# Drift chamber with a c-shaped frame

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For tracking positively charged pions appearing in near-threshold reactions such as $pp \to pp\pi^+\pi^-$ with momenta by a factor of $m_\pi/m_p$ smaller then the proton momenta the momentum acceptance of the COSY-11 experimental facility was extended towards smaller values. Another important advantage was the detection of positively charged kaons prior to their decay what is especially important for the measurement of the $pp \to ppK^+K^-$ close to threshold due to its small cross section on the level of a few nanobarns. For this, an additional drift chamber was built and installed in the free space along the COSY-11 dipole magnet.

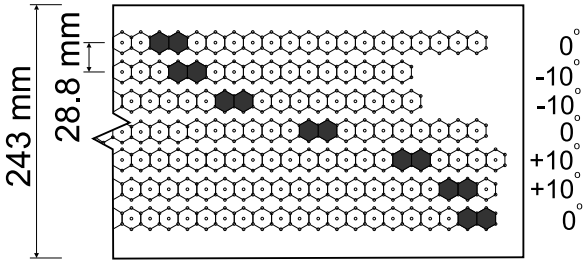


Fig. 1: Upper end-plate with indicated positions of openings for feedthrough used for mounting the wires. The shaded cells indicate the response of the chamber in case when one particle was registered.

The sensitive chamber volume consists of hexagonal drift cells identical with the structure used in the central drift chamber of the SAPHIR detector [1]. The cells are arranged in seven detection planes as indicated in Fig. 1 showing one of two parallel aluminium endplates between which the wires are stretched. Three detection planes (1, 4 and 7) contain vertical wires, two planes (2, 3) have wires inclined at $-10°$ and the remaining two planes (5, 6) contain wires inclined at $+10°$. This arrangement makes it possible to reconstruct particle trajectories in three dimensions, also in cases of multi-track events. The two aluminium endplates for mounting the wires are 15 mm thick and are supported by two c-shaped frames made out of 20 mm thick aluminium (see a three-dimensional view in Fig. 2). The frames hold the total load of about 2.4 kN originating from the mechanical tension of the wires. For the reconstruction of particle tracks a simple algorithm was developed and implemented as a computer code written in the C-language. The reconstruction proceeds in three stages: (i) finding track candidates in two dimensions, independent for each orientation of the wires, (ii) matching the two-dimensional solutions in three dimensions, (iii) three-dimensional fitting in order to obtain optimal track parameters. The chamber is calibrated using the experimental data. In a first step an approximate drift time to drift distance relation is determined by integration of the drift time spectra as provided by the uniform irradiation method. In the next step, corrections to this calibration are determined using an iterative procedure. For this, the average deviations between the measured and fitted distances of the tracks from the sense wires are calculated. Fig. 3 shows differences $\Delta d$ of the measured and fitted distances calculated as a function of the drift time for three subsequent iterations. The mean value of $\Delta d$ deviates from zero only after the first iteration (upper panel in Fig. 3) and the corresponding correction to the space-time relation is of the order of 0.3 mm. For higher iterations the corrections are negligible. The standard deviation of $\Delta d$ is about 0.2 mm and is a measure of the single wire resolution. The chamber allows to determine the track position and inclination in the horizontal plane with an accuracy of about 0.3 mm and 1 mrad, respectively. In the vertical direction these accuracies decrease by about an order of magnitude, which is in accordance with the design values. For the tracking in the vertical magnetic field of the COSY-11 dipole magnet no higher precision was envisaged. For other applications the precision can be improved by choosing a larger inclination of the wires.

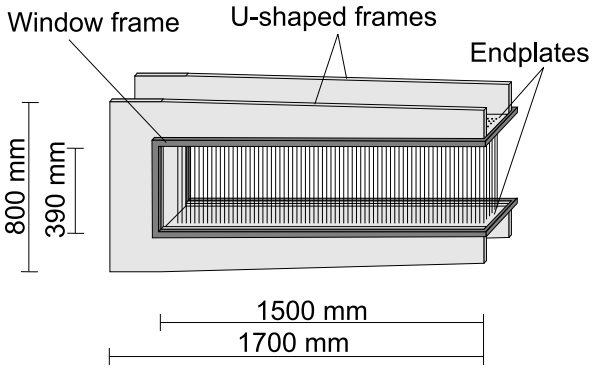


Fig. 2: Schematic three-dimensional view of the chamber frame for mounting the wires. The window for particles is 1500 mm wide and 390 mm high.

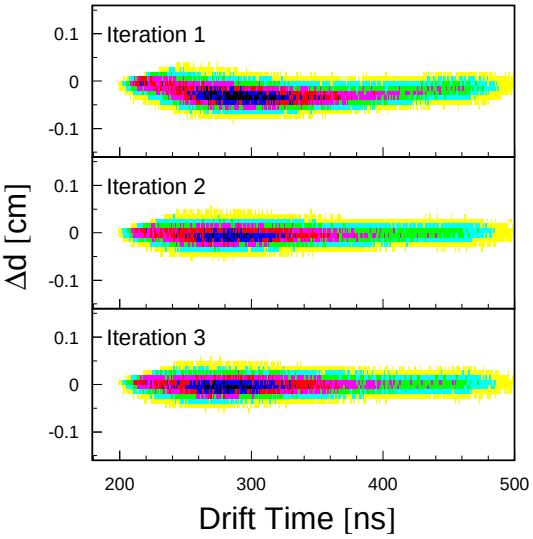


Fig. 3: Differences of the measured and fitted distances calculated as a function of the drift time for the first detection plane and the angular bin $\theta \in (50°, 60°)$ in three subsequent iterations of the calibration procedure.

**References:**

[1] W. J. Schwille et al., Nucl. Instr. and Meth. **A 344** (1994) 470.

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