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Experimental study of the production of (e^+e^-) pairs in pion-nucleon interactions.

PROGRESS REPORT
prepared for the EEC

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A brief account is given of what has been done during the five weeks of PS time (effective days: 15).

1 - Beam. The new $m_{4/e}$ beam, which has the last branch 2.5 meters above the ground level, has been adjusted and optimized at 2.1 Gev/c, 1.9 and 0.8 Gev/c .

2 - The Right neutron telescope. This telescope consists of 12 plastic scintillator counters. The dimensions of these counters are 100× 18× 18 cm^3. Each of the two smaller faces is viewed by an XP-1040 phototube. These counters have been timed relative to each other and to the beam-counter system to within ± 0.15 nsec (see Fig. 1). The points in the "t_1" and "t_2" bands correspond to the timing between the beam counter and the two ends of the neutron counter whose number is indicated in the abscissa. The points in the "Θ" band correspond to the difference $(t_1 - t_2)$ obtained using the Charpak-Dick-Fevrais principle for position measurement. The time resolution achieved agrees with that anticipated in the proposal[1].

3 - Determination of mass resolution. In order to check the mass resolution of our apparatus in known conditions we have studied the production of η in π^- - p interactions at 0.8 Gev/c, incident pion momentum. In Fig. 2 we display the time-spectrum and the Θ -spectrum obtained. The Θ-spectrum is in fact the projection of the Jacobian peak along the angular axis with given time window of 4 nsec. The data presented are obtained directly on a TMC display without computer on or off line. Notice that the width of the " η " in the Θ -spectrum is the smallest so far obtained in a direct study of η-production (i.e. excluding Primakoff like effects). The mass resolution follows again our expectations[1].

4 - Production of φ in π^- - p collisions. At the time of our proposal [1] (31th January 1966) the production of φ had't been observed in pion nucleon interactions. In Table 1 of our proposal [1] we guessed $\sigma_\varphi \simeq 10^{-2} \sigma_\omega$. In fact since then a group in Berkeley using bubble chambers, and another group in Nimrod, using spark chambers, have observed the production of φ with a cross section of ~ 50 μbarns (for $P_\pi \simeq 2$ Gev/c). In Fig. 3 we present our results on the search for φ in π-N interaction, using pions of 2.1 Gev/c. The data are too preliminary to be translated into cross-section figures. Notice that our mass resolution is again confirmed to be of the order of 10 Mev and that no visible techniques have been used to detect the reported peak. In order to quote figure for cross-section we need further checks, and improved statistics.

Conclusions

The data reported show that the aims specified in our original proposal[1] have been achived and we consider the results of the test run to be successful.

Request of PS time

Before the shut-down we would like to finish our study of ϕ, ω and ρ production in π^- - p interactions. Obviously the ϕ is the hardest one and this is why we started with it.

We are at present running (week n.5) and we are already scheduled for week n.6, but we would like to have two more weeks in order to complete our studies. In particular one week will be needed for the setting up of the left neutron telescope.

During the shut down we will mount our two electron detectors. Each one consists of 9 spark chambers and 9 plastic scintillators. The sensitive cross-sectional area is 120× 60 cm^2. In order to calibrate these two electron detectors we need 4 weeks of real parasiting time, i.e. ~5% on target 1.

Then we are ready to run for the (e^+e^-) decay of ω, φ and possibly ρ (in fact the branching ratio for ρ-decay seems now to be well established).

In our search for (e^+e^-) production in (π^-p) interaction we would like to start studying the ω and ϕ regions; this will allow us to have a direct determination of the $(\omega - \varphi)$ mixing angle, which is expected to be 35° but, according to certain theories, (Schwinger, for instance) could be as high as 90° or as low as zero (for instance Low).

We need two weeks of running time (with ~30%—50% on target 1, 19.2 Gev/c, 300 m sec flat-top) for the φ and 4 days for the ω, in order to reach a statistical accuracy of 25% in the branching ratios, if the (e^+e^-) decay rates follow the present theoretical expectations (see table 1 of our proposal [1]).

Further requests of machine time concerning a thorough study of (e^+e^-) production in other missing mass intervals should be postponed until the present program has been accomplished.

Reference:

1 - AN EXPERIMENTAL PROPOSAL TO MEASURE THE PRODUCTION OF (e^+e^-) PAIRS FROM TIME-LIKE PHOTONS PRODUCED IN PION-NUCLEON INTERACTIONS, P. Dalpiaz, G. Fortunato, T. Massam, Th. Muller and A. Zichichi.
Paper for the EEC, 31 January 1966, (66/197/3/p/jmf).

RIGHT NEUTRON COUNTER TIMING

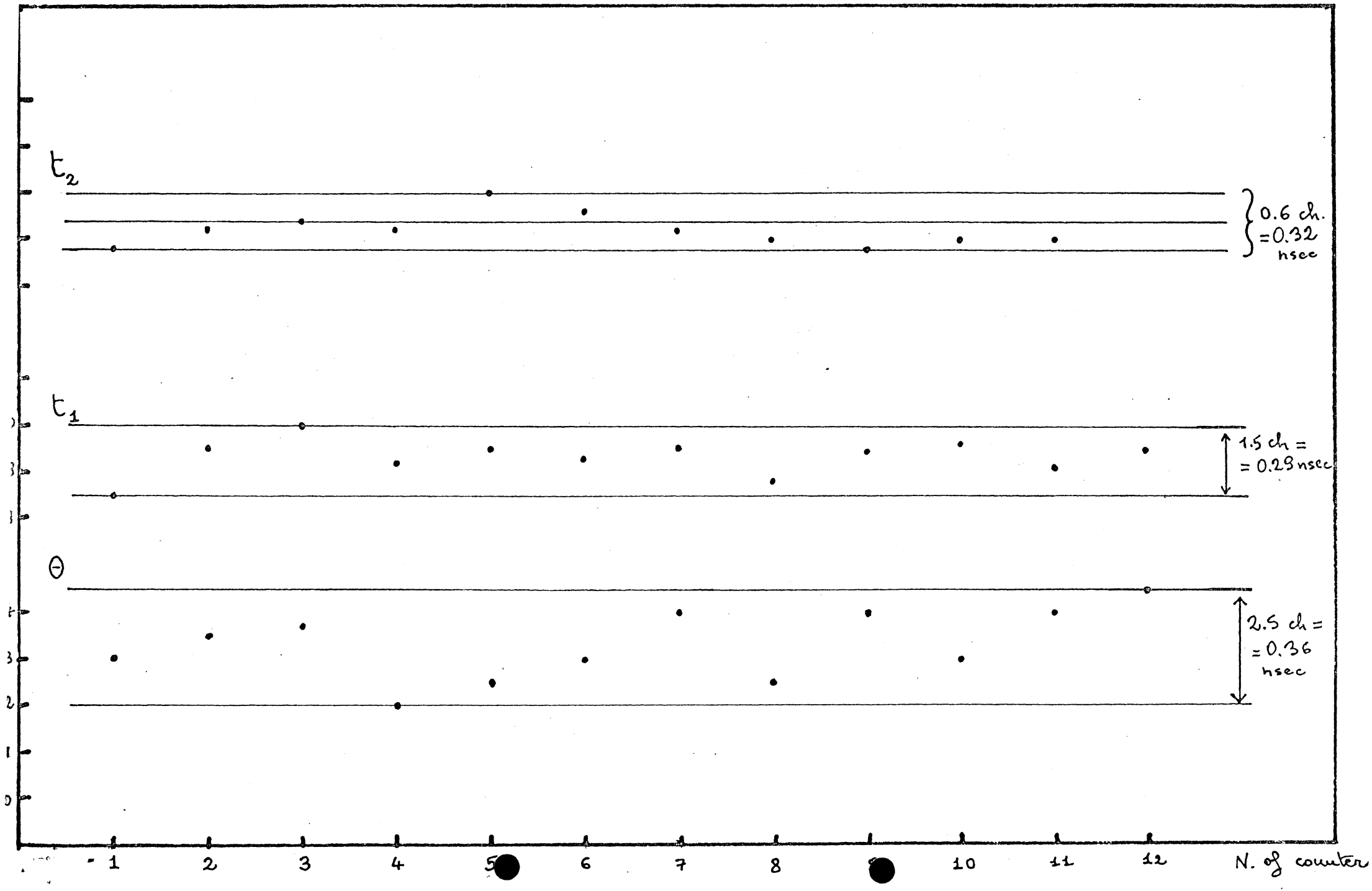
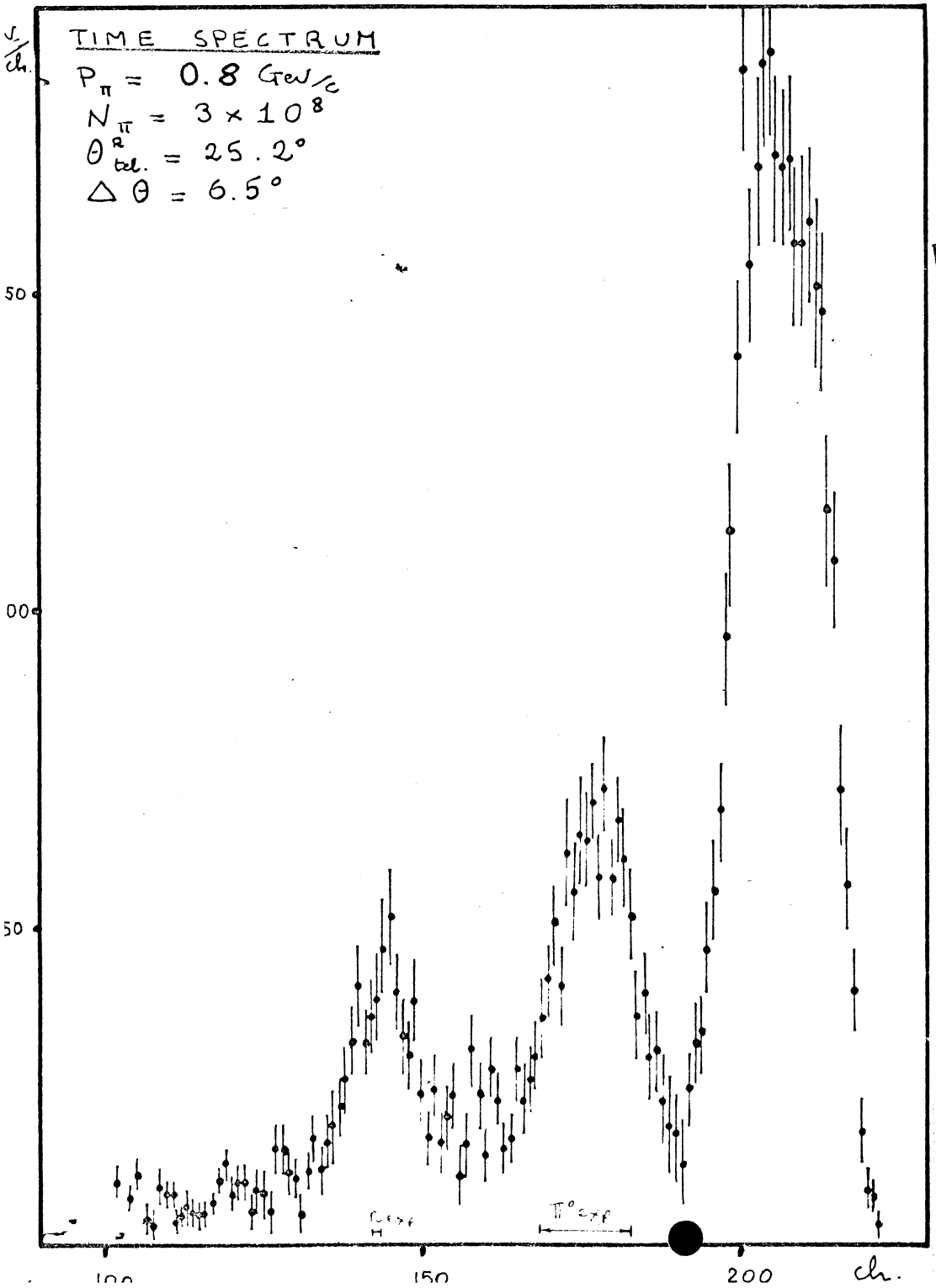
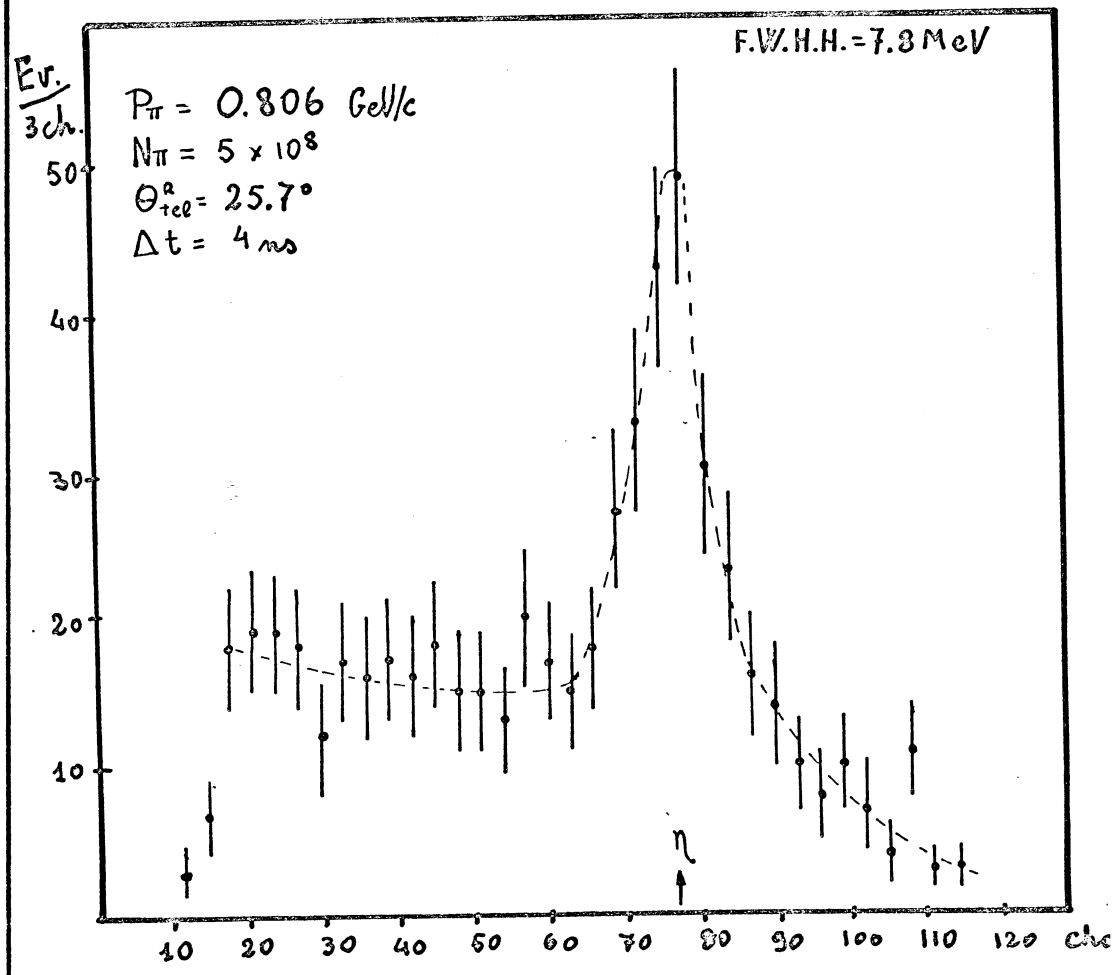


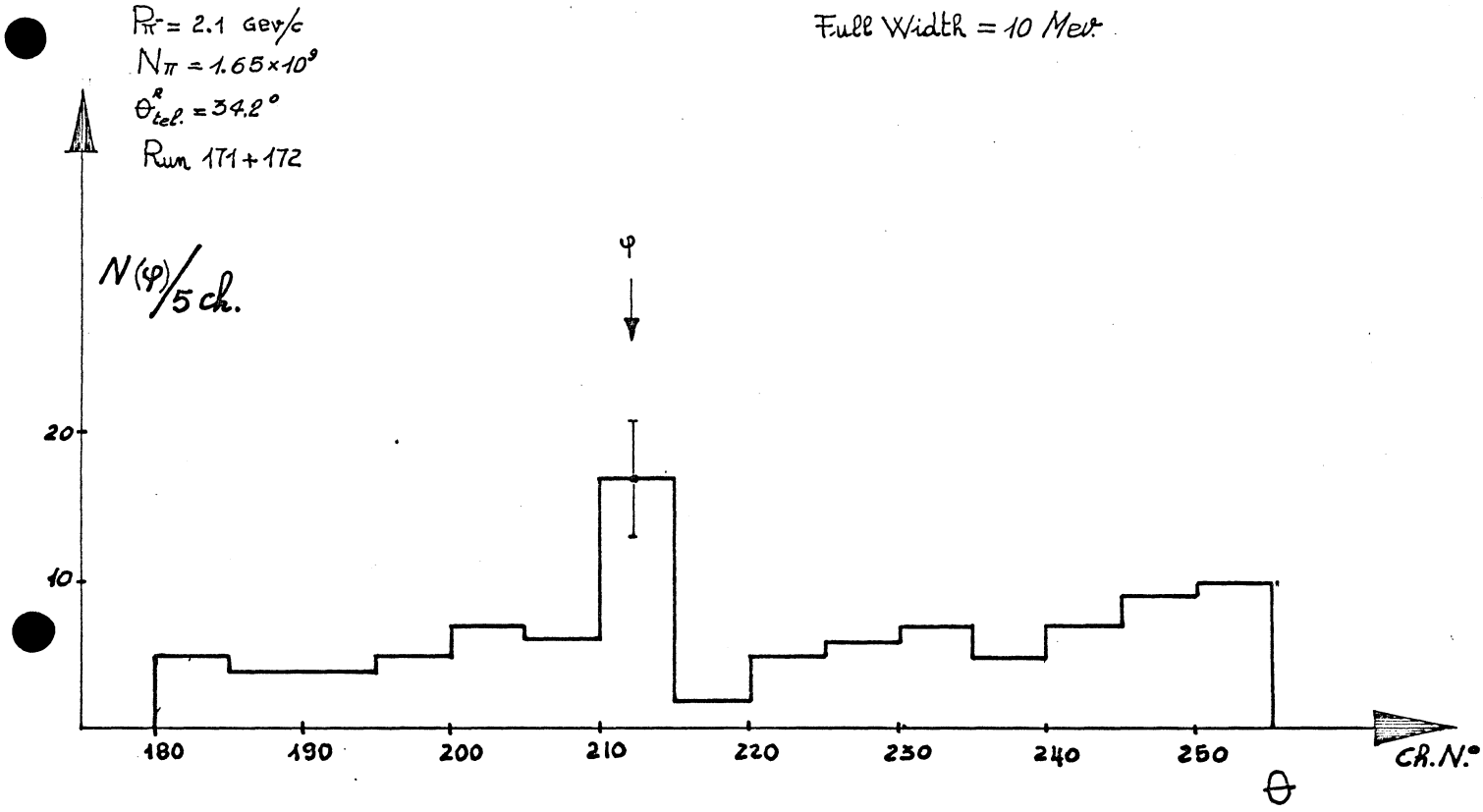
Fig. 2





ANGLE SPECTRUM.

Fig. 3



ANGLE SPECTRUM