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NEW RESULTS ON KAON-PROTON ELASTIC SCATTERING
AT LARGE MOMENTUM TRANSFERS

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ABSTRACT

Measurements of the K^-p and K^+p elastic differential cross-sections at 20 and 50 GeV/c, respectively, have been made in the momentum transfer range $0.7 < |t| < 8.0$ GeV/c.

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We report measurements of large momentum transfer elastic scattering differential cross-sections for K^-p at 20 GeV/c and K^+p at 50 GeV/c.

The data presented in this paper were obtained concurrently with the πp data of [1]. The apparatus, shown schematically in Fig. 1, was described in that publication, so that only details specific to the measurement of the Kp cross-sections are included here. At 20 GeV/c the unseparated negative beam contained 3% K^- , and at 50 GeV/c the positive beam contained 5% K^+ . In both cases the incident kaons were identified by a differential Cerenkov counter (Cedar).

The event reconstruction procedure was identical to that used for πp scattering and is described in [1]. The event selection criteria were also similar, but with the constraint that the information from the two atmospheric pressure Cerenkov counters (C1, C2) in the fast arm had to be compatible with the passage of a kaon. At 20 GeV/c the first Cerenkov counter, C1, was filled with a 80% nitrogen, 20% helium mixture to give pion, kaon and antiproton thresholds of 6.65, 23.5 and 44.7 GeV/c respectively, and the second, C2, with a 55% carbon dioxide, 45% freon mixture to give corresponding thresholds of 3.75, 13.3 and 25.3 GeV/c. The additional requirements that only one beam track be reconstructed in the beam hodoscope and that there be no signal from a beam threshold Cerenkov counter, filled with Neon at atmospheric pressure to give pion and kaon thresholds of 12.8 and 45.8 GeV, respectively, limited the maximum contamination of the K^-p data in any $|t|$ bin to 0.3%, taking account of the measured detector efficiencies. At 50 GeV/c the fast arm Cerenkov counters were both filled with a 46% helium, 54% nitrogen mixture, in order to optimize the meson (π, k): proton separation, giving pion, kaon and proton thresholds of 7.8, 27.6 and 52.4 GeV/c respectively. Kaon and pion events were separated using the signal from the Cedar counter in the beam, set to identify kaons. There was a small contamination of pion events in the kaon event sample, due to the arrival of a kaon and a pion in the beam, within the time resolution of the trigger electronics. The K^+p cross-section has been corrected to compensate for this effect.

The data have been corrected for the angular dependent efficiencies of the Cerenkov counters and MWPC track reconstruction. Corrections, at each energy separately, have been applied for detector efficiencies, target absorption, muon beam component, and random and δ -ray vetoes.

The K^-p elastic differential cross-section at 20 GeV/c, shown in Fig. 2, includes data taken during the first phase of this experiment [2] for $|t| > 7$ (GeV/c)². It is clear that a dramatic change of slope occurs in the region of $|t| = 3$ (GeV/c)². For $1.0 < |t| < 2.5$ (GeV/c)² the K^-p and π^-p cross-sections, shown in Fig. 3, are observed to be identical, although the difference in total cross-sections, 21.4 and 25.4 mb, respectively, indicates that this is not a simple manifestation of geometrical scaling.

The K^+p elastic scattering data at 50 GeV/c, shown in Fig. 4, has an exponential slope to $|t| = 3.6$ (GeV/c)², followed by a narrow dip and a change of slope. There is a remarkable similarity between the K^+p data and the π^+p cross-section at 50 GeV/c reported in [1], although once again the total cross-sections differ, being 18.2 and 23.3 mb respectively.

The existence of data for both π^+p and K^+p elastic scattering at 50 GeV/c allows a stringent test to be made of the generalized geometrical scaling of Barger, Luthe and Phillips [3], which tries to relate the differential cross-sections of channels with different σ_{el}/σ_T . Fig. 5a shows that the rescaling of the eikonal from pp elastic scattering at 1496 GeV/c gives an excellent description of the K^+p data. However the same method applied to π^+p scattering at 50 GeV/c, Fig. 5b, does not agree nearly so well, predicting a dip in the differential cross-section at $|t| = 3.2$ (GeV/c)² instead of the observed value of $-t = 3.8$ (GeV/c)². The fact that not one of the four rescaling prescriptions given in [3] is adequate to describe both the π^+p and the K^+p data clearly casts doubt upon the suggested generalizations of geometrical scaling.

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FIGURE CAPTIONS

- Fig. 1 The experimental apparatus.
- Fig. 2 K^-p elastic scattering at 20 GeV/c. The data for $|t| > 7$ GeV/c² is from the first phase of this experiment [2].
- Fig. 3 The forward K^-p elastic scattering cross section at 20 GeV/c compared with the π^-p cross section at the same incident momentum.
- Fig. 4 K^+p elastic scattering at 50 GeV/c. The solid line is the smoothed 50 GeV/c π^+p data of [1].
- Fig. 5a K^+p elastic scattering at 50 GeV/c. The solid line indicates the predicted differential cross-section of [3] from eikonal rescaling of pp elastic scattering data at 1496 GeV/c.
- Fig. 5b π^+ elastic scattering at 50 GeV/c. The solid line is the predicted differential cross-section of Ref. [3] from eikonal rescaling of pp elastic scattering data at 1496 GeV/c.

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5a

Fig. 5b