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THE K^-p CHARGE-EXCHANGE REACTION AT 2.45, 2.63, AND 2.70 GeV/c

Berkeley, California

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July 8, 1964

THE K^-p CHARGE-EXCHANGE REACTION AT 2.45, 2.63 AND 2.70 GeV/c*

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The charge-exchange reaction

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

has been studied at 2.4, 2.6, and 2.7 GeV/c incident K^- momentum in the 72-inch hydrogen bubble chamber, in a current experiment at the Bevatron. The angular distribution at all momenta shows a sharp forward peaking for the $\bar{K}^0$, the backward peaking observed at 1.22 GeV/c by Ferro-Luzzi et al. has completely disappeared.[1]

Of 7300 events having the V zero-prong topology 727 events fit reaction (1). All events have been fitted to Λ or K^0 for the neutral particle decaying in the V. The ambiguities have been solved on the basis of ionization of the positive track of the V; only in 4% of the events was this not possible, and for these events the hypothesis with the higher confidence level has been chosen. The angular distribution for these ambiguous events agreed with the rest of the data.

Figure 1 shows the missing-mass-squared distribution for the neutrals recoiling against the $\bar{K}^0$. The separation of reaction (1) from events with other neutrals is quite unambiguous (the events in Fig. 1 are not the complete sample).

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*Work done under the auspices of the U. S. Atomic Energy Commission.

To correct for scanning biases, we accepted only events with $\bar{K}^0$ length in the chamber greater than 0.4 cm. Afterwards, we applied event by event the corresponding correction, as well as the correction for escape of a $\bar{K}^0$ from the chamber. In the accepted fiducial volume, this correction factor had an average value $f_c = 1.03$, which did not vary appreciably with energy. Furthermore, we plotted the distribution of events for various orientations of the scattering plane, to check for possible biases in detecting events in which the scattering plane is nearly vertical. This distribution should be and is isotropic.

In order to evaluate the cross section, the beam flux has been determined by using the τ decay of the K^- as a normalization. A branching ratio for this decay mode of 5.5±0.1 has been used.[2] Corrections have been made for events that simulate a τ decay, bringing the branching ratio for τ-like events up to 5.9±0.2%. Since the statistics for the 2.63-GeV/c data is very poor, we did not attempt to evaluate the cross section.

The number of events has been corrected for scanning efficiency and for failing events not yet remeasured. The overall error has been increased 5% to account for errors in these corrections not yet well determined at this stage of the experiment. Furthermore, a correction of 2/0.69 has been applied to account for the branching ratio of $K^0 \rightarrow K_1^0 \rightarrow \pi^+\pi^-$.[2] Table I summarizes the results.

The cross sections at these momenta seem to be quite low, but this is expected from the behavior of σ at lower momenta.[3] Figure 2 is a plot of the cross section for K^-p charge exchange from 300 MeV/c up to 2.70 GeV/c.

The differential cross sections in microbarns per steradian are reported in Fig. 3, (a) and (c) for the 2.45- and 2.7-GeV/c data; the 2.63 GeV/c distribution is plotted in Fig. 3(b) expressed in number of events. The quoted errors are statistical. At 2.45 GeV/c the distribution shows a dip in the forward direction similar to the one observed at 1.8 GeV/c by Dauber.[3] It looks statistically significant, and we cannot think of any energy-dependent bias in our data which may produce it; furthermore it does not show at the other momenta where the data have been treated in the same way.

The distributions have been fitted by Legendre polynomials $P_n(\cos\theta)$ according to the expansion

$$\frac{d\sigma}{d\Omega} = \frac{\lambda^2}{4} \Sigma B_n P_n(\cos\theta).$$

For the 2.45-GeV/c data we cannot reproduce the dip in the forward direction and the absence of events in the backward direction with any order fit up to $n = 15$. The best fit is obtained for a polynomial series up to $n = 5$, but does not show the dip in the forward direction; its confidence level is 9%. This fit is drawn on the corresponding distribution in Fig. 3a. For the 2.63-GeV/c data the best fit was obtained for $n = 5$, with a confidence level of 67%. A sixth-order fit was necessary and sufficient to fit the 2.7-GeV/c data. Table II shows the coefficients B_n obtained at 2.45 and 2.7 GeV/c. The quoted errors are only statistical. The order of the fits is surprisingly low. In fact, at 1.8 GeV/c, Dauber has detected the presence of partial waves with $L \geq 5$, since the coefficient A_{10} for the 1.8-GeV/c distribution was sensibly different from zero.

The presence of the dip in the forward direction at 2.45 GeV/c precludes interpretation of the data in terms of a simple ρ-exchange model. Ahmadzadeh has succeeded in fitting the sharp forward peak in np charge-exchange in terms

of the ρ-meson Regge trajectory and the R trajectory.[4] An attempt to fit the K-p charge-exchange with the same model is in progress in collaboration with W. Rarita.

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FIGURE LEGENDS

Fig. 1. Missing-mass-squared distribution for the neutrals recoiling against the K^0.

Fig. 2. Cross section for K^-p charge exchange for incident K^- momentum ≥ 300 MeV/c.

Fig. 3. Angular distribution for the charge-exchange reaction at (a) 2.45, (b) 2.63, and (c) 2.7 GeV/c. The number of events in each distribution is in parenthesis. The solid lines represent the best fit obtained for a Legendre polynomial expansion of the distribution. The order of the fit is also reported, with its confidence level.

Table I. Cross sections

P_K (GeV/c)	Number of visible events	Corrected number of events	σ (μb)
2.45	338±19	1025±108	520±70
2.63	86±9	137±22	
2.70	275±17	910±100	300±40

Table II. Coefficients B_n of the $P_n(\cos\theta)$ expansion of the angular distribution at various momenta

Coefficients	2.45-GeV/c*	2.7-GeV/c†
B_0	2.44±0.15	1.56±0.10
B_1	4.48±0.33	3.10±0.22
B_2	3.51±0.45	3.10±0.30
B_3	3.34±0.60	2.73±0.35
B_4	2.20±0.55	2.64±0.35
B_5	1.30±0.86	1.55±0.35
B_6		0.71±0.28

*Confidence level is 9%.

†Confidence level is 65%.

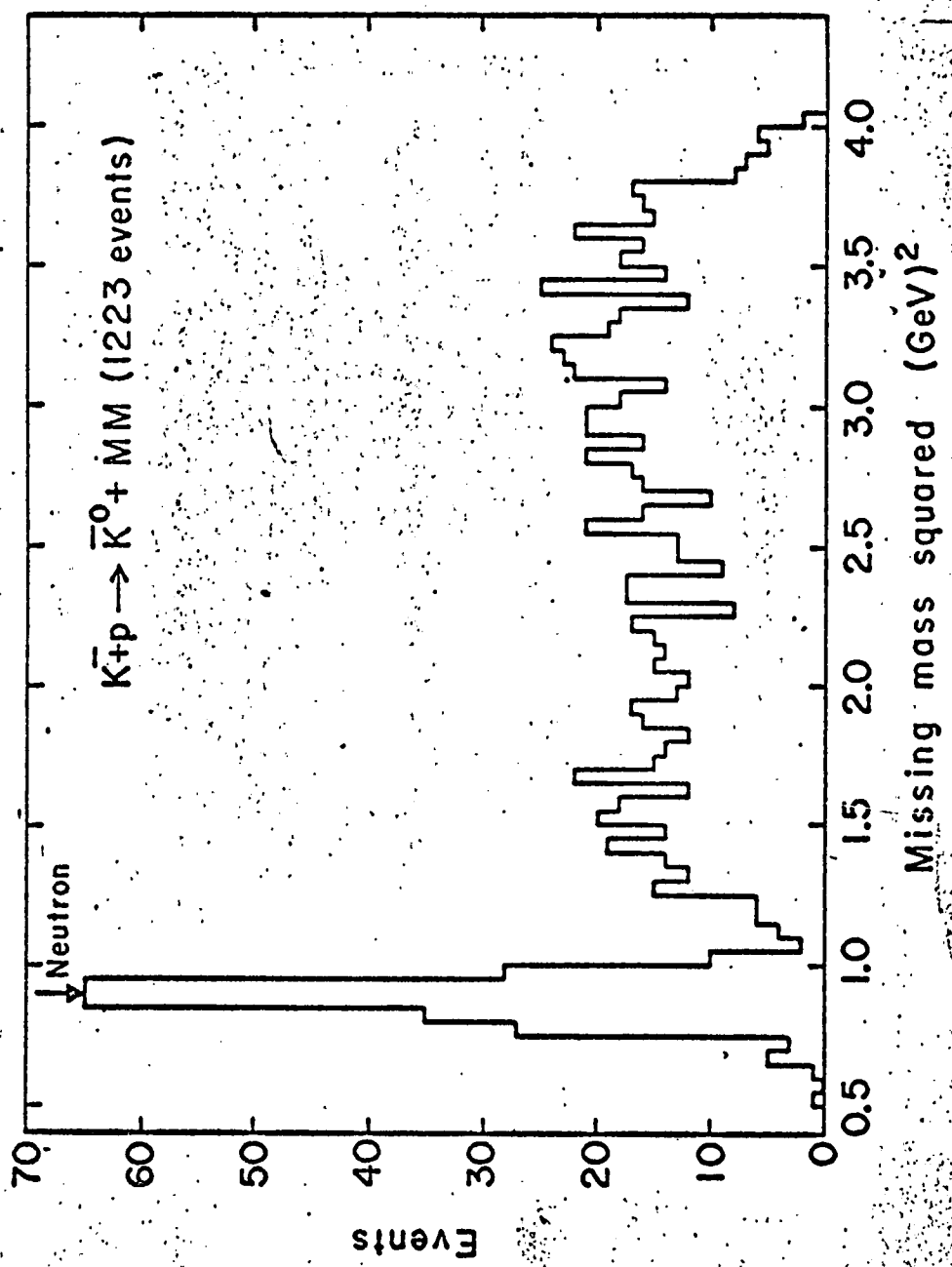

Fig. 1

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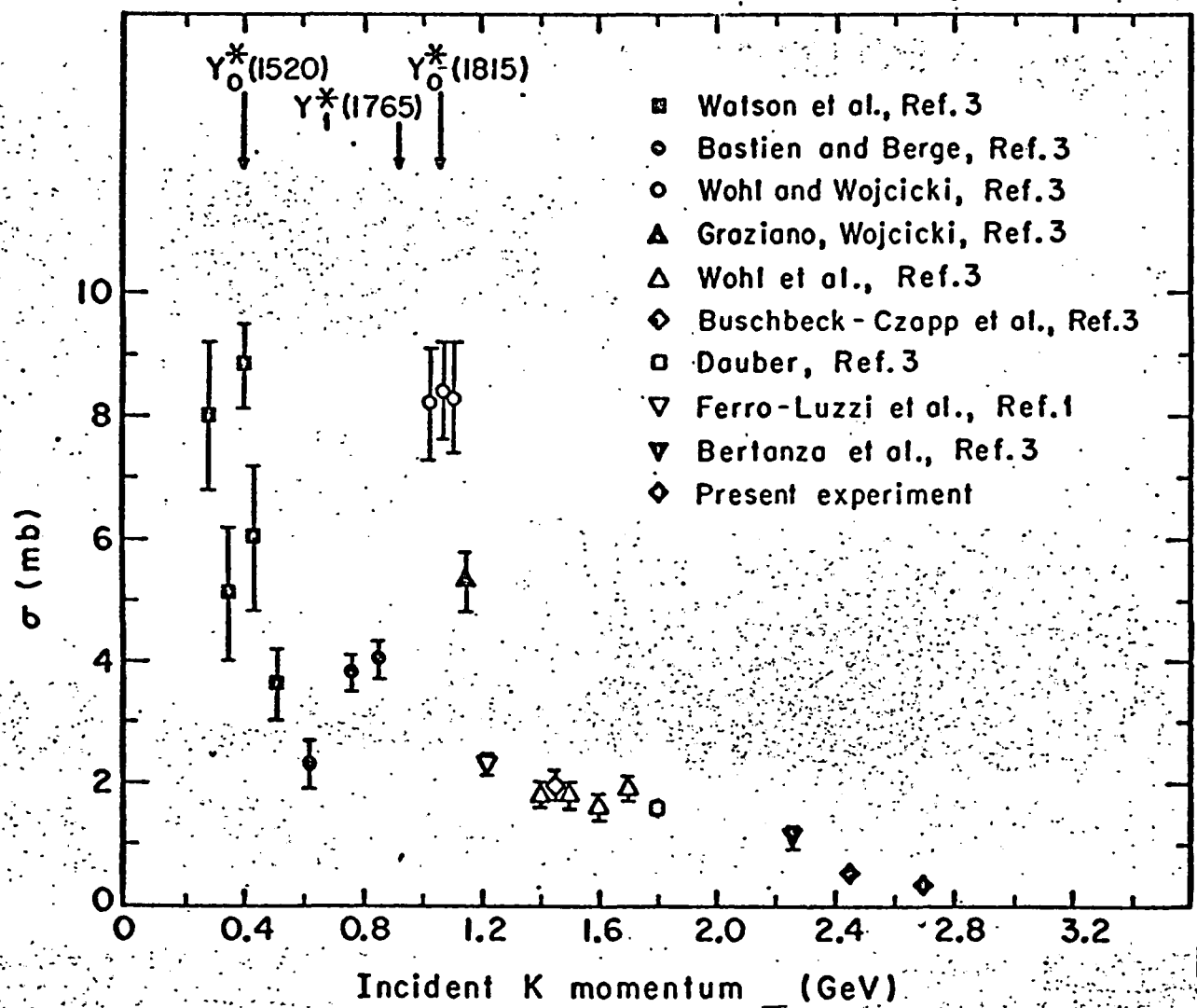

Fig. 2

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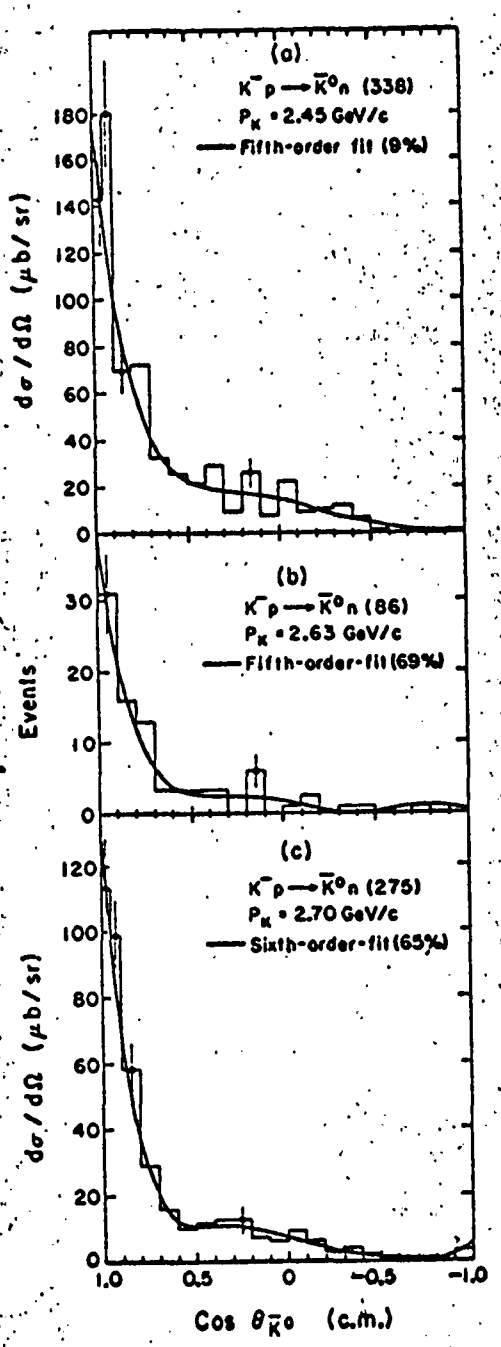

Fig. 3 MUB-3445

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