Laboratori Nazionali di Frascati

LNF-61/76 (1961)

C. Mencuccini, R. Querzoli, G. Salvini: THE POLARIZATION OF THE PROTONS FROM THE REACTION $\gamma + p \longrightarrow \pi^0 + p$ AT 910 MeV.

Estratto da: The Aix-en-Provence International Conference on Elementary Particles - C. E. N., Saclay, 1961 Vol. I, pag. 17.

THE POLARIZATION OF THE PROTONS FROM THE REACTION $\gamma + p \rightarrow \pi^\circ + p$ AT 910 MeV

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Extending our earlier measurements [1] on the polarization of the recoil protons from the process $\gamma + p \longrightarrow \pi^\circ + p$ we have measured a new polarization point at an energy of 910 MeV, at 90° c.m.s.

The experimental technique is just the same as described in the first paper [1] ; figure 1 shows the general disposition of the experiment.

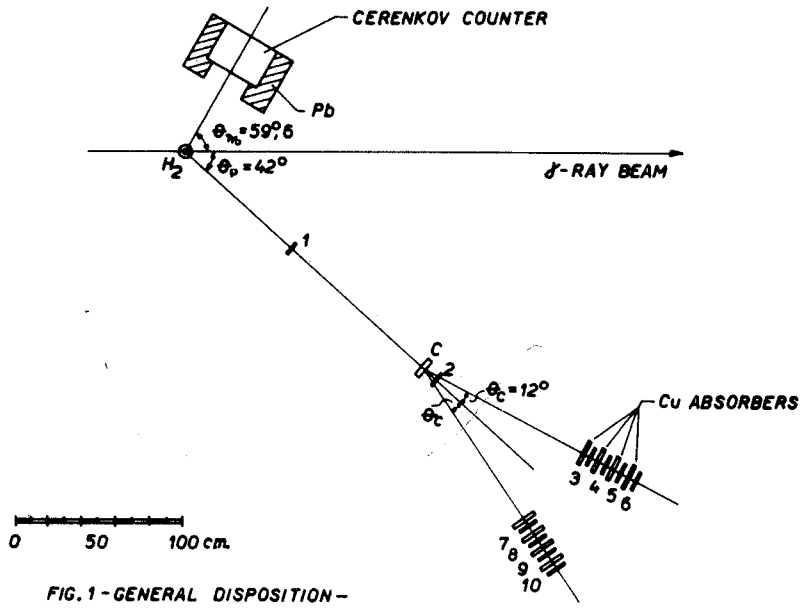

FIG. 1 - GENERAL DISPOSITION -

The counters 1, 2, 3,..... 10 are plastic scintillation counters which detect the protons ; the Cerenkov counter detects the γ-rays of π° meson decay.

C indicates the carbon scatterer, and Cu the copper absorbers which define the range of the proton energy. We were counting, at the same time, four kinds of coincidences :

(Cer 1, 2, 3, 4-5) (Cer 1, 2, 3, 4, 5-6)

(Cer 1, 2, 7, 8-9) (Cer 1, 2, 7, 8, 9-10)

thus measuring two different energy intervals of the protons, corresponding to two different energy intervals of the γ's.

Discrimination of the protons against the pions is done by the required coincidence with the Cerenkov counter as well as by pulse height discrimination in the counters 2, 3, 7.

The kinematic situation of the measurement is given in figure 2. For the γ-energy resolution we can assume a value of about 100 MeV. The rough data have been corrected as usual for empty target contribution, accidentals in the various counter telescopes, and inelastic collisions of the protons in carbon.

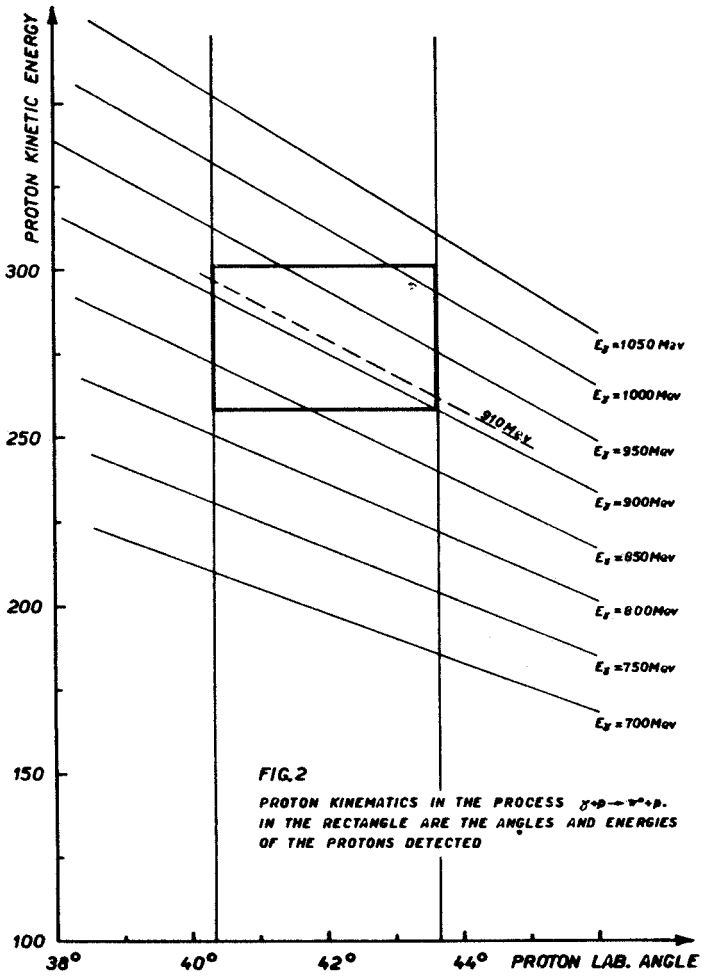

FIG. 2

PROTON KINEMATICS IN THE PROCESS $\gamma + p \rightarrow \pi^0 + p$. IN THE RECTANGLE ARE THE ANGLES AND ENERGIES OF THE PROTONS DETECTED

We have found that the main contribution to the accidentals is due to the Cerenkov counter with about 10 % of the total counting rate.

The counting rate from the empty target was practically zero.

Our estimate of the correction due to those protons which, having an energy higher than the upper limit of the proton energy channel, undergo in the carbon an inelastic scattering such that they can be counted in the proton channel, has been made by measuring the counting rates of the too high energy protons and subtracting their contribution using the published cross section for inelastic scattering [2].

We have found for this effect a contribution to the measured asymmetry $\varepsilon = \frac{L - R}{L + R}$ not greater than 5 %. The computation of the polarization from the corrected experimental asymmetry has been done by the application of "Monte-Carlo" method and the use of the FINAC electronic computer ; the data used in this calculation have been the analysing power of carbon and the proton elastic scattering cross section in carbon as published by Hafner [3] and Chamberlain [4].

The value of polarization we have found at 910 MeV is 0.43 ± 0.07, not different, statistically

from the values at lower energies. A general view of the results of all measurements of the polarization of the recoil proton at 90° c.m. versus the γ-ray energy is given in figure 3.

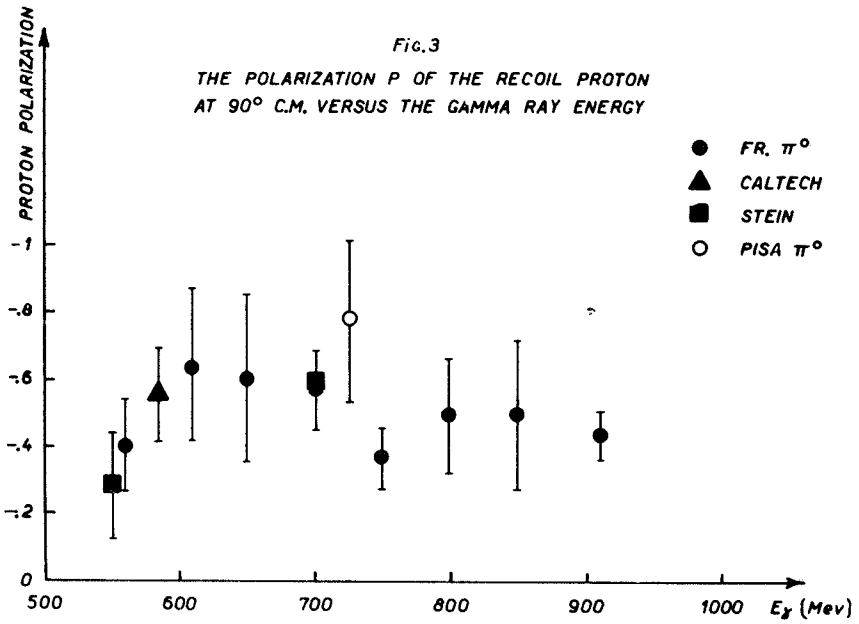

Fig.3
THE POLARIZATION P OF THE RECOIL PROTON AT 90° C.M. VERSUS THE GAMMA RAY ENERGY

A discussion of the previous polarization results has already been done in the paper [1].

Following the same lines, on the basis of Peierls suggestion [5], we may conclude that so high a value of polarization up to 910 MeV agrees with the hypothesis that the neutral photoproduction in the 500-1 000 MeV energy range can be described by three resonant states A, B, C with the following quantum numbers :

Level	j_ν	I_π	J	ω	T
A	1	1	3/2	+	3/2
B	1	2	3/2	-	1/2
C	2	3	5/2	+	1/2

In particular our new value of polarization certainly indicates the presence of at least two states of opposite parities at 910 MeV, in agreement with the assignement of the state B and C. The sign and the value of the polarization we found in fact agrees with the polarization calculated assuming only these two states present, and a single-level formula for their amplitudes, with a width of ~ 60 MeV for the second resonance.

Finally, in the hypothesis of only two states contributing, a high value of the polarization could be expected from the consideration of the experimental angular distribution at 950 MeV ; at this energy in fact, the asymmetry around 90° c.m. found by De Wire [6], Berkelman [7], Stein [8] and Vette [9] for the differential cross section suggestes the presence of two states of opposite parity in this energy region.

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