Lawrence Berkeley National Laboratory

Recent Work

Title

RESULTS FROM AN ENRICHED NEGATIVE K-MESON BEAM

Permalink

<https://escholarship.org/uc/item/49j977pq>

Authors

Barkas, Walter H.
Dudziak, Walter F.
Giles, Peter C.
et al.

Publication Date

1956-12-21

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

Radiation Laboratory
Berkeley, California

Contract No. W-7405-eng-48

RESULTS FROM AN ENRICHED NEGATIVE K-MESON BEAM

W. H. Barkas, W. F. Dudziak, P. C. Giles,
H. H. Heckman, F. W. Inman, C. J. Mason,
N. A. Nichols, and F. M. Smith

December 21, 1956

RESULTS FROM AN ENRICHED NEGATIVE K-MESON BEAM*

W. H. Barkas, W. F. Dudziak, P. C. Giles,
H. H. Heckman, F. W. Inman, C. J. Mason,
N. A. Nichols, and F. M. Smith

Radiation Laboratory
University of California
Berkeley, California

December 21, 1956

We have recently obtained a K^- -meson beam from the Bevatron in which the intensity was greatly enhanced by selection of particles emitted in the forward direction. We further improved the usefulness of the beam incident on our emulsion stacks by causing the magnetically analyzed particles of 435 Mev/c to traverse a polystyrene degrader of 18.36 g/cm^2 and undergo a second bending of 180° , thus discarding the pion component of the beam. The remaining background tracks are chiefly muons and electrons. A small emulsion stack exposed in order to evaluate the beam has already yielded useful information. Although much more work is planned on this and a larger stack, some of the data now in hand are of sufficient interest and reliability for a preliminary report. In order to make quantitative measurements the emulsion density was carefully determined, and we employed our new range-energy curve.¹ The numbers in Table I were derived from along-the-track scanning of 1224 K mesons. Of these 21 decayed in flight, 182 interacted inelastically in flight with emulsion nuclei, 6 scattered elastically from free protons in the emulsion, 2 interacted in flight with free protons to produce negative hyperons, and

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

¹ Barkas, Barrett, Cüer, Heckman, Smith, and Ticho, Phys. Rev. 102, 583 (1956); Phys. Rev 100, 1797 (1955); and Bull. Am. Phys. Soc. II, 1, 184 (1956).

only 2 interacted at rest with free protons to produce charged hyperons (the two had opposite signs). The K-meson energy interval for which the interaction cross sections were calculated was 30 to 90 Mev. Analysis of hyperfragments and their parent stars was carried out on an IBM 650 digital computer using a program kindly supplied by Dr. C. Violet. We are greatly indebted to Ernestine Beale, Anna-Mary Bush, Thoma Davis, John Dyer, Renée Feldman, Hester Lowe, Lynn Reynolds, and Toni Woodford for their conscientious scanning work.

Table I

K ⁻ mean life	$1.46^{+0.38}_{-0.31} \times 10^{-8}$ sec
K ⁻ -proton elastic scattering cross sections	$52^{+31}_{-21} \times 10^{-27}$ cm ²
K ⁻ free path for inelastic collisions in emulsion	27.2 ± 2.3 cm
Σ^+ mass (from $\Sigma^+ \rightarrow$ proton decay)	2327.8 ± 0.7 m _e
Σ^- mass (from $\Sigma^- - \Sigma^+$ mass difference)	2341.5 ± 2.3 m _e
K ⁻ mass (from $K^- + p \rightarrow \Sigma^+ + \pi^-$ at rest)	965.3 ± 1.5 m _e
K ⁻ mass (from $K^- + p \rightarrow \Sigma^- + \pi^+$ in flight)	961.4 ± 3.3 m _e
K ⁻ mass (from $K^- + p$ elastic collisions)	978 ± 57 m _e
Binding of Λ^0 in Λ He ⁵	3.0 ± 0.6 Mev
Binding of Λ^0 in Λ He ⁴	1.2 ± 1.0 Mev
Binding of Λ^0 in Λ Li ⁹	3.8 ± 3.0 Mev
Decay branching ratio $\frac{\Sigma^+ \rightarrow p + \pi^0}{\Sigma^+ \rightarrow N + \pi^+}$	13/13
Frequency distribution of prongs from K ⁻ stars at rest	
0:1:2:3:4:5:6:7:8:9	36:43:63:30:28:20:9:2:2:1
Frequency distribution of prongs from K ⁻ stars in flight	
0:1:2:3:4:5:6:7:8:9:10:11:12	16:22:46:34:31:14:8:4:0:1:1:0:1
Frequency distribution of prongs from K ⁻ stars that emit hyperfragments	
1:2:3:4:5:6:7:8	1:3:11:12:6:3:2:3:1
Frequency distribution of hyperfragment prongs	
1:2:3:4:5:6:7	4:11:15:5:3:1:1
Frequency of hyperfragment emission from K ⁻ stars	28/1152
Ratio of mesonic to nonmesonic decay of hyperfragments	9/42