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Publication Date
1967-04-18

UCRL-17404

University of California

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Submitted to Physical Review Letters

UCRL-17404
Preprint

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AEC Contract No. W-7405-eng-48

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We have examined the reaction $K^-D \rightarrow \Sigma^-\pi^+\pi^-p$ in the K^-n c.m. energy range from 1660 to 1900 MeV in an attempt to confirm the existence of the $Y_2^*(1415)$ reported previously by two of the authors.[1] The evidence for this isobar was based on a study of the reaction $K^- + n(\text{carbon}) \rightarrow \Sigma^-\pi^+\pi^-$ in a heavy-liquid chamber. If such a Y_2^* exists, it would be the only confirmed candidate for the 27plet of SU_3. In the present experiment K^- mesons with incident momenta of 815, 915, 1015, and 1115 MeV/c interacted in the LRL 25-in. deuterium bubble chamber. The experimental details were reported in a previous letter,[2] in which it was shown that the dominant reaction in this channel at these energies is $K^-n \rightarrow Y_1^*(1760) \rightarrow Y_0^*(1520)\pi^- \rightarrow \Sigma^-\pi^+\pi^-$.

The Dalitz plot of Fig. 1 shows that the $Y_0^*(1520)$ is produced copiously throughout the majority of the available energy region of this experiment, and therefore this isobar will reflect strongly into the $\Sigma^-\pi^-$ mass spectrum. We attempted to remove this reflection in the following manner: As is discussed in reference 2, the expected three-body phase space is the sum of phase spaces at each available energy, weighted by the probability that that energy occurs; the probability can be determined from the deuteron wave function. The derived phase space, plus Breit-Wigner curves to describe production of the $Y_0^*(1520)$ and $Y_0^*(1405)$, were combined to give the best fit to the $\Sigma^-\pi^+$ mass plot. In this way we determined the correct percentages of the reflections of these two resonances to remove from the $\Sigma^-\pi^-$ mass spectrum. The resulting distribution, together with the expected three-body phase space, is shown in Fig. 2 and gives no indication of structure near 1420 MeV or anywhere else.

A further test for an enhancement in the $\Sigma^-\pi^-$ final state involves the decay angular distribution of the $Y_0^*(1520)$. It can be simply shown that this parity-conserving decay must yield a distribution of the form $I(\theta) \sim [1 + AP_2(\cos\theta)]$, with $\cos\theta = \underset{\sim}{P}_\Sigma \cdot \hat{n}/|P_\Sigma|$. Here $\hat{n}$ is the direction of the axis of quantization and A is a function of E_{Kn} and the choice of $\hat{n}$. However, a $\Sigma^-\pi^-$ final-state interaction could cause a distortion of this distribution through interference effects where the $Y_0^*(1520)$ and assumed Y_2^* bands crossed in the Dalitz plot. A particularly good choice for $\hat{n}$ is the line of flight of the $Y_0^*(1520)$ since $\cos\theta$ varies from +1 to -1 along lines of constant $\Sigma^-\pi^+$ mass. Unless the Y_2^* were wide, we would expect to see these interference effects only in a certain range of K^-n c.m. energies. Figure 3, which shows the $Y_0^*(1520)$ decay distributions as a function of K^- beam momentum, is completely symmetric and is typical of the distributions for any choice of K^-n c.m. energy ranges. It is possible to fit these distributions under the assumption that the only process present is $Y_1^*(1760) \rightarrow Y_0^*(1520)\pi^- \rightarrow \Sigma^-\pi^+\pi^-$ with $J^P = 5/2^-$ for the $Y_1^*(1760)$.[2]

There are several fundamental differences to be observed in the comparison of the present data with those of reference 1. Most striking is the almost total lack of $Y_0^*(1520)$ in the $\Sigma^-\pi^+$ events of the K^--carbon data although the decay $Y_0^*(1520) \rightarrow \Sigma^+\pi^-$ is quite pronounced. If the Y_2^* production were so strong as to compete with the $Y_1^*(1760)$, we should expect to see the same effect in the K^-D events also, but do not. It should be mentioned that in the carbon experiment no constraint at the events' production origin was possible and that the Σ momentum was determined by a zero-C calculation at the Σ decay vertex. We examined the K^-D data with this method and found that the net effect is to smear the mass distributions. As an example, the $Y_0^*(1520)$ was found to have a width of about 60 MeV compared to an accepted width of 16 ± 2 MeV. (The K^-D production-origin constraint gave a width of 20 ± 5 MeV.) Nevertheless $Y_0^*(1520)$ production was quite pronounced in the $K^-D \rightarrow \Sigma^-\pi^+\pi^-p$ events. Another asymmetric aspect of the carbon data is the fact that the $\Sigma^-\pi^+\pi^-$ events had a much lower average K^-n center of mass energy than did the $\Sigma^+\pi^-\pi^-$ events. Most of the events in the $Y_2^*(1415)$ peak came from these lower K^-n c.m. energies. In contrast to these asymmetries, the K^-n c.m. energies available and the mass plots for the $\Sigma^-\pi^+\pi^-$ and $\Sigma^+\pi^-\pi^-$ events produced from K^-D were found to be identical.

In the previous experiment the peak interpreted as a possible Y_2^* resonance corresponded to a cross-section of 0.07 ± .015 mb. From Fig. 2 we estimate that there are less than 7 events above background in a comparable energy bin, implying a cross-section of less than 0.02 mb for Y_2^* production in the present data.

In conclusion we find no evidence for a T = 2 resonance in this experiment and set an upper limit for its production of 0.02 mb averaged over the K^-n c.m. energy interval from 1660 to 1900 MeV. The previous experiment reported the enhancement to exist down to a K^-n c.m. energy of 1615 MeV but was not confined to energies below 1660 MeV. We feel that the negative result of our experiment makes it unlikely that the enhancement of reference 1 should be interpreted as a resonance.

We would like to express our appreciation to the members of the Powell-Birge group for their interest and assistance during the course of the analysis of this data. In particular thanks go to Dr. R. W. Birge for his constant interest and encouragement.

FOOTNOTES AND REFERENCES

*Work done under the auspices of the U. S. Atomic Energy Commission.

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1. Y. L. Pan and R. P. Ely, Phys. Rev. Letters 13, 277 (1965).
2. R. B. Bell, R. W. Birge, Y. L. Pan, and R. T. Pu, Phys. Rev. Letters 16, 203 (1966).

FIGURE LEGENDS

Fig. 1. Dalitz plots of $K^-n \rightarrow \Sigma^-\pi^+\pi^-$ events and the allowed regions for various K^-n c.m. energies.

Fig. 2. $\Sigma^-\pi^-$ mass-squared plot after removal of the reflections of the $Y_0^*(1520)$ and $Y_0^*(1405)$, and the expected three-body phase space.

Fig. 3. $Y_0^*(1520)$ decay angular distributions with respect to its line of flight as a function of K^- beam momentum.

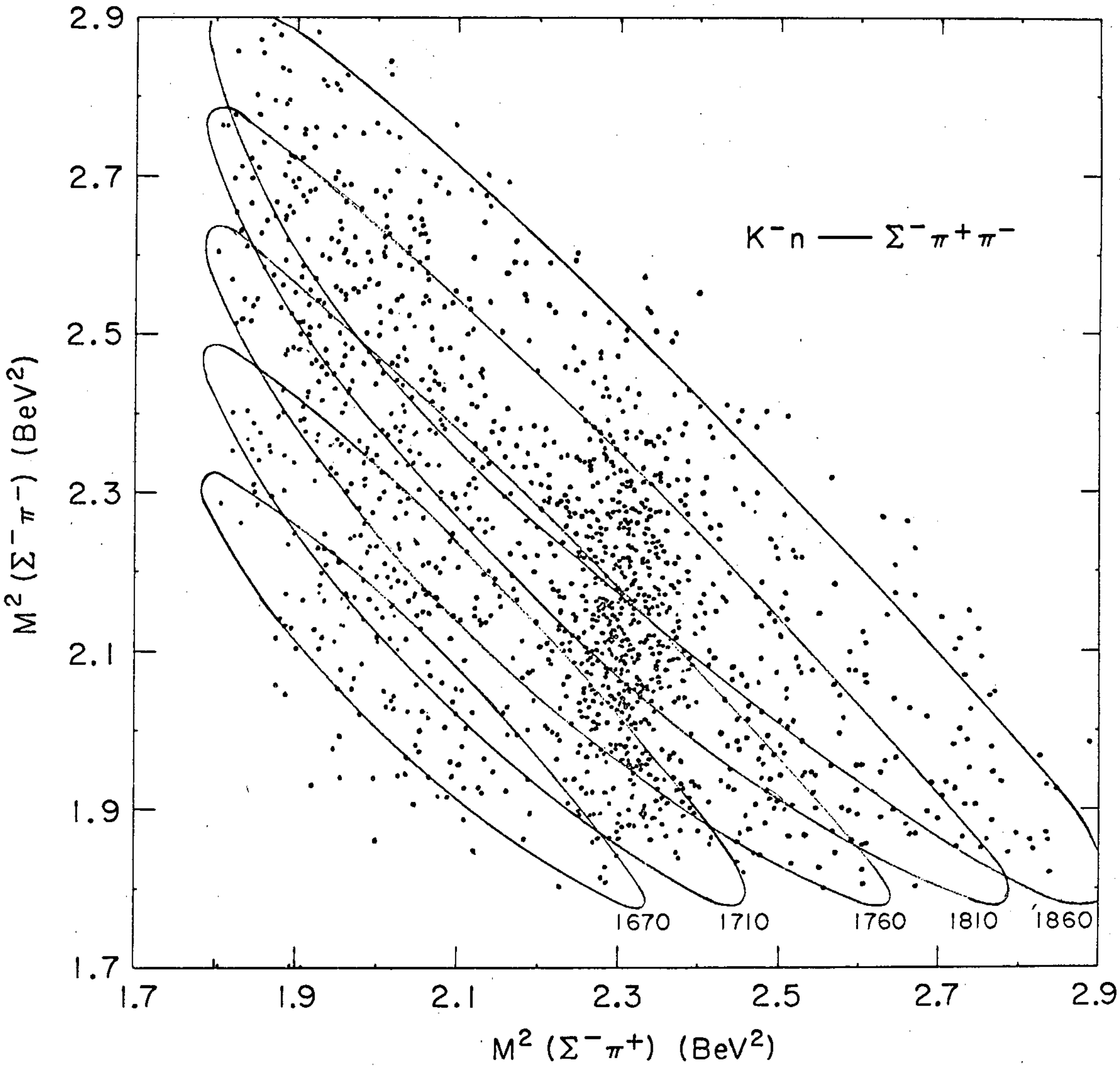

Fig. 1

MUB-11602

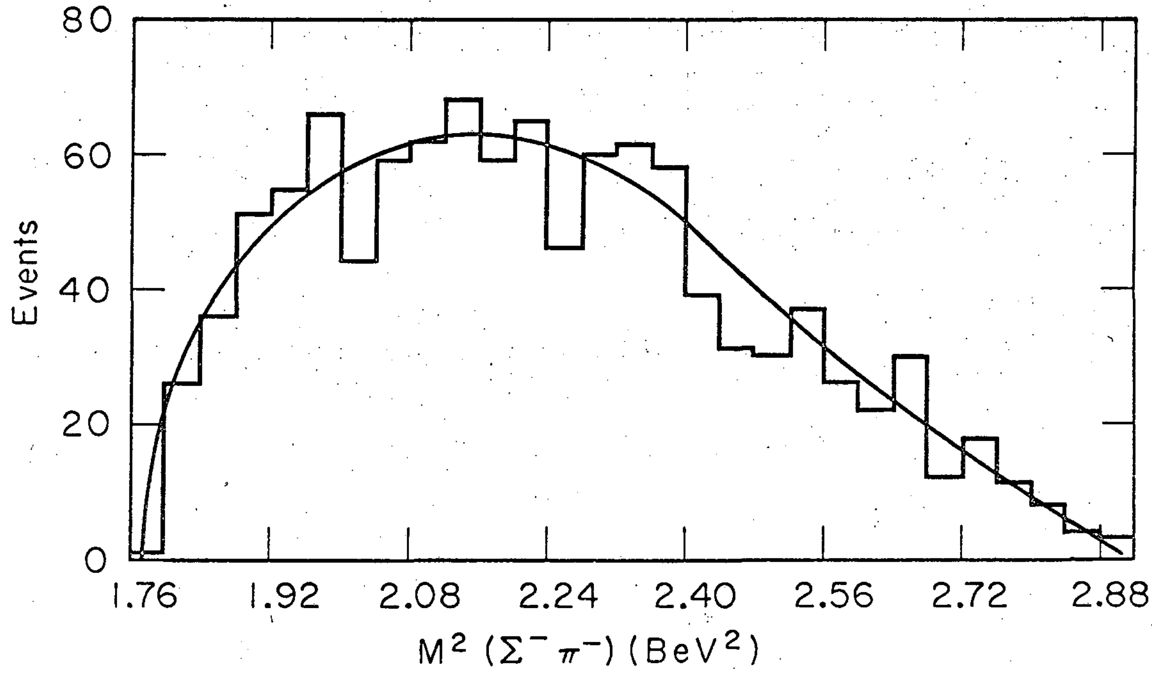

Fig. 2

MUB-11587

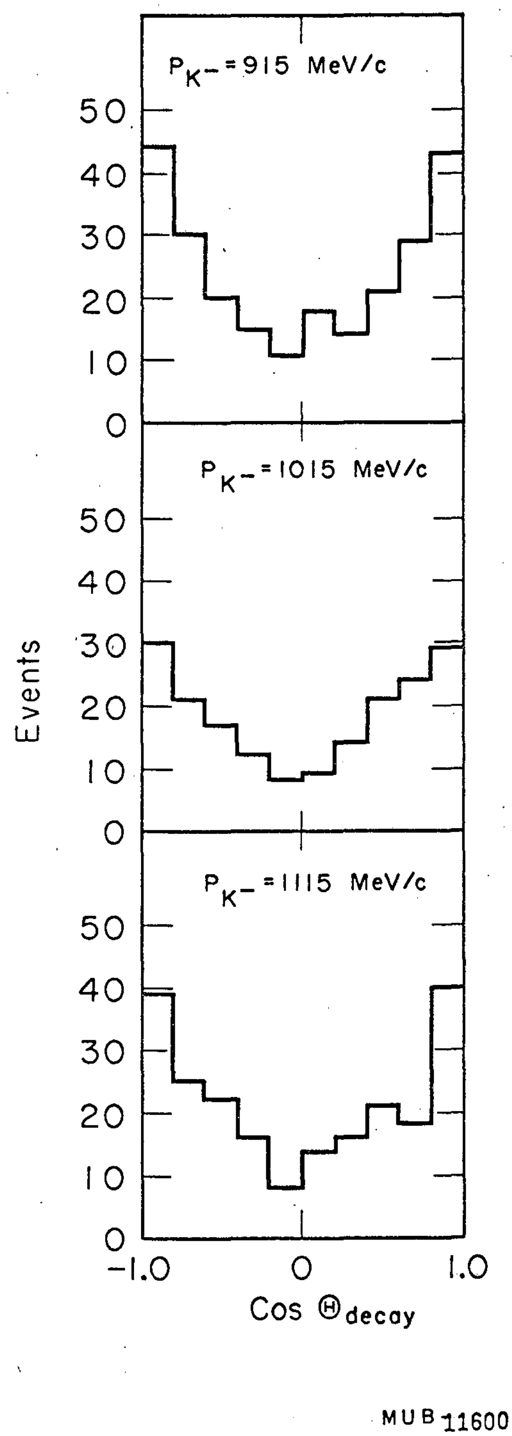
P_K- = 915 MeV/c
P_K- = 1015 MeV/c
P_K- = 1115 MeV/c
Events
50
40
30
20
10
0
-1.0
0
1.0
Cos Θdecay
MUB 11600

Fig. 3