Determining Timing from the fADCs

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Equations for timing

We make use of equations taken from “Precision timing measurement of phototube pulses using a flash analog-to-digital converter” GlueX Doc 1483

$$t_0 = \frac{S_p/2 - b_L}{a_L}.$$

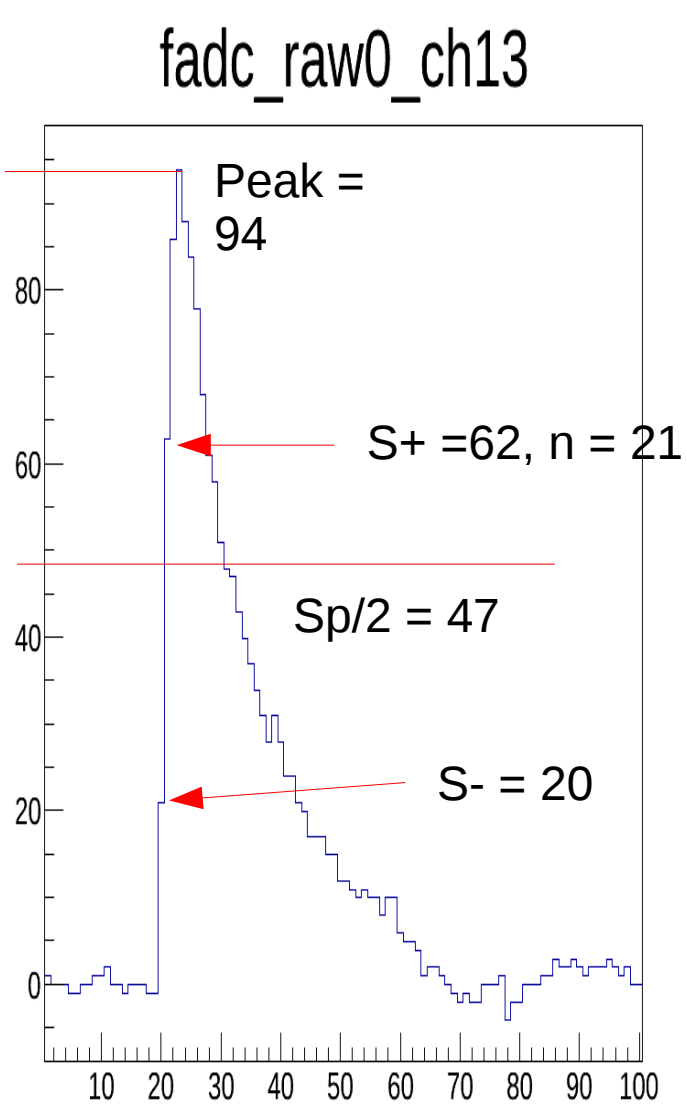
where
$$a_L = \frac{S_+ - S_-}{T}$$
$$b_L = S_+ - a_L t_+,$$

- $S_p/2$ is the peak height divided by 2
- S_+ is the height of the bin after crossing the mid-point
- S_- is the height of the bin before crossing the mid-point
- T is the time per bin on the fADC (4 ns)
- t_+ is the time that S_+ occurs
- After some rearrangement of the variables we get:

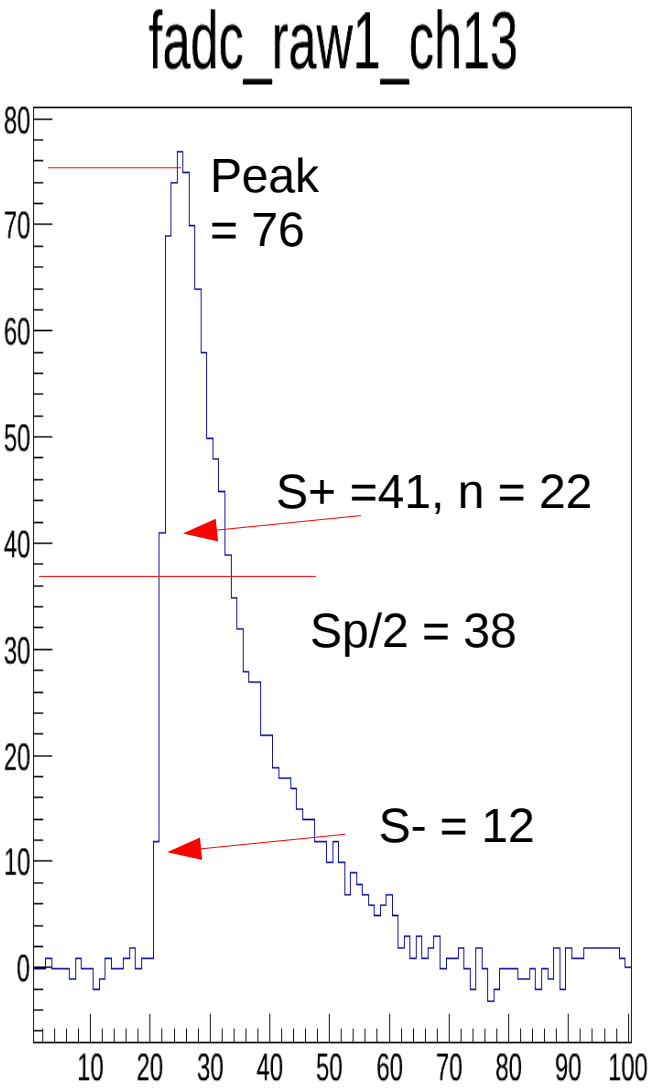
$$T_0 = T\left(\frac{S_p/2 - S_+}{S_+ - S_-} + n\right)$$

- Where n is the number of bins to S_+

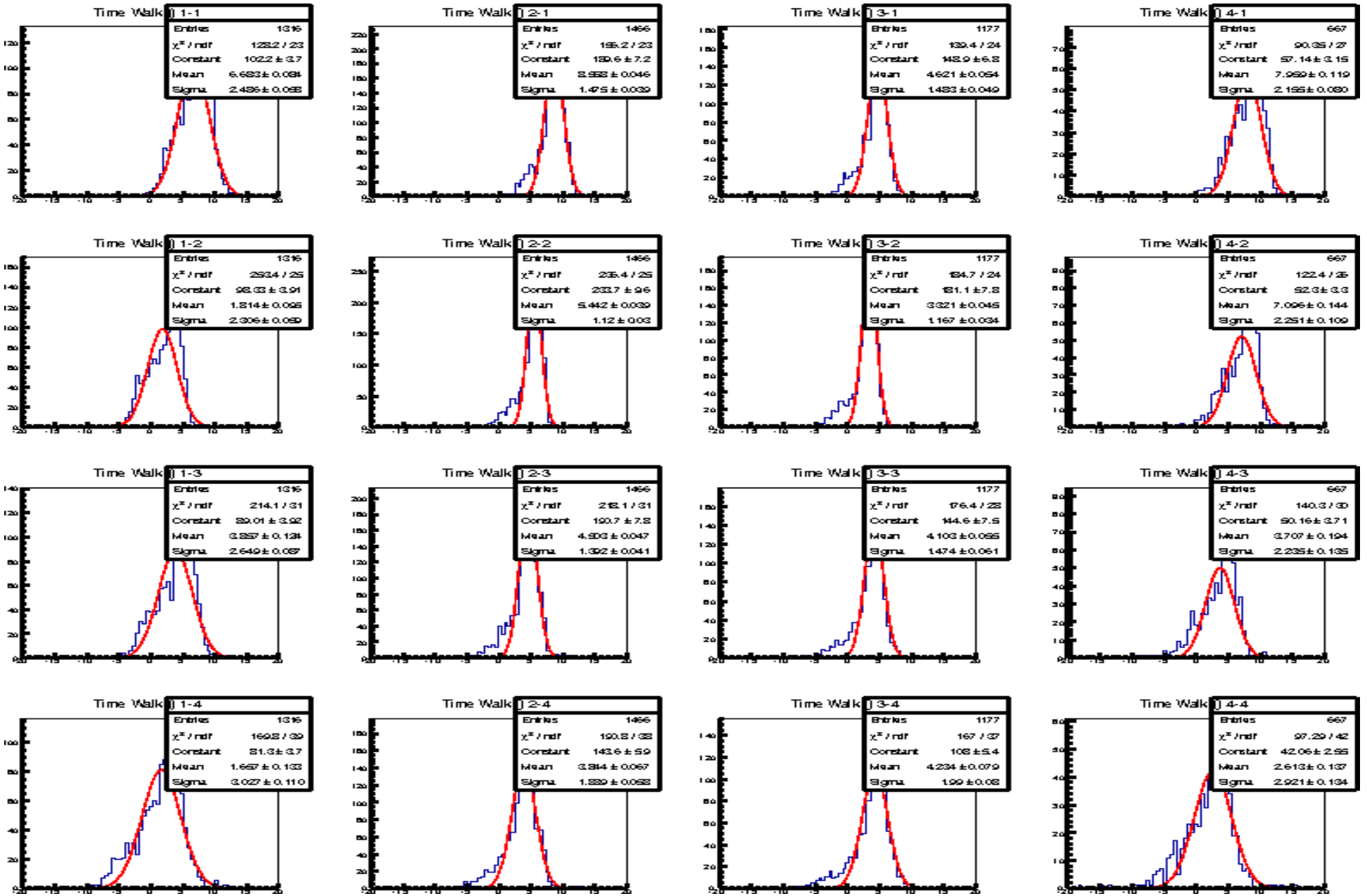
fADC Peaks



- An example of pulse used:
- Left pulse:
  - T0 = 82.5 ns
- Right Pulse:
  - T0 = 87.6 ns

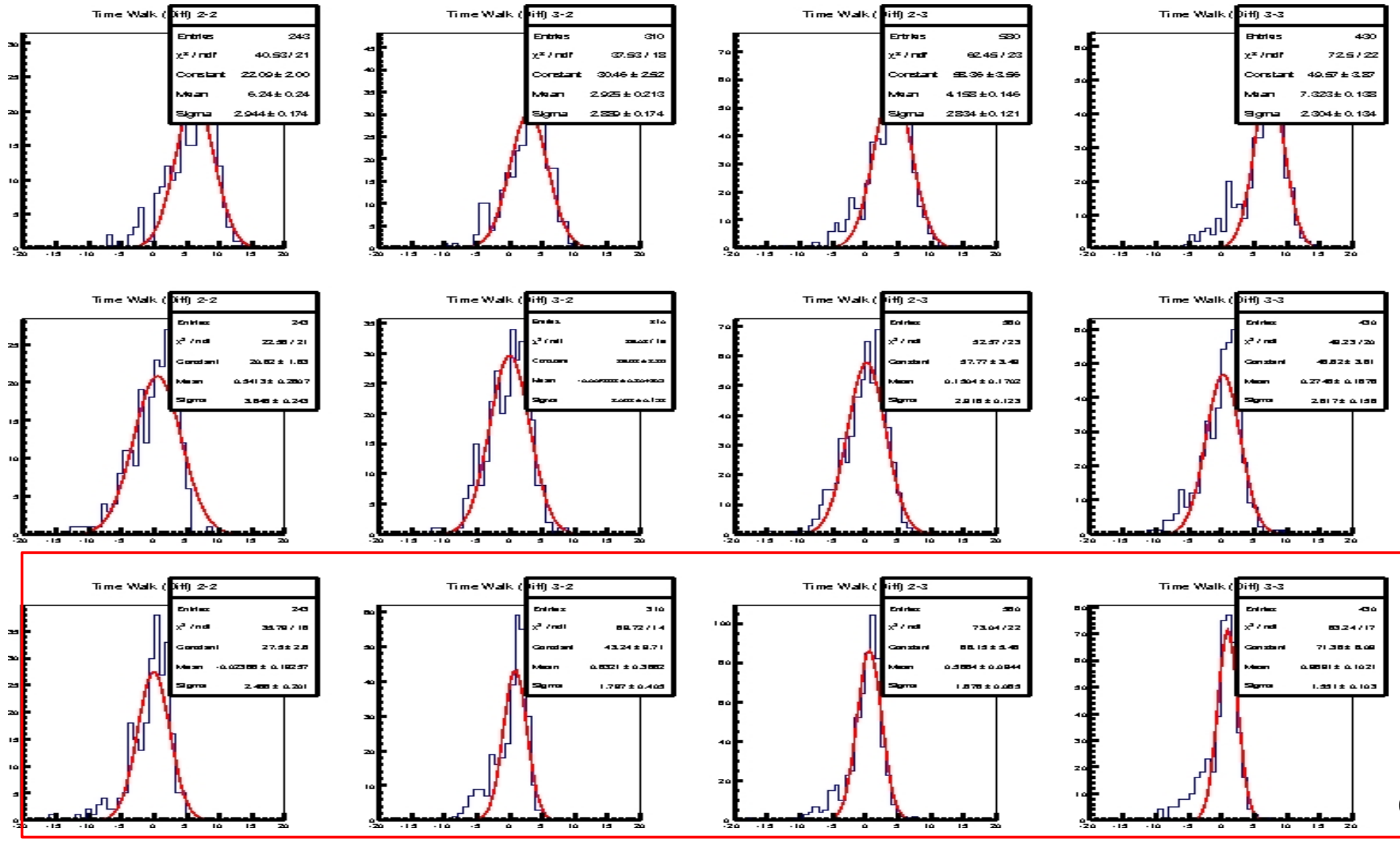


fADC Timing Difference (up-down)



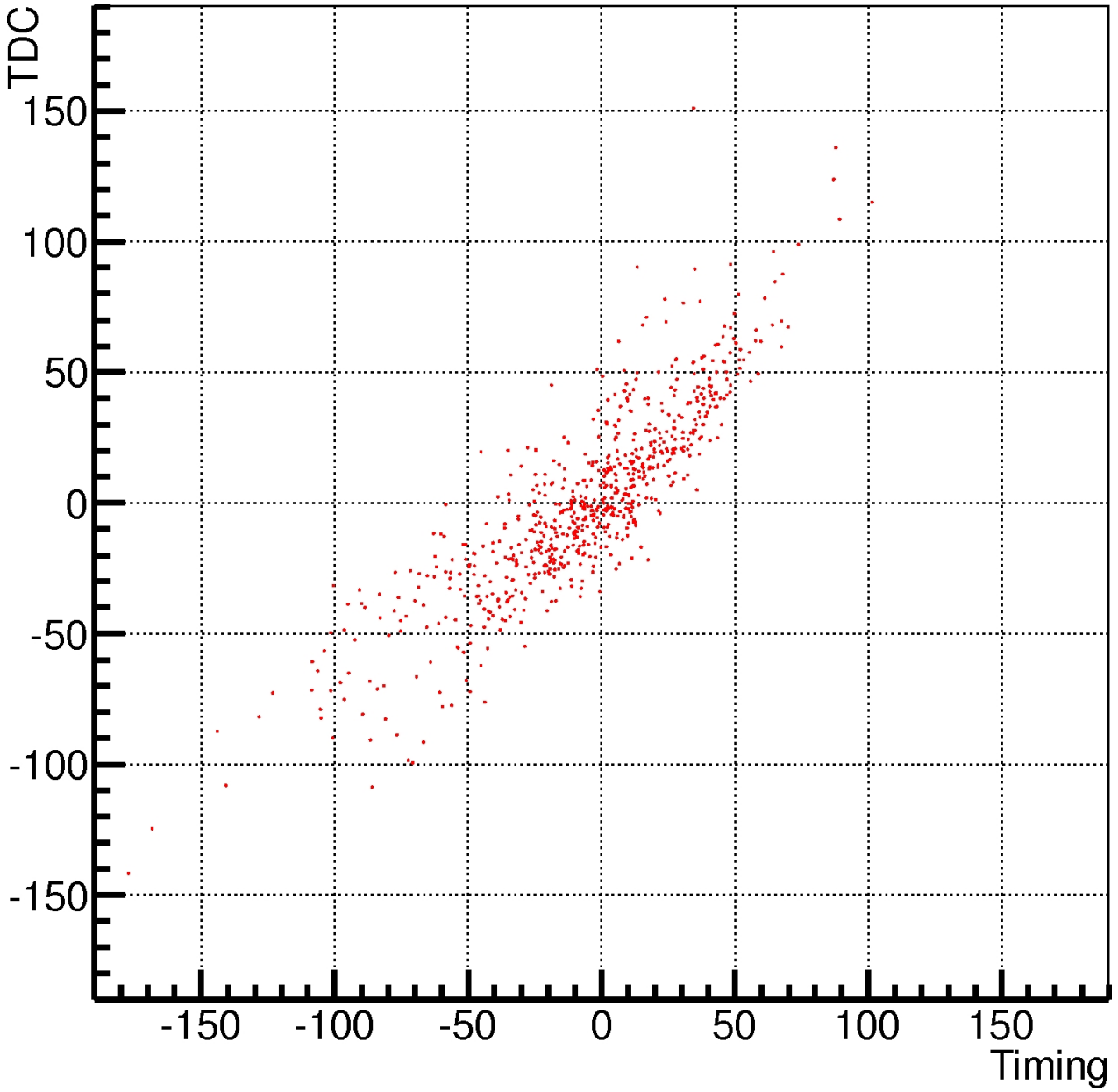
- Previous slide displayed timing of upstream-downstream sides for each of the 16 readout cells (top being single SiPM and bottom being 4 summed SiPMs)
- Tail seen on left side seen in 5 modules investigated
- If plotted as downstream-upstream a mirror image is produced as expected
- The x scale is in ns

TDC timing Difference (up-down)



After time walk correction

FADC timing vs Flash



Slopes

- Particle tracks determined through fADC timing information
- Slope calculated using method of least squares
- Slope = Length/Height