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MASTER

BACKWARD ELASTIC K^-p SCATTERING BELOW 1 Gev/c

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DISCLAIMER

Abstract

A high precision measurement of the momentum dependence of backward K^-p elastic scattering from 476 to 1077 MeV/c incident momentum has been performed at the Brookhaven National Laboratory Alternating Gradient Synchrotron. With the same apparatus we have also measured the 0° production of pions in the reaction $K^-p \to \Sigma^-\pi^+$ and K^+p backward elastic scattering. Preliminary cross sections are presented for K^-p backward elastic scattering and 0° $\Sigma^-\pi^+$ production.

Since January 1978 I have been involved with a group of physicists from Lawrence Berkeley Laboratory (LBL) and Brookhaven National Laboratory (BNL) performing a series of experiments at the BNL Alternating Gradient Synchrotron (AGS) to study kaon nucleon scattering below 1.1 GeV/c. To date we have completed a measurement of the K^-p backward elastic differential cross section, a measurement of the differential cross section $K^-p \to \Sigma^-\pi^+$ with the π^+ emerging at 0° and a measurement of the K^+p backward elastic differential cross section in the momentum interval 476 to 1077. In addition to the study of these reactions, which were discussed in my original Department of Energy Proposal, we are also able, using essentially the same equipment, to measure the $\bar{p}p$ backward elastic cross section in the vicinity of the S meson and the reported 2020 resonance.[1,2] Finally, in January, we plan to repeat an experiment in which we measured the $\bar{p}p$ charge exchange total cross section,[3] this time with a shorter target for better energy resolution again in the vicinity of the S meson and the 2020 resonance. With this new data we hope to study the S meson, perhaps establishing its parity, and confirm the 2020.

A discussion of the importance of the K^-p elastic scattering and the 0° $\Sigma^-\pi^+$ production differential cross sections is given, along with preliminary experimental results, in an LBL report in Appendix A. Final corrections to the $\Sigma^-\pi^+$ cross sections are being applied to the preliminary data using a Monte Carlo program developed at Mount Holyoke by myself and a Berkeley graduate student Bob Hamilton early in November 1978 using the newly acquired remote job entry terminal supported by DOE. Final data analysis remains to be done on the K^+p backward elastic cross sections

but very preliminary results indicate that the cross sections are structureless as predicted by the quark model. The data from the $\bar{p}p$ reactions has not yet been obtained and programs to optimize the design of the experiment as well as analyze the data are currently being developed at Mount Holyoke and at Berkeley.

I have worked on these experiments both at Mount Holyoke and at BNL full time from January 1 1978 until September 1, 1978 and part-time thereafter. From January 1 until May 31, I have been on sabbatical leave from Mount Holyoke. From June 1 until August 31 I have received summer salary support from DOE. During the fall I have spent about two weeks at BNL taking data. In December I expect to be at BNL setting up the $\bar{p}p$ total and charge exchange total cross section experiment and taking data in January 1979. Other work, such as program development, has been going on at Mount Holyoke College during the fall 1978.

References

1. A.S. Carroll et al., Phys. Rev. Lett. 32, 247 (1974).
2. C. Evangelista et al., Phys. Lett. 72B, 139 (1977).
3. M. Alston-Garnjost et al., Phys. Rev. Lett. 35, 1685 (1975).

APPENDIX A

BACKWARD K^-p ELASTIC SCATTERING AND 0° $\Sigma^-\pi^+$ PRODUCTION

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INTRODUCTION

The forward and backward angular distributions decomposed into partial waves are particularly simple since the Legendre polynomials are either ±1, and the spin-flip amplitude is absent. The forward elastic cross section is well determined through the total cross section using the optical theorem and dispersion relations.[1] The backward elastic cross section has been found by bubble chamber experiments[2] to quite small, generally an order of magnitude smaller than the forward cross section. This is easily understood; the many absorption channels present make the amplitudes largely imaginary so that even and odd parity states cancel in their contributions to backward scattering. For this reason a small resonant amplitude will be expected to reveal itself most prominently in the backward direction. If a resonance has too small an elasticity to be seen in the elastic channel, but has a large branching fraction into $\Sigma\pi$ then it should be observed at 0° in this reaction.

METHOD

The apparatus to measure the momentum spectra of particles at 0° is shown in Fig. 1. The K^- beam is focused on an 8" liquid hydrogen target, with suitable counters in front of the target to define the beam and identify

METHOD (continued)

those particles which are K mesons. Immediately following the target is a bending magnet whose purpose is to sweep away the unscattered beam and most of the unwanted particles at 0°. This is immediately followed by a pair of quadrupoles capable of capturing approximately 10 msr. of solid angle in the forward direction and another bending magnet to yield a high dispersion at the image of the target 2 meters beyond the magnet. A thin counter (P) directly in front of the first quadrupole defines the solid angle acceptance and a counter hodoscope (H) at the focus counts the desired particles and measures the spectrum of particles of nearby momenta. Time-of-flight between the beam counter (M) and the timing counter (T) 8 meters from the target serve to further define the particles of interest.

Runs were made at all momenta with the target full and empty and a subtraction performed. A small background from other reactions was also subtracted.

RESULTS

Figures 2 and 3 show preliminary results for both reactions together with the predictions of two recent phase shift analyses.[3] In both reactions the results agree well with the predictions. We find no evidence for the narrow structures between 500 and 600 MeV/c reported by Carroll et al.[4]

REFERENCES

1. P. Baillon et al., Phys. Lett. 50B, 377 (1974) and Nucl. Phys. B105, 365 (1976) and B107, 189 (1976).

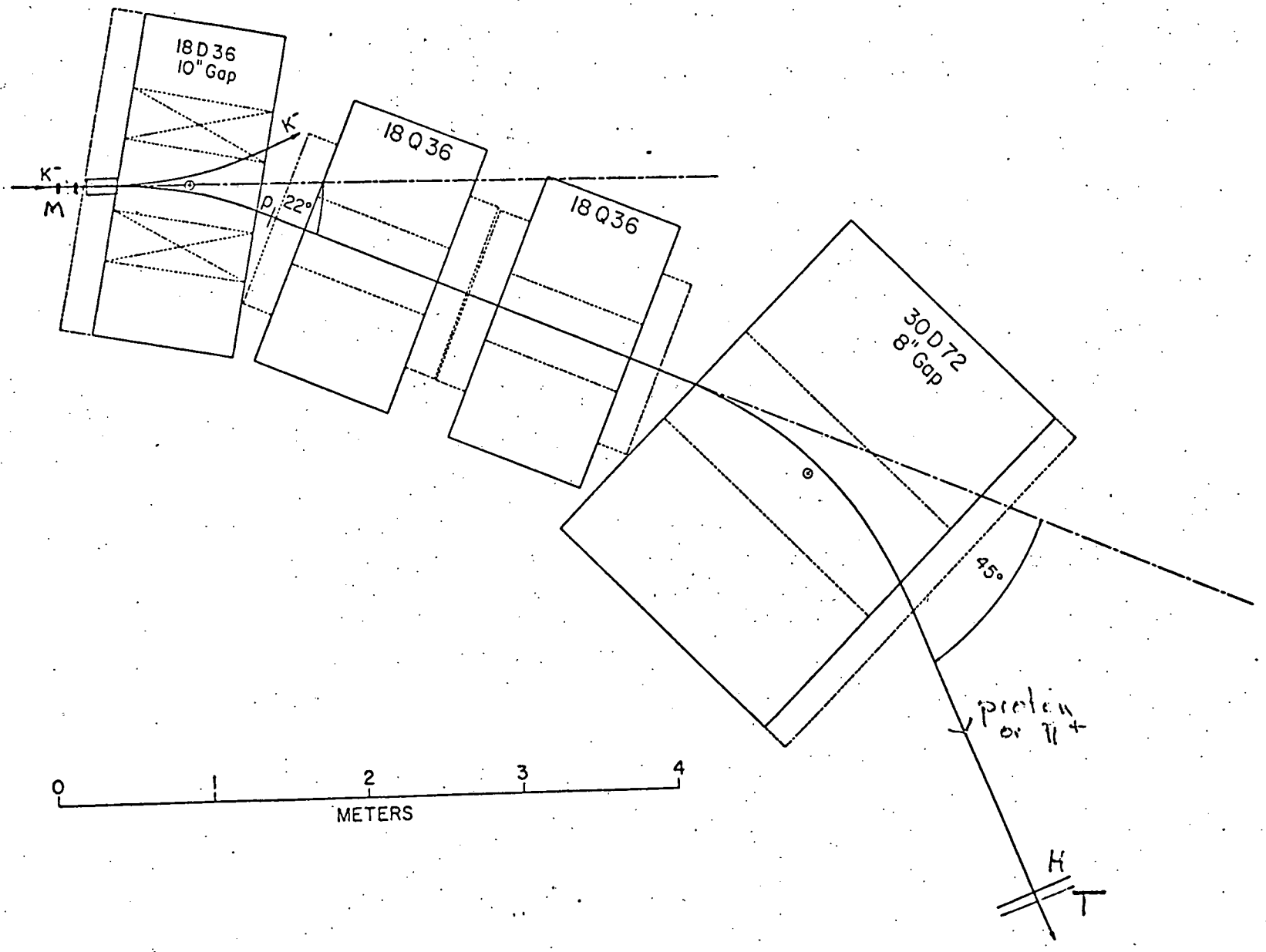
2. R. Armenteros et al., Nucl. Phys. B21, 15 (1970), B. Conforto et al., Nucl. Phys. B34, 41 (1971), B. Conforto et al., Nucl. Phys. B105, 189 (1976).

3. G.P. Gobal et al., Nucl. Phys. B119, 262 (1977), M. Alston-Garnjost et al., Phys. Rev. D (in press).

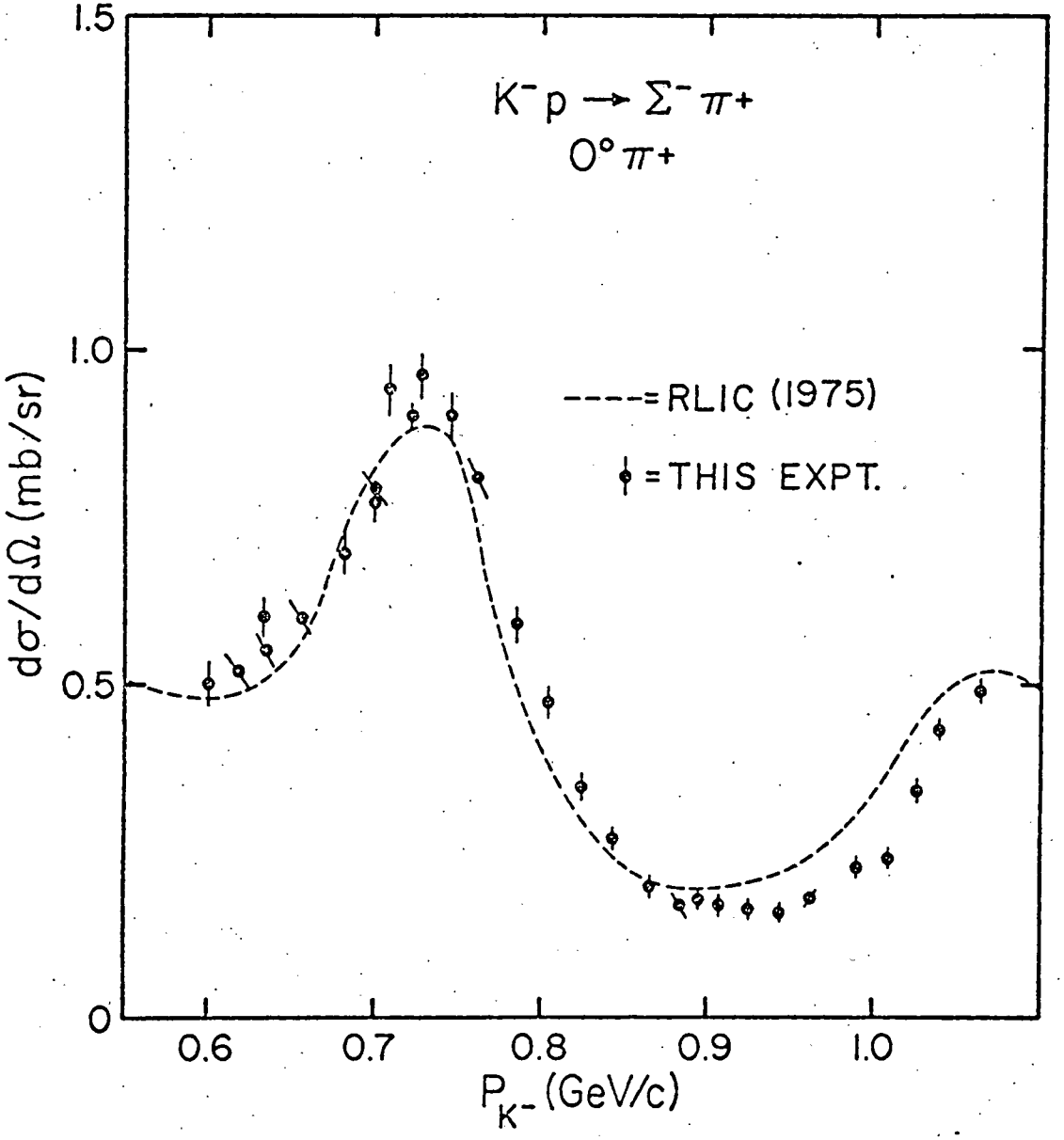
4. A.S. Carroll et al., Phys. Rev. Lett. 37, 806 (1976).

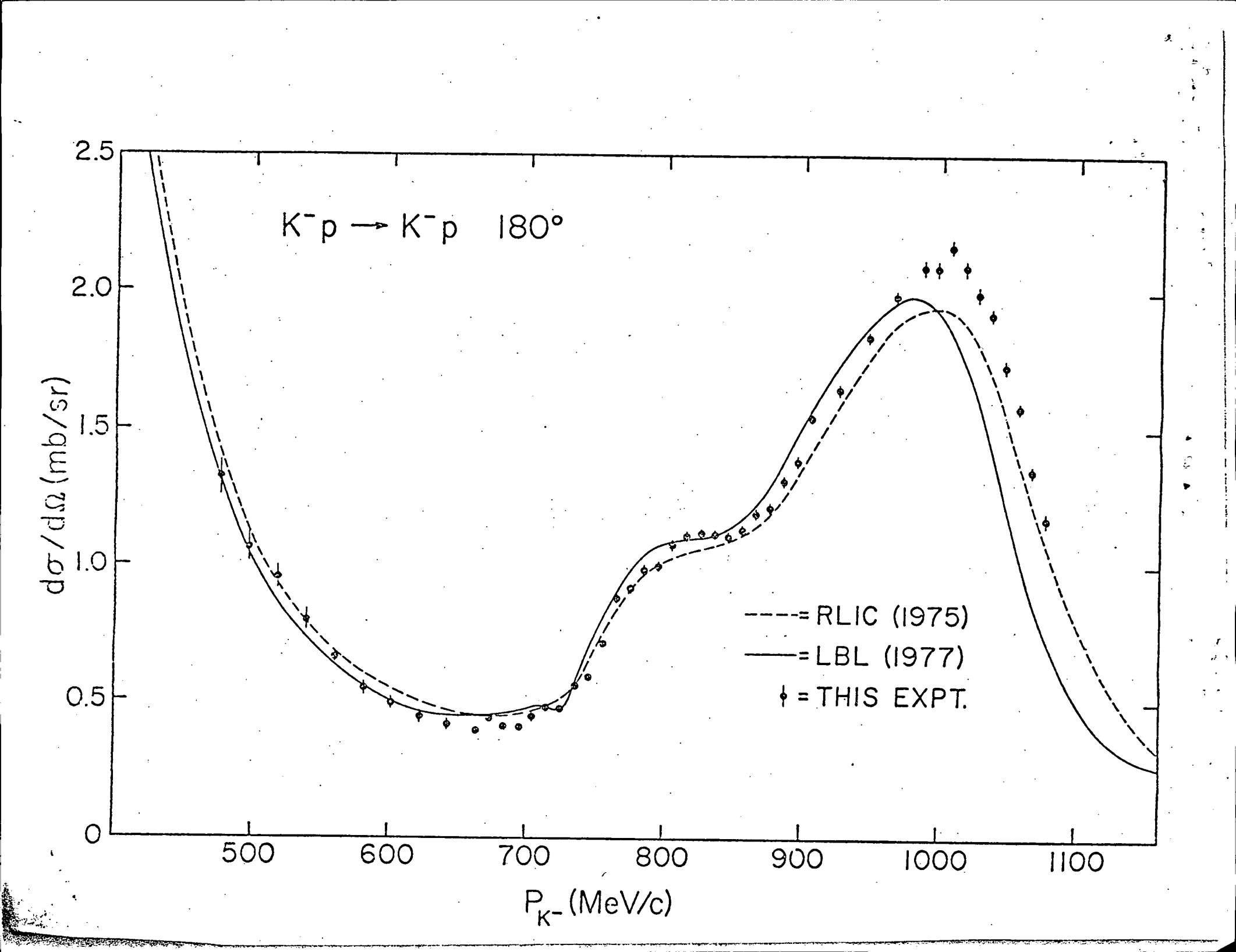
FIGURE CAPTIONS

1. Experimental Apparatus
2. Differential Cross-section for $K^-p \to K^-p$ at 180°
3. Differential Cross-section for $K^-p \to \Sigma^-\pi^+$ at 0°


18D36
10" Gap
18Q36
18Q36
30D72
8" Gap
K⁻
K⁻
M
p, 22°
45°
proton
or π+
H
0
1
2
3
4
METERS

XBL 764-1038


$K^- p \rightarrow \Sigma^- \pi^+$
$0° \pi^+$
----= RLIC (1975)
= THIS EXPT.
$d\sigma/d\Omega$ (mb/sr)
1.5
1.0
0.5
0
0.6
0.7
0.8
0.9
1.0
P_{K^-} (GeV/c)


$K^-p \rightarrow K^-p$ 180°
$d\sigma/d\Omega$ (mb/sr)
P_{K^-} (MeV/c)
2.5
2.0
1.5
1.0
0.5
0
500
600
700
800
900
1000
1100
----= RLIC (1975)
——= LBL (1977)
= THIS EXPT.