Time Correlation Experiment with Timestamping module for Heterogeneous VME & CAMAC Data Acquisition System

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Introduction

In conventional Data Acquisition System(DAQ), a common GATE signal is used to acquire correlated events. But in case of large detector arrays and Heterogeneous DAQ it may not be possible without introducing significant dead times. It is proposed to run multiple DAQ independently on its own trigger and mark the data with high-resolution timestamps. Timestamp may be the absolute time or a local counter value. The offline event builder generates the global correlated events by matching the timestamp values. With this approach Timestamp Generator and Receiver modules [1] have been developed for VME & CAMAC DAQ [2,3] and correlation experiment has been carried out successfully.

Experimental Setup

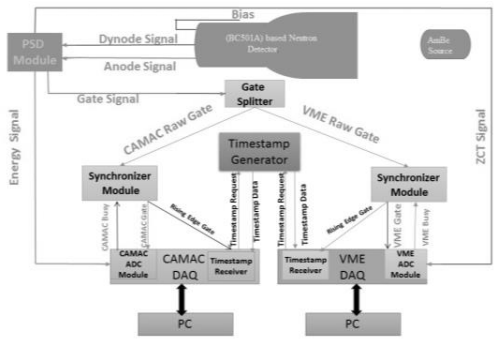

Fig.1 Block Schematic of Experimental setup

Timestamping Experiment has been carried out with AmBe(Neutron,Gamma) radioactive source & Liquid Scintillator (BC501A) based Neutron Detector as shown in Fig1 & Fig.2. Anode and Dynode output of scintillator detector feed to Pulse Shape Discriminator module. It produces the gate signal and Zero Cross over Time (ZCT) signal from anode input and Energy signal from dynode input. Energy information is captured by CAMAC DAQ and Zero cross over time by VME DAQ. The Gate signal produced from PSD module separated into two parts for CAMC & VME DAQ. Two Synchronizer Modules [4] have been used, each for VME & CAMAC DAQ to synchronize the Gate signal between Timestamp Receiver Module and ADC Module.

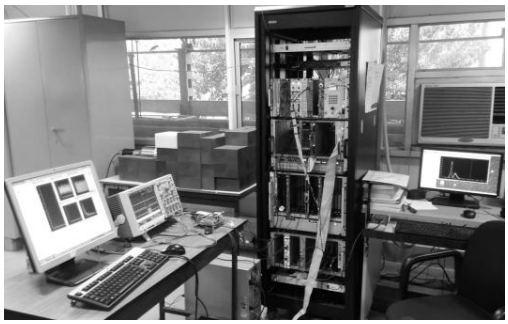

Fig.2 Experimental setup

Experimental Results and Discussions

Correlated events are merged using their timestamps with offline merger program. Pulse height i.e. Energy vs Zero Cross over Time (ZCT) 2D correlated spectra has been generated based on VME & CAMAC merged Timestamp.

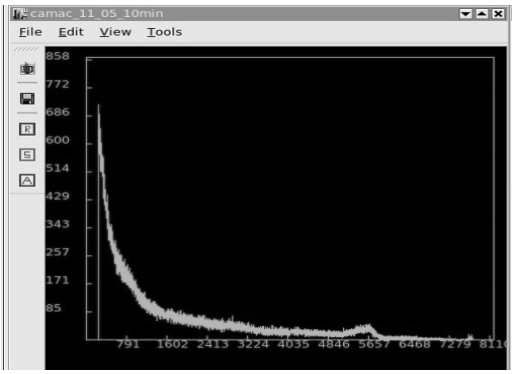

Fig.3 Energy Spectrum in CAMAC DAQ

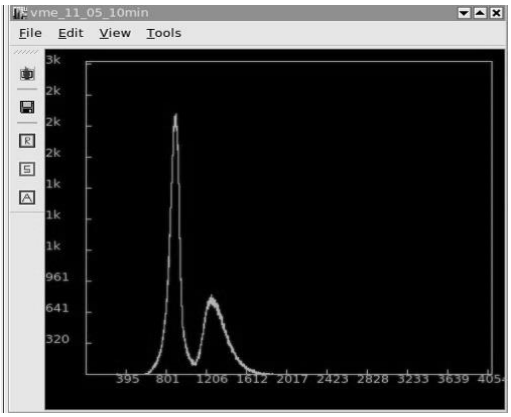

Fig.4 ZCT Spectrum in VME DAQ

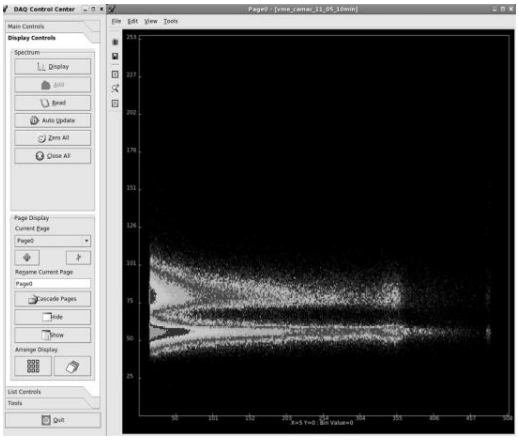

Fig.5 2D Correlated Spectrum based on Timestamp

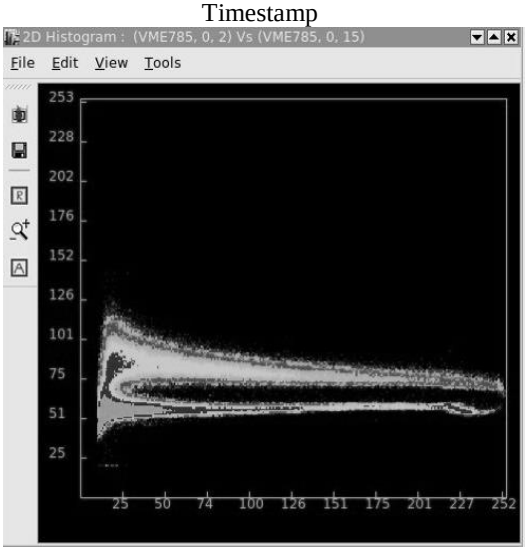

Fig.6 2D Hardware Correlated Spectrum

Figure 3,4&5 are spectrum output of Timestamping Correlation Experiment. We have compared the Timestamp correlated spectrum with hardware correlated spectrum shown in Fig.6. The timestamp generated spectrum matched with the hardware correlated spectrum and proves the authenticity of the experimental results.

We have carried the experiment for a fixed time interval and found CAMAC read out is ~20% slower than VME read out. In our experiment ~1% erroneous timestamp data was there due to Timestamp Generator Receiver serial cable communication error and we have rejected that non zero CRC data in final merging. Overall we are getting ~85% correlated data in 2D correlated spectrum, generated from VME & CAMAC merged Timestamp.

SFP based optical communication development process is going on to improve the Timestamp Generator Receiver communication performance and overall correlation Timestamping performance.

References

[1] Ram Kumar Paul et al., "Prototype VME & CAMAC form factor Timestamping module development for Nuclear Physics Experiment", DAE-BRNS Symp. on Nucl. Phys. 60 (2015), p.922-923.

[2] P. Dhara et al., "Multi-threaded object-oriented VME data acquisition system on Linux", DAE-BRNS Symposium on Nuclear Physics, Vol. 46B, p. 530-531 (2003).

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[4] P. Dhara et al., "The Multi-crate VME Data Acquisition System", DAE Symposium on Nuclear Physics, Vol: 57 (2012), pp 916-917.