Preamplifier Test Hardware and Firmware Development

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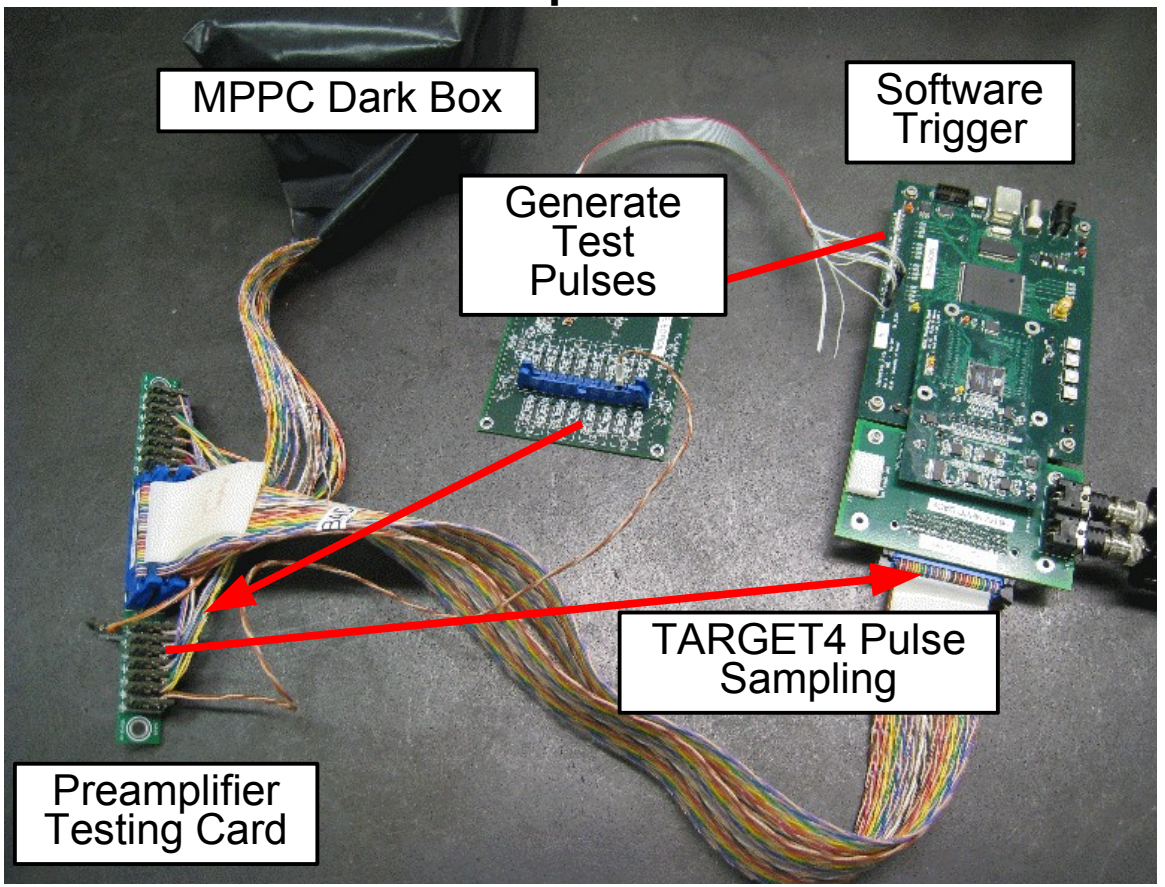
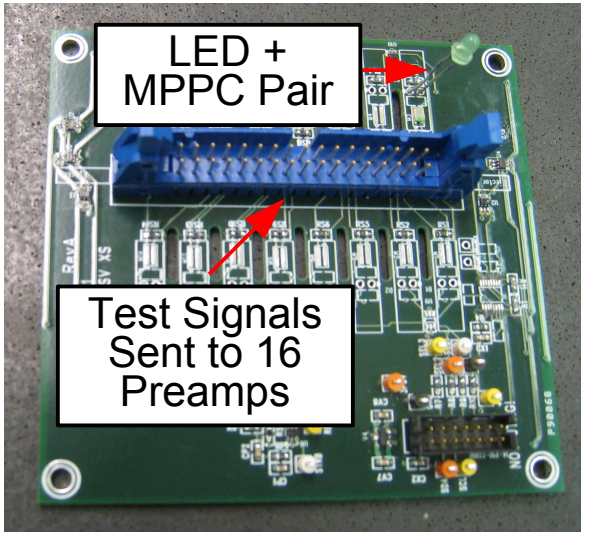
KLM/SciFi Preamp Test Setup

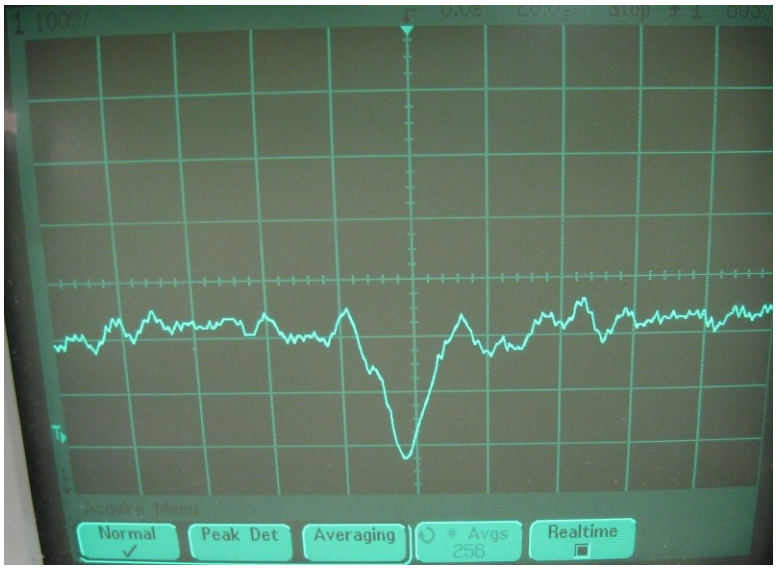
Test Setup Overview



Example Optical Test Card



Example MPPC Test Pulse

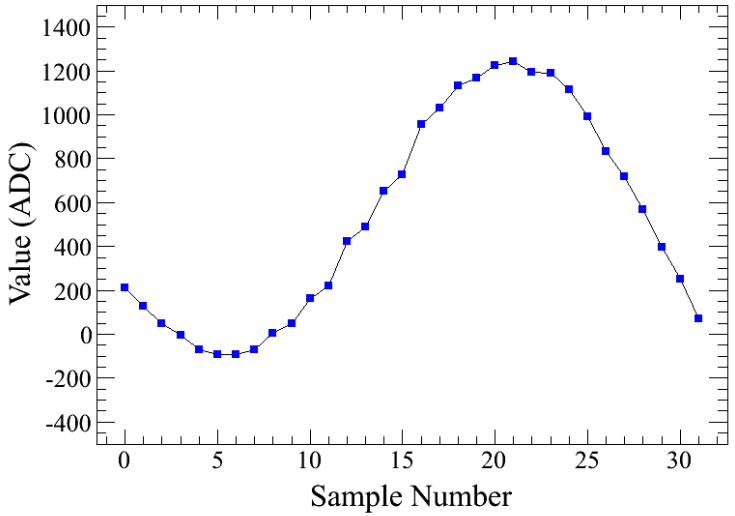


- Test system uses TARGET4 based readout to send either MPPC or RC pulses to preamplifiers
- Use to characterize KLM and SciFi preamplifiers

TARGET4 Readout Firmware I

- TARGET4 has 16 channels, for each channel input signal sampled and written to storage cells in groups of 32 (see TARGET4 documentation for details)
- For preamp test, only read out a single group of 32 stored/digitized samples
- Basic check of the readout firmware: sample a continuous sine wave signal produced by function generator
- Vary sine wave signal frequency to show sampling rate is ~2.4 Gsamp/s, unfortunately can't be reduced

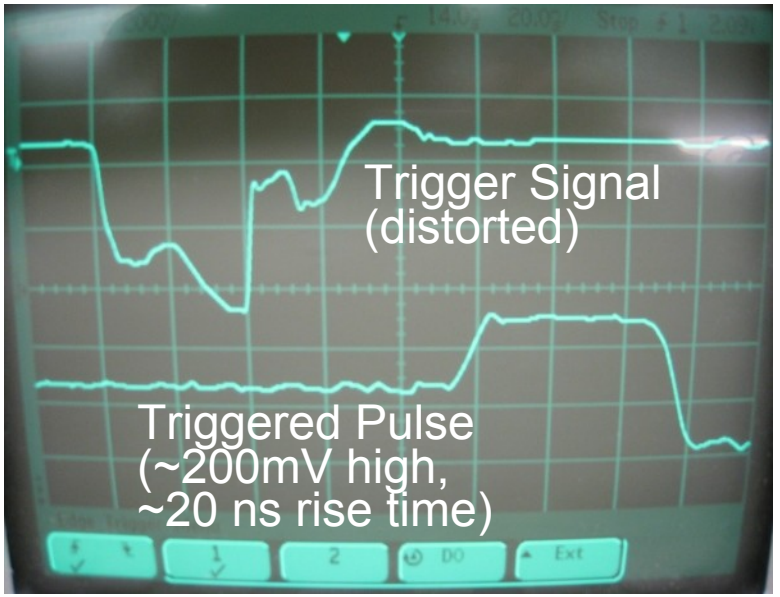
32 Sample Waveform
with 70 MHz 400mVpp
input sine wave



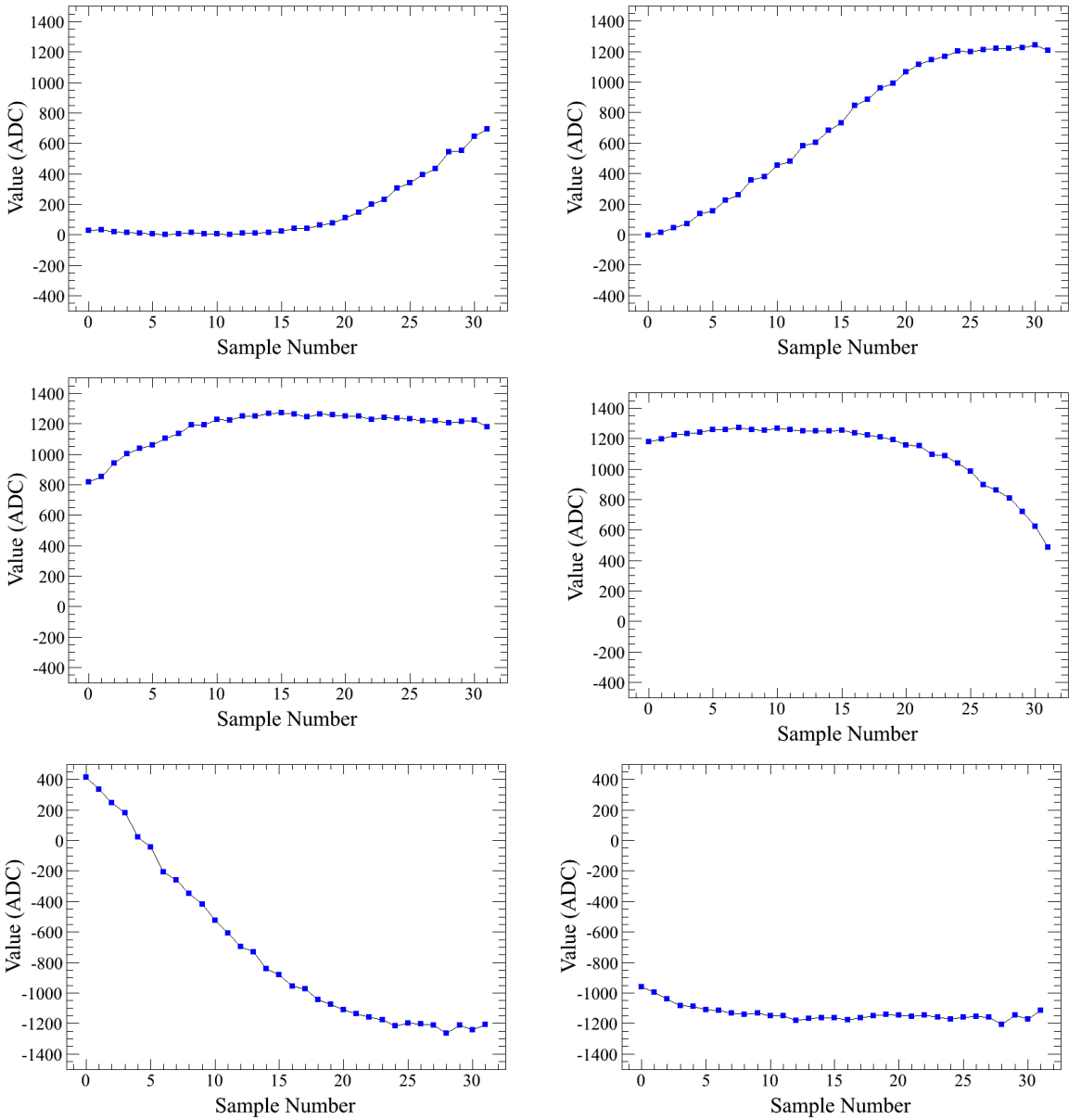
Freq. (MHz)	Observed Period (# samples)	Sampling Freq. (Gsamp/s)
50	48	~2.4
60	40	~2.4
70	34	~2.4
80	30	~2.4

TARGET4 Readout Firmware II

- Function generator can also provide triggered pulse
- Triggered pulse signal will arrive at a consistent time relative to software trigger, can test readout delay parameters
- Can adjust sampling window position wrt trigger in 3ns increments



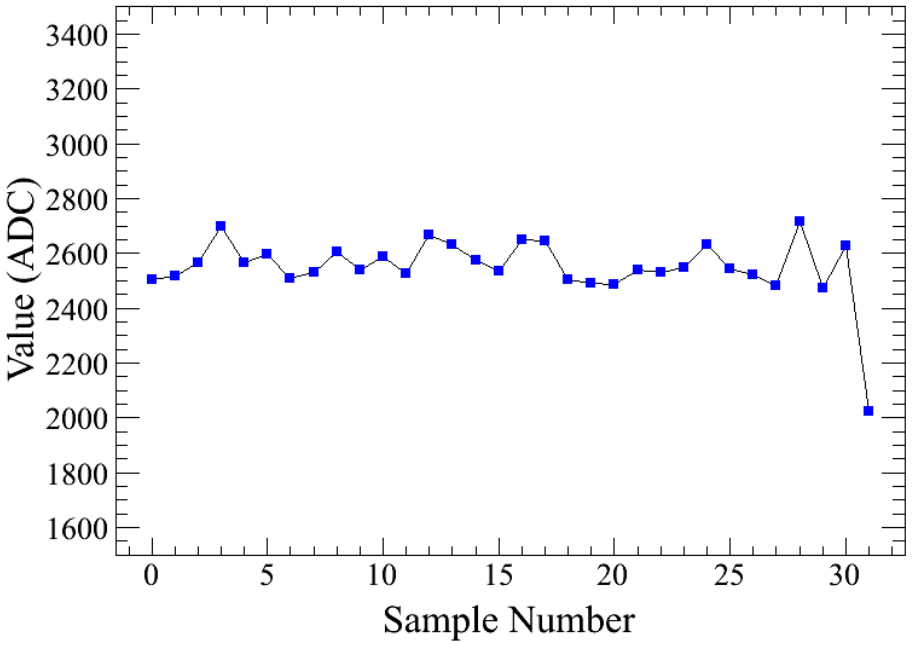
Example Waveform Readout
Using Different Sampling Window Times



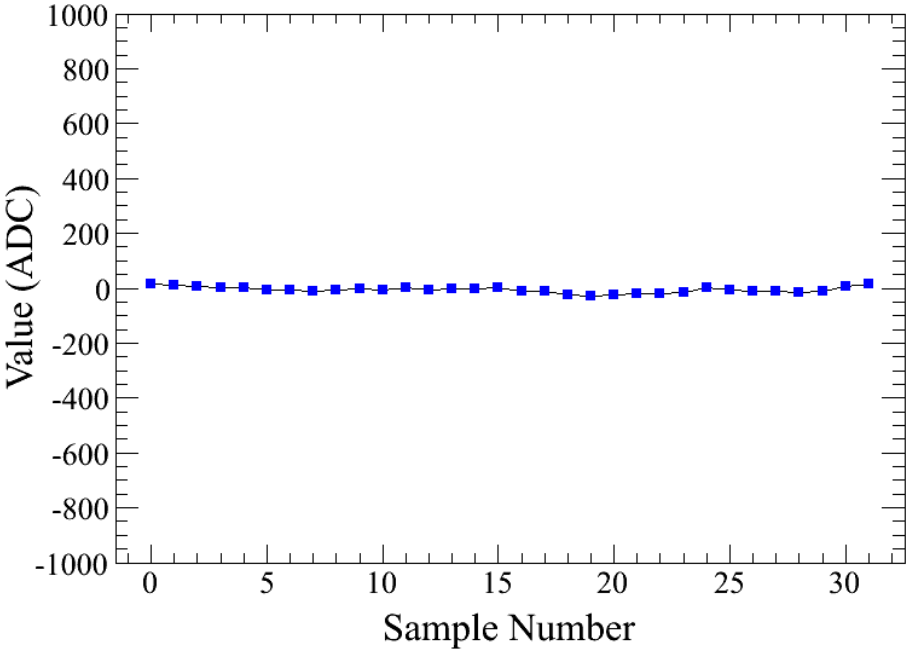
TARGET4 Readout Firmware III

- When sampling MPPC signals, need to correct for variation in baseline noise signal for each sample in the 32 sample group
- Requires a dedicated pedestal run, processed to infer pedestal value
- Analysis framework then uses measured pedestal to correct waveforms
- Pedestal histograms (not shown) have some odd features, RMS is too wide, needs further work

Baseline Noise Signal
Before Pedestal Correction



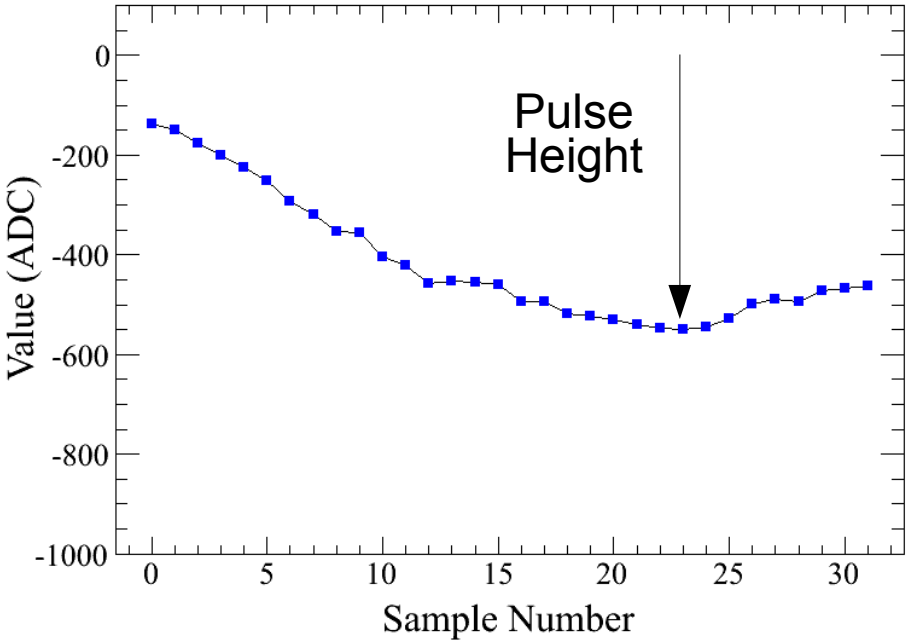
Baseline Noise Signal
After Pedestal Correction



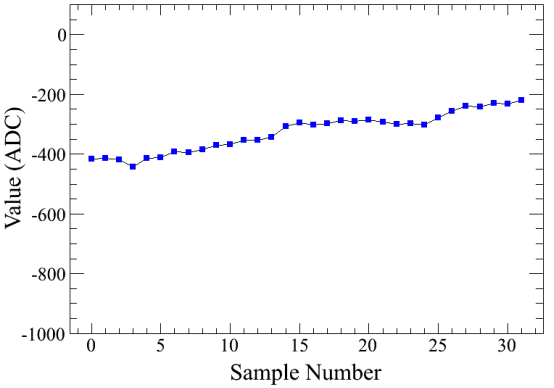
MPPC Board Tests

- With firmware readout and pedestal correction working, can look at MPPC signals produced by test board
- Strobe signal is sent to test board after software trigger, lights LED for configurable time (currently ~60ns)
- Observe MPPC pulse signals, pulse start times are not consistent (probably not fixable)

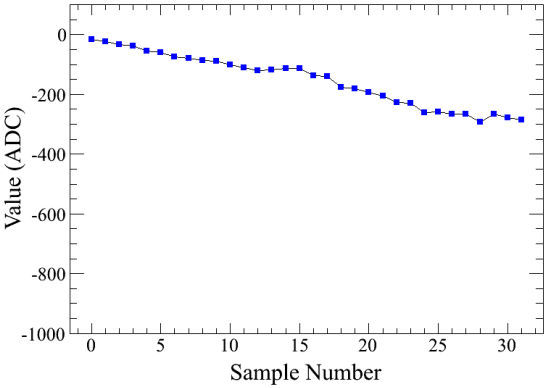
Large MPPC Pulse Waveform



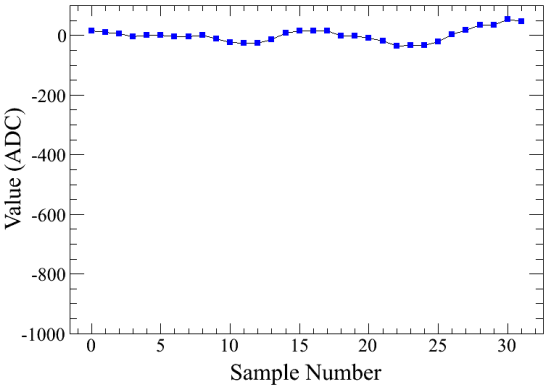
Early MPPC Pulse Waveform



Late MPPC Pulse Waveform

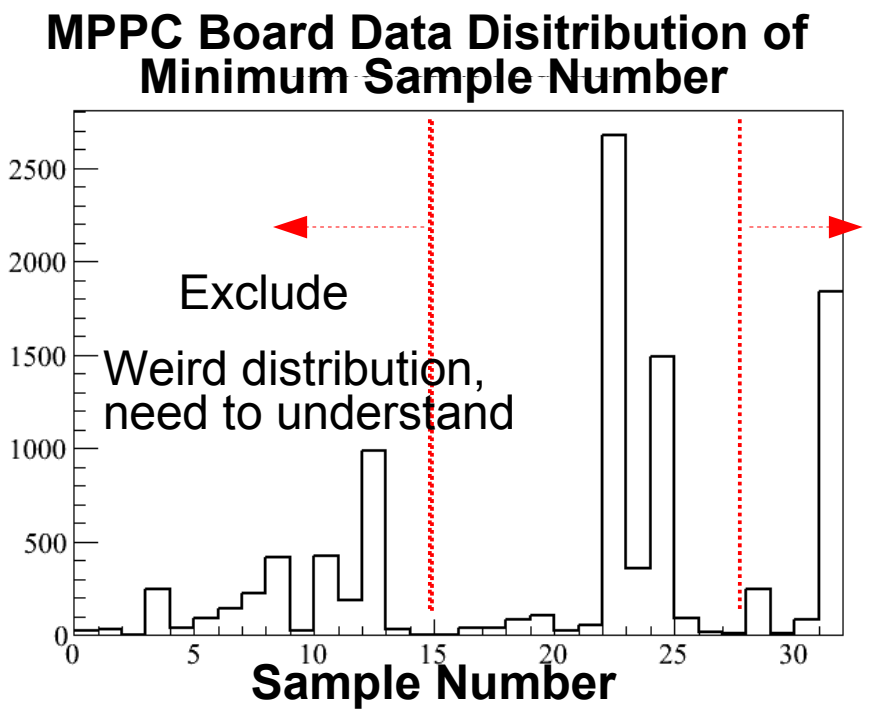


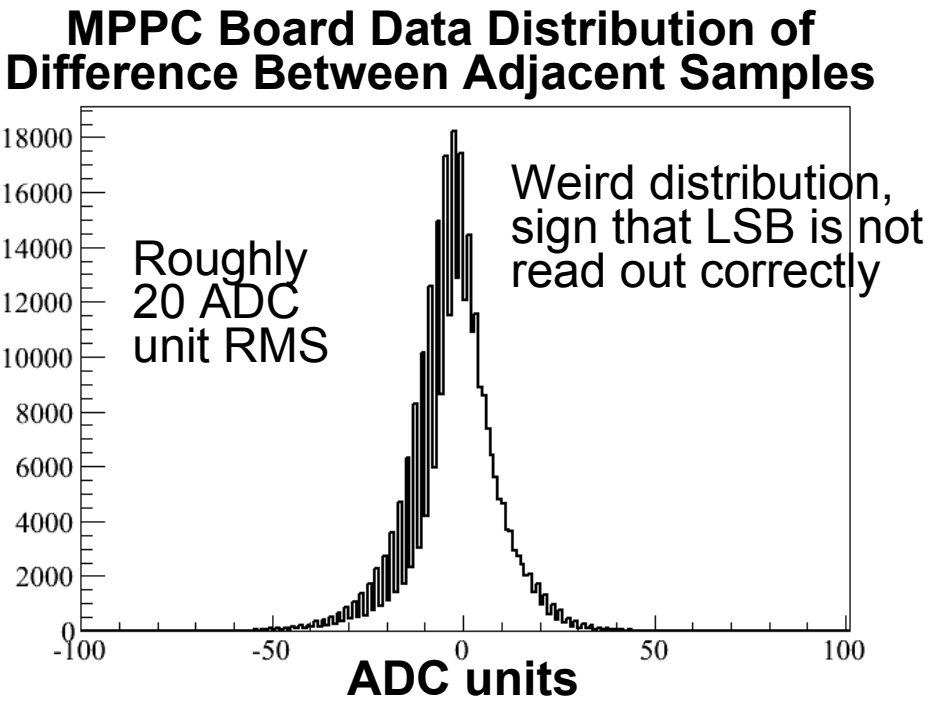
No MPPC Pulse Waveform



MPPC Pulse Selection

- Implement a preliminary selection to identify pulses that occur within the sampling window (significant improvement needed)
  - Require minimum sample in waveform to occur between samples #15 and 28
  - Require “local minimum”, minimum sample is at least 20 ADC counts below samples 0 and 31
  - If cuts passed, minimum sample is assumed to be MPPC peak





MPPC Pulse Spectrum

- Histogram of selected “pulse” heights shows a typical multi-peak distribution
  - Good indication that we are sampling at least some MPPC pulses
- Peaks are smeared out, noise and pulse selection need improvement
- Measuring position of single pixel peak provides gain estimate
  - Ideally measure positions of multiple peaks to improve gain estimate