the same order of magnitude as the weak interaction contribution to κ_μ calculated by Pietschmann and Segrè.[10] Clearly it will take some time before these contributions can be verified experimentally.

[10] H. Pietschmann (unpublished); G. Segrè, Phys. Letters **7**, 357 (1963).

ACKNOWLEDGMENTS

I wish to thank Professor A. Pais for suggesting this investigation and express my debt to Professor J. R. Oppenheimer for hospitality at the Institute for Advanced Study. I am grateful to Professor C. N. Yang for several conversations on the ξ-limiting formalism.

PHYSICAL REVIEW VOLUME 134, NUMBER 6B 22 JUNE 1964

K^-p Charge-Exchange Scattering at 1.80 GeV/c

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(Received 10 February 1964)

Measurements have been made of the differential and total K^-p charge-exchange cross section at 1.80 GeV/c. The total cross section found was 1.55±0.09 mb. Terms including $\cos^{10}\theta_{K^0K^-}$ were required in fitting the $\bar{K}^0$ angular distribution.

A STUDY has been made of the reaction

$$K^-+p\rightarrow\bar{K}^0+n \quad (1)$$

using film obtained from an exposure of the Lawrence Radiation Laboratory 72-in. hydrogen bubble chamber to a separated K^- beam. This beam had a central momentum of 1.80 GeV/c (2150 MeV total c.m. energy and 785 MeV/c c.m. K^- momentum) and a 6% momentum spread. The distribution of the $\bar{K}^0$ production angle in the center-of-mass system is strongly peaked forward. This contrasts with the pronounced backward peak observed[1,2] at lower momenta (760–1220 MeV/c). The result reported here continues the tendency first noticed at 1.53 GeV/c incident momentum,[2] for the backward peak to be replaced by a forward one.

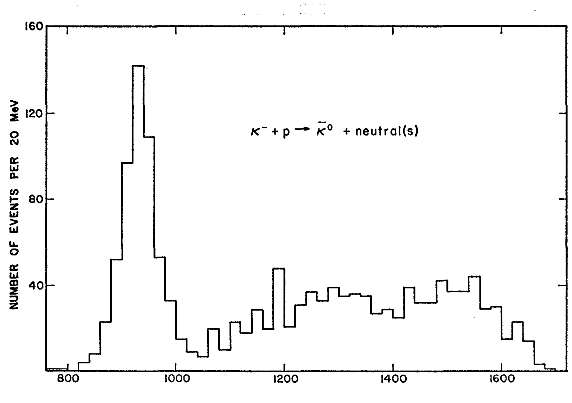

FIG. 1. Mass distribution of the neutrals in the reaction $K^-+p\rightarrow\bar{K}^0+$neutral(s) for incident K^- momentum 1.80 GeV/c (2150 MeV/c total c.m. energy). $K^-+p\rightarrow\bar{K}^0+n$ events are contained in the peak at the neutron mass.

The events appeared in the chamber as zero prong interactions accompanied by a decay V. A large fraction of the Λ hyperons produced in zero prong interactions was rejected on inspection of the ionization of the positive V track. For the measured events, the kinematical fits were usually adequate to identify the decaying particle as a Λ or a K_1^0. The particle was called a K_1^0 decaying *via* $K_1^0\rightarrow\pi^++\pi^-$ if the hypothesis fitted with a $\chi^2\leqslant 30.0$ (3 constraints); 2.5% of the sample remained ambiguous between Λ and K_1^0 on the basis of both kinematical fit and ionization.

Figure 1 shows the distribution of mass of the neutral particle(s) produced in addition to the $\bar{K}^0$. For 16 events (3.5% of the sample), the ambiguity between the $\bar{K}^0n$ final state and events in which additional pions were produced could not be resolved on the basis of the missing mass and its error.

To reduce scanning biases, only events with K^0 track length in space greater than 0.5 cm were allowed in the sample. A correction factor was later applied to each angular interval to compensate for the loss. The number of events in the sample was also corrected as follows: (a) +2.5% due to over-all scanning loss (the scanning efficiency was found to be independent of scattering angle); (b) +3.0% due to events which were unmeasurable; (c) +1.0% due to K_1^0's incorrectly identified as Λ's in the preliminary ionization study; (d) +3.0% due to ambiguous events discussed above.

The beam flux was determined by a count of the τ-like decays of K^- in the same sample of film. A branching

* Work supported in part by the U. S. Atomic Energy Commission.

[1] W. Graziano and S. G. Wojcicki, Phys. Rev. **124**, 1868 (1962).
[2] M. Ferro-Luzzi, F. T. Solmitz, and M. L. Stevenson, *Proceedings of the 1962 International Conference on High Energy Physics at CERN*, edited by J. Prentki (CERN, Geneva, 1962), p. 376.

TABLE I. Coefficients A_S of the $P_S(\cos\theta)$ expansion of the angular distribution for the reaction $K^-p \rightarrow \bar{K}^0 n$ at 1.80 GeV/c.

S	A_S
1	1.25±0.08
2	1.15±0.12
3	0.96±0.14
4	0.63±0.16
5	0.34±0.18
6	−0.44±0.19
7	−0.96±0.21
8	−0.14±0.22
9	−0.46±0.24
10	−0.65±0.25

fraction of 6.1±0.2% for three-prong decays was used.[3] When account is taken of the $\bar{K}^0 \rightarrow K_1^0 \rightarrow \pi^+ + \pi^-$ branching ratio[4] of $\frac{1}{3}$ the total cross section for reaction (1), $\sigma_{CE} = 1.55 \pm 0.09$ mb. The error includes the statistical uncertainty, the uncertainty in beam flux, the uncertainty in the correction for systematic errors and the uncertainty in matching samples of $\bar{K}^0 n$ and τ-like decays. Figure 2 shows this result along with charge-exchange cross-section determinations at other momenta.[1,2,5–9]

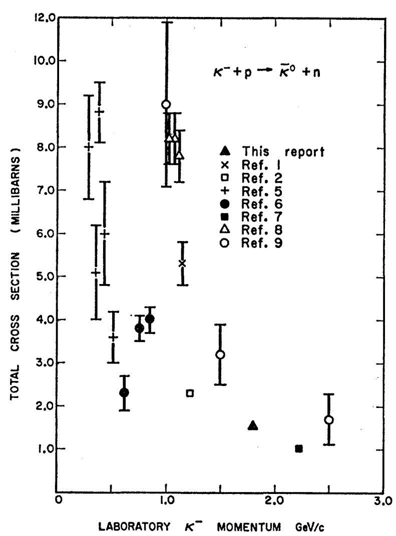

FIG. 2. Total $K^- + p \rightarrow \bar{K}^0 + n$ cross section as a function of momentum.

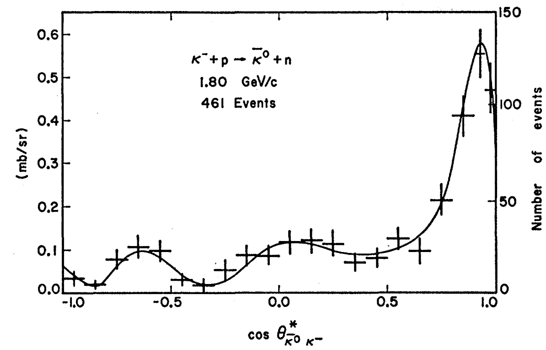

FIG. 3. Center-of-mass angular distribution of the reaction at 1.80 GeV/c. The curve is a fit to $P_{10}(\cos\theta)$.

The differential cross section is plotted in Fig. 3: the errors shown are the statistical errors only. The distribution was fitted by Legendre polynomials $P_S(\cos\theta)$ according to

$$4\pi(d\sigma/d\Omega) = \sigma_{CE}\{1 + \sum_{S=1} A_S P_S(\cos\theta_{\bar{K}^0 K^-})\}. \quad (2)$$

Table I shows A_S up to $S=10$. The coefficients were calculated by averaging the Legendre polynomials over the experimental distribution. The corresponding distribution function is shown in Fig. 3 and yields a χ^2 probability of 27%. When the expansion is carried to only $S=8$, the χ^2 probability reduces to 2%. Apparently the coefficient A_{10} differs significantly from zero, which implies the existence of outgoing partial waves with $L \geqslant 5$.

Charge exchange depends on the difference between the production amplitudes in the isotopic spin states $I=1$ and $I=0$. Therefore the understanding of the charge-exchange data requires a fairly detailed knowledge of the behavior of the two production amplitudes. This information is not yet available.[10] Events with $\bar{K}^0$'s going steeply forward have been especially examined to rule out the possibility of systematic scanning errors. No such biases could be detected and hence the forward dip in the differential cross section appears to be real. Its presence precludes the interpretation of the forward rise of the cross section in terms of a simple ρ exchange model.

The author wishes to thank Professor H. K. Ticho for his assistance and support. Thanks are also due to Dr. Richard C. Arnold, Dr. P. E. Schlein, Dr. W. E. Slater, and Dr. D. H. Stork for helpful discussions. In addition, the patient work of C. Olson and the scanning and measuring staff is gratefully acknowledged.

[3] W. H. Barkas and A. H. Rosenfeld, Lawrence Radiation Laboratory Report UCRL-8030 (unpublished).

[4] See M. Chretień, V. K. Fischer, H. R. Crouch, Jr., and R. E. Lamou, Jr., Phys. Rev. **131**, 2208 (1963). The results of various groups reported in their Table IV yield $B_K = 0.323 \pm 0.010$ when averaged. However, all the results in the table do not appear compatible with each other.

[5] P. L. Bastien *et al.*, in *Proceedings of the 1962 International Conference on High Energy Physics at CERN*, edited by J. Prentki (CERN, Geneva, 1962), p. 373.

[6] P. L. Bastien and J. P. Berge, Phys. Rev. Letters **10**, 188 (1963).

[7] L. Bertanza, V. Brisson, P. L. Connolly, E. L. Hart, *et al.*, in *Proceedings of the 1962 International Conference on High Energy Physics at CERN*, edited by J. Prentki (CERN, Geneva, 1962), p. 284. Preliminary results uncorrected for scanning biases.

[8] S. G. Wojcicki (private communication).

[9] V. Cook, B. Cork, T. F. Hoang, D. Keefe, L. T. Kerth, W. A. Wenzel, and T. F. Zipf, Phys. Rev. **123**, 320 (1961).

[10] *Note added in proof*. Data on K^-p elastic scattering at 2.0 BeV/c has been published recently by R. Crittenden, H. J. Martin, W. Kernan, L. Leipuner *et al.*, Phys. Rev. Letters **12**, 429 (1964).