CERN/TCC 67-66
24th November 1967

# Proposal for a Major Extension of the 10 GeV/c $K^-p$ Experiment

Aachen - Berlin - CERN - London (I.C.) - Vienna Collaboration

## Introduction

First results from the measurements of high energy $K^-p$ interactions seem to indicate that this is and will be a fruitful field of study. However there are many channels and some of the more interesting ones lack statistics. Here we propose an extension of the present study of 10 GeV/c $K^-p$ interactions by the Aachen - Berlin - CERN - London (I.C.) - Vienna Collaboration, to allow a significant increase in the number of events for study. The coming into operation of new types of measuring machines in several laboratories of the collaboration in 1969, should allow this much larger number of events to be measured in a reasonable time. This proposal requests 800,000 photographs of 10 GeV/c $K^-$ to be taken in the two metre chamber partly in late 1968 and partly in 1969.

After a first proposal in 1963 to study high energy (14 GeV/c) $K^+$ and $K^-$ interactions, an amended proposal to study 10 GeV/c $K^-$ mesons was made in Jan. 1965. As it was hoped to make this an extended experiment, 500,000 photographs were requested. In Feb. 1965, 200,000 photographs of 10 GeV/c $K^-$ with 5 $K^-$ per photograph were taken in the 150 cm British hydrogen bubble chamber. In August 1966, 70,000 photographs with $6\frac{1}{2}$ $K^-$ per photograph were taken (because of difficulties with the beam, 62,000 additional photographs which were taken had a large $\pi^-$ contamination; these photographs have not been used). In Jan/Feb 1968 it is hoped to take 200,000 more photographs.

The present results are based mainly on some 30,000 events of 2 and 4 prongs, 2 prong $V^o$ and 4 prong $V^o$ and of events with two or more observed strange particle decays, the photographs being taken in the 150 cm British Hydrogen bubble chamber. In addition, results from a first sample of film taken with the two-metre chamber have been used. Here in addition six and eight prong events with and without $V^o$'s have been measured. Most groups in the collaboration hope to finish measuring this latter film in Nov, 1967 giving a further 30,000 events.

The major reasons for an extended study of 10 GeV/c $K^-p$ interactions are as follows:-

1) The $(K\pi\pi)$ mass spectrum is of particular interest. Near 1300 MeV there is a broad ($\Gamma \approx 200$ MeV) enhancement which is suspected to be composed of several resonances, better statistics should help to separate these and allow their spin and parity to be determined. A new resonance, the L-meson has been found in the $(K\pi\pi)^-$ mass distribution near 1800 MeV. So far only about 100 events above background are available for spin and parity analysis which is quite inadequate as there are many possible decay modes, $(K^{*-}(890)\ \pi^0)$, $(K^{*0}(890)\ \pi^-)$, $K^{*-}(1400)\pi^0)$, $(K^{*-}(1400)\ \pi^0)$, $(K\pi\pi)^-$, $(K^-\rho^0)$ and $(K^0\rho^-)$. The L-meson appears to decay into $(K\omega)$ but there are inadequate statistics to decide whether the $K^*(1300)$ and $K^*(1400)$ decay into $K\omega$.

2) The reactions $K^-p \rightarrow K^*(890)p$ and $K^-p \rightarrow K^*(890)n$ would appear to be particularly suitable for the test of models of reaction mechanisms. The latter reaction proceeds mainly by pion exchange while the former proceeds mainly by vector meson exchange. However these statements must be qualified as the fraction of vector and pseudoscalar exchange in the former reaction appears to vary with the four-momentum transfer, t. The detailed results cannot be explained by the absorption model at 10 GeV/c and are difficult to explain even with modified Regge pole models. Attempts are now being made to understand the results using the quark model. Improved statistical accuracy is required to study these reactions as function of t, and carry out a similar detailed analysis of the production of $K^{*-}(1400)$ and $K^{*0}(1400)$.

3) Lambda production is of special interest as the reaction requires, in some way, baryon or strangeness exchange. For quasi two-body processes ($\Lambda\eta$, $\Lambda\omega$, $\Lambda\rho$, $\Lambda f^0$, etc.) the cross sections are only a few microbarns so that an order of magnitude more events than are presently available, are required to study differential cross sections and backward peaks.

4) Production of $\Xi^-$ and $\Omega^-$ events is of great interest, both in studies of the production reactions and in the search for higher resonance states, since only the $\Xi^*(1530)$ is well established although many other excited states are predicted. Unfortunately few events are found in any one channel (4 unambiguous

examples of $\Omega^-$ events were found in the first set of 30,000 events of 10 GeV/c $K^-p$ reactions so that again an order of magnitude more events are required. With the extended experiment proposed here a total of about 60 $\Omega^-$ events would be expected.

Measuring equipment available in 1969

In Aachen it is expected that a spiral reader will be operational in 1969 in addition to six IEP's on-line. Berlin hopes to have a SMP working. In CERN a first spiral reader which could measure 10 GeV/c $K^-$ film should begin measuring in April 1969 and should this not be available, it is hoped to measure with an HPD. An HPD will soon be operating in London. In Vienna a spiral reader will not be operational until 1970, but it is hoped to measure on IEP's events which are difficult to measure on automatic machines.

It thus seems that the 5 groups in the collaboration could measure 300,000 events in about a year.

Number of photographs requested

The present situation is:

| | | |
|---|---|---|
| 150 cm chamber : | 200 K photos taken in Feb.'65, 5 $K^-$/photo, | 30,000 events |
| 200 cm chamber : | 70 K photos taken in Aug.'66, $6\frac{1}{2}$ $K^-$/photo, | 30,000 events |
| 200 cm chamber : | 200 K photos to be taken Jan/Feb.'68, $6\frac{1}{2}$ $K^-$/photo, | 80,000 events |
| | Total : | 140,000 events |

The above is assuming that almost all event types are measured. However about one third of the events are two prongs and one must consider whether it is worth measuring two prong events when the results would be presented in 1970. There are three main advantages in measuring two prongs: (a) to study elastic scattering - at present the most complete results are the 10 GeV/c $K^-p$ bubble chamber data, as there are no good counter experiments at high $K^-$ energies and apparently none are planned for the immediate future. However the situation might be different in 1970. (b) to study the reactions $K^-p \rightarrow K^{*-}p$, though some information with about one third statistics can also be obtained from

2 prong $V^o$ events. (c) to study the reaction $K^- p \rightarrow K^{*o} n$. This can only be done by measuring two prong events. The reaction is interesting as explained in (2) above.

If it is assumed that in 1968/69 the beams are improved so that 10 $K^-$ per photograph are possible (note there are usually an equal number of $\mu^-$), then 800,000 photographs of 10 GeV/c $K^-$ in the two metre chamber would give about 300,000 events of 4 prong, 6 prong and 2 prong $V^o$, 4 prong $V^o$ and 6 prong $V^o$. If it is decided in 1969 that it is worthwhile to measure two prong events as well, then a total of 500,000 photographs would give 300,000 events for measurement. Should the beam not yield 10 $K^-$ per photograph, then a different number of photographs would be required.

Summary

To allow a substantial increase in statistics in several interesting reactions with low cross section, 800,000 photographs with 10 $K^-$ per photograph are requested in late 1968 and 1969. Automatic measuring machines should allow the events to be measured in about one year.