Wire Chamber Test Stand Trigger Tests

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The Wire Chamber Test Stand (WCTS) has been developed to monitor wire aging and changes in the readout electronics of the CLAS drift chambers (DCs) by parasitically collecting from ninety-six sense wires of a super layer TDC and ADC data. The WCTS trigger can be based on the Time of Flight (TOF), Segment Collector (SC), or the wires being monitored (ECL_OR Logic). This note describes these trigger systems and presents the results of the analysis.

WCTS [1] data quality depends on: the trigger system's efficiency (determines the signal to noise ratio, S/N), ADC and TDC signal synchronization (the LeCroy 1877 TDC runs in common stop mode, whereas LeCroy 1885F ADC runs in common start mode), and ADC gate width (must accommodate ~ 1.3 μs long DC signals of region 3).

Data analysis uses Root, an object-oriented framework written in C++ that allows creation of charts, graphs, and histograms from data files. To test the Root-based analysis package, a special C++ code was written, which extracts the signal by fitting the ADC pedestal with a Gaussian and then subtracting this fit from the original plot. The code also calculates the mean and sigma of the ADC signal.

The TOF-based WCTS trigger (TOF_ Trig.), Fig. 1, is the L1 trigger and is received from the SRS535 pulser on the Space Frame.

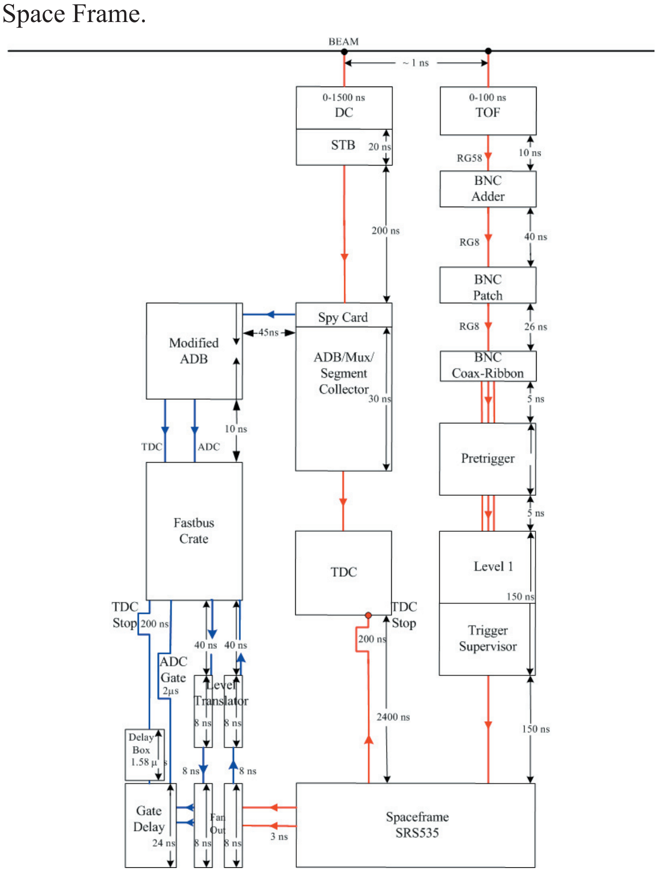

FIG. 1. TOF_Trig. schematic.

TOF_ Trig. timing information, Fig. 2, shows that the earliest DC signals – tracks close to the sense wire, arrive ~380 ns before (after all possible adjustments are made) the ADC gate opens; a flat distribution of the number of tracks across the cross-section of the cell implies that ~ 25% of the tracks arrive before the gate opens, and these tracks are longer, generate more charge, and have wider widths (~ 1.3 μs) than those that arrive after the gate opens. These signals that come before the gate bias the ADC towards smaller charges.

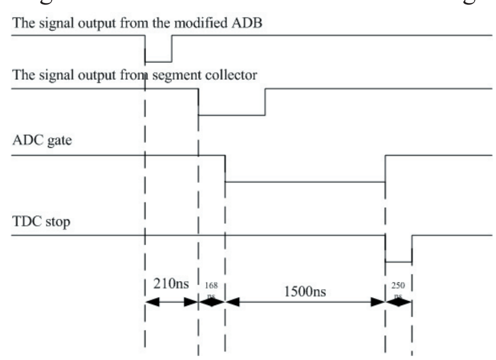

FIG. 2. TOF_ Trig. timing.

The ADC histogram's peak is expected to be at ~225 pc, assuming 70 primary e^-/cm (~ 200 e^-s on the average in a region 3 cell), a gas gain of 5×10^4, and an electronic gain of ~140.

Since there are ~ 36,000 wires in the drift chambers, S/N for TOF_Trig. is expected to be, because of cosmics, lower than ~ 1/36,000.

Perhaps because of this low S/N, no ADC peak other than the pedestal is discernable, Fig. 3. – a plot of the raw data. The signal has to be extracted [2].

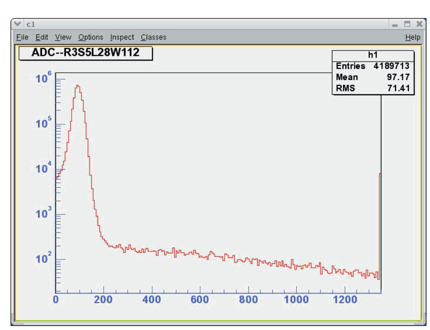

FIG. 3. ADC (electron beam data) acquired with TOF_ Trig.

The SC-based WCTS trigger (SC_Trig.), Fig. 4, gets its trigger from the SC board of a super layer, from which the data are being acquired. A trigger is generated whenever a particle passes through this super layer. As there are 2304 wires in a region 3 sector, S/N is expected to be ~ 1/2500.

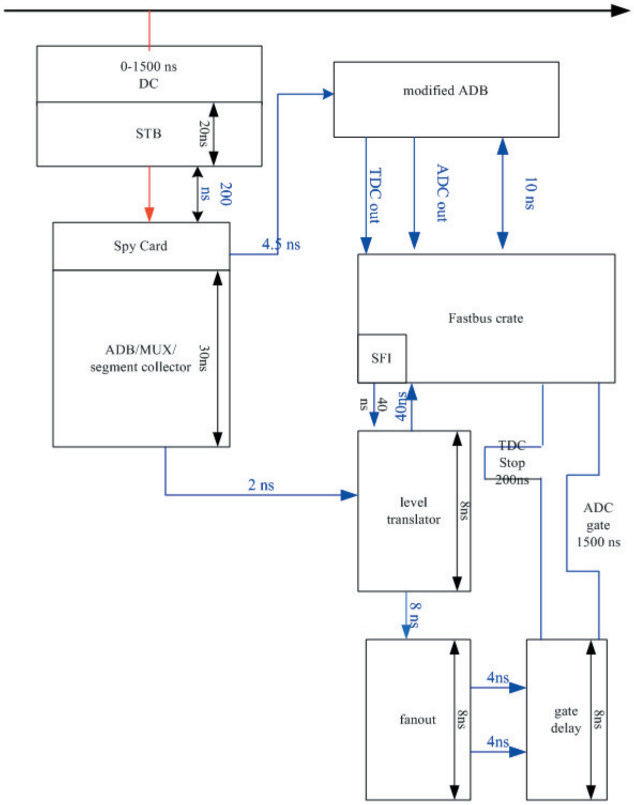

FIG. 4. SC_Trig. schematic.

For the SC_Trig., the DC signal arrives about ~ 468 ns before the ADC gate opens, Fig. 5.

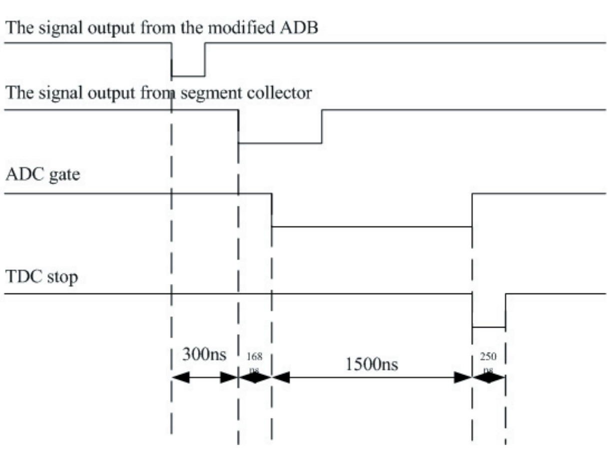

FIG. 5. SC_Trig. timing.

The ADC plot, Fig. 6, of the raw data hints a slight widening of the pedestal. The ADC peak has to be extracted.

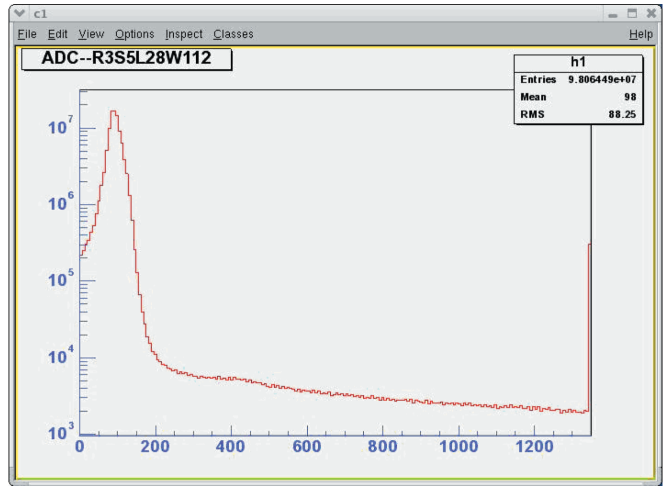

FIG. 6. ADC (beam data) acquired with SC_Trig.

The ECL-OR-based WCTS trigger (ECL_OR_Trig.), Fig.7, obtains its trigger from the earliest DC signal of the ninety-six wires that are being read out. The input to the ECL_OR_LOGIC is the TDC output from the modified ADB. The S/N ratio is expected to be ~1/100.

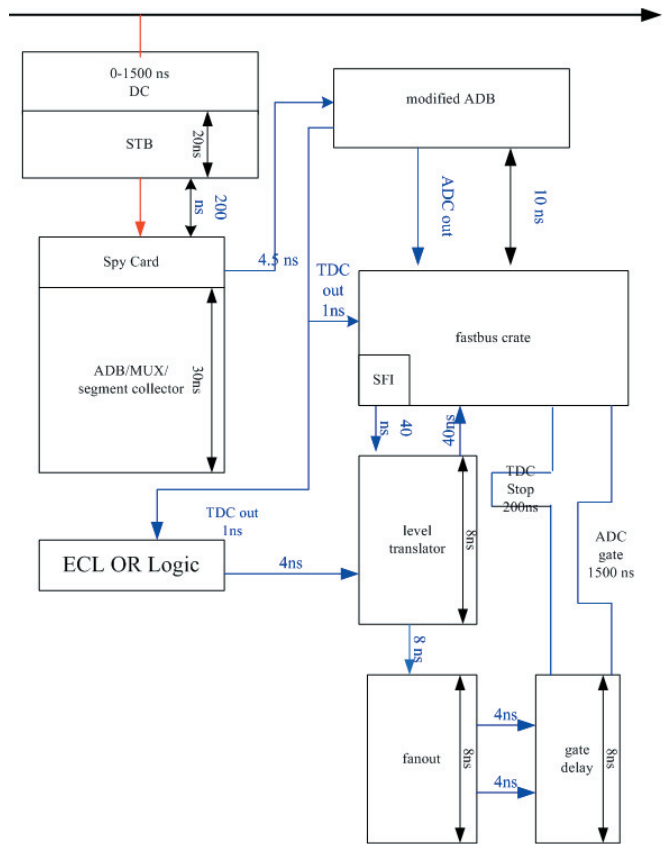

FIG. 7. ECL_OR_Trig. schematic.

For the ECL_OR_Trig., the DC signal arrives ~ 95 ns earlier than the ADC gate, Fig. 8.

The ADC plot, Fig. 9, of the raw data shows a peak at 225 pc.

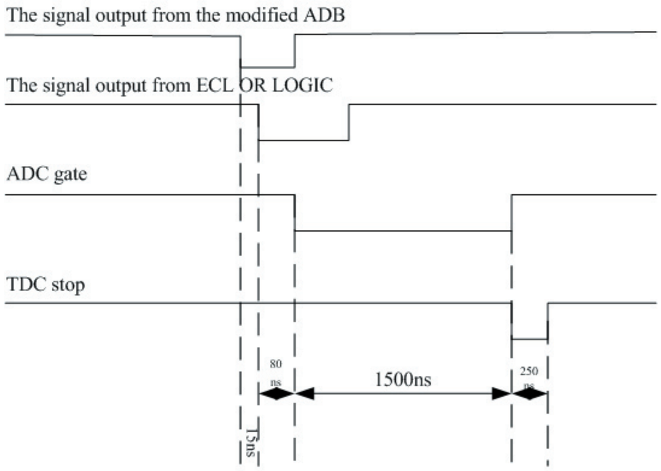

FIG. 8. ECL_OR_Trig. timing.

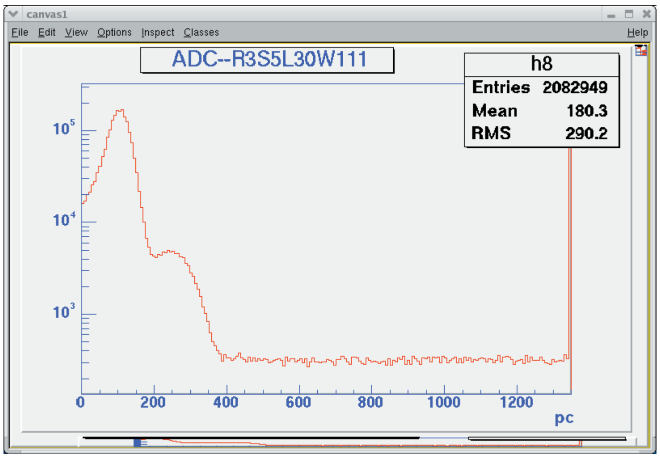

FIG. 9. ADC (beam data) acquired with ECL_OR_Trig.

In conclusion, pulser, cosmic and beam data were acquired using each trigger system and analyzed to obtain the mean and sigma of the ADC signal. Even though the software exists to successfully extract the signal and the signal's mean and sigma, it is impossible to run the system routinely. Fragile equipment, slow repairs, and poor communications between various groups make the WCTS unreliable over a long period. Changes in beam conditions further exacerbate the problem, making it almost impossible to acquire data systematically. Hopefully this situation will be remedied in the future.

[1] C. Cutter, "Wire Chamber Test Stand" Masters Thesis, CNU, 2000.
[2] G. Hou, R. Shenoy, "Analysis of the Wire Chamber Test Stand (WCTS) Data", CLAS Note, JLAB-02-014.