Wyld.[3] They considered two cases, $a+$ and $a-$, of the nuclear K^{-}-p scattering phase shifts, and these two curves are shown in Fig. 1. It is seen that our results, as also those of the Berkeley bubble chamber group, suggest the attractive $a+$ set of K^{-}-p nuclear phase shifts.

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*Fulbright and Guggenheim scholar on leave from University of Illinois, Urbana, Illinois.

†On leave from University of Mysore, Mysore, India.

‡On leave from University of Warsaw, Warsaw, Poland.

‖Miss V. Mayes and Mr. M. G. Bowler assisted in the early part of the work.

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Ξ^{-} PRODUCTION BY K^{-} MESONS

William B. Fowler,* Robert W. Birge,† Philippe Eberhard,‡ Robert Ely, Myron L. Good,‖ Wilson M. Powell, and Harold K. Ticho**
Lawrence Radiation Laboratory, University of California, Berkeley, California
(Received January 6, 1961)

The Berkeley 30-inch propane chamber was operated in a 1.17-Bev/c K^{-} beam[1] at the Bevatron to produce cascade particles. Out of the 100 000 pictures taken, there have been 18 positively identified negative cascade decays with the decay mode $\Xi^{-} \rightarrow \Lambda + \pi^{-}$. Of these, six were produced with a K^{+} meson and three were accompanied by a visible θ_1 decay. Three of the events with a K^{+} satisfy the kinematics for the hydrogen interaction

$$K^{-} + p \rightarrow \Xi^{-} + K^{+},$$

and the other three are assumed to have been produced from protons in carbon. Two of the K^{+} decayed in the chamber and the other four were identified by comparing momentum and ionization. Since only one-third of the K^{0} produced in the interaction

$$K^{-} + n \rightarrow \Xi^{-} + K^{0}$$

decay into a visible mode, it is quite consistent to attribute the nine events in which no positive-strangeness K particle was observed to the neutral mode of the θ_1 decay, to the θ_2 decay, or to a K^{+} that could not be distinguished from a proton.

The 18 events were selected from a sample of 47 in which a V particle was thought to come from a prong of a K^{-} interaction which appeared to decay into a π^{-}. The selection consisted of a series of two single-origin constraints on an IBM-704 calculator: (a) the Q of the V particle was required to be consistent with that of a Λ, 37 Mev, and its line of flight consistent with the assumed Ξ^{-} decay origin; (b) the Λ and the π^{-} were required to be coplanar with the assumed Ξ^{-} and to balance transverse momentum. Revised estimates of the momentum and angles of the Λ and π^{-} were obtained from the constraint program, and the average mass of the Ξ^{-} for the 18 surviving events, weighted by the estimated probable error of each event, was found to be

$$M_{\Xi^{-}} = 1317.9 \pm 1.9 \text{ Mev}.$$

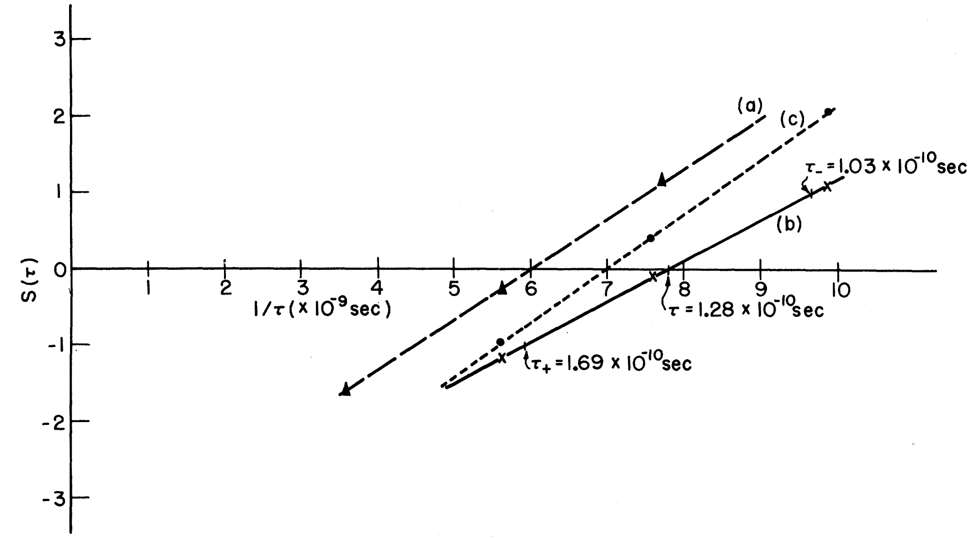

FIG. 1. Bartlett's $S(\tau)$ function with a Λ lifetime correction for (a) the 18 observed Ξ^- from this experiment, (b) this experiment corrected for scanning bias, and (c) the corrected data of this experiment combined with six events from Trilling and Neugebauer.[3]

The mean life of the Ξ^- has been determined by means of a modification of the statistical method of Bartlett[2] which accounts for the necessity of seeing the Λ decay before the Ξ^- leaves the chamber. The possible time for decay was determined by calculating the time of flight to the boundary of the fiducial region, which was chosen to allow a minimum of 4 cm for the measurement of the Λ decay. In all cases the correction due to finite chamber size is small, and the total correction amounts to less than 10% of the uncorrected mean of the actual flight times. The flight times include dE/dx corrections and the possible times were modified for those cases in which the Ξ^- would have come to rest before leaving the chamber. Figure 1 shows a plot of Bartlett's S function as a function of $1/\tau$. This function is zero at the most probable lifetime and ± 1 at the best estimate of the standard error. Figure 2 is a cumulative histogram of the calculated times of flight, t_i, and indicates a considerable scanning bias against flight times less than 0.5×10^{-10} sec. An estimate of the total number of events was obtained by fitting those events with a time of flight greater than 0.5×10^{-10} sec to the exponential $N_0e^{-t/\tau}$. The revised mean life consistent with this procedure required the addition of seven events in the interval from zero to 0.5×10^{-10} sec, and was found to be

$$\tau=(1.28^{+0.41}_{-0.25})\times10^{-10}\text{ sec.}$$

The S function corrected for scanning bias is shown as the solid line b in Fig. 1. This mean life is considerably shorter than that found by Trilling and Neugebauer.[3] However, their events at high cascade momentum required much greater corrections for chamber size. The dashed line c in Fig. 1 shows the S function for their six events combined with our 25 (including corrections for scanning bias), and it is seen that the combined mean life falls within our error.

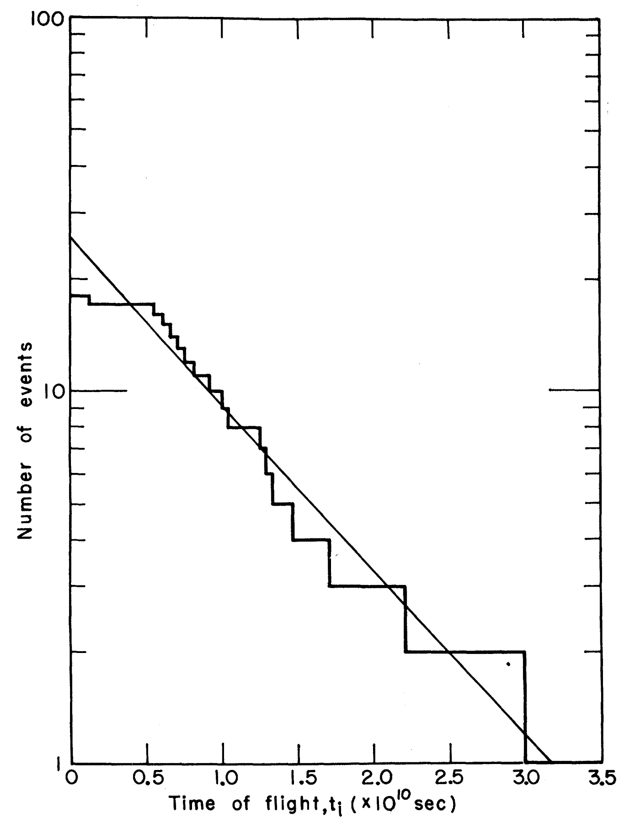

FIG. 2. A cumulative histogram of the times of flight of the Ξ^-. The solid line is the best fit of those events with $t_i > 0.5\times10^{-10}$ sec to an exponential.

A violation of parity conservation in the cascade decay will manifest itself as a fore-aft asymmetry in the Λ decay, the Ξ^- serving to polarize the Λ with the strength α_Ξ which is then analyzed by the Λ decay. Denoting a unit vector in the direction of the Λ in the Ξ^- rest frame as $\hat{u}$ and a unit vector in the direction of the proton in the Λ center-of-mass system as $\hat{p}$, the distribution of $\hat{u}\cdot\hat{p}$ is[4]

$$P(\hat{u}\cdot\hat{p})\,d(\hat{u}\cdot\hat{p}) = \tfrac{1}{2}[1 + (\alpha_\Xi\alpha_\Lambda)(\hat{u}\cdot\hat{p})]\,d(\hat{u}\cdot\hat{p}).$$

We have found, on the basis of the above 18 events,

$$(\alpha_\Xi\alpha_\Lambda) = -0.65 \pm 0.35,$$

using $(\alpha_\Xi\alpha_\Lambda) = (3/N)\sum_i(\hat{u}\cdot\hat{p})_i$ as the best method of estimation. The negative sign shows the helicity of the Λ from the Ξ^- to be opposite to that of the proton from Λ decay. Birge and Fowler[5] find the helicity of the proton to be positive, implying that the helicity of the Λ is negative. Using the best estimate of the magnitude of $|\alpha_\Lambda|$ as 0.95 ± 0.07,[6] and the sign of α_Λ as determined by Birge and Fowler, we find

$$\alpha_\Xi = 0.69 \pm 0.36.$$

The possibility of an up-down asymmetry of the decay π^- from $\Xi^- \rightarrow \Lambda + \pi^-$ produced in the reaction

$$K^- + N \rightarrow \Xi^- + K$$

has been examined, and $(\alpha_\Xi\bar{P})$ is -0.28 ± 0.40, where $\bar{P}$ is the polarization of the Ξ^- in production and α_Ξ the decay asymmetry parameter. There seems to be no indication that the Ξ^- produced in this manner from carbon are polarized.

In the 100 000 pictures we had a total of $(1.5 \pm 0.2) \times 10^7$ cm of K^- track length. After adding seven events to correct for scanning bias and then 50% to correct for the unobserved neutral decay mode of the Λ, we estimate the total number of Ξ^- to be 37.5. On this basis the Ξ^- production cross section in the reaction $K^- + N \rightarrow \Xi^- + K$ is

$$\sigma_{\Xi^-} = 18 \pm 5\ \mu\text{b/nucleon},$$

assuming an $A^{2/3}$ correction for shielding in the carbon nucleus.

*Brookhaven National Laboratory, Upton, New York.

†Laboratoire de Physique, Ecole Polytechnique, Paris, France.

‡Laboratoire de Physique, Collège de France, Berthelot, Paris, France.

‖Physics Department, University of Wisconsin, Madison, Wisconsin.

**Physics Department, University of California, Los Angeles, California.

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TEST FOR PION-PION RESONANCE

G. Pinski
Department of Physics and Astronomy, University of Rochester, Rochester, New York
(Received January 9, 1961)

It has been suggested[1] that the two-pion effective mass squared distribution in antinucleon annihilation could serve as an efficient test for the proposed pion-pion resonance. This currently fashionable resonance has been investigated on several fronts.[2-4] In this note, we would like to suggest a particular decay mode for study, in which the effects of a pion-pion resonance would be most easily detected.

The relative transition probability for annihilation into n mesons is given, according to the covariant statistical theory,[5] by

$$W_n = \int \prod_i^n [d^4p_i\ \theta(p_i^0)\delta(p_i^2 - 1)]f(P_N, P_{\bar{N}}, p_i)\delta^4(P_N + P_{\bar{N}} - \sum_i^n p_i).$$