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PHYSICS I

ELECTRONICS EXPERIMENTS COMMITTEE

Letter of Intention

STUDY CT (PRIMARILY) TWO-BODY PROCESSES AT ~10 GeV WITH INCIDENT $\pi^{\pm}$, $K^{\pm}$ AND $p^{\pm}$ ON PROTONS

by

C.J.S. Damerell, R.J. Homer and T. Tso,
Rutherford High Energy Laboratory.
V. Gracco, Genova.
P.J. Carlson, E. Johansson, Stockholm.
A. Eide, A. Lundby, P. Staurset, CERN.

In previous experiments it was shown that comparisons of accurate measurements in the same geometry of coplanar processes with incident positive and negative particles are particularly useful in helping to clarify our present picture of strong interactions[1,1a] (see also enclosed figures). These experiments also collected data on non-coplanar processes, which only in one case ($\pi^+ p \to p\rho^+$ at 5.2 GeV/c [2]) could be extracted from the background due to the limited momentum resolution.

We propose a geometry (fig. 1) in which, besides the coplanar processes, reactions like :

$\pi^+ p \to K^+ \Sigma^+$ A) $\qquad$ $K^- p \to \pi^- \Sigma^+$ B)

$\pi^+ p \to p\rho^+$ C) $\qquad$ $\bar{p}p \to \pi^- \rho^+$ D)

$K^+ p \to pK^{+*}$ E) $\qquad$ $\bar{p}p \to \bar{K}K^{+*}$ F)

etc.

would be resolved and measured over practically the complete angular range. The reactions B), D) and F), which will be studied in the negative beam, are obtained by line-reversal of the preceding reactions A), B) and C), to be studied in the positive beam.

Comparing such reactions, and studying for example the differences of differential cross-sections for the same reactions with incident particles and antiparticles (e.g. $X^{\pm} p \to X^{\pm *} p$), we have a better chance of being free of important systematic errors than when data are derived from different experiments. This applies also to the polarization information which we get from the decay distributions of the unstable particles in the final state.

10 GeV/c is at the moment the maximum momentum for which a beam of adequate intensity (with either polarity) can be obtained.

Currently existing data on reactions A) and B) are not sufficiently accurate to check the proposed theoretical models [3]. One is in needs of directly comparable data of good accuracy for these reactions.

The backward region for reactions A) and B) involve respectively hyperon and Δ exchange. Existing data is poor and there is considerable theoretical interest (because, for example, of the anomalously low backward cross-section for $\pi^- p \to p\pi^-$, also Δ exchange).

We shall also obtain accurate data on the elastic scattering processes and so, should be in a good position to observe possible structure in wide angle differential cross-sections.

The apparatus includes a large spectrometer magnet (fig. 1) from the Rutherford High Energy Laboratory. The spark chambers inside this magnet, and also those in the forward C-magnets, are provided with capacitive read-out. We will increase the space resolution in some of the chambers by using 0.5 mm wire spacings. Notice that the capacitive read-out requires $\leq$ 0,1 current in the spark compared to the core read-out. We therefore get much less problems with memory in the chambers when working with short dead-times ($\lesssim$ 5msec). We have in previous experiments successfully used 2000 wires with capacitive read-out inside the C-magnets.

The incident beam is defined by fast scintillation hodoscopes (as before) and no active spark chamber is in the beam. The

experiment will be run at an incident flux > 10^6 particles/ burst and will use a 1 m liquid H_2 target (fig. 1).

In order to give an idea of the results to be expected, we enclose some data from a previous experiment[1]. For the same running time we hope to increase the statistics by a factor of 10 away from the forward direction by operation at a higher incident intensity and using shorter event dead-time.

We could do this experiment in the d_{30} beam in the South Hall of CPS, or even better in a new beam in the West Area looking at the same target as the Ω-facility. We could also go back to the p_5-beam in the East Area. We would be ready to install the equipment in the Summer of 1972.

To summarize :

1) We would attempt to work at $\gtrsim$ 10 GeV/c with the maximum intensity available in the beams.
2) We would record coplanar events, $K^{\pm}p \to K^{\pm}p$, $\bar{p}p \to \bar{p}p$, $\bar{p}p \to \pi^+\pi^-$ or K^+K^- ; and $\pi^{\pm}p \to \pi^{\pm}p$, $pp \to pp$ at large momentum transfers.
3) We would emphasize the study of the line-reversed reactions mentioned above, comparing differential cross-sections and polarizations.
4) We may have to, as before, set up a priority among the different triggering modes so as to favour the channels of most interest (mainly suppressing forward scattering).
5) Most of the final data analysis will be done outside CERN.

AL/ea

1. P. Baglin et al. CERN-ORSAY-PARIS-STOCKHOLM Collaboration. To appear in Physics Letters.

1a. M.Ross, F.S. Henyey, G.L. Kane. Nuclear Physics B23, 269 (1970).
H. Harari. SLAC-PUB-821.
M. Davier and H. Harari. Preprint.
R. Phillips. Private Communication.

2. P.J. Carlson et al. Physics Letters 33B, 502 (1970).

3. See for example D.P. Roy, J. Kwiecinski, B.R. Desay, F. Zachariasen CERN TH 1287 (1971)..

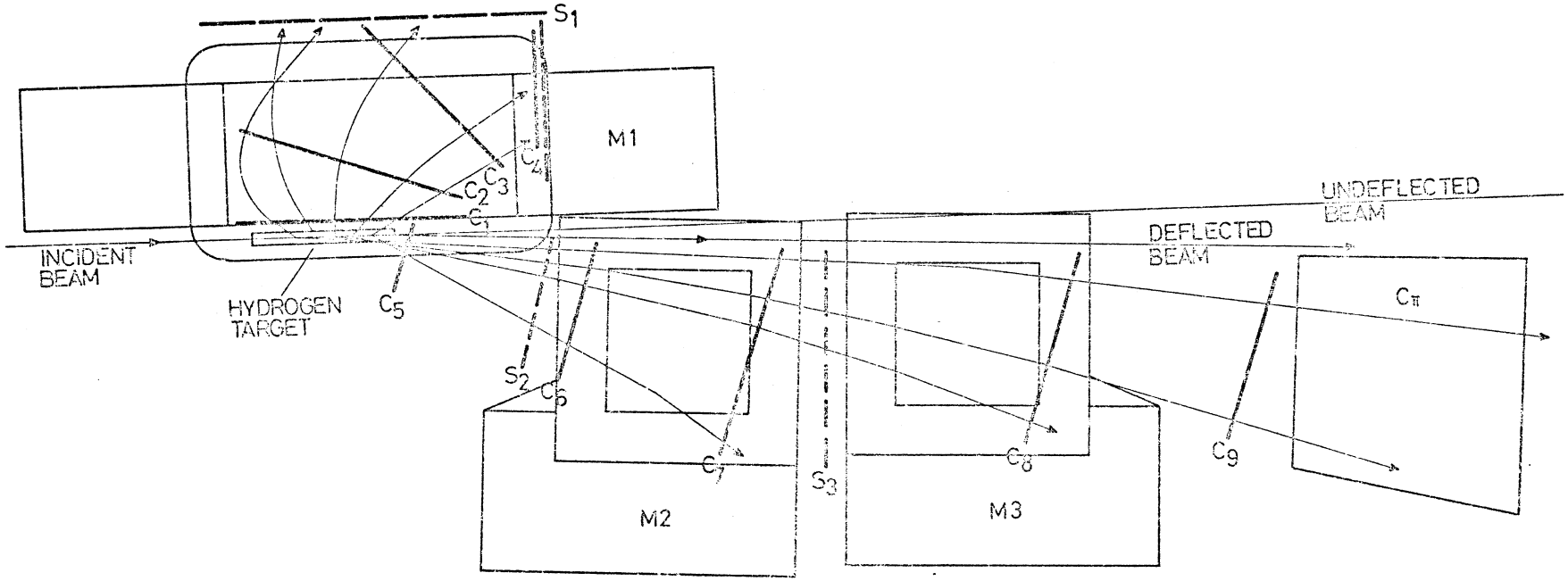
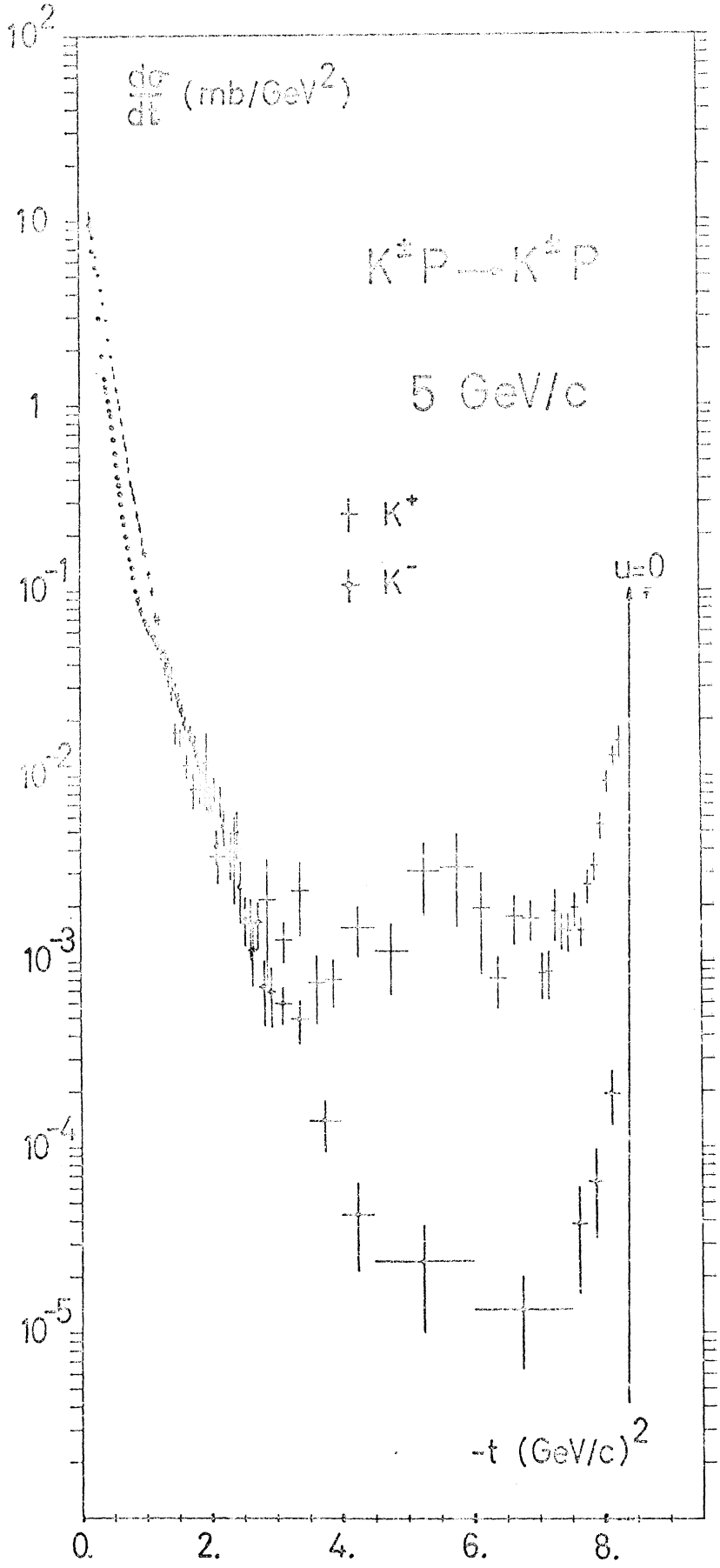
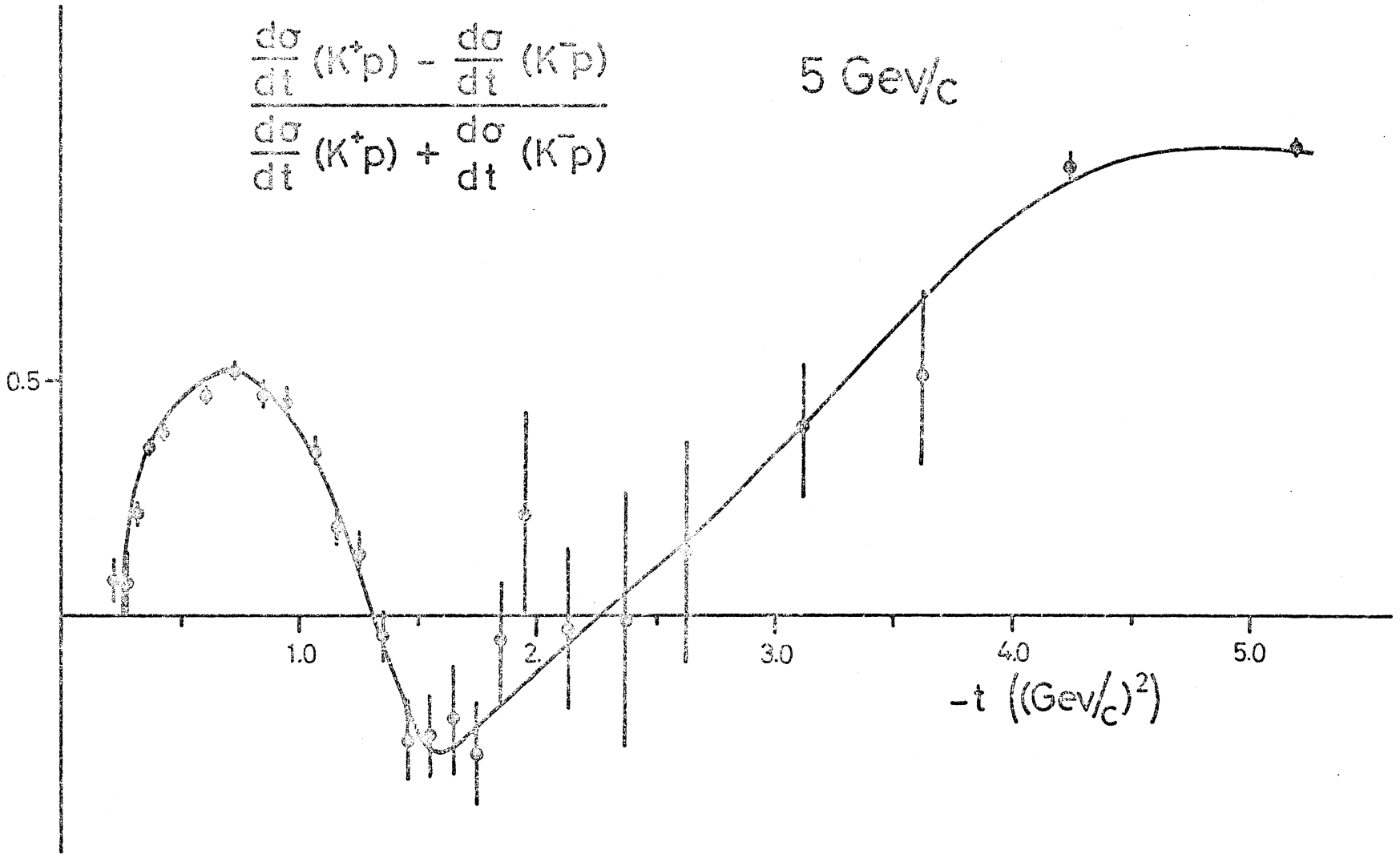
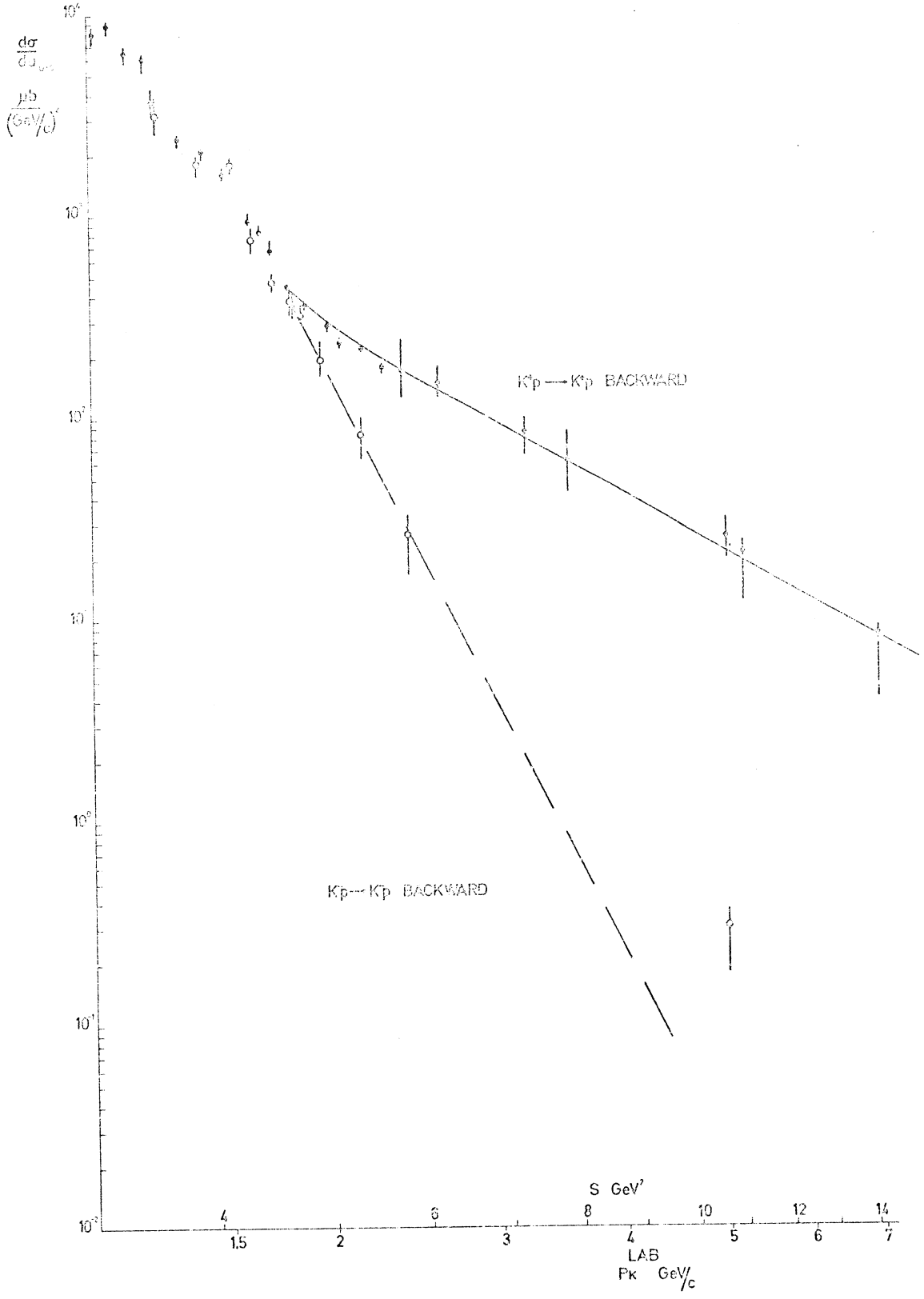
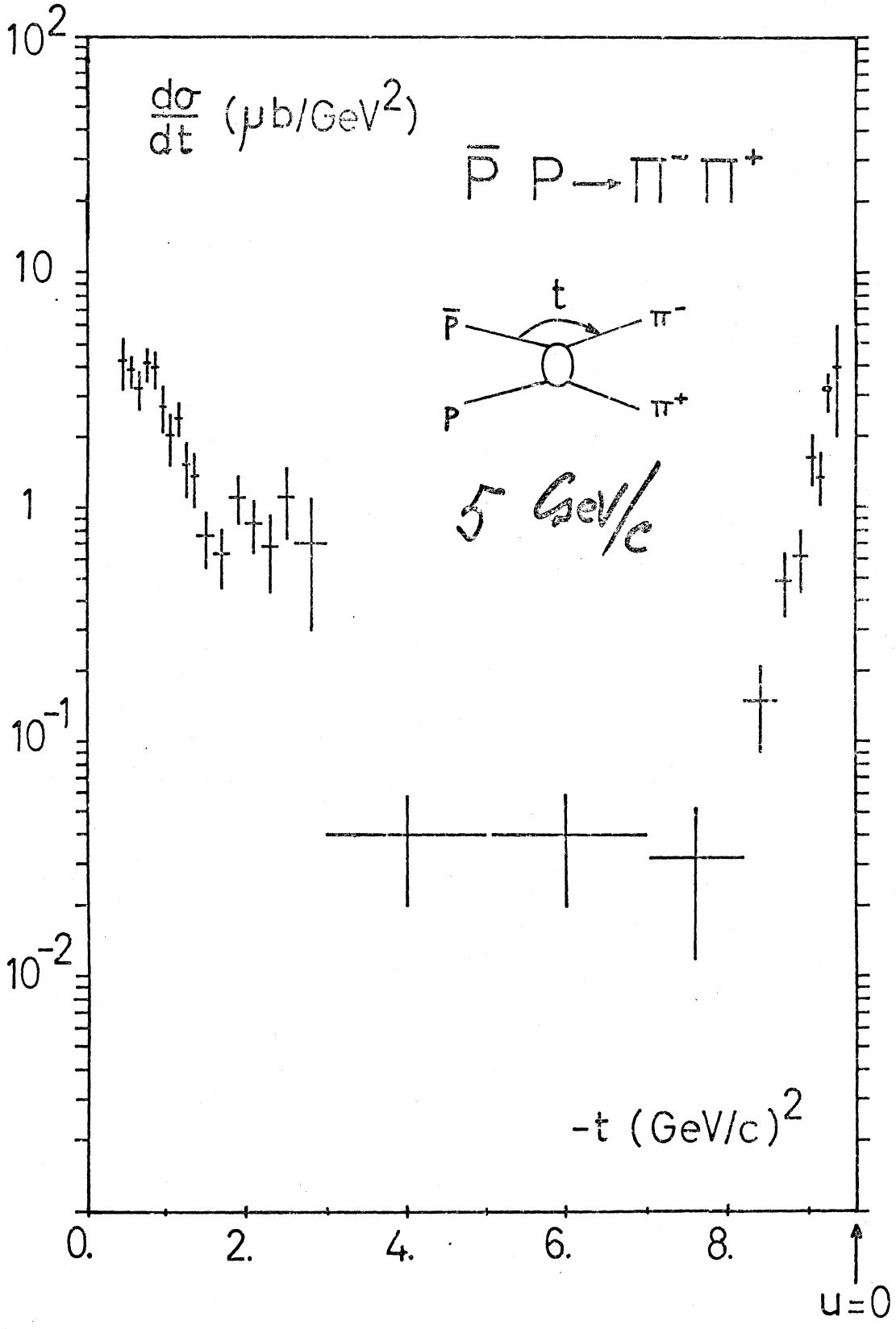


Fig. 1. Tentative Layout of Experiment.


10^2
$\frac{d\sigma}{dt}$ (mb/GeV^2)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
$K^+P \rightarrow K^+P$
5 GeV/c
K^+
K^-
u=0
-t (GeV/c)^2
0.
2.
4.
6.
8.


$\frac{\frac{d\sigma}{dt}(K^+p) - \frac{d\sigma}{dt}(K^-p)}{\frac{d\sigma}{dt}(K^+p) + \frac{d\sigma}{dt}(K^-p)}$
5 Gev/c
0.5
1.0
2.
3.0
4.0
5.0
$-t$ ((Gev/c)^2)

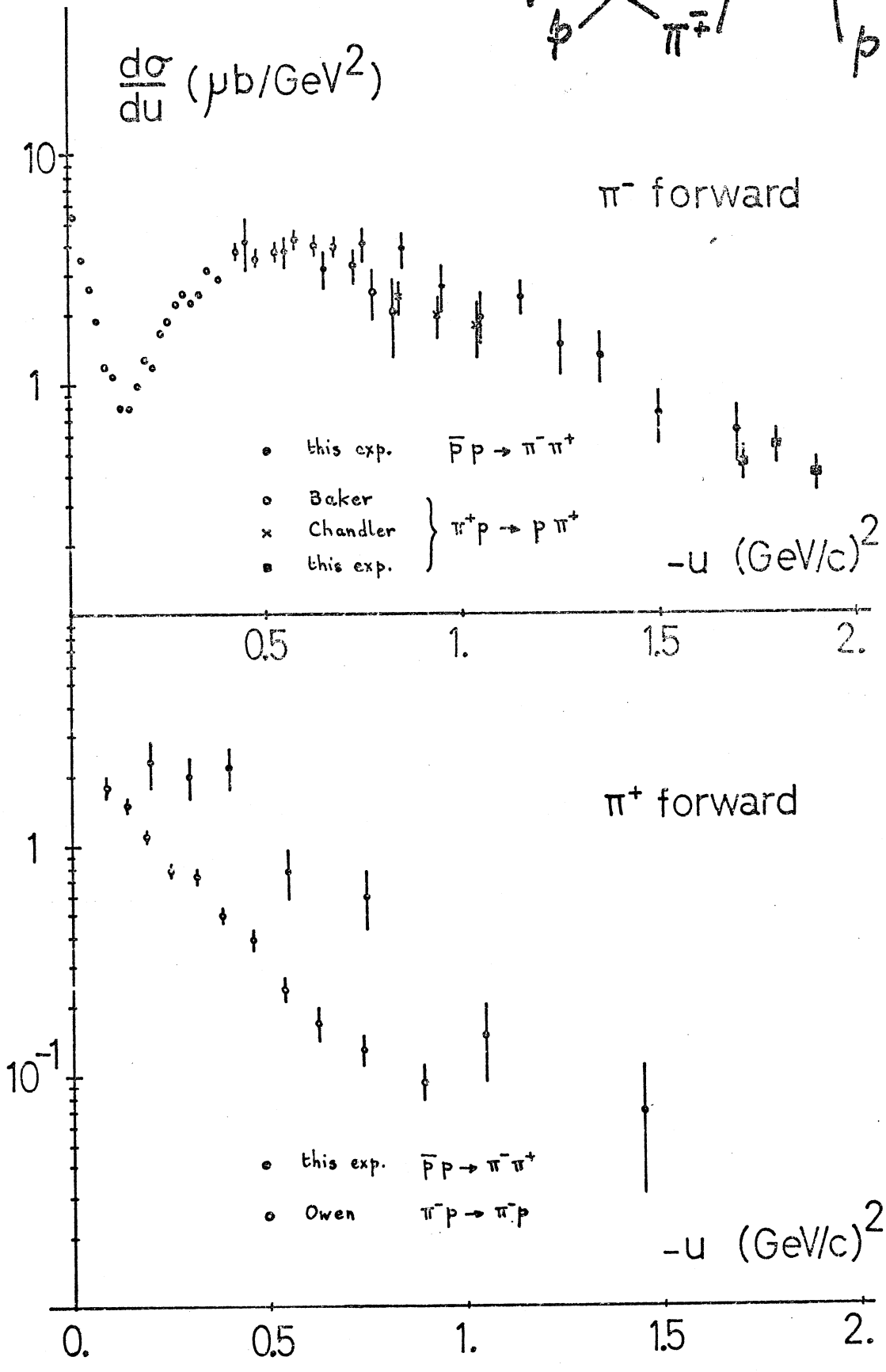

dσ/dΩ
μb/(GeV/c)²
K⁺p ⟶ K⁺p BACKWARD
K⁻p ⟶ K⁻p BACKWARD
S GeV²
LAB
Pk GeV/c


10^2
$\frac{d\sigma}{dt}$ (μb/GeV^2)
$\bar{P}P \to \pi^-\pi^+$
10
t
$\bar{P}$
π^-
P
π^+
1
5 GeV/c
10^{-1}
10^{-2}
$-t$ (GeV/c)^2
0.
2.
4.
6.
8.
u=0

LINE-REVERSAL

5 GeV/c

$2\frac{d\sigma}{du}\left(\bar{p}p \to \pi^{\pm}\pi^{\mp}\right) = \frac{d\sigma}{du}\left(\pi^{\mp}p \to p\pi^{\mp}\right)$



LINE-REVERSAL 5 GeV/c

2. $\frac{d\sigma}{du}\left(\bar{p}p \to K^-K^+\right) = \frac{d\sigma}{du}\left(K^+p \to pK^+\right)$