Mott DAQ Speed

Raw ADC Data Samples Mode

vs.

Pulse Integral and High Resolution Time Mode

December 17, 2014

How to speedup DAQ

I. Reject low-energy electrons:

    1. Increase E-detector hardware threshold

    2. Vetoing dump events

II. Use faster DAQ mode

Increase E-Detector Hardware Threshold

- E-detector discriminator threshold (NIM715) is now at -25 mV
- Change threshold to -50 mV will reduce DAQ rate by a factor of 2

Vetoing Dump Events

- Use laser ToF to veto dump events in NIM754 logic.

Use Faster DAQ Mode

- No Readout of CAEN v775 TDC or SIS3801 Scalers
- Instead: use FADC high resolution time and FADC scalers (?) → use new FADC mode
- Add block readout

Comparison of:

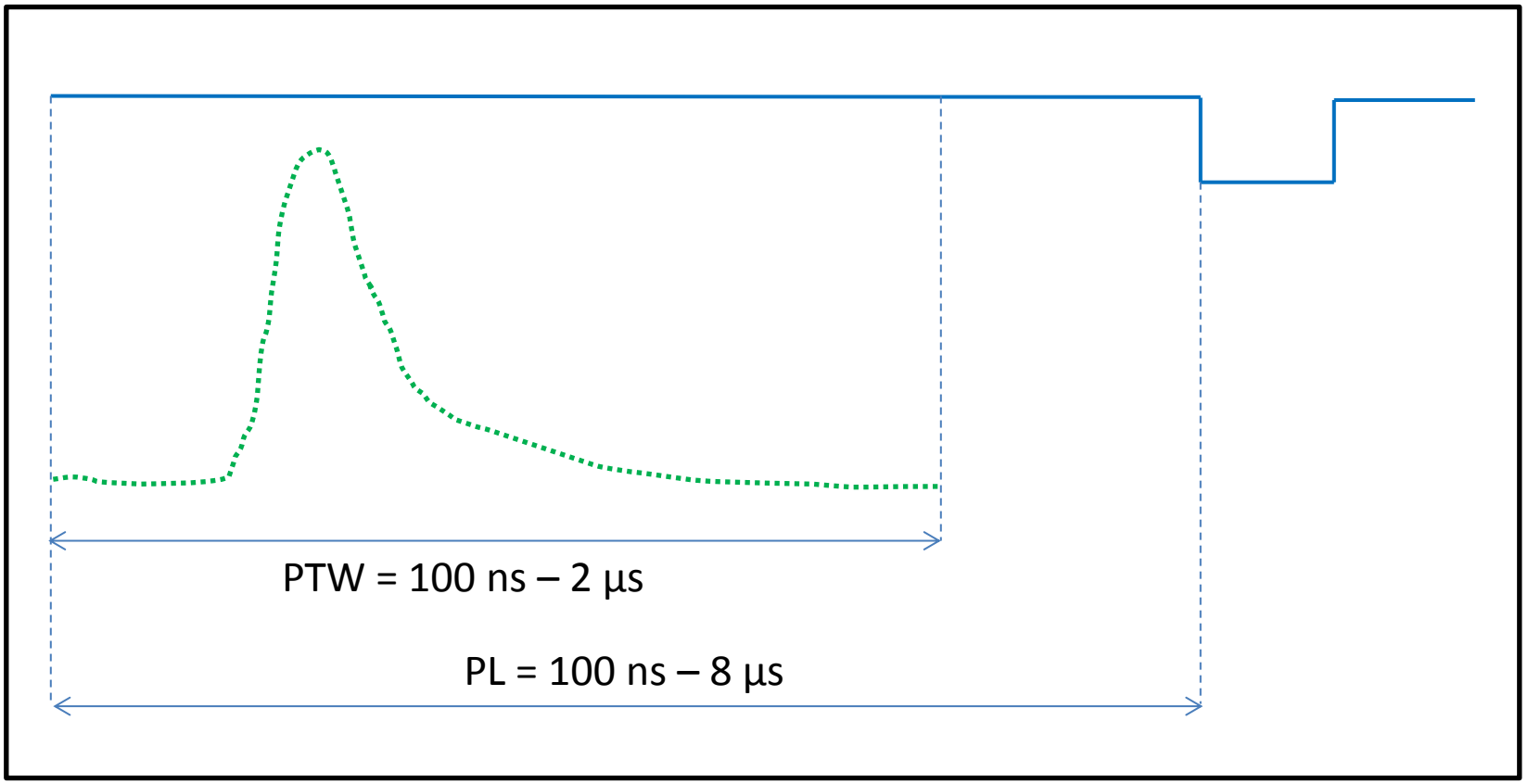
Raw ADC Data Samples Mode

vs.

Pulse Integral and High Resolution Time Mode

RAW ADC DATA SAMPLES – RUN 7673

Raw ADC Data Samples



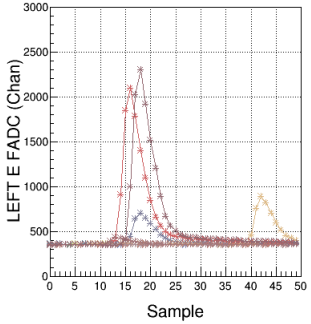
Mott Settings:

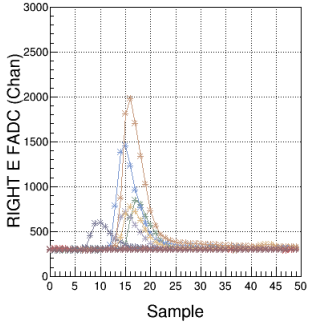
I. Programmable Latency (PL) = 60 samples
II. Programmable Trigger Window (PTW) = 50 samples
III. Threshold = 0
IV. Each Sample = 4 ns (250 MHz), 0 – 4096 (2^{12})

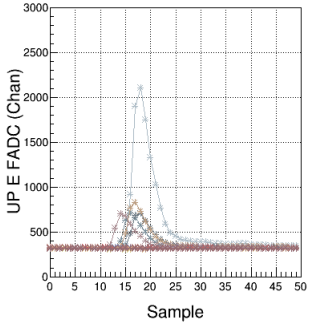
Mott Readout:

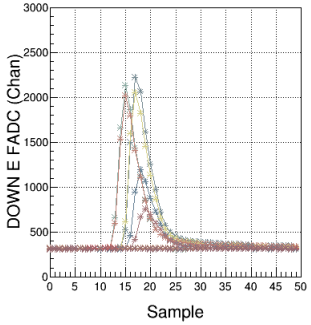
I. 50 samples

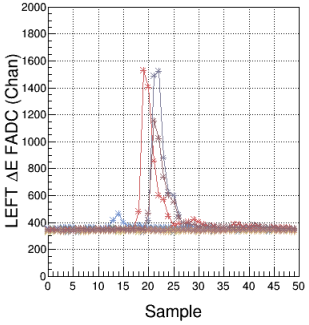
Samples


LEFT E FADC (Chan)
Sample


RIGHT E FADC (Chan)
Sample


UP E FADC (Chan)
Sample


DOWN E FADC (Chan)
Sample


LEFT ΔE FADC (Chan)
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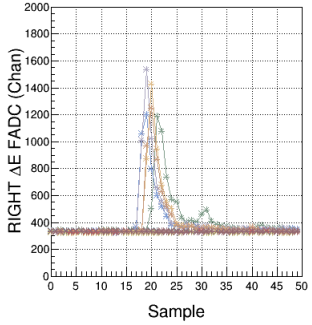
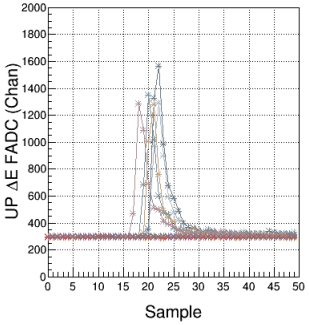

RIGHT ΔE FADC (Chan)
Sample


UP ΔE FADC (Chan)
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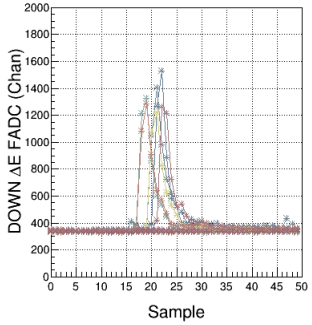
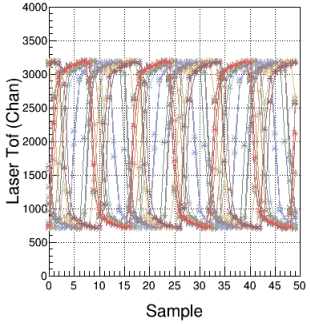
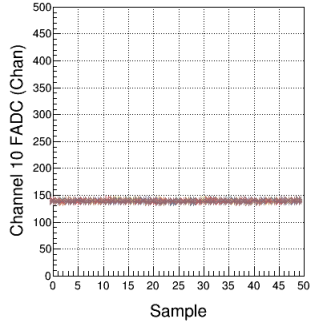
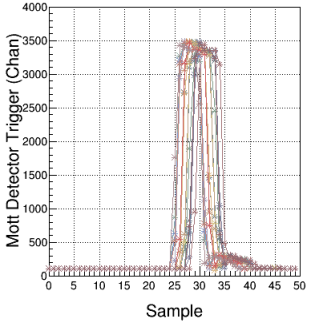
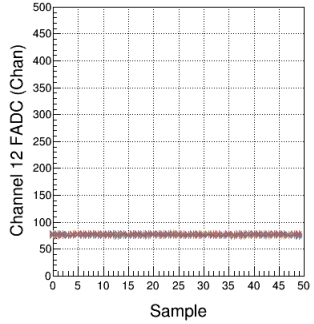

DOWN ΔE FADC (Chan)
Sample

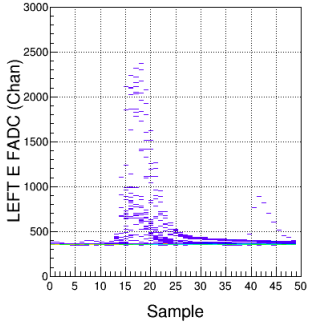

Laser Tof (Chan)
Sample

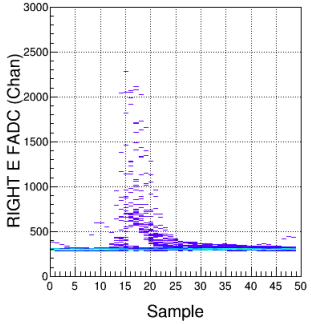

Channel 10 FADC (Chan)
Sample

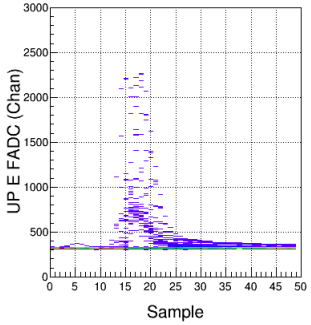

Mott Detector Trigger (Chan)
Sample

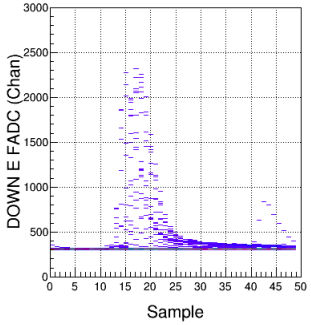

Channel 12 FADC (Chan)
Sample

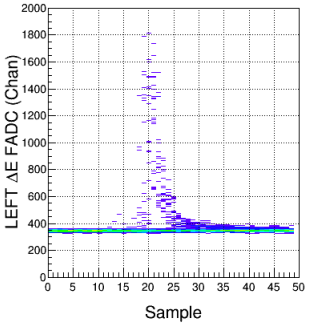
Samples

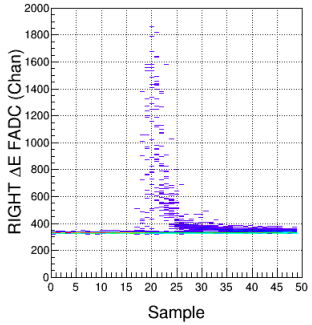

LEFT E FADC (Chan)
Sample

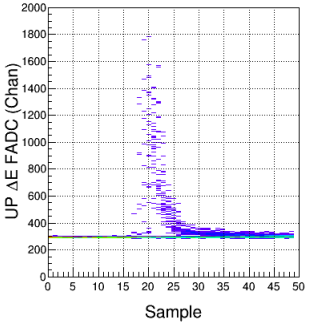

RIGHT E FADC (Chan)
Sample

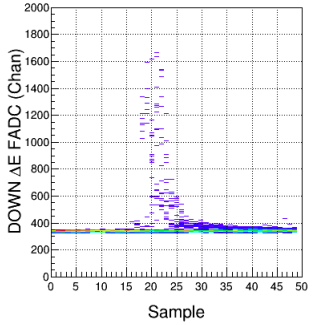

UP E FADC (Chan)
Sample

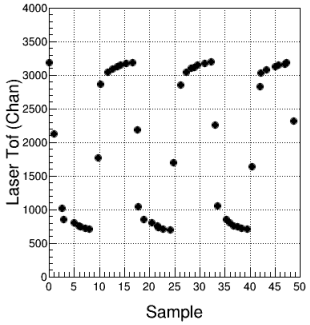

DOWN E FADC (Chan)
Sample

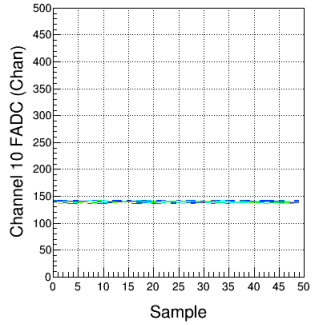

LEFT ΔE FADC (Chan)
Sample

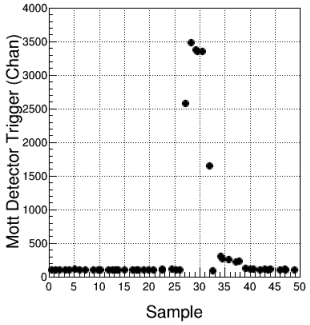

RIGHT ΔE FADC (Chan)
Sample

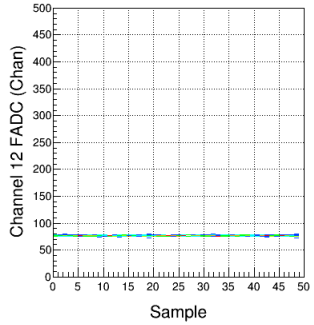

UP ΔE FADC (Chan)
Sample


DOWN ΔE FADC (Chan)
Sample

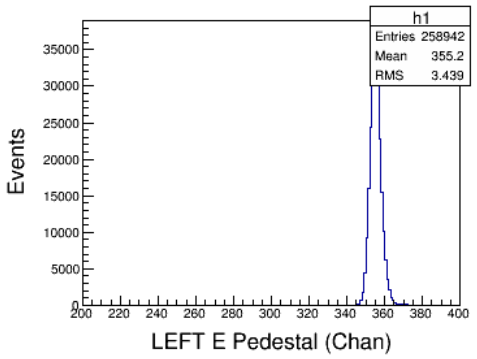

Laser Tof (Chan)
Sample

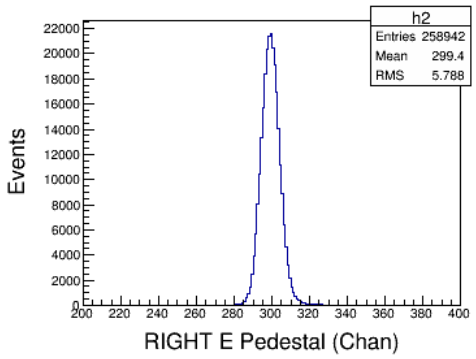

Channel 10 FADC (Chan)
Sample

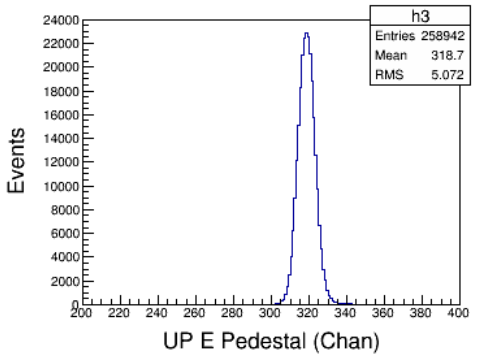

Mott Detector Trigger (Chan)
Sample

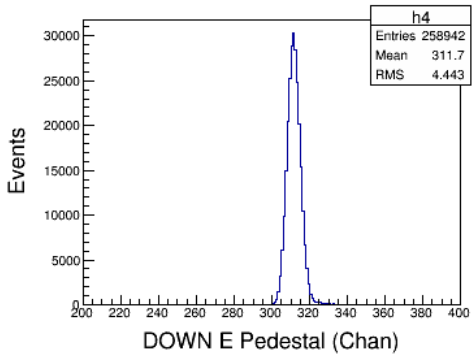

Channel 12 FADC (Chan)
Sample

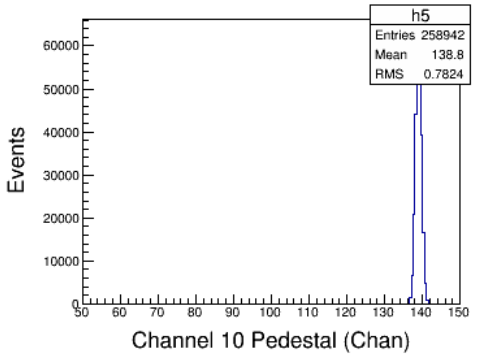
Analysis: Pedestals

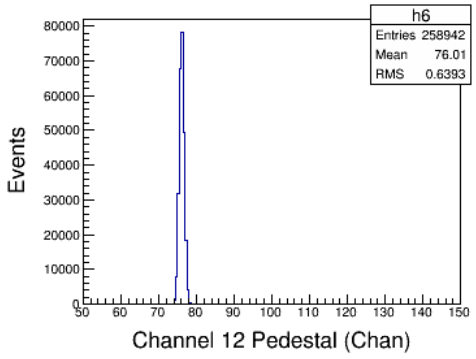






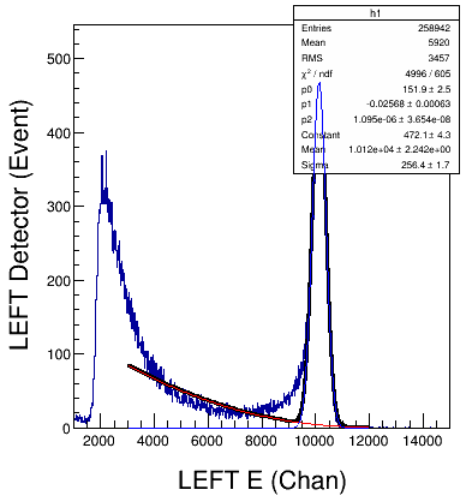


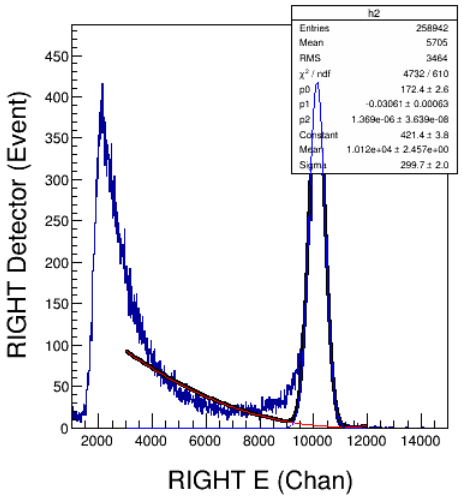


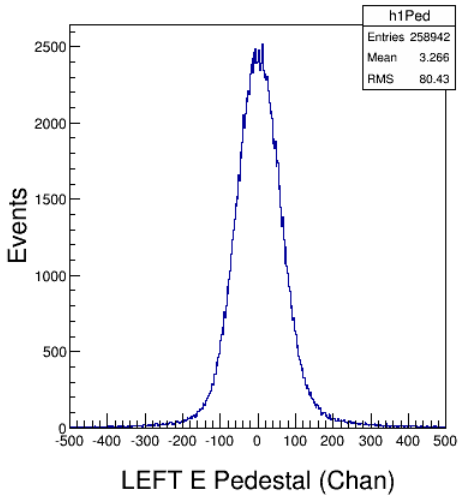


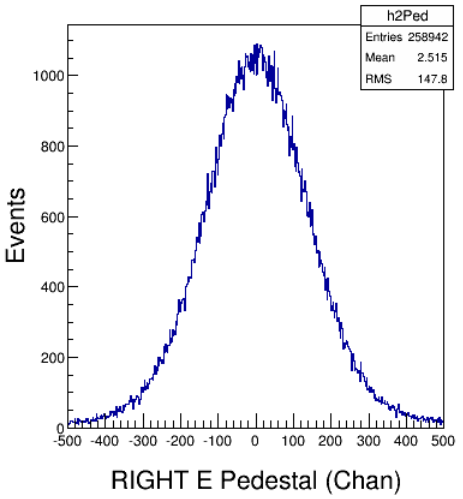
Analysis: Energy

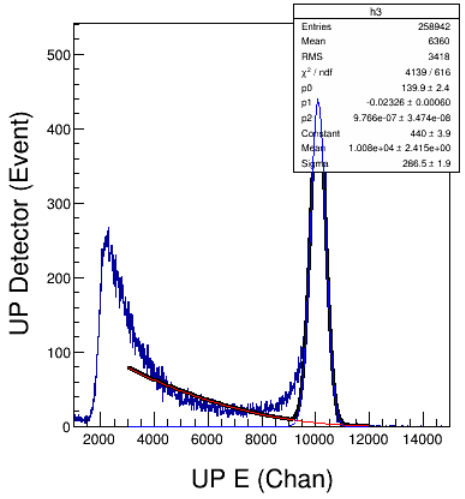
$\sigma_E \sim 2.7\%$

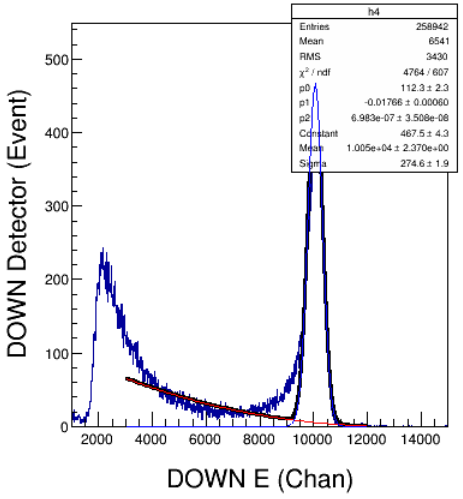


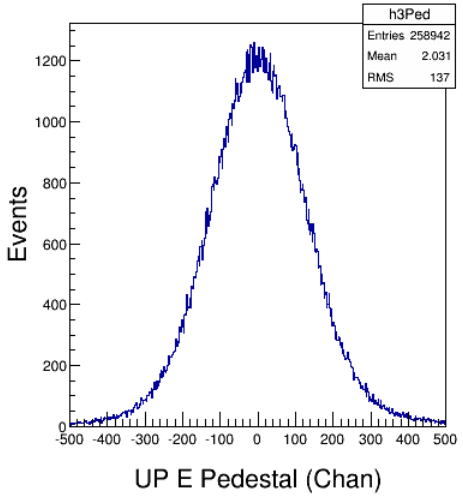


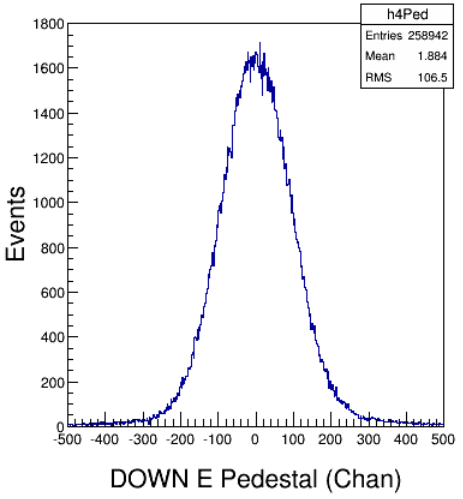




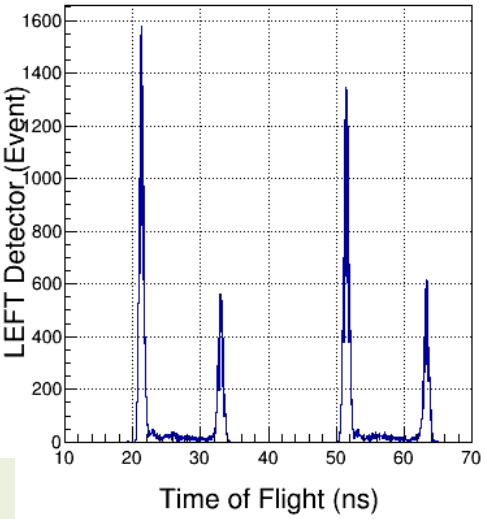


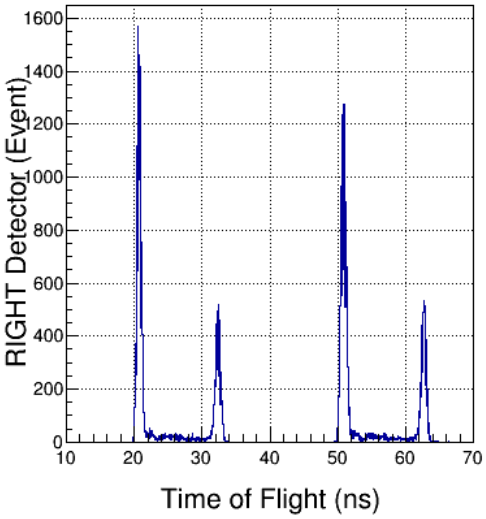




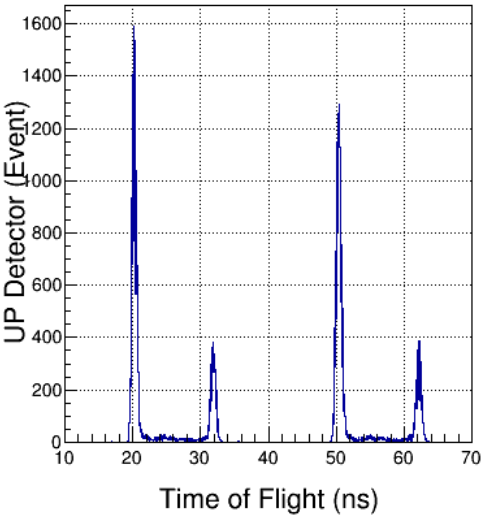


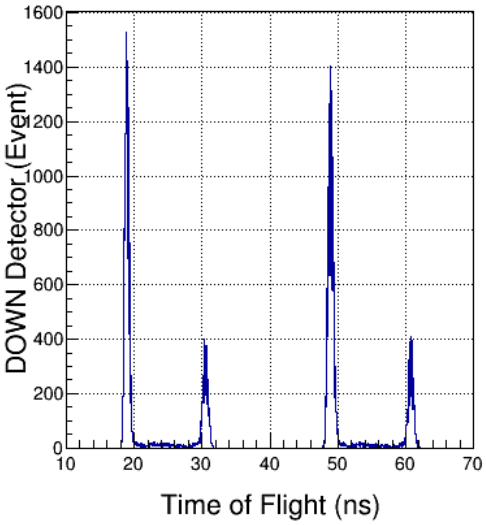
Analysis: Time-of-flight





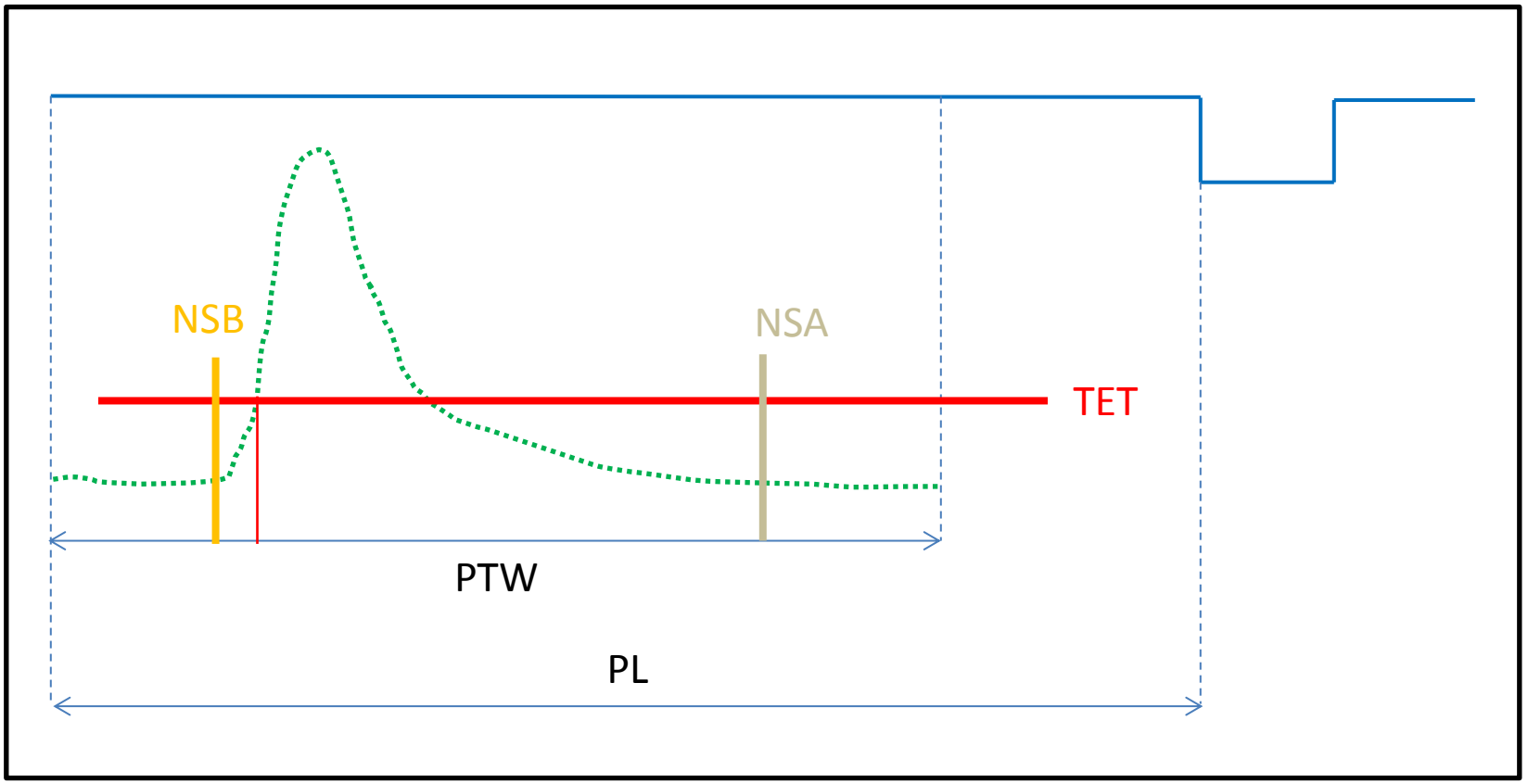
$\sigma_t \sim 0.2$ ns





PULSE INTEGRAL AND HIGH RESOLUTION TIME – RUN 7672, 7642

Pulse Integral & High Resolution Time



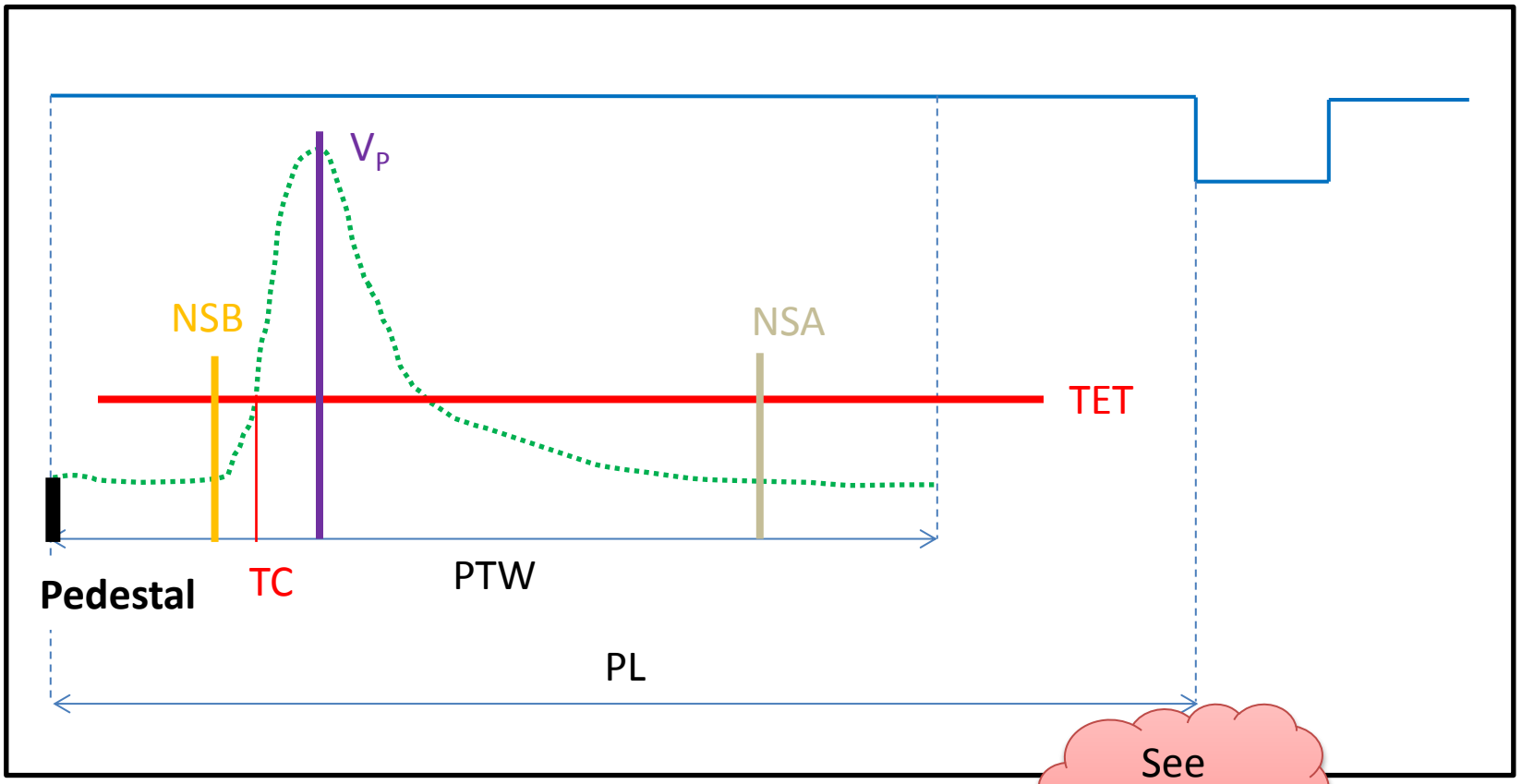
Mott Settings:

I. PL = 60 samples, PTW = 50 samples, or NW = NSB + NSA?
II. Programmable Trigger Energy Threshold (TET)
III. Number of pulses (NP) in PTW = 1 (up to 3 pulses)
IV. Number of Samples Before threshold crossing (NSB) = 5
V. Number of Samples After threshold crossing (NSA) = 28

TET

```
fadc_threshold[0] = 600;        // CH1 - E LEFT
fadc_threshold[1] = 600;        // CH2 - E RIGHT
fadc_threshold[2] = 600;        // CH3 - E UP
fadc_threshold[3] = 600;        // CH4 - E DOWN
fadc_threshold[4] = 600;        // CH5 - dE LEFT
fadc_threshold[5] = 600;        // CH6 - dE RIGHT
fadc_threshold[6] = 600;        // CH7 - dE UP
fadc_threshold[7] = 600;        // CH8 - dE DOWN
fadc_threshold[8] = 1750;       // CH9 - BFM
fadc_threshold[9] = 100;        // CH10 - Free
fadc_threshold[10]= 1000;       // CH11 - Mott Trigger
fadc_threshold[11]= 100;        // CH12 - Free
fadc_threshold[12]= 10;         // CH13 - Delayed Helicity
fadc_threshold[13]= 10;         // CH14 - T_Settle
fadc_threshold[14]= 10;         // CH15 - Pat Sync
fadc_threshold[15]= 10;         // CH16 - Pair Sync
```

Pulse Integral & High Resolution Time



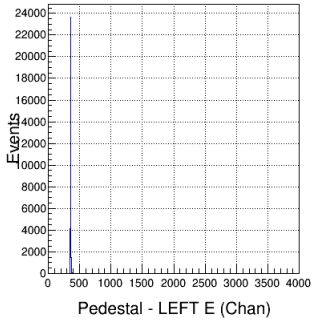
Mott Readout:

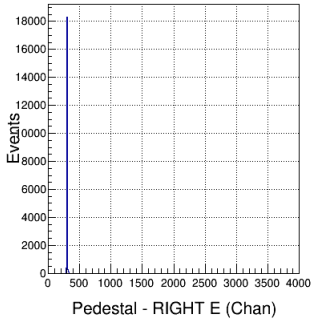
I. Pedestal = Average of first 4 samples of window
II. Peak Value (V_P)
III. Pulse Integral = Sum of raw samples MIN(NSB+NSA, PTW)
IV. Pulse Coarse Time = Sample number of first Threshold Crossing (TC)
V. Pulse Fine Time =

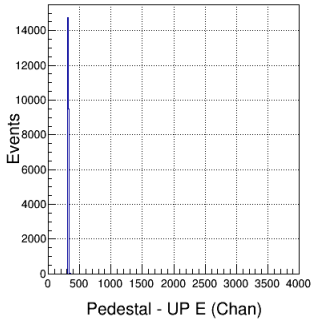
See Note 1

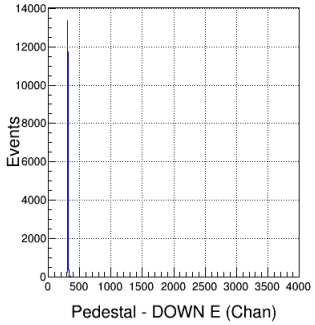
See Note 2

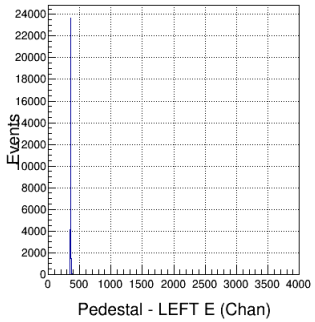
Pulse Pedestal

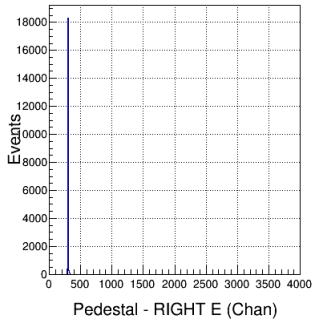


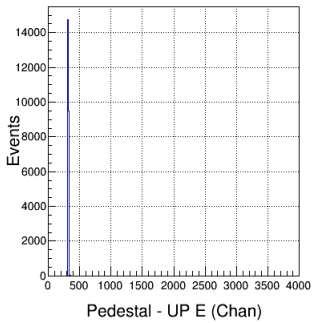


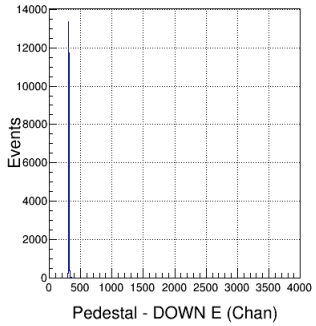


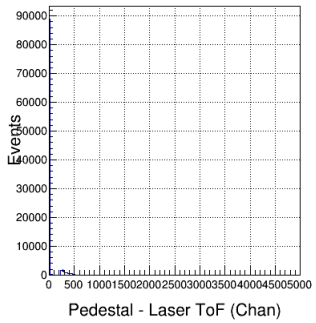


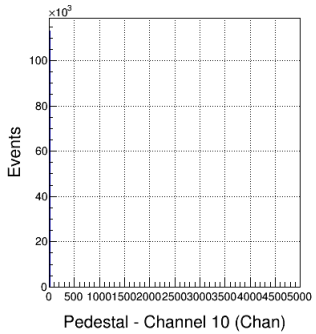


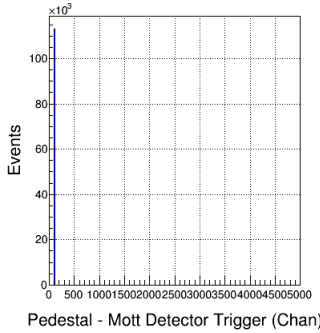


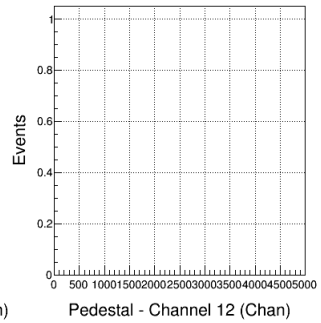




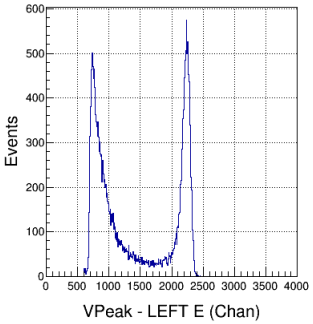


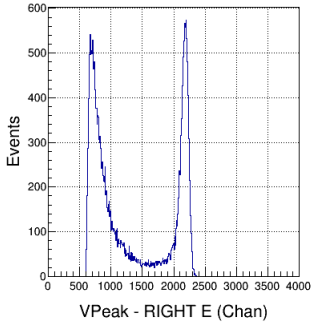


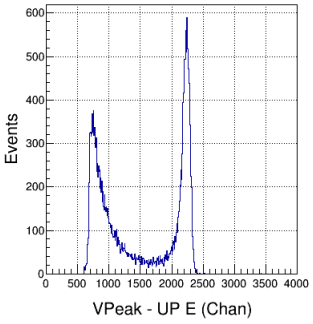


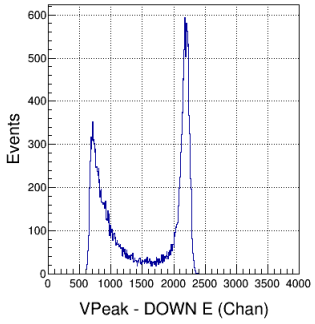


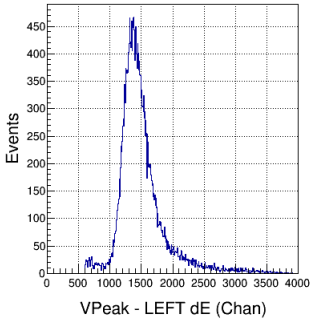
Pulse Peak Value (VP)

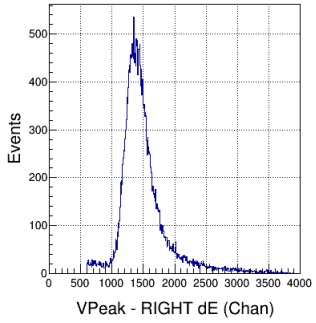


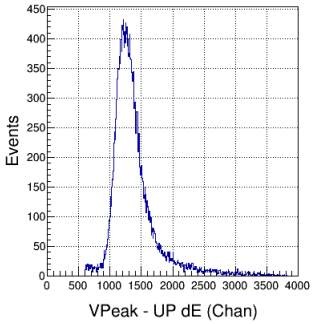


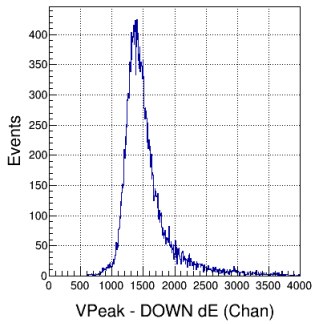


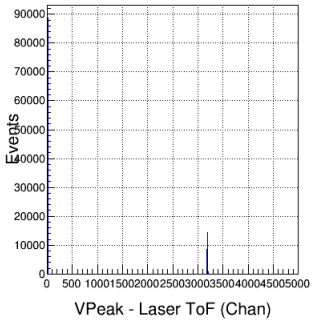


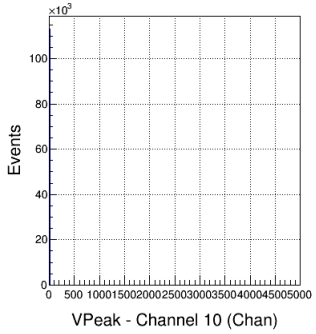


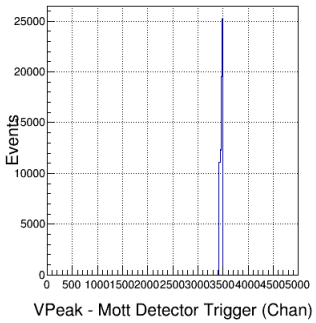


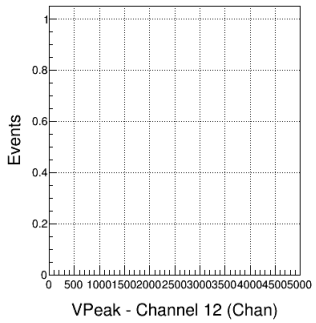




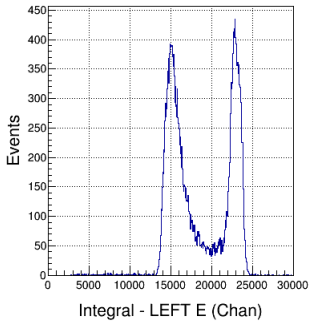


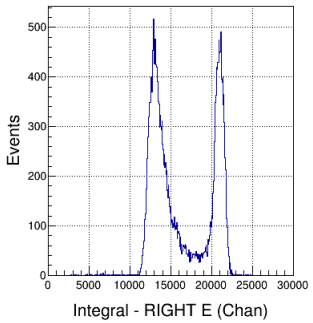


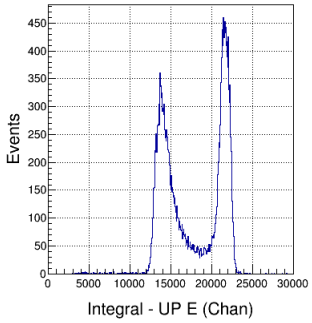


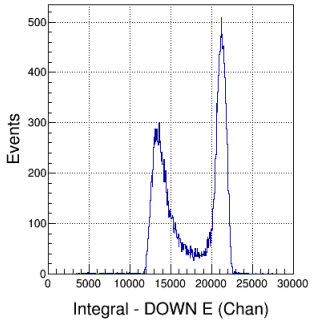


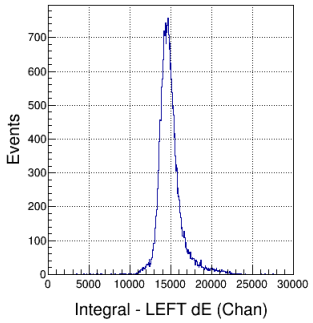
Pulse Integral

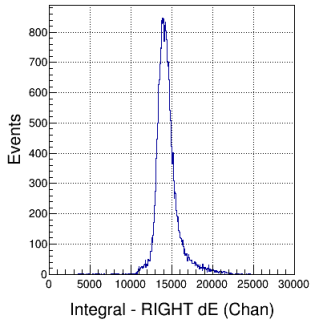


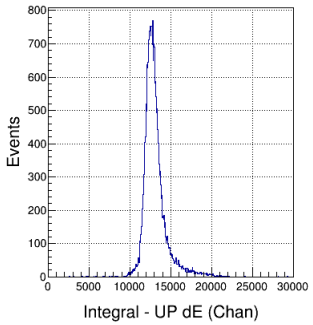


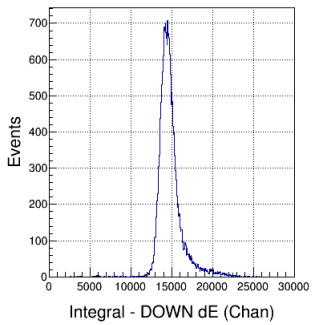


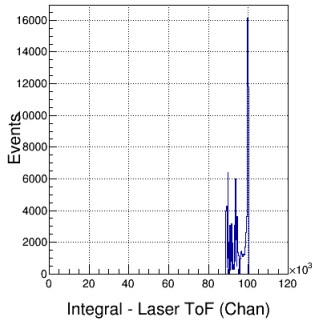


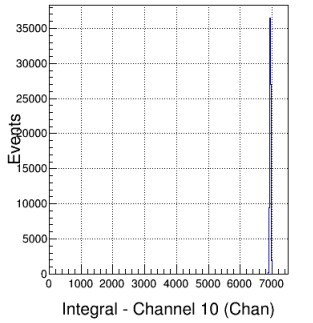


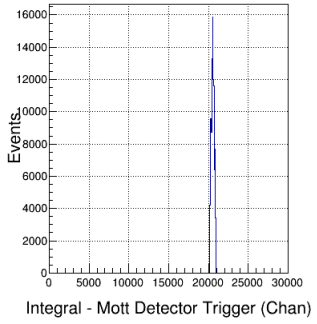


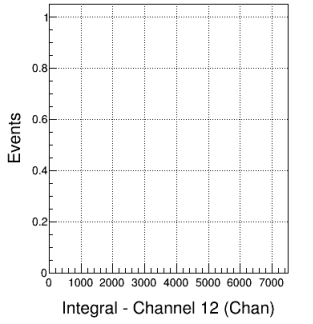




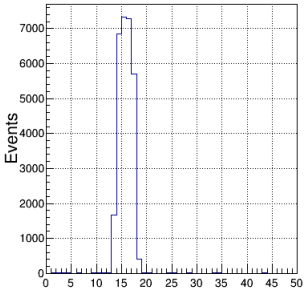


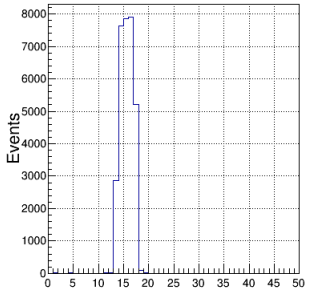


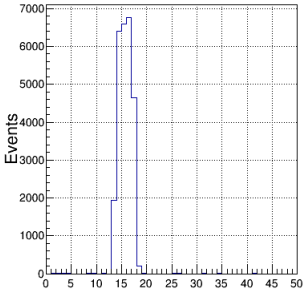


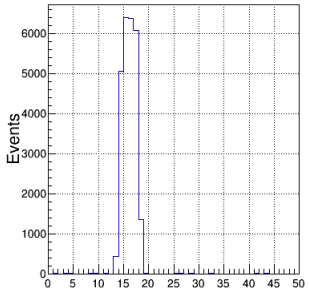


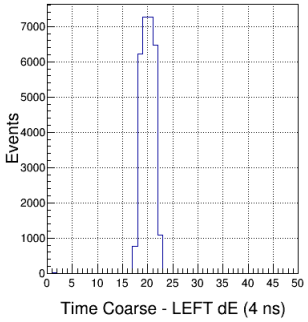
Pulse Coarse Time

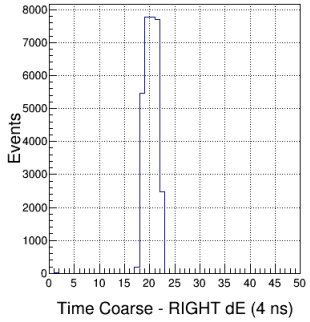


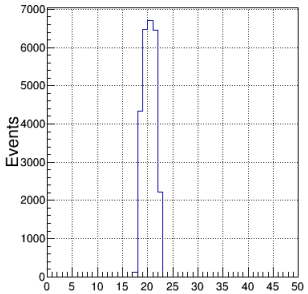


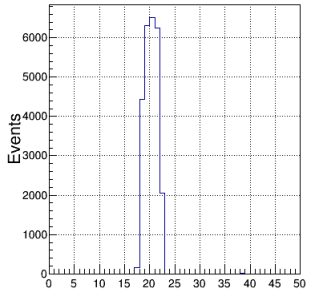




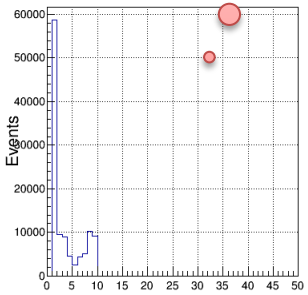


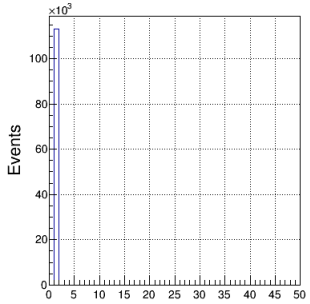


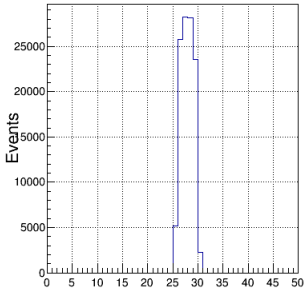


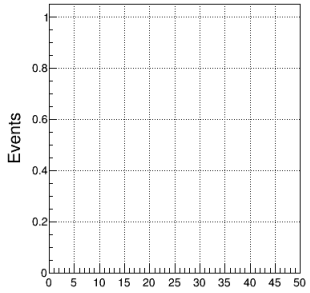


See Note 3

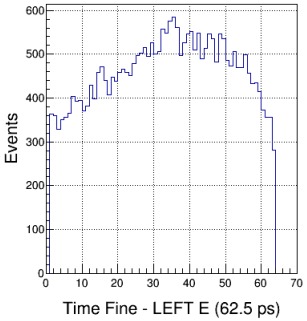


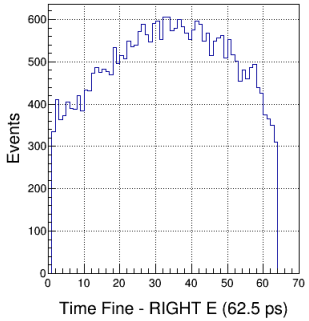


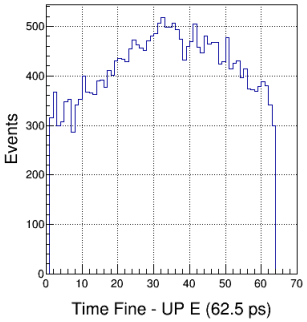


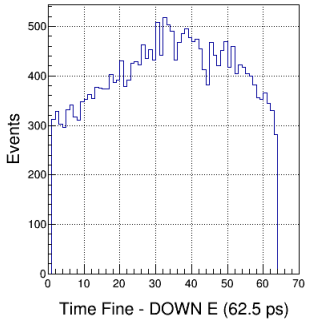


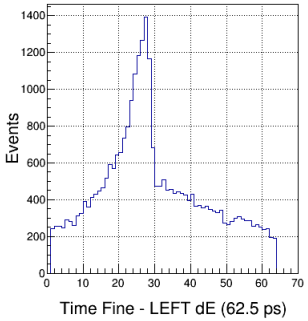
Pulse Fine Time

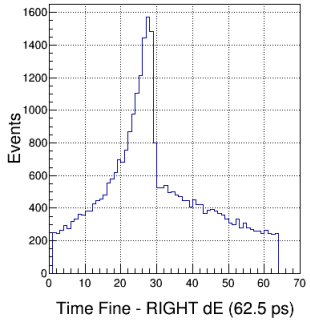


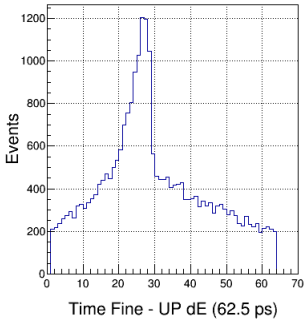


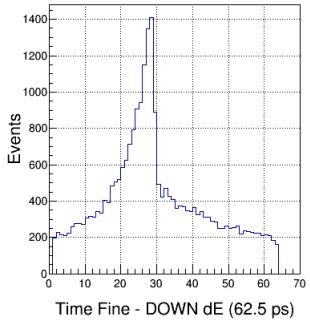


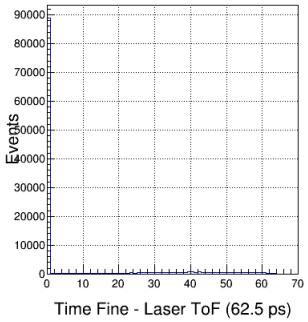


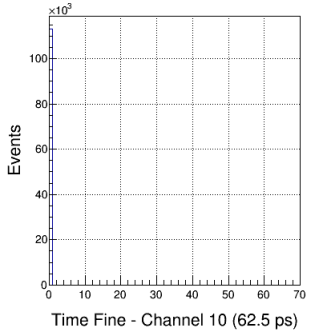


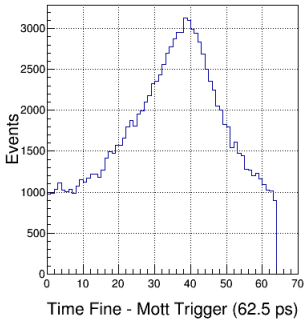


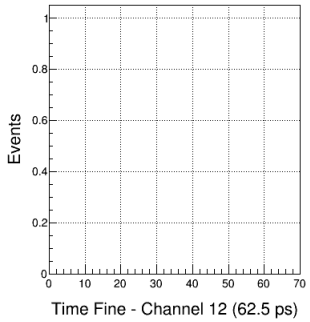




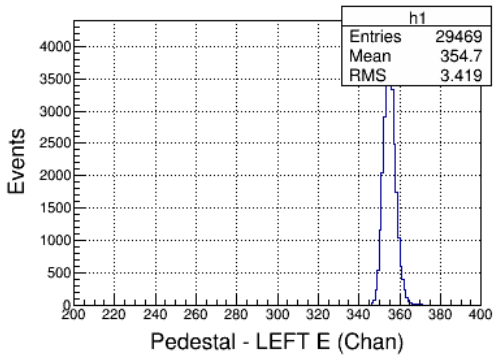


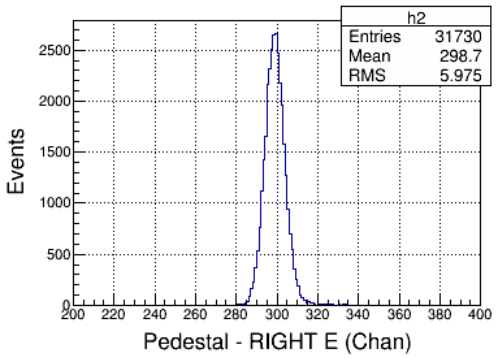


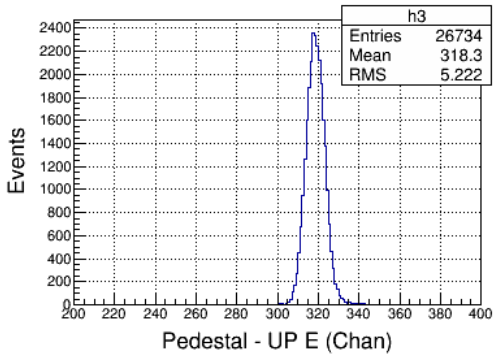


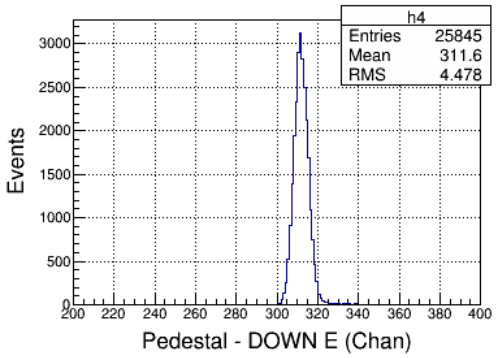


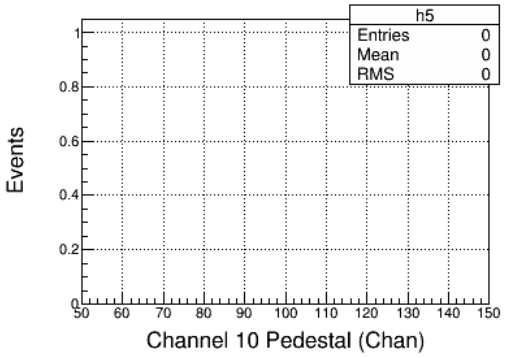
Analysis: Pedestals

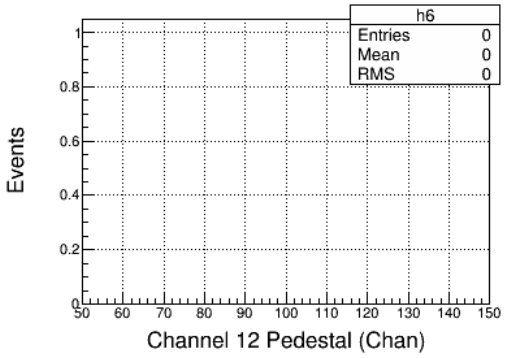




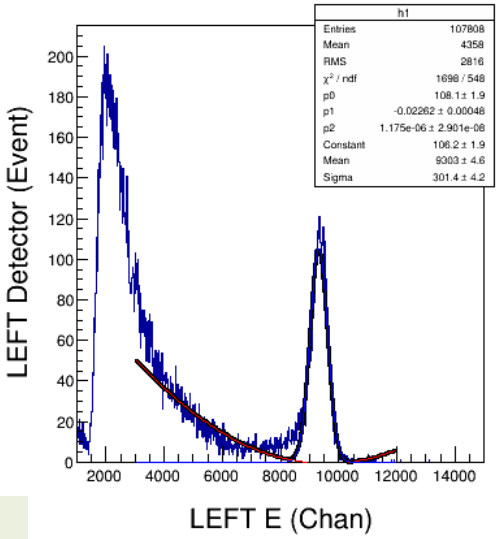


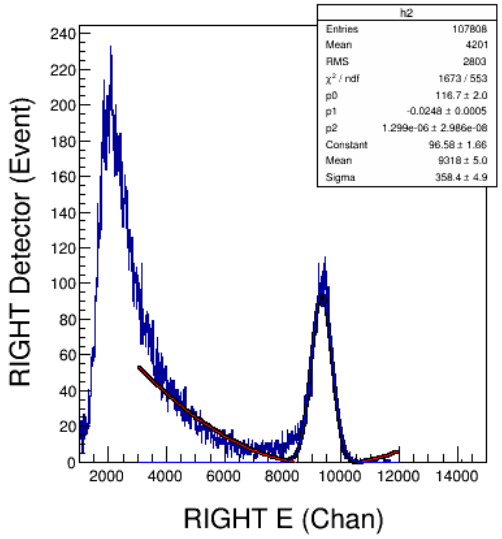






Analysis: Energy

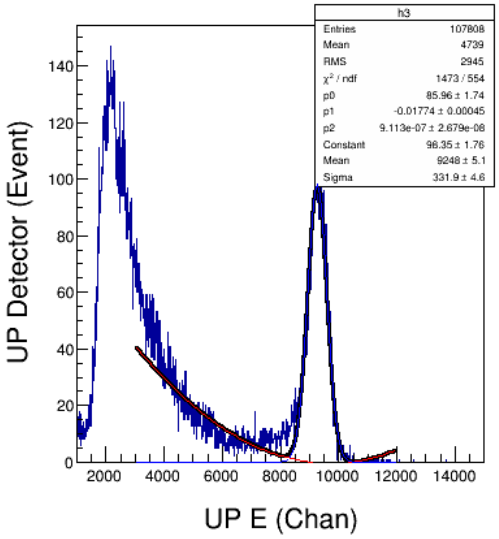


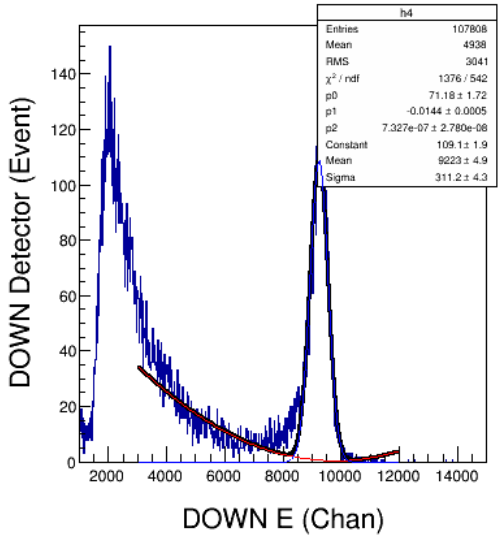


- Energy from run 7642
- Pedestal from run 7672

$\sigma_E \sim 3.2\%$

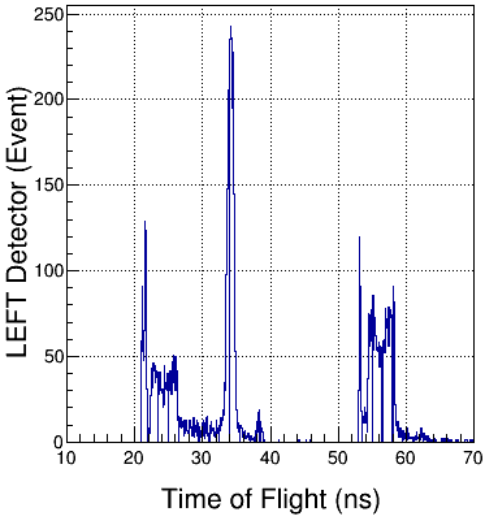
The increase partially due to average pedestals being subtracted. New data will have this fixed

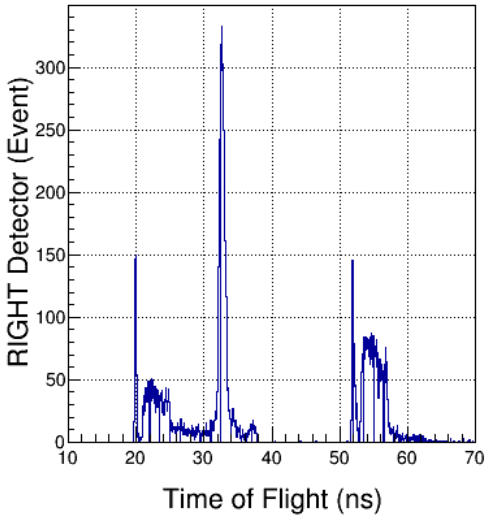


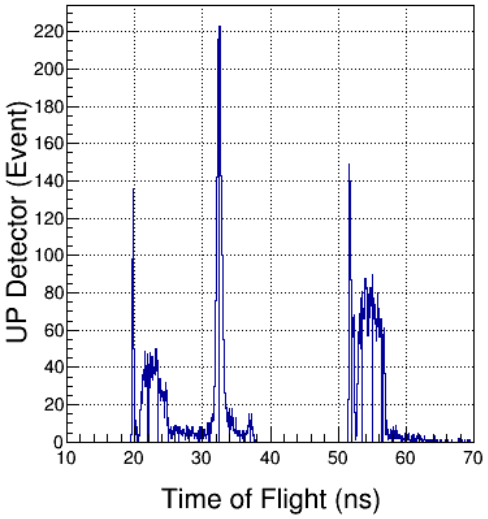


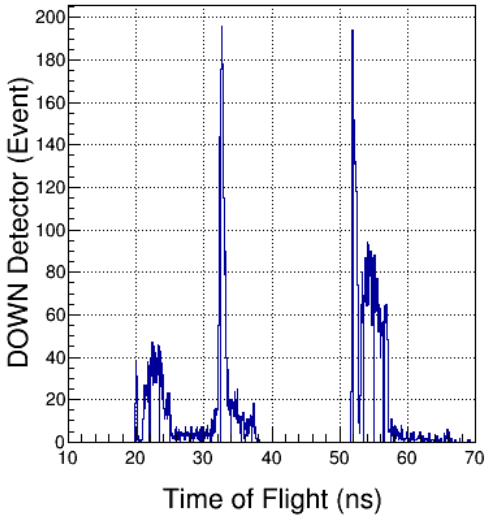
Analysis: Time-of-flight

σ_t ~ ? ns









Notes

Note 1

I. If first sample above threshold then:
course time =1, fine time = 0, and ped = 0

Note 2

I. MIN(NSB+NSA, PTW): Make sure NSB+NSA is less than PTW. Otherwise cannot till how many samples were summed; this is needed for pedestal subtraction.

Note 3

I. How FADC deal with a periodic square wave. Solution: add same signal to another channel delayed by ½ period