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Study of the precision of positioning of Ring-Cathode Chambers for the TPC prototype for ALICE

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Abstract

The precision of positioning of cathode elements of Ring-Cathode Chambers on the TPC readout board is measured to be better than 50 μm for the first three readout planes.

1 Introduction

A prototype of the Time Projection Chamber (TPC) for the ALICE experiment will act as the Forward-TPC of the NA49 experiment [1]. The prototype will serve as a test-bed to study the main features of a full-size detector. The readout of the prototype TPC will be done using the Ring Cathode Chambers [2] glued to a multilayer printed circuit board on which also preamplifier chips [3] will be fixed.

The pattern printed on the chamber side of a readout board ensures that the 4 neighbouring cathode elements (2.15x5.7 mm^2) are electrically connected to form one readout pad. The deviations of positions of cathode elements with respect to the nominal ones contribute to the precision of the measurement of space coordinates of the charge deposited by a track in a chamber. To keep this contribution below others, like diffusion in the chamber gas, the cathode elements should be placed on the motherboard with a precision not worse than 100μm. The preamplifiers-shapers mounted on the other side of the motherboard will be connected by 2 meters long co-axial cable of small diameter ($\simeq$ 0.51mm, produced by AXON) to Analog-to-Digital Converters (ADC). The readout electronics of the prototype TPC will be connected to the NA49 experiment data acquisition system.

In this note the results of measurement of positions of cathode elements on three dummy readout boards are presented. The study of dummy boards allowed to improve the technology of positioning the cathode elements and to estimate its precision before using it for mounting the cathodes on the readout boards for the TPC prototype.

The measuring procedure is described in section 2, the results are shown in section 3.

2 Measuring procedure

The readout boards were mounted on a milling machine with a tool position precision of 10μm. In place of a mill a microscope with cross-hairs was mounted. The position of cathode elements was measured with respect to the reference frame of the milling machine. The nominal position of a cathode element was determined from the measurement of the position of the part of the footprint corresponding to this cathode. The precision of the milling machine in determining the cathode position was estimated to be 15 μm from the measurement of the size of a set of calibration elements.

3 Results

The single readout plate carries 2592 cathode elements in 18 rows corresponding to 18 anode wires. For each row the positions of sample of uniformly distributed cathode elements were measured. The typical sample size was 15. The mean value of the positions was used to determine the row position. The mean row position for all three boards is shown in Figure 1a), the spread of the row position within the board in Figure 1b), and the spread within the rows in Figure 1c). Assuming that the spread of positions of cathode elements within a row and the spread between rows on the readout planes are uncorrelated and combining them in quadrature results in a positioning precision better than 50 μm (Fig. 1d), well within the required 100μm.

References

[1] J.Bächler et al., CERN/SPSC 98-4,CERN/SPSLC/P264 Add. 2.

[2] J.Bracinik et al., 8th Vienna Wirechamber Conference, 1998.

[3] designed by J-C.Legrand.

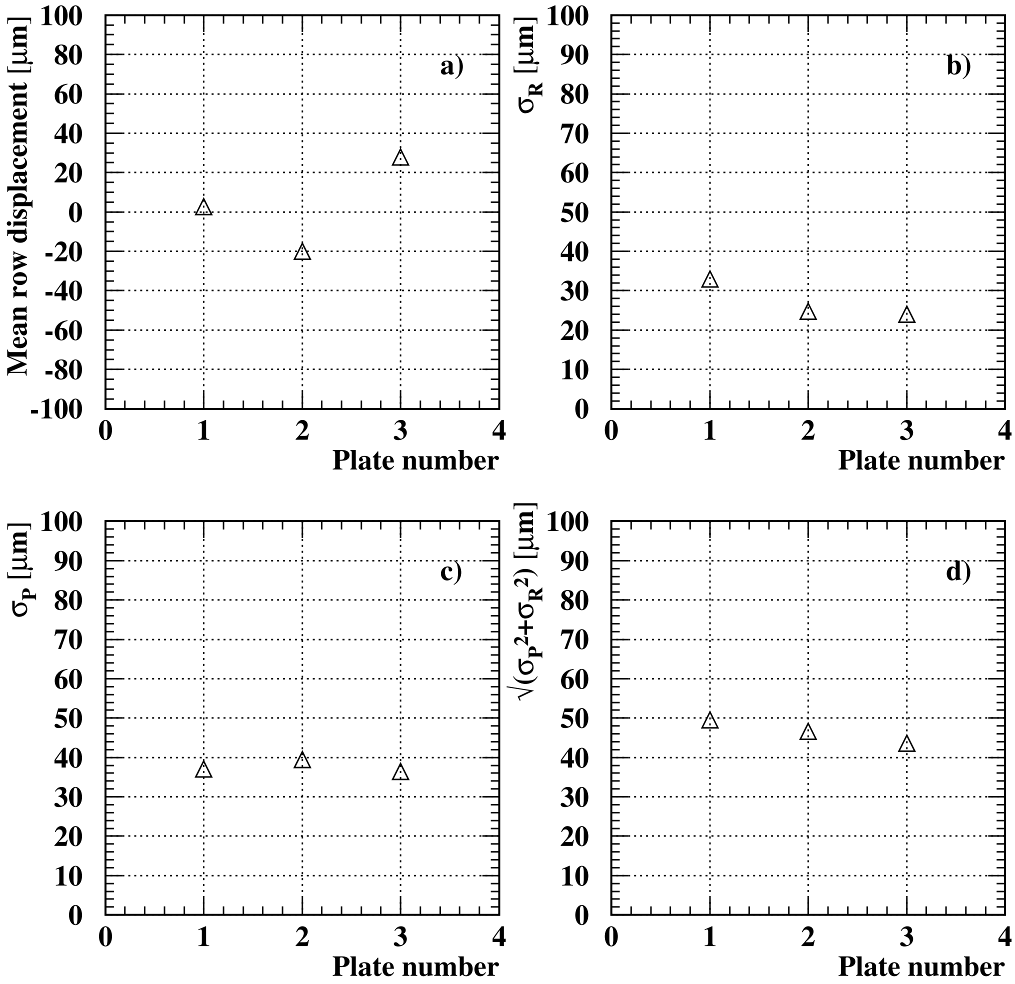

Figure 1: For three readout boards: a) the mean row displacement with respect to the nominal position; b) the spread of row displacements, $\sigma_{\rm R}$; c) the spread of the cathodes' displacements within a row, $\sigma_{\rm P}$; d) the $\sigma_{\rm R}$ and $\sigma_{\rm P}$ added in quadrature.