Performance test of MRPC with different pad size

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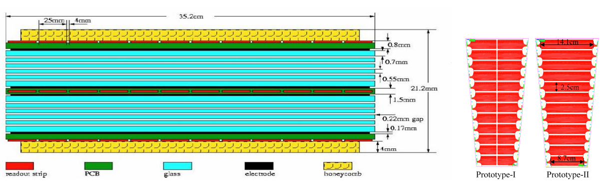
The multi-gap Resistive Plate Chamber (MRPC), a technology with excellent timing performance, is proposed to be the most promising candidate for the CBM-TOF. In the CBM-TOF wall, there are four regions with different rate and multiplicity requirements [1]. For the two central regions, not only plates with low resistivity are necessary to cope with the high particle flux, but also the granularity is an important issue because of the high particle multiplicity.

To improve the understanding of the performance dependence on the pad size, two MRPC prototypes with variable pad size and different readout method were constructed and tested.

Both prototypes are twelve-gap modules with 0.22 mm gap size, as shown in Fig. 1 (a). These gaps are arranged in two stacks to relax the high voltage (HV) requirement. Normal floating glass is used as the resistive plate. The HV electrodes are made of graphite tape with surface resistivity of about 200 kΩ/□. The shape and size of the two prototypes are the same but with different readout pads (see Fig. 1 (b)). Prototype I has single-end readout pads while prototype-II has a double-end readout. The pad width is 2.5 cm and the gaps between pads are 4 mm.

The prototypes were tested with a 600 MeV proton beam in July 2010 on the E3 line at the Institute of High Energy Physics (IHEP), Beijing, China. The setup of the test is shown in Fig. 2. The gas mixture used during the test consists of 90% Freon (R-134a) + 5% SF_6 + 5% iso-C_4H_{10}. The time reference given by four PMTs is $\sim$ 40 ps.



(a) (b)

Figure 1: (a) Side view of the MRPC structure. (b) The readout pattern of the two prototypes.

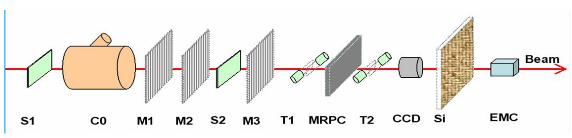
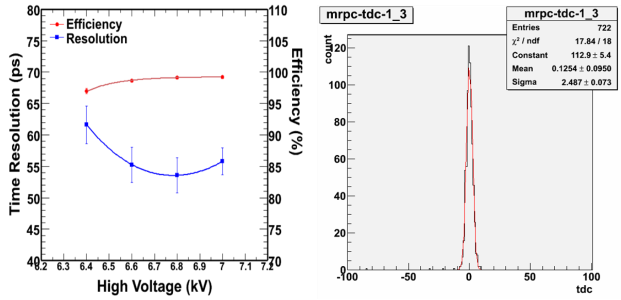


Figure 2: The setup at the E3 line at IHEP

Figure 3 (a) shows efficiency and time resolution as functions of the applied differential HV for one selected pad (the third shortest pad) of prototype I. The efficiency is higher than 98% for HV $\geqslant \pm$ 6.8 kV, and the time resolution is around 55 ps. The time distribution after slewing correction at HV = $\pm$ 6.8 kV is shown in Fig. 3 (b).



(a) (b)

Figure 3: (a) Efficiency and time resolution as functions of the applied HV for the third shortest pad on prototype I. (b) A typical time distribution of MRPC after slewing correction (25 ps/TDC bin).

To investigate the performance dependence on the pad size, a position scan was performed in the test. Figure 4 shows the time resolution of each pad, from the shortest (4.3 cm) to the longest (7.0 cm) of the prototype I under HV = $\pm$ 6.8 kV. For most of the pads, the time resolution varies between 50-60 ps.

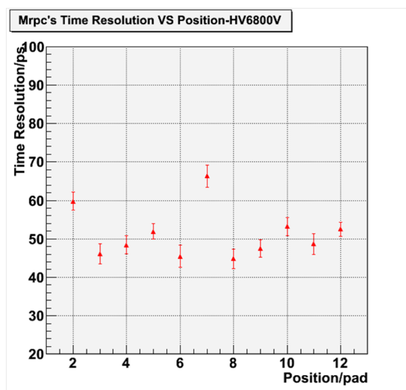


Figure 4: Time resolution of different pads of prototype I. A lower pad number corresponds to shorter pad length.

Prototype II was not tested because of the limited beam time. From the results of prototype I, we found no dependence of MRPC timing performance on the pad size in this range.

References

[1] I. Deppner *et al.*, Nucl. Instrum. Meth. **A** (2010), doi:10.1016/j.nima.2010.09.165