

ON THE INTERACTION OF 10 GeV/c  $K^-$  MESONS WITH EMULSION NUCLEI

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The photonuclear emulsion plates analyzed in this work were taken from a stack of 40 pellicules (size  $10 \times 20 \times 0.06$  cm<sup>3</sup>) of Ilford K5 emulsion belonging to the European  $K^-$  Collaboration. The stack was exposed in April 1967 at CERN to a 10 GeV/c  $K^-$  meson beam from a proton synchrotron. The beam contamination with  $\pi$  and  $\mu$  mesons did not exceed 6%.

The  $K^-$  mean free path was determined by the method of along-the-track scanning with a Zeiss biological microscope adapted for the work with nuclear emulsions, at a magnification of 900 $\times$ . Seventy stars were found on a total track length of 7000 cm. The mean free path without correction for the contamination was found to be

$$\bar{\lambda} = (100 \pm 17) \text{ cm}$$

Unfortunately, there are only a few reported data on the mean path of  $K^-$  mesons in emulsion. Some of the results are presented in Fig. 1<sup>1)</sup>.

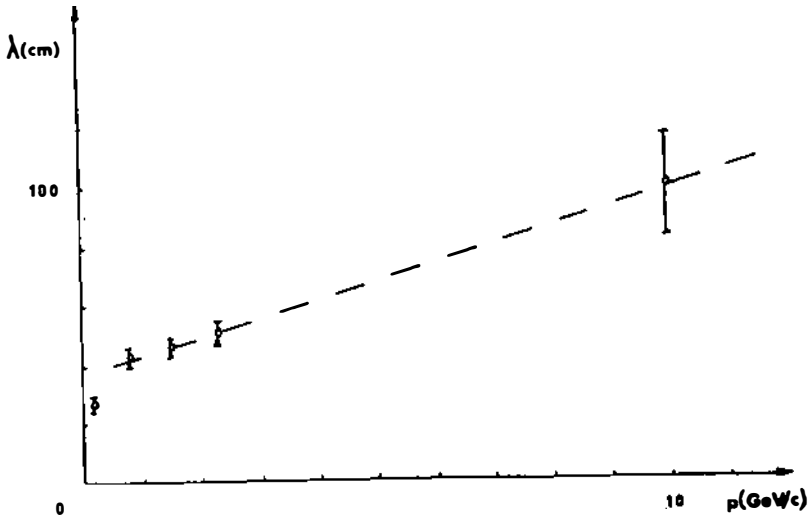


Fig. 1

The dependence of the  $K^-$  meson mean free path in emulsion on its momentum

The total cross section for the given mixture of  $K^-$ ,  $\pi^-$  and  $\mu^-$  mesons was computed from the mean free path to be

$$\sigma_{\text{tot}} = (127 \pm 24) \text{ mb}$$

The stars were classified into heavy and light groups according to the following criteria:

for heavy stars	H1 H2	$n_h > 7$ or $n_h \leq 7$ and $R_b(\text{min}) > 80 \mu\text{m}$
for light stars	L	$n_h \leq 7$ and $R_b(\text{min}) \leq 80 \mu\text{m}$

A track with a grain density exceeding  $1.4 g_0$  was taken to be a heavy track. Here  $g_0$  is the grain density at the minimum of ionization ( $g_0 = (179 \pm 6) \text{ mm}^{-1}$ ), and  $n_h$  is the number of such tracks in a star. Tracks with  $g \leq 1.4 g_0$  pertain to shower particles. The range of the shortest black prong (without gaps) of a star is denoted by  $R_b(\text{min})$ .

By along-the-track scanning we found 45 H1 stars, 8 H2 stars and 17 L stars. By area scanning 180 stars were found, of which 95, 28 and 57 were H1, H2 and L stars, respectively. The mean free path in  $K^-$  interactions with light and heavy emulsion nuclei is  $\bar{\lambda}_1 = (334 \pm 86) \text{ cm}$  and  $\lambda_h = (146 \pm 26) \text{ cm}$  respectively. The corresponding cross sections are  $\sigma_1 = (51 \pm 13) \text{ mb}$  and  $\sigma_h = (337 \pm 60) \text{ mb}$  respectively. The value of  $\sigma_1$  may be compared with the  $\sigma_{\text{tot}} = (23.2 \pm 0.7) \text{ mb}$  obtained by Baker et al.<sup>2)</sup> in a hydrogen bubble chamber investigation of  $K^-$ -p interaction at 10 GeV/c. The average multiplicity of shower particles was determined for all space and also for the symmetry cone ( $\theta = \pm 25^\circ$  at 10 GeV/c). The results are given in the following table:

The average multiplicity	For all stars	For H1	For L
of showers in all space $\langle n_s \rangle$	$3.75 \pm 0.12$	$4.14 \pm 0.28$	$3.21 \pm 0.19$
of showers in the symmetry cone $\langle n_s(25^\circ) \rangle$	$2.20 \pm 0.08$	$2.13 \pm 0.11$	$2.35 \pm 0.20$
of heavy prongs $\langle n_h \rangle$	$10.64 \pm 0.44$	$15.61 \pm 0.50$	$3.45 \pm 0.20$

For comparison we note that the mean charged particle multiplicity in the  $K^-p$  interaction is  $\langle n_{ch} \rangle = 3.40 \pm 0.01$ <sup>3)</sup>

Since  $\langle n_S(25^\circ) \rangle_h < \langle n_S(25^\circ) \rangle_l$ , it may be concluded that there is a spread of secondaries, caused by more pronounced diffraction on the nucleons of heavy nuclei. Gottfried<sup>4)</sup>, in his energy flux cascade theory, relates this spread to the mean number of collisions within the nucleus. Thus it seems that the secondary processes in the  $K^-A$  interaction are important.

At the end we should state that among H2 stars some L stars may be present, since the given criteria for classification were not completely reliable. Considering other properties of light and heavy stars, the error in the number of L stars was estimated to be about 7%.

#### REFERENCES

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- 3) *Comparative study of charged multiplicity distribution IIHE-74.3, Universities of Brussels*
- 4) K. Gottfried, *Ref. TH 1735-CERN* (1973)