Status of the CBM TOF free streaming electronics chain*

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The CBM experiment will have a data acquisition system operating in free-streaming mode for most of its detectors. In the case of the CBM Time-of-Flight (ToF) wall electronics chain, this new readout mode applies first to the Time to Digital Converter (TDC) and then to one or more FPGA based boards acting as Readout Controller (ROC) and Pre-Processor [1], until the input of the computer farm.

A first prototype of this readout chain consisting of the PADI3 and GET4 prototype ASICS and of the Syscore v2 ROC was assembled and tested in beam with Resistive Plate Chamber (RPC) prototypes[2]. Results of these test helped for the development of the GET4 v1.0 chip [3] and new versions of the PCB boards [4].

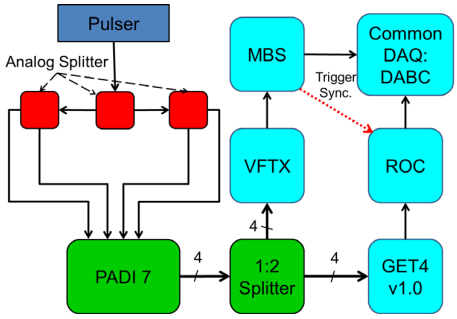

Figure 1: Sketch of the setup used to take pulser data with GET4 and VFTX in parallel.

These new developments were tested in beam with heavy ions at GSI in November 2012 and later in the laboratory with pulser signals. During the beam test, an RPC detector was equipped with PADI6 discriminators and two Plastic scintillators readout by Photo-multipliers (PMT) were equipped with PADI7 discriminators. The signals from the PADI boards were then splitted. On one side they were readout in a MBS/VME based triggered system using VFTX boards [5] as digitizer. On the other side the GET4 v1.0 based free-streaming system was used. Additionaly, a signal from the trigger board of the VME system is inserted in the data stream of the free-streaming system. This provides synchronization points between both systems. This also allows a comparison in the free streaming part between an event reconstruction based on using data themselves to detect events and a "triggered-like" event reconstruction. The pulser test is performed by replacing the 4 PMT signals with a single analog splitted pulser signal. A sketch of this setup is shown in figure 1.

The analysis software composed of an unpacker based on the GO4 framework and ROOT macros is now the same for the triggered and free streaming systems. A class for the VFTX unpacking and calibration and a class for the GET4 v1.0 unpacking and event building are feeding the same classes describing the detectors hits and clusters. The data taken in parallel can also be merged in a single output event using the event index sent from the triggered system to the free-streaming system. This allows direct comparison of the results, in particular time difference distibutions, obtained with the two systems.

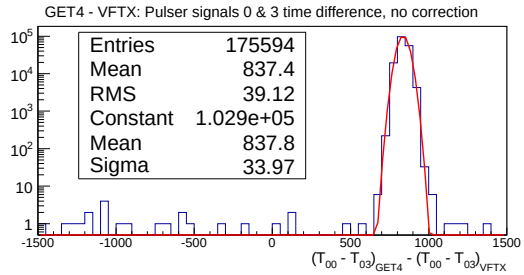

Figure 2: Example of a VFTX to GET4 comparison with pulser signals.

In the pulser test, the time differences between each pair of signals in each system are fitted with gaussian distributions. The difference between the time differences obtained in each system is also computed and fitted with a gaussian. Figure 2 shows an example of timing performances comparison between VFTX and GET4 based systems for the pulser test in the laboratory. Table 1 presents the mean sigma of the 6 possible signal combinations for each TDC and for their comparison.

Table 1: Mean sigma of the Gaus fit for each distibution in the pulser test for a 20mV pulse and a 150mV threshold.

	σ[ps]
PADI7 + VFTX	17.5
PADI7 + GET4	27.5
GET4 - VFTX	34.5

References

[1] C. Xiang et al., "The online data pre-processing for CBM-TOF", this report

[2] P.-A. Loizeau et al., "CBM Progress report 2011", Darmstadt 2012, p.59

[3] H. Flemming et al., "GET4 1.0", this report

[4] J. Frühauf et al., "Hardware Development for CBM ToF", this report

[5] J. Frühauf et al., "VFTX (VME-FPGA-TDC 10ps)", this report

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