THE CHARGE EXCHANGE $K^- + p \rightarrow K^0 + n$ AT 9.5 GeV *

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In this paper we present preliminary results from an experiment done with a large magnet spark chamber exposed to a high-energy negative particle beam from the CERN PS. The analysis has yielded so far results of charge exchange scattering of 9.6 GeV/c $K^-$ on a hydrogen target.

Fig. 1 shows a schematic drawing of the target, the anticoincidence system and the magnet spark chamber. A Pb-scintillator sandwich with counters $R_1, ..., R_5$ and $F_1, ..., F_3$ was used to select events in which no charged secondary or $\gamma$-ray was produced. $A_4$ and $S_5$ are the last counters of a beam telecope, containing further counters to define the shape of the beam and two threshold Čerenkov counters of the Vivargent-type [1] to select the $\pi^-, K^-$ and $\bar{p}$ in the beam. The magnet spark chamber has a useful volume of $60 \times 67 \times 170$ cm$^3$ in a field of 10.7 kg and con-

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tains 72 gaps. The radiation length in the cham-
ber is 30 metres. The typical momentum reso-
lution for tracks of 9.50 GeV/c, 160 cm length,
is \( \frac{\Delta p}{p} = 0.017 \).

The efficiency for seeing multiple sparks is better than 60% for 8 tracks. The beam had an average intensity of \( 1.2 \times 10^6 \) particles per burst and a \( \pi^- : K^- : \bar{p} \) ratio of \( 1 : 0.0053 : 0.0009 \); the momentum spread was \( \sim \pm 2\% \).

The results presented here are about 3/4 of the data taken in 3\( \frac{1}{2} \) days in February 1964.

Fig. 3 shows the mass distribution of \( K^0 \)'s from charge exchange. Events with apex in the gap between two units have been excluded.

The charge exchange events were identified by the following criteria: 1) the counter logic must indicate an incoming \( K^- \) and no outgoing charged particle or \( \pi^0 \); 2) the \( V^0 \) photographed in the magnet spark chamber must fit kinematically the decay of a \( K^0 \); 3) the momentum and scattering angle of the \( K^0 \) must fit kinematically the process \( K^- + p \rightarrow K^0 + n \).

Fig. 4 shows the mass distribution of the \( K^0 \) mesons selected as charge exchange. The width of \( \approx \pm 15 \text{ MeV/c}^2 \) in the mass distribution for particles of 9.5 GeV/c momentum.
gives an idea of the over-all precision in the analysis of events photographed in our chamber.

Eighty per cent of the charge exchange events are uniquely identified as $K^0_\pi$ mesons; 10% fit either $K^0_\Lambda$ or $\Lambda$; 10% fit either $K^0_\Sigma$ or $\Sigma$. In fitting an event to the process $K^- + p \rightarrow K^0 + n$ and in calculating the momentum transfer we have associated the momentum and direction of the observed $K^0$ with the mean momentum and direction of the beam. In Fig. 4 we give the distribution of the difference between the «measured» momentum of the $K^0$ (i. e. that derived from the momenta of the secondary particles) and its «computed» momentum (i. e. that derived from its direction of flight and the assumed process $K^- + p \rightarrow K^0 + n$).

For a determination of the charge exchange cross section we had to evaluate the following corrections:

The probability for a $K^0_\pi$ decay in our fiducial volume; absorption of the incident $K^-$ in the target; absorption of the $K^0$ in the target and in the anticoincidence system; the loss of events due to neutron detection in the anticoincidence counters; the loss of triggers due to chance anticoincidence; this loss, dependent on the beam intensity, was monitored electronically. Runs with the hydrogen target empty showed no charge exchange-like events, corresponding to a background of less than 3%.

We find for the total cross section for $K^-$ charge exchange

$$\sigma_{o.e.} = 76 \pm 11 \mu b$$

The detection efficiency is substantially constant up to the highest momentum transfer observed ($t = -2.3 \text{ GeV/c}^2$); at twice this momentum transfer the efficiency has fallen by less than a factor 2. Of course, we cannot exclude the unlikely occurrence of a backward peak which would affect the total cross section cited above. The error quoted includes 7% for statistical fluctuations; the remainder is due to the uncertainty in the applied corrections.

The differential cross section $d\sigma/dt$ is shown in Fig. 5. The error in $t$ is $\Delta t \sim 0.01$ at $t = -0.05$ and increases to $\Delta t \sim 0.06$ at $t = -1.0 \text{ (GeV/c)^2 units}$. For comparison we have drawn into the figure the fit to elastic $K^- p$ scattering given by Foley et al. [2] (note the change of scale). The $d\sigma/dt$ distribution for charge exchange is substantially less peaked than that for elastic scattering. The shape of the curve for low $t$-values is compatible with constant cross section for $0 \leq -t \leq 0.2(\text{GeV/c})^2$ but not compatible with an exponential fit in that region.

We also show the point at $t = 0$ derived, using the optical theorem, from results on total cross sections ($K^- p$ and $K^- n$) presented by T. F. Kycia [3] at this Conference.

REFERENCES