Test of drift chambers at ANKE

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The forward multiwire proportional chambers at ANKE will be exchanged in summer 2003. Construction work is in progress and will not be finished before the next ANKE beam time (dd $\rightarrow$ ^{4}Heη). Therefore the necessity arose to find another tracking detector. Eventually an existing set of multiwire drift chambers was tested at ANKE in September 2002. The detectors, previously used at the COSY-11 and GEM installations, are described in detail in [1]. Their positions during the test were close to the former positions of the second and third multiwire proportional chambers (see fig.2 in [2]).

The test of the drift chambers at ANKE comprised the observation of the chamber behaviour in a magnetic field and their count rate capability.

To separate the two effects, the test was split in two parts. First, there was no magnetic field switched on (ANKE remained at 0°) and the count rate effect was studied exclusively. In the second part the magnetic field was switched on in addition. In both cases data at various beam intensities were taken using solid state targets and a 2.085 GeV/c proton beam.

The voltage on the cathode wires was set to 2100 V, on sense wires to 2250 V. The gas system of the COSY-11 collaboration was used to provide the chambers with the appropriate gas mixture: equal parts of ethane and argon plus a small admixture of ethanol.

Fig. 1 (left part) shows the drift time spectra obtained at similar count rates in the two tests (only events with 1 hit per plane were considered here). The dotted and solid line histograms represent data for the same plane of sense wires (closest to the D2 magnet), without and with the presence of a magnetic field, respectively. The solid line histogram shows an enhancement at lower drift times, which can be ascribed either to a change of the chamber properties or to the magnetic field influence. The latter case is confirmed by the fact, that the drift time spectrum obtained for the first plane without magnetic field (1st measurement) is almost identical with the one obtained for the plane furthest from the D2 magnet (where the magnetic field is negligible) in the second measurement.

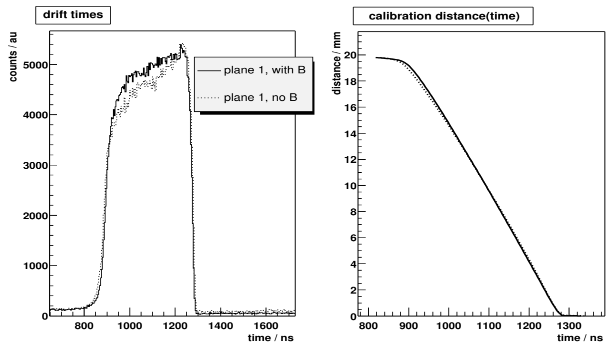

Fig. 1: Left: drift time spectra obtained for the plane closest to the D2 magnet with ANKE at 0° - no magnetic field (dotted line) and with ANKE at 8.2° - with magnetic field on (solid line). Right: corresponding drift time calibrations.

The calibration (mapping a drift time to a distance from a wire) was found using the autocalibration method [3], which relies only on the shape of the drift time spectrum and the assumption, that the particle flux is uniformly distributed over the cells. The calibrations corresponding to the two presented drift time spectra are plotted in the right part of fig. 1. The solid line differs from the dotted one for low drift time values. However, the differences are so small, that in the further analysis a common drift time calibration for all planes was used (i.e. neglecting the influence of the magnetic field).

As for the second investigated aspect, the increase of count rate manifested itself in an increase of the accidental background, visible on both sides of the regular drift time spectra in fig. 1. This effect results in a reduced probability to unambiguously identify single-track events. While the direct contribution of N$\geq$2 track events from pA reactions should not depend on the count rate, the number of fake hits due to background does. At low count rates, i.e. $1.6{\cdot}10^4$ s^{-1} in terms of the forward hodoscope OR trigger, the probability to obtain a single track was about 95%, while for high count rates, i.e. $1.2{\cdot}10^6$ s^{-1}, it dropped to 84%. Although the contribution of single tracks decreased by 12% at this change of count rate, yet there is still the gain in the absolute number of analysed single track events. At the count rate of about $1.3{\cdot}10^6$ s^{-1} the current on the sense wires reached the value of 22 μA.

For all those clean, single-track events the momentum was reconstructed. Using solid state targets (C, CH_2, Cu), free and quasifree pp scattering dominate. Therefore the results of momentum reconstruction were compared with the expectations based on the kinematics of proton-proton elastic scattering. Fig.2 shows the difference between the reconstructed momentum and the expected value. The distribution reveals a clear peak around zero. The achieved resolution is σ=1.7%.

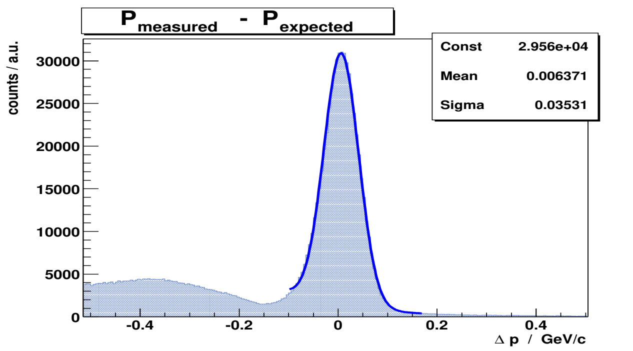

Fig. 2: Deviation of the reconstructed momenta from the values predicted by kinematics of pp elastic scattering. In the frame parameters of the reconstructed gaussian function are listed.

The results of the test show that drift chambers can be operated at ANKE in the forward region. They are able to withstand typical count rates and the position resolution is not significantly affected by the presence of a magnetic field.

References:

[1] *Drift Chambers with Double Sense Wires for the COSY-11 Facility*, COSY-11 collaboration, IKP Annual Report 1995, Jül-3200, p.44

[2] *ANKE, a new facility for medium energy hadron physics at COSY-Jülich*, S.Barsov at al., Nucl. Instr. and Meth. A 462 (2001) p.364

[3] *Principles of operation of multiwire proportional and drift chambers*, F.Sauli, CERN 77-09

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