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B. Borgia, M. Grilli, P. Joos, L. Mezzetti, M. Nigro, E. Schiavuta, F. Villa: Λ^o POLARIZATION FROM THE REACTION $\gamma + p = K^+ + \Lambda^o$ IN THE ENERGY RANGE 950-1050 MeV.

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Λ^o POLARIZATION FROM THE REACTION $\gamma + p = K^+ + \Lambda^o$ IN THE ENERGY RANGE 950 - 1050 MeV

B. Borgia
Istituto di Fisica dell'Università - Roma

M. Grilli
Laboratori Nazionali del CNEN - Frascati

P. Joos
Physikalisches Institut der Universitaet - Hamburg

L. Mezzetti, M. Nigro, E. Schiavuta and F. Villa
Istituto di Fisica dell'Università - Padova

We are carrying out measurements of the cross-section and of the Λ^o polarization for the reaction

$$\gamma + p = K^+ + \Lambda^o$$

in the energy range $950 < E_\gamma < 1050$ at the Frascati electronsynchrotron. We report here some preliminary results obtained in the measurement of the polarization.

The experimental arrangement used is outlined in Fig. 1. The K-mesons are momentum analyzed and identified by means of the deflecting magnet M and of the scintillation (S) and Cerenkov (C) counters $S_1S_2S_3S_4C_1C_2C_DS_5$. The K mesons of the selected momentum bands are brought to rest in the center of the large liquid Cerenkov counter C_D, where their charged decay secondaries are detected in a 4π geometry. Additional selection criteria are based on the Cerenkov threshold condition in C_1 and C_2, on the measurement of the pulse heights in S_3 and S_4, and on the anticoincidence condition set by S_5. In this way, the number of spurious events is reduced to a very small fraction (less than 5%), as confirmed by the shape of the delay distribution of the C_D signals, which is in good agreement with the hypothesis of the decay of a stopping particle, with the characteristic lifetime of the K^+ disintegration (see an example in Fig. 2).

The measurement of the Λ^o polarization is based on the detection of the proton from the $\Lambda^o \rightarrow p + \pi^-$ decay mode, in coincidence with a K-event. The arrangement to detect the proton consists of two identical scintillation counter telescopes (each of three counters L_1, L_2, L_3) symmetrically arranged above and below the K-Λ^o production plane.

What we look for is an up-down asymmetry between the two L telescopes: if N_u, N_d are the numbers of K-events accompanied by a decay proton in the upper or lower telescope, respectively, then the transverse Λ^o polarization is given by

$$\left| \alpha P_\Lambda \right| = G \left| \frac{N_u - N_d}{N_u + N_d} \right|$$

where G is a constant, depending on the geometry of the L-telescopes, and $\alpha = 0.62$(1) is the asymmetry parameter of the Λ^o decay.

The identification of the decay proton is based essentially on its time coincidence with the K-event. The signals of all L counters and of one of the K telescope counters are displayed on fast oscilloscope traces and photographed.

The delays read from the film are punched on IBM cards. Using an electronic computer we then select among all the L signals which are in rough time coincidence with a K-event, those corresponding to the passage of the same particle through the three counters of the same L-telescope and calculate for each event, the mean (t) of the three delays. An example of the resulting distribution of t-values is shown in Fig. 3. The main peaks are interpreted as due mainly to K-Λ events, while the secondary peaks, whose spacing is in agreement with the RF bunching of the synchrotron beam, are used to calculate the chance coincidence background.

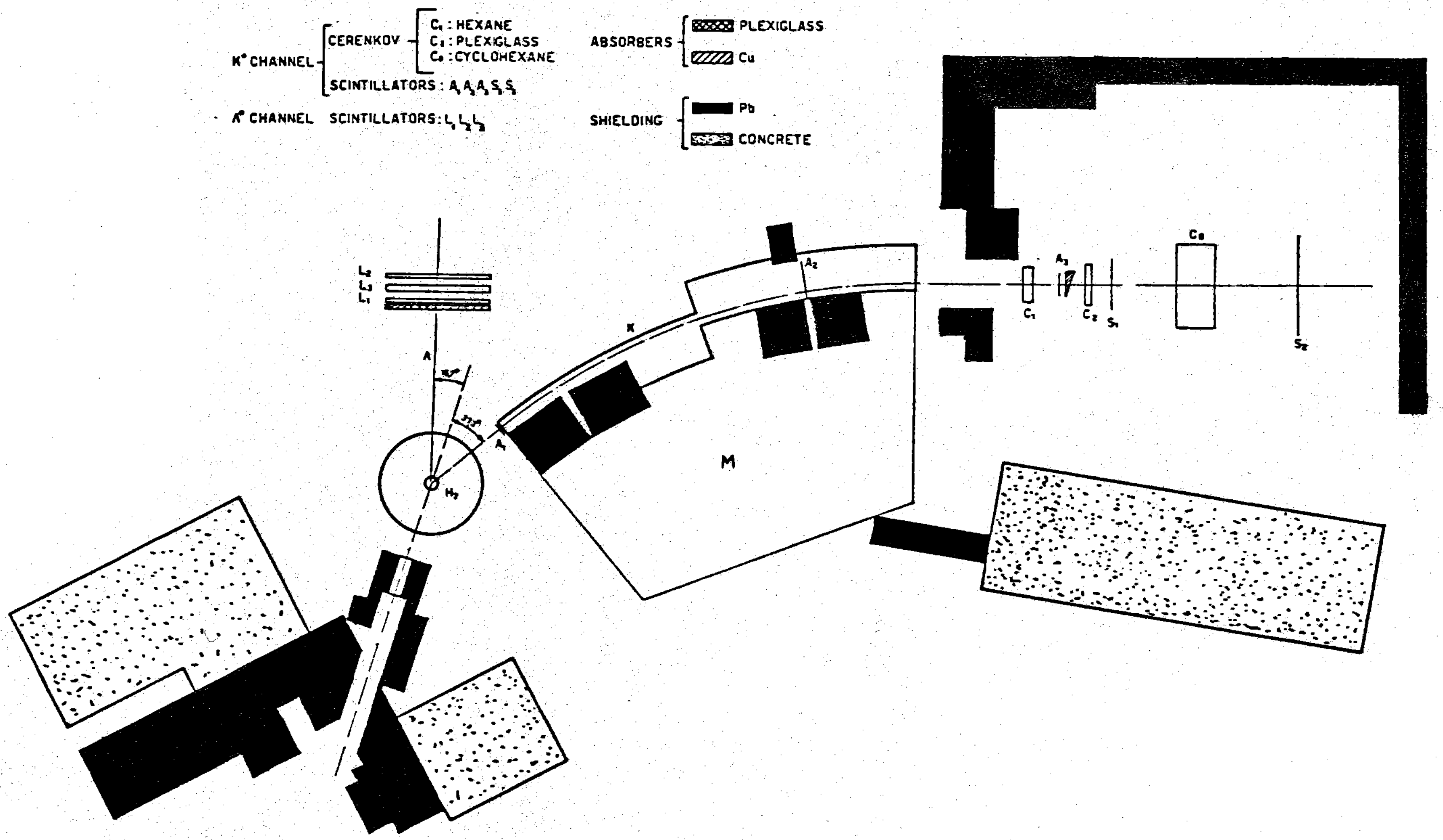

FIG. 1 - Experimental apparatus for $\gamma + p = K^+ + \Lambda^0$.

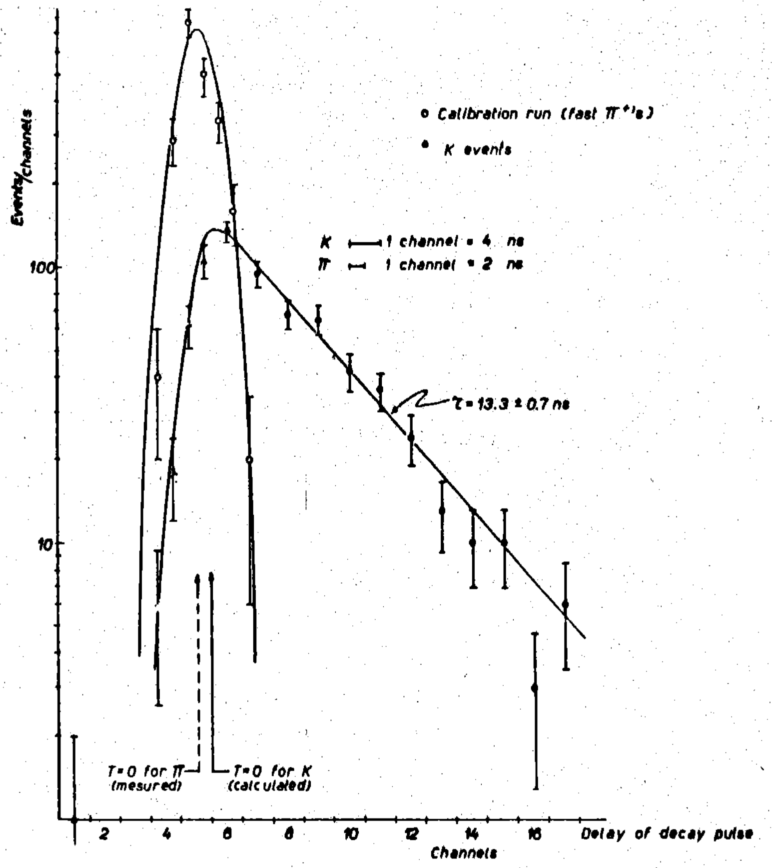

FIG. 2 - Timing of the decay pulse of K^+ (in C_D) with respect to the reference counter S_3. The timing of π^+ pulse passing through S_3 and C_D are shown for reference.

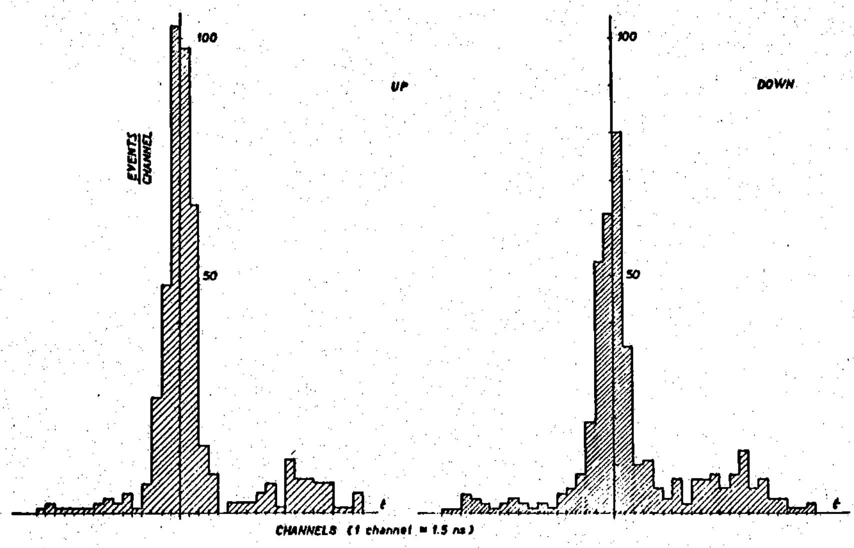

FIG. 3 - Delay distribution of threefold L coincidences with respect to the K telescope signal.

TABLE I

E_γ (1) (MeV)	θ^K CM	$\frac{Nu - Nd}{Nu + Nd}$	P_Λ (2)	Nr of EVENTS
1040 ± 20	86° ± 6°	0.24 ± 0.09	+0.47 ± 0.18	321
1015 ± 20	94° ± 7°	0.11 ± 0.08	+0.21 ± 0.16	316
960 ± 10	93° ± 9°	0.00 ± 0.09	+0.00 ± 0.16	395

(1) The limits shown represent the energy resolution. The central values may be in error by at most 1%, due to the present incertainty in the calibration of the magnet.

(2) The indicated error includes the contribution due to the subtraction of the background, which amounts to 15 ÷ 20% of indicated number of events. Apositive value for P_Λ means that $\overline{P}_\Lambda$ is along $\overline{p}_\gamma \wedge \overline{p}_\Lambda$, where $\overline{p}_\gamma$ (Λ) is the γ (Λ) momentum in the L. S.

The results obtained are summarized in table I. The errors quoted are purely statistical but include the rather important contribution due to the background subtraction.

Systematic errors might arise from geometrical or detection asymmetries of our system. To minimize their effects the positions of the two Λ -telescopes were interchanged systematically every few hours.

Moreover; overall symmetry tests have been performed before and after every polarization run using the reaction: γ + nucleus $\rightarrow$ p + π^- + nucleus. The π^- was detected by the magnetic spectrometer, and the proton by the L-telescopes. The asymmetries measured in this way were always compatible with zero.

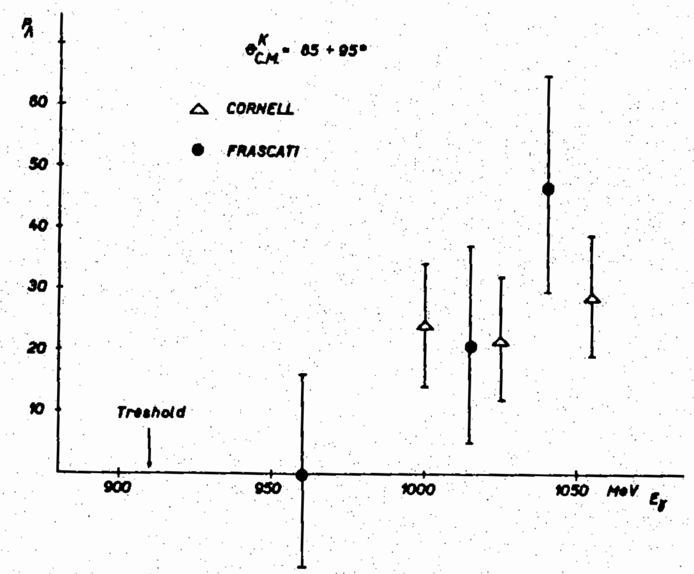

FIG. 4 - Plot of P_Λ (Λ -transverse polarization) vs E_γ. A positive value means that $\overline{P}_\Lambda$ is along $\overline{p}_\gamma \wedge \overline{p}_\Lambda$, where $\overline{p}_{\gamma(\Lambda)}$ is the γ(Λ) momentum in the Lab. system.

Fig. 4 displays the values of P_Λ obtained in the present work, togheter with those obtained by the Cornell group(2). The existence of a positive Λ polarization for $E_\gamma > 1000$ MeV appears well established; this indicates that partial waves other than S come into play above that energy, in agreement with the behaviour shown by the differential cross section. The sign of Λ polarization is in disagreement with the predictions of some simple theoretical models(3), which give a negative value of P_Λ .

(1) - J.W. Cronin and O.E. Overseth, Phys. Rev. 129, 1795 (1963).

(2) - B.D. McDaniel, Proceedings of the Cambridge Conference (January, 1963).

(3) - T.K. Kuo, Phys. Rev. 129, 2264 (1963); N.W. Beauchamp and W.G. Holladay, "A resonance model for γ + N = K^+ + Λ^0 (reprint).