

Installation of a Digitizer based Pulse Processing and Data Acquisition System and related developments

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Introduction

The use of digitizer based pulse processing and data acquisition system at the recent campaign of the Indian National Gamma Array (INGA) at Tata Institute of Fundamental Research (TIFR) [1], Mumbai, has emanated the use of digital signal processing in spectroscopic endeavours being pursued in the country. The long and successful operation of the system at TIFR, and several experiments carried out therein, have contributed in edifying the user community on the nuances of the new technology and the possible refinements / requirements in the context of the γ -ray spectroscopic endeavours.

A digitizer based system has recently been procured at the UGC-DAE CSR, Kolkata Centre, primarily for use with an array of Compton suppressed Clover detectors. The hardware is similar to that used in the TIFR setup and consists of PIXIE-16 digitizer modules, from XIA LLC, each accepting 16 inputs and digitizing the same with 12-bit 250 MHz ADCs. The firmware for the system has been conceptualized at the Kolkata Centre and implemented by the manufacturer. The tests for the performance of the system are currently in progress and shall be detailed at the Symposium.

Specific features of the PIXIE-16 System at UGC-DAE CSR, Kolkata Centre

The pulse processing logic conceived for the system attempts to emulate the processing conventionally practiced with the analog NIM based modular electronics. The particular features of the system are as follows.

1. Each PIXIE-16 module, with 16 input channels, can support 3 Compton suppressed Clovers wherein the Anti Compton signal can be processed internally in the digitizer module. This is, however, optional and the ACS signal can be processed independently on the conventional NIM electronics and be provided as veto input to the PIXIE system through NIM-LVDS converter.
2. Following the previous feature, the master trigger in the new system is generated based on the multiplicity of Compton suppressed Clover detectors.
3. In addition to the master trigger, each input channel is also subjected to an individual trigger, to restrict random coincidences.
4. A new CFD algorithm has been implemented in the current system.
5. Provisions have been made to access the different logic signals, at different stages of processing, for probing and setup.

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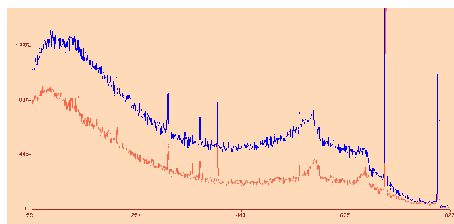


FIG. 1: Comparison between suppressed and unsuppressed spectra acquired with the current system.

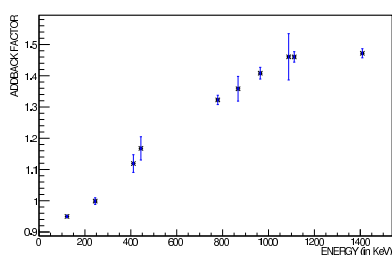


FIG. 2: Plot of addback factor with energy from the data acquired with the present system.

Programming developments

The data reduction programs developed for the digitizer based system used at the INGA campaign in TIFR [1] are also generally valid for the present system at UGC-DAE CSR. However, with a different CFD algorithm implemented in the present system, a slight modification in the data read-out part of the existing codes would be required in the event of data acquisition in the CFD enabled mode.

Independently, a set of data reduction programs have been / are being also developed for reduction of the data acquired with the present system. These codes work on a pre-sorted data format, generated by one of the developed programs, with reduced disk space requirement compared to the raw data. The rest of the reduction process includes, time sorting of data for an individual module and subsequently together for all modules in the system, energy calibration, gain-matching, addback and generation of matrix.

Preliminary performance tests and Outlook

The system has been tested for Compton suppression and time correlated (crystal-wise) acquisition of a single Clover data. The comparative suppressed and unsuppressed spectra are illustrated in Fig. 1 while the plot of the addback factor is presented in Fig. 2. The initial tests have been satisfactory.

The system is being further tested for two Clover coincidence data acquisition and would eventually be subjected to in-beam tests with an array of Compton suppressed Clovers. These tests and the results obtained therefrom would be detailed at the Symposium.

References

- [1] R. Palit *et al.*, Nucl. Instr. Meth. Phys. Res. A680, 90(2012).