ЛАБОРАТОРИЯ ВЫСОКИХ ЭНЕРГИЙ

ОБЪЕДИНЕННЫЙ ИНСТИТУТ ЯДЕРНЫХ ИССЛЕДОВАНИЙ

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TOTAL CROSS-SECTIONS FOR K^+-PROTON INTERACTIONS

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It is shown that K^+p total cross section rises from (15.0 ± 2.1) mb to (25.8 ± 2.7) mb in the momentum range 2.72 – 4.75 Bev/c.

The reported experimental data on K^+p interactions[1],[2], give an indication to the existence of a maximum in the total cross section equal to ~ 19 mb, at a momentum ~ 1 Bev/c with a drop to ~ 13 mb at 2.4 Bev/c. Preliminary data of the Dubna group [3] and the CERN results[4] give larged values of the total cross section for higher energies.

The aim of the present work is to investigate the behaviour of the total cross section for K^+p interaction in the momentum range 2.7 – 4.8 Bev/c.

The measurements were performed at the synchrophasotron of the JINR with 'good geometry' setup. Positive particles, generated on an international target, were analysed according to their momenta by the magnetic field of accellerator, focused by 2 quadrupole lenses, collimated and deflected at 6.3° by the bending magnet. The K^+ -mesons in the beam were selected by their velocity with two differential gas Cerenkov counters in coincidence with scintillation counters and a threshold gas Cerenkov counter connected in anticoincidence for decreasing the π^+ -meson contaminotion.

A typicol plot of the counting efficiency for different particles vs gas pressure (etylene) in the Cerenkov counters is shown in Fig. 1. The background and the accidental accidences is 1% of K^+-meson peaks. Similar curves were obtained for each momentum, for some momenta with two gases-ethylene and air. The momenta were determined by the position of the peaks for different particles with an accuracy of ~ 1%.

The change of the halfwidth of the peaks shows, that the momentum spead is ~ 2%.

A 50 cm liquid hydrogen target, made of styrofoam, was used. The geometry of experiment is shown on Fig. 2. S_8 is the last monitor counter and S_4 counts particles, which passed through the target without interactions. Three ring counters were used for determining the small angle scattering corrections to the total cross sections. These counters recorded particles in the given solid angle from elastic and inelastic interactions.

It may be of interest to compare the ring counter data for different primary particles. In the 3 th column of table I corrections to the total cross sections are given, determined from ring counter data. The 4 th column presents the calculated corrections by the optical theorem. As is seen from the table, for π^+-mesons the ring counters gave a correction appreciably larger, than that from the optical theorem. At the same time for K^+-mesons the ring counter correction does not exceed that from the optical theorem. This gives in particular an evidence for a small contribution of inelastic K^+ interactions in the given angle interval.

The corrected values of the total cross sections are listed in column 5 of table 1 and also in Fig. 3, where data from other groups are shown for comparison. It is seen, that the present data point to a rise in the total cross sections from 15.0 ± 2.1 mb up to 25.8 ± 2.7 mb in the momentum range 2.72 ÷ 4.75 Bev/c. This result is in disagreement with the CERN data /4/.

If one plots the K^+p total cross sections from this work and from /1/,/2/ together with the summary data on π^+p total cross sections /5/ as a function of pc/mc^2 in the laboratory system /Fig. 4/, similarity in these dependences are seen.

In the region of the first maxima for π^+ and K^+ total cross sections lies the p-p total cross section maximum.

At the present time the measurements of the K^+ total cross sections are being continued. A detailed re – port will be published in JETP. We are grateful to V.J. Veksler for the constant interest to our work and helpful discussions.

Table I

Total cross sections for K^+ and π^+-meson interaction with protons obtained in this paper. In the 5th Column are indicated the croaa sections corrected for K^+ -mesons by the optical theorem, for π^+-mesons from the ring counter data, as well as for the μ -meson admixture which is 2.8 %.

Momentum Bev/c		without corrections mb	Ring counter corrections mb	Optical theory corrections mb	with corrections mb
2.72	K^+ mesons	14,9 ± 2.1	~ 0	0.085	15,0±2.1
2.8	"	17.4 ±1,7	0.05±0.05	0.285	17.7±1.7
3.38	"	18.5 ±1.6	0.1± 0.04	0.1	18,6±1.6
3.72	"	20.1 ±1.6	0.4±0.33	0.49	20.6±1.6
4.75	"	25.4 ±2.7	0.15±0.04	0.35	25.8±2.7
4.75	π^+ mesons	27.7 ±1.35	0.73±0.15	0.5	29,3±1.4

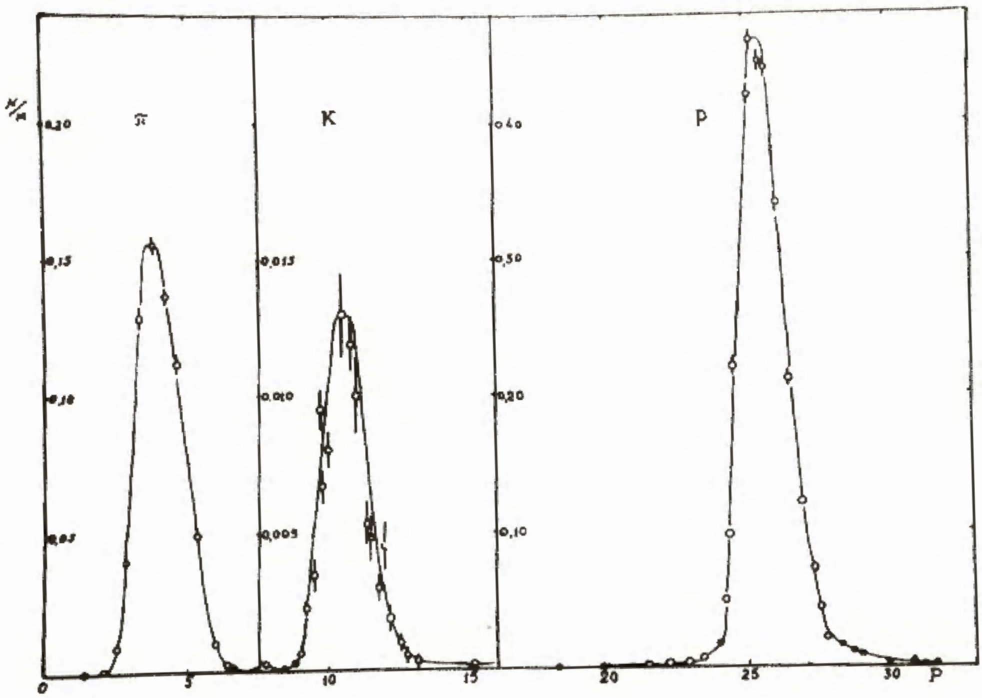

Fig. 1 The dependence of the counting efficiency for different particles as a function of ethylene pressure in the differential Cerenkov counters. The particles momentum is 4.75 Bev/c.

On the axis the pressure in atm. is plotted.

The ordinate gives the N/M ratio of differential counters to the beam monitor counts.

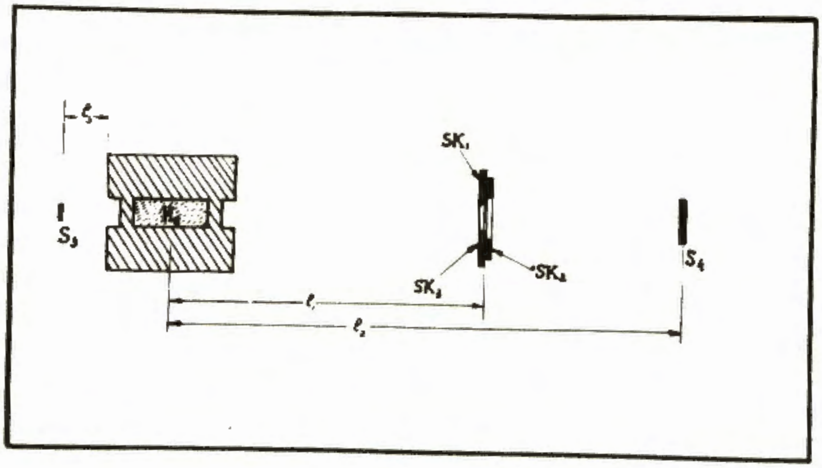

Fig. 2 The geometry at the experiment S_3, S_4 – scintillation counters, ϕ 6 and ϕ 14.6 cm respectively.
SK_1, SK_2, SK_3 – ring scintillation counters.

	The inner diameter.	The outer diameter.
SK_1	– 33cm	23cm
SK_2	– 28cm.	15cm
SK_3	– 19cm	10cm

l_1 = 185cm	l_2 = 339cm	for	p =	4.75 Bev/c and 3.38 Bev/c
l_1 = 185cm	l_2 = 235cm	for	p =	2.72 Bev/c
l_1 = 215 cm	l_2 = 180cm	for	p =	2.9 Bev/c and 3.72 Bev/c

H_2 – liquid hydregen target. l_3 = 15 cm

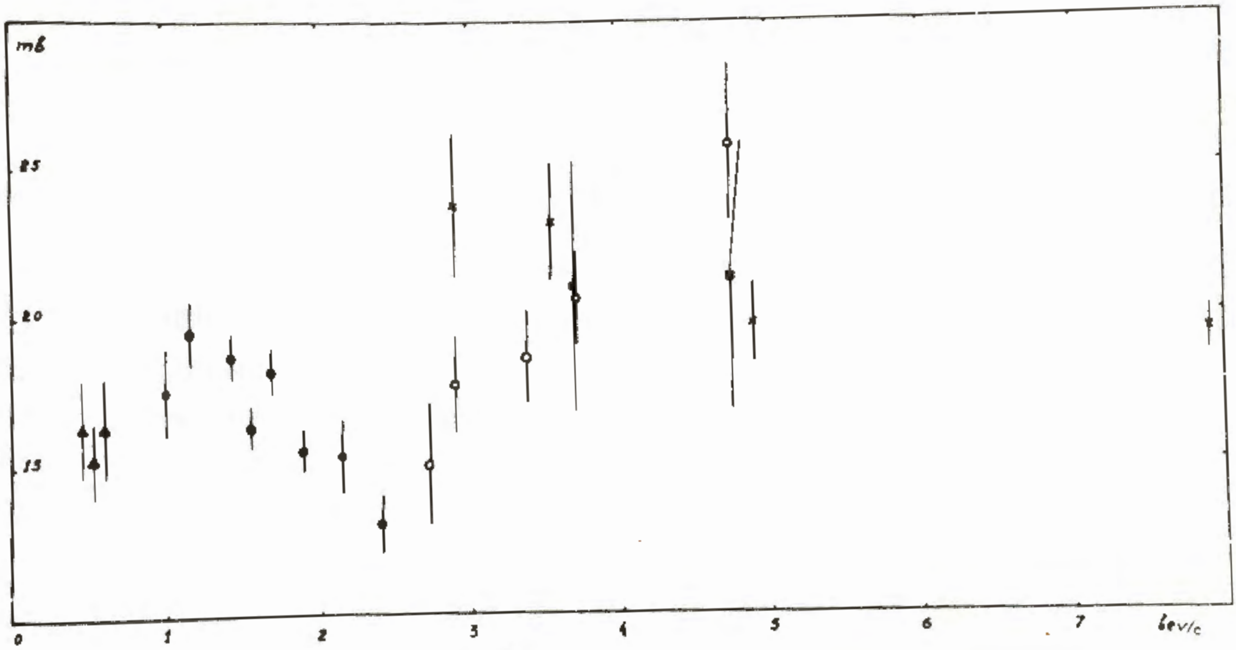

Fig. 3.

K^+p total cross section. ▲ /1/, ● /2/, ● /3/, ✱ /4/, ○ - this work.

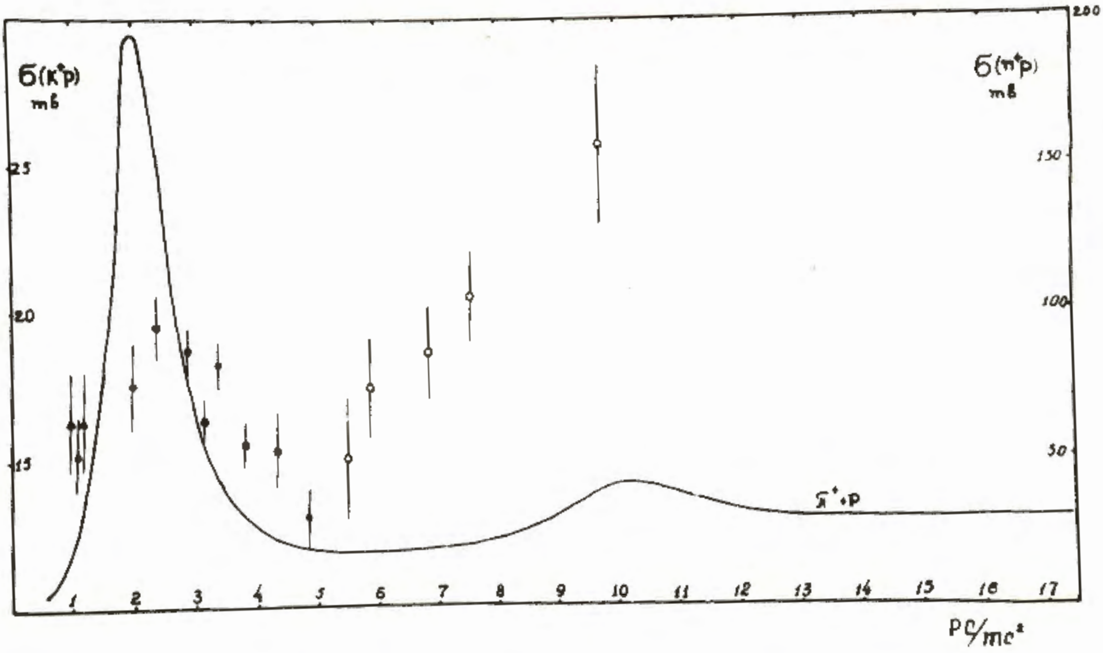

Fig. 4.

Total cross sections for π^+ and K^+ -meson interaction with protons are plotted against $P\ c/mc^2$ in the lab. system.

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