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STUDY OF K^+p - INTERACTIONS IN BEBC AT 70 GeV/c

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SUMMARY

We propose an exposure of either bare BEBC or BEBC assisted by an E.P.I. to a K^+-beam of highest energy available from the West-Hall R.F.-beam. A total of approximately 400 K pictures with an intensity of about 15 K^+ per picture is requested. The aim of experiment is to study charge multiplicities, topological cross-sections and a broad class of inclusive reactions in addition to certain exclusive channels.

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Study of K^+p Interactions in BEBC at 70 GeV/c

We want to express our interest in a study of K^+p interactions in BEBC at the highest energy available from the West-hall R.F. beam. The main purpose of the experiment would be the study of K^+p reactions mechanisms prevailing at those energies. We would examine these mechanisms as unbiased and systematically as possible by analyzing and measuring all topologies. Since reaction mechanisms are probably better separated at higher energies we expect to get interesting information on these strong interactions by studying on the same data, inclusive distributions up to at least order two correlations on the one hand and the (accessible) exclusive channels on the other hand.

The problem of extracting interesting physics results from a bubble chamber in a beam of the energy requested here, are discussed at length in the ECFA Tirrenia reports. It was found that a hydrogen bubble chamber because of its known target, 4π geometry, good visibility of the target-region and slow secondary particles and high multiparticle (and multi-vertex) efficiency is well suited for a systematic model independent survey-type of study. This has been confirmed by the results recently obtained in NAL for pp-interactions from an exposure in the ANL 30" at 100, 200 and 300 GeV/c incident momentum resp. Furthermore, the larger size of BEBC and its correspondingly better momentum resolution as well as its larger decay

paths should in principle result in a substantial improvement over the present NAL-experience.

The choice of the beam is based on the following considerations. NAL has started and will continue to explore the πp and pp interactions. NAL has no immediate plans for an RF-beam. This places the $K^{\pm}p$ and $\bar{p}p$ interactions among the most urgent and most interesting fields to be examined with the BEBC RF-beam. Our preference for $K^{+}p$ is based on our commitment to a 7 GeV/c $K^{+}p$ BEBC exposure. (Proposal T223). A comparison with identical reactions at lower energies would provide information about energy-dependences. Furthermore in view of checking such questions as factorization etc. we would be equally interested in exchanging and comparring our results with $K^{-}p$, $\pi^{\pm}p$ and pp-collaborations. If possible we would like our exposure to be part of a systematic survey conducted with different beam particles (at approx. the same beam-momentum) and set up with the explicit goal of data exchange and comparison.

The details of the physics interest of the experiments depend on the performances of BEBC and the amount of assistance it will have available at the time of exposure. In the following we will assume that the run has to be done

- either with "bare" BEBC only
- or with BEBC assisted with an external hadron identifier (E.H.I.).

It is probably realistic to assume that none of the other devices suggested for BEBC (TST, spectrometer, etc.) will be available in the initial running period. A possible (but not exhaustive) list of physics problems which could be studied in these circumstances are:

1) Charge multiplicities and topological cross-sections.

2) Inclusive reactions such as:

$K^{+}p \rightarrow K^{o} + \ldots$ (1)
$\rightarrow \pi^{-} + \ldots$ (2)
$\rightarrow p + \ldots$ (3) } with E.H.I.
$\rightarrow \pi^{+} + \ldots$ (4) } or p_{lab}
$\rightarrow \Delta^{++} + \ldots$ (5) } cut off

or second order reactions such as

$K^+p \to K^o\pi^- + \ldots$ (6).

3) S=+1 mesons in the missing-mass-mode (two-body inelastic channels)

$K^-p \to p + MM$ (7)

$\to \Delta^{++} + MM$ (8)

The advantage of similar counter-experiments is that the number of charged mesons present "on the other side" is explicitely observed. In reaction (7) we expect a $\Delta MM \sim 0.1/MM$ (GeV).

4) Certain exclusive channels (i.e. 4C-type events):

$K^+p \to K^op\pi^+$ (9)

$\to K^+p\pi^+\pi^-$ (10)

$\to K^+p\pi^+\pi^-\pi^+\pi^-$ (11)

Monte-Carlo studies have indicated that at 70 GeV/c incident-momentum reactions such as (9), (10) and (11) can be separated (by fitting) from the corresponding reactions with an extra π^o, with a remaining contamination of the order of 10%.

In general these reactions will show a very high $K^+\pi^+$ and $K^+\pi^+p$ inversion ambiguity, the solution of which requires an E.H.I. Specific subreactions however, such as :

- proton-target diffraction dissociation

  $K^+p \to K^+(p\pi^+\pi^-)$ (12)

- double diffraction dissociation

  $K^+p \to (K^+\pi^+\pi^-)\ (p\pi^+\pi^-)$ (13)

- pionisation

  $K^+p \to K^+(\pi^+\pi^-)p$ (14)

will be identifiable on the basis of the presence of 'slow' particles only.

The number of pictures needed is a function of the physics topic studied. Using an intensity of 15-20 K^+ per picture and a fiducial region of 2 meters, we obtain on the average 2 interactions per picture.

For some channels the fiducial region might have to be reduced to $\sim$ 1 m. For topological cross-section determinations we need a sample of the order of 5-10 K pictures. For a 500-1000 event-study of say $K^+p \rightarrow K^+N^*_{1700} \rightarrow K^+(p\pi^+\pi^-)$ one needs of the order of 300 K pictures. We propose a total exposure of the order of 300 K pictures to be shared by, say, 3 participating laboratories. It would be extremely helpful if scheduling would allow us to have a short exposure ($\sim$30-45 K pictures; 10-15 K per laboratory) before the long ν-runs. In this way we could get started and obtain a realistic impression of the difficulties and potentialities resp. needs of the longer run. The main run could be adapted to the findings of this 'test-run' both in terms of no. of pictures as well as in terms of additional equipment requested.

The film would be measured for all topologies. This would be a measuring effort (per lab.) of the order of $\sim$ 100 K events. In 1977 Nijmegen will have the following film-measuring equipment available for this task: one P.E.P.R.; 3 manual measuring machines; 2 BESSY-scan tables.