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SOME OBSERVED PROPERTIES OF THE LOW ENERGY SEPARATED BEAM

I. INTRODUCTION

The Low Energy Separated Beam from the AGS C Station is described in two reports by its designer, John Fox[1,2] and also in the 1970 AGS Summer Study.[3] The beam was constructed by late 1971, and since then the authors of this report have had some running on an experiment measuring total cross sections to a high accuracy on hydrogen and deuterium, mainly with incident K^+ mesons up to the present time.

This report is written in response to inquiries by prospective users concerning various beam properties. No systematic study of beam properties has been made, since most effort was directed to the total cross section experiment, but some information on the beam has been obtained as a by-product, which may be of interest to others. As more information is obtained, this report will be updated.

II. DATA TAKING CONDITIONS

We report data taken in the south (or momentum recombined, or C4) branch of the beam. The beam particles were recorded by a liquid differential Cerenkov counter situated at a distance of 571-in. from the C target, with defining scintillation counters upstream and downstream of it - the latter at a distance of 588-in. from the C target. All counters are believed to be oversize so that all the beam was contained within them. The Cerenkov counter, which will remain as part of the beam, was measured to be at least 91% efficient for 750 MeV/c K^-; a kaon identification system consisting of the Čerenkov counter and at some momenta a time of flight measurement over a 205-in. flight path, gives kaon beams with less than 0.1% pion contamination at all momenta in the range 500 to 1100 MeV/c.

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III. FLUX MEASUREMENTS

A secondary emission chamber (SEC) just upstream of the C target recorded the total number of protons in the external proton beam (to $\sim \pm$ 10% accuracy), but there is some uncertainty as to what fraction strikes the C target in a given run. A counter telescope viewing the C target at 90° gave a relative normalization, and to obtain absolute fluxes we multiply the flux/telescope rate by the highest telescope/SEC rate obtained in a reasonable period of time near the measurement. It is estimated that uncertainties in the flux measurements are $\sim \pm$ 20%.

In Fig. 1, we give the number of particles at our counters for 10^{12} incident protons; most data are for K^+, but with one point each for K^- and $\bar{p}$. The data are for a mass slit opening >0.125-in, a 4.1-in. long copper target, horizontal jaw D.V.M. setting of 5.25 volts ($\sim$ 3.7-in. opening), and momentum bite of $\pm$ 1% $\Delta p/p$ (See later for the effect of these).

The values obtained are in approximate agreement with the predictions of Reference 3.

IV. MASS SLIT APERTURE AND BEAM PURITY

The vertical opening of the mass slit affects the particle flux, as shown in Fig. 2. The number of unwanted particles is also affected by the mass slit opening, and in Fig. 2 we also show the π/K ratio; π is defined as any particle in the beam not a kaon - in general it will be some mixture of pions and muons. From the curves it is seen that there is little improvement in flux, and a poorer π/K ratio, in slit openings greater than 0.125-in.

The π/K ratio is also a function of momentum, as seen in Fig. 3, where all data were obtained with a mass slit opening of 0.200-in. A $\pi/\bar{p}$ ratio of $\sim$200 was obtained for 750 MeV/c antiprotons, until the installation of a collimator to shield the pole pieces of dipole D 1. Subsequent measurements indicate that the $\pi/\bar{p}$ ratio should now be $\sim$ 50.

V. TARGET LENGTH

The variation of flux of 550 MeV/c K^+ with C target length as seen by an incident proton in Fig. 4. (Note that the AGS control room definition of target length is 1.1-in. less than given here, due to taking different dimensions of a parallelogram-shaped traget). Two points measured with copper targets for 750 MeV/c K^- show the same fractional increase of flux with target length as in Fig. 4. Measurements with 212 MeV/c π^- also show the same copper effect, but with a beryllium/copper ratio of 0.9 for a 2.1-in. target.

VI. HORIZONTAL JAWS

These jaws are placed between quadrupole Q_2 and dipole D_2, and are a means of controlling flux. Figure 5 shows the effect of varying the jaw opening on 750 MeV/c K^-, and on the accompanying "pions". There is little advantage in opening the jaws above a D.V.M. reading of 5.25 volts, which corresponds to an opening of $\sim$3.7-in.

VII. MOMENTUM BITE

The variation of kaon and accompanying "pion" fluxes with momentum bite is given in Fig. 6. (The momentum scale is obtained by assuming that $\pm$ 1% $\Delta p/p$ is given by the upstream jaw being 2.5-in. to the right of the beam, and the downstream jaw 1.5-in. the left of the beam, and scaling linearly for other momentum bites.)

VIII. ACKNOWLEDGMENT

We wish to thank John Fox for much helpful advice concerning the beam.

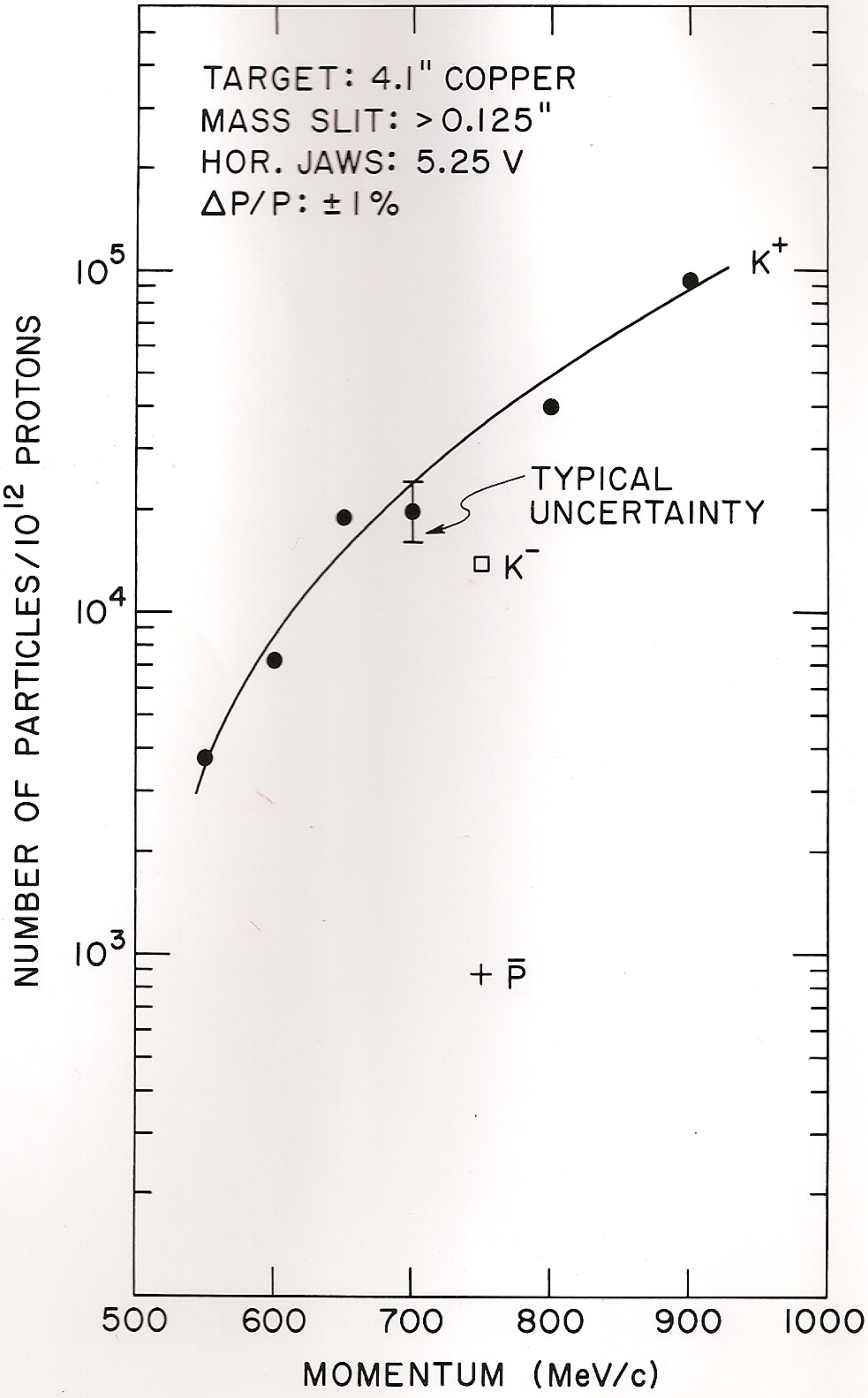
REFERENCES

1. J.D. Fox, BNL Accelerator Dept. EP&S Division Technical Note No. 7 (1967)

2. J.D. Fox, BNL Accelerator Dept. EP&S Division Technical Note No. 20 (1968)

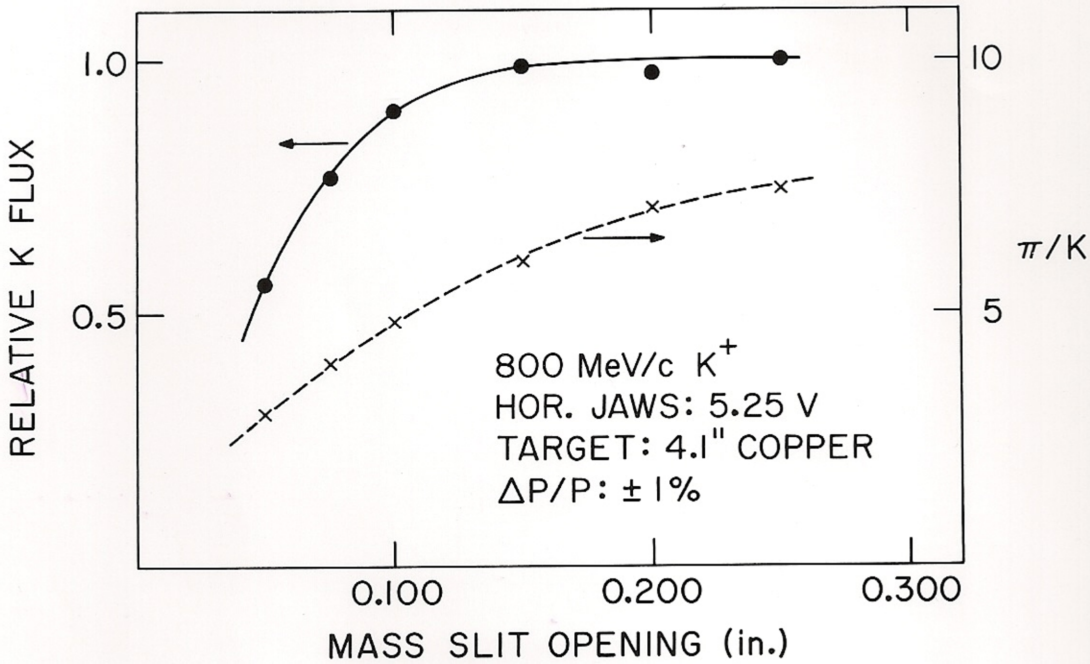
3. M. Zeller, L. Rosenson and R.E. Lanou, BNL AGS Summer Study - BNL 16000, P. 193 (1970)

B1 Limited Distribution



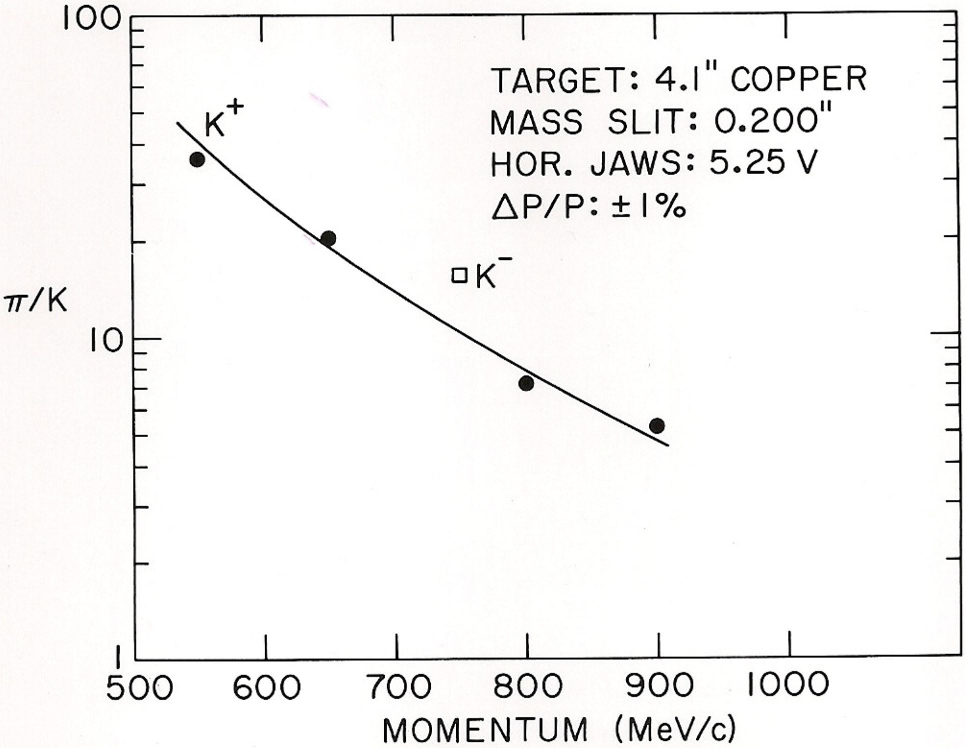
TARGET: 4.1" COPPER
MASS SLIT: >0.125"
HOR. JAWS: 5.25 V
ΔP/P: ±1%
10^5
10^4
10^3
K^+
TYPICAL UNCERTAINTY
K^-
$\bar{P}$
NUMBER OF PARTICLES/10^{12} PROTONS
500
600
700
800
900
1000
MOMENTUM (MeV/c)

FIG. 1



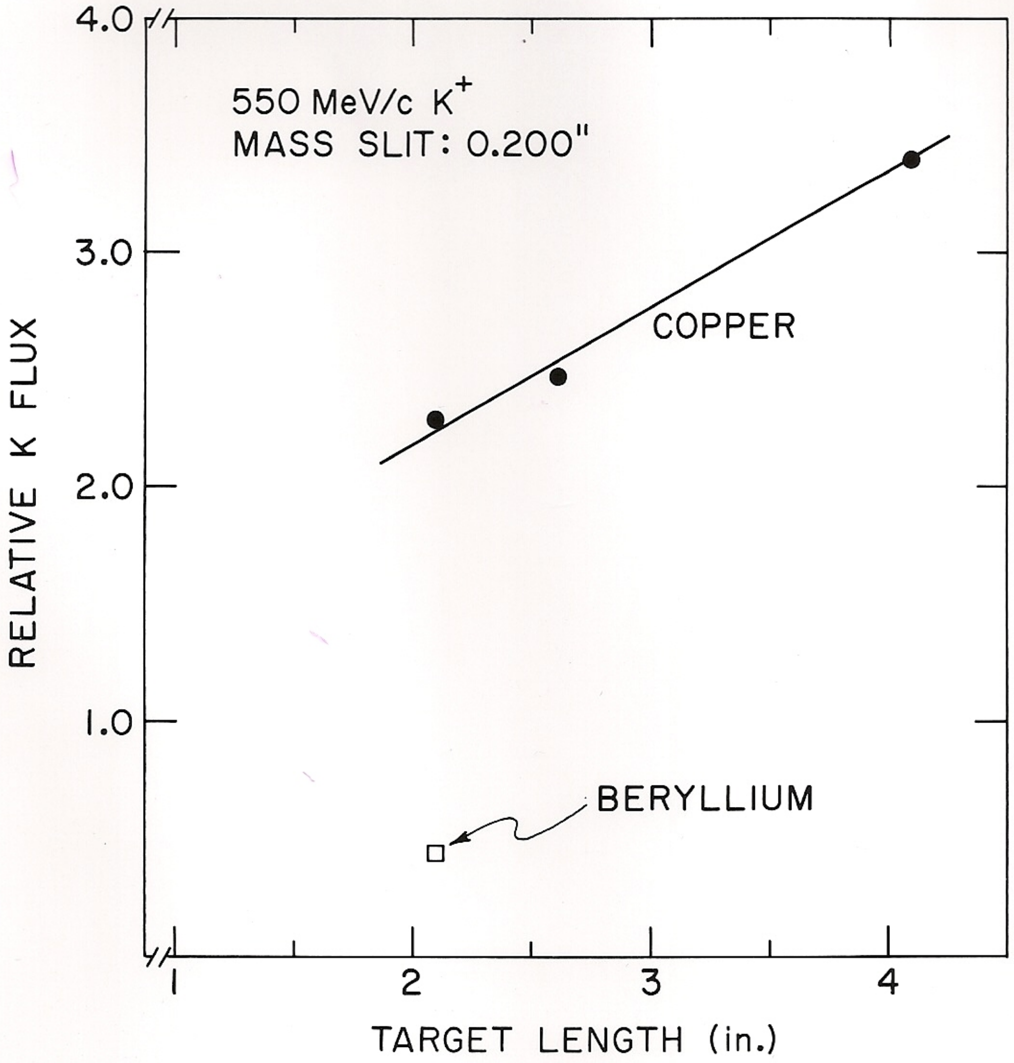
1.0
0.5
10
5
π/K
RELATIVE K FLUX
800 MeV/c K+
HOR. JAWS: 5.25 V
TARGET: 4.1" COPPER
ΔP/P: ±1%
0.100
0.200
0.300
MASS SLIT OPENING (in.)

FIG. 2



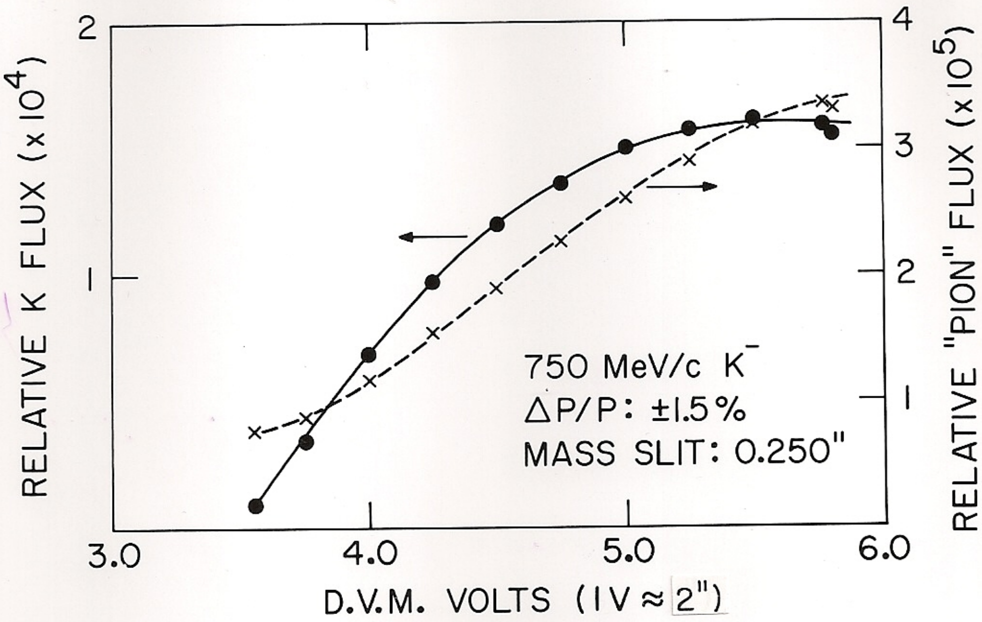
100
10
1
π/K
K+
K−
TARGET: 4.1" COPPER
MASS SLIT: 0.200"
HOR. JAWS: 5.25 V
ΔP/P: ±1%
500
600
700
800
900
1000
MOMENTUM (MeV/c)

FIG. 3



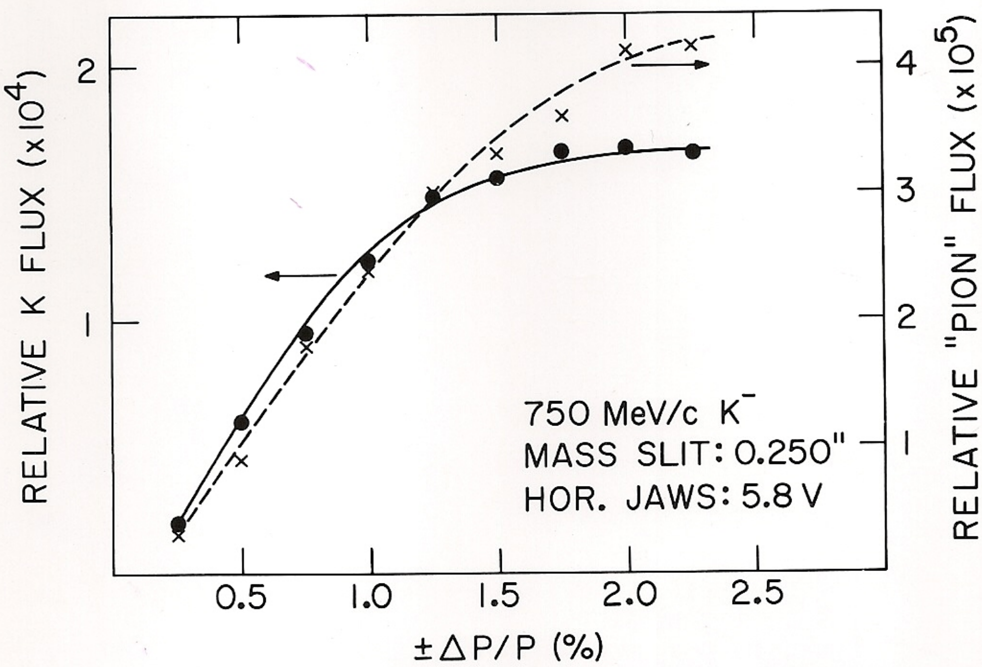
550 MeV/c K⁺
MASS SLIT: 0.200"
COPPER
BERYLLIUM
RELATIVE K FLUX
4.0
3.0
2.0
1.0
1
2
3
4
TARGET LENGTH (in.)

FIG. 4



RELATIVE K FLUX (x 10^4)
RELATIVE "PION" FLUX (x 10^5)
750 MeV/c K$^-$
ΔP/P: ±1.5%
MASS SLIT: 0.250"
D.V.M. VOLTS (1V ≈ 2")

FIG. 5



RELATIVE K FLUX (x 10^4)
RELATIVE "PION" FLUX (x 10^5)
750 MeV/c K$^-$
MASS SLIT: 0.250"
HOR. JAWS: 5.8 V
±ΔP/P (%)

FIG. 6