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A Search for Narrow and Broad Resonances Decaying into $K^o_s K^o_s$ and $\Lambda\bar{\Lambda}$ from $\pi^- p$ Interactions at 200 GeV/c using the Fermi MPS

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One of the most effective ways to search for resonances in hadron interactions is to probe a definitive quantum state such as e^+e^- or $\mu^+\mu^-$ (ρ, ω, ϕ, J/Ψ, Ψ'). Due to the nature of dilepton resonances, these are restricted to the $J^P = 1^-$ system. Unexpected states such as J/Ψ and Ψ' have been discovered using this technique.

We propose to expand the search to other quantum states such as 0^+, 0^-, and 2^+ with at least an order of magnitude greater sensitivity than all other previous measurements. The reactions we plan to study are:

$$\pi^- p \rightarrow \Lambda\bar{\Lambda} + X \qquad (1)$$

$$\rightarrow K_s^o K_s^o + X \qquad (2)$$

These reactions (1) and (2) are for high-mass meson states searches. It is worth noting that the $K_s^o K_s^o$ system can only be in $J^P = 0^+, 2^+ \ldots$ states with an isospin of 0 or 1 whereas the $\Lambda\bar{\Lambda}$ system can only be in I = 0 state. We believe new, high-mass, narrow resonances in these quantum states may be uncovered which cannot be produced directly in $e^+ e^-$ collisions. The long sought after pseudoscalar $c\bar{c}$ meson, η_c, can decay into $\Lambda\bar{\Lambda}$. A rough estimate of the production cross section of such states gives the order of 2-4 μb (or $\sigma \cdot B$ 40-80 nb) at $\sim$ 200 GeV/c which is about the right estimate of our sensitivity (see Appendix I and Fig. 1).

Our aim is to reach masses of up to 15 GeV with high sensitivity in cross section (20 visible events per nb) and good mass resolution ($\sigma \sim$ 50-70 MeV or less). This represents a measurement at least one order of magnitude more sensitive than all the other previous measurements.[1] Since the MPS has demonstrated its performance and productivity in carrying out the jet experiment, we shall be brief in describing our request.

a. Beam: 600 hours with 250 pulses per hour and $2x10^6$ π^- per pulse at 200 GeV/c, i.e. $3x10^{11}$ π^- for the experiment.

b. Target: A 30-cm liquid hydrogen target will be used. Cylindrical MWPC's will surround the target as discussed below in section d.

c. Setup: In order to detect K^o_s and Λ with adequate efficiency, a decay region of the order of the particle's decay length is required. We have chosen 4 meters.

The LH_2 target will be immediately followed by a rectangular MPWC. This chamber defines the upstream boundary of the 4-meter decay region (which will be filled by Helium) and also serves as a veto for events where the number of prompt charged tracks is too large. MWPC's before and after the magnet will serve to reconstruct the V's. These chambers also will be used in the trigger to identify the appearance of four charged tracks after the decay region. Cylindrical MPWC's α,β surround the target and record other outgoing particles to aid in vertex location. Spark chambers follow the magnet to complete the measurement of the event. The proposed configuration is shown in Fig. 2.

d. Sensitivity: In 600 hours of running, we expect to produce 160 events/nb for the $K^o_s K^o_s$ and $\Lambda\bar{\Lambda}$ decays into charged particles. The charged decay mode correction factor of 4/9 has already been applied. The geometrical acceptance of the spectrometer corrected for a 4-meter decay volume is shown in Fig. 3, and varies smoothly between 10 and 1% as the 2-V mass goes from threshold to 10 GeV. Figure 4 shows the acceptance of the system as a function of Jackson angle.

Using an average acceptance of 10%, our net sensitivity is reduced to $\sim$ 20 detected events per nb for $K^o_s K^o_s$ and $\Lambda\bar{\Lambda}$.

e. Yield: The cross section for inclusive $\Lambda\bar{\Lambda}$ and $K_s^oK_s^o$ production as a function of the number of accompanying charged tracks has been measured in 250-GeV/c π^-p interactions.[2] The total inclusive $\Lambda\bar{\Lambda}$ and $K_s^oK_s^o$ cross sections are 0.15 mb and 0.60 mb respectively. Requiring that the accompanying charged track multiplicity be ≤ 4, these cross sections reduce to 0.02 mb and 0.045 mb respectively. At 20 events/nb then, we expect $\sim 4\text{x}10^5$ $\Lambda\bar{\Lambda}$ events and $8\text{x}10^5$ $K_s^oK_s^o$ events. The event rate is expected to be 2 in 10^5, giving roughly 12 events/pulse. Backgrounds are discussed in the next section.

f. Trigger: Telescope counters S_A, S_B, S_C, and MWPC module BB identify an incoming beam pion. MWPC module A, immediately followed by a dE/dx counter, restricts the trigger to events with a limited number of particles entering the decay region. Cylindrical MPWC's α and β which surround the target aid in vertex location by detecting low-momentum, large-angle recoils. They may also be used to insure that an interaction has taken place in the target. Following the decay region, MWPC modules B', B, C, and D detect the additional tracks produced by the decays of the two V's. These chambers, together with the spectrometer magnet and spark chamber modules E and F, analyze the momenta of the decay tracks.

g. Event Rate and Background: Preliminary results obtained from the Chicago Circle (E110) group indicate a substantial hadronic background. A trigger consisting of 1 charged track entering a "decay region" and the subsequent appearance of two V's was dominated by beam interactions in chambers and air. The signal-to-noise ratio was 1:30. Demanding that an interaction take place in the target by requiring a hit in chambers α and β only reduced this to 1:10. (The singles rates in these chambers were very high, so accidental coincidences formed a substantial part of this trigger.)

E110 ran with 0.3 g/cm^2 of material in their "decay region." By installing a helium bag and by placing the dE/dx counter after MWPC module A, we would expect to have 0.1 g/cm^2 in our 4-meter decay region. Thus we might expect a signal-to-noise ratio of about 1:3 for events with a single charged particle entering the decay region. Events with 2 or more particles entering the region are almost certainly sure to arise from real interactions in the target and, as E110 found, are significantly cleaner. Overall, then, we might expect our noise to be about 2.5 times the real event rate for the following triggers:

Hit in α,β	Number of Charged Particles Entering Region	Number of Charged Particles Leaving Region
No	0	4
Yes	1	5
No	2	6
No	3	7

With a true event rate of 12/pulse we would thus expect 42 triggers per pulse. The 30 ms dead time of the spark chambers limits the actual rate to about 26/pulse. We therefore require 600 hours of running, at 250 pulses/hour, to acquire our data.

References

1. W. Beusch et al., Physics Letters 25B, 357 (1967); Physics Letters 28B, 211 (1968).

2. D. Bogert, et al., Fermilab preprint, 3/18/77.

APPENDIX I

Search for η_c at the MPS

Assuming that the J is a $c\bar{c}$ bound state, we suggest searching for the η_c, its pseudoscalar partner, in $\pi^- p$ interactions at 200 GeV/c. We consider in particular

$$\pi^- p \to \eta_c X, \quad \eta_c \to \Lambda\bar{\Lambda}. \tag{1}$$

Using the MPS as a detector, one could reach a sensitivity of 10 events/nb for this reaction. The cross-section for production of the η_c is not known, nor can it be reliably calculated. However, a reasonable estimate (see below) gives a $\sigma \cdot B$ of the order of 40-80 nb. This value is about the level at which we would expect to begin to see a significant signal above background.

The reaction $pp \to JX \to e^+e^-X$ has, of course, been observed at the Fermi Lab. Using the experimental cross section and the branching ratio[1] for $J \to e^+e^-$ of 7%, one finds

$$\sigma(pp \to JX) \approx 200 \text{ nb at } 200 \text{ GeV/c}. \tag{2}$$

To estimate the η_c cross section we can clearly write

$$\sigma(\pi^- p \to \eta_c X) = \frac{\sigma(\pi^- p \to \eta_c X)}{\sigma(\pi^- p \to JX)} \frac{\sigma(\pi^- p \to JX)}{\sigma(pp \to JX)} \sigma(pp \to JX) \tag{3}$$

We expect that both the η_c and the J will be formed by the annihilation of an ordinary $q\bar{q}$ quark pair through gluons to form a $c\bar{c}$ pair. See Fig. 1. The main difference is that the J must be formed through three gluons because its spin-parity is 1^-, while the η_c can be formed through two gluons. Thus the cross section for the J is smaller by $O(\alpha_s^2)$, where $\alpha_s = q_s^2/4\pi$ is the effective gluon coupling constant. Exactly this difference has been used by several authors to find the relative hadronic widths of the η_c and the J by calculating their couplings to $q\bar{q}$. Schnitzer[2] finds

$$\frac{\Gamma(\eta_c \to \text{had.})}{\Gamma(J \to \text{had.})} = 70, \tag{4}$$

while Appelquist in a review[3] of several calculations gives

$$\frac{\Gamma(\eta_c \to \text{had.})}{\Gamma(J \to \text{had.})} \approx 100. \tag{5}$$

As a check we can use the estimate of α_s by Barnett, Georgi, and Palitzer[4] to compute

$$\frac{\Gamma(\eta_c \to \text{had.})}{\Gamma(J \to \text{had.})} \sim \frac{1}{\left(\frac{\alpha_s}{\pi}\right)^2} = 50. \tag{6}$$

Thus let us take

$$\frac{\sigma(\pi^- p \to \eta_c X)}{\sigma(\pi^- p \to JX)} \gtrsim \frac{\Gamma(\eta_c \to \text{had.})}{\Gamma(J \to \text{had.})} \approx 50 - 100 \tag{7}$$

We can estimate the second factor in Eq. 4 from experiment. We know that at FNAL energies[5]

$$\frac{\sigma(\pi^- p \to JX)}{\sigma(pp \to JX)} \approx 2. \tag{8}$$

Then

$$\sigma(\pi^- p \to \eta_c X) \approx (50\text{–}100) \times 2 \times 200 \text{ nb}$$
$$\approx 20\text{–}40\ \mu\text{b}. \qquad (9)$$

The branching ratio for $\eta_c \to \Lambda\bar{\Lambda}$ is of course not known, but there is no reason to suppose that it is less than that for $J \to \Lambda\bar{\Lambda}$:

$B(\eta_c \to \Lambda\bar{\Lambda}) = B(J \to \Lambda\bar{\Lambda}) \approx 0.2\%$[1] giving $\sigma \cdot B$ 40–80 nb and

$B(\eta_c \to \Lambda\Lambda)$ could be as high as 1.0%, giving $\sigma \cdot B \approx$ 200 to 400 nb.

It is important to note that η_c cannot be produced by e^+e^- annihilation process directly. We also understand that the detection efficiency of the SPEAR for two V^0's is less than a few percent.

References:

1. G.S. Abrams, Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies, Stanford University, August 21-27, 1975, Ed. W.T. Kirk, p. 25.

2. H.J. Schnitzer, Lectures on New Particle Spectroscopy, BNL, August 1976.

3. T. Appelquist, "Comments on the New Particles", Invited talk presented at the 2nd International Conference at Vanderbilt University on New Results in High Energy Physics, Nashville, Tennessee, March 1-3, 1976. Yale Report COO-3075-141.

4. R.M. Bennett, H. Georgi, H.D. Politzer, Harvard Preprint, July 1976.

5. G.J. Blanar et al., Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies, Stanford University, August 21-27, 1975, Ed. W.T. Kirk, p. 195.

6. S.C.C. Ting, Proceedings of the 1975 International Symposium on Lepton and Photon Interactions at High Energies, Stanford University, August 21-27, 1975, Ed. W.T. Kirk, p. 155.

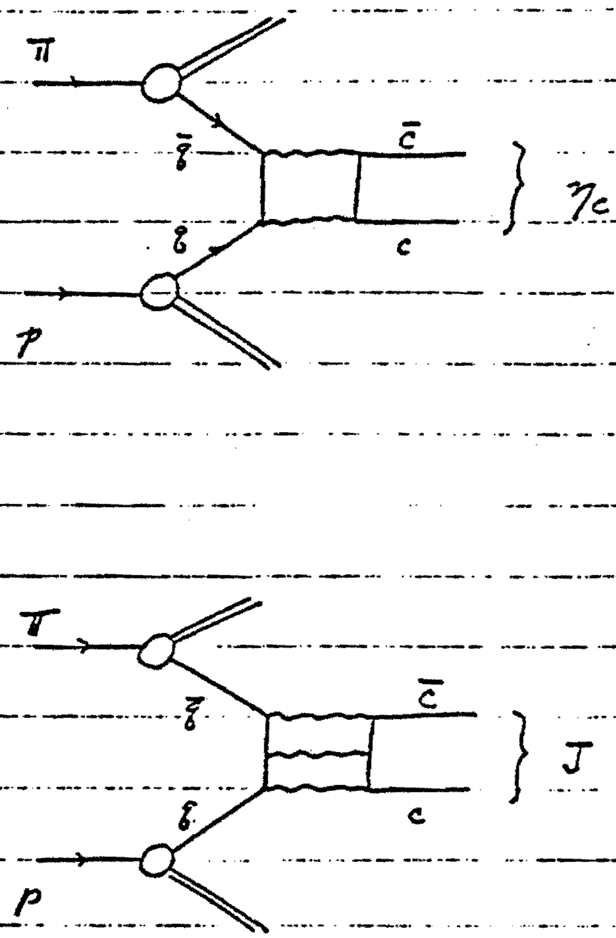


Figure 1: Production mechanisms for η_c and J.

APPENDIX II

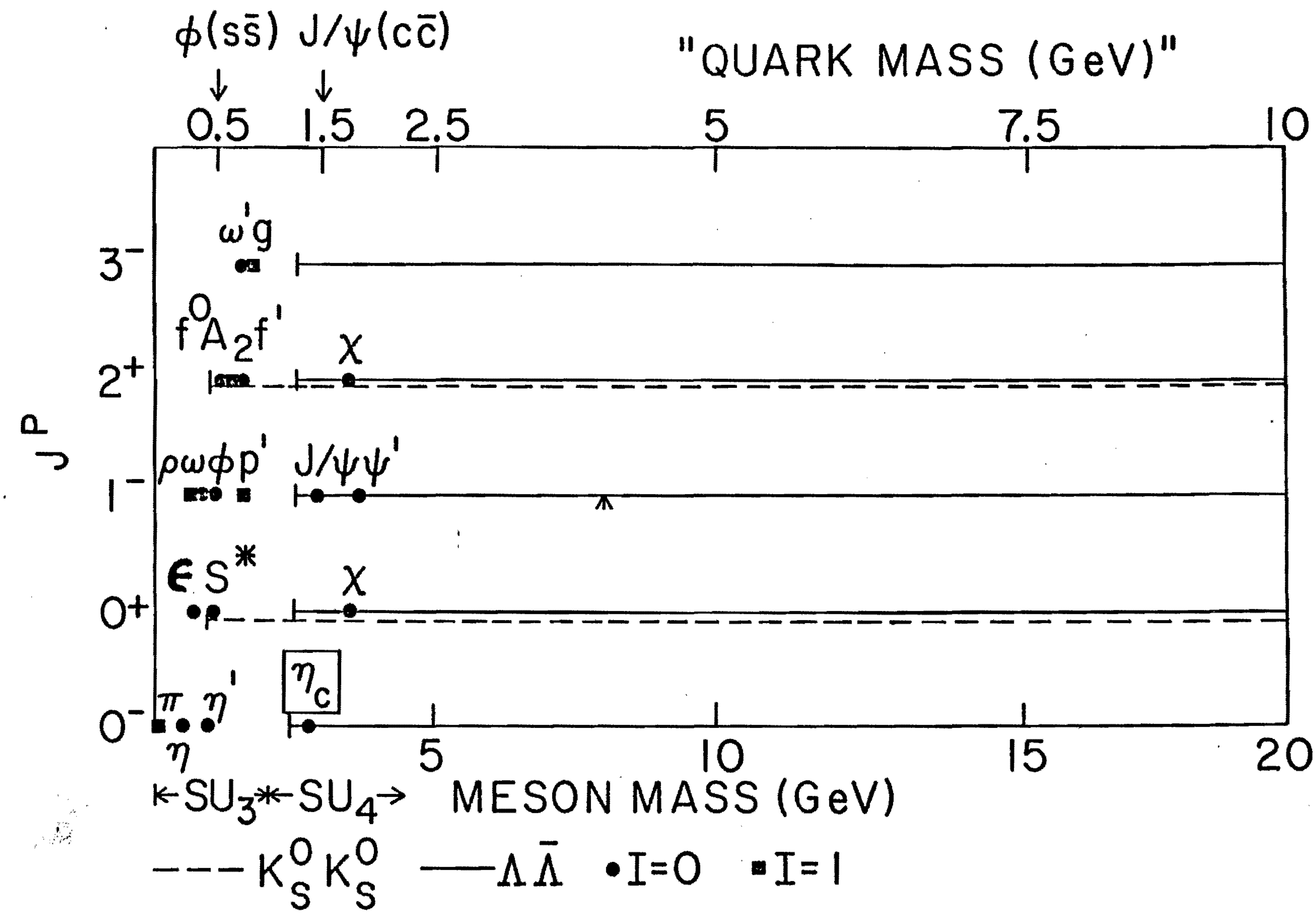
A simple estimate of yield for two (of many) particles of current interest.

1. The η_c

As discussed in Appendix I, the product of cross section times branching ratio into $\Lambda\bar{\Lambda}$ is of the order of 40-80 nb. Since our sensitivity is 20 events/nb, we could see as many as 400-800 of these particles.[5] However, our trigger excludes events with large numbers of forward charged particles, so the actual number of η_c's is likely to be somewhat less.

2. A recent report from a Fermilab group (B. Cox *et al.*) suggests the presence of another new particle in $\gamma\gamma$ final states at 3.9 GeV. For brevity, we will refer to this object as the C. Cox reports that $\sigma \cdot B_{\gamma\gamma} \approx 60$ nb. If we assume that $\sigma \cdot B_{\Lambda\bar{\Lambda}}$ is of the same order, then we expect as many as 600 such events, but the multiplicity requirement in the trigger will reduce this number too.

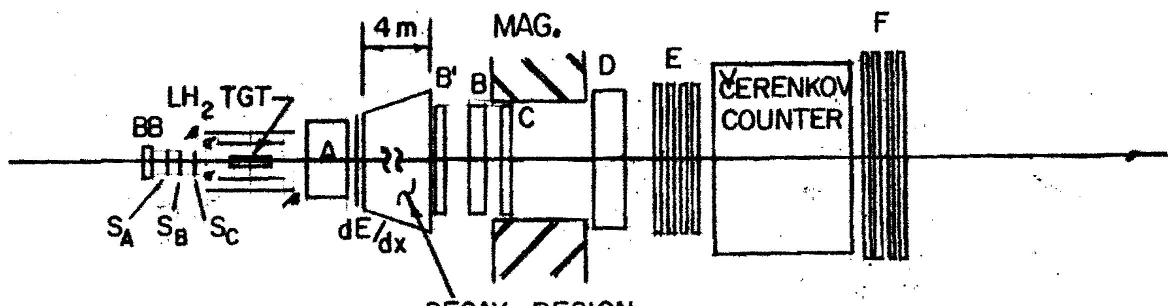
If C is 0^- can go only $\Lambda\bar{\Lambda}$ 600 events;
If C is 0^+ can go either $\Lambda\bar{\Lambda}$ or $K_s^o K_s^o$
expect $\sim 2 \times 600 \approx 1200$ events.



φ(ss̄) J/ψ(cc̄)
"QUARK MASS (GeV)"
0.5 1.5 2.5 5 7.5 10
J^P
3⁻ 2⁺ 1⁻ 0⁺ 0⁻
ω' g
f⁰ A₂ f'
χ
ρ ω φ ρ'
J/ψ ψ'
ε S*
χ
π η'
η
η_c
5 10 15 20
←SU₃→←SU₄→ MESON MASS (GeV)
--- K⁰_S K⁰_S —— ΛΛ̄ • I=0 ■ I=1

FIG. 1

FERMILAB MPS CONFIGURED FOR
2V° EXPERIMENT



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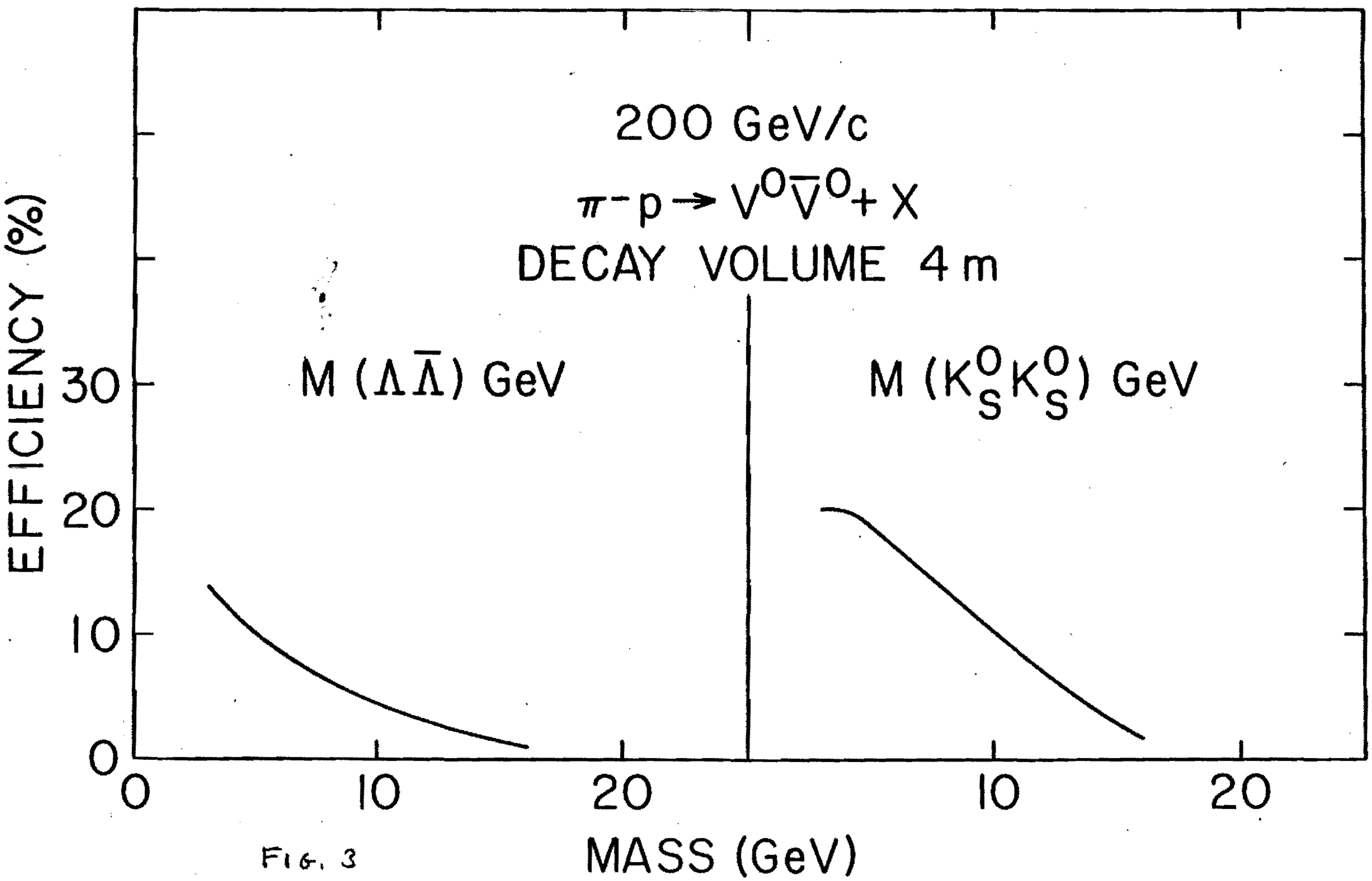
LEGEND

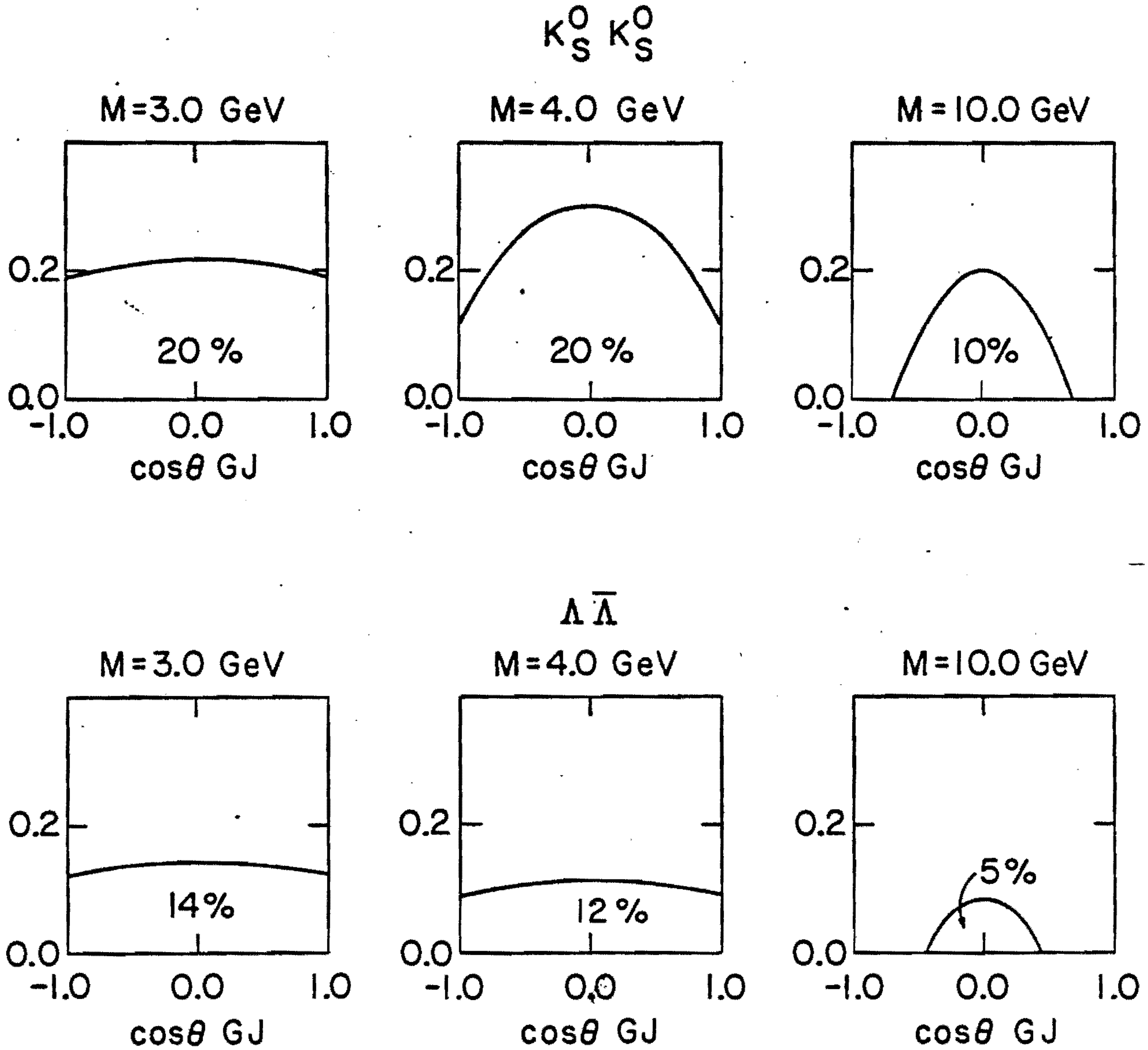
A, B, BB, B', C, D - PLANAR PWC'S
α, β, - CYLINDRICAL PWC'S
S_A, S_B, S_C, - BEAM TELESCOPE COUNTERS
dE/dx - dE/dx COUNTER
E, F - SPARK CHAMBER MODULES

FIG. 2



200 GeV/c
$\pi^- p \rightarrow V^0 \bar{V}^0 + X$
DECAY VOLUME 4 m
M $(\Lambda \bar{\Lambda})$ GeV
M $(K_S^0 K_S^0)$ GeV
EFFICIENCY (%)
0
10
20
30
0
10
20
10
20
MASS (GeV)

FIG. 3



$K^0_S K^0_S$
M=3.0 GeV
M=4.0 GeV
M=10.0 GeV
0.2
0.0
20 %
20 %
10%
-1.0
0.0
1.0
cosθ GJ
$\Lambda\bar{\Lambda}$
14%
12 %
5%

FIG. 4

1. Addendum Contain Description of Fermilab MPS

The spectrometer acceptance is presented in Fig. 1 as a function of the Feynman X of the V^o pair. A decay length of 4 meters was used in the acceptance calculation and events with prongs too close to be resolved as distinct tracks have been rejected. Fig. 2 shows the MPS.

In order to estimate trigger rates we have looked at a sample of data from E110. These data were obtained with abnormally low spark chamber efficiency, with air rather than helium in the decay region, and with a shorter decay length than we have proposed. Helium bags have since been installed and the trigger rates have been observed to decrease by a factor of 3. Using this factor of 3 and the E110 data we find trigger rates of 15 μb for the 1 to 5 trigger and 17 μb for the 2 to 6 trigger. The 0-4 data were taken along with eight other triggers and we cannot extract the trigger cross section for this topology, but it is small compared to either 1-5 or 2-6. The 250 GeV/c π^- FNAL-FSU 15 foot exposure has 10 events which had two vees and observed prongs which would have satisfied our 1-5 or 2-6 trigger. Using these ten events we estimate a true V^oV^o rate which is approximately half the observed trigger rates. Since this estimate is based on only 10 events (the current world sample), it is obviously consistent with as little as 20 or 25% true double vee events among the triggers.

In order to limit the data rate to a manageable level, we will restrict ourselves to 0-4, 1-5, and 2-6 triggers. With these triggers the rate is 18 triggers per 10^6 π. Since a two second flat top is now feasible, we can take 4×10^6 π per pulse resulting in 50% dead time, an effective flux of 2×10^6 π per pulse, and 36 triggers per pulse. Thus in 600 hours of running at 250 pulses/hour and at our peak spectrometer acceptance of 35% (see figure) we get a sensitivity of 25 events/nb.

To evaluate the continuum contribution to the 2-V events, we have obtained data from M. Good, et al. for $pp \rightarrow K^+K^- + X$, $p\bar{p} + X$ which indicate that this background falls as $e^{-1.7m_{h\bar{h}}}$. $h = K, p\pi$. Combining this with the observed number of $K_s^o K_s^o$ events in the FSU/FNAL exposure, we find that a 10 nb signal in one 50 MeV bin represents an effect of 5.5 standard deviation - over background at a $K_s^o K_s^o$ mass of 4 GeV. At higher masses, the background becomes negligible.

We have planned to do the $2V^o + n(n = 1)$ physics such as $\left(\Sigma(1385) \rightarrow \Lambda + \pi\right) \bar{\Lambda}$ $\left(K^*(890) \rightarrow \left(K_s^o + \pi\right) K_s^o\right)$ final states. From our simple estimate we feel that the acceptance will be similar to and slightly less than for the $2V^o$ topology.

2. Study of Double Vee Events Based on E110 Data

We have studied the efficiency for the ratio of double-vee events to background using a sample of data from experiment E110. The physicists associated with the Fermilab MPS, in particular Carl Bromberg of Caltech, provided us with invaluable assistance in this study, though the data we used were of marginal quality. These data were obtained with abnormally low spark chamber efficiency, air rather than helium in the decay region, and with a shorter decay length than we have proposed. Following table summarizes the E110 data:

Run	Trigger topology	Triggers	Percent of triggers reconstructed	Percent of triggers with $K_s^oK_s^o$ (without He bag)	Expected Percent of triggers with $K_s^oK_s^o$ (with He bag)	$K_s^oK_s^o$ Event #
93-99	0-to-4	253	15%	5%	10%	$5X\ 10^3$
105	1-to-5	996	4%	.1%	4%	$2X\ 10^4$
106	2-to-6	1404	3%	.1%	3%	$2X\ 10^4$
						$\sim 4.5\ x\ 10^4$

#Based on $3X\ 10^{11}\pi^-$ and triggers taken with He bag.

Of the reconstruction, the number of "$K_s^oK_s^o$ events" is 12, 1, and 1 respectively for the trigger topologies. In these triggers, the number of downstream tracks minus the number coming from the target is 4. The 0-to-4 trigger was in reality run with the following conditions: (a) no tracks in A chambers and (b) at least 3 but no more than 5 tracks in any 5 of 6 chambers immediately following the decay region. Two factors contribute to two-vee inefficiency; firstly, the spark chambers were having difficulty (gas problems, etc.), their efficiency varied from 70% to 95% and averaged perhaps at 85%; secondly, the reconstruction programs were not tuned especially well, as scrutiny of computer-generated event pictures revealed many instances of track-like spark configurations which were not reconstructed.

If we required that each "K_s^o" be in the decay region and that both "K_s^o" extrapolated back to a common vertex in the target region, the number of $K_s^o K_s^o$ events reduced to 6 or 3% of triggers. Figure 3 shows the mass of the reconstructed vee in the 0-to-4 trigger. A clean K_s^o signal, defined with mass between 0.44 and 0.54 GeV, can be observed in the plot. The invariant mass for these six $K_s^o K_s^o$ events are shown in Fig. 4. For the other two triggers we tried, we did not observe a significant K_s^o signal in the mass of the reconstructed vee. This is due to the serious problem of secondary interactions from the primary tracks. With the helium bag presently installed (or with a vacuum pipe introduced), this problem should be reduced by a factor of 3 to 10. The data discussed here was unfortunately run before this installation.

In summary, we can say that the reconstruction efficiency of double vees is $\sim$ 3% in the 0-to-4 trigger. By improving the chamber performance (which has been accomplished in recent E110 runs) and by tuning the programs, we expect to increase the 0-to-4 trigger efficiency perhaps by a factor of two. There were inadequate data for the 1-to-5 and 2-to-6 triggers in our study. Their reconstruction efficiency was 25% of the 0-to-4 trigger efficiency because of deteriorating chamber conditions. Overall we expect to improve their efficiency by $\sim$ a factor of 10. With the vacuum pipe installed the fraction of 2-to-6 triggers yielding good $K_s^o K_s^o$ may reach 4-to-10%

Same argument can be applied to $\Lambda\bar{\Lambda}$ systems. We expect $\sim 1 \times 10^4$ $\Lambda\bar{\Lambda}$ events.

3. COMPARISON BETWEEN P-548 AND E-110

It is expected that E110 will detect zero-prong $2V^o$ events as one of their 9 triggers in the course of normal running. There will be no overlap between $2V^o + n$ (n = 1,2 prongs) physics in our experiment and that of E110. Our experiment concentrates exclusively on the $2V^o$ trigger and $2V^o + n$ (n = 1,2 prongs) as compared to E110. Their 9 triggers already saturate the readout. We propose to saturate the system with $2V^o + n$ (n = 0, 1, 2) and to gain a factor of ~ 8 in zero-prong $2V^o$ events. The various enhancement factors are:

a) Decay region 4 meter vs. 2 meter. The calculated acceptances increase by a factor of ~ 1.5.

b) Beam. 10^6/sec. vs. 5 x 10^5/sec., giving a factor of ~ 2.

COMMENT: A 10^6/sec. beam may prove conservative. From the operational view the M-6 beamline has higher flux capability. Similarly the PWC memory time (100 ns) and the trigger logic times (200 ns) do not preclude higher fluxes.

c) Flat top. We plan to run the flat top at 2.0 sec.* yields a factor of ~ 1.6, an improvement over the present 1 sec. flat top.

d) Cross section. $2V^o$ production at 200 GeV vs. 100 GeV, giving a factor of ~ 1.5.

Thus the overall multiplicative improvement factor (R) in data rate per pulse is

$$R = \sim 8$$

As a further comment, we note that E110 will plan to collect data at several energies (one of them is 100 GeV/c) while this experiment concentrates at 200 GeV only. The higher available center-of-mass energy at 200 GeV allows us to explore the mass region up to 18 GeV, about 6 GeV higher than is available at the 100 GeV/c beam.

The new physics which can be obtained by running this experiment: a) an order of magnitude in the sensitivity for zero-prong double vee events, b) the exploration with excellent sensitivity of the one and two prong double vee topologies, and c) the exploration of higher mass region.

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4. OPERATION OF THE FERMILAB MPS

We believe the most effective way to maximize the physics output from the FERMILAB MPS would be to make it a facility. We are prepared, however, to carry-out P-548 in the MPS with a minimum of FERMILAB facility support. Present members of the P-548 collaboration with counter/track chamber experience are J.R. Ficenec, E. Jenkins, K.W. Lai, J. Marraffino, W. Morris, C. Roos, A. Segar, C. Spencer, M.S. Webster, and P. Yamin. In addition, B. Gobi and D. Miller of Northwestern and D. McLeod of Chicago Circle have expressed an interest in participating in P-548 to the extent allowed by their other commitments.

We plan to have enough individuals become 'expert' in the operation of the MPS so that three such 'experts' are available during all running periods of the experiment. Another three 'partial experts' will also be available during all running periods. The remaining members of the collaboration will also participate in the data collection as required. Those individuals responsible for the operation of the MPS will be trained by participating in the running of E-110.

This experiment could also be performed by alternate running with E-110. In this mode we would saturate the trigger rate by 0-to-4, 1-to-5, and 2-to-6 triggers. Because of our software expertise we would contribute significantly to the overall software capabilities of the FERMILAB MPS.

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5. COMMITMENTS TO P-548

The groups involved in this proposal have expressed their firm and enthusiastic commitment. I understand that they have sent letters to you confirming these commitments. Arizona, Florida State, Tufts, Virginia Tech., and Vanderbilt will each devote substantial manpower in the nature of either a research associate or graduate student who will be exclusively dedicated to this experiment. In addition, all participating physicists have agreed to spend time at Fermilab. E. Jenkins can spend a six-month leave of absence there if the experiment is approved. People with counter experience, such as W. Morris, C. Spencer, and A. Segar, will also be stationed at Fermilab. Florida State intends to seek to hire a research associate who will work full time at Fermilab, if the experiment is approved. Kwan-Wu Lai can be at Fermilab before, during, and after the P-548 run. Peter Yamin can also devote a substantial fraction of his time to this experiment.

The participants from BNL, Tufts, and Vanderbilt are also preparing the approved BNL - MPS experiment #705 which is scheduled to run in July and late fall of 1978. BNL-705, like the present proposal, requires almost no hardware modifications of existing equipment. Our work with the BNL experiment will help us to do this FNAL experiment. We feel that these two experiments compliment one another.

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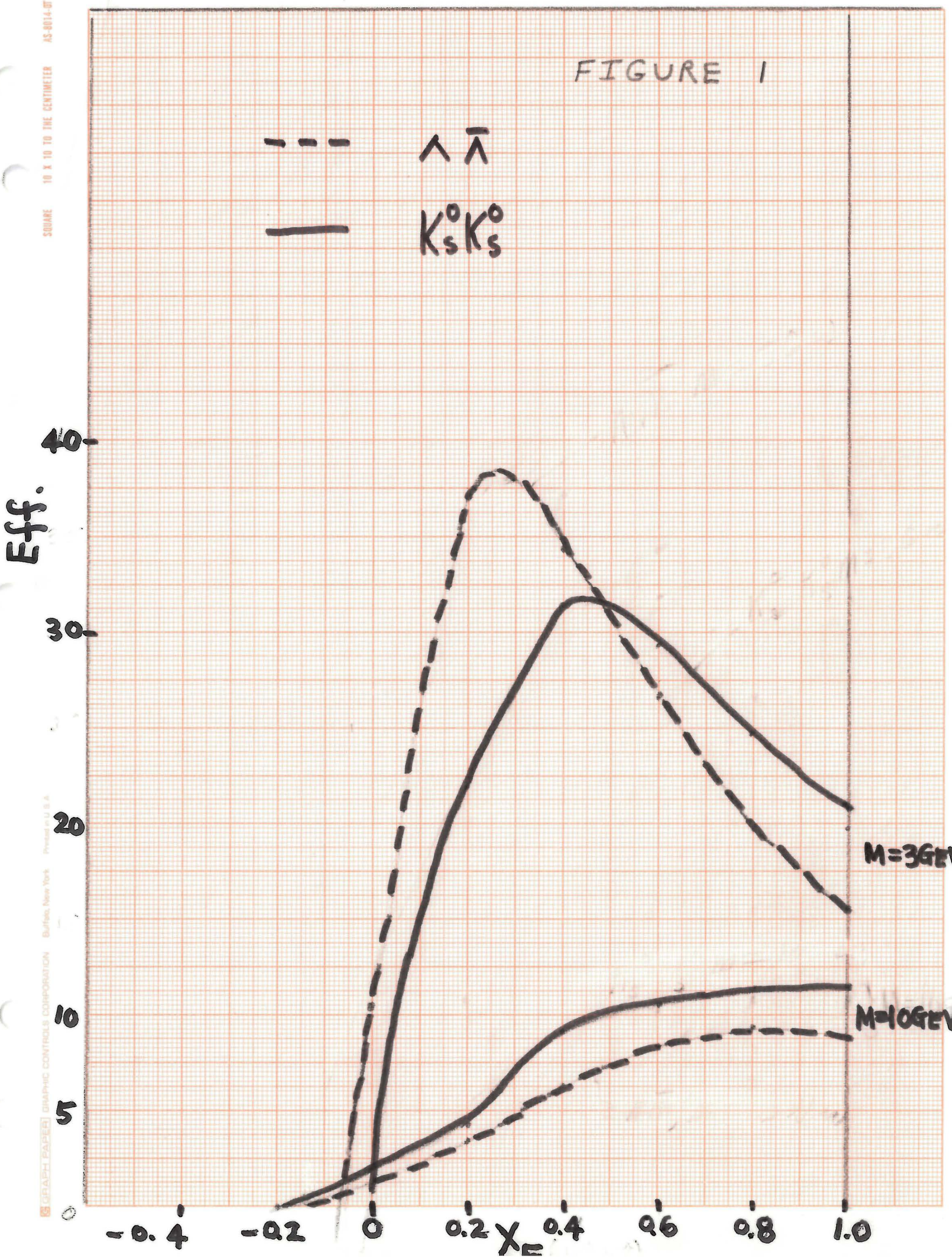
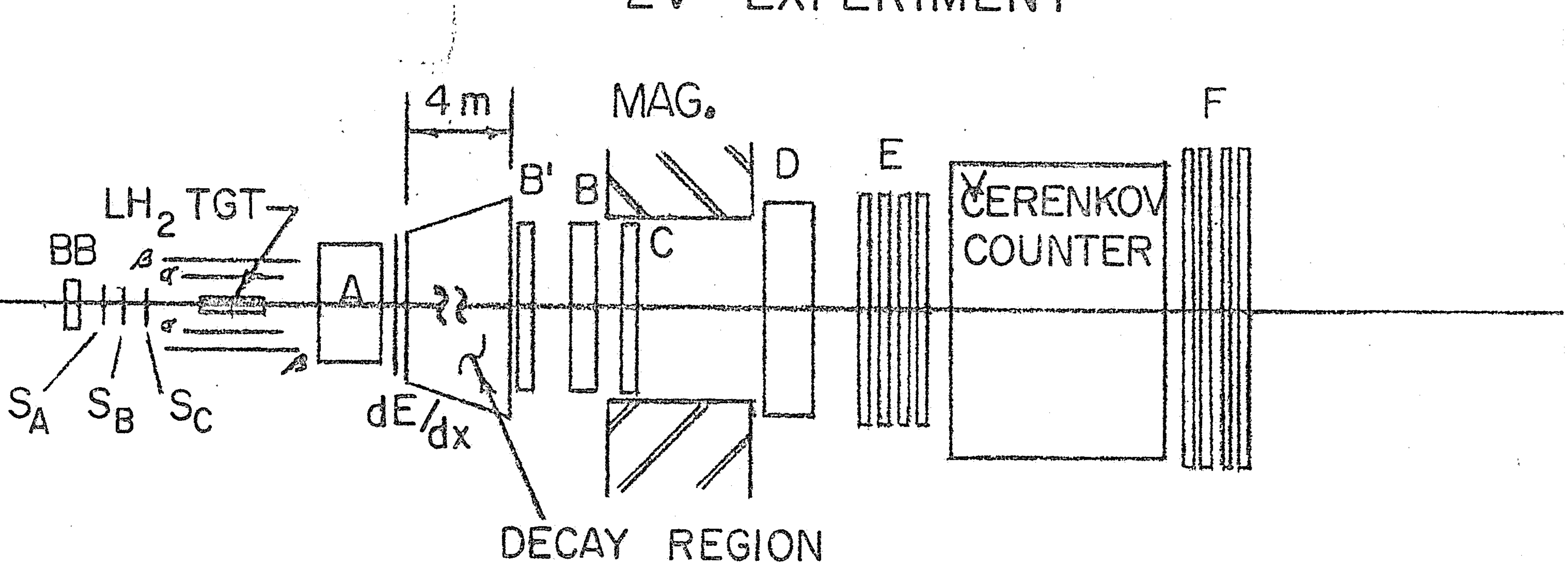


FIGURE 1
Λ Λ̄
$K_s^0 K_s^0$
Eff.
40
30
20
10
5
M=3GEV
M=10GEV
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1.0
X_F

FIGURE 2

FERMILAB MPS CONFIGURED FOR 2V° EXPERIMENT



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LEGEND

A, B, BB, B', C, D – PLANAR PWC'S

α, β, – CYLINDRICAL PWC'S

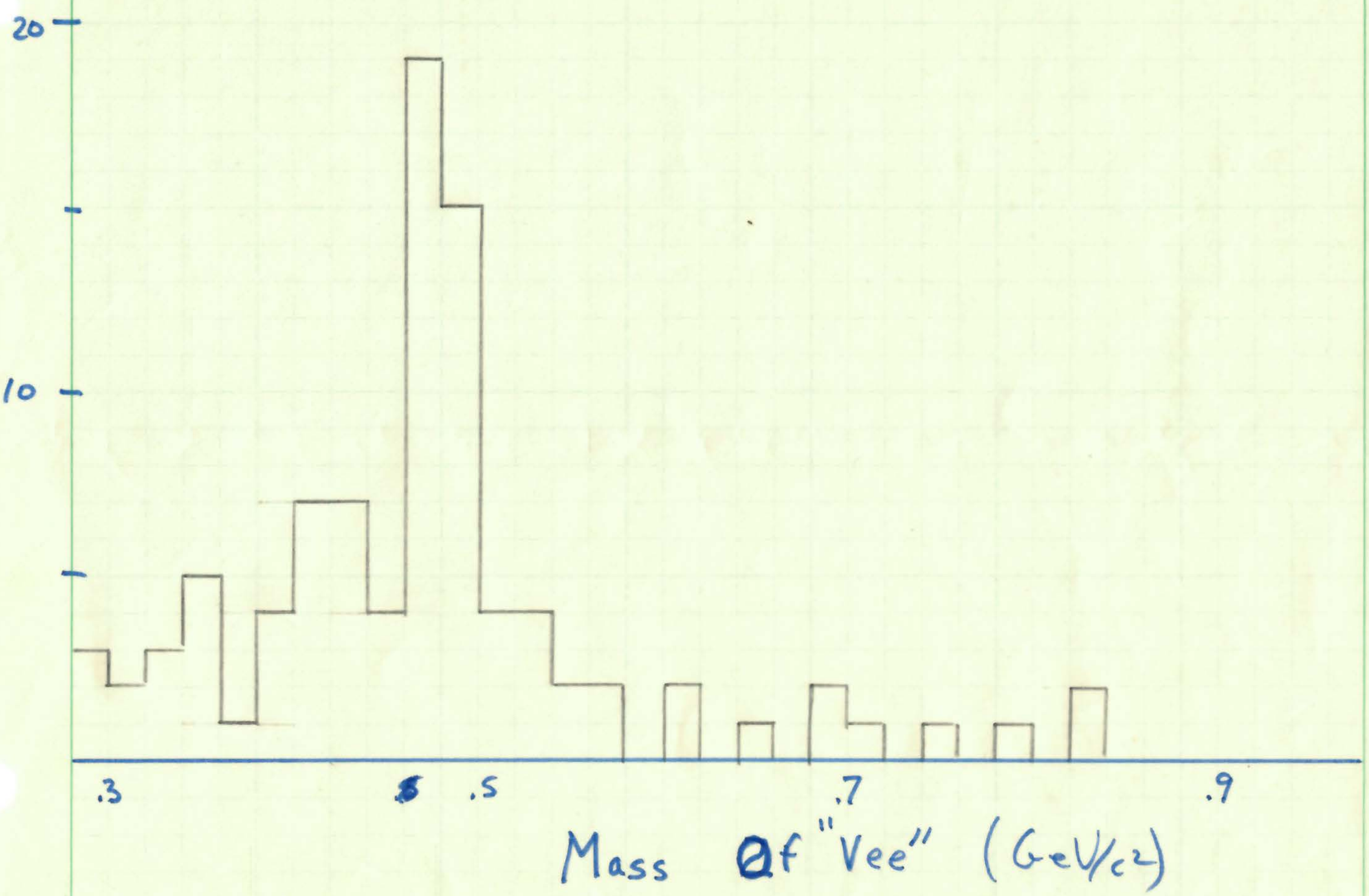
S_A, S_B, S_C, – BEAM TELESCOPE COUNTERS

dE/dx – dE/dx COUNTER

E, F – SPARK CHAMBER MODULES

Figure 3

Mass of "Vee"
0-4 Trigger with
npart = 4



100 GEV/c

$\pi^- p \rightarrow K_S^0 K_S^0 X$

Sample events from "0-to-4 trigger"

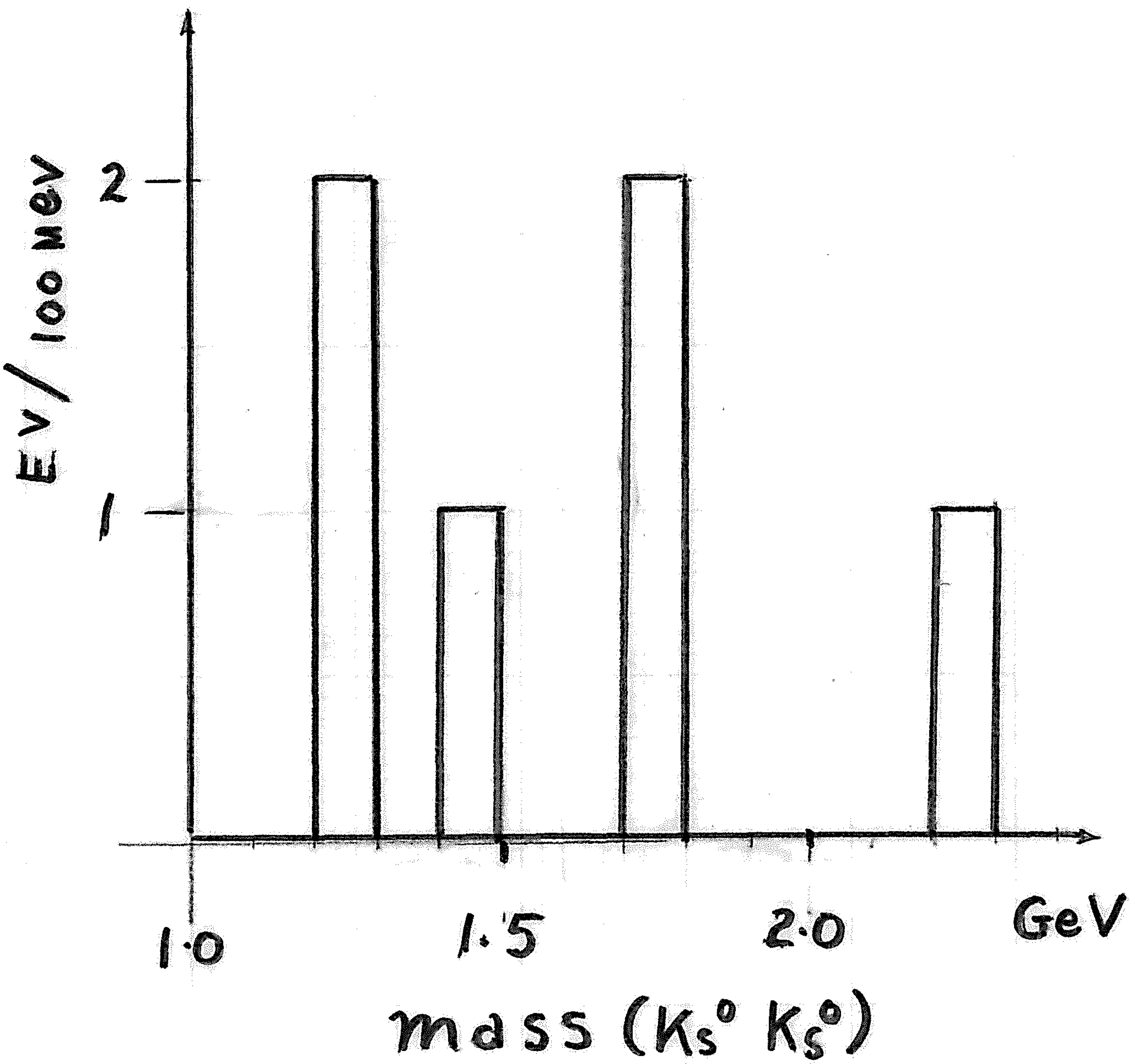


Figure 4