TestBeam results of a slat CPC Prototype for the Alice Dimuon Spectrometer

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The ALICE Dimuon Spectrometer will measure the production of vector mesons in their muon decay mode in heavy ions collisions at the LHC in 2007. The Spectrometer includes a Tracking System, composed of 10 planes of Cathode Pad Chambers. Six larger planes (Stations 3-4-5) consists of several independent detectors, called slats. This poster presents the results, obtained in test beams at CERN in 2002, on a final slat of 1.20 m long.

1. Introduction

The main feature of Stations 3-4-5 of the Alice Tracking System is the semi-modular design [1]. The detection area, which represents a surface of $\sim$18 m^2 per chamber for the bigger ones, is composed of rectangular modules (400 mm wide, 800 mm up to 2400 mm long), called slats, each independant from the others in terms of gas supplies, mechanics and electronics. Modules are designed to be as transparent as possible so that they can be overlapped, avoiding dead areas. The average radiation length of one slat reaches $\sim$1.5% of X/Xo.

Each Cathode Pad Chamber (CPC) slats is built with two cathode planes :

- the Bending plane cathode (perpendicular to the anode wires), used to measure the Y coordinate, must satisfy the resolution requirement of 100 μm,
- the Non-Bending plane cathode, which measures the X coordinate as the resolution of the order of: anode-pitch$(mm)/\sqrt{12}(\sim 720\,\mu$m), fulfills the tracking requirements of 1 mm.

The sizes of pads, etched on the cathode Printed Circuit Boards (PCBs), have been chosen so as to be able to cope with the expected particle densities, which decreases exponentially along the radius, and to satisfy the Muon Spectrometer requirements (the maximum occupancy must stay at the level of $\sim$5%). This leads to six different types of PCBs (three densities of pads for X measurements and the same for Y measurements).

2. Prototype description : Mechanics and Electronics

The 2002-prototype dimensions are 1200 $\times$ 400 mm^2 for the active area. It is composed of the six PCBs *(Bending pad sizes= 5 $\times$ 25, 5 $\times$ 50, 5 $\times$ 100 mm^2 ; Non Bending pad sizes = 7.143 $\times$ 25, 7.143 $\times$ 50, 7.431 $\times$ 100 mm^2)*. PCBs are aligned and glued on a lightweight and rigid Carbon-Nomex sandwich panels. An intermediate isolant sheet of Nomex (high permittivity) allows to reduce the capacitance effect between PCBs and ground plane. Anode wires (W-Re ; diameter : 20 μm) are glued in a Noryl spacer's groove. The wire pitch is 2.5 mm. The gas sealing is obtained by a silicon joint which allows quite easy opening of the prototype. The gas gap is 5 mm, and the gas mixture has been optimized in previous testbeams and is now fixed at 80%Ar+20%CO_2.

The read-out electronics for Tracking System and prototypes used the same method of muliplexed charge measurements. This prototype is equipped with boards, essentially composed of :

- Four Gassiplex 0.7 μm (preamplifiers, filters and shapers with 16 channels each). In 2003, Gassiplex are replaced by Indian MANAS chips.
- Two 12 bits ADC with a conversion range of 0 to +3 V.

- One asic chip (MARC), which sequences the Gassiplex readout, the coding, and perfoms the pedestal substractions, the zero suppression and pushes the data on the numerical buses towards the data acquisition.

3. Summary of 2002 TestBeams results

The main goal of this prototype was to determine the characteristics of the chamber and its homogeneity in terms of noise, resolution and efficiency for the different pads densities.

Tests were performed with negative pions of 7 GeV/c at the CERN-PS. The prototype was mounted on a mechanical support which allowed vertical and horizontal displacements. The prototype was located between a set of ten Silicon detectors along the beam axis, that defined the telescope for the reference tracking system (5 planes to measure the X coordinate and 5 other planes for the Y coordinate, all with 15 μm of resolution). The trigger system was defined by the coincidence between two pairs of crossed plastic scintillator blades, located upstream and downstream the prototype.

To define a track from the Silicon detectors, a 4 σ pedestal substraction has been applied on-line and only one hit per Y plane has been required. A simple linear extrapolation to CPC is done without multiple scattering correction. The position of the cluster in the chamber is obtained by the Mathieson method [2]. The spatial resolution is defined as the standard deviation of a Gaussian fit to the residual distribution of the expected track position on the CPC and the CPC impact point determined from Mathieson evaluation.

Figure 1 shows an example of resolution at 1725 V, obtained in both plane in the region of small pads, without multiple scattering correction. This result fulfill widely the Tracking requirements.

Figure 2 summarizes the 2 campaigns of tests in July and September 2002. Resolution and efficiency are consistent with the specifications around 1650 V and 1700 V. In spite of an increase of the noise for larger pads ($\sim$ 1400-1650 e$^-$), resolutions and efficiencies are comparable for the three densities of pads. The lower edge of the efficiency plateau starts around 1575 V.

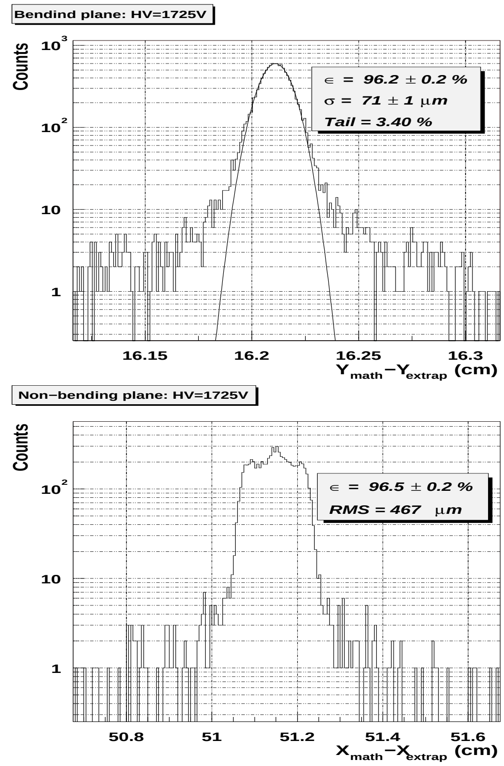

Figure 1. Resolution in both cathode planes with the higher density of pads at 1725 V, without multiple scattering correction.

In running conditions, HV should be set between 1650 V and 1700 V.

REFERENCES

1. *ALICE: Addendum to the Technical Design Report of the Dimuon Forward Spectrometer*, Addendum 1 to ALICE TDR 5, CERN/LHCC 2000-046, Dec.2000.
2. *Cathode charge distributions in multiwire chambers*, E. Mathieson, NIM, A270 (1988), 602.

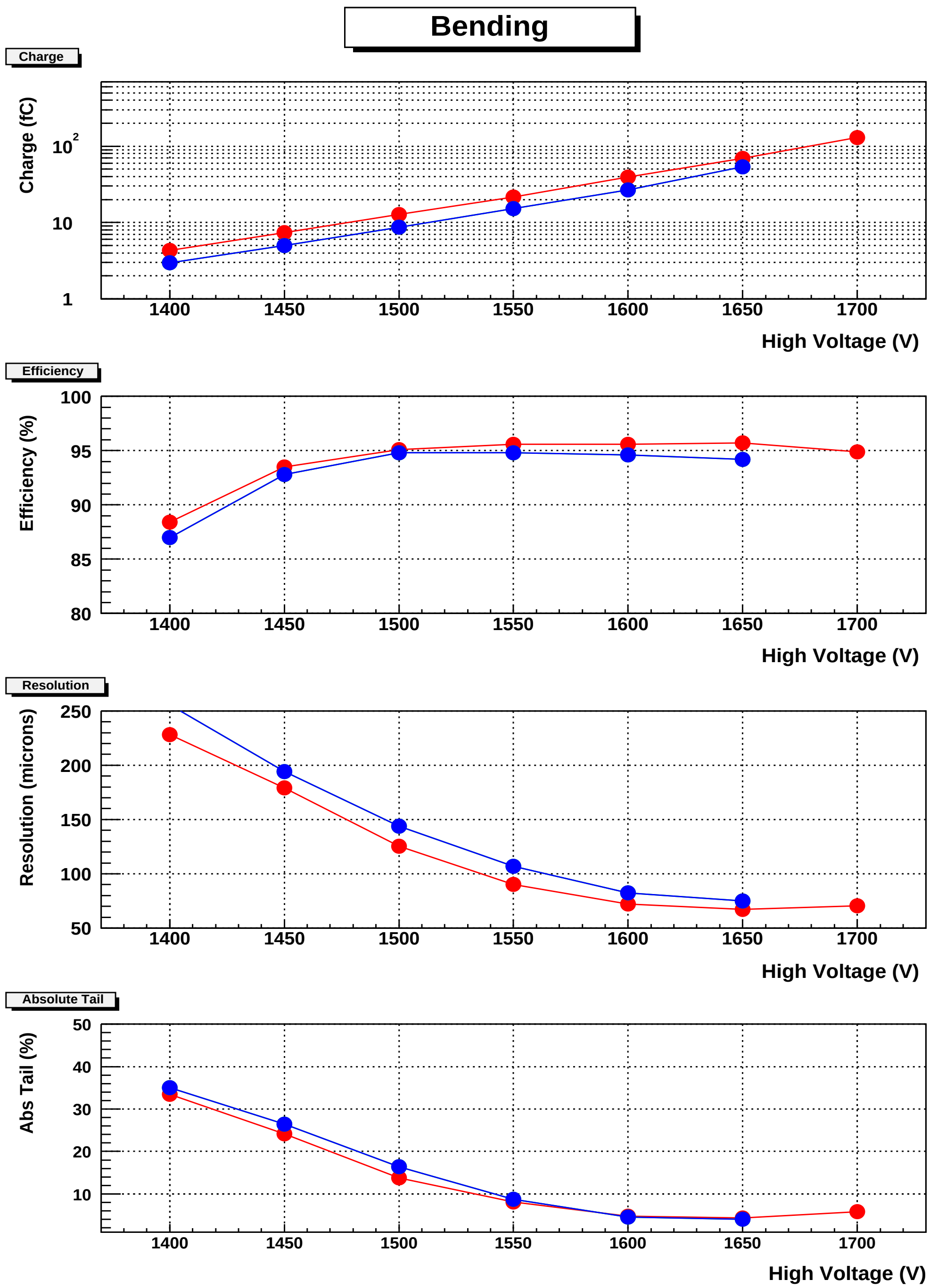

Figure 2. Charge, efficiency ($\pm$ 1 mm), resolution ($\pm$ 1 mm) and distribution tails (events with residual between 250 μm and 1 mm) versus high voltage. Blue circles: Bending region of medium pads (July 2002). Red circles: Bending region of large pads (September 2002).