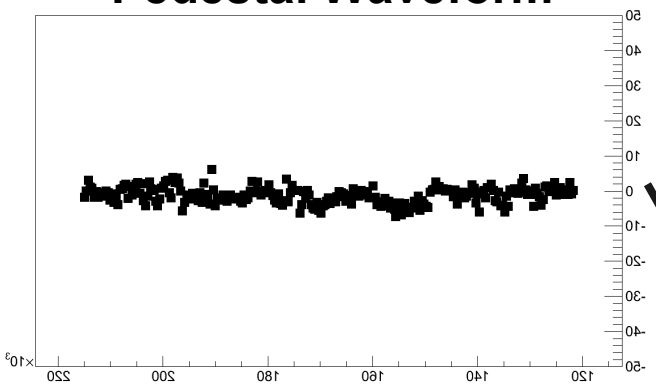
IRS3B Test Setup Update

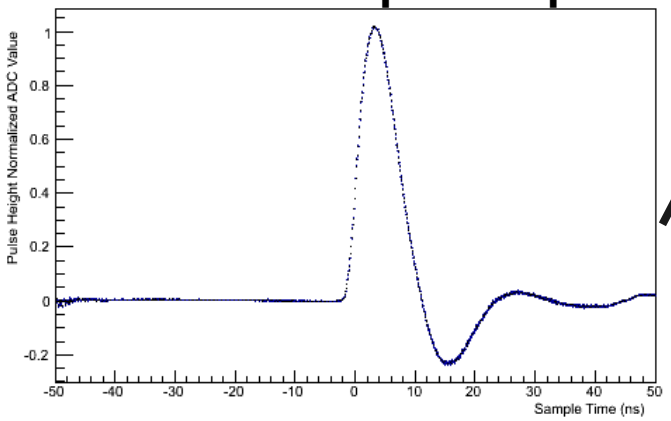
TOP Meeting, July 16th 2013

IRS3B Waveform Simulation

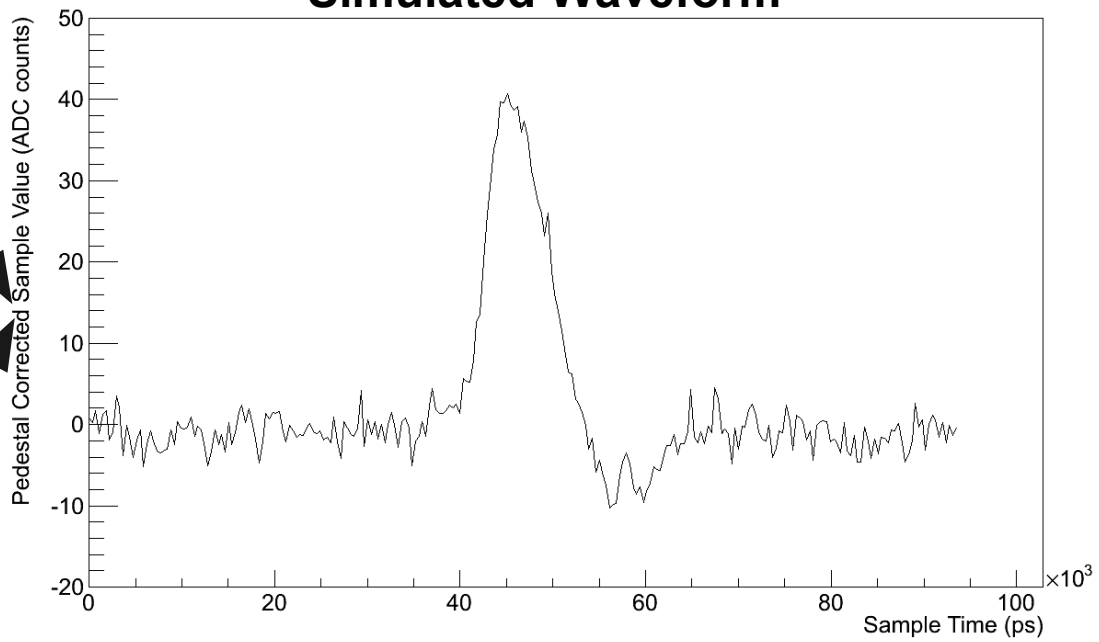
Pedestal Waveform



PMT Pulse Shape Template



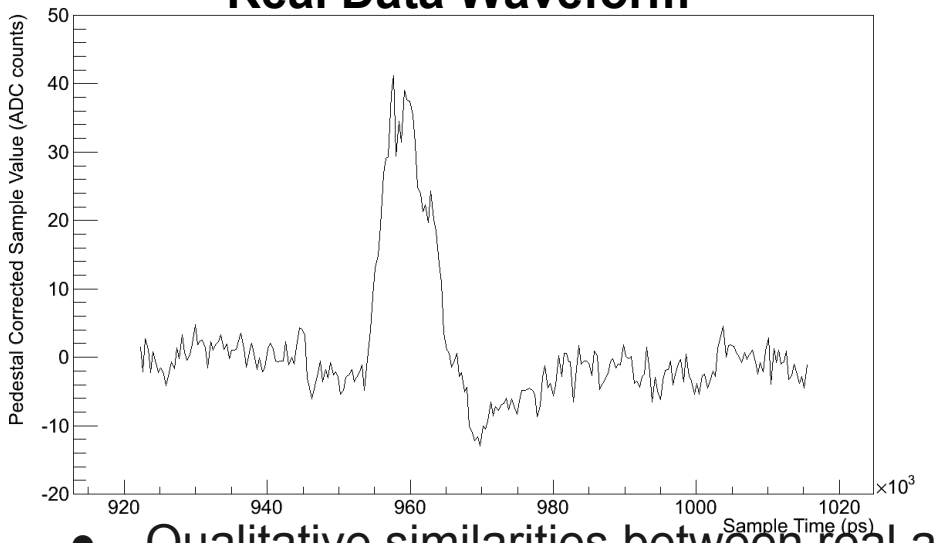
Simulated Waveform



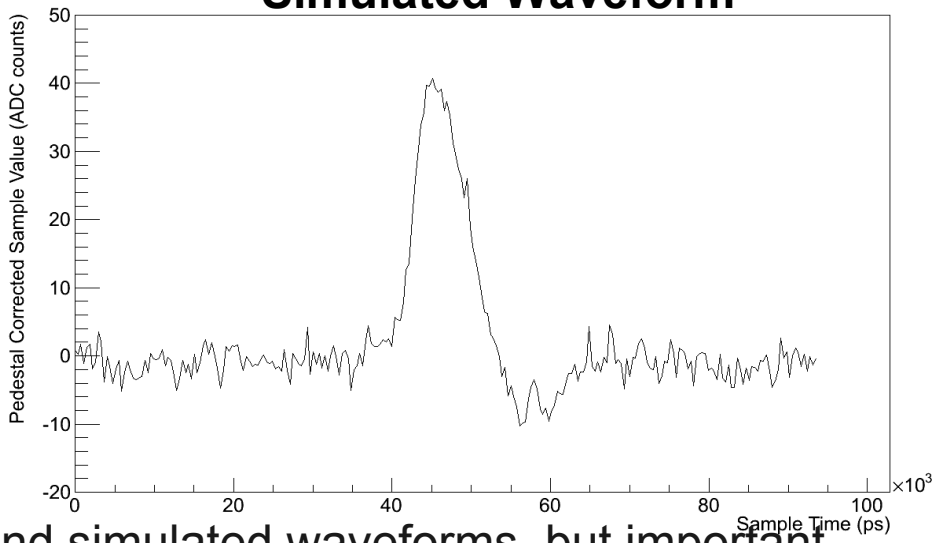
- Simulated waveforms use real pedestal waveforms combined with pulse shape templates averaged from real laser or beam data

Simulated vs Real Waveforms

Real Data Waveform

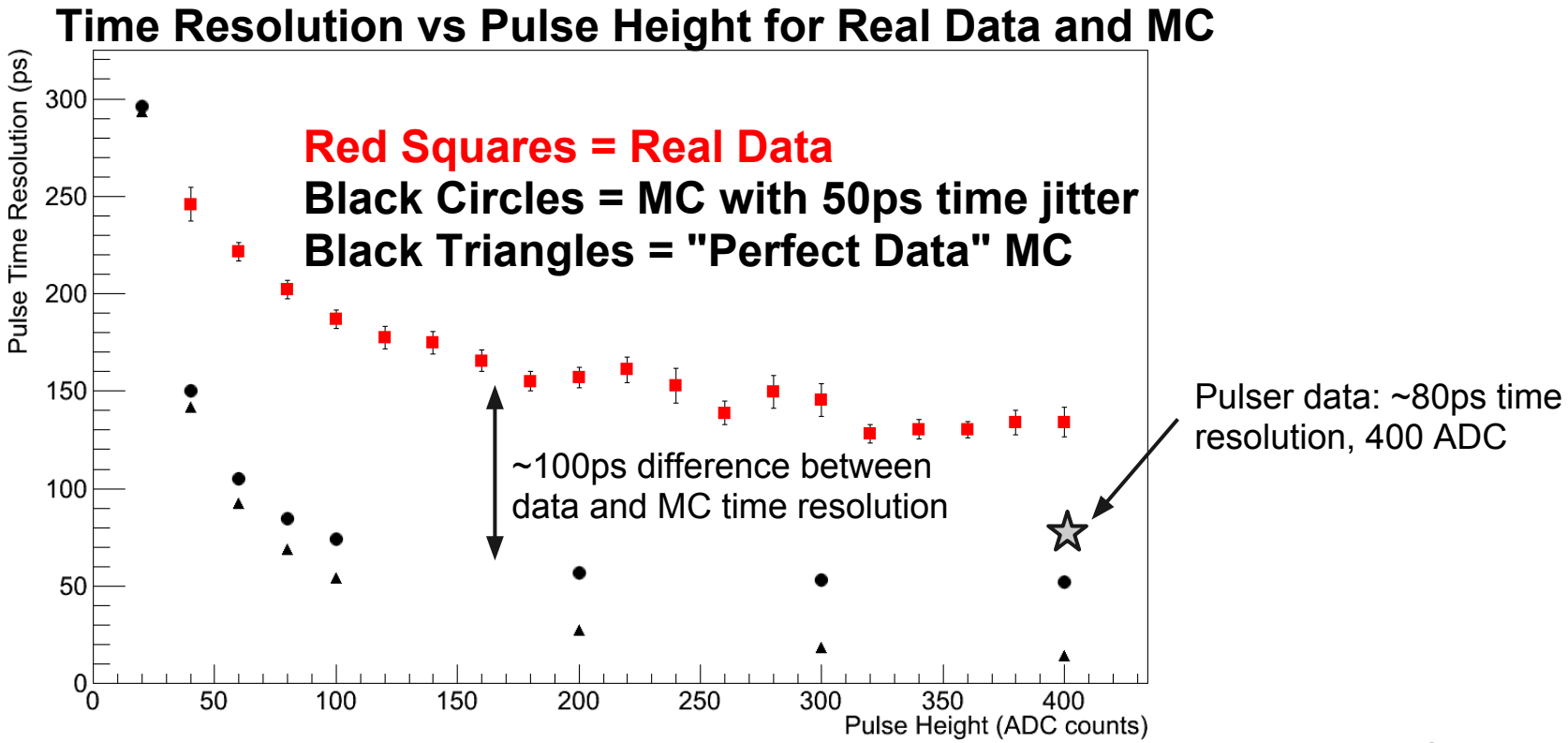


Simulated Waveform



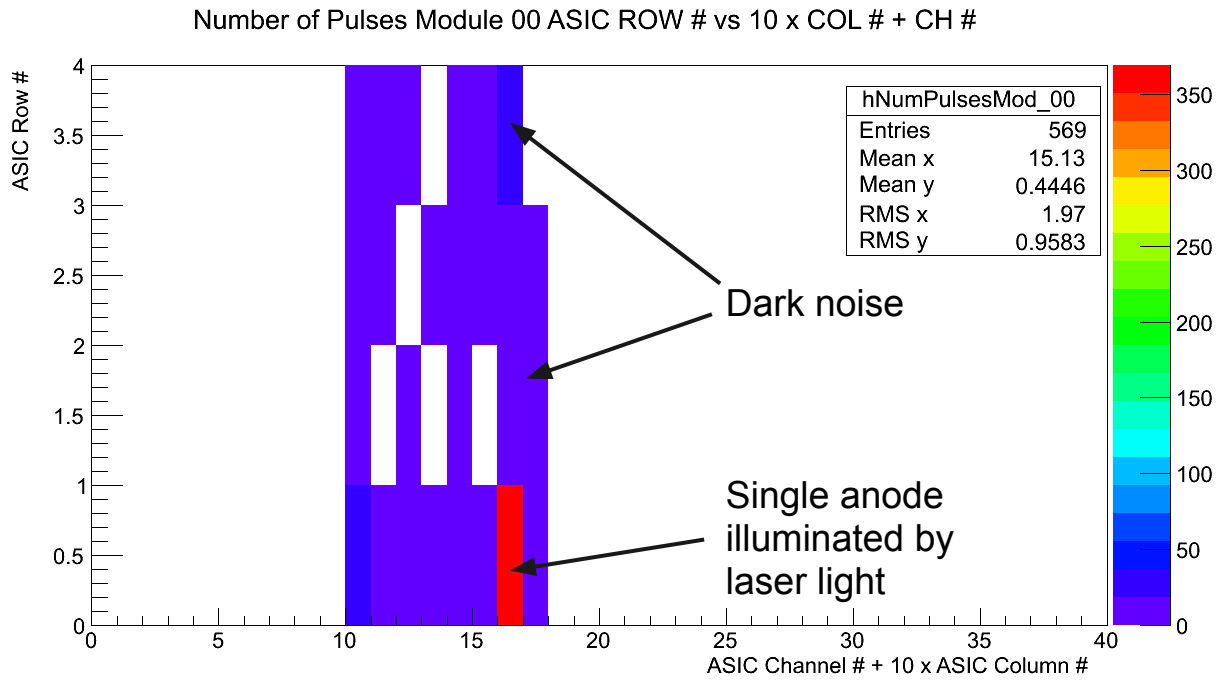
- Qualitative similarities between real and simulated waveforms, but important differences remain:
  - **Pulse shaping time**: slightly different shaping time, need to modify templates but ok for now
  - **Non-ideal sampling**: including sample-to-sample time variation (sample), ADC non-linearity and sporadic glitches
  - **Noise**: real pulses may add additional noise above baseline levels
  - **Time jitter**: trigger jitter, sampling phase correction error and PMT transit time spread. Approximated by smearing overall waveform time by ~50ps

Time Resolution Vs Pulse Height



- MC time resolution much better than real data, evidence that there is room for improvement in calibration procedure (ie. gain non-linearity correction)
- Time resolution degrades for < 100 ADC (SNR ~47.5) even for "perfect" MC
  - Indicates noise and analysis method become the limiting factors

Laser Test Setup and Data Taking



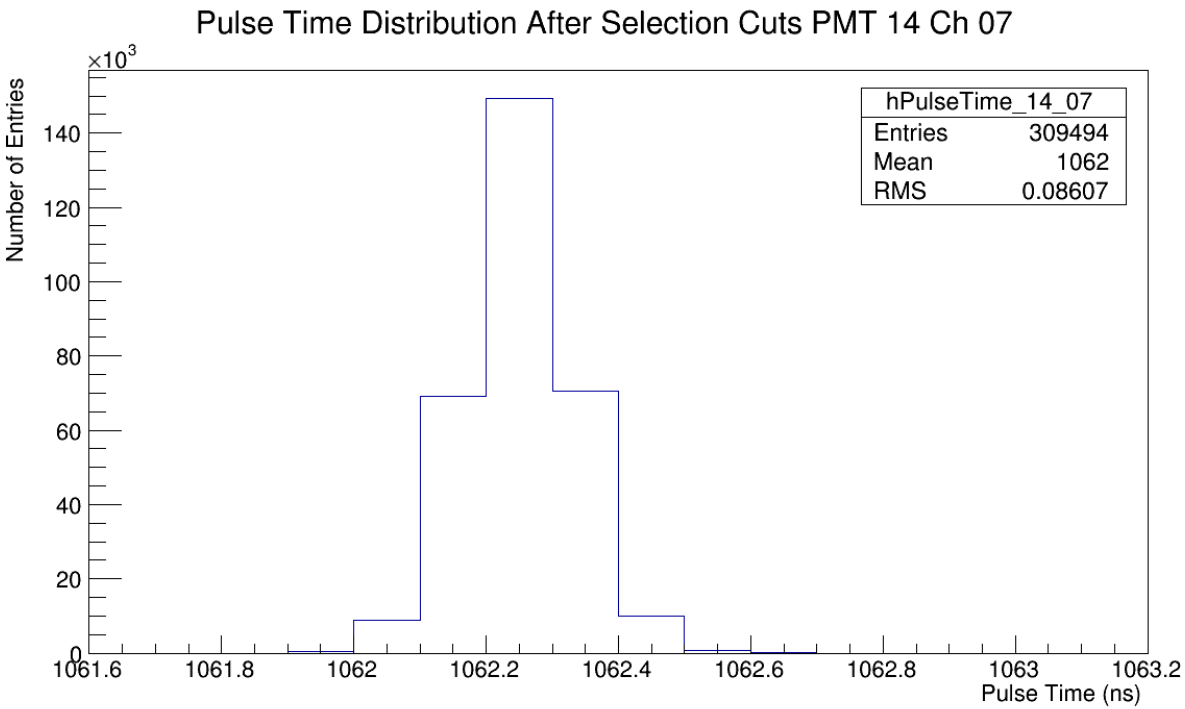
- Laser test setup working well, able to get 1-4% laser hit rates in specific channels with < 0.1% in the remainder, crucial for accurate time resolution and efficiency measurements
- Generally taking combined pulser + laser data, where pulser pulses are injected into a non-adjacent channel on the same ASIC
  - Makes processing tricky, but provides useful cross-check on performance

Test Setup Sampling Rate Measurement

Module 0 ASIC #	Beam Test Sampling Rate (GHz)	Test Setup Sampling Rate (GHz)
Row 0 Col 0	2.728	2.751
Row 0 Col 1	2.733	2.739
Row 0 Col 2	2.705	2.724
Row 0 Col 3	2.750	2.730
Row 1 Col 0	2.719	2.704
Row 1 Col 1	2.716	2.702
Row 1 Col 2	2.734	2.712
Row 1 Col 3	2.734	2.737

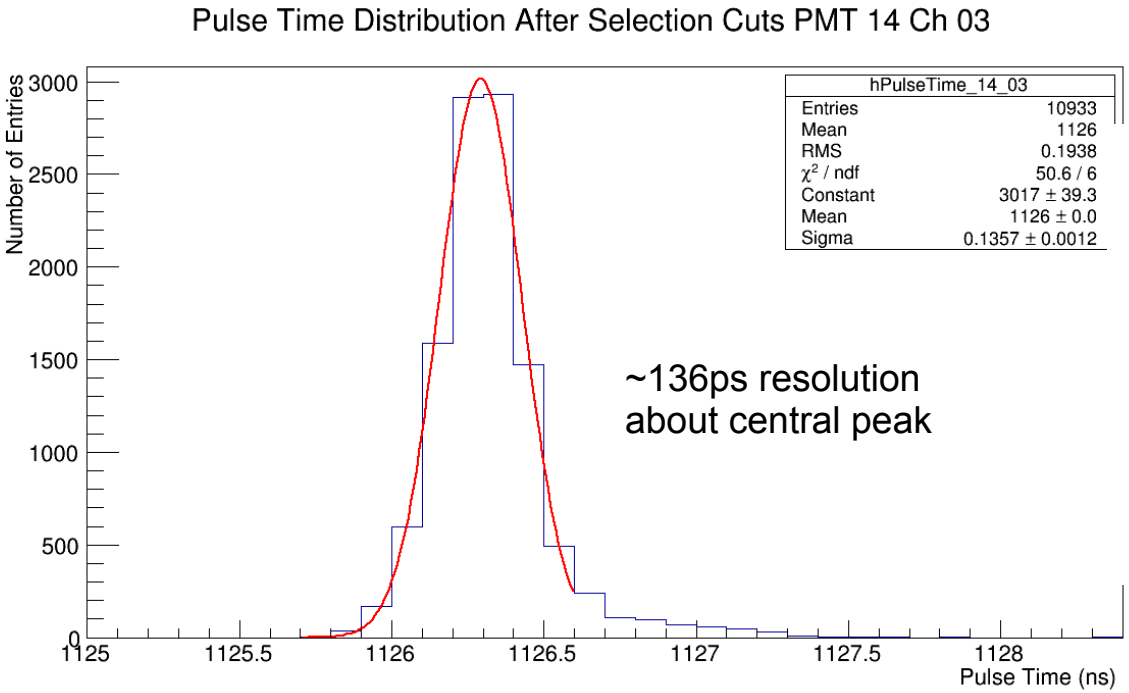
- Pulser data used to measure sampling rate and sample-DTs using same method as used during the beam test
  - See significant differences in measured sampling rates, despite using same configuration files => related to sampling rate stability problem?

Pulser Time Resolution Measurements

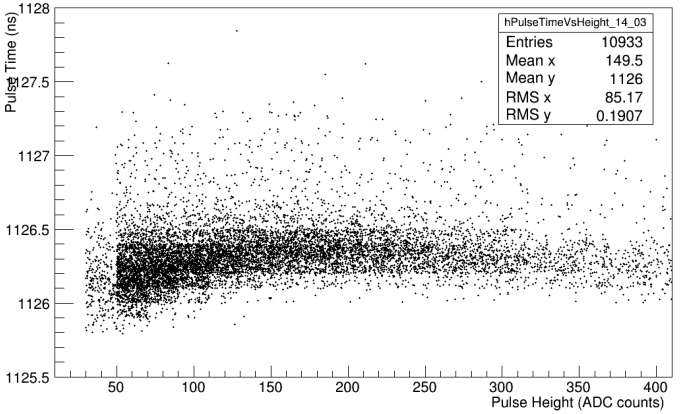


- Pulser time resolutions generally between 70-100ps (table will be posted soon)
- Discrepancy with simulated expectation is significant, need to understand

Laser Pulse Time Resolution Measurements

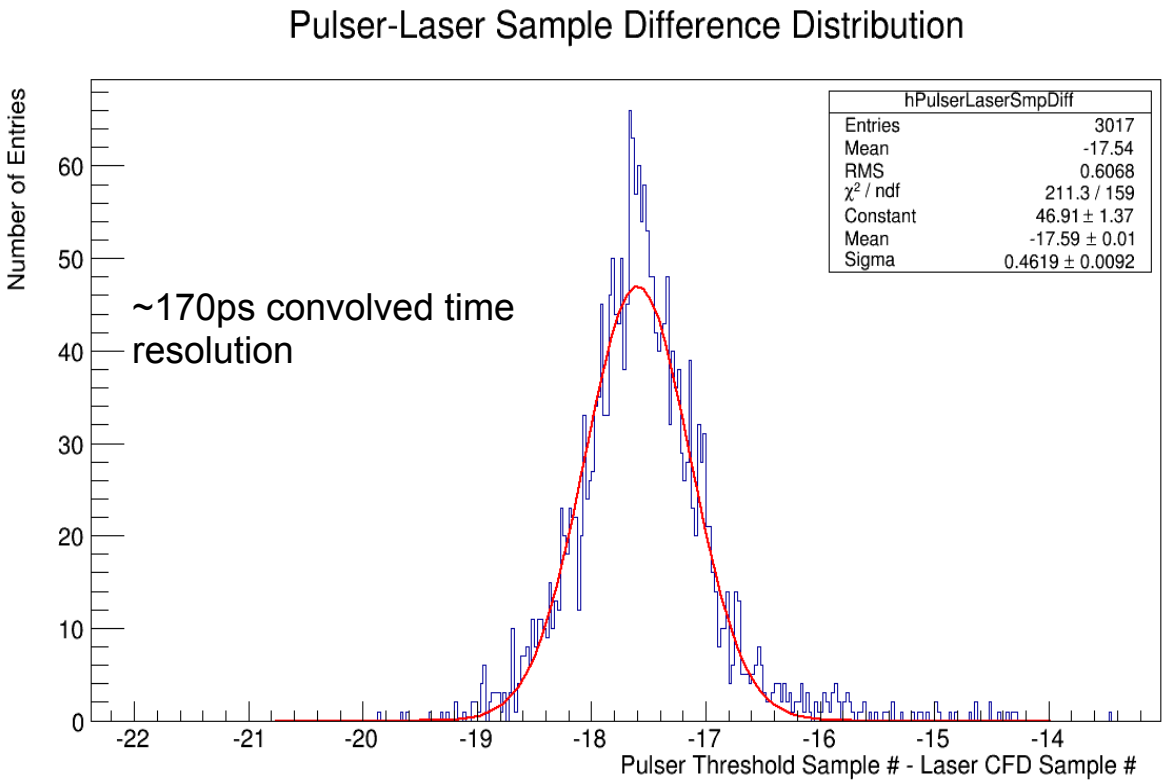


Pulse Time Vs. Height



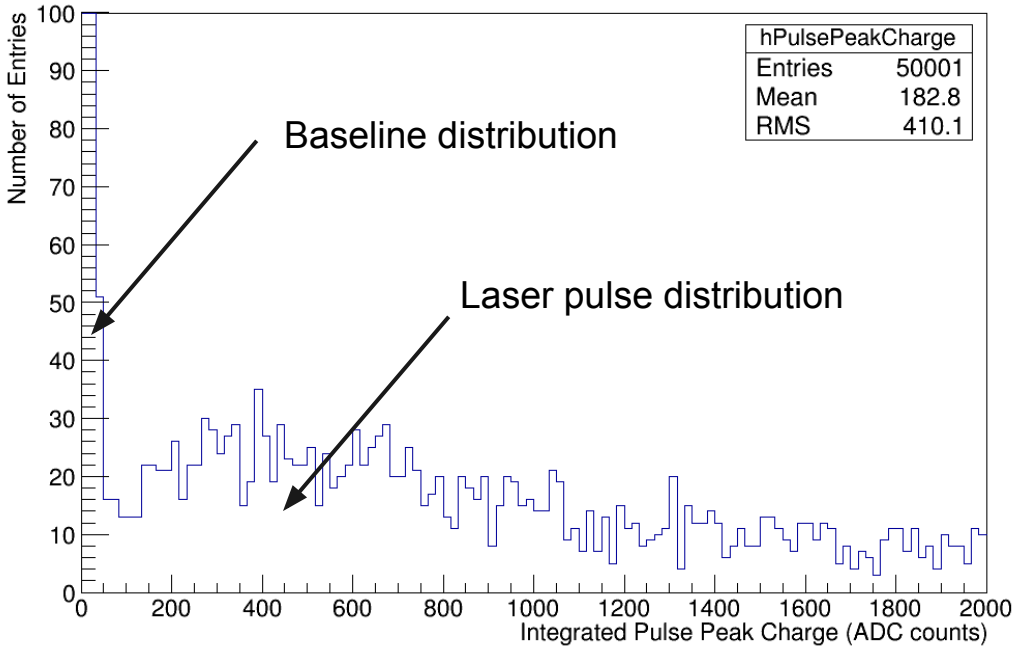
- Straightforward to measure time resolution using established method
- See time walk effect, sample correction becoming increasingly important
  - Small pulses have much worse time resolution, getting most pulses > 100 ADC counts (at same SNR) would significantly help resolution

Relative Time Resolution Measurements



- Can measure laser pulse time with respect to pulser pulser time to cross-check the amount of jitter introduced by the sampling phase correction, CAMAC etc.
- Roughly consistent with alternative measurements, indicates that CAMAC-based sampling phase correction not introducing jitter much greater than ~50ps

Laser Pulse Efficiency Measurement



- Can use pulser pulse to predict when laser pulse SHOULD be
- Integrate samples about the expected laser pulse position using forced readouts to get unbiased charge distribution
  - Done at nominal gain (+100V resulted in a few high current events)
  - Ideally can perform absolute efficiency measurement using this method
  - Would like to also perform standard relative efficiency measurement as a cross-check, but this requires modifying the laser system