Lawrence Berkeley National Laboratory

Recent Work

Title

INTERACTION AND DECAY OF NEGATIVE K PARTICLES IN FLIGHT

Permalink

https://escholarship.org/uc/item/1gm0v8xm

Authors

Goldhaber, Gerson Goldhaber, Sulamith Iloff, Edwin L. et al.

Publication Date

1955-06-10

UNIVERSITY OF CALIFORNIA

Radiation Laboratory

TWO-WEEK LOAN COPY

This is a Library Circulating Copy which may be borrowed for two weeks. For a personal retention copy, call Tech. Info. Division, Ext. 5545

BERKELEY, CALIFORNIA

DISCLAIMER

This document was prepared as an account of work sponsored by the United States Government. While this document is believed to contain correct information, neither the United States Government nor any agency thereof, nor the Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or the Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof or the Regents of the University of California.

UNIVERSITY OF CALIFORNIA

UNCLASSIFIED

ā

Radiation Laboratory Berkeley, California Contract No. W-7405-eng-48

INTERACTION AND DECAY OF NEGATIVE K PARTICLES IN FLIGHT

Gerson Goldhaber, Sulamith Goldhaber, Edwin L. Iloff, Joseph E. Lannutti, and Francisch. Webb

and

M. Widgoff - Harvard University

and

A. Pevsner and D. Ritson - M. I. T.

June 10, 1955

To be published in the PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON ELEMENTARY PARTICLES, Pisa, Italy, June 1955

Printed for the U. S. Atomic Energy Commission

INTERACTION AND DECAY OF REGATIVE W PARTICLES IN FLIGHT

Gerson Goldhaber, Sulamith Goldhaber, Edwin I., Hoff, Joseph E. Lannutti, and Francis Z. Webb

> Radiation Laboratory, University of California, Berkeley, California

> > and

M. Widgoff,

Harvard University, Dept. of Physics, Cambridge, Massachusetts

and

A. Pevsner and D. Ritson,

Massachusetts Institute of Technology, Cambridge, Massachusetts

June 10, 1955

Tegether with the study of the interactions and decays of positive K particles, we have also started a similar study on negative K particles in flight. The problem here is considerably harder because of the low abundance of negative K particles.

In contrast to the behavior of K^{*} particles, the observed interactions of K^{*} mesons in flight include occasional large stars, accompanied by n-meson emission. We also have evidence that the cross section for K^{*} interaction is larger than the K^{*} cross section. In particular, we agree with Hornbostel and Salant that the cross section may be geometric. All these factors add up to the striking difference in the nature of the interactions between positive and negative K particles. As mentioned before these factors tend to confirm the cuncept of a quantum number 4,5,6 ("strangeness"), which has two different values for K[†] and K^{*} mesons.

The observed larger interaction cross section for K mesons can be considered evidence for a "stronger interaction". It may also perhaps account partly for the much lower abundance of K mesons. As production has so far once observed only with complex nuclei, it may be considered that the K once produced is more easily reabsorbed, while the K under similar circumstances would be smitted. Of course a possible shorter lifetime (see below) for K meson. It also contribute to their lower abundance, as does the presumed removed that K mesons be graduced in pairs. 4, 5, 6

We exposed an emulsion stack to the focused K beam and, by techniques very similar to those described for K mesons, we have looked for K interactions and decays. One difference here was that scanning could be started right at the edge where the K mesons enter, as there are no protons of the same momentum.

In 3 meters of K followed, we have found six interactions in flight. We have also found three events which we have classified as decays in flight.

A. Interactions in Flight

The six interactions in flight of K⁻ mesons observed are described in Table I.

In three cases, numbers 1, 2, and 5, the visible energy release plus the binding energy of the outgoing particles exceeds the kinetic energy of the incoming K⁻ meson.

Of the six stars, at least two and probably three have pions coming out. The mean free path for K -particle interaction is thus probably consistent with the geometric mean free path.

B. Decay in Flight

In the 3 meters of K⁻ track followed, three decays in flight were found. We have classified as a decay in flight an event having one outgoing prong that has a smaller grain density than the K⁻ track being followed. Of course, in the case of K⁻ mesons, it cannot be completely ruled out that some of these events are nuclear interactions in which just a π meson is emitted. However, because of the catastrophic nature of the K⁻ interactions in flight, it appears to us very unlikely that no sign of a recoil or black evaporation prong should appear in conjunction with a π emission.

The K⁻ track followed corresponds to a proper time of 1.95 x 10^{-8} second. The last 2 mm of K⁻ tracks that stopped were not included, since decays in flight in this part of the track cannot be readily identified. The resulting mean lifetime for K⁻ mesons is $0.65 \pm 0.45 \times 10^{-8}$ second. The error quoted is due to the statistical standard deviation, other errors being negligible in comparison. This appears to be shorter than the K⁺ mean lifetime; however, with the small number of events involved, no definite conclusion can be reached.

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

Table I

K Interactions in flight

Vo.	Energy of K at Interaction [Niev]	Prong Number	Range	Energy* (Mev)	Identity	Comments
1	05 4 5	1	180µ	5	(p)	ille a behraum vistan 16. Tertikahan. 3 34 f Tendrin yahr shandigi 2 Pennepitrini taun dan dara dan dara var vaganyan
		2	440µ	9	(p)	
		3		55	(π)	Grain density is 1,5 x minimum
s.		Pion rest energ	зу	140		If Prong 3 is a proton, its energy is 380 Mev and the total
		Binding energy		16		energy would be 413 Mev.
			TOTAL	225		
2	87 ± 5	1	1790μ	20	(p)	ann air a' a dheathaidh a chairt a bha a se chuir deadh an dheadh a chuir fheath de a dheath an seach se agus T
٠.		` 2	>15.9 mm	> 68	(p)	
		3	370µ	8	(p)	
		4	28,8 mm	42		s. Gives 1-prong star.
		5	113μ	4	(p)	
		6	230μ	6	(p)	
		7	75µ	3	(p)	
		Pion rest energy Binding energy		140 48		
			TOTAL	>339		
3	77 ± 6	1 2	62μ 1490μ	2.6 17.8	(p) (p)	a final of Blanck of Blanck (1) final control y or a control graph modely paper to the control of control control of the contr
		Binding energy		16	•	
			TOTAL	36		
4	70 ± 6	1	716µ	12	(p)	● Britan editional to 2 (2) March 10 (March 10) Britan 10 (1) March 10 (March 10) Annother 1 (March 10) March 10 (March 10) M
	•	Binding energy		8 		
5		·	TOTAL	20		ery america desir del trata part i mandra del refer del como como como como como como como com
J		2			(p) (π)	· .
6		1			(p)	and the second section of the second
•		2 3			(p) ?} G:	rey ozona

References

- 1. W. W. Chupp, Gerson Goldhaber, S. Goldhaber, E. L. Hoff, J. E. Lannutti, "Interactions and Decay of Positive K Particles in Flight," University of California Radiation Laboratory Report No. UCRL-3021, June 13, 1955 (Report for Pisa meeting.)
- 2. W. W. Chupp, S. Goldhaber, G. Goldhaber, W. R. Johnson, F. Webb, "K-Particle Production at the Bevatron" University of California Radiation Laboratory Report No. UCRL-3009 Abstract, May 19, 1955 (Report for Pisa meeting).
- 3. Hornbostel and Salant, Phys. Rev. 98, 218 (1955).
- 4. Gell-Mann and Pais, Proceedings of the International Physics Conference, Glasgow, July 1954.
- 5. M. Goldhaber, "Compound hypothesis of heavy unstable particles." Private communication, unpublished.
- 6. R. G. Sachs, "A Classification of the Fundamental Particles," Private communication, unpublished.
- 7. Kerth, Stork, Haddock, and Whitehead, Bull. Am. Phys. Soc. 30, 41 (1955).