CERN - EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

SPSC/76-15/P62
February 23, 1976

PROPOSAL(*)

STUDY OF 70 GeV/c K^+p - INTERACTIONS IN BEBC WITH AN E.P.I.

Brussels : J.J. Dumont, J. Lemonne, P. Peeters

CERN : R. Casali, M. Drevermann, Y. Goldschmidt-Clermont(+) E. Pagiola, E. Quercigh, A. Stergiou, G. Vassiliadis

Genova : C. Caso(⊕), M. Dameri, S. Squarcia, V. Trevisan, G. Tomasini

Mons : F. Grard, V.P. Henri, P. Herquet, R. Windmolders

Nijmegen : W. Kittel, W. Metzger, C. Pols, J. Schotanus, R.T. Van de Walle(+)

Serpukhov : P.V. Chliapnikov, L.N. Gerdyikov, S.V. Klimenko, V.M. Kubic, B.A. Manyukov, N.G. Menaey, V.M. Perevozchikov, O.G. Tchikilev, A.P. Verobjev, V.A. Yarba

Tel-Aviv : O. Benary, Y. Gnat, A. Levy, D. Lisauer, Y. Oren

(*) Replaces the K^+p-proposals in:
SPSC/74-47/P14
SPSC/74-73/P17
SPSC/74-118/P32
SPSC/75-53/I71

(+) Contactmen

(⊕) Now at CERN

SUMMARY

We propose a 500 K picture exposure of BEBC to a 70 GeV/c K^+p separated beam using the External Particle Identifier. The present proposal replaces and updates all previously submitted proposals and/or letters of intent for 70 GeV/c K^+p physics in BEBC.

The most important topics of current physics interest which will be studied are: K^+-diffraction dissociation, inclusive distributions for K^+, K^0, π^-, π^+, Λ, p, $K^*(890)$ and Δ^{++} and their correlations, reaction mechanisms in specific exclusive channels. For all these topics the E.P.I. is of fundamental importance. Exploratory topics in our request are searches for remaining two-body reactions (due to Reggeon and/or Pomeron exchange) and searches for charmed particles.

Our request is for 500 K pictures with an intensity of approx. 8 K^+'s per picture. This would yield 235.000 K^+p-interactions inside a 'small' fiducial volume of 1 meter length; using a maximum fiducial volume of 3 meter (e.g. for particle searches) the exposure is equivalent to a 40 events/μb experiment. The collaboration has (from Jan. '77 onwards) a yearly capacity of approximately 200.000 events/year. Taking the film in batches would be acceptable to the collaboration but in order to set up the chain of scanning measurement, data processing and analysis, it would be very desirable to take a first, relatively small, batch of pictures at an early stage of BEBC-SPS operation. Some physics results may already come out of this first sample.

I. INTRODUCTION

A systematic study of hadronic interactions induced by different incident particles is a logical and interesting starting point for the BEBC hadron program. The presence of an RF-beam and the fact that FNAL is now exploring the $\pi^- p$ and pp-interactions, places $\pi^+ p$, $K^\pm p$ and $\bar{p}p$ among the most urgent and most interesting fields to be examined with the BEBC RF-beam. No RF-beam is at present foreseen for FNAL; plans for enriched K-beams into the 30" chamber (using for K^+, nuclear absorption techniques) do exist but will result in experiments typically a factor 25 to 50 lower in statistics than the one requested here(1). In addition, the possibility of performing the exposure at CERN using the External Particle Identifier(2) greatly enhances the possibilities and quality of our experiment.

Our preference for a K-beam (and in particular a K^+-beam) is connected with the physics we want to study as well as with the fact that several of the participating groups have been and/or will be invloved with K^+-bubble chamber physics. Study of meson-proton interactions has the advantage over pp-interactions of asymmetry both in the initial and final state, allowing the exploration of the full (i.e. unfolded) phase space. Over π-p interactions study of K-p interactions has the advantage that the identity of the beam particle is more easily traced in the final state and that detection of K^0_S makes more fit channels available. K^+p-interactions in particular, become 'asymptotic' (and start to show the cross-section increase mechanism) at lower momenta than the corresponding K^-p-processes. Finally a run at 70 GeV/c would not only use the highest available K^+-momentum of the West-Hall RF-beam, it would also be a good continuation of the CERN-PS 16 GeV/c experiment by the CERN-Birmingham-Mons-Saclay-LPNHE (Paris) collaboration, and the Serpukhov 32 GeV/c experiment by the French-Soviet Union and the CERN-Soviet Union collaborations. The s-variable of the experiment ($s=132$ GeV^2) is enough higher than the values 16 and 32 GeV/c ($s=31$ GeV^2 and $s=61$ GeV^2 resp.) to provide valuable information on the approach to scaling. It also provides a good connection between the 16 and 32 GeV/c experiments and the (lower statistics) FNAL-experiments.

The main purpose of the experiment would be the study of K^+p-reaction mechanisms. Since reaction mechanisms are probably better separated in phase space at higher energies, we expect interesting information by studying in the same data, <u>inclusive</u> distributions up to at least second-order correlations on the one hand and the (accessible) <u>exclusive</u> channels on the other hand. In addition the bubble chamber is still the ideal instrument for the detection of new processes and the collection of wide-band data. There is always the challenge of the exploration of the unknown and a fair chance that the data will be a useful testing ground for ideas and effects which are not known yet but which will appear in the foreground during the forthcoming years.

II. PHYSICS MOTIVATIONS

In this section we will discuss our physics motivations in a logical order, which is not necessarily the one of physical importance. Our most important goals are the study of diffraction dissociation and second order inclusive processes; both topics should be studied using the EPI. An overall a priori remark is that a detailed comparison between reactions induced by K^+ and K^- will be of particular interest[(*)]. For this purpose our collaboration wishes to keep in close touch with the groups working with incident K^- at the same incident momentum.

a. Multiparticle Distributions and Topological Cross Sections

For charged particles we expect (essentially already on the scanning level) complete information on the topological cross-sections, multiplicity distributions, the average (charged) multiplicity $\langle n_c \rangle$, the dispersion $D = (\langle n_c \rangle - \langle n_c \rangle^2)^{\frac{1}{2}}$, the ratio $\langle n_c \rangle / D$ and the (integrated) correlation function f_2. With some measurement effort the same information will become available for K^0, Λ, γ, and a study of the complete multiplicity distribution (charged and neutral particles) will become possible. All these quantities may be obtained rapidly, by scanning and limited measurements, from a relatively small sample of photographs. The present situation in terms of σ-topological - known up to 32 GeV/c - is summarized in fig. 1 (taken from ref. 4).

Multiparticle distributions are of great importance in understanding hadron reaction mechanisms. In first approximation there are striking similarities between the distributions observed with different incident particles[(5)]. However a closer examination reveals that there are significant systematic differences (Fig.2-3)[(5)(6)]. It will be interesting to follow the behaviour of these differences up to 70 GeV (and higher). A specific point on which the topological cross-sections and associated quantities may shed light is the mechanisms responsible for the rise in the total cross-section, a mechanism known to be effective already at rather low energies in K^+p interactions.

[(*)] An example is the reaction $K^{\pm}p \rightarrow Q^{\pm}p$[(3)]

b. Inclusive Reactions (1st and 2nd order)

Inclusive reactions which may be studied readily are:

$K^+p \rightarrow K^0 + X$

$K^+p \rightarrow p_{slow} + X$

$K^+p \rightarrow \pi^- + X$

$K^+p \rightarrow \Delta^{++}{}_{slow} + X$

$K^+p \rightarrow K^{*-} + X$
$\hookrightarrow (K^0\pi^-)$

With the use of the E.P.I. the reactions:

$K^+p \rightarrow K^+ + X$

$K^+p \rightarrow \pi^+ + X$

$K^+p \rightarrow p_{fast} + X$

will become accessible. Results on the role of the K^+ as a leading particle and comparisons with p, π^+ will be completely new. Here, as in reactions with forward emitted p, $\pi^\pm$, Λ, $\bar{\Lambda}$, etc., the advantages of BEBC equipped with EPI over smaller chambers will be striking; the fast forward particles may be disentangled over a long path and identified. Approach to scaling, triple Regge-model interpretations, mass-dependence of the multiplicity of X, charge and strangeness transfer distributions, etc. belong among the most interesting subjects which can be studied with these data. Comparison with pp-results will yield more information about factorization.

The most interesting second order inclusive processes which can be studied are:

$K^+p \rightarrow K^0\pi^- + X$

$\left.\begin{array}{l} \rightarrow K^0\pi^+ + X \\ \rightarrow K^+\pi^- + X \\ \rightarrow K^+\pi^+ + X \end{array}\right\}$ with EPI

Some properties of two-particle correlations between (like and unlike) charged secondaries in the fragmentation and central regions are known(5)(7); the correlation between charged and neutral particles, between strange and non-strange particles or between identical K's and between non-identical (exotic) pairs (such as $K^+\pi^+$) have hardly been studied yet and are accessible in the experiment proposed here. To examine higher order correlations in momentum, azimuth and hemisphere, we will make use of the recently developed 'cluster' searching techniques(8).

A special example of 2nd order inclusive study will be the determination of the total and topological $K^+\pi^-$ cross sections by means of a Chew-Low extrapolation applied to the reactions $K^+p \to \Delta^{++} + X$[9]. It would be useful to study these reactions at higher energies than presently available; besides the significant increase in the mass of the $K\pi$-system, this would at the same time allow a better accuracy of extrapolation due to the smaller value of t_{min} (p, Δ^{++}) precisely for these higher mass $K\pi$-systems.

c. Diffractive Reactions

Diffractive phenomena will be studied both in exclusive and inclusive channels. The constancy of the diffraction cross-sections with increasing s will make the study of these reactions (quantitatively) one of the most important topics in our experiment.

The inelastic diffractive channels $p \to p\pi$, $p\pi\pi$, ... observed in the FNAL 30" bubble chamber experiments, may be similarly studied here in the backward c.m. hemisphere, allowing comparisons to be made. More specific however to the present exposure is the study of the K^+-diffraction.

The low-energy K-diffraction shows three major structures: the Q-bump, the $K^*(1420)$ and the L-peak. The $K^*(1420)$ is a bonafide resonance, whose (diffractive) production is not definitely established yet, but would violate the Gribov-Morrison rule. The Q- and L-peaks are not simple Breit-Wigner resonances but more complicated objects; the data do not rule out however that part of these structures are due to normal resonances; other possible (non-resonant) contributions are Deck-type amplitudes. Their decay modes as well as their spin and helicity-structures are complicated and confusing(*). Based on a p^{-n} energy dependence (n=0.2) we expect a Q^+ production cross-section at 70 GeV/c of the order of 75μb (or ∿1000 events for the exposure requested). Studying the Q (and L) enhancement at substantially higher momenta will result in a dynamically different mixture of the various possible contributions on top of a smaller background, and could be helpful in disentangling this puzzle. In these studies particle identification will play a crucial role (i.e.

(*) The Q-region 1^+S $K^*\pi$ state shows t-channel helicity conservation; the 1^+S $K\rho$ state s-channel helicity conservation[10].

in performing the J^P-analysis on the $K\pi\pi$-states). This same particle identification will also allow a study of K-diffraction into $KK\bar{K}$ and allow further comparisons between $K\pi\pi$ and $KK\bar{K}$ diffractive final states.[11]

The K^+-diffractive dissociation data will also be used to check excitation into high-mass $K\pi\pi$ systems; for an incident momentum of 70 GeV/c, masses up to 3.5 GeV are observable at $|x|=0.9$. In exclusive (4C) channels higher spin waves and linear spin-mass relations can be studied. In the inclusive channels the data will be examined for triple Pomeron-contributions. A special topic will be the search for diffractive fragmentation of the K^+ in baryon-antibaryon pairs, such as $p\bar{\Lambda}$. Here again the EPI will be necessary.

After a clear separation of both p and K^+ diffraction dissociation (using e.g. the cluster-search techniques mentioned above), factorization can be meaningfully tested. There are many puzzling aspects of factorization (connected with Regge-cuts, rescattering effects, etc.) for which information on low-mass nuclear excitation using kaon beams will play a crucial role.

Finally there is the question of double diffraction dissociation. We expect that it can be studied in the (exclusive) channel $K^+p \rightarrow (K^+\pi^+\pi^-)(\pi^+\pi^-p)$ for which we estimate a cross section of 10 to 20 μb. Again questions related to (Pomeron) factorization will be answerable.

d. Non-Diffractive Multiparticle Reactions

In addition to the diffractive mechanisms, one can also look for other components of multiparticle production, in particular for multiperipheral contributions and central emission of clusters. Again both exclusive and semi-inclusive channels will be used in this study. For the identification of clusters (or short range order correlations) several techniques may be used. They vary from simple effective mass plots to gaps in rapidity distributions, longitudinal phase space plots and special cluster search techniques in the complete phase space[8]. Once clusters are indeed found, questions about leading resonance production, origin of clusters (target fragmentation, projectile fragmentation or central), double Pomeron-exchange, etc. can be answered. A relatively simple reaction to look for double Pomeron-exchange would be: $K^+p \rightarrow K^+(\pi^+\pi^-)p$. This reaction demonstrates the general advantage of the K^+-induced reactions: both initial particles (K^+ and p) may be identified in the final state - if an EPI is available. If the final state is e.g. represented by a multiperipheral ladder, the two external rungs are ex-

e. Non-Diffractive Quasi-Two Body Reactions

Due to the exoticity of the K^+p s-channel, Regge behaviour in K^+p reactions appears already to set in at low incident momenta (3 GeV/c). It would be interesting to look at such Regge-trajectory dominated reactions as $K^+p \rightarrow K^*_{890}p$, $K^*_{1420}p$, $K^0\Delta^{++}$, $K^{*0}\Delta^{++}$, etc. with a 'lever arm' extending from 3 to 70 GeV/c. In general an extrapolation of the cross-sections with a form p_{lab}^{-n} ($n \simeq 2$) predict a small number of events at 70 GeV/c. However there may be interesting exceptions and these may be detected unambiguously if the final state is identified by a 4C-fit. An example is given by the reactions $K^+p \rightarrow K^*(1420)p \rightarrow K^0\pi^+p$ or $K^+\pi^-\pi^+p$ where a sizable cross-section seems to exist. At Serpukhov the reaction $K^-p \rightarrow K^{*-}(1420)p$ was observed still to have a cross-section of $(18 \pm 2)\mu b$ (12). Combined with lower energy data this gives $n = 0.8 \pm 0.2$; such an energy dependence predicts a cross-section for the $K^*(1420)$ at 70 GeV/c of $12\mu b$.

Although in general the 2-body reactions present in 3-body final states are better studied in a counter experiment, the bubble chamber should be able to provide crude, but rather unbiased, information useful (at least) as checkpoints for high-statistics counter experiments. In addition there is the exploration of reactions with ≥ 4 particles in the final state. For all these studies the EPI will (again) be an indispensable tool in resolving the internal K-π ambiguities.

f. Search for Rare Particles (Charm)

In general events which are rare in the 10-20 GeV region will become more common at higher energies (example: baryon-anti-baryon pairs, $\overline{\Omega^-}$ and $\overline{\Xi^-}$ production, etc.). The most attractive possibility would be the detection of charmed particles.

Recent FNAL-results indicate significant differences between πp and $\bar{p}p$ collisions in (inclusive) ψ-production. Although from the point of view of detecting D's, a non-strange beam looks a priori more promising than a strange one, making a more or less complete exploration of the production dynamics will require looking into experiments with K-beams. There exist essentially two different search-methods for the D-particles. The first one is direct observation as a visible (neutral or charged) secondary tracks; with the present spatial resolution of BEBC this would require rather long D-lifetimes(*). The second method consists of using effective mass-techniques on groups of final state particles containing particles which are likely to be decay-products of D's (i.e. strange particles[13]) As the D-decay modes are unknown, in this method bubble chambers - and especially large bubble chambers such as BEBC - have an obvious advantage over other detection instruments because of their capability to see all charged secondary tracks and a substantial part of the neutral ones. (see table 2).

Recently, D. Sivers discussed methods for estimating associated production cross-sections of charmed particles (and ψ's) in hadron collisions[14]. Our $\sqrt{s}$ - value is well above threshold for pair production for currently predicted D (and C) masses. Based on his calculations we estimate at 70 GeV/c that $Kp \rightarrow D\bar{D}$ + ... has a cross-section of approx. 10μb. (The symbol D refers to the sum of all charmed hadrons). Accepting the Sivers-estimate our exposure should contain some 400 events with $D\bar{D}$ produced pairs. Just how to translate this into specific final state topologies depends on the D-decay modes. However the detection efficiencies for the various strange particles (in particular for the neutral ones) and the presence of a combinatorial background, makes the detection of D-particles on the basis of these numbers, if not impossible, at least marginal. We will in any case look for D-decays and our experiment should be able to give (depending on the decay-mode assumptions made) various upper limits for production cross-sections.

(*) For this part of the experiment a special camera viewing the vertex-region with a larger magnification would be useful.

III. TECHNIQUE

The capabilities of BEBC, in a beam of the energy requested here, have been discussed at length in the ECFA-Tirennia reports (15(20). Since then, the exposures in the 30" FNAL bubble chamber have confirmed that a hydrogen bubble chamber is indeed well suited for a systematic, model-independent survey type of study as proposed here. Furthermore, the large size of BEBC results in a substantial improvement in the detection of both charged and neutral particle decays. Table 2 gives mean decay lengths and average decay probabilities. Experience with the FNAL 30" chamber(16) and preliminary results from the first BEBC-experiments also confirmed the findings of earlier kinematics studies, showing that K^0, Λ and $\bar{\Lambda}$-decays can to a large extent be identified without ambiguities. Although the γ-ray conversion efficiency in BEBC is not very high (of the order of 10%) there will be at least 1.3 converted γ's per picture(*). Again we know from FNAL 30" experiments(17) and from the 70 GeV/c pp Mirabelle-experiments(18) that by kinematical fitting the γ/Λ and γ/K ambiguities can be made very small. In addition, the observed and identified γ- conversions will be useful by themselves, providing a measurement of π^0 multiplicities(17)(19).

The ECFA-reports mentioned above contain estimates of the BEBC-measuring accuracy for individual tracks, the resulting accuracy for various quantities of direct physical interest (effective masses, four-momentum transfers, etc.) and the discrimination between competing hypotheses obtained as a result of fitting(20). In particular these estimates show that at 70 GeV/c incident momentum:

. 4C fit events may be separated from their corresponding π^0 channels with a contamination $\leq$ 10%(+).

. Missing masses of neutral systems (not seen to decay or materialize in the chamber) may be measured with a precision $\Delta(MM^2)$ varying [illegible] GeV^2 for a π^0 at 2 GeV/c to .40 GeV^2 for a π^0 at

---

(*)Based on the hypothesis that the mean π^0-[illegible] is half the mean charged multiplicity.

(+)This assumes that the corresponding π^0 reaction has $\sim$3 times the cross-section of the 4C-channel.

40 GeV/c[*].

These conclusions were obtained assuming that BEBC would reach a setting error $\varepsilon \simeq 300\mu$. Preliminary results from the 12 GeV/c $\bar{p}p$ BEBC experiment have confirmed this spatial resolution. In addition an error was found for the K^0 effective mass of $\pm$ 5 MeV.

A well-known ambiguity will exist for the identification of fast positive tracks ($\pi^+/K^+/p$ ambiguity). This problem is important not only for all inclusive and semi-inclusive channels with fast leading positive particles, but also plays a role 'inside' 4C-channels. An example often quoted is the reaction $K^+p \rightarrow K^+\pi^+\pi^-p$. At 16 GeV/c incident momentum already 30% of all events in the reaction $K^+p \rightarrow Q^+p$, $Q^+ \rightarrow K^+\pi^+\pi^-$ have an indistinguishable K^+-π^+. Monte-Carlo studies indicate that at 70 GeV/c incident momentum, the average ambiguity level for the complete channel could be as high as 50%[20]. Discrimination of $\pi^+/K^+/p$ will be possible with the External Particles Identifier now under construction. This device makes use of the logarithmic rise of the ionization in gases such as argon; it will be able to discriminate $\pi^+/K^+/p$ essentially up to 50 GeV/c[2]. The EPI will be used together with a system of proportional wire chambers in order to resolve multi-particle events. Used in conjunction with the fringe-field of the BEBC-magnet, these detectors may give, in addition, as illustrated in fig. 4, a significant improvement in the determination of particle momenta and a corresponding improvement in accuracy. Simulation studies indicate that even with a total number of particles of order 30 entering the EPI[**] (incident tracks, secondary tracks, tracks from interactions of secondaries in chamber and in exit-window), the K^+/π^+ ambiguity will be resolved by the EPI for approx. 75% of the events[21].

---

[*] With these precisions, discrimination between events with <u>one</u> and events with <u>more than one</u> undetected neutral particle will (in general) not be possible. Additional discrimination however could result from the use of the BEBC-fringe field and the EPI-MPWC's as a spectrometer for fast forward particle. (see text)

[**] For our beam intensity, the average number of particles actually expected to enter the EPI is approx. 20.

Finally, a few comments about the beam. The study of the R.F. beam[22] indicates that, using a few percent of the internal flux of protons and a momentum bite of $\Delta p/p \sim 0.2\%$, a beam intensity of $8K^+$ per picture (or more) can be reached at 70 GeV/c. The contamination of strongly interacting particles is expected to be small. ($\pi^+/K^+ \leq 2\%$). The beam transport system will provide a sufficient definition of the incident track momentum, but its position and direction will have to be measured by MPWC's in front of the chamber with an angular resolution of $\pm$ 0.5 mrad. Thus, the incident track will not need to be measured in the chamber with high accuracy, allowing a choice of the fiducial region close to the entrance window and maximising the track length available for measurements of secondary tracks. The accuracy requested for the beam momentum is matched to the tracks in the chamber; the one requested for the beam angle is likewise matched to the limitations imposed by multiple scattering in the entrance beam window.

IV. EXPOSURE AND ANALYSIS

Our proposal is for 500 K pictures at approximately 8 K^+ incident K^+ per picture(*).

For the analysis of some reactions, e.g. 4C-fits, we need high accuracy momenta measurements of the secondaries, e.g. secondary track lengths of the order of 2 - 3m. For these final states, the events will be selected in a fiducial volume extending for about 1m into the chamber from the entrance window. With this fiducial volume our request corresponds to ∿13 events/μb. For some studies (e.g. particle searches) a larger fiducial volume (up to 3m) may be used; the exposure then becomes equivalent to a 40 events/μb experiment.

The corresponding number of events for a few typical reactions are estimated in table 1. These values result from extrapolations of the energy dependence of cross-sections as measured up to 16 and/or 32 GeV/c. Needless to say some of these extrapolations are very uncertain.

The groups involved have access to a large variety of semi-automatic measurement instruments (from ERASME, HPD, PEPR, Polly to Sweepnik) in addition to or with manual back-up facilities. A conservative estimate is that each group can handle approximately 25K events/year from January 1977 onwards; this implies a capacity for the whole collaboration of approx. 200K events/year. Taking the film in batches would (therefore) be acceptable to the collaboration but in order to set up the chain of scanning, measurement, data-processing and analysis, it would be very desirable to take a first (relatively small) batch of pictures (say 70 - 100K) at an early stage of BEBC-SPS operation(+). Some physics results may already come out of this sample.

(*) This number implies on the average 1.75 visible primary interactions/pictures or approx. 21 (primary and secondary) tracks per picture. It is not altogether clear yet whether [illegible] intensity. It is still possible that we will [illegible] to [illegible] what smaller average number of incidents tracks, (and a correspondingly larger exposure) or alternatively, a cut on the pictures as a function of the number of secondary interactions.

(+) Part of this first batch of pictures could be used to optimize the incident track number e.g. by taking a fraction of them with an average of 4 resp. 6 beam tracks/picture.

REFERENCES

(1) W.W. Neale
FNAL-Report FN 259/2200

(2) M. Aderholz et al.
Nuclear Instr. & Methods, 118 (1974) 419
Nuclear Instr. & Methods, 123 (1975) 237

N.B. Durusoy and I. Lehraus
CERN/Dph.II/Beam 75-4 (1975)

(3) A. Stergiou et al.
Nuclear Physics B102 (1976) 1

G. Vassiliadis et al.
CERN/D.Ph.II/Phys. 75-21 (1975)

(4) G.A. Akopdjanov et al.
Nuclear Physics B75 (1974) 401

(5) J. Whitmore
Physics Reports no. 10 (1974) 273

A. Wrobleswski,
Proceedings of the Kiev Conference, 1971, p.42

V.V. Ammosov et al.
Nuclear Physics B58 (1973) 77

(6) Birmingham-Brussels-Mons-CERN-Paris Saclay-Collaboration
W. Dunwoodie (private communication)

Y. Goldschmidt-Clermont
Acta Physica Polonica B4 (1974) 805

(7) P.V.Chliapnikov et al.
Paper submitted to Palermo-Conference (1975) and Nucl.Physics B.
(in press)

(8) T. Ludlam et al.
Phys. Letters 48B, p.449 (1974)

G. Friedman
Proc. CERN School of Computing CERN 74-18

W. Kittel
Proc. Symposium on Nucleon-Antinucleon Interactions
CERN 74-18, p.418.

(9) P.V. Chliapnikov et al.
Nucl. Phys. B91 (1975) 413

(10) N. Carney et al.
Phys. Letters 55B (1975) 117

G. Otter et al.
CERN/D.Ph.II/Phys. 75-6 (1975)

(11) P. Bosetti et al.
CERN/D.Ph.II/Phys. 75-28 (1975)

(12) Y.M. Antipov et al.
CERN-IHEP Collaboration, Nuclear Physics B63 (1973) 202

(13) D. Bogert et al.
FNAL-preprint FM 281 (7200.234) Oct. 75

(14) D. Sivers
Rutherford Lab. Report RL-75- 171; T.142 (Nov. '75)

(15) J. Meyer
CERN/ECFA/72/4 Vol. I. p.3

(16) F.T. Dao et al.
Phys. Rev. Letters 30 (1973) 1151

E.L. Berge et al.
CERN/D.Ph.II/Phys. 74-27 (1974)

(17) G. Charlton et al.
Phys. Rev. Letters, 29 (1972) 1759

(18) H. Blumenfeld et al.
Phys. Letters 45B (1973), 28

(19) D.J. Miller et al.
CERN/ECFA/72/4 Vol. I p.13

(20) A. Grant et al.
CERN/ECFA/72/4 Vol. I p.31

(21) N. Elverhaugh and A. Grant
CERN/D.Ph.II/Bèam 74-2

(22) P. Bernard et al.
CERN/ECFA/72/4 Vol. I p.435

TABLE 1

Number of Events expected for a run of 500 K pictures

(8 K^+ per picture)

Reaction	σ	Fraction of events seen	Number of events in small[3] fiducial volume	Number of events in large[4] fiducial volume
$K^+p \to$ all	18.4 mb	0.96 [1]	235 K	705 K
$K^+p \to K^+p$	2.5 mb	0.75 [1]	25 K	75 K
$K^+p \to$ 4 prong	4.0 mb	1	53 K	160 K
$K^+p \to$ 6 prong	4.5 mb	1	60 K	180 K
$K^+p \to$ 8 prong	3.2 mb	1	43 K	128 K
$K^+p \to K^0 + X$	7.2 mb	1/3 x 0.76[2]	24 K	--
$K^+p \to \Lambda + X$	2.4 mb	2/3 x 0.66[2]	14 K	--
$K^+p \to K^0p\pi^+$	9 μb[5]	1/3 x 0.76[2]	30	--
$K^+p \to K^+\pi^+p\pi^-$	270 μb[5]	1	3.6K	--
$K^+p \to Q^+p$	75 μb[5]	1	1 K	--
$\to K^+\pi^+\pi^-$				
$K^+p \to K^*(890)p$	2.5μb[5]			
$\to K^0\pi^+$		2/3x1/3x0.76[2]	6	--
$K^+p \to K^*(1400)p$	12μb[5]			
$\to K^0\pi^+$		0.55x1/3x0.76[2]	23	
$\to K^+\pi^+\pi^-$		0.3	48	

(1) Taking into account the losses due to small angle scattering

(2) Assuming an average geometrical detection efficiency of 0.76 for K^0_s and 0.66 for Λ.

(3) One meter long fiducial volume leaving approx.two meters for momentum determination and V_0 detection.

(4) Three meters long fiducial volume

(5) Assuming correctness of a p^{-n} behaviour; checking this behaviour is one of the aims of the experiment.

TABLE 2

Mean Decay Length and Decay Probability[(*)]

	20 GeV/c		40 GeV/c		60 GeV/c	
K_S^0	100 cm	94 %	205 cm	76 %	310 cm	62 %
Λ	140 cm	88 %	275 cm	66 %	410 cm	52 %
Σ^+	40 cm	100 %	80 cm	97 %	120 cm	91 %
Σ^-	75 m	98 %	150 cm	87 %	225 cm	74 %
Ξ^-	75 m	98 %	150 cm	87 %	230 cm	74 %
Ω^-	45 cm	100 %	95 cm	96 %	145 cm	88 %

(*) Assuming a decay length of 3 m, i.e. roughly the maximum decay length available in BEBC

FIGURE CAPTIONS

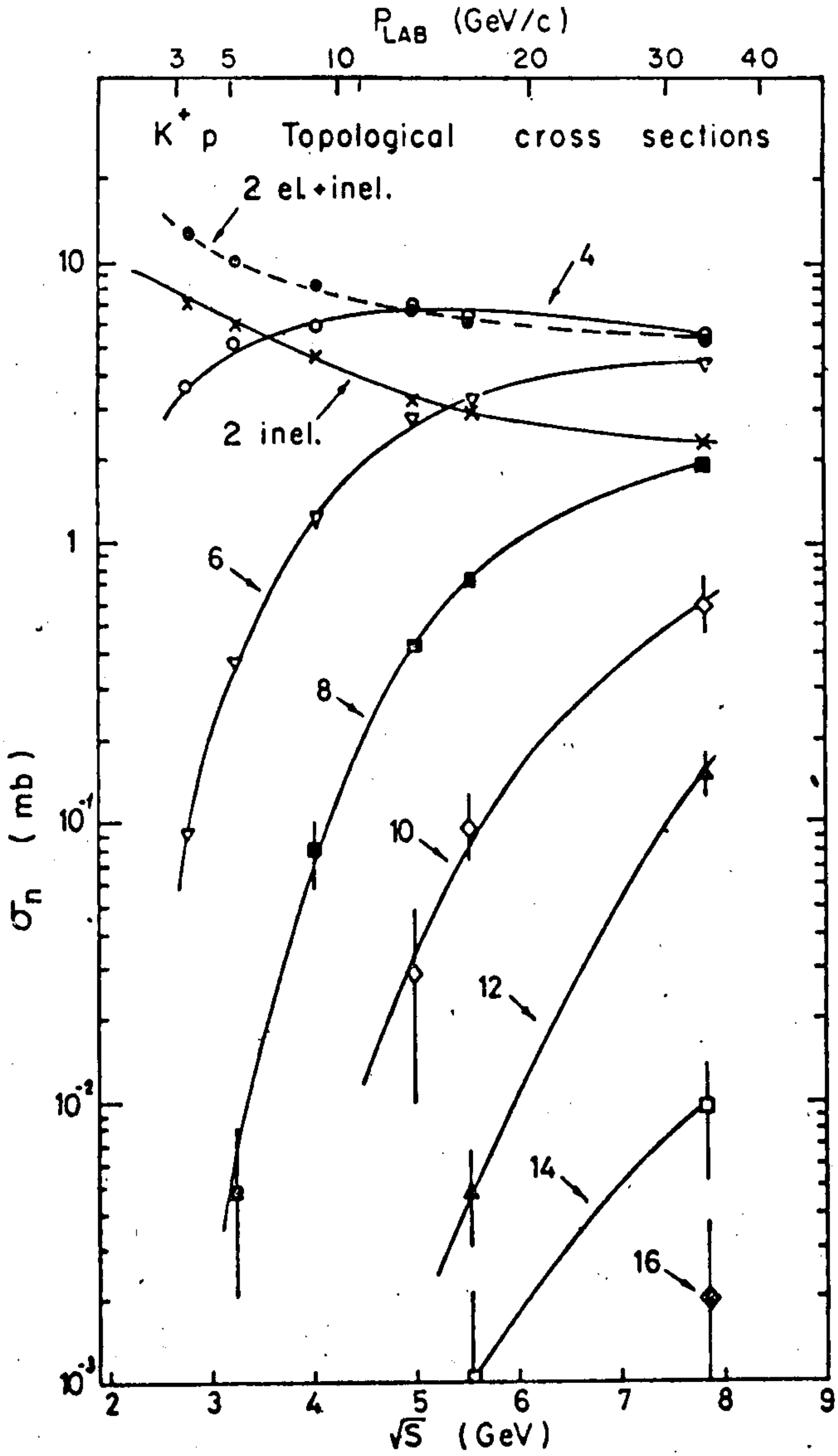
Fig.1: Topological cross sections for K^+p vs. $\sqrt{s}$ and p_{lab}(4)

Fig.2: Dispersion $D = \sqrt{<n^2> - <n>^2}$ and second order structure function $f_2 = <n(n-1)> - <n>^2$ for positive incident particles (5)(6)

Fig.3: Average charged multiplicities vs. s for positive incident particles

Fig.4: Simulation of missing mass determination in 'bare' BEBC and with an outside measurement of outgoing track momenta to an accuracy of $\Delta p/p = 0.3\%$.

Fig. 1



P_LAB (GeV/c)
3
5
10
20
30
40
K⁺p Topological cross sections
2 el.+inel.
4
10
2 inel.
6
1
8
10
10⁻¹
12
10⁻²
14
16
10⁻³
σn (mb)
2
3
4
5
6
7
8
9
√S (GeV)

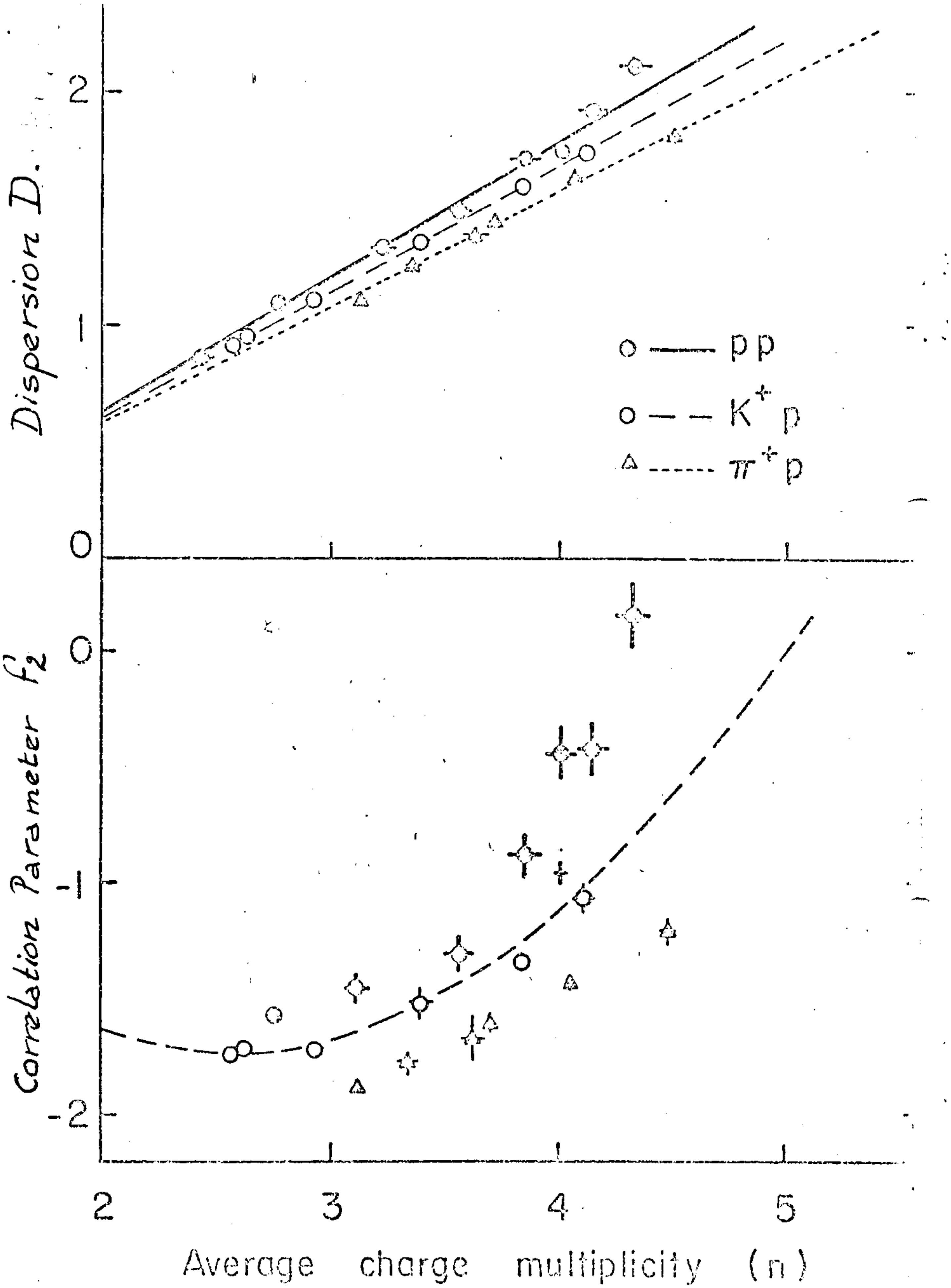

Dispersion D.
2
1
0
o —— p p
o — — K⁺ p
△ ------ π⁺ p
Correlation Parameter f₂
0
-1
-2
2
3
4
5
Average charge multiplicity ⟨n⟩

Fig. 2

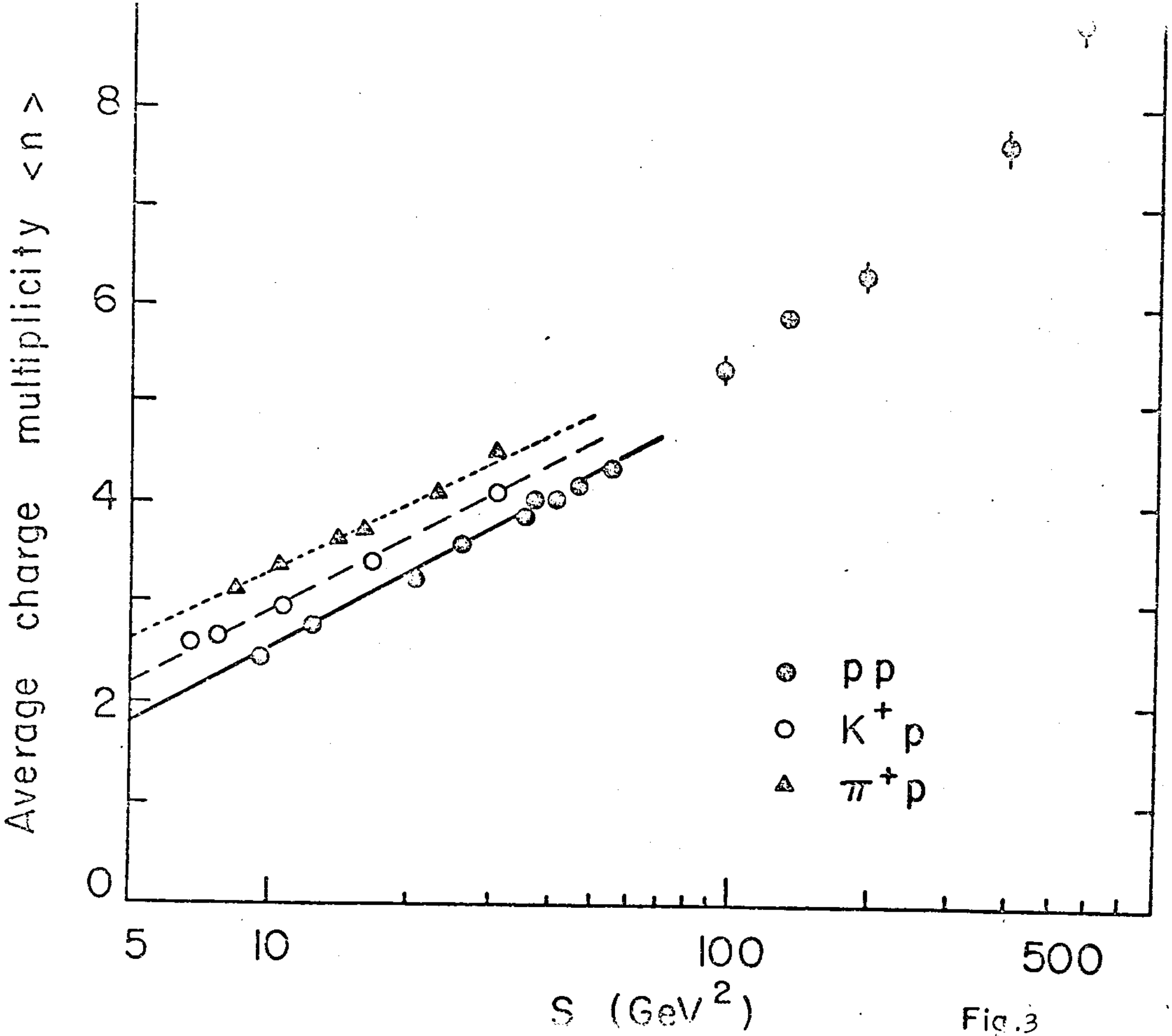

Average charge multiplicity < n >
0
2
4
6
8
5
10
100
500
S (GeV²)
pp
K⁺p
π⁺p

Fig.3

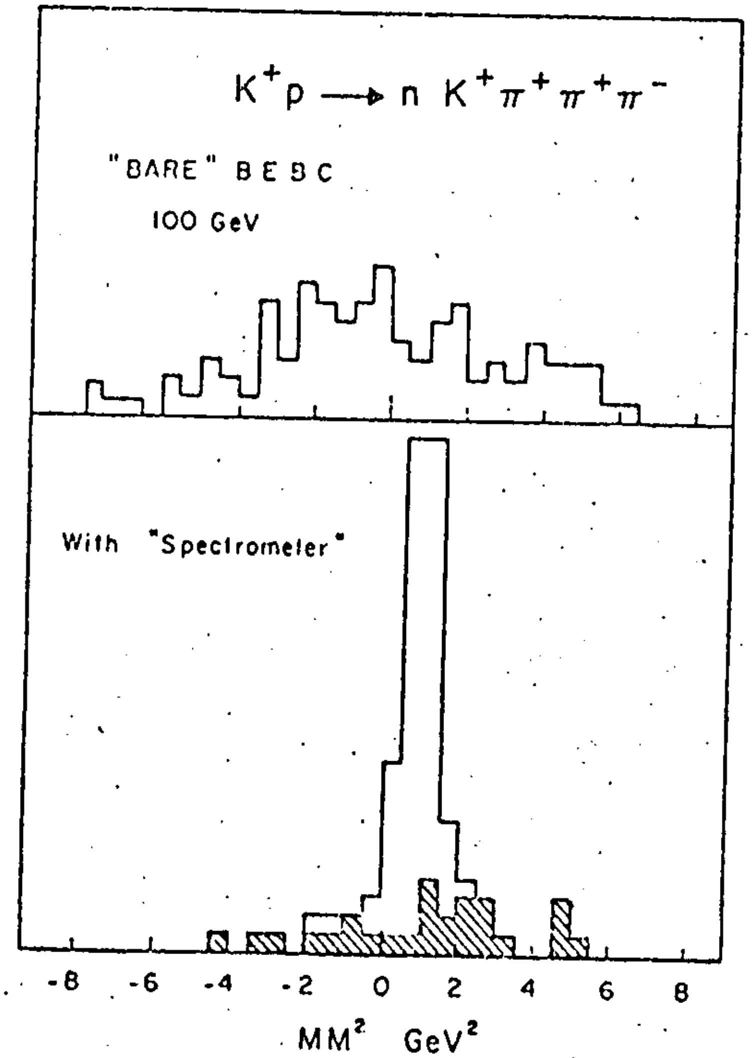

$K^+p \longrightarrow n\ K^+\pi^+\pi^+\pi^-$
"BARE" BEBC
100 GeV
With "Spectrometer"
-8
-6
-4
-2
0
2
4
6
8
MM² GeV²

FIG. 4