EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

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M e m o r a n d u m

To : The members of the EEC

From : S. Anderson, C. Daum, F.C. Erné, J.P. Lagnaux, J.C. Sens and F. Udo (CERN/Holland team)

Subject : Request for an extension of the $K^{\pm}$ polarized proton experiment

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The experiment started in October 1968. Up to 12 September, 1969, a total of 60 angular distributions and polarizations has been measured on incident $\pi^{\pm}$, $K^{\pm}$, $p^{\pm}$ between 0.9 and 2.8 GeV/c. Data-taking time has been maintained at more than 90% of the available PS time over the entire duration of the experiment.

Although the experiment had been planned primarily for $\bar{p}p$ and K^-p scattering, about 65% of the available PS time has, in fact, been spent on K^+ (with simultaneous π^+ data-taking) once it had been shown that the equipment could be adapted to accept reactions from positive particles as well.

In a phase-shift analysis on six K^+ angular distributions and polarizations [done in collaboration with F. Wagner (Theory Division)], it has appeared that the K^+p system is possibly resonant in the $J^P = {}^3/_2{}^+$, I = 1 state.

Since then, four more K^+ angular distributions and polarizations have been obtained; it is intended to update the phase-shift analysis in October 1969. The results will indicate whether still more data are required before it can be decided whether or not the P_3 wave describes a circle in the Argand diagram.

In addition, we are at present investigating [in collaboration with C. Schmid, (Theory Div.)] to what extent the K^+ amplitudes obtained from

the phase-shift analysis, taken together with whatever is known about K^- amplitudes, can be used to test the conjecture of exchange degeneracy and to calculate finite energy sum rules for the KN system. The main difficulty in doing such an analysis lies in the lack of reliable K^- amplitudes. K^-p angular distributions have been measured at many momenta below $\sim$ 2.5 GeV/c, but no unique solution for the amplitudes can be expected until more and more accurate polarization data become available. In the present experiment we have obtained, in addition to the K^+ (π^+) results, polarization and angular distribution data at eight momenta in K^-. The precision of these data is considerably higher than that of the previous K^- experiment, partly due to better equipment (butanol polarized target instead of LMN, 2° angular resolution instead of 4°, computer-supervision of the electronics), partly due to higher statistics. It is clear that the present equipment can, without any modifications, produce the data necessary to obtain K^- amplitudes from a phase-shift analysis. It may be noted that at present three groups [Lovelace/Wagner, Moorhouse(RHEL), Donnachie(Glasgow)] are setting up the necessary machinery to do such a phase-shift analysis.

CONTINUATION OF THE EXPERIMENT

In view of these considerations, we propose to continue to exploit the present apparatus in order to obtain polarization data and angular distributions at as many momenta between 1 and 3 GeV/c and with as good a statistical accuracy as is required to get reliable answers from a phase-shift analysis. There is no way of knowing *a priori* how many measurements are needed, and hence such a programme is necessarily somewhat open-ended. Periodic feedback with the analysis programmes can indicate how much progress is being made. A tentative schedule, based on experience gained thus far, is as follows:

1) K^+p at 3 to 4 more momenta above 1.9 GeV/c (where no data are yet available), depending on the outcome of the October analysis and on what is being done at other laboratories (BNL, ANL), where similar experiments are in progress. This requires about three weeks of PS time.

2) K^-p at $\sim$ 12 momenta between 1.3 and 2.5 GeV/c, at momenta where either no or insufficient data exist. (The region 1.0 - 1.3 GeV/c has been covered by the present experiment.) This requires about six weeks of PS time.

3) K^-p below 1 GeV/c. A considerable effort has been made in recent years [CERN/Heidelberg/Saclay/Chicago collaboration (Ferro-Luzzi et al.), Berkeley K^- group (Tripp et al.), etc.] to extract information on Y^*'s from low-energy K^-N data. Even a few polarization measurements below $\sim$ 1 GeV/c would greatly reduce the number of solutions that fit the data. The lowest momentum reached in K^- in the present experiment is 1.0 GeV/c (six days of running). The q_7 beam is not suitable for continuing downwards below 0.8 GeV/c. It is estimated that with approximately three PS weeks the structure-rich region between 0.8 and 1.0 GeV/c could be explored successfully.

A total of about twelve PS weeks is thus requested in order to carry out this programme of measurements.

It may be stressed here that if the recent developments in cooling (Saclay, Argonne Nat. Lab.) would be incorporated in the present polarized target set-up, the target polarization would increase from 35 to $\sim$ 65%, and hence for a given precision a reduction in running-time is obtained. At momenta where angular distributions are available from literature, the running-time is reduced by a factor $\sim$ 3; at other momenta the gain is less since the accuracy of the angular distributions (which depends on running-time only) cannot be reduced arbitrarily. The over-all gain is possibly a factor of about two, i.e. six PS weeks instead of twelve.

A few other remarks, relevant to this request are

1) Without extra running-time, accurate $\pi^\pm$ and $p^\pm$ data are obtained. In particular, π^+ data are in strong demand by the phase-shifters.

2) The q_7 beam is free, while the target feeding it (No. 8) is in use anyhow for m_8. About 30% on No. 8 is adequate for efficient running.

3) At the end of the currently requested extension (∿ Summer 1970) the larger part of the group will begin preparing an experiment at the ISR (assuming approval by the NPRC). Hence, if still more data would be required, another team would have to take over. If not, the q_7 beam would become available for other experiments.