60°K, and by about 13% at 64°K. Unfortunately, in order to verify these deviations from Eq. (7) one needs more accurate data on α and $2H_EH_A$ than are available at present.

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[7]To obtain D one must use the appropriate exchange constants. If these are taken from neutron diffraction data [A. Okazaki et al., Phys. Letters 8, 9 (1964)] one obtains $T_N = 86°K$ and $D = 1.06 \times 10^{-10}$ °K/G^2. Alternatively, one may neglect the intrasublattice exchange constant, which neutron diffraction shows to be small, and use the measured T_N to evaluate the intersublattice exchange constant. One then obtains $D = 1.25 \times 10^{-10}$ °K/G^2. Still another procedure was used by Heller (Ref. 6) who expressed D in terms of the measured value of T_N and the susceptibility, χ_N, at T_N. This gives $D = 0.7 \times 10^{-10}$ °K/G^2. It should be noted, however, that when the measured χ_N and T_N are interpreted in the molecular-field approximation, they lead to different values for the exchange constant.

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SEARCH FOR A POSSIBLE $I = 0$, $Y = 0$ BARYON IN $\bar{K}^-d$ INTERACTIONS AT LOW ENERGY*

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An attempt has been made to detect possible existence of a new neutral hyperon by studying both the missing-mass system and the $\Lambda\gamma$ system. Our result does not warrant the necessity of introducing any new hyperon near the mass of Λ, although it is not sensitive enough to dismiss the possibility entirely.

According to the SU(3) scheme, the existence of a singlet member belonging to the baryon nonet that contains the nucleons is possible, although its mass cannot be predicted. Even without the theoretical motivation it would still be interesting to search for any possible new $I = 0$ hyperon near the Λ-Σ mass region, hereafter referred to as X^0. An investigation in this region has not previously been reported. We have carried out a search for the possible existence of X^0 that might be produced in K^-d interactions at low energy. In particular, we looked for it in the region just slightly above the mass of Λ. Our investigation includes the study of the missing-mass system as well as the search for the possible decay products $\Lambda+\gamma$ and/or $\Lambda+2\gamma$.

Approximately 80 000 pictures were taken to study K^-d interactions by exposing the 30-in. Brookhaven National Laboratory deuterium-filled bubble chamber to a low-energy separated K^-

beam at the alternating-gradient synchrotron. About half of the K^- interact at rest while the remainder interact in flight with momenta ranging up to 250 MeV/c. We scanned for the following event types: (a) a two-prong that consists of a proton and a π^-, (b) a two-prong plus a Λ, and (c) both configurations associated with a Dalitz pair or with obvious e^+e^- conversion pairs. The scan for (a) and (b) covers about two-thirds of the available pictures, while the scan for (c) includes the entire exposure. To mimimize the measurement errors, a fiducial region is imposed to ensure that at least 10 cm of measurable charged track length is available for all nonstopping tracks in the selected events. Events which do not contain any secondary scatterings were measured, reconstructed, and appropriately fitted to the hypotheses

$$K^- + d \to p + \pi^- + \text{missing mass}, \quad (1)$$

$$\to p + \pi^- + \Lambda, \quad (2)$$

$$\to p + \pi^- + \Sigma^0, \quad (3)$$

$$\to p + \pi^- + \Lambda + \gamma. \quad (4)$$

All events with a stopping proton having a measured track length of less than 2 mm are discarded.

Figure 1 shows the missing-mass distribution from Reaction (1). It includes 13 827 events, and the average mass error is estimated to be about 16 MeV. Figure 2 exhibits the $\Lambda\gamma$ combined mass distribution from a sample of 656 stopping K^- events fitting Reaction (4). These events also fit (2) and (3). From both figures it is obvious that the Λ and Σ^0 peaks are very well separated. In fact, there are no ambiguous fits between hypotheses (2) and (3). Events outside the peaks were investigated. If X^0 exists, its mass is not expected to be smaller than the Λ mass; otherwise Λ would preferably decay into $X^0+\gamma$ rather than decaying into the dominantly observed pion-nucleon mode. Therefore, all the events in the tail of the lower mass half of the Λ peak may be attributed entirely to statistical errors. The events in the region between 1135 and 1170 MeV and between 1210 and 1250 MeV can also be ascribed to similar experimental uncertainties. The upper limit for the production of X^0 outside Λ and Σ^0 peaks is estimated to be no more than 3 % of the Σ^0 production rate. Above 1250 MeV, production of π^0 is possible; however, no significant number of events are present in this region and the distribution is excluded. If X^0 exists, its signature may be revealed only by detecting the possible decay modes such as $\Lambda+\gamma$ and $\Lambda+2\gamma$. In the event that X^0 is close to the Σ^0 peak, the separation of X^0 from Σ^0 will be almost impossible unless $X^0 \to \Lambda + 2\gamma$. Detection of just one γ will not allow unambiguous distinction from the Σ^0. On the other hand, the chance of observing both γ's is negligible in this study. However, if X^0 is hidden under the Λ peak, then its existence can be uncovered unambiguously as long as the production rate is large enough to allow conversion of some gammas into e^+e^- pairs or detection of unambiguous Compton scatterings. We discuss the detailed examination below.

Compton electrons. — The Compton-scattering cross section rises rapidly as the energy of the γ decreases. Therefore, in principle it should offer the best means to detect soft-photon emission from K^-d interaction. In practice, however, it is difficult to associate the Compton electron with the interaction vertex simply by scanning. From the sample of 656 events fitting Re-

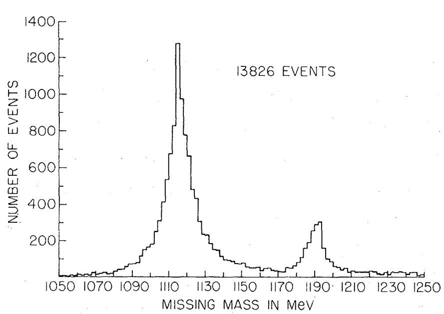

FIG. 1. Missing-mass distributions.

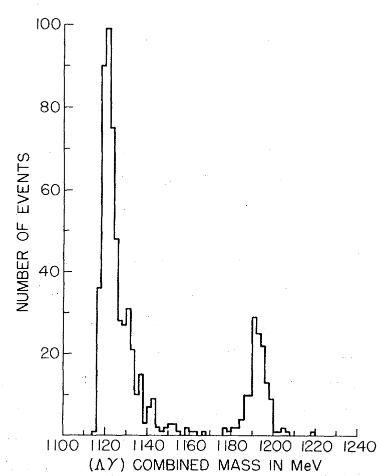

FIG. 2. $\Lambda\gamma$ combined mass distributions from a sample of 651 K^-d interactions at rest.

action (4), efforts were made to measure all possible Compton electrons that appear along the direction of the emitted gammas. At least 77 events with low-energy photons fitted Reaction (4) with seven constraints. In most cases, however, only a small fraction of the photon energy is imparted to the scattered-off electron. Therefore, spurious fits cannot be ruled out. To examine the problem we investigated the events with higher energy γ from Σ^0 where less than three Compton scatterings are expected to occur. We found 32 good fits. This implies a Compton-scattering cross section of γ at an energy of about 60 MeV to be ten times larger than expected. Since we cannot eliminate the stray electrons from the sample, we are unable to draw any conclusions from these Compton events.

Events with e^+e^- pair. —21 events with a low-energy e^+e^- pair were found to fit hypothesis (4) with ten constraints. Another 18 events with unmeasured Λ were found to fit (4) with four constraints. The χ^2 of these events are less than four times the constraint number. The average gamma energy and $\Lambda\gamma$ mass of these events are, respectively, 7.5 and 1122 MeV. Two sources of background must be considered: (a) radiation at the production vertex and (b) stray photons originated from outside the chamber volume. Contribution from (a) is estimated to be less than one event. By scanning for all e^+e^- pairs inside the chamber, we have estimated that there are about 3300 conversion pairs with energy lying between 5 and 10 MeV for the entire exposure. From the 41 observed candidates we found that the average distance the photon traveled before conversion is about 20 cm, and the average angular uncertainty reconstructed for the gamma's line of flight is about 1.5 deg. If we take the uncertainty of the vertex association to be about $l\Delta\theta = 0.5$ cm, then the contribution ascribed to (b) is estimated to be about 35 ± 6 events. This result may be interpreted as being consistent with no evidence of any X^0 production. On the other hand, it is also consistent to assume that there may be 6 ± 6 possible genuine candidates present. Hence, a total of about 1000 ± 1000 X^0 may be produced in the reaction of the kind (1) for the entire sample because the conversion efficiency for photon at 7.5 MeV inside the fiducial region is estimated to be about 1/180. This corresponds to a production rate of about 0.25 ± 0.25 times the Σ^0 production rate via Reaction (3).

Dalitz pairs. —Observation of associated Dalitz pair will undoubtedly provide the most convincing evidence for the existence of X^0. Using the formula given by Kroll and Wada,[1] the probability of gamma conversion into Dalitz pair at 7 MeV is estimated to be about 0.002. We have not observed any candidates with Dalitz pairs at this energy nor at any other energy which is not consistent with $\Sigma^0 \to \Lambda + e^+ + e^-$. However, it is worth pointing out that the production of 1 ± 1 Dalitz pairs could still be possible, which would imply the possibility that 1000 X^0 may be produced.

The result of our experiment certainly does not warrant the necessity of introducing any new hyperon near the mass of Λ, although it is not sensitive enough to dismiss the possibility entirely.

The author wishes to express appreciation to Professor M. Perl for support and to the scanning crew for their careful and diligent efforts.

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ALGEBRAIC REALIZATION OF CHIRAL SYMMETRY AND VENEZIANO MODEL

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It is shown that the algebraic realization of chiral symmetry in which one assigns the mesons to a representation of the chiral algebra is not consistent with the Veneziano model.

The Veneziano model[1,2] enables an amplitude to be extrapolated to zero energy at which the amplitude is sensitive to the chiral-symmetry–breaking mechanism. In this way it has been shown recently[3] that the Veneziano model is consistent with the chiral-symmetry–breaking mechanism as proposed