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Publication Date

1956-02-01

UNIVERSITY OF CALIFORNIA

Radiation Laboratory

BERKELEY, CALIFORNIA

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Radiation Laboratory
Berkeley, California

Contract No. W-7405-eng-48

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A mean lifetime for K^- mesons has been determined by the method previously used[1] for the K^+ meson lifetime. Stacks of stripped 600-μ Ilford G.5 nuclear emulsions were exposed to the focused K^--meson beam[2] of the Bevatron so that the particles entered parallel to the emulsion layers. The mesons were produced by 6.2-Bev protons on a copper target and emerged at 90° to the proton beam. A bending magnet was used for momentum selection of the particles. Particles of momenta from 285 Mev/c to 415 Mev/c were obtained in the various exposures used for this experiment. The distance traveled by the particles from the target to the emulsion stack was about 3 meters in all cases.

Plates were scanned independently by the Berkeley, Livermore, and M.I.T.-Harvard groups for K^- interactions in flight and at rest, and for decays in flight. Tracks of grain density appropriate to K particles of the selected momentum were found near the edge of the plate where they entered and were followed until they decayed in flight, interacted in flight, or came to rest in the emulsion stack. An event was interpreted as a decay in flight if there was only one outgoing prong and if it had a grain density less than that of the incoming K particle. (No event of this type was found that had a blob associated

[1] Iloff, Chupp, Goldhaber, Goldhaber, Lannutti, Pevsner, and Ritson, Phys. Rev. **99**, 1617 (1955).

[2] Kerth, Stork, Haddock, and Whitehead, Phys. Rev. **99**, 641 (A) (1955).

with it.) An event so interpreted could also possibly be an interaction in flight of a K^- meson and a nucleus with a lightly ionizing π meson emerging. In K^- interactions at rest less than 3% of the stars were found to be of this nature. Since interactions in flight would be expected to leave the nucleus in a more highly excited state than interactions at rest, the proportion of stars with a single pion and with no other tracks or "blobs" associated would be even smaller. We estimate that certainly less than 15% of the events we have taken to be decays in flight may have been interactions in flight (this corresponds to 3% of all interactions in flight).[3]

The mean lifetime is

$$\tau_{K^-} = \sum_{i=1}^{N} t_i/n = T/n,$$

where N is the number of tracks observed, n is the number of decays in flight observed, $T = \sum_{i=1}^{N} t_i$, and t_i is the proper time during which a particle travels in the emulsion from where it is first observed to the point of interaction or decay in flight, or (if the particle comes to rest) to 2 mm from the end of the track. (The last 2 mm of a stopping track are not included, since a decay in flight would be difficult to identify in this region.) The tables of Barkas and Young[4] were used to calculate T. Table I gives the total proper time of flight T, the number n of decays in flight observed and the resulting mean lifetime τ_{K^-}, for each of the three groups. The combined result is

$$\tau_{K^-} = 0.95^{+0.36}_{-0.25} \times 10^{-8} \text{ sec.}$$

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[3] No correction for this effect was made in our results.

[4] W.H. Barkas and D.M. Young, University of California Radiation Laboratory Report No. UCRL-2579 (Rev.), Sept. 1954.

Table I

Results of determinations of mean lifetime of τ_{K^-}- mesons			
Group	Total proper time	Number of decays in flight n	Mean lifetime τ_{K^-}
Berkeley	3.96×10^{-8} sec	4	0.99×10^{-8} sec
Livermore	2.63×10^{-8} sec	3	0.88×10^{-8} sec
M.I.T.-Harvard	5.78×10^{-8} sec	6	0.96×10^{-8} sec
Total	12.37×10^{-8} sec		$\tau_{K^-}= 0.95^{+0.36}_{-0.25} \times 10^{-8}$ sec.

The error quoted is the statistical standard deviation, other errors being negligible in comparison. If the K^- beam consists of a mixture of particles of different mean lifetimes, the quantity we have measured is an average, of the form

$$\tau_{K^-} = \left(\sum_i \frac{a_i}{\tau_i} \right)^{-1} \quad ,$$

where a_i is the fraction of the particles entering the stack associated with a mean lifetime of τ_i. Particles of mean lifetime less than 0.3×10^{-8} sec would be highly discriminated against, since less than 1% of those leaving the target would arrive at the emulsion stack. No. decay in flight of a τ^- meson was observed.

It is of interest to compare the K^--meson mean lifetime with the various measurements of the K^+ mean lifetime. These data, together with

results of the work reported herein, are presented in Fig. 1.[5] It is
evident that within the experimental error there is no detectable difference
between the mean lifetimes of the K^- and K^+ mesons.

We wish to express our appreciation to Dr. Edward J. Lofgren and the
Bevatron crew for their help in making the exposures. We also wish to thank
the scanners with each of the three groups for their invaluable assistance in
scanning the plates.

This work was performed under the auspices of the U.S. Atomic Energy
Commission.

LEGEND

Fig. 1. A comparison of the K^- meson mean lifetime with K^+ meson mean lifetimes reported by various experimenters. (Values are plotted on a logarithmic scale.)

(A) L. Mezzetti and J. Keuffel, Phys. Rev. 95, 859 (1954).

(B) Barker, Binnie, Hyams, Rout, and Sheppard, Phil. Mag.
46, 307 (1955), and Proceedings of the International Conference
on Elementary Particles, Pisa, Italy, June 1955 (to be published).

(C) L. Alvarez and S. Goldhaber, Nuovo Cimento 2, 344 (1955).

(D) Iloff, Chupp, Goldhaber, Goldhaber, Lannutti, Pevsner, and
Ritson, Phys. Rev. 99, 1617 (1955).

(E) K. Robinson, Phys. Rev. 99, 1606 (1955).

(F) G. Harris, J. Orear, and S. Taylor, Phys. Rev. 100, 932 (1955).

(G) Alvarez, Crawford, Good, and Stevenson, Phys. Rev. 101, 496
(1956).

(H) V. Fitch and R. Motley, Phys. Rev. 101, 496 (1956).

0.5 1.0 2.0

		APPROX. TIME DELAY PRIOR TO DETECTION
K^+(EXCEPT τ^+)	(A) COSMIC RAYS, COUNTERS	1.2×10^{-8} SEC
K^+(EXCEPT τ^+)	(B) COSMIC RAYS, COUNTERS, & CLOUD CHAMBER	0.5 "
τ^+	(C) BEVATRON, EMULSIONS	0.2 "
K^+(EXCEPT τ^+)	(D) BEVATRON, EMULSIONS	1 "
K^+ (EXCEPT τ^+)	(E) COSMIC RAYS, COUNTERS	1.2 "
τ^+ K^+ (EXCEPT τ^+)	(F) BEVATRON, EMULSIONS	1.3 "
$K^+_{\mu 2}$ $K^+_{\pi 2}$ K^+	(G) BEVATRON, COUNTERS	1.6 "
$K^+_{\mu 2}$ $K^+_{\pi 2}$	(H) COSMOTRON, COUNTERS	2 "
K^-	PRESENT WORK, BEVATRON, EMULSIONS	1.5 "

0.5 1.0 2.0

τ_K, IN UNITS OF 10^8 SEC