ANKE: Request for beam time using the cluster target

In connection with COSY proposals
 # 20 (Deuteron-breakup studies),
 # 38 (Investigation of NN FSI) and
 # xx (Study of ω/ϕ production).

The ANKE collaboration

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A beam time of **one week** *is requested for first measurements with a cluster target which is tentatively scheduled to be installed at ANKE in May 1999 (week 21). The aim of these measurements is fourfold: (i) commissioning and first test of the target at ANKE, (ii) start of measurements on NN final-state interactions using a hydrogen target, (iii) first measurement of the proton induced deuteron breakup and (iv) study of the experimental conditions for the coincidence measurement of spectator protons and fast deuterons. For each of these tasks 1–2 days of beam time will be required. Since the experimental setup is similar for all four cases, we apply for one common beam time.*

1 Status of ANKE

ANKE has been implemented at the target place TPA in the COSY ring in May 1998. Since then during three weeks of beam time (22nd, 29th and 40th week) ANKE commissioning and measurements on subthreshold K^+ production have been performed using a carbon-foil target. Furthermore, for the calibration of the spectrometer, pions from the "standard" two-body reaction $pp \rightarrow d\pi^+$ at various beam energies have been detected. For the latter measurements CH_2 targets have been used where the background has been subtracted by measuring on pure carbon targets under equivalent conditions.

The measurements showed that all detection systems at ANKE work according to the expectations. In particular, the side-detection system optimized for the identification of K^+ mesons was successfully put into operation and inclusive K^+ spectra were measured at various beam energies (see beam-time request for the continuation of the K^+ studies at ANKE). These detectors also allow to detect the π^+ mesons from the $pp \rightarrow d\pi^+$ reaction. During the measurements, the beam momentum has been varied between 0.826 and 1.135 GeV/c such that different telescopes in the side-detection system were scanned with (almost) mono-energetic pion beams for calibration purposes.

The forward detection system consisting of two scintillator planes is located between D2 and D3. It has been used during the second and third ANKE beam time in July and September. It allows to detect and identify fast deuterons which are e.g. emitted in coincidence with

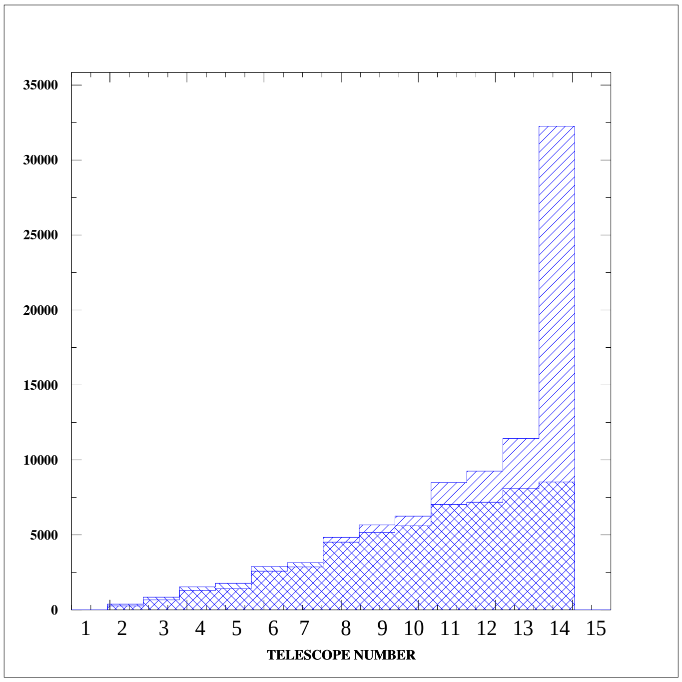

Figure 1: Hit distribution (difference of the CH_2 and C data) of pions in the side telescopes. In case of the cross-hatched histogram an anticoincidence with the forward counters is demanded whereas the hatched histograms shows all pions. For the normalization of the C and CH_2 data the counting rates in telescope #15 were subtracted since only pions from carbon can reach this telescope.

the pions from the calibration reaction.

The hatched histogram Fig.1 shows the counting rate in the 15 side telescopes measured at $p_{\rm beam} = 1.083$ GeV/c. At this momentum it is expected that pions from the two-body reaction hit telescope #14. For the plot the rate difference CH_2-C has been determined and pions were selected by setting proper gates on the time-of-flight between the start counters close to D2 and the stop counters which are the first counters in each K^+ telescope. The cross-hatched histogram shows the remaining events if a *anti*coincidence with the forward counters is requested. Clearly, the difference between the two histograms stems from events where a fast charged particle has been detected in the forward counters. Fig.2 shows the energy loss in one of the forward scintillators vs. the time difference of the pion and the fast particle detection. Almost all events lie in the region where deuterons are expected. Thus the difference of the two histograms in Fig.1 stems to a large extent from pions which were produced in the two-body reaction.

It is expected that the pions from the reaction $pp \to d\pi^+$ which are detected in telescope #14 have a very sharp momentum distribution ($\delta p/p < 0.5\%$) if their emission angle is restricted to $\vartheta < 5°$. Due to small angle scattering in the 0.5 mm thick vacuum window made from Aluminium we expect that a resolution of $\delta p/p \approx 1.5\%$ can be reached at ANKE[1]. In

[1] It is planned to install a thinner window made from carbon-fibers with which a resolution of better than

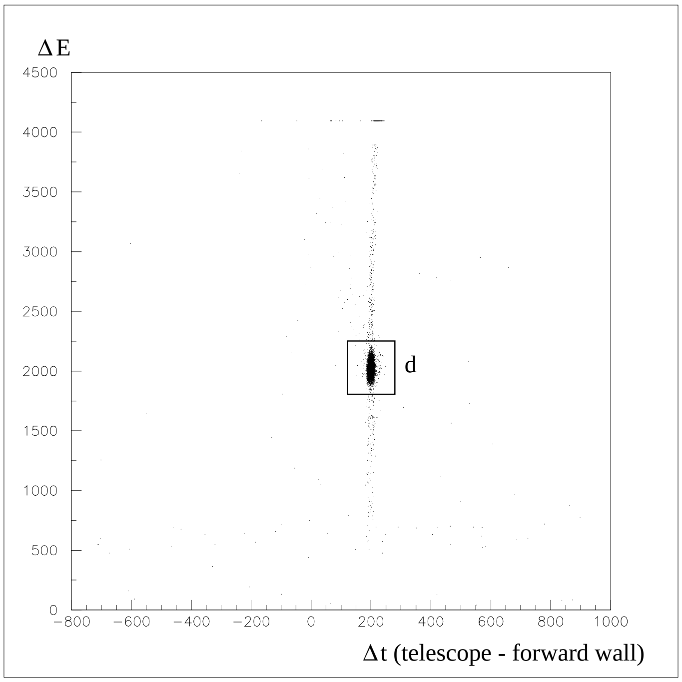

Figure 2: Energy loss in forward scintillator #4 vs. time difference of the pion detection in the telescopes and the signal in the forward counter. The region where deuterons are expected is indicated.

fact, the with the track reconstruction algorithms now used for the analysis of ANKE data this value could be verified.

The backward detector consists of a two-plane scintillator hodoscope for particle identification and of three drift chambers for track reconstruction. The scintillators have already been tested and a good pion-proton separation could be achieved. The chambers will be ready for installation in the beginning of 1999.

For the detection of slow spectator protons an existing three-layer semiconductor counter can be used. This counter has already been successfully tested in the previous beamtimes and will also be used in the test beam time requested here where one wants to detect spectator protons in coincidence with fast deuterons.

2 Requested time for measurements

Immediately after the installation of the cluster target, the following measurements are foreseen:

Commissioning of the cluster target It is planned to install the cluster target at TPA in May 1999 during week # 21. After the installation a beam time of **1 day** will be required for the commissioning of the target (adjustment of the cluster beam and

1% can be reached

optimization of the target-beam interaction). During the commissioning hydrogen will be used as target material.

First measurement for NN FSI The first measurement we want to perform with the cluster target is the measurement of the reaction pp $\rightarrow$ pnπ^+ at one or two beam momenta between 0.950 and 1.150 GeV/c. At these momenta data have already been taken using C and CH_2 targets. Under the much cleaner conditions using the pure hydrogen target the observation of FSI will be possible. However for these studies a momentum resolution of better than 1.5% finally is desirable. This can only be achieved with a thin carbon-fiber vacuum foil which will be installed later in 1999. Thus, we want to start the measurements with a short beam time of **2 days** in which the feasibility of the experiment can be shown.

Test measurements for the deuteron-breakup studies The measurements of the deuteron breakup in reactions pd $\rightarrow$ p(0°)p(180°)n will in the end be performed using a polarized beam ($p \approx 3.3$ GeV/c) and a polarized deuteron target. However, for tests and tuning of the detection system as well as background studies we want to start under simpler conditions using the cluster target with deuterons as target material and an unpolarized beam. For these first measurements we request a beam time of **2 days**.

Measurement of spectator-deuteron coincidences In COSY proposal # xx presented in this PAC meeting it is described that the measurement of slow spectator protons in coincidence with fast deuterons allows to determine the cross section of the reaction pd $\rightarrow$ dωp$_{\mathrm{sp}}$. During the requested **2 days** of beam time we want to optimize the particle identification in the spectator counter and the coincident measurement in the two detection systems under realistic beam conditions. As it was shown in the proposal already the existing setup should allow to extract first information on the ω-production cross section within a few hours of data taking at a beam momentum of $p \approx 2.8$ GeV/c.

In summary, for the tests described above, a total beam time of **one week** is requested.