

$\pi^+$  AND  $K^+$  PRODUCTION CROSS-SECTIONS FOR  
12.5 GeV PROTONS ON BERYLLIUM

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(presented by T.B. Novey)

A beam survey was conducted with the ZGS external beam operated in a "parasitic" mode. The purpose of this survey was to obtain pion and kaon yields from a Be target for a momentum range of 1- 10 GeV/c and for production angles from  $0^\circ$  to  $16^\circ$ . These yields are to be used for an accurate calculation of the neutrino and antineutrino spectra.

A "parasitic" beam (about 1% extraction efficiency) from an internal target was focused (a spot of  $\frac{1}{2}$  in. diameter) onto a Be target (10, 20 and 40 cm length and 2.8 cm diameter). During the experiment the intensity was  $10^8 - 10^9$  protons of 12.5 GeV kinetic energy per pulse. Two accurate foil irradiations were performed to calibrate the counters used to monitor the intensity\*).

The  $\pi^+$  and  $K^+$  yields were measured by means of a simple magnetic spectrometer consisting of a standard ZGS bending magnet (BM- 105) and small ( $\sim \frac{1}{4} \times \frac{1}{4} \times \frac{1}{4}$  in scintillators) counter telescopes, mounted in front of and behind the magnet gap; see Figs. 1 and 2. The various particles (protons, electrons, pions and kaons) were separated by using a simple single or double gas Čerenkov counter, which was suitably operated in coincidence or anti-coincidence with the telescope. The resolution of this spectrometer (determined experimentally) was  $\Delta p/p = 15\%$ , and the accepted solid angle was  $0.8 \times 10^{-6}$  sterad.

The whole magnetic spectrometer was mounted on rails allowing measurement at various angles. The counters in turn were mounted on accurate lead-screw drives attached to the magnet, allowing remote alignment of the spectrometer without interrupting the ZGS operation. The positioning was better than one thousandth of an inch over a range spanning several feet. The arrangement is shown in Figs. 1 and 2.

The electronics employed was of a conventional style (GASL) with special precautionary arrangements to monitor chance rates at every point where this would affect the final data.

The measured differential cross-sections for positive and negative pion production are given in Figs. 3 and 4. The cross-sections are given in millibarns per Be nucleus per GeV/c per steradian so as to eliminate the ambiguities inherent in quoting yields per "interacting" proton.

$K^+$  and  $K^-$  cross-sections vary in a somewhat limited momentum range. See Figs. 5 and 6.

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\*) We wish to thank A.F. Stehney and E.P. Steinberg of the Nuclear Chemistry group for performing these calibrations.

The over-all error in these data is a composite of various uncertainties:

- a) Proton flux:  $\sim 5\%$
- b) Multiple scattering: 1-3%
- c) Target absorption correction: 3-5%
- d) Solid angle: 1-2% .

The statistical error, where applicable, due to the finite number of counts, is indicated with bars on the cross-section curves. Taking the above errors into account, we estimate that the over-all normalization of this data is good to  $\pm 10\%$ .

Beam-survey data from other laboratories (AGS, CERN) have no direct measurement in common with our data (different momenta, angles, targets and/or primary energy), but extrapolations from these data are in good agreement with our values.

#### ACKNOWLEDGEMENTS

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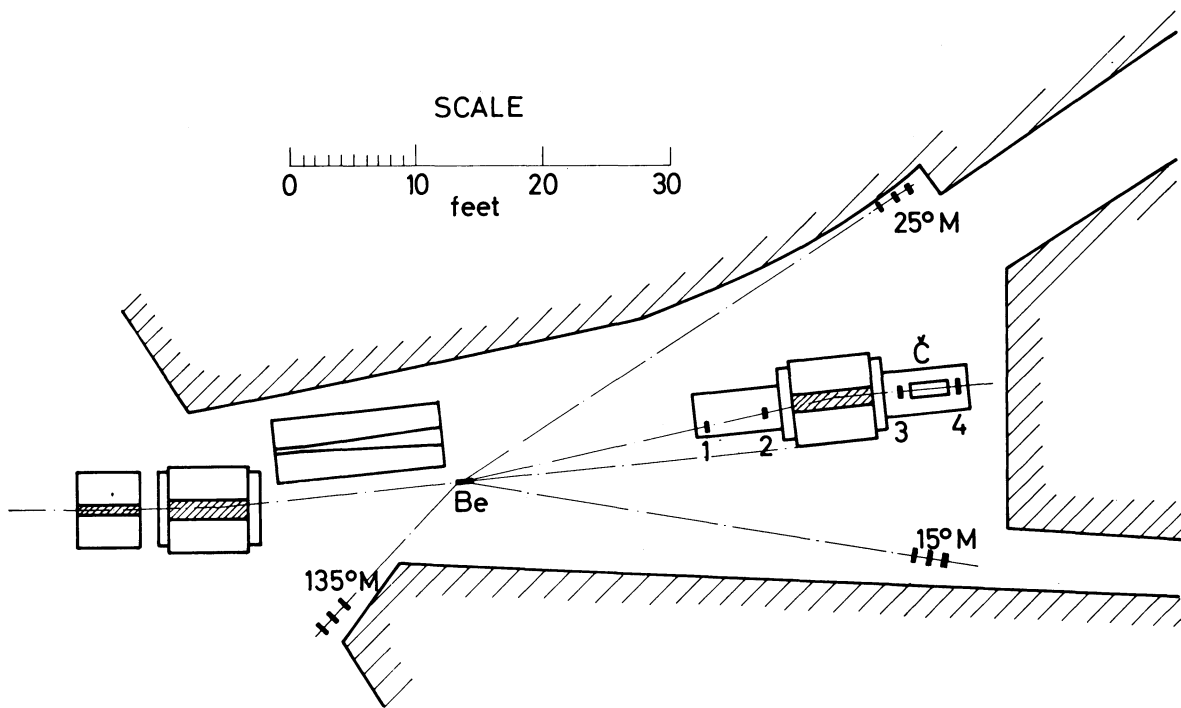


Fig. 1

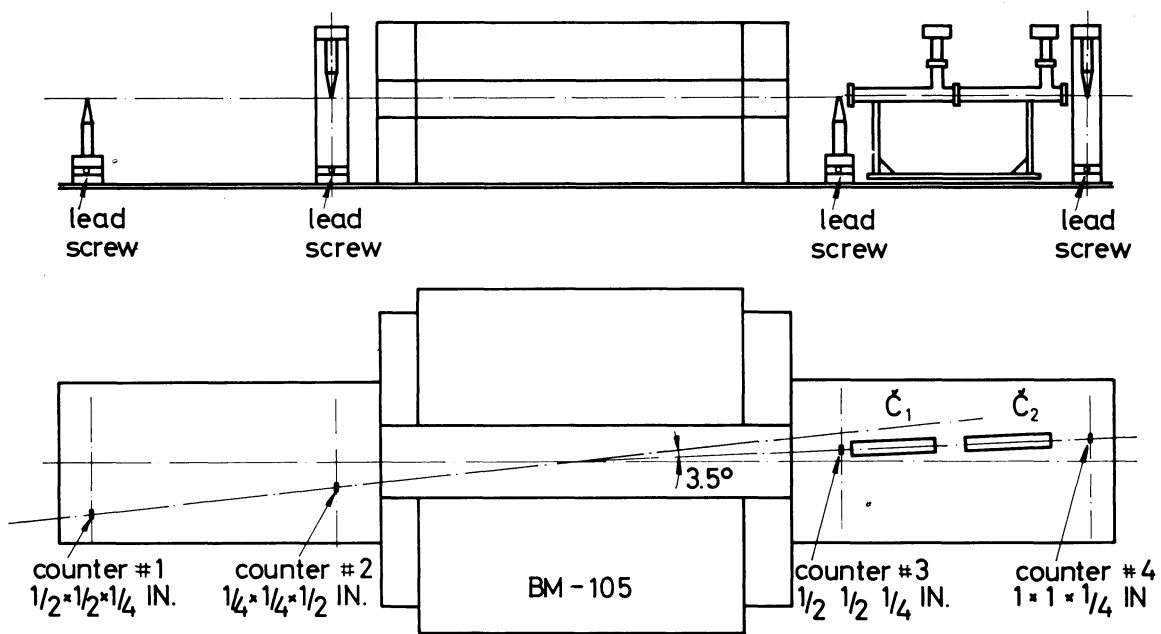


Fig. 2

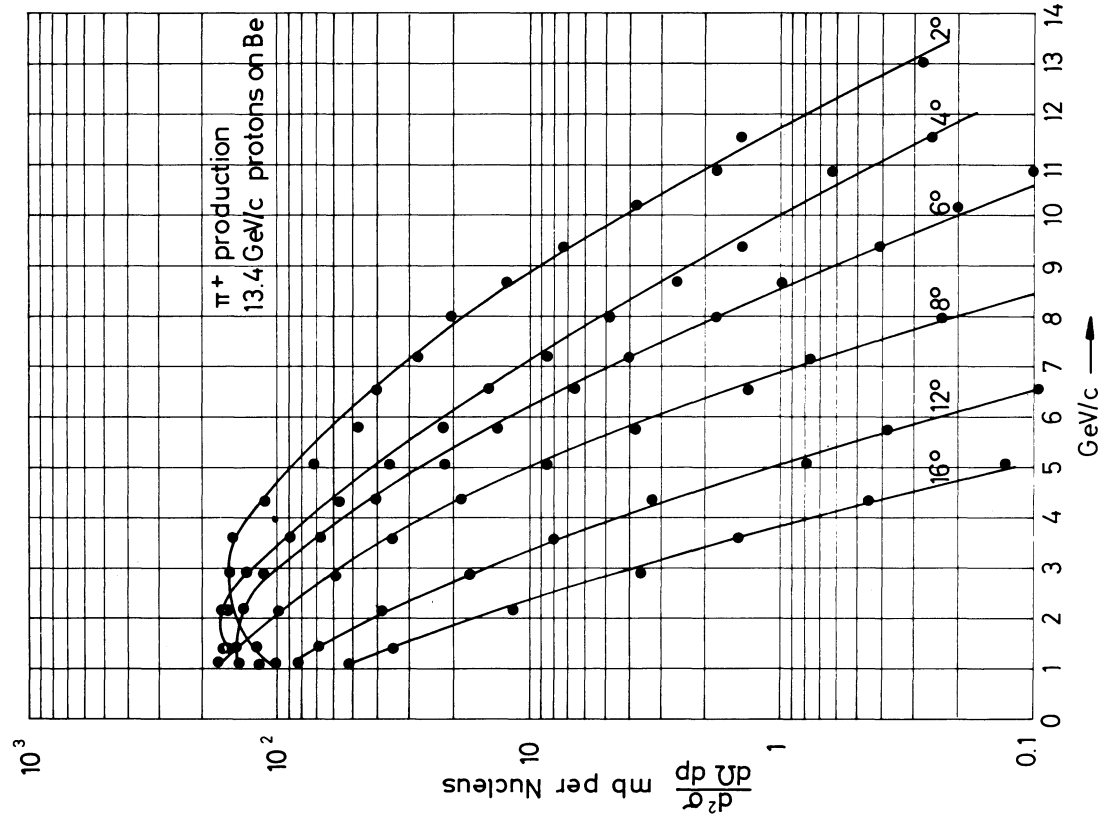


Fig. 3

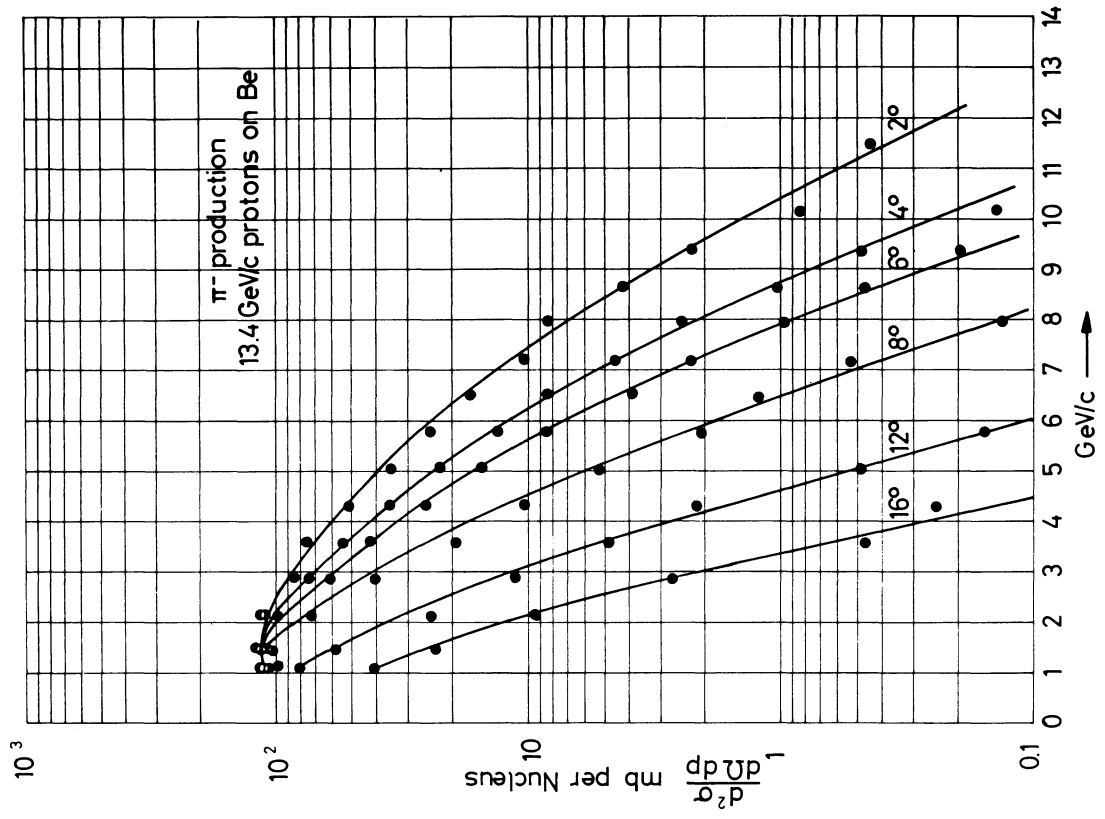


Fig. 4

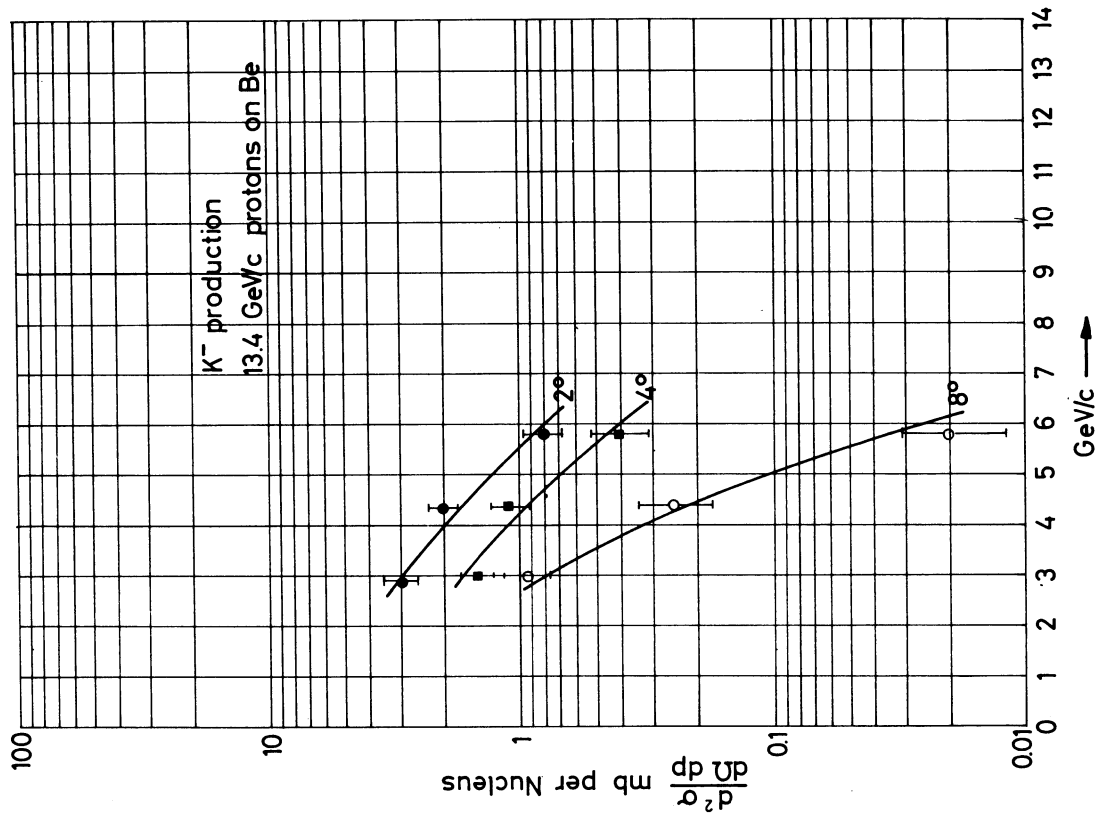


Fig. 6

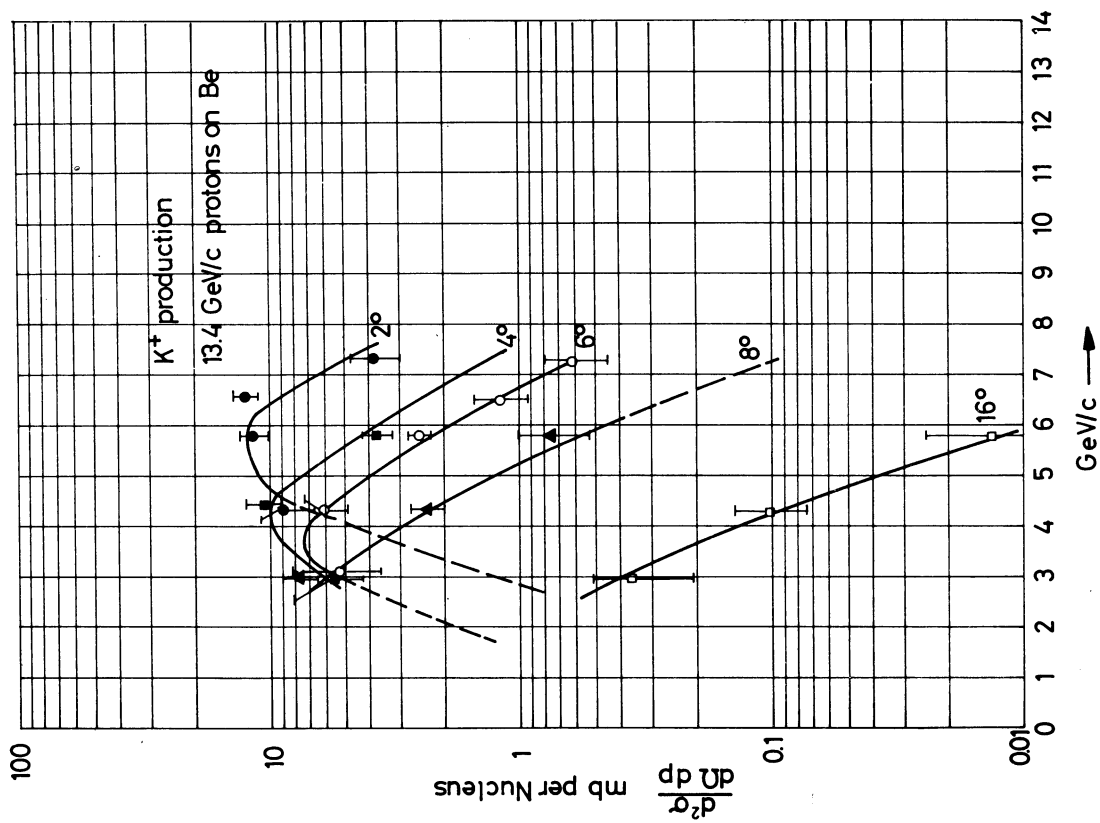


Fig. 5