RPC setup in the ATLAS Muon Test area M2

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Abstract

The setup and the performance of two RPC's operated with Ar / Isobutane / Freon (55/40/5) are presented. Each RPC has 32 vertical strips read out, with 8 mm pitch. These detectors are used in the M2 test area to measure the coordinate along the MDT wires. They are also used as a trigger device in coincidence with the scintillator hodoscope.

We present some preliminary results on the performance; we obtained a resolution of about 5 mm.

1 Introduction

The resistive plate chamber [1] is a gaseous parallel-plate detector well suited for fast particle tracking as required by the ATLAS muon trigger [3]. It is built from a pair of parallel bakelite plates saparated by spacers giving a 2 mm active gas gap. The outer surfaces of the plates are coated with graphite paint connected to a high-voltage supply. An insulating film is glued on the graphite to shield external signal electrodes from the high voltage.

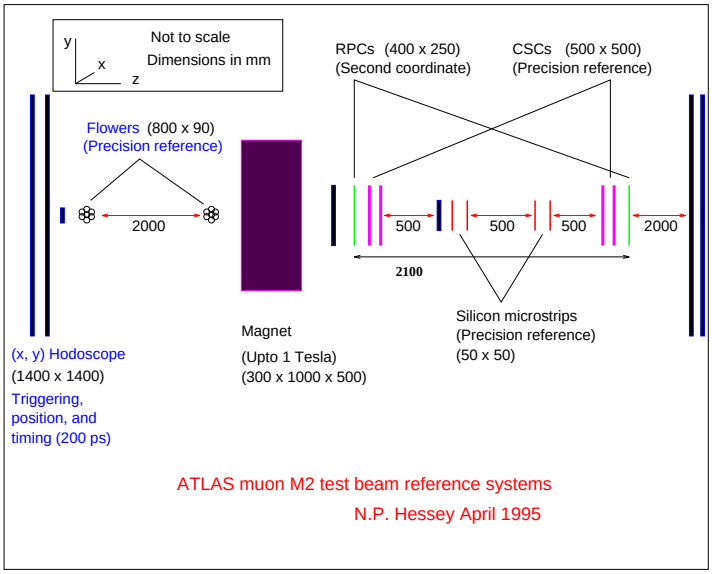

Figure 1: M2 test area

The chambers are placed perpendicular to the beam direction, with the readout strips vertical. Their vertical length is 40 cm, their horizontal lenght is 40 cm as well, but we connected only the 32 central strips, giving the effective horizontal length of 26 cm. In the M2 coordinate system each chamber is placed at a constant z and reads out the x coordinate of a particle as it crosses the z plane.

The strips are readout using electronic boards housing 16 channels each. The boards provide the discrimination of the analog signals with a 60 mV threshold, along with a fast signal which is the logical OR of the 16 channels; this signal is used in coincidence with the scintillator hodoscope signal to produce the trigger.

The individual strip signals are fed to a VME register board which is readout by the standard M2 data acquisition system [2].

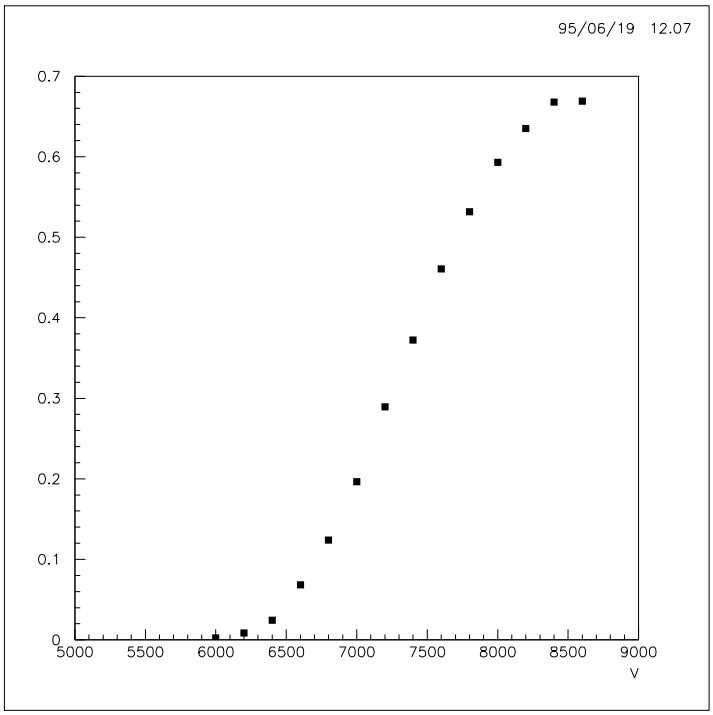

Figure 2: RPC plateaux

The chambers are operated with a gas mixture of argon - isobutane - freon($F_{13}B_1$) 55/40/5.

Figure 1 shows the layout in 1995 of the M2 area. The two RPC's are placed on a flat steel table at a distance of 2.10 m from each other; the upstream RPC is at 7.00 m from the upstream hodoscope plane, while the downstream RPC is at 3.70 m from the downstream hodoscope plane.

2 Operating point (high voltage)

The chambers operating points were chosen by measuring the efficiency as a function of the high voltage. Figure 2 shows the plateaux of the downstream RPC. There is a few hundreds volts difference in the operating voltage of the two RPC's due to the difference of the bakelite bulk resistivity in them. The efficiency for one RPC is calculated as the ratio of the three-fold coincidence of the two RPC's and the hodoscope signals and the two-fold coincidence of the other RPC and the hodoscope.

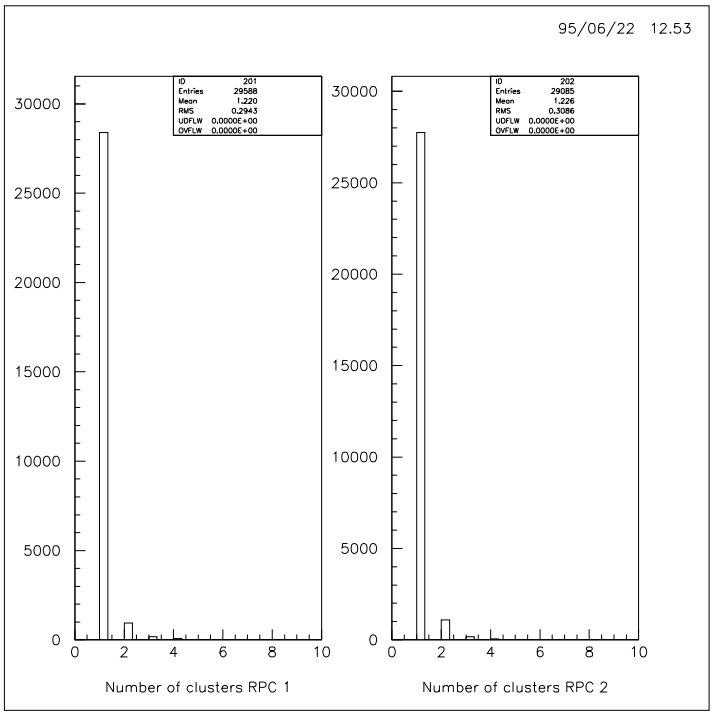

Figure 3: Number of clusters RPC 1 and RPC 2

The appearent inefficiency is due to the geometrical acceptance ($\simeq$10%) and to the absence of the signal coming from two strips ($\simeq$10%). We have chosen 8.4 KV for the operating voltage.

3 Hits distribution and cluster size

The main parameters that we studied to evaluate the behaviour of the RPC system are: the number of clusters for each event, the cluster size, the resolution on the beam angle reconstruction, and the correlation between the firing strips of the two RPC's.

We define a cluster as any group of adjacent strips firing in one event, and the cluster size as the number of strips belonging to the cluster; in principle when a track crosses an RPC it should generate only one cluster, so we used this feature as a test of the chambers' performance. To take this data we used as a trigger the coincidence of the two planes.

From figure 3, we see that the average number of cluster is 1.2 in the two RPC's. Currently events with more than one cluster are rejected

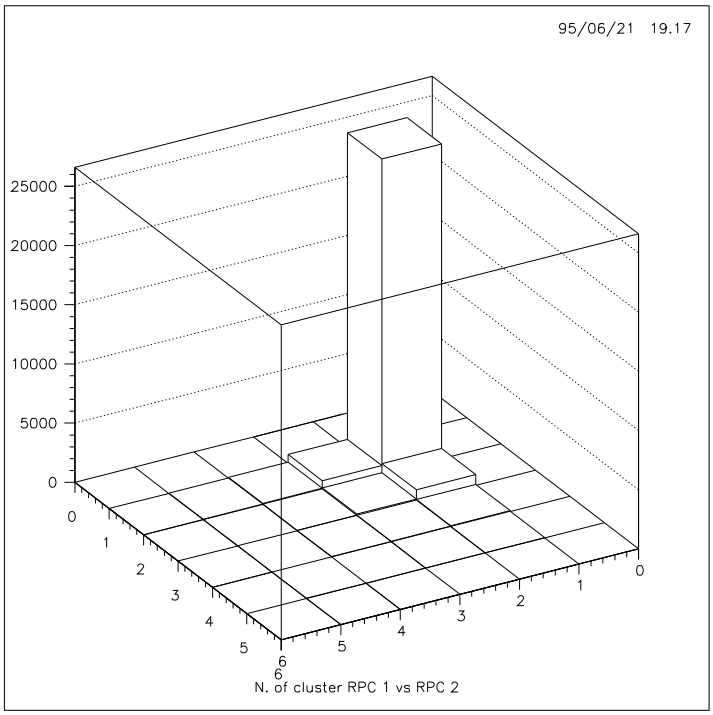

Figure 4: Correlation of number of clusters in RPC 1 and RPC 1

during the analysis but we plan to recover this inefficiency by making use of the spatial information of the hodoscope. However events with more than one cluster in one of the two RPC's are less than 8% of the total. The correlation between the number of clusters in RPC 1 and RPC 2 is shown in figure 4; as there is a negligible number of events with two cluster in both RPC's, the events with more than one cluster are due to noise.

The cluster size has a mean value of 2.0 in the two RPC's as can be seen from figure 5. This means that the effective pitch of the strips is about 16 mm. This reflects on the angle reconstruction resolution which is limited by the effective pitch of the strips. In figure 6 we present the tangent of the beam angle as measured in the RPC's; the width of this distribution is 5 mrad, compatible with an effective strip width of 16 mm, which should give a spatial resolution of $16/\sqrt{12} =$ 4.6mm.

In figure 7 we present the linear correlation between the position of the firing strip in the first and the second RPC, confirming the good behaviour of the RPC tracking.

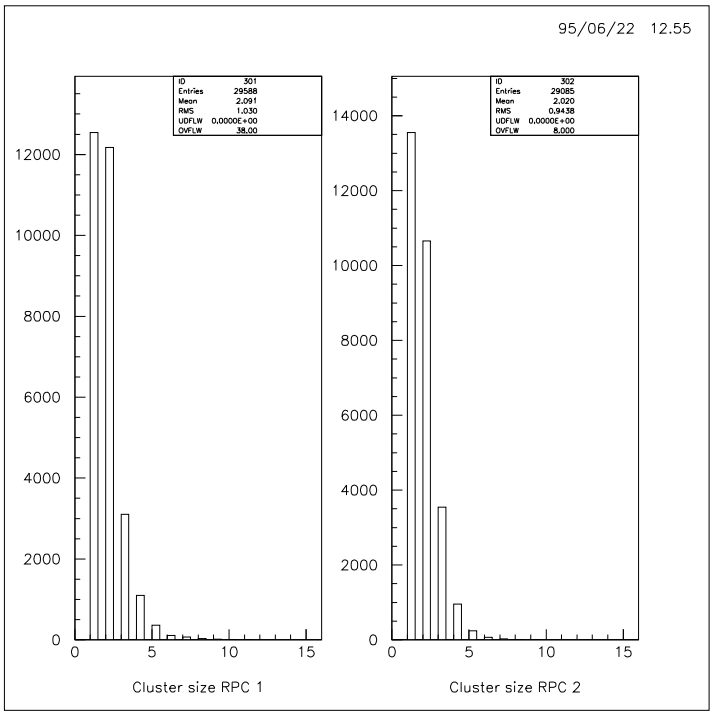

Figure 5: Cluster size RPC 1 and RPC 2

4 Conclusions

We have presented the setup of two RPC's, together with the preliminary analysis of their performance; almost all events were found to have only one cluster in both RPC's, while the mean value of the cluster size was 2. The first estimate of the resolution is 5 mm; this value is compatible with the pitch of the strips and with the mean value of the cluster size.

The RPC system can be used to measure with a resolution $\simeq$5 mm the coordinate along the wires of the MDT that are tested in M2 area, and for the trigger as well.

References

[1] R. Santonico and R. Cardarelli, Nucl. Instr. and Meth. A 187 (1981) 377; R. Cardarelli et al., Nucl. Instr. and Meth. A 263 (1988) 20; R. Santonico, Int. Workshop on Resistive Plate

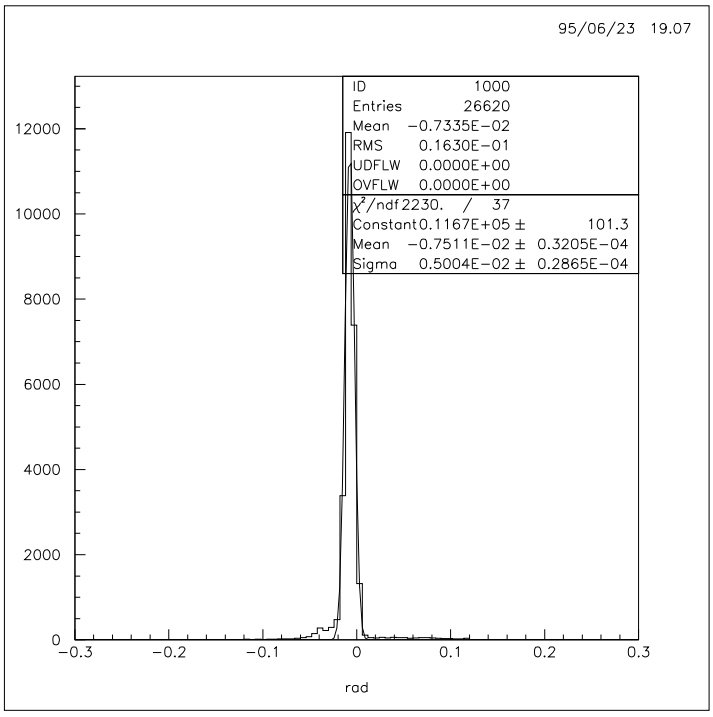

Figure 6: Angle of the track reconstructed with RPC's

Chambers in Particle Physics and Astrophysics, ed S. Ratti, G. Ciapetti and R. Santonico, Scientifica Acta 8 (1993) 1.

[2] The ATLAS Muon Beam Test Data Acquisition System in M2; N.P. Hessey ATLAS Muon note (in preparation)

[3] ATLAS Technical Proposal, CERN/LHCC/94-43 LHCC/P2 15-12-94

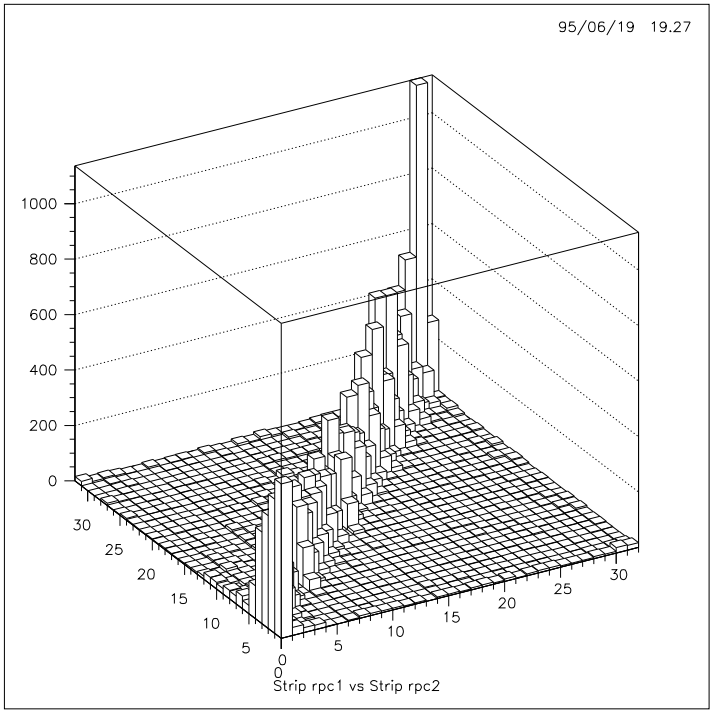

Figure 7: Correlation between hit strips