Systematic study of effect of setting parameters of n-XYTER self triggered electronics for CBM MUCH

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Introduction

Triple-GEM detectors will be used for the muon tracking in the CBM experiment at FAIR [1]. The detectors to be positioned in the first few stations of MUCH, will have to cope up with a high particle density. For the operation of CBM-MUCH at high interaction rates, a self triggered fast readout electronics is required. For the beamtest of GEM prototypes, we have used n-XYTER ASIC for readout. This is a 128 channel ASIC and is able to process data at an average rate of 32 MHz with a maximum of 10% dead time. It has several register settings via which one can set the optimum condition for operating the ASIC. Parameters such as V$bias$S, V_{th}, Vbfb. are some of the main ones which directly affect the signal amplitude or the noise characteristics of the detector. V_{th} is the global threshold voltage for the comparators i.e. it defines the pulse strength that is neccessary to trigger the comparator. V$bias$S is the bias voltage for the first stage of slow shaper of n-XYTER and sets the baseline. Vbfb sets the discharge time for preamplifier by controlling the resistance of the transistor used in preamplifier of n-XYTER and its setting governs the behaviour of the response at high rates.

In this report, we discuss the variation of signal with varying FEB parameters. The goal is to study the characteristics of the FEB parameters and to have a better understanding of the test beam data already acquired. Previously [2], dependence of signal on Vbfb parameter, has been reported. We present here a detailed and systematic study of these parameters.

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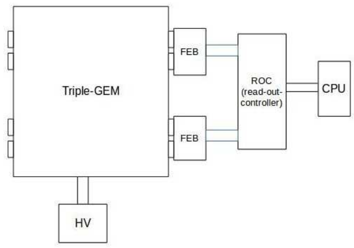

FIG. 1: Schematic of the experimental Setup.

Experimental Setup

The tests have been carried out using a triple GEM of 10 cm x 10 cm and Fe^{55} source, as schematically shown in Figure 1. The readout plane consists of pads of 3mm×3mm in size, read out using two n-XYTER FEBs. These FEBs are connected to ROC(read out controller). Fe^{55} source was placed at a fixed position of the detector such that the same pad was hit most of the times. Only one setting parameter was changed at any given time and data were acquired using DABC [3] framework developed at GSI. For all the measurements we have kept the FEB temperature fixed. We have allowed only a small variation of temperature by 1°C.

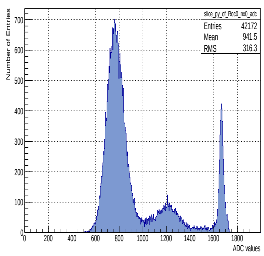

FIG. 2: Raw spectrum of Fe^{55}, HV=2900 V.

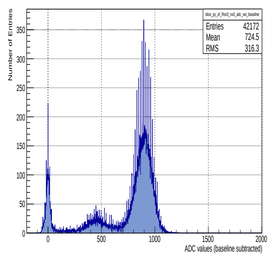

FIG. 3: Corrected spectrum of Fe^{55}.

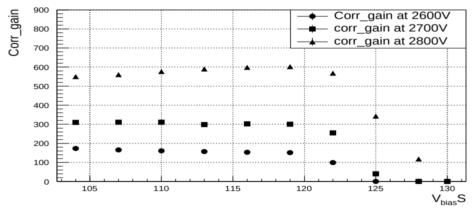

FIG. 4: Variation of photo-peak with $VbiasS$ for three different detector voltages.

Results and Discussion

The baseline of the n-XYTER is fixed around 2000 ADC for negative signal and due to this, the pulse height spectra is inverted implying lower amplitude signal occuring at higher ADC and vice-versa. The pulse height spectra obtained from the source or beam particles need to be subtracted from the baseline to have a meaningful picture of the ADC. The accuracy in baseline determination is thus an important issue and can directly affect the amplitude estimation of the signal. Figure 2 and Figure 3 show the raw and baseline-corrected pulse height spectra of Fe^{55}, respectively. The FEB parameters also affect the baseline position. Figure 4 shows the variation of corrected ADC with V*bias*S for three different GEM voltages. The photo-peak position remains rather flat for lower gains but shows a slight increase at higher gains, before all of them start to decrease after a nominal value, which varies from FEB-to-FEB. The observation is in line with the expected behaviour of the electronics. This study indicates the range of V*bias*S values within which one can expect stable signals. While the decrease in amplitude is understood from the simple understanding of the reference level, the reason for the increase at higher gains could be due to nonlinearity of the ADC, but this is under study.

In Figure 5, we study the variation of the photo-peak ADC(squares) and noise-peak(circles) with changing V_{th}. By increasing V_{th} value, the threshold increases. It also shows that the ADC gets affected only slightly by less than 5 %, while the noise peak position

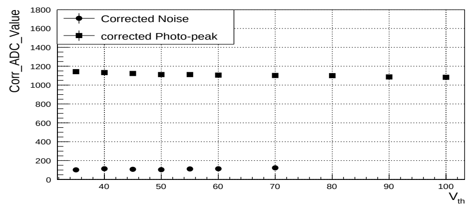

FIG. 5: Variation of photo-peak ADC & corresponding pedestal of central pad with V_{th}.

remains the same with V_{th}. Figure 6 shows the variation of peak pulse height for two different $Vbfb$ values at varying GEM voltages. In the past test beams, we have taken data at these two settings, hence the choice of these particular $Vbfb$ values, so as to comprehend well the corresponding datasets. By increasing $Vbfb$, the charge on the pad dissipates faster, which may result into some amplitude loss. As seen from the Figure 6, the reduction is at the level of 100 ADC at a ΔV_{GEM} 325 Volts, when going from $Vbfb$ =30(squares) to 150(circles). Detailed study is underway. All these results will be presented and discussed.

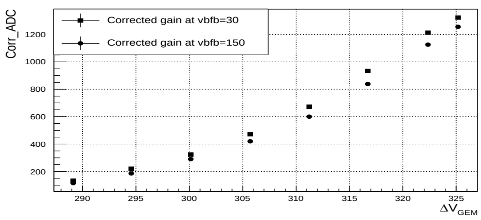

FIG. 6: Variation of peak pulse height with Vbfb.

References

[1] DAE Symp. on Nucl. Phys. **57**, 132 (2012).
[2] DAE Symp. on Nucl. Phys. **58**, 978-979 (2013).
[3] IEEE Transactions on Nuclear Science 09/2011; 58(4-58):1728 - 1732.