrow \pi^- + p + \text{one or two } \gamma - \text{rays.}$$
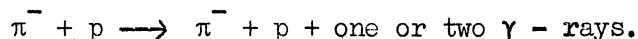
In many cases, (the fraction depending on the missing mass resolution), the separation between the $\rho \longrightarrow \pi^- \pi^0$ and $\pi^- \gamma$ may be made unambigiously. For the rest, the background of $\rho \longrightarrow \pi^- \pi^0$ events where only one of the γ's is detected, can be subtracted out using the distribution from events in which both γ - rays from the π^0 materialise.

The analysis of this investigation could be undertaken in parallel with the already planned experiments with this film.

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(3) G. Feinberg, P.R.L. 8, 151, 1962
   M. Gell-Mann and F. Zacharisen, P.R. 125, 953, 1961
   P. Singer, Phys. Rev. 130, 2441, 1963

(4) Pevsner et al. Rochester Conference Report, CERN 1962.