HCal fADC Timing Resolution

3/13/2020

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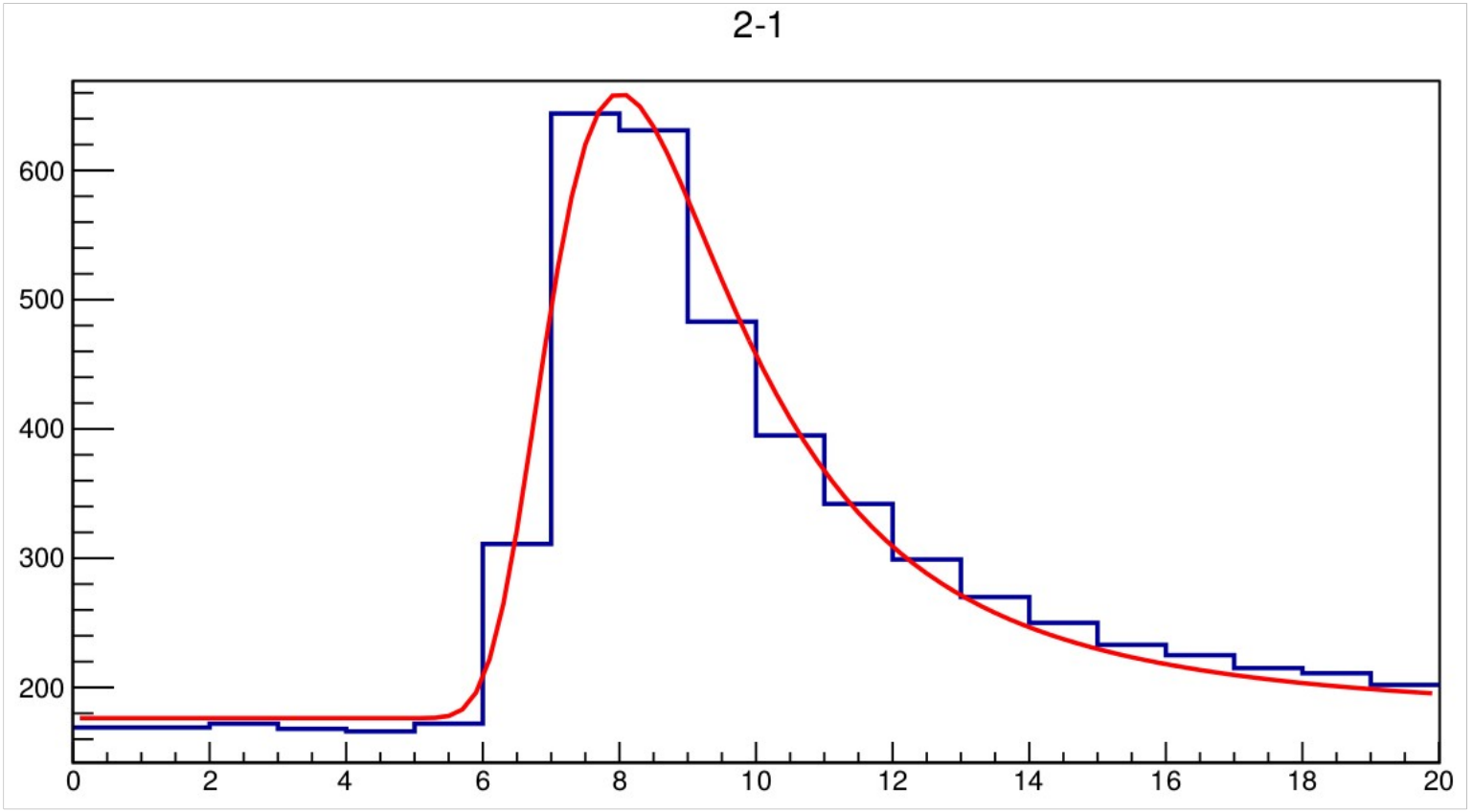
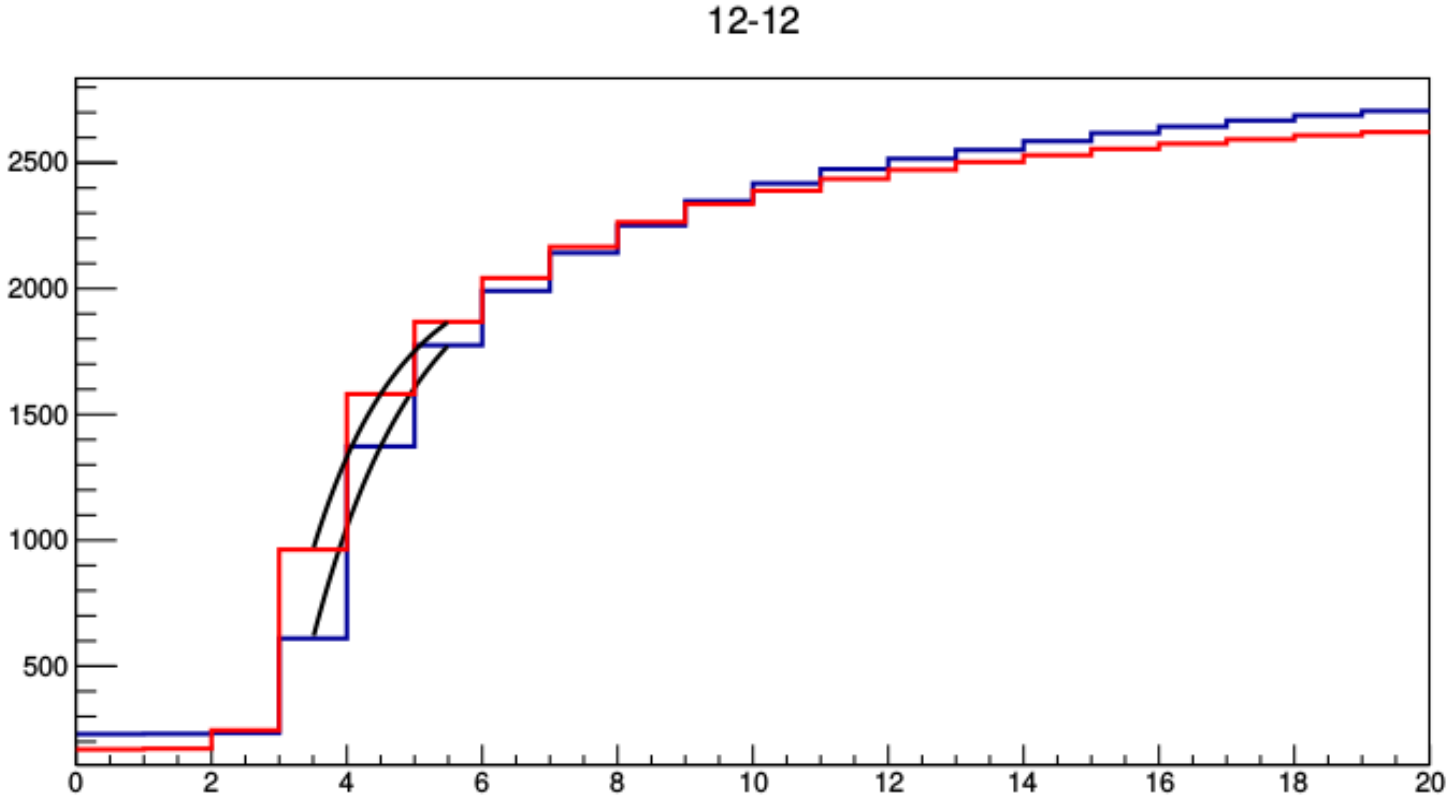
fADC Time Over Threshold

- Threshold crossing defines fADC time.
  - Threshold defined as ¼ average fADC peak height.
- fADC signals fit with Landau function.



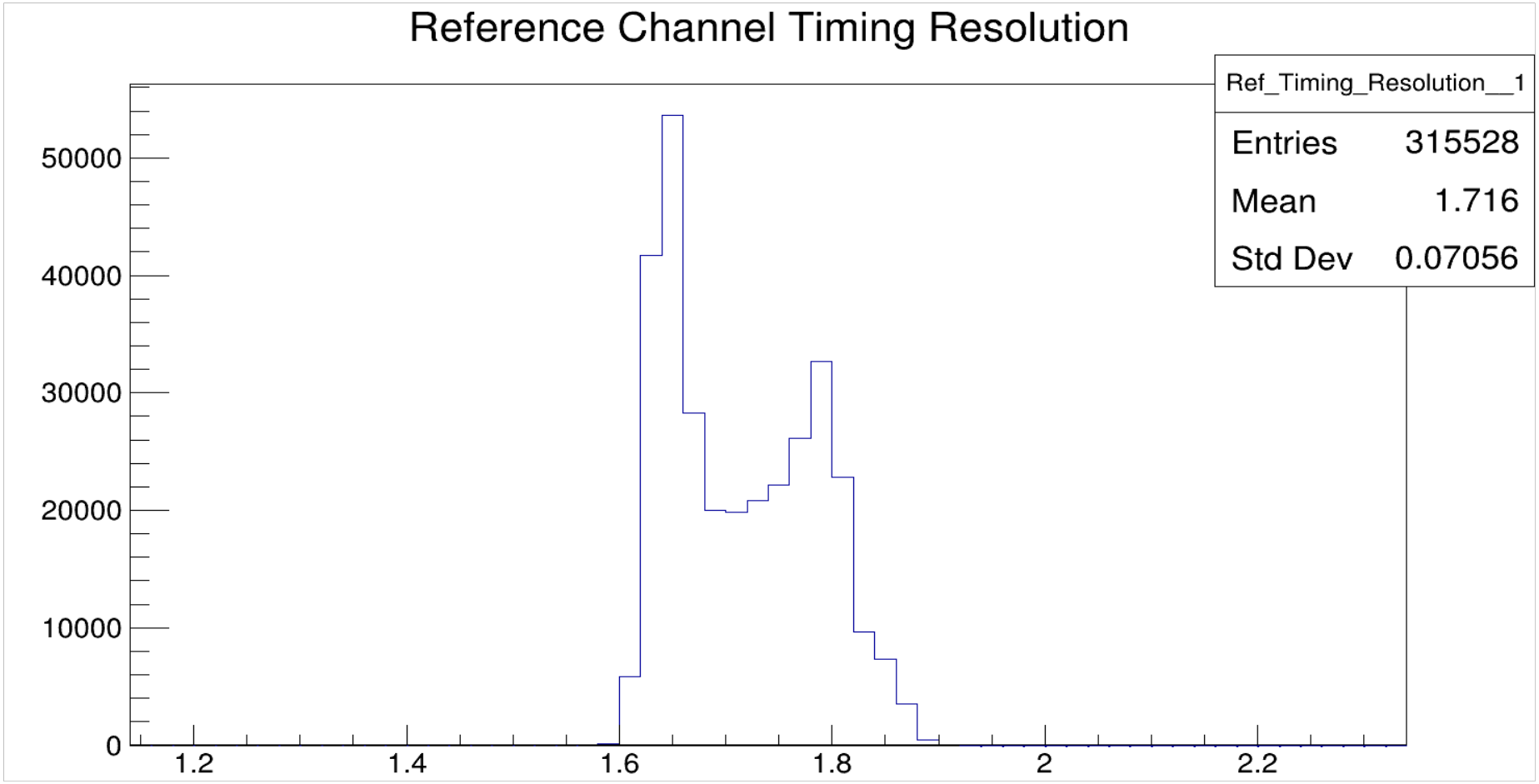
fADC Reference Time

- Send two trigger copies over long cables to two fADC channels to get sloped edge for timing.
- Fit the leading edge of trigger copies with an exponential. (Linear fit was tested and worse.)
  - Ref time defined by threshold of fADC=1250.
  - PMT Time = fADC T.O.T. - ref time.



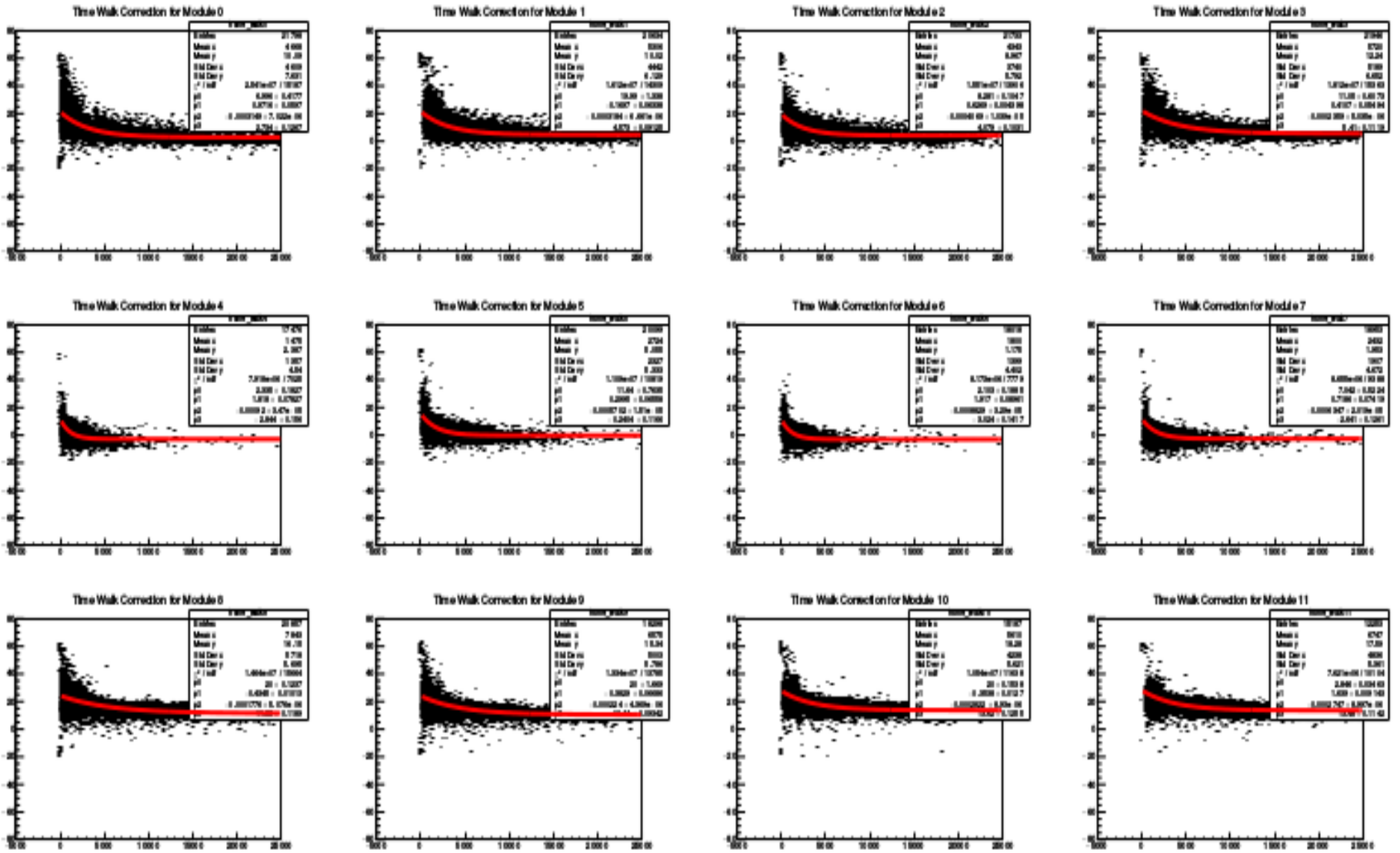
Timing Jitter Between Ref Ch.s

- Histogram of ref_time1 – ref_time2.
- Oddly shaped (other thresholds even worse).



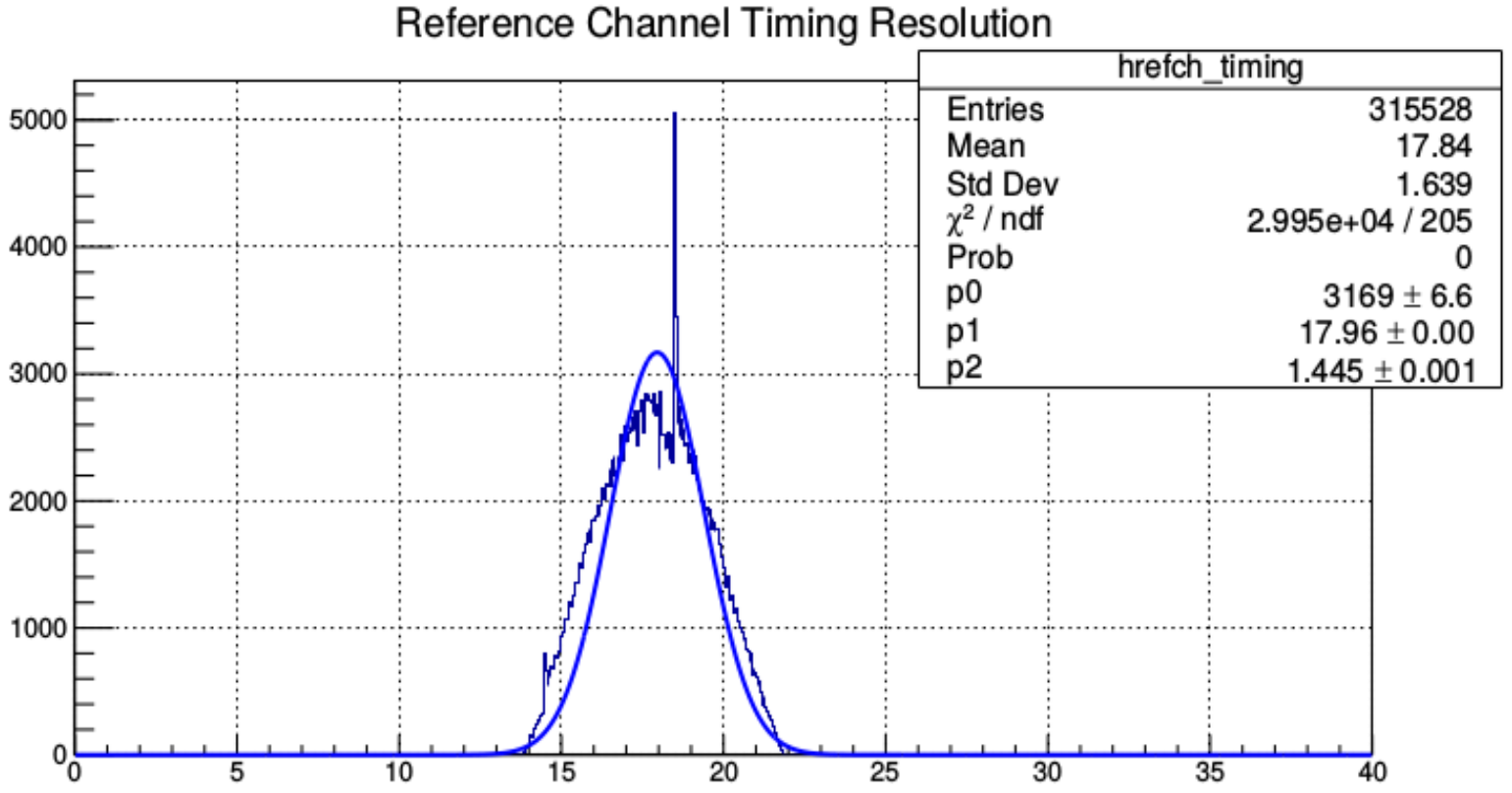
Time Walk Effect

- Plot fADC signal integral vs. fADC T.O.T.
- Fit with exponential.



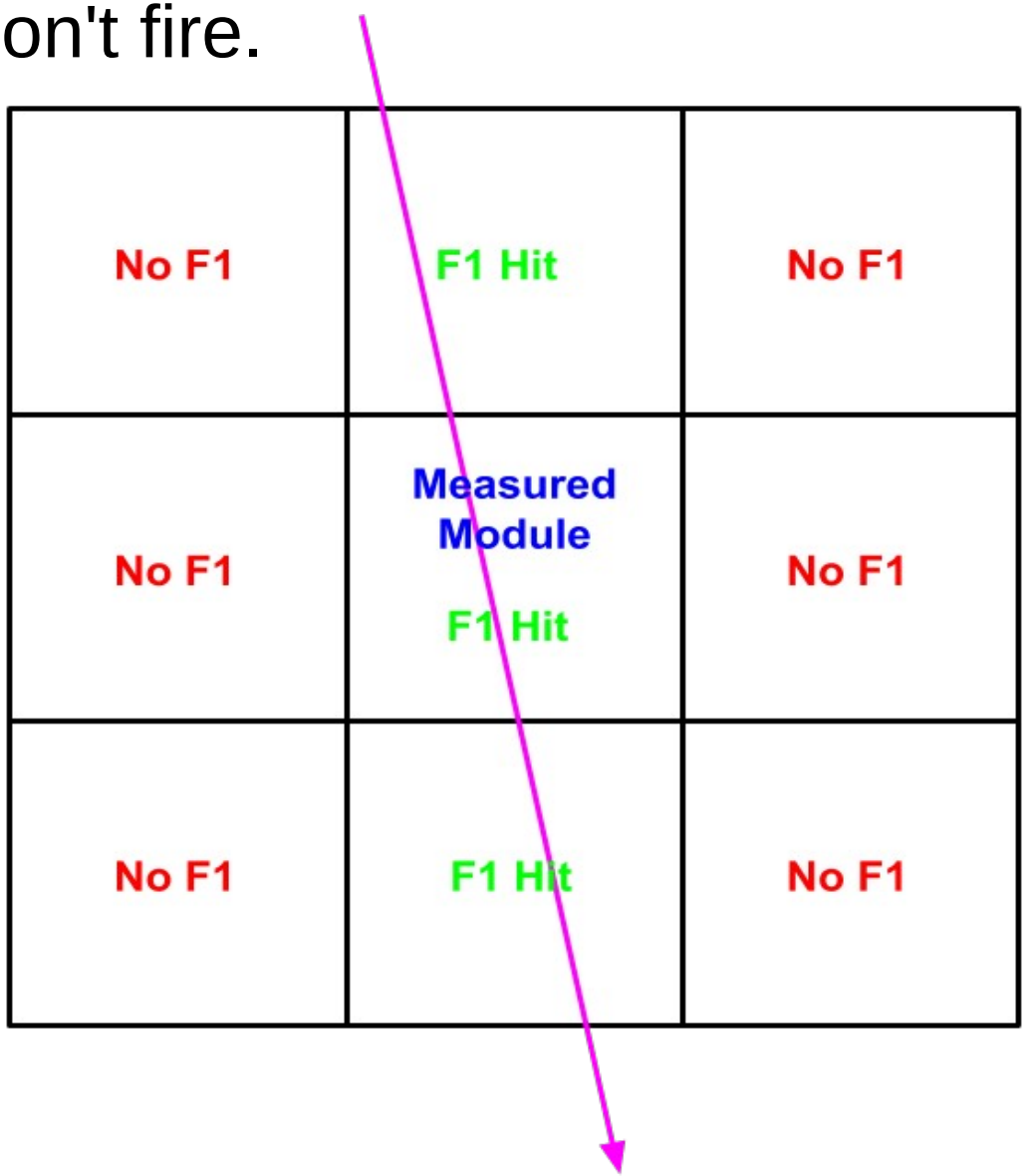
Time Walk Correction

- Corrected Time = fADC T.O.T. - ref time – f(exp fit)
- Both T.O.T. and ref time have distributions.
- $\sigma^2_{\text{corrected time}} = \sigma^2_{\text{fADC T.O.T.}} + \sigma^2_{\text{ref time}}$
- $\sigma_{\text{ref time}}$ not Gaussian.



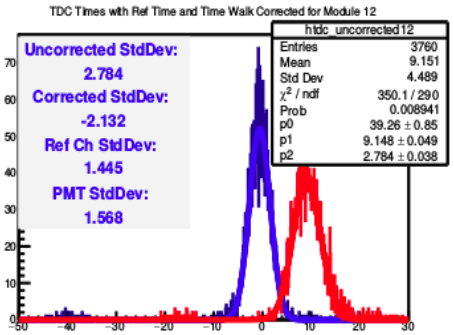
Individual PMT Timing Resolutions

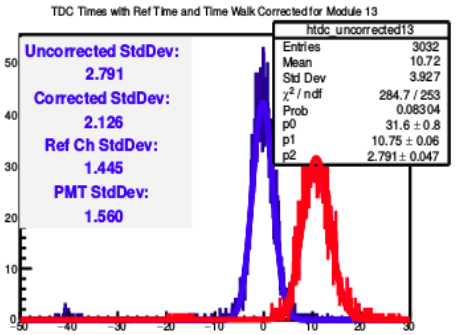
- Require vertical cosmics for best timing.
  - Three F1s fire vertically in a row and surrounding six F1s don't fire.

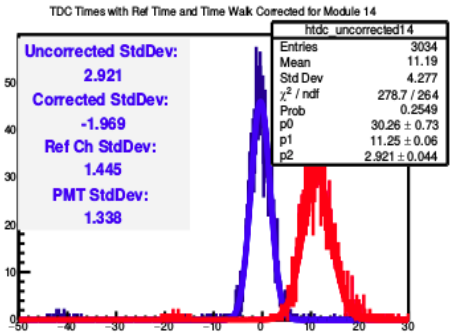


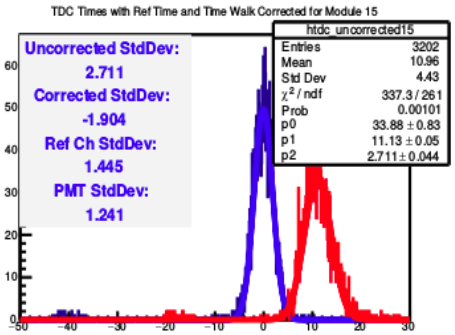
Time Walk Corrected Timing Resolutions

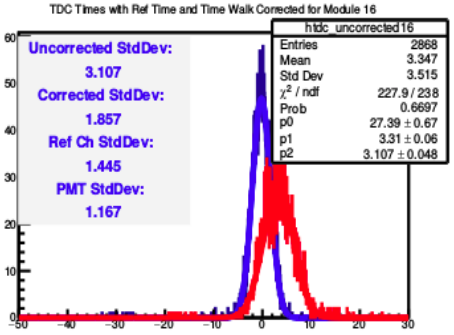
- $\sigma_{\text{fADC T.O.T.}} = (|\sigma^2_{\text{corrected time}} - \sigma^2_{\text{ref time}}|)^{1/2}$. (Gaus)

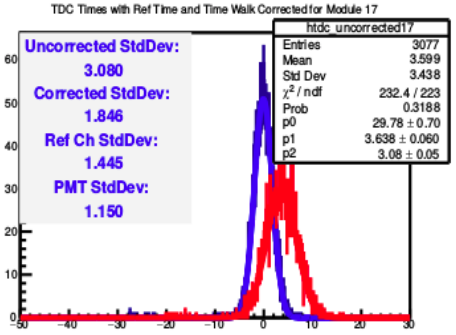


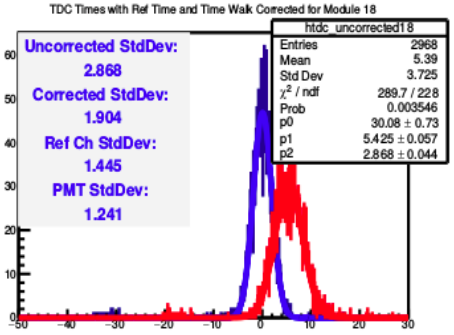


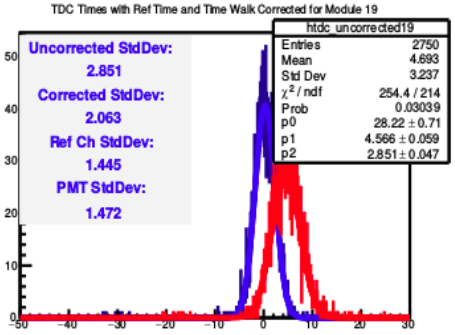


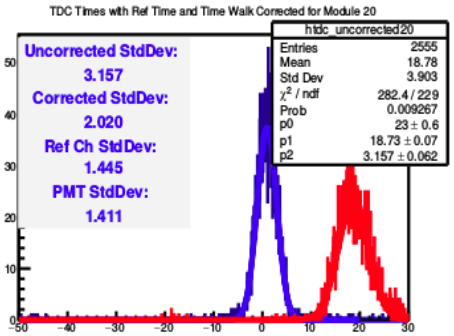


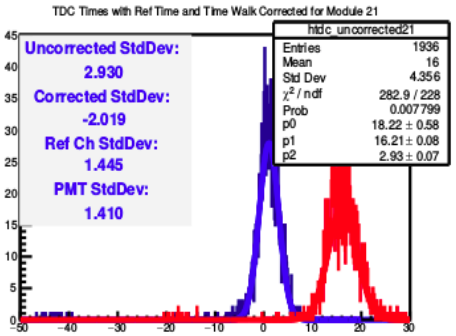


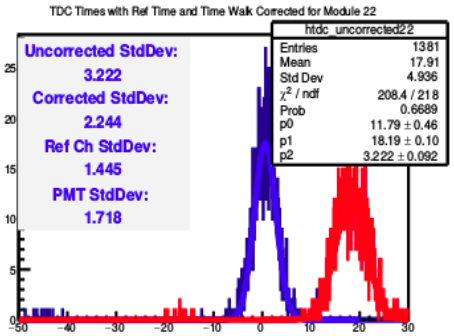


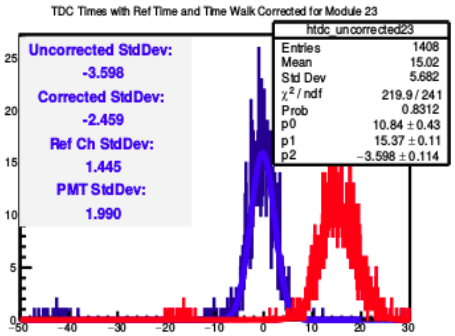




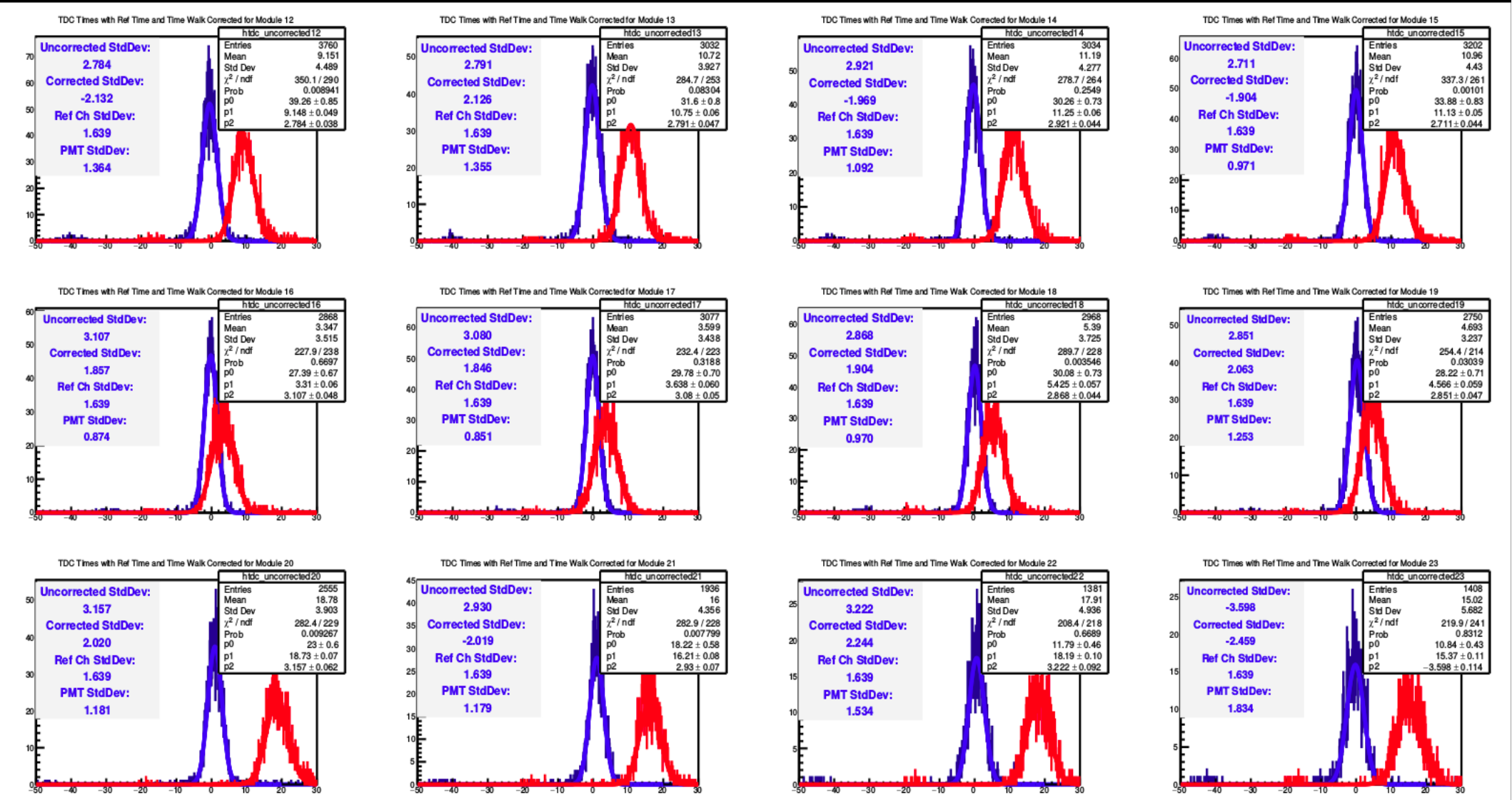








- Using histogram standard deviation.
  - 1.639 vs. 1.445 for Gaussian.



- Timing resolution worse lower down in HCal.
  - Probably just geometry. (histogram std. dev.)