

Spokesman: D. Duane Carmony\*  
 Dept. of Physics  
 Purdue University  
 Lafayette, Ind.  
 47907  
 TEL: (317) 749-2961

# AGS PROPOSAL

## A Proposal for an Additional Exposure of 9 GeV/c $K^+$ Mesons in the 80" D<sub>2</sub> filled Chamber

### ABSTRACT

An additional 600,000 pictures of  $K^+$  interactions in the 80" deuterium filled chamber are requested. Details of  $K_N^*(1760)$  and  $K_N^*(2200)$  production and decay will be studied and the various decay modes compared with the SU(3) predictions.

Requirements: Separated 9 GeV/c  $K^+$  beam

Ten tracks per picture

80" deuterium filled bubble chamber

600,000 pictures with 35 mm. cameras

\* On leave August 1, 1972 - September 1, 1973

Interim spokesman: F. J. Loeffler (same address and telephone)

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## I. Brief Description

This proposal is a continuation of experiments 353 and 514 which totaled 380,000 pictures. We request an additional 600,000 pictures (in not more than two chamber fills, if possible) in order to improve the current data on the new high mass resonances, the  $K_N(1760)$  and  $K_N(2200)$ , and to search for additional states. The increased data will allow a detailed comparison of the rarer decay modes of the  $K_N(1760)$  with the SU(3) predictions. This would be the largest (40 ev/ $\mu$ b per nucleon) high energy  $K^+d$  exposure to date.<sup>1</sup>

## II. Discussion of the Experiment

We are primarily interested in the charge exchange reaction

$$K^+n \rightarrow p + \text{something}$$

which is particularly rich in resonant states. In the current sample we have studied the details of  $K^*(890)$  production<sup>2</sup> and have established - without specific production mechanism assumptions - the existence of an S-wave  $K\pi$  state<sup>3</sup> of mass  $1.305 \pm .030$  GeV/ $c^2$  and width  $0.33 \pm .06$  GeV. We also see copious production of the  $K^*(1420)$  and its branching ratios have been studied.<sup>4</sup> In a recent letter<sup>5</sup> we reported the discovery of the  $K_N(1760)$  and suggested that it is the strange analogue of the  $3^-$  g-meson. We are now in a position to confirm this state in the original  $K\pi$ ,  $K^*(890)\pi$  and  $K\rho$  decay modes and have stronger evidence that the spin is indeed  $3^-$ . We also see the decay of the  $K_N(1760)$  into  $K^*(890)\rho$  and we are investigating other decay modes. In Figs. 1-4 we show the current evidence for this state. Since there are no G-parity restrictions, the high mass  $K^*$ 's have numerous decay modes and the entire  $3^-$  nonet provides a very interesting test of SU(3). We also have the largest sample of

high energy  $\pi^+p$  film in house ( $1.5 \times 10^6$  pics. at 13 GeV/c) and expect to compare the  $K_N(1760)$  to the g-meson in detail.

We also see in the above mentioned figures confirmation of the  $K_N(2200)$  which was previously reported by Lissauer et al<sup>6</sup> only as a  $\bar{N}N$  state. In the current film we have about 200 events of the final state  $\bar{N}NN$  and also see evidence (Fig. 5a) for the  $\bar{N}N$  decay mode. This could be the analogue of the  $S(1930)$  where nucleon-antinucleon decay modes as well as pionic decay modes have been reported<sup>7</sup>. We have measured about half of our 5 and 6 prongs and see possible evidence for the decay of these high mass states into  $K^*\rho$  (Fig. 5b).

Although the 1760 and 2200 MeV states are well established by the current 400,000 pictures, we need the additional data to improve the statistics of the rarer channels and to provide data for a search for still higher mass states. The additional data should unambiguously determine the spin of the 1760 MeV state and perhaps we will learn something about the spin of the 2200 MeV state. In addition the study of the coherently produced Q-effect will be continued.<sup>8</sup> We also plan to undertake a detailed study of  $K_N$  phase shifts using the entire data sample.

### III. Data Analysis

The scanning for this experiment will be done at the University of California at Davis and at the Indiana University-Purdue University at Indianapolis scanning facility. Davis already has three strip 35mm scanning capability. We plan to add or convert 3 or 4 scanning machines this year. We estimate that the entire scan can be carried out within a 18 month period. The measuring will be done at Purdue-Lafayette. Our present analysis system consists of 5 SMPs and 2 conventional measuring machines on

line to an IBM 360/40-44 system with on-line geometry (TVGP) and is producing 200,000 events per year. The first Purdue built POLLY is currently undergoing hardware and software debugging and will be phased into the measuring system in the coming months. The final double POLLY system should be capable of 500,000 events per year with 2 micron accuracy on the film. The group's 360/44 is being upgraded to handle this load.

IV. Experimenters:

The current experimenters are:

Purdue-D. D. Carmony, A. F. Garfinkel, F. J. Loeffler and L. K. Rangan.

IUPU-I F. T. Meiere and W. L. Yen.

UC-Davis R. L. Lander, D. E. Pellett and P. M. Yager.

### References

1. The only other large high energy  $K^+d$  exposure is the 12 GeV/c data of Goldhaber et al. (500,000 pictures).
2.  $K^*(890)$  Production in the Charge Exchange Reaction  $K^+n \rightarrow K^+\pi^-p$  at 9.0 GeV/c; D. Cords, D. D. Carmony, H. W. Clopp, A. F. Garfinkel, R. F. Holland, F. J. Loeffler, H. B. Mathis, L. K. Rangan, J. Erwin, R. L. Lander, D. E. Pellett, P. M. Yager, F. T. Meiere, W. L. Yen; Phys. Rev. D4, 1974-1978 (1971).
3. S-Wave Structure in the  $K\pi$  System; D. Cords, D. D. Carmony, A. F. Garfinkel, F. J. Loeffler, L. K. Rangan, R. L. Lander, D. E. Pellett, P. M. Yager, F. T. Meiere, W. L. Yen; Purdue Report C00-1428-308 (to be published).
4. The  $K\pi$  and  $K\pi\pi$  Spectrum from  $K^+$  Meson Charge Exchange Interactions in Deuterium at 9 GeV/c; H. W. Clopp, Jr., Ph.D. Thesis (Purdue University, 1972), unpublished.
5. Observation of a New  $K_N(1760)$  Resonance in the  $K\pi$  and  $K\pi\pi$  Systems; D. D. Carmony, D. Cords, H. W. Clopp, A. F. Garfinkel, R. F. Holland, F. J. Loeffler, H. B. Mathis, L. K. Rangan, J. Erwin, R. L. Lander, D. E. Pellett, P. M. Yager, F. T. Meiere, W. L. Yen; Phys. Rev. Letters 27, 1160-1163 (1971).
6. D. Lissauer, G. Alexander, A. Firestone, G. Goldhaber; Nucl. Phys. B18, 491 (1970). See also Review of Particle Properties, Physics Letters 39B, 86 (1972) for other references.
7. See the Review of Particle Properties, Physics Letters 39B, 76 (1972) for reference to the  $S(1930)$ .
8. Evidence for Splitting in the Q Region of  $K^+\pi^-\pi^+$  Mass; A. F. Garfinkel, R. F. Holland, D. D. Carmony, H. W. Clopp, D. Cords, F. J. Loeffler, L. K. Rangan, R. L. Lander, D. E. Pellett, P. M. Yager; Phys. Rev. Letters 26, 1505-1508 (1971).

### Figures

Fig. 1 shows the  $K\pi$  mass spectrum and Fig. 2 the  $K\pi\pi$  mass spectra. The curve is the simultaneous best fit to both plots assuming resonances at 1403 and in the vicinity of 1760  $\text{MeV}/c^2$ . Separate backgrounds are allowed in the two plots. An excess of events is seen at 2200  $\text{MeV}/c^2$ . Fig. 3 shows the  $K^*\pi$  and  $K\rho$  mass spectrum with  $\Delta(1238)$  removed. Fig. 4 shows the  $Y_{\ell}^0$  moments for the  $K\pi$  system for  $-t < 0.2$  GeV. The  $Y_6^0$  moment shows evidence for spin 3 in the 1760 mass region. Fig. 5 shows the evidence for  $\bar{A}N$  and  $K^*\rho$  decay modes from a sample of about  $\frac{1}{2}$  of the current data.

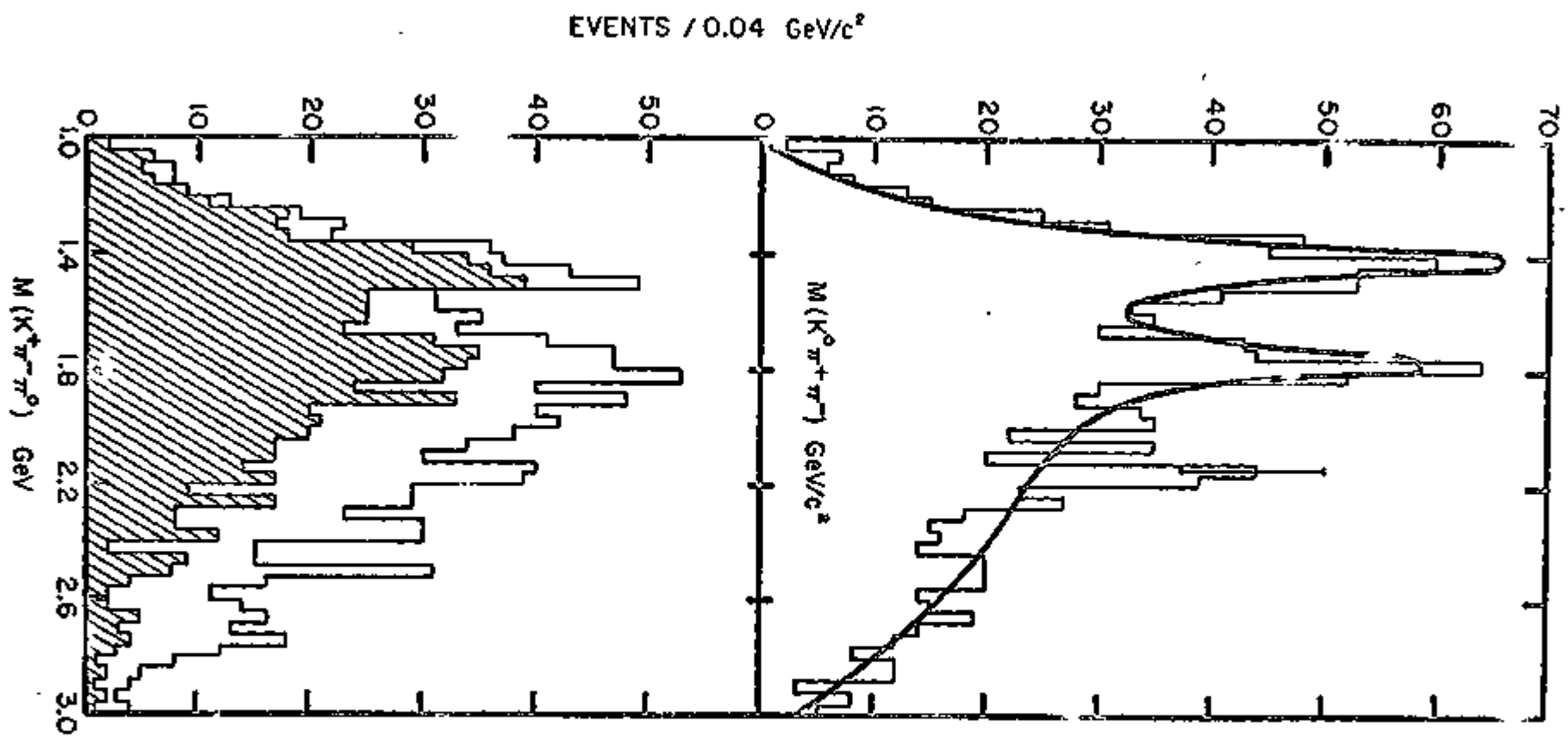


Fig. 2

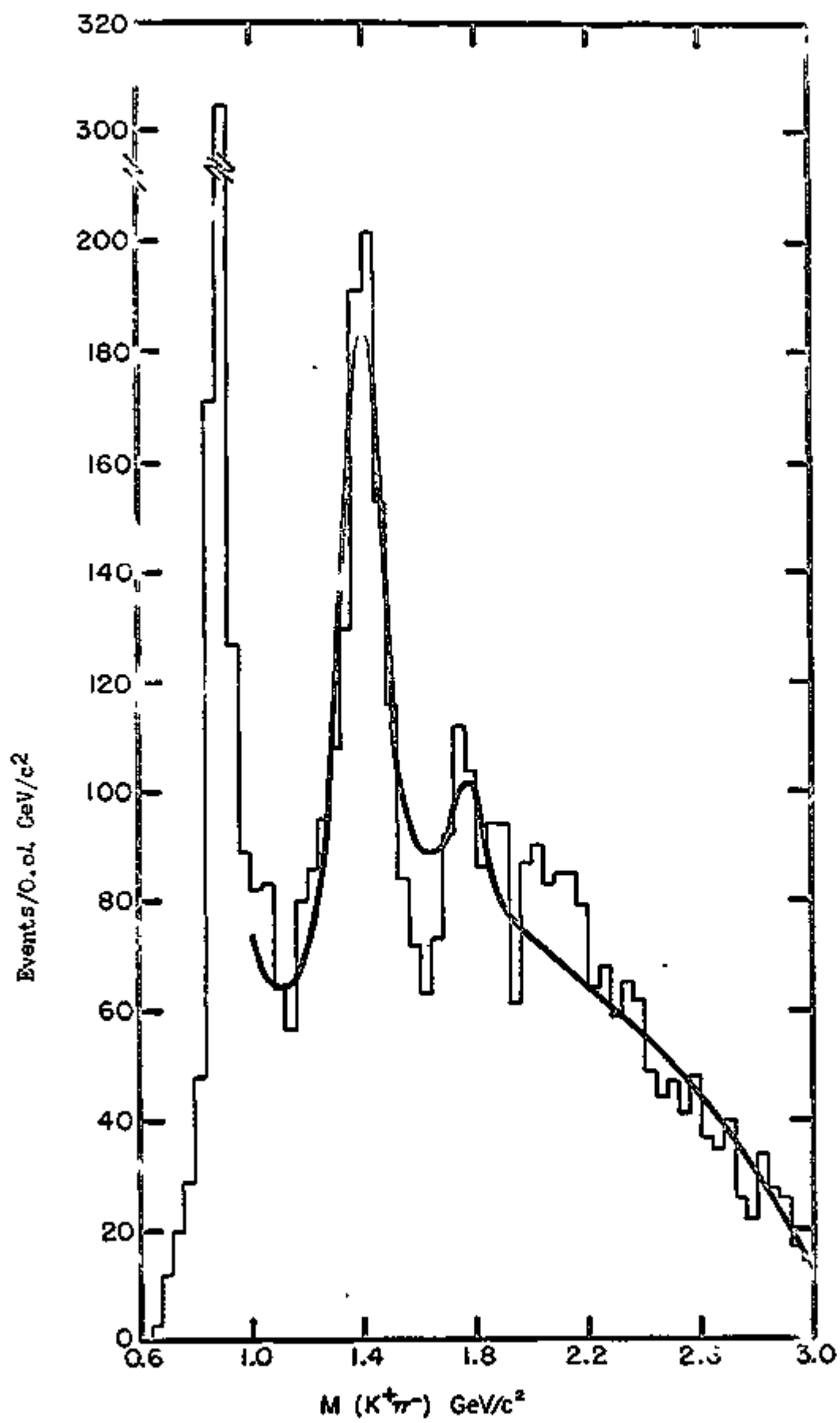


Fig. 1

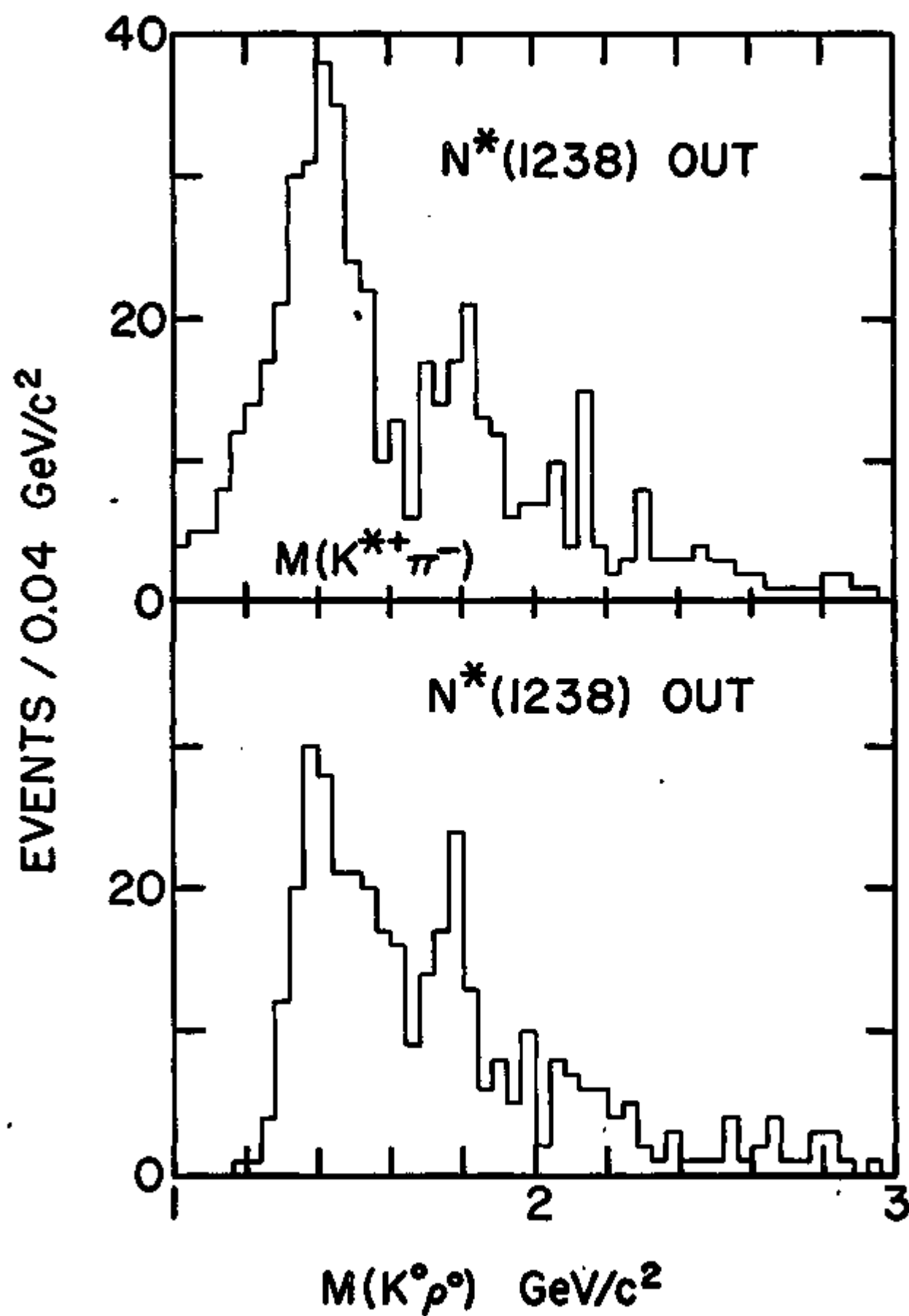


Fig. 3

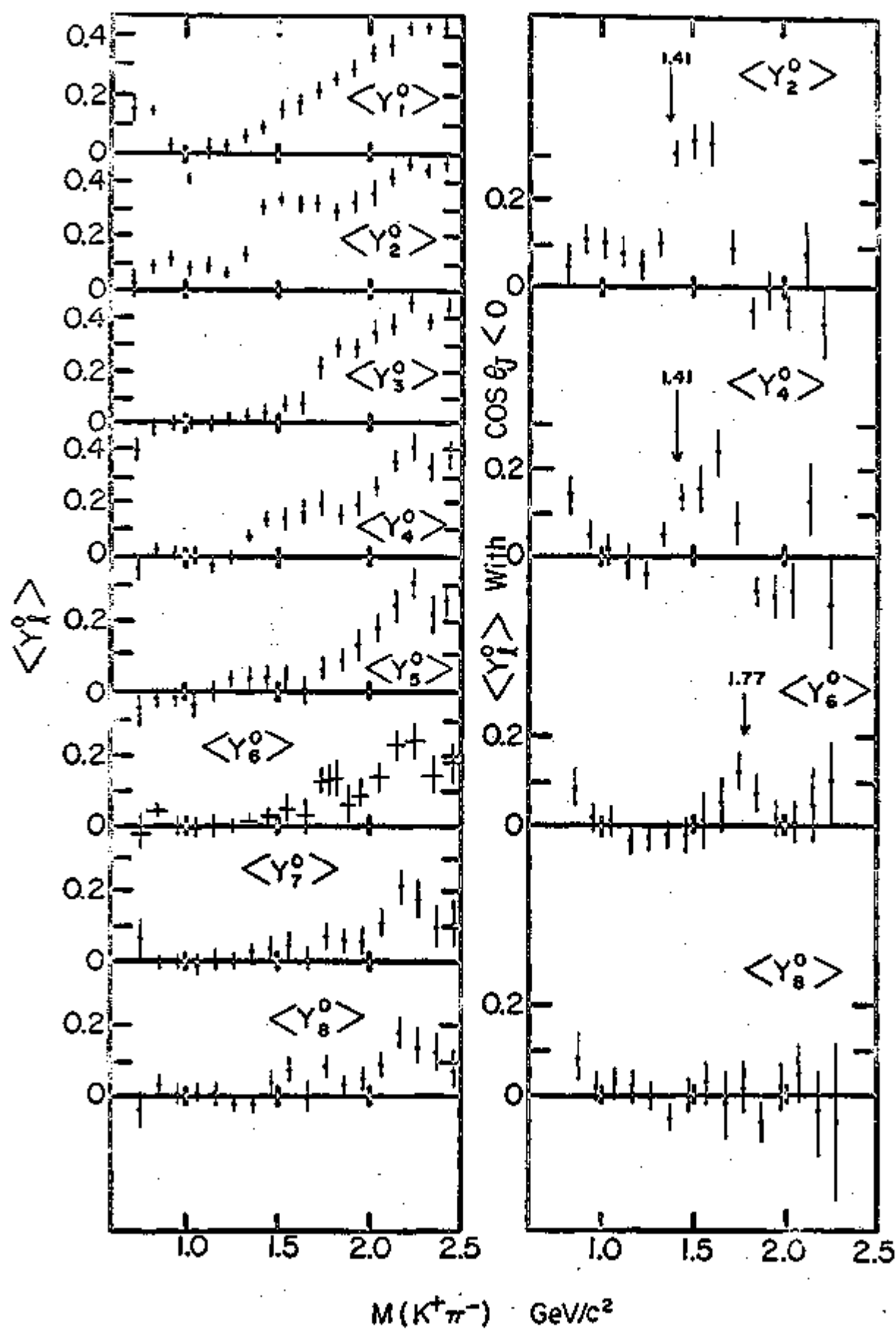


Fig. 4

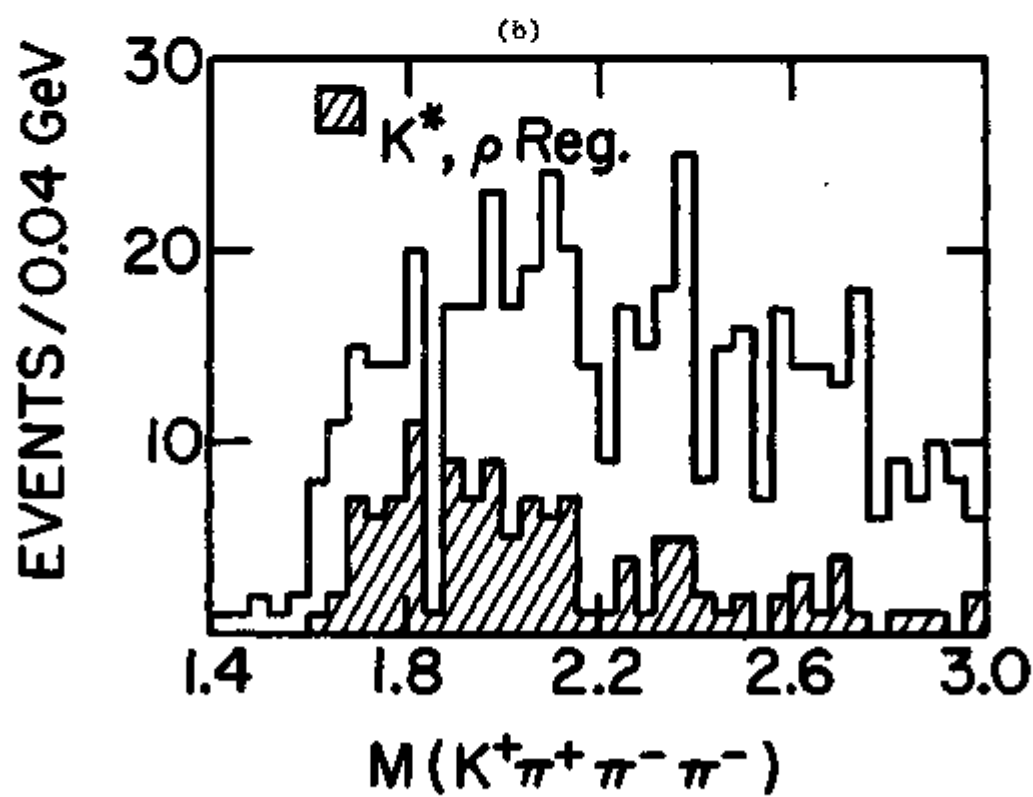
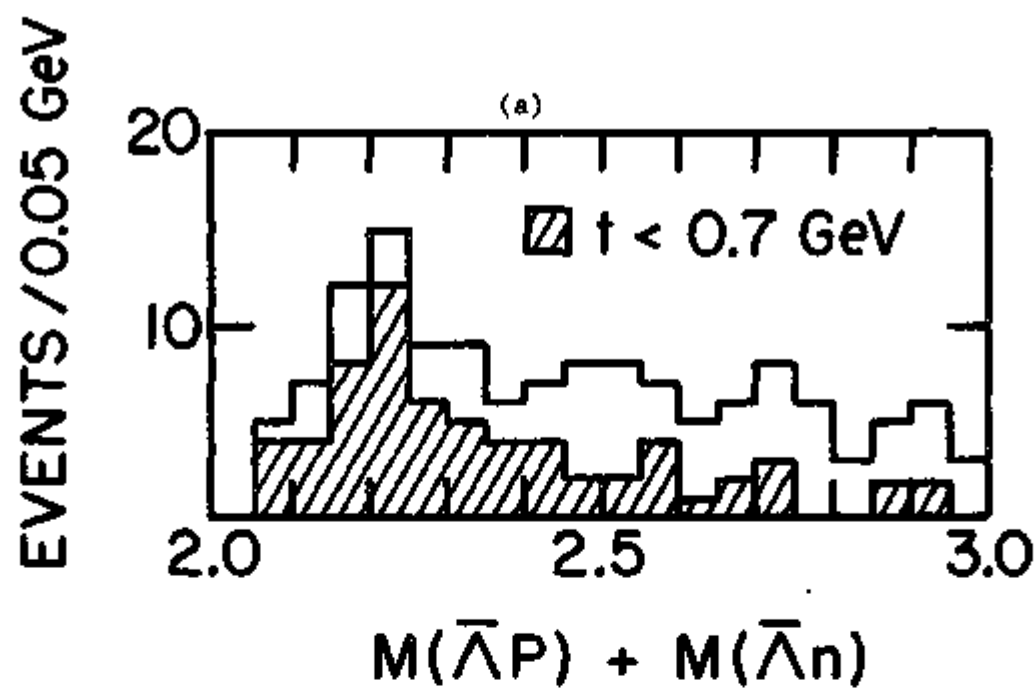


Figure 5