Validation method to merge digital data acquisition with analog data-acquisition system in SAMURAI30 experiment

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In this paper, the method to combine the digital data acquisition system (DDAQ) of our low-energy neutron detector PANDORA[1)] and the analog data cquisition system (DAQ) of standard detectors of SAMURAI spectrometer[2)] during the SAMURAI30 experiment[3,4)] is reported.

PANDORA was optimized to detect neutrons with a kinetic energy of 0.1–5 MeV by measuring the related Time-of-Flight (ToF) in the range of 50–300 ns. Data from PANDORA bars (each with a signal from both ends) were read out with duplicated readout. CAEN V1730 modules were used for the charge and pulse shape discrimination information while an analog circuit (discriminators and CAEN V1290 TDC modules) was used for timing and triggering.

For the DDAQ, we daisy chained six CAEN V1730B (16-channel modules) and one CAEN V1730D (8-channel module) waveform digitizers using an optical connection. The unpublished software of digiTES based on Digital Pulse Processing for the Pulse Shape Discrimination (DPP-PSD) firmware[5)] was used to manage different modules in the daisy chain condition and control the digitizers. A LUPO (Logic Unit for Programmable Operation) module[6,7)] was used to generate a 62.5 MHz signal to synchronize timestamps of the seven modules and share the clock with another LUPO in the DAQ system.

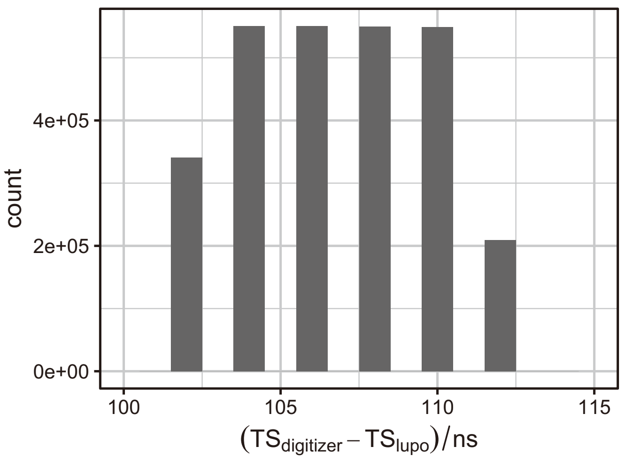

Fig. 1. Time stamp difference between DDAQ and DAQ. V1730B/D has 2 ns timestamp resolution while LUPO has 10 ns resolurion.

The acquisition in the digitizers was not based on the self-triggering of each channel. The local triggering option of the two-two coupled channels (in V1730, two neighboring channels were paired) was used to ensure the coincidence between photomultipliers of both sides of PANDORA. The digitizers were configured to ensure that the validation of the local triggers came from an external trigger based on the costumer configured software criteria. To manage the coincidence requirements between the two separate acquisition systems, the first channel (ch 0) of each digitizer was dedicated to a logic signal. This external trigger validated the PANDORA self-triggers in a time window of approximately 1 μs.

The validation signal originated from the accepted trigger of analog DAQ based on the triple coincidence of "BEAM" (from SBT detectors), analog "PANDORA" (recoil neutron) and "HODOSCOPE" (reaction residues at hodoscopes). This typical trigger rate was 1.3×10^3 Hz.

Consistent with our expectation, six different values were observed in Fig. 1. In comparison with the typical dead time of SAMURAI DAQ (approximately 100 μs), this method is enough for us to align the two data sets.

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References

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