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# $K^+$ p ELASTIC SCATTERING AT 3.0 AND 3.5 GeV/c

J. Debaisieux, F. Grard, J. Heughebaert, L. Pape and R. Windmolders
Laboratoire des Hautes Energies, Bruxelles

M. Ferro-Luzzi, R. George, Y. Goldschmidt-Clermont, V.P. Henri, B. Jongejans
D.W.G. Leith, G.R. Lynch, F. Muller, J.M. Perreau
C.E.R.N., Geneva

G. Otter and P. Sällström
Institute of Physics, Stockholm

## Introduction

The $K^+$ p scattering reaction has been studied systematically below 2.0 GeV/c(1) using emulsion, bubble chamber and counter techniques. Recently, the region from (7 - 15) GeV/c has been carefully studied in a counter experiment by Foley et al.(2). We present here data on this reaction at 3.0 GeV/c and 3.5 GeV/c.

The Saclay 80cm hydrogen bubble chamber was exposed to a separated beam(3) of $K^+$ mesons at 2.97 GeV/c and 3.43 GeV/c at the CERN proton synchrotron. The pion contamination in the beam was estimated less than 3 o/o.

About 60.000 photographs were scanned in all, and the two prong events within a fiducial volume were measured. 1394 elastic scattering events at 3.0 GeV/c and 1162 events at 3.5 GeV/c were identified and processed through the CERN analysis programmes.

The cross-sections have been reported previously(4) and are:

$$\left.\begin{aligned} \sigma_{(2p)} &= 11.2 \pm 1.0 \text{ mb} \\ \sigma_{el} &= 4.3 \pm 0.8 \text{ mb} \end{aligned}\right\} \quad \text{at } 3.0 \text{ GeV/c.}$$

More accurate values of the total and elastic cross-sections at 3.0 GeV/c and 3.5 GeV/c will be available later.

Elastic scattering analysis

In the study of the small angle scattering events a cut-off was applied on the azimuthal angle, taken as the angle between the scattering plane and the front glass of the chamber. This correction is important since the scanning efficiency falls rapidly when the scattering plane approaches the normal to the glass and is especially critical for the small momentum transfer region (i.e. for small laboratory scattering angle). For events with cosine of center of mass scattering angle less than 0.95, the cut-off in the azimuthal angle was chosen as $80^{\circ}$, and for those in the interval $(0.98 \geq \cos\theta \geq 0.95)$, the cut-off angle was taken as $70^{\circ}$.

The angular distribution for the elastic scattering events is shown in Figure I, where appropriate corrections have been taken into account. The straight lines shown are the maximum likelihood fits to the data in the range $0.95 \geq \cos\theta \geq 0.5$, normalized to the total number of events in this interval, where we have taken:

$$\frac{d\sigma}{d\omega} = K\, e^{-b.t}$$

The fittings shown in Fig. I are for:

$$b = (3.78 \pm 0.13)\ (\mathrm{GeV/c})^{-2} \text{ at } 3.0\ \mathrm{GeV/c}$$

and

$$b = (3.45 \pm 0.13)\ (\mathrm{GeV/c})^{-2} \text{ at } 3.5\ \mathrm{GeV/c}.$$

From these preliminary fittings it was found unnecessary to use higher powers of t in the expansion of the cross-section.

Using the total cross-section for the $K^{+}p$ interactions[(4)(5)], the optical point was calculated and found to be $(5.70 \pm 0.25$ mb/sterad) at 3.0 GeV/c. It is seen that the curve goes through the optical point, which implies that the amplitude is predominantly imaginary.

In Figure 2 the value of the b coefficients for $K^{+}p$ scattering at energies between 2.0 GeV/c and 15 GeV/c are shown. A rapid change in the coefficient is seen in the range between (2 - 6) GeV/c, after which the change of slope of the diffraction peak is very slow. If one describes the scattering process as diffraction from a black disc, then the data in Fig. 2 implies the scatter has the dimensions of $\sim 0.5$ fermi at 2 GeV/c, has grown to 0.7 fermi by (3 - 3.5) GeV/c, reaching $\sim 0.9$ fermi at 7 GeV/c. The high energy data implies a slow growth from 7 GeV/c to 15 GeV/c, where the scattering radius is around 1 fermi.

A further analysis of the change of slope of the $K^+$ p diffraction peak in the energy range shown in Figure 2 will be given later, together with a more complete investigation of the entire angular distribution in the 3.0 and 3.5 GeV/c data. It is also hoped to present data on 5.0 GeV/c $K^+$ p elastic scattering, to confirm the shrinking type behaviour of the diffraction peak.

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References

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Figure Captions

Fig. 1 The angular distribution of a) 3.0 GeV/c and b) 3.5 GeV/c, $K^+$ p elastic scattering events. The straight line is a maximum likelihood fit to the data between (0.95 - 0.5), using the relation $\frac{d\sigma}{d\Omega} = K\ e^{-b.t}$. The fits have been normalized to the total number of events in this interval.

Fig. 2 The slope of the diffraction peak, expressed as the value of the coefficient, b, in the expression

$$\frac{d\sigma}{d\Omega} = K\ e^{-b.t},$$

is plotted against the incident $K^+$ momentum. The figure shows a rapid charge in slope from (2 - 6) GeV/c, and thereafter a slow trend to "shrinking" behaviour.