FNAL Experimental
Proposal 376
Spokesman: Thomas W. Ludlam

STUDIES OF K^--MESON COLLISIONS WITH PROTONS AT AN INCIDENT MOMENTUM CLOSE TO 150 GeV/c

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SUMMARY

We propose exposures of approximately 0.5 ev/μb equivalent for K^- mesons as close as possible to 150 GeV/c in the FNAL 30-inch Bubble Chamber Proportional Wire Hybrid system. We request these exposures as soon as suitably enriched beams of K^- mesons are available to that facility. For beams with K^- /contaminant ratio R, each exposure will require $\frac{1}{R}$ x 100,000 pictures and will yield approximately 10,000 Kp interactions for study.

The purpose of these experiments is to carry out a detailed study, with modest statistical accuracy, of kaon-proton collisions at energies significantly above those at which such data currently exists, and to further extend the range of incident channel quantum numbers over which multiparticle production has been explored at FNAL energies. The choice of energy is such as to allow us to make a reasonable Cross Particle comparison with existing data at 147 GeV/c.

A fundamental part of this proposal is the development of the K^- meson beam. We are prepared to explore the techniques described in W. W. Neale's FN-259/2200 report, either alone or in collaboration with other interested parties. We are also prepared to study alternate K^- beam producing techniques. We expect this proposal to proceed in two phases. The first phase being a feasibility study of the K^- beam and the second phase, contingent on the success of the first phase, being the proposed physics exposure.

I. INTRODUCTION

This experiment is seen as proceeding in two phases, the first is the development of a K^+ beam and the second is the physics experiment.

The starting point for Phase one will be W. W. Meule's work. This is conveniently summarized in his FNAL Report FN-259 2200, "Enriched Particle Beams for The Bubble Chambers at The Fermi National Accelerator Laboratory" 24 June, 1974. In addition to the techniques described in that report we will investigate other possible methods for producing a K^- beam. We will be pleased to collaborate with other outside groups or individuals who are interested in studying a K^- beam.

The physics interaction is the study of K^-p interactions in a new energy regime. We would like to perform the study at an energy close to 150 GeV/c so as to make comparisons with π^+, π^-, $\bar{P}$ and P interactions. However, this desire will be modified by the K^- beam we will actually be able to produce. Namely, we will run the experiment at the closest energy to 150 GeV/c that we can produce a beam.

Cross sections for both leading-kaon and leading-proton events will be measured and compared with lower energy kaon data as well as with existing πp and pp collision data at 150 GeV/c. The total cross section for K^-p collisions falls by about 10 percent between 10 GeV/c and 100 GeV/c incident momenta. This experiment should determine whether this variation is reflected in, or can be accounted for, by variations in the cross sections for diffractive excitation.

In some respects, K^-p reactions at the NAL and SPS energies can therefore be expected to be different from pp reactions at ISR energies. To investigate whether and to what extent such difference does exist, is the first main aim of our experiment.

In as far as such a difference to pp reactions will indeed be observed, an advantage of the K^-beam is that it avoids the symmetry of the pp-reactions. Over π^+p reactions, K^+p reactions have the advantage that the identity of the beam particle can be traced in the final state.

We intend to perform the comparison to higher energy pp reactions and the exploitation of the asymmetry of the K^+p reactions in several steps. Among the most important of these are:

1. Topological cross sections
2. Elastic cross section
3. Lending particle peaks at low t.
4. Resonance production
5. Central emission
6. Public diffractions dissociation

Phase I: Beam Study

We propose to establish a K^- bubble chamber beam to the Fermilab 30" Hybrid Bubble Chamber System. This beam should have a $\Delta p/p < 1\%$ and a $K^+/(\pi^+ + p)$ ratio greater than 20%.

We will attempt to make a beam with momentum close to 150 GeV/c. However, the experiment will be run at the highest practical energy. As stated in the introduction, we would start with the concepts developed by W. W. Neale and would welcome other individuals or groups in this phase of the experiment.

Phase II: Physics Proposal

1. Topological Cross sections

Topological Cross sections are predicted for 75, 150 and 300 GeV/c incoming lab. momentum in fig. 1. These cross sections values have been calculated from the K^+p data at 32 GeV/c [1] under the assumption of

1. a logarithmic increase of the total K^+p cross section [2] and average charge multiplicity and
2. a KNO scaling law for K^+p reactions.

These predictions are rough ana can be used only for a provisional planning of the layout of the experiment. How the energy dependence of particularly the low multiplicity reactions (diff. diss.) actually contributes to the total cross section will have to be answered from the first step. The multiplicity distribution and its statistical moments can be obtained essentially from the scanning of photographs from the bare bubble chamber.

2. Elastic Cross Section at low t.

Of immediate interest in connection with the increasing total cross section σ_T is the elastic cross section. One usually distinguishes betw. three regions.

a) very small t ($|t| \lesssim 0.05$ GeV^2) for the estimation of the real to imaginary part ratio ρ. The value of ρ can be of interest for the prediction of the further increase of σ,

b) small t ($0.05 \lesssim |t| \lesssim 0.30$ GeV^2) for the estimation of the slope or the slopes of the forward peak and their shrinkage,

c) large t ($|t| \gtrsim 0.3$ GeV^2) for the search for diffraction minima.

While this is a priory a typical counter experiment, high quality data have been obtained in particular for point (a) as a "by-product" of bubble chamber K^-p experiments at 4.2, 10 and 14.3 GeV/c [3]. The high measurement precision of low $|t|$ elastic events in bubble chambers comes from the exact measurement of the proton momentum from its range in hydrogen. It does therefore not depend on the incident energy.

3. Leading particle peaks at low t

a) leading K^- may be used to separate proton dissociation,

b) leading backward proton may be used to separate K^- dissociation.

One dimensional Feynman X- or missing mass distributions contain large overlap of diffraction dissociation and other mechanisms. This overlap makes the estimation of the diffractive cross section as well as a further study of diffraction dissociation a difficult task. We therefore plan an attempt of separation of diffraction dissociation in two- and more dimensional inclusive distribution. Besides conventional separation methods we intend to make extensive use of newly developing "cluster" searching techniques [4]. We therefore need to know the momenta of leading and as far as possible also the non-leading particles.

After and only after clean separation of diffraction dissociation factorization properties can be meaningfully tested [5]:

$$\frac{\sigma_{K^+p}(\text{elastic})}{\sigma_{pp}\ (\text{elastic})} = \frac{\sigma_{K^+p}(\text{leading } K^+)}{\sigma_{pp}(\text{leading } p)}$$

$$\frac{\sigma_{K^+p}(\text{elastic})}{\sigma_{\pi^\pm p}(\text{elastic})} = \frac{\sigma_{K^+p}(\text{leading } K^+)}{\sigma_{\pi^\pm p}(\text{leading } \pi^\pm)}$$

4. Resonance Production

4a) Leading resonance production

A predominant feature of kaon-induced final states is the presence of the narrow K^* (890) resonance which, unlike the rho, is relatively easy to isolate even in the face of large combinatorial backgrounds. This feature should allow a more detailed study of two-body resonance formation in multibody final states than is possible in pp and πp collisions.

The mechanism of resonance production at high energies is of great importance. In particular, K^*_{890} production is allowed to proceed by pomeron exchange from the quark model [6], but forbidden by the Gribov-Morrison rule [7]. Should K^*_{890} production be allowed by pomeron exchange, we could expect a leading K^*_{890} peak, similar to the K^+ peak (as well as a clear signal in the exclusive 4C channel $K^-p \rightarrow K^0\pi\, p$)

The partial wave analysis of 3π system [8] grants a rather flat energy dependence for the $J^P=2^+$ component. If a similar behaviour exists in the $K\pi\pi$ system, one can expect a nonzero amount of K^*_{1420} production at high energies, as well.

While "diffractive" K^* production is an open question, diffractive N^* production is present. The question there is the exact mechanism [9]. We believe that as much information as possible has to be collected. $\bar{K}p$ reactions can contribute to the study of factorization properties.

This exposure should yield some 300 events of the 4-constraint reaction $K^-p \to K^-p\pi^+\pi^-$, which is dominated at lower energies by the diffractively produced Q enhancement. We should measure the cross sections for both the Q and the L and have sufficiently good statistical precision and mass resolution to determine whether the shape (width) of the Q is significantly different at 150 GeV/c than at 15 GeV/c. Such a change is to be expected if the enhancement seen at lower energies is an interfering mixture of $J^{PC} = 1^{++}$ and 1^{+-} states.

The expected large yields of K_1^0, Λ, Ξ, and perhaps Ω particles will add a new dimension to the study of single-particle production spectra and multi-particle correlation data at high energies, offering a rich array of comparisons with (and, it is to be hoped, constraints on) theoretical and phenomenological predictions. At this energy, diffractive excitation of the form $K^- \to \Lambda\bar{p}$, for which some evidence has been seen in 10 and 13 GeV/c data, may be available for study.

b) Cascade production

The main part of resonance production will probably proceed via cascade decay of peripherally or centrally produced clusters. If we can trace the K^+ (or K^0) in the final state we have the advantage over incoming pions of less identical particles.

5. Central Emission

The possible mechanisms usually summarized as central emission give rise to the largest contribution to the total cross section. They involve high multiplicity reactions which are difficult to study. Therefore relatively little is known here.

The simplest problem is that of "central emission" of a neutral pion pair in a four-body final state via double pomeron exchange. It is not yet clear whether this mechanism exists. One can expect to get useful information from the (asymmetric) K^-p four or six body final states (4C fit):

$$K^-p \rightarrow K^-(\pi^+\pi^-)p$$
$$K^-(\pi^+\pi^+\pi^-\pi^-)p$$

Tests of predictions based on Mueller's generalized optical theorem and the Regge pole model may be carried out for pion production in the fragmentation and central regions by comparing exotic (K^+p) and nonexotic (K^-p) incident channels. It will be important to confirm at this high energy the "early scaling" results which have been reported at lower energies for K^+ induced reactions.

6. Double Diffraction Dissociation

It is expected to contribute to the total cross section with a sizeable amount (0.5 - 1.0 mb estimated from factorization). Nevertheless little is known about it so far.

Monte Carlo calculations [10] for the SFM show that diffraction dissociation almost completely overlaps with central emission even on two-dimensional inclusive X-plots.

We expect that diffraction dissociation can be studied better in medium multiplicity exclusive 4C fits like

$$K^-p \rightarrow (K^-\pi^+\pi) \quad (\pi^+\pi^-p).$$

for which we expect a 20 - 40 μb cross section.

At high energies one can expect to separate it from single diffraction dissociation and central emission with multidimensional cluster searching techniques as mentioned in sect. 3 (and useful also for 4).

From factorization we should get as diffractive and double diffractive component in the inelastic topological cross sections [5]

$$\sigma^n = \sigma_{1K^+} + \sigma_{1p} + \frac{1}{\sigma_{el}} \sum_{j=o}^{\frac{n-2}{2}} \sigma_{1K^+}^{n-2j} \sigma_{1p}^{2j+2}$$

with σ_{el} being the elastic K^+p cross sections, σ_{1K+} the leading K^+ and σ_{1p} the leading proton cross sections.

7. Cross Particle Comparisons

We expect to compare the details from this experiment with data from π^+, π^-, P, $\bar{P}$, and K^+ exposures that have already been approved or may soon be approved. A comparison of such a large number of incident projectiles should yield some knowledge about any fundamental differences among hadrons.

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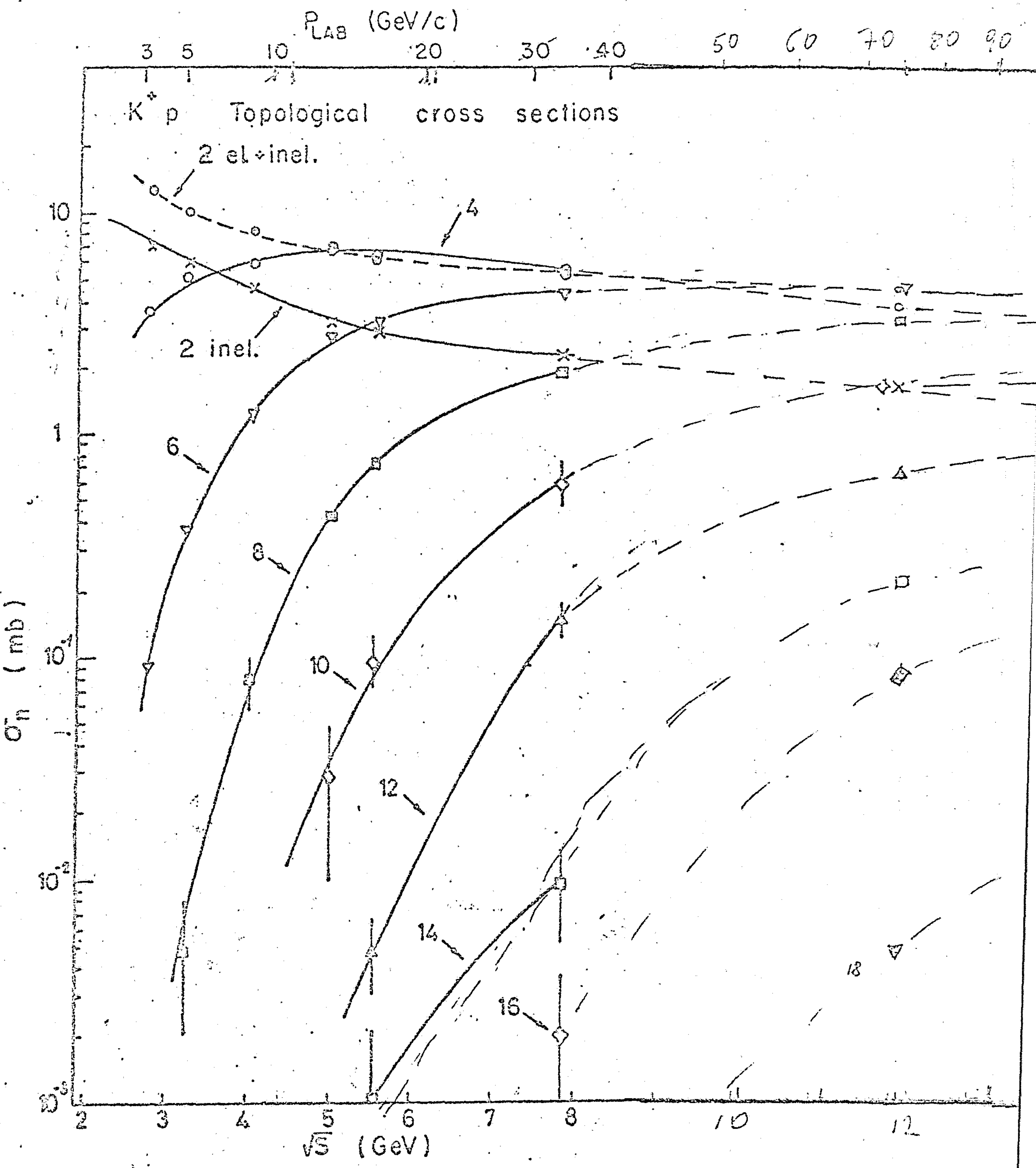

P_{LAB} (GeV/c)
3 5 10 20 30 40 50 60 70 80 90
K⁺p Topological cross sections
2 el.+inel.
4
2 inel.
6
8
10
12
14
16
18
10
1
10^{-1}
10^{-2}
10^{-3}
σ_n (mb)
2 3 4 5 6 7 8 10 12
$\sqrt{s}$ (GeV)

FIG 1

OVER →

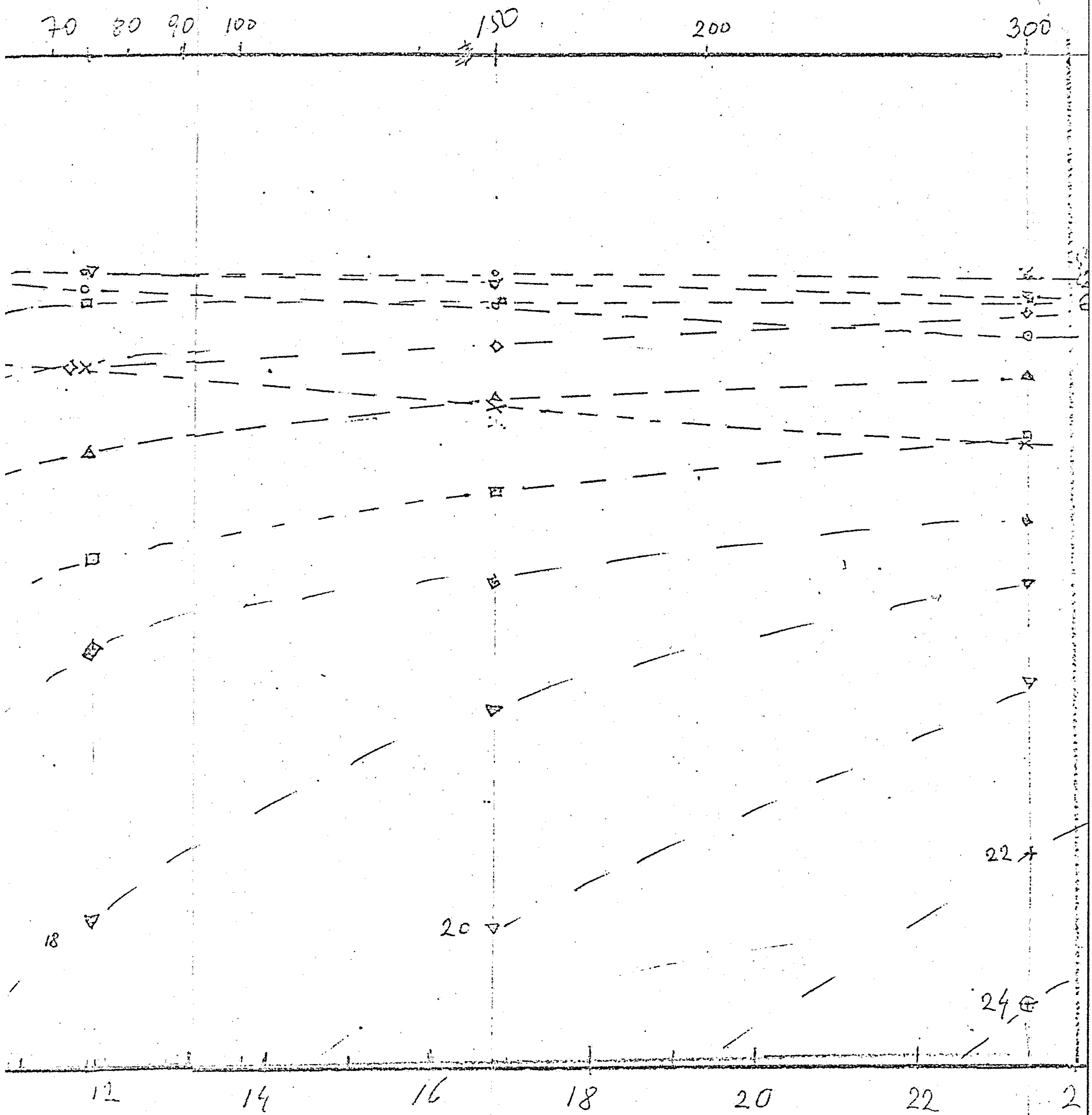

FIG 1 CONT.

FERMILAB Experimental
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Spokesman: Thomas W. Ludlam

STUDIES OF K^- MESON COLLISIONS WITH PROTONS AT AN INCIDENT MOMENTUM CLOSE TO 150 GeV/c

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SUMMARY

We propose an exposure of approximately 0.5 ev/μb equivalent for K^- mesons as close as possible to 150 GeV/c in the FNAL 30-inch Bubble Chamber Proportional Wire Hybrid system. We request this exposure as soon as a suitably enriched beam of K^- mesons is available to that facility. For a beam in which the K^- component is in the ratio R to the total number of hadrons incident at the bubble chamber, this exposure will require $\frac{1}{R}$ x 100, 000 expansions and will yield approximately 10, 000 K^-p interactions for study. We expect that for a feasible experiment the ratio R would have to be 1/5 or greater.

The purpose of this experiment is to carry out a detailed study, with modest statistical accuracy, of K^- proton collisions at energies significantly above those at which such data currently exists, and to further extend the range of incident channel quantum numbers over which multiparticle production has been explored at Fermilab energies. The choice of beam momentum is such as to allow us to make a reasonable cross particle comparison with existing data at 150 GeV/c.

A fundamental part of this proposal is the development of the K^- meson beam. We are prepared to explore the techniques described in W.W. Neale's FN-259/2200 report, either alone or in collaboration with other interested parties. We are also prepared to study alternate K^- beam producing techniques. We expect this proposal to proceed in two phases: The first phase being a feasibility study of the K^- beam and the second phase, contingent on the success of the first phase, being the proposed physics exposure.

I. INTRODUCTION

This experiment is seen as proceeding in two phases, the first is the development of a K^- beam and the second is the physics experiment.

The starting point for phase one will be W.W. Neale's work on enriched particle beams.[1] In addition to the techniques described in Ref. 1 we will investigate other possible methods for producing a K^- beam. We will be pleased to collaborate with other outside groups or individuals who are interested in studying a K^- beam.

The physics interest is the study of K^-p interactions in a new energy regime. We would like to perform the study at an energy close to 150 GeV/c so as to make comparisons with π^+, π^-, $\bar{P}$ and P interactions. However, this desire may be modified by the K^- beam we will actually be able to produce. That is, we will run the experiment at the closest energy to 150 GeV/c at which we can produce a suitable beam.

Cross sections for both leading-kaon and leading-proton events will be measured and compared with lower energy kaon data as well as with existing πp and pp collision data at 150 GeV/c. The total cross section for K^-p collisions falls by about 10 per cent between 10 GeV/c and 100 GeV/c incident momenta. This experiment should determine whether this variation is reflected in, or can be accounted for, by variations in the cross sections for diffractive excitation.

A principal aim of the experiment is to investigate the systematics of particle production at high energies with respect to incident channel quantum numbers. For studies of multiparticle channels a sample of K^-p data has the feature that both the baryonic charge of the target and the strangeness of the projectile can often be uniquely identified among the final-state particles. Thus the dependence of particle production on the initial state quantum numbers can be studied in more detail than is possible in πp or pp collisions. Much can be learned by studying the differences in behavior among particles produced in πp, pp, $\bar{p}p$ and Kp collisions.

The present proposal is designed to make such studies and comparisons for the following aspects of particle production:

(1) Topological cross sections

(2) Leading particle effects and the diffractive component

(3) Resonance production

(4) Particle emission in the central region

In Section II of this proposal we discuss our expectations for Phase One of the experiment: The production of a suitable K^- beam. In Sec. III we outline specific physics objectives. Sec. IV addresses the questions of momentum resolution and neutral particle detection.

II. BEAM STUDY

As Phase One of this experiment we propose to establish a K^- bubble chamber beam to the FERMILAB 30-inch Hybrid Bubble Chamber System. This beam should have $\Delta p/p < 1$ o/o and a $K^-/(\pi^- + \bar{p})$ ratio (R) greater than 20 o/o, and a manageable muon contamination. The number of bubble chamber expansions required for the experiment will be 100.000/R, or, by this criterion, less than 500, 000.

We will attempt to produce a beam with a momentum of 150 GeV/c, in order to facilitate comparisons with other experiments (completed, in progress, and proposed) with other beam particles at that energy. However, the experiment will be run at the nearest practical energy. As stated in the introduction, we would start with the concepts of W.W. Neale, [1] and intend to coordinate our work with a general study of enriched hadron beams for the Fermilab bubble chambers which is being undertaken by Fermilab and other users. The special beamline hardware (pulsed magnets) required for multiple targetting schemes is being provided by the Cavendish Laboratory, and we will provide manpower and engineering assistance as well.

III. PHYSICS OBJECTIVES

(1) Topological Cross Sections

The broadening of the charged particle multiplicity distribution with increasing beam momentum is a characteristic feature of high energy hadron collisions for which detailed information can place important constraints on models for production mechanisms. Studies of semi-inclusive scaling laws have been carried out systematically for pp collisions[2] up through the ISR energy range and for πp collisions[3-5] well into the energy range of the Fermilab accelerator. In this experiment we wish to extend these studies for K^-p collisions upward from the highest energy data currently available, which is at 32 GeV/c.[6]

The charged particle multiplicity distribution and its statistical moments will be obtained essentially from the scanning of photographs from the bare bubble chamber. Systematic errors will be minimized by an accurate separation of elastic and inelastic 2-prongs: The moments of the multiplicity distribution are extremely sensitive to the inelastic 2-prong cross section.

(2) Leading Particle Effects and the Diffractive Component

The cross sections for leading, or quasi-elastic, K^- and proton signals will be measured and compared with similar measurements for high energy πp and pp collisions, as well as lower energy kaon data. With the Proportional Wire Hybrid System both of these signals can be extracted on an event-by-event basis and subjected to detailed analysis in terms of the expected behavior for diffractive excitation of the beam or target. On the basis of existing data for πp and pp collisions, for which the inelastic leading particle cross sections are comparable to the elastic cross sections, we expect to obtain some 1000-1500 leading particle events for study in this exposure.

Given a clean separation of diffractively produced events, the predictions of factorization hypotheses can be meaningfully tested:

$$\frac{\sigma(K^- p,\ \text{elastic})}{\sigma(pp,\ \text{elastic})} = \frac{\sigma(K^- p \to K^- p^*)}{\sigma(pp \to pp^*)}$$

$$\frac{\sigma(K^- p,\ \text{elastic})}{\sigma(\pi^\pm p,\ \text{elastic})} = \frac{\sigma(K^- p \to K^- p^*)}{\sigma(\pi^\pm p \to \pi^\pm p^*)}$$

In addition, double diffractive excitation is expected to be present with a significant cross section (0.5 - 1.0 mb, based on factorization estimates). Little is known about this process, since it does not exhibit a unique kinematic configuration of final state particles. It is important to know whether it in fact contributes in amounts expected on the basis of single excitation cross sections. We expect to be able to study this in the 2-prong inelastic sample which should be dominated by diffractively produced events, with only a small contribution from non-diffractive, many body channels. We expect also to study this phenomenon in medium multiplicity exclusive channels, for which multidimensional analysis techniques can be brought to bear. For example, we expect a cross section of 20 - 40 μb for the reaction

$$K^- p \to K^* p^* \to (K^- \pi^+ \pi^-)(\pi^+ \pi^- p) \quad .$$

If low-mass, diffractive excitation represents one of two distinct components contributing to the inelastic cross section, i.e., if the Two Component Model first proposed by Wilson(7) has validity, then the magnitude of the diffractive component can be related to the energy dependence of the multiplicity distribution.(5, 8) With precise information on the leading particle cross sections and some measure of the double diffractive contribution, this result can be checked. If the factorization hypothesis proves valid, then the total diffractive contribution can be obtained as a function of prong number,(3) and the multiplicity distribution for the non-diffractive component can be extracted.

(3) Resonance Production

A prominent feature of kaon-induced final states is the relatively narrow $K^*(890)$ resonance which, unlike the rho, is relatively easy to isolate even in the presence of large combinatorial backgrounds. This is especially true if one of the decay products is an observed $\bar{K}^o$. The latter remark applies as well to hyperon resonances decaying to $\Lambda\pi$. This should allow a more detailed study of two-body resonance production in multibody final states than is possible in pp and πp collisions. We expect to study inclusive production of ρ, K^*, Δ and Y^* resonances.

$K^*(890)$ production is allowed to proceed by Pomeranchuk exchange in the quark model,[9] but forbidden by the Gribov-Morrison rule.[10] Should Pomeranchuk exchange occur, we expect a leading $K^*(890)$ peak, similar to the K^- peak, as well as a clear signal in the exclusive, constrained channel $K^- p \to \bar{K}^o \pi^- p$.

While the existence of diffractive $K^*(890)$ has yet to be demonstrated, diffractive N^* is certainly present at high energies. Here the question is one of detailed analysis to determine the exact mechanism. $K^- p$ reactions will contribute to the study of factorization properties, as discussed above.

This exposure should yield some 300 events of the 4-constraint reaction $K^- p \to K^- p \pi^+ \pi^-$, which is dominated at lower energies by the diffractively produced Q enhancement. We should measure the cross sections for both the Q and the L and have sufficiently good statistical precision and mass resolution to determine whether the shape (width) of the Q is significantly different at 150 GeV/c than at 15 GeV/c. Such a change is to be expected if the enhancement seen at lower energies is an interfering mixture of $J^{PC} = 1^{++}$ and 1^{+-} states.

Partial wave analysis of the 3π system in $\pi p \to (3\pi)p$ indicates a rather flat energy dependence for the $J^P = 2^+$ component.[11] If a similar behavior exists in the $K\pi\pi$ system, one can expect a nonzero amount of $K^*(1420)$ production at high energies, as well.

(4) Particle Emission in the Central Region

The mechanisms which produce particles in the central region of C.M. momenta give rise to the largest contribution to the total cross section. They involve high multiplicity reactions which are difficult to study. Little is known here save for certain general characteristics which have helped to focus theoretical and experimental investigations, but have not yet circumscribed a specific class of production models. Examples are the predominance of short-range correlations among pairs of particles and the importance of clustering phenomena.

At Fermilab energies the behavior of the high-multiplicity component is evidently sensitive to the incident channel quantum numbers. In the highest energy $\pi^- p$ data analyzed to date, strong asymmetries are observed in both the electric charge and transverse momentum distributions of final-state pions. These asymmetries cannot be accounted for by the diffractive component seen in low multiplicity events.(13) Phenomenological analyses of multiparticle production in terms of cluster emission(14, 15) and the related concept of local quantum number conservation(16, 17) will be extended considerably by the availability of data in which an additional quantum number (strangeness) can be traced from the initial to the final state.

The expected significant yields of K_1^0, Λ, Ξ and perhaps Ω particles in the proposed experiment will afford important comparisons with strange particle production in πp, pp and $\bar{p}p$ collisions, and with lower energy $K^- p$ data. In addition, we expect that a comparison of the yields and kinematic behavior of ρ and $K^*(890)$ resonances in the high multiplicity component of data from this experiment will give new insight into the role of few-body resonances in clustering phenomena, and help to set quantitative limits on the length of rapidity interval over which particles are emitted independently of the nature of the incident particles.

IV. MOMENTUM RESOLUTION AND NEUTRAL PARTICLE DETECTION

(1) Momentum Resolution

Good momentum resolution for fast, forward-going charged tracks is of central importance for this experiment. We require sufficient accuracy to accomplish the following:

(i) Obtain a clean separation, on an event-by-event basis, between elastic and inelastic 2-prong events.

(ii) Isolate leading (quasi-elastic) K^- signals in final sta tes of higher charged particle multiplicity.

(iii) Measure 2- and 3-particle effective masses with sufficient accuracy to detect resonant states over the full kinematically available range of momenta.

(iv) Isolate exclusive channels by kinematic (4-constraint) fits.

All of these goals have been achieved, for 150 GeV/c π^-p collisions, utilizing the Proportional Wire Hybrid System (Fermilab expt. no. 154). A full discussion of the resolving power of the system is given in Ref. 3 and in Fermilab proposals 154 and 299.

(2) Neutral Strange Particle Production

The detection efficiency for neutral strange particles (K_s^o and Λ) in the 30-inch chamber is quite good in the backward C.M. hemisphere, but drops sharply in the forward direction. Nonetheless, we expect in this experiment to detect sufficient numbers of K_s^o and Λ, over an adequate momentum interval, for the studies discussed in Sec. III.

Fig. 1a shows the percentage of K_s^o decaying in the bubble chamber as a function of the scaled C.M. momentum variable, x, of the K_s^o. Three separate curves are plotted; each assumes a different potential path length for decay. If the production vertex is required to be in the upstream half of the chamber, 40 cm is approximately the average potential length. This allows at least 10 cm of track length for the decay products. For high momentum vees the decay tracks can be accurately measured in the downstream PWC system, provided the vertex is visible in the bubble chamber. The maximum potential path in the 30-inch bubble chamber is about 75 cm. Fig. 1b shows the same set of curves for Λ decay.

In Fig. 2 we estimate the number of identified K_s^o and Λ to be expected in this experiment, as a function of x. In making this estimate, we have scaled the shapes of the Lorentz-invariant differential cross sections from data obtained at 13 GeV/c,[18] and have renormalized the cross sections to reflect the increased yields of strange particles observed in high energy πp and pp experiments.[19] This is highly speculative procedure, giving at best a rough estimate of expected yields, and an indication of the effects of detection efficiency on the observed spectra.

With these assumptions, and correcting for neutral decay modes as well as an expected overall loss of 20 °/o of the vees in scanning and measuring, we obtain the unshaded histograms in Fig. 2. Here we have used the .5 event/μb sample size. The shaded histograms result after correcting for escape losses, assuming an average potential path of 40 cm. The shaded areas correspond to 630 K_s^o and 430 Λ events.

These results indicate that we will detect an adequate number of K_s^o and Λ forward of x = 0 to examine the entire central region as well as fragments of the beam. Note that above $x \simeq .3$ the detection efficiencies (Fig. 1) are relatively flat. The numbers of detected decays predicted in Fig. 2 go to zero at large x because the assumed differential cross sections go to zero. If the differential cross sections are larger than our extrapolations indicate in this momentum range, we should detect such an effect.

(3) Neutral Pion Detection

The detection of neutral pions is not presupposed in the physics objectives outlined in Sec. III. We will, of course, scan the film for γ conversions in the liquid hydrogen, and will obtain cross sections for π^o production as a function of charged prong multiplicity, as has been done in previous experiments in the 30-inch bubble chamber. If the Forward Gamma

Detector proposed by the PHS Consortium for expt. 299 is operational when this experiment is run, we will take advantage of the information available from that detector to amplify and extend the physics analysis program discussed here.

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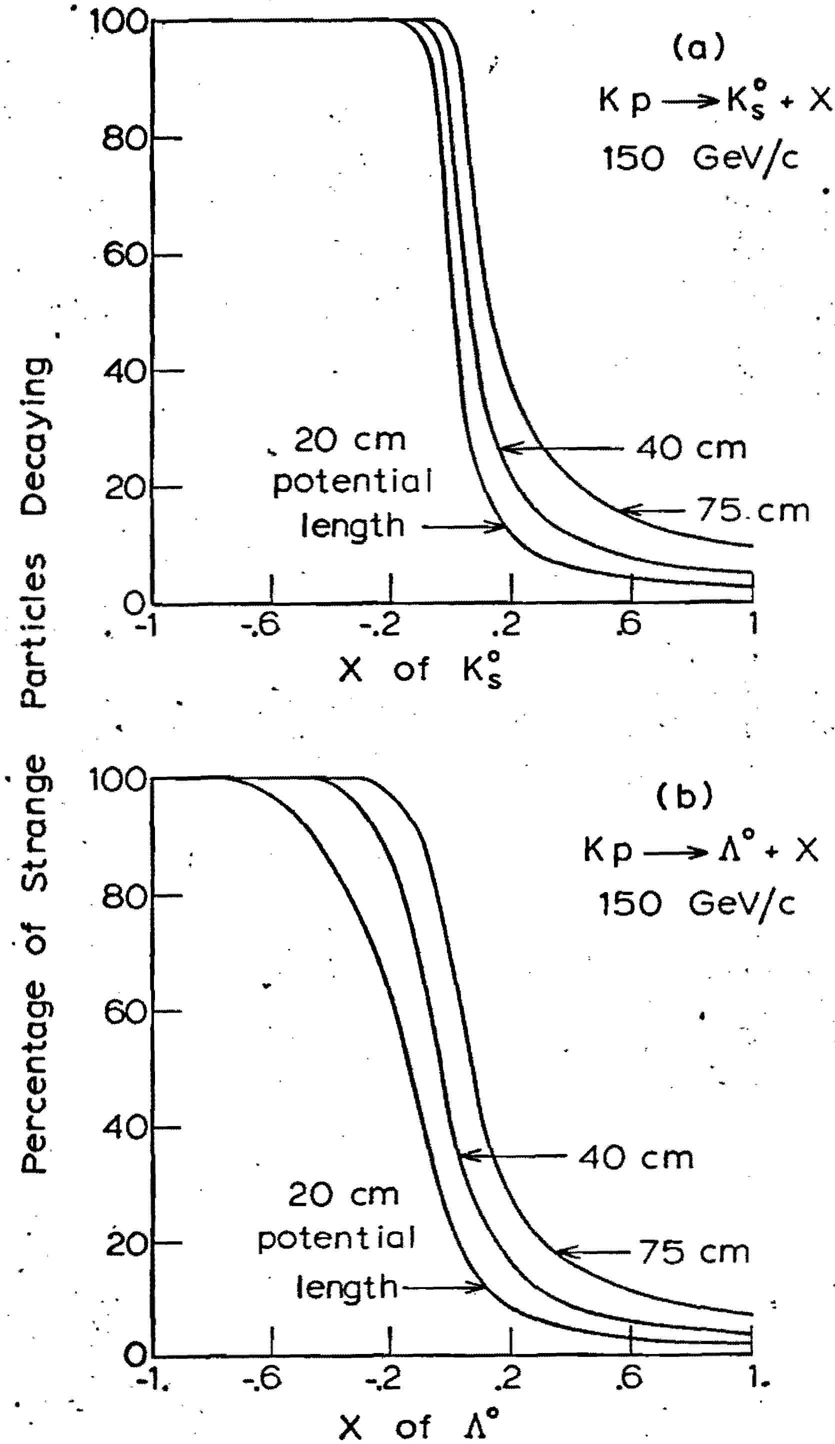
(a)
Kp ⟶ K_s° + X
150 GeV/c
100
80
60
40
20
0
-1
-.6
-.2
.2
.6
1
X of K_s°
20 cm potential length
40 cm
75 cm
Percentage of Strange Particles Decaying
(b)
Kp ⟶ Λ° + X
150 GeV/c
100
80
60
40
20
0
-1.
-.6
-.2
.2
.6
1.
X of Λ°
20 cm potential length
40 cm
75 cm

Fig. 1

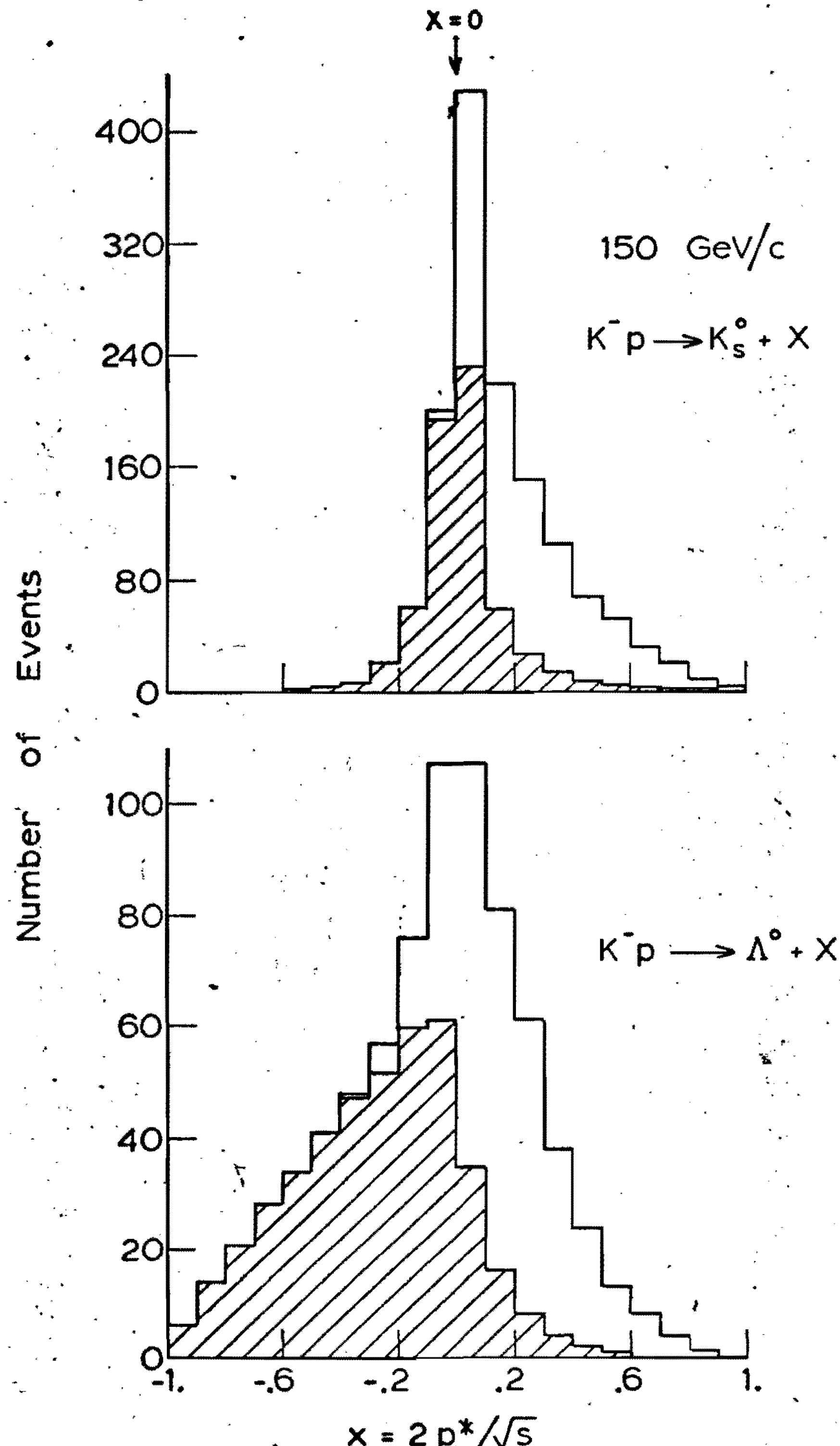
X = 0
400
320
240
160
80
0
150 GeV/c
K⁻p ⟶ K_s^0 + X
Number of Events
100
80
60
40
20
0
K⁻p ⟶ Λ^0 + X
-1.
-.6
-.2
.2
.6
1.
$x = 2p_L^*/\sqrt{s}$

Fig. 2