Performance of a differential CBM-TOF demonstrator

I. Deppner[1], *N. Herrmann*[1], *P.-A. Loizeau*[1], *K. Wisniewski*[1], *C. Xiang*[1], *Y. Zhang*[1], *M. Ciobanu*[2], *and J. Frühauf*[2]

[1]Physikalisches Institut, Universität Heidelberg, Germany; [2]GSI, Darmstadt, Germany

Currently multi-gap Resistive Plate Chambers (MRPC) are the optimal choice to fulfill the CBM-TOF requirements [1]. For the low rate region (< 1 kHz/cm^2) a MRPC in multi-strip configuration with thin standard float glass can be considered. Here we report on results obtained during a test experiment at COSY/Jülich with an fully differential MRPC prototype developed at Physikalische Institut in Heidelberg (more details regarding this prototype see [2]). In addition a high granularity MRPC prototype from Bucharest with electrodes made of low resistive glass delivered from China [3] was tested.

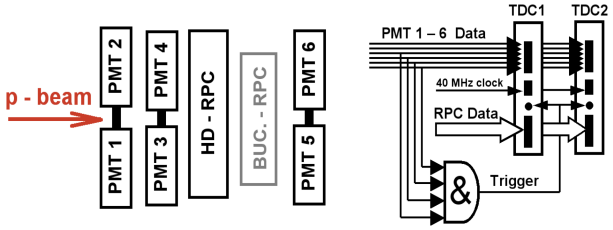

Figure 1: Experimental setup. Left: detector arrangement; right: trigger and data processing.

Figure 1 shows the experimental setup as used in the test experiment. The trigger was formed by coincidence between two plastic scintillators read out by two photomultiplier tubes (PMT) each (PMT 3 - 6 see fig.1 right). An additional pair of PMTs (PMT 1,2) was used for time resolution measurement. All PMTs and the HD-MRPC were connected to customized designed preamplifier cards called PADI [4]. In order to extract the time over threshold information the LVDS signals from PADI output were split and fed into two different TDCs (Caen V1290A). One of them measured the rising edge and the other the falling edge of the signal. Both TDCs were synchronized by a external 40 MHz clock. The time over threshold information of each contributing channel was used to correct the pulse height dependencies (walk) of the measured time difference between the average of the PMT and the RPC times. Additional corrections on the nonlinearities of the TDC were done in order to minimize the electronics time resolution.

Figure 2 displays the time resolution of one strip of the RPC (only two strips were covered by the trigger scintillator) as a function of the applied high voltage (HV) for two thresholds settings at 30 mV and 50 mV including the electronics resolution estimated to be about 30 ps. At the nominal operation voltage (HV = 11.7 kV), the time resolution is in the order of 50 ps, whereas for the higher thresholds

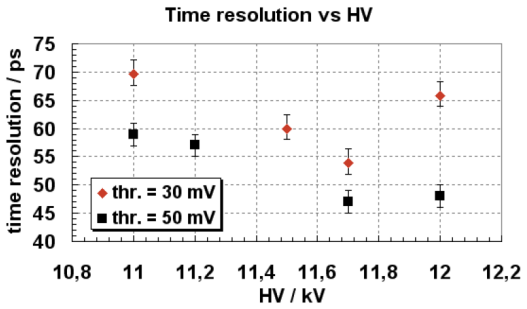

Figure 2: Time resolution as a function of high voltage for different preamplifier thresholds

small signals are not detected, and therefore a better time resolution is obtained as compared to a lower threshold. The efficiency, which is about 93% for $thr. = 30$ mV at nominal operation voltage, drops by 3% for $thr. = 50$ mV.

In Figure 3 the average cluster size, i.e. the number of neighboring strips that fire simultaneously, is depicted as a function of the high voltage. The average cluster size depends on the threshold. For both thresholds the dependence on the HV is nearly linear with a similar slope of about 0.46 kV^{-1}. At HV = 11.7 kV, the cluster size reaches values between 1.4 and 1.6.

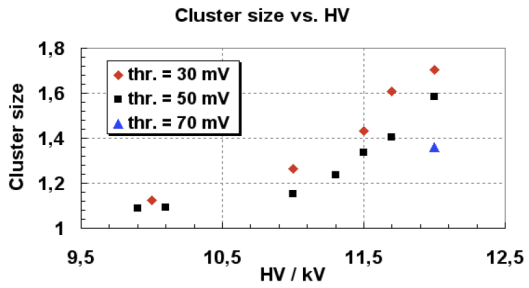

Figure 3: Cluster size as a function of high voltage for different preamplifier thresholds

References

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

[2] I. Deppner *et al.*, *CBM Progress Report 2009*, Darmstadt 2010, p. 40

[3] Y. Wang *et al.*, *Performance of low-resistivity glass*, this report

[4] M. Ciobanu *et al.*, IEEE NSS, Dresden 2008, 2018