Report on DAQ preparation of CDet module (SBS facility at Jefferson Lab)

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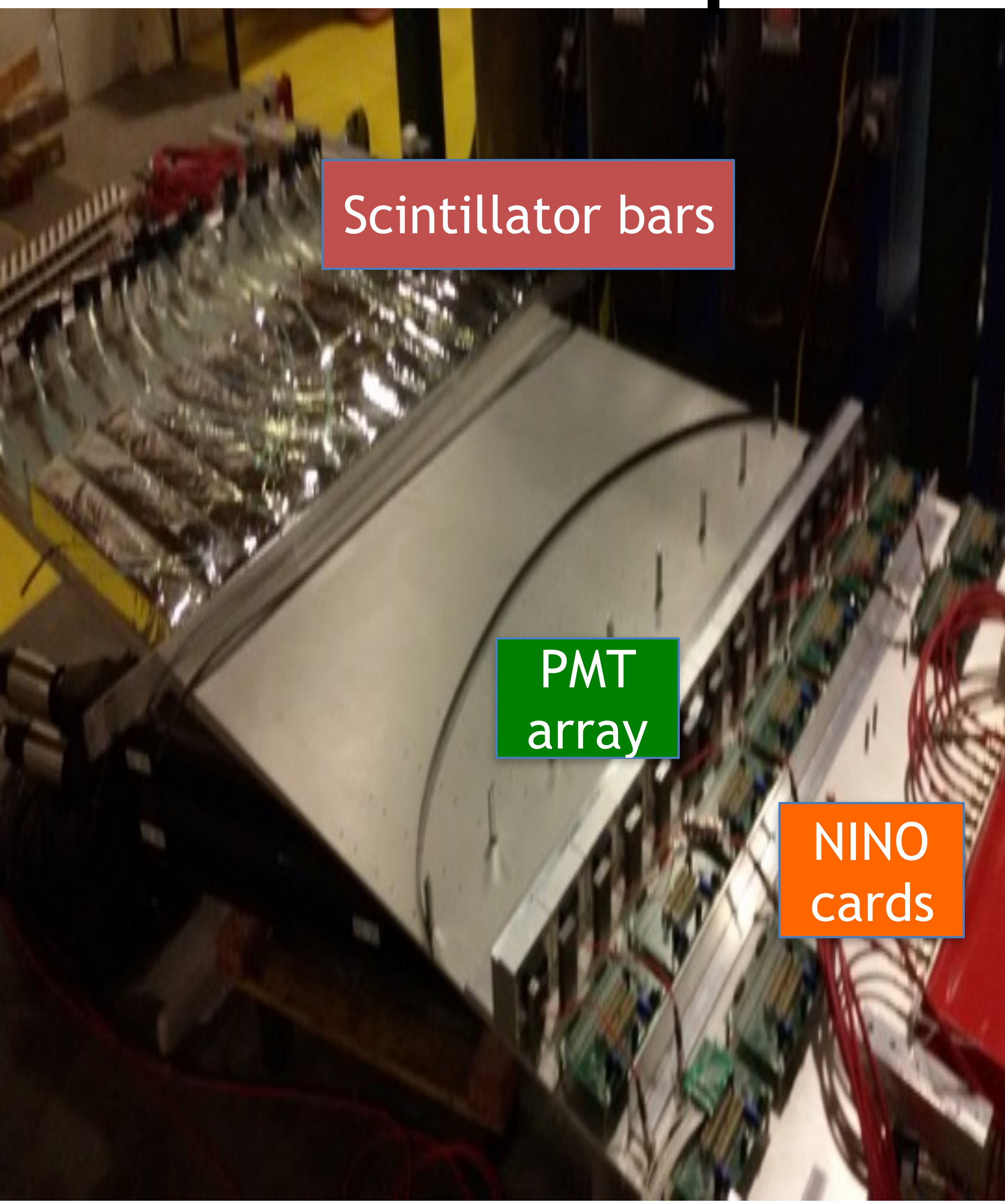
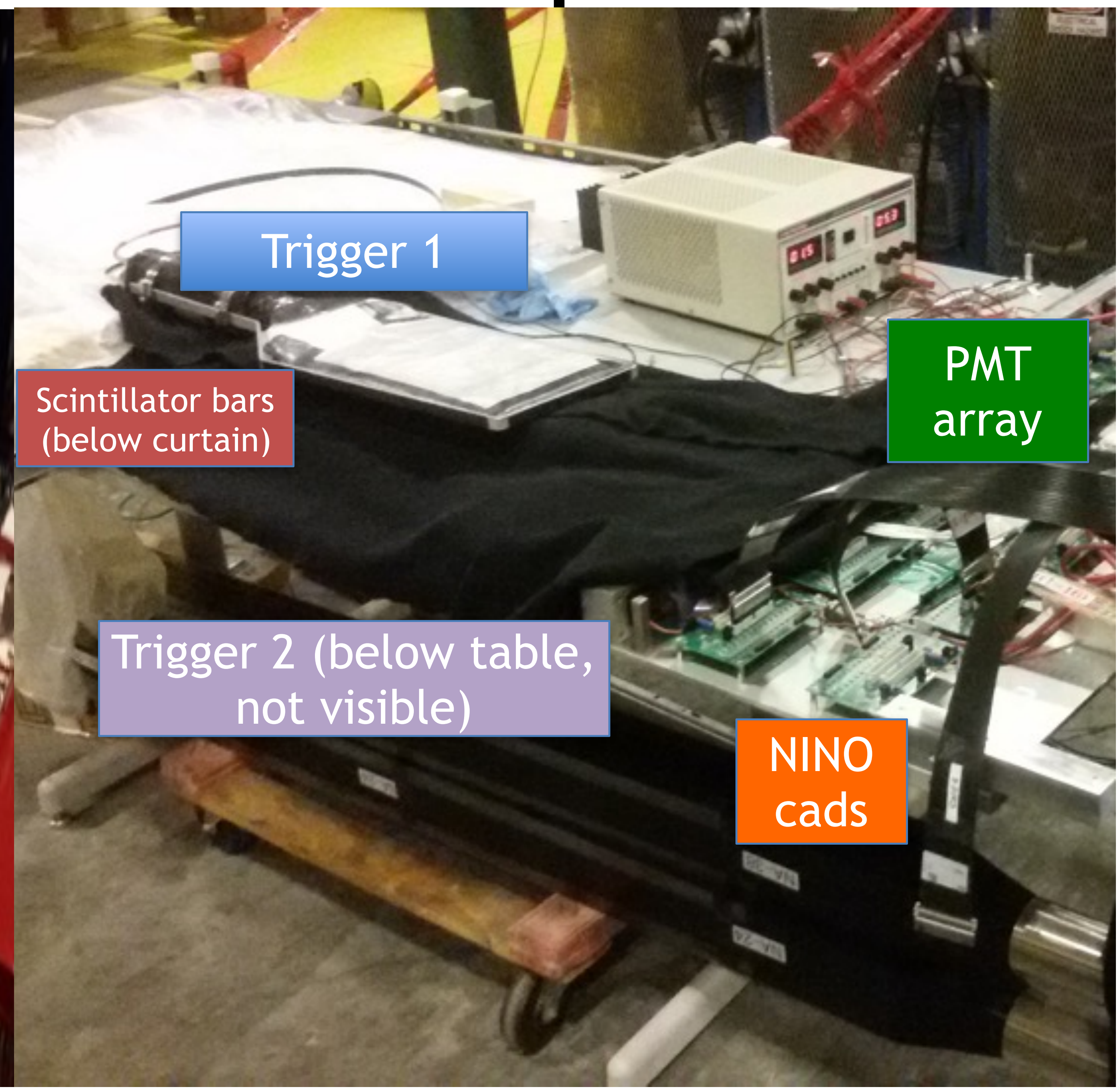
Overview

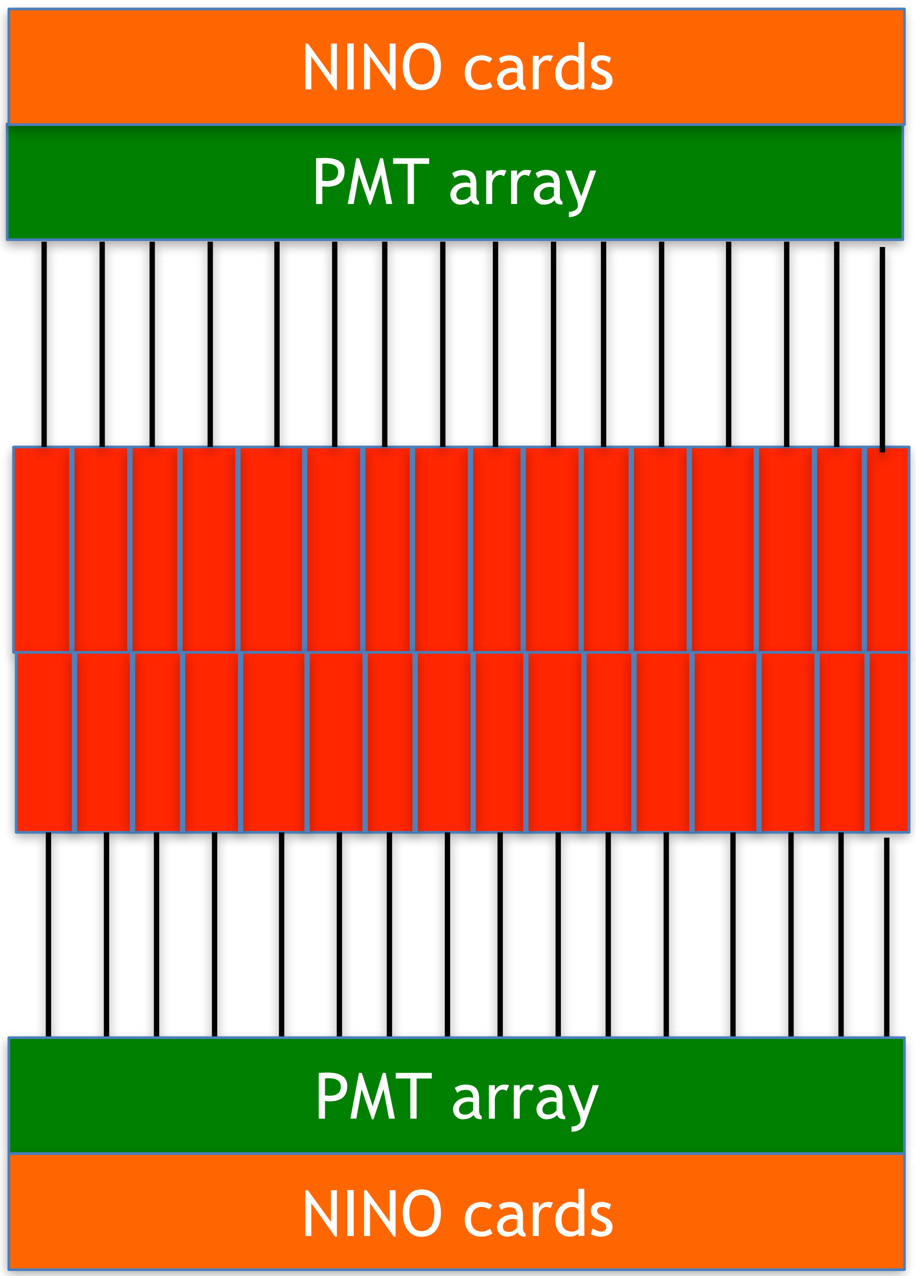
- Layout of experimental setup
- Commissioning
- Block diagram of the DAQ system in construction
- A few photos of the current hardware status
- Presentation of some analysis tools
- Summary

Experimental setup





Layout of the experimental setup



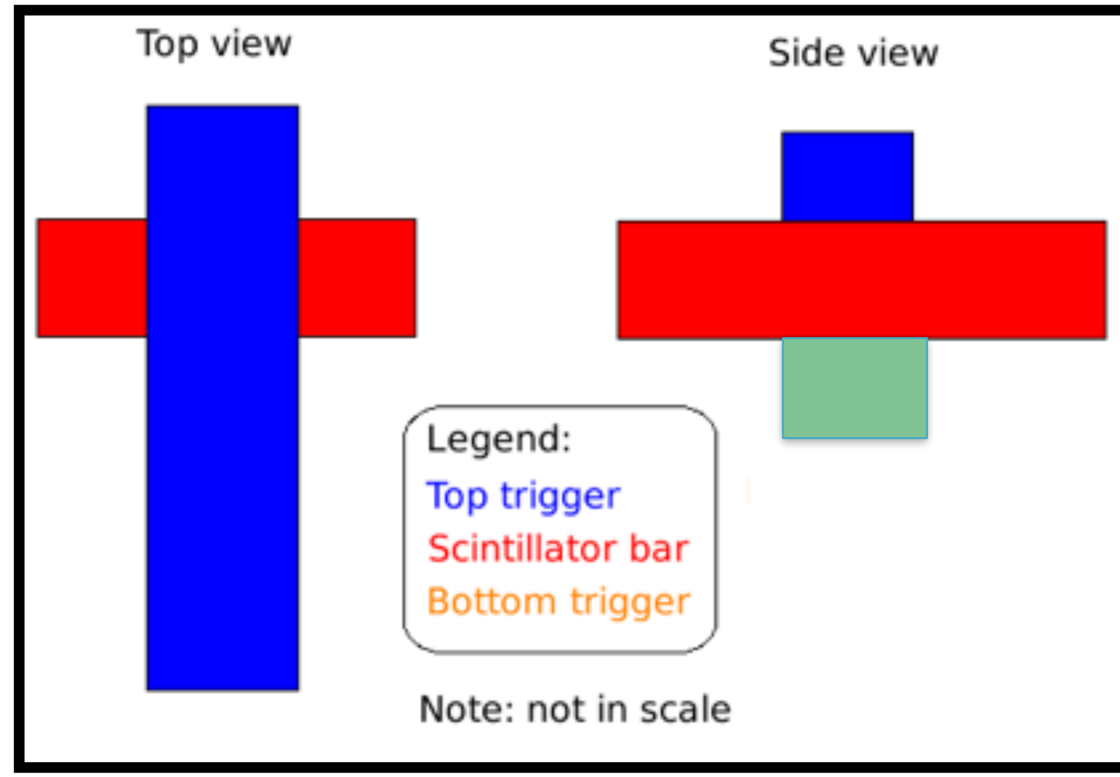
Top view

Scintillator bars array

Wavelength shifter fibers

(Settable threshold, output ADC and TDC)

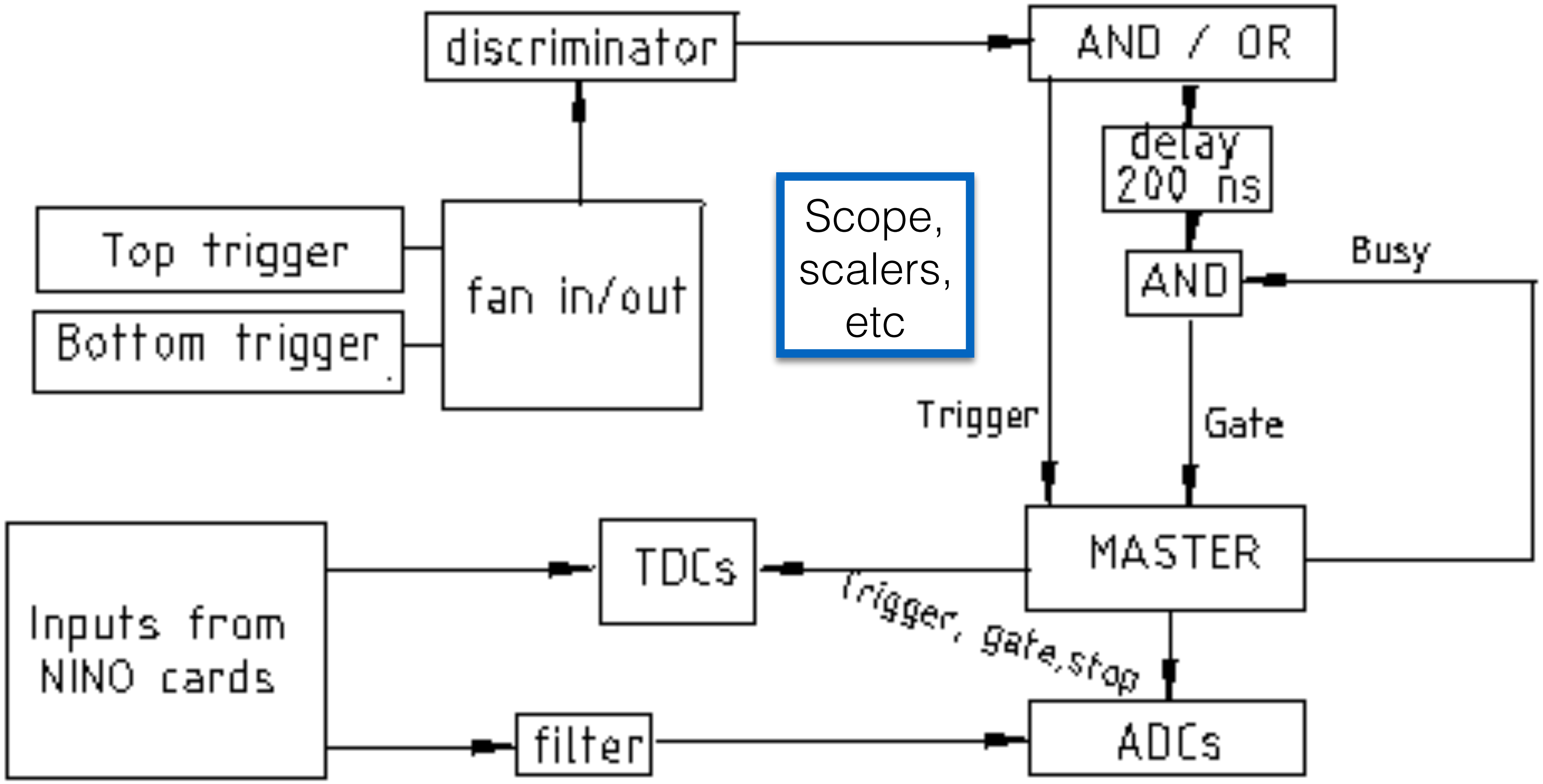
Trigger system



Commissioning

- Measure signals from cosmic rays: time between leading and trailing edges, pulse charge

Block diagram of DAQ



- Each scintillator bar (each composed by 14 smaller bars) is connected to one PMT (one pixel for each smaller bar), which in turn is connected to one NINO card
- One pixel = one ADC channel, one TDC channel

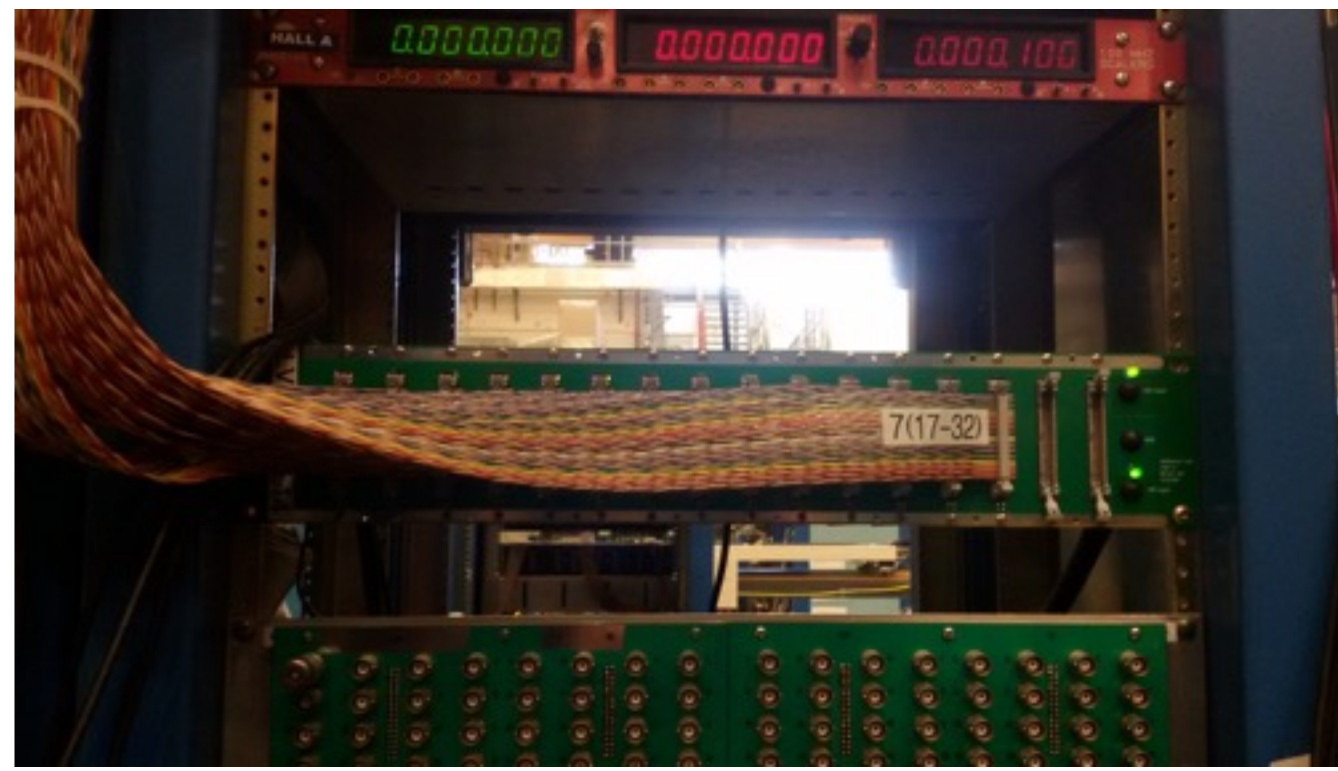
Notes about diagram

- The inputs will come from 14 PMT (each has 16 pixels, 2 of which -the worst ones - are not used). At the moment, only 1 is used for the tests of the electronic chain
- MASTER is a Fastbus unit in common stop mode. It drives the ADC and TDC modules
  - It needs about 200 ns between trigger and gate
- The AND/OR module has 4 inputs; the user can set how many of them need to be in coincidence in order to have a logical 1 as output. Currently, the triggers are set in coincidence
- The modules are distributed in a few crates for logistic reasons. An additional delay module (not shown for simplicity) takes globally into account the lengths of input/trigger/gate/busy cables of the current configuration so that the inputs arrive at the ADC modules in sync with the gate
  - No need to delay TDC as well, because we work in common stop mode as opposed to common start mode

Level translators

Inputs (LVDS from NINO)

Outputs (to ECL for TDC)

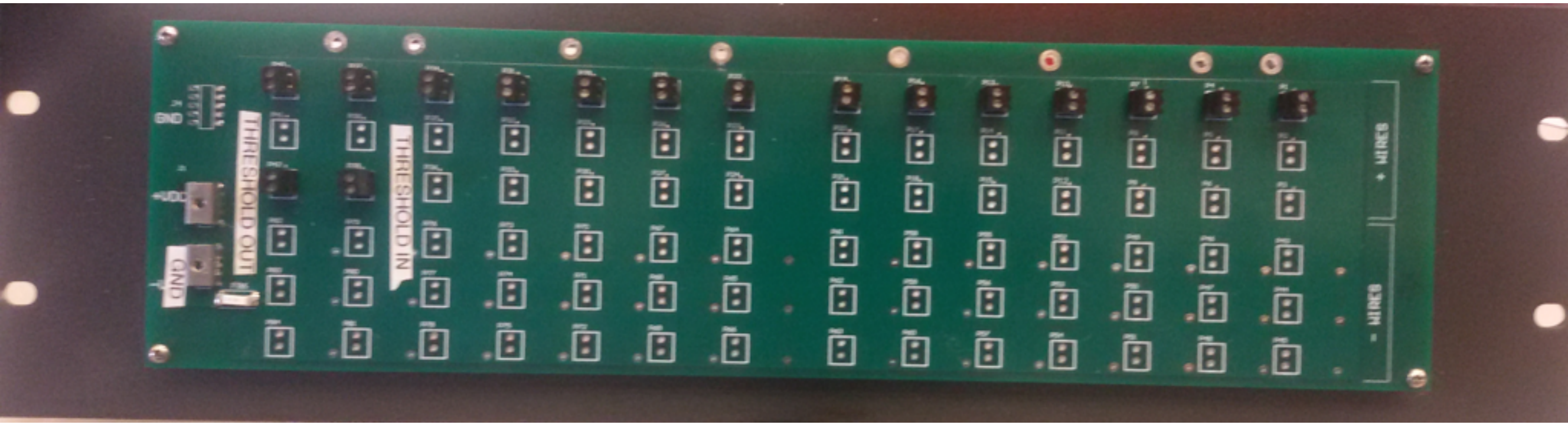


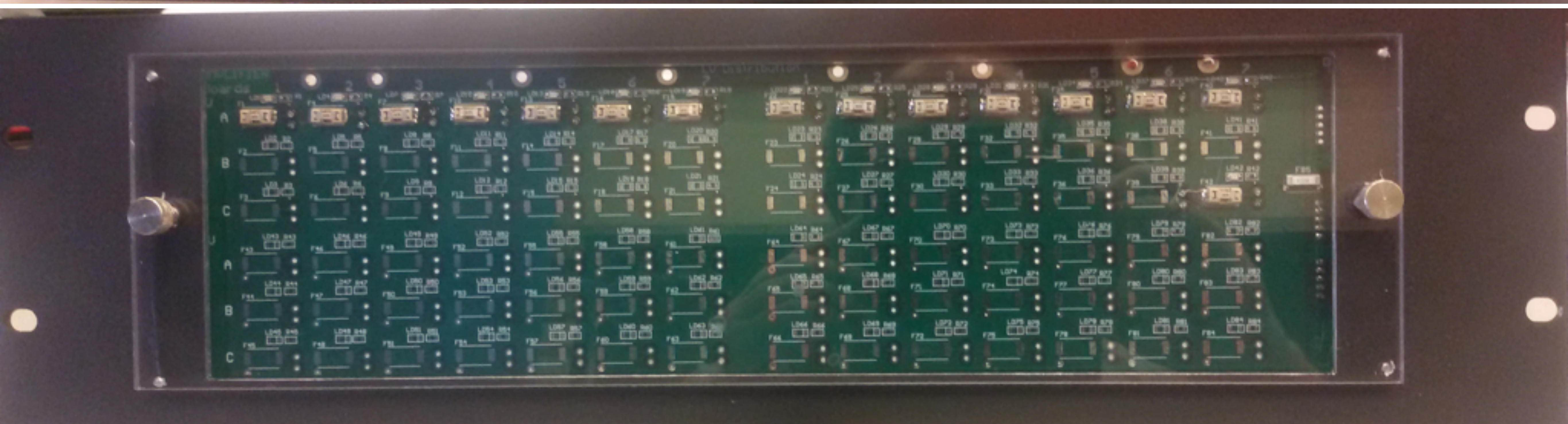
Adapters

Inputs (from analogic NINO)

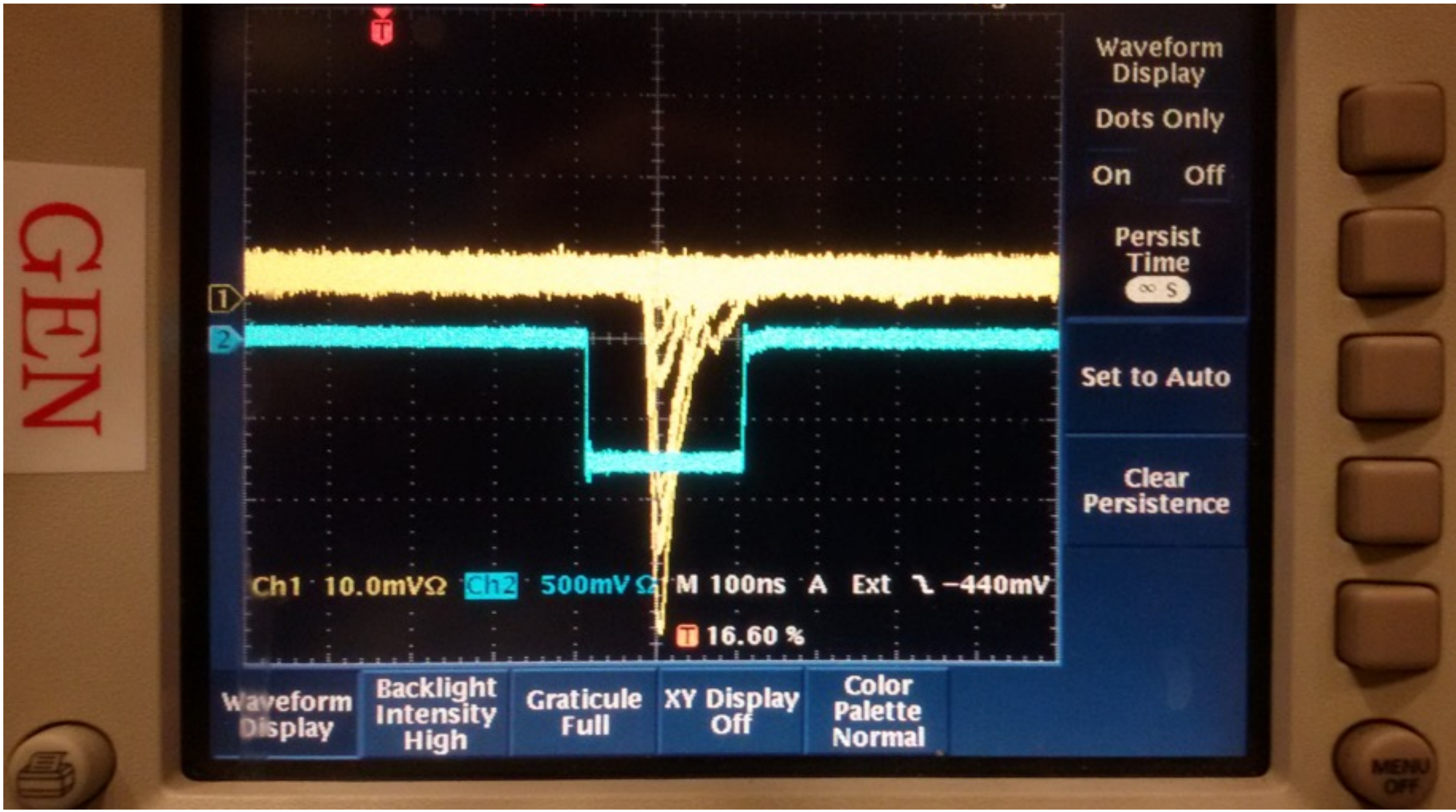
Outputs (to ADC)

Power supply distributor for NINO cards





First signals from cosmic rays



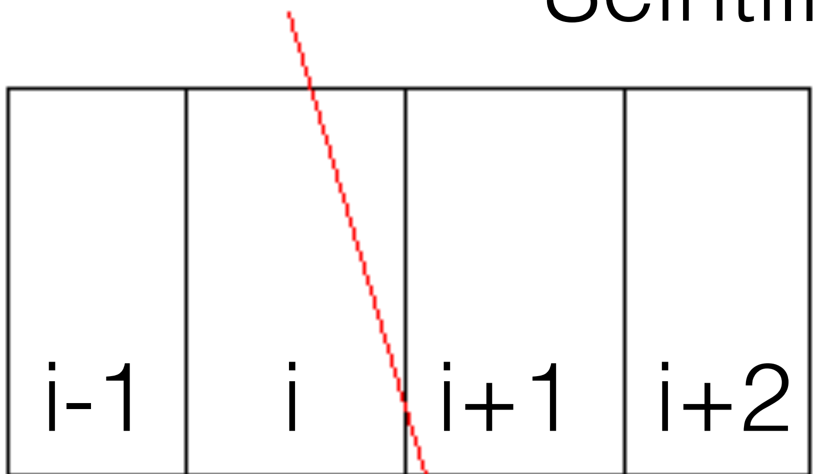
Scope and DAQ trigger is coincidence between triggers 1 and 2

Data analysis tools

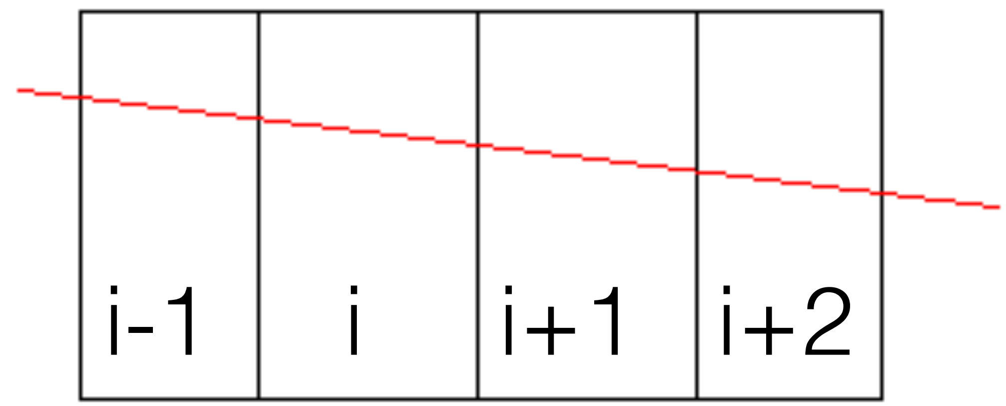
- (Interactive) track direction selection
- Cut efficiency
- Number of photoelectrons
- Duration of pulse vs amplitude
- Walk

Track direction selection

Scintillator bars (side view)



Vertical track
through bar “i”



Horizontal track

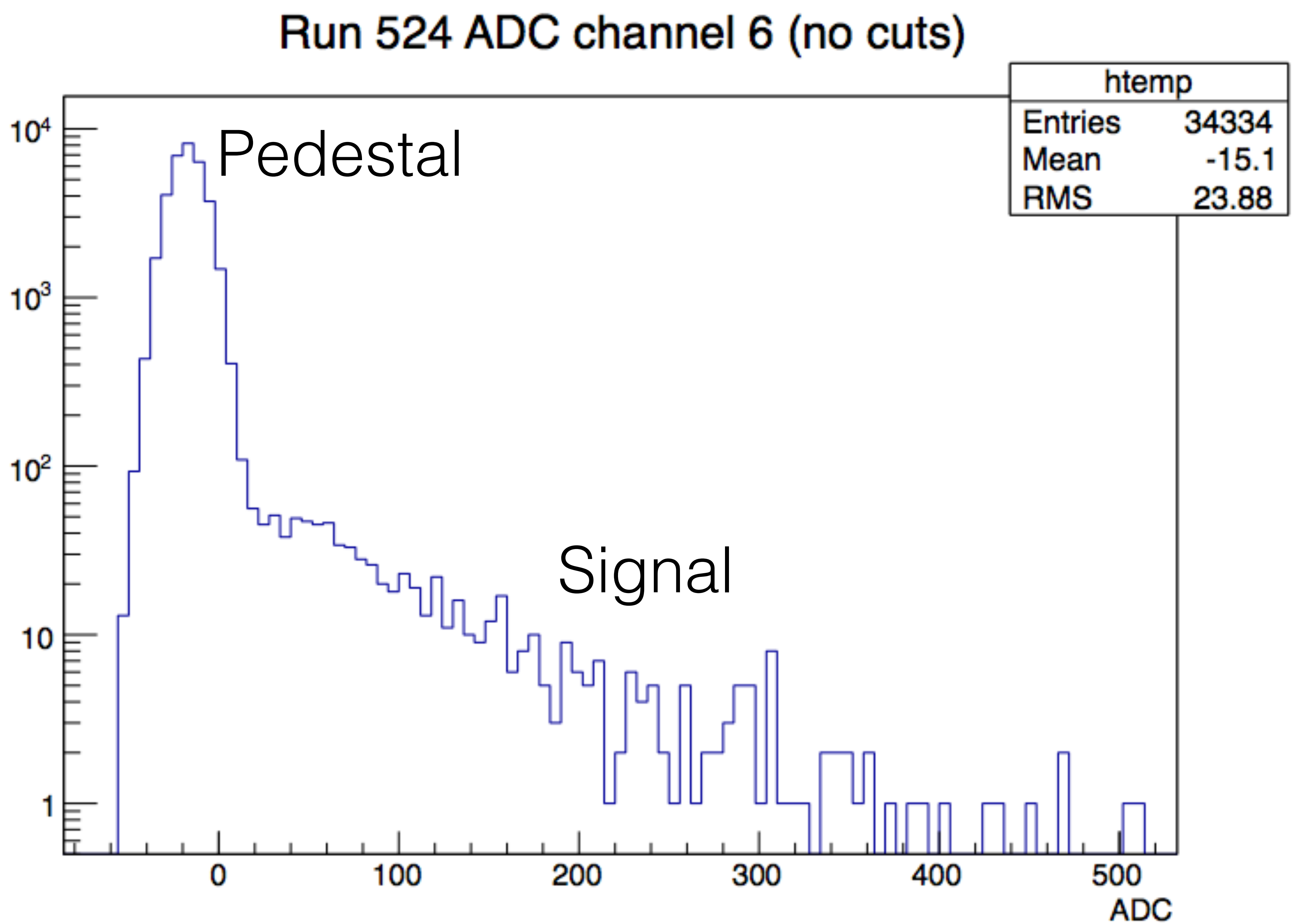
Cuts on channels:

ADC(i) high,
ADC(i-1) & ADC(i+1) low

ADC(i-1) & ADC(i)
& … high

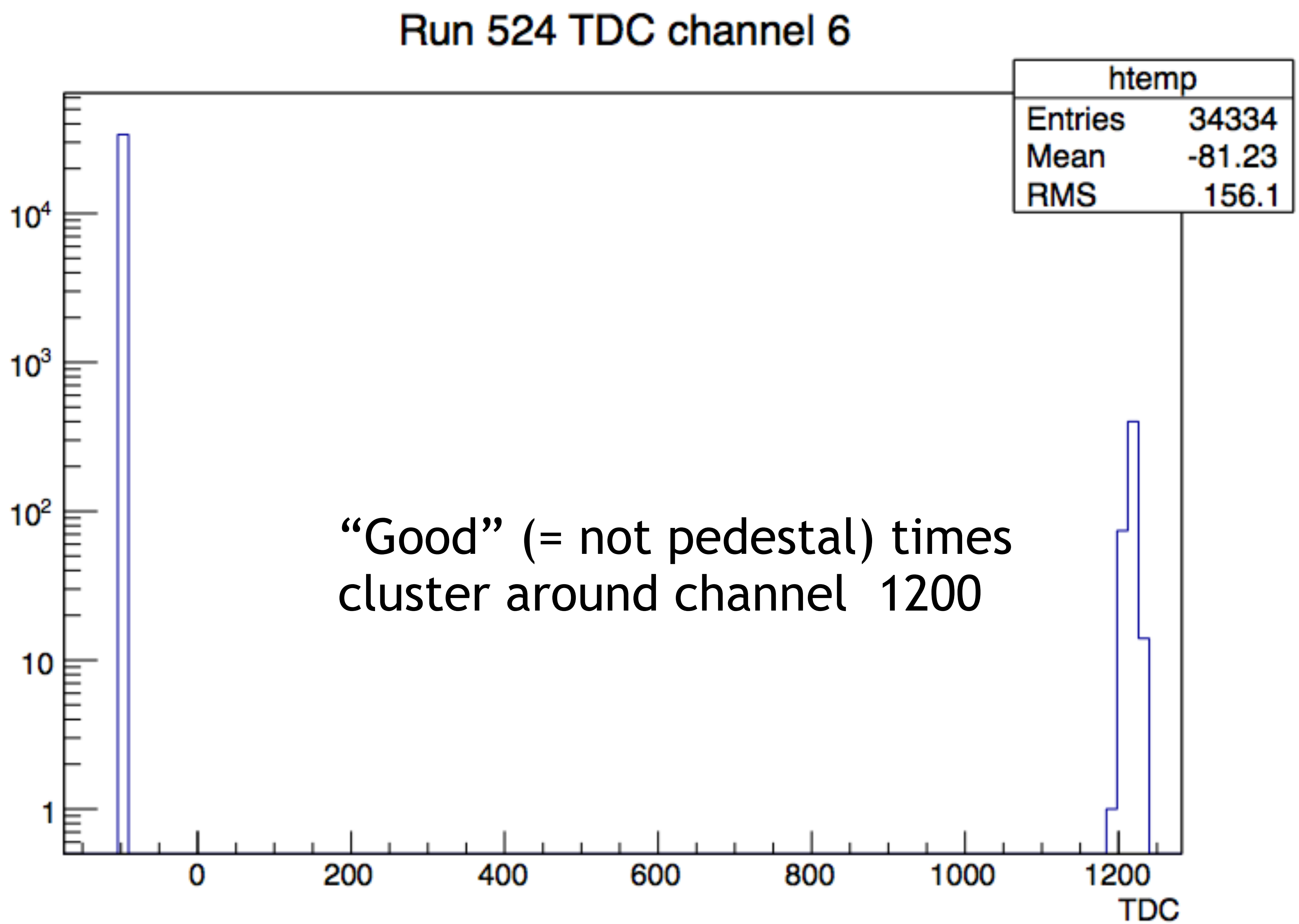
Efficiency 1/5

- Let us start with an histogram of an ADC channel



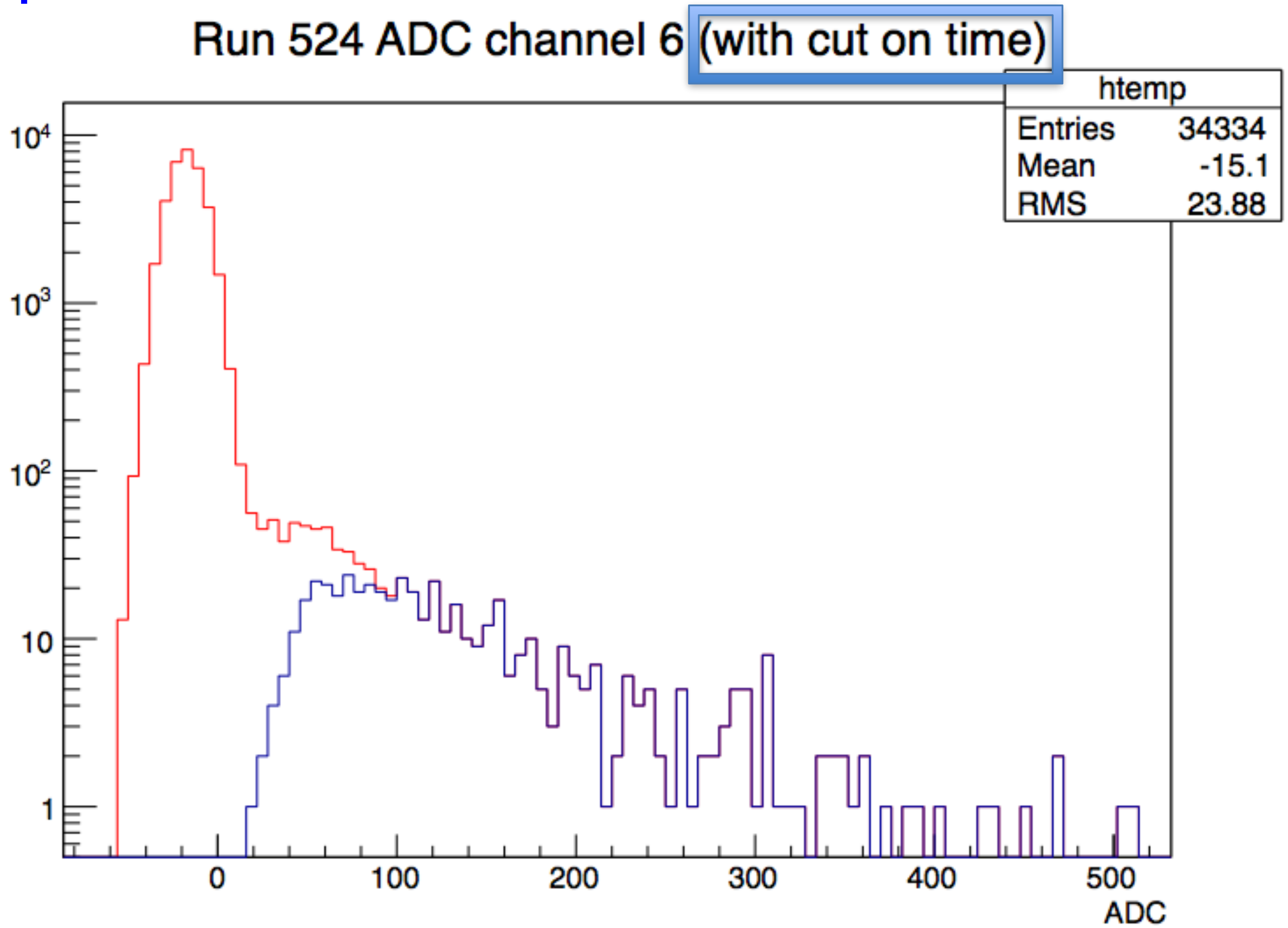
Efficiency 2/5

- Now let us see the corresponding TDC histogram



Efficiency 3/5

- Requiring TDC > 1000, ADC old spectrum becomes new spectrum

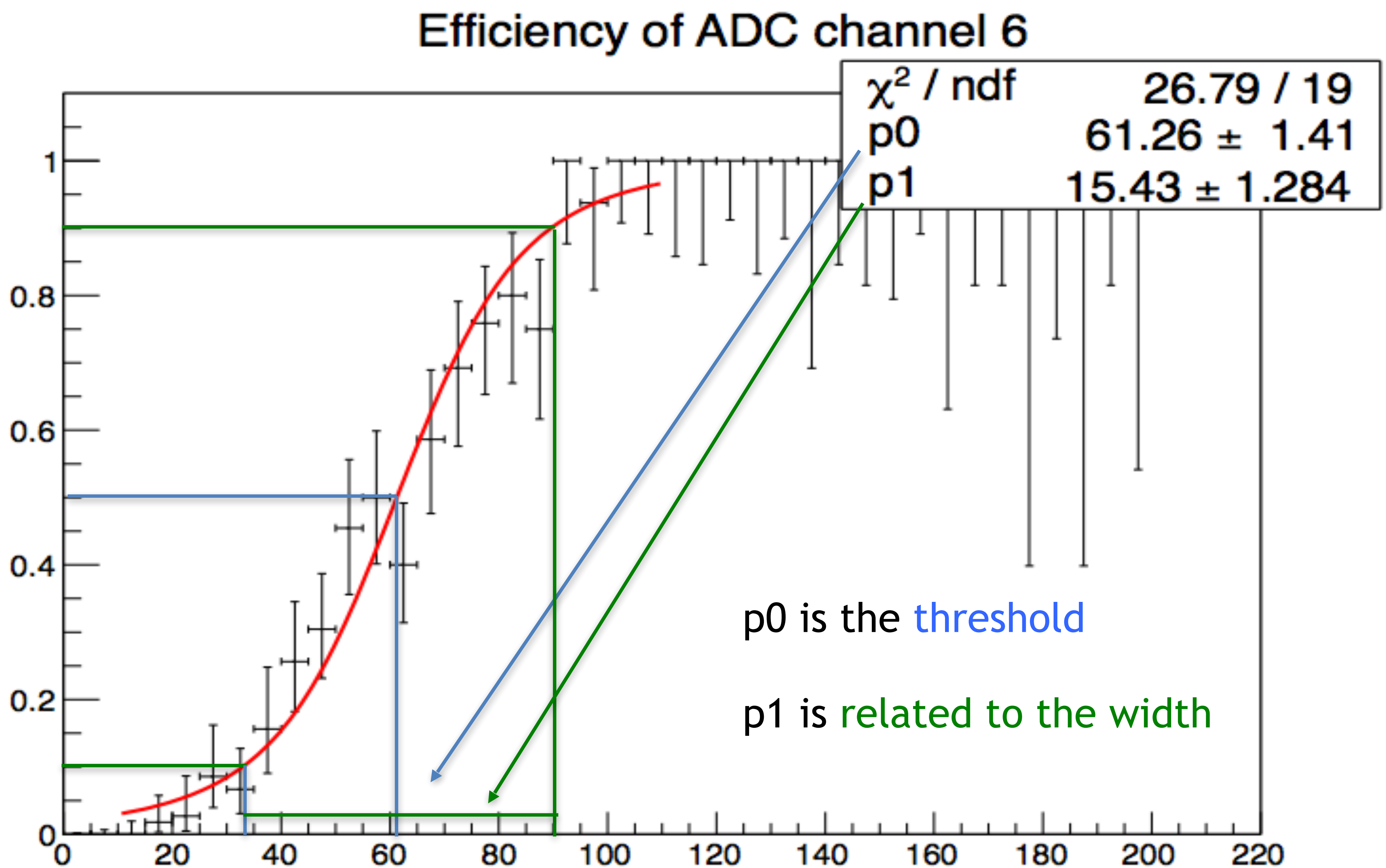


Efficiency 4/5

- For each bin, we can calculate the efficiency of the cut

$$\frac{\text{Counts AFTER cut}}{\text{Counts BEFORE cut}}$$

Efficiency 5/5



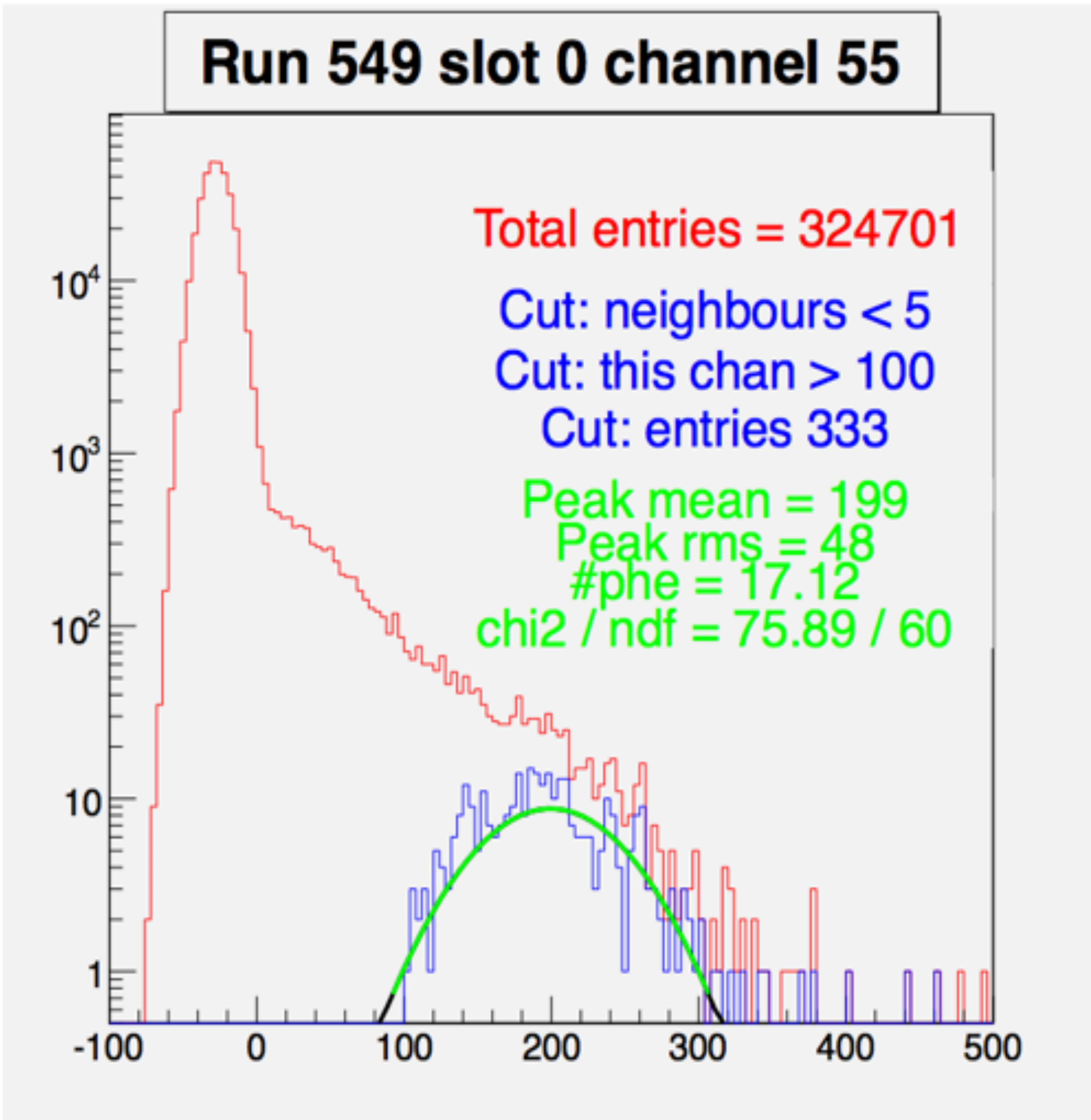
p0 is the threshold

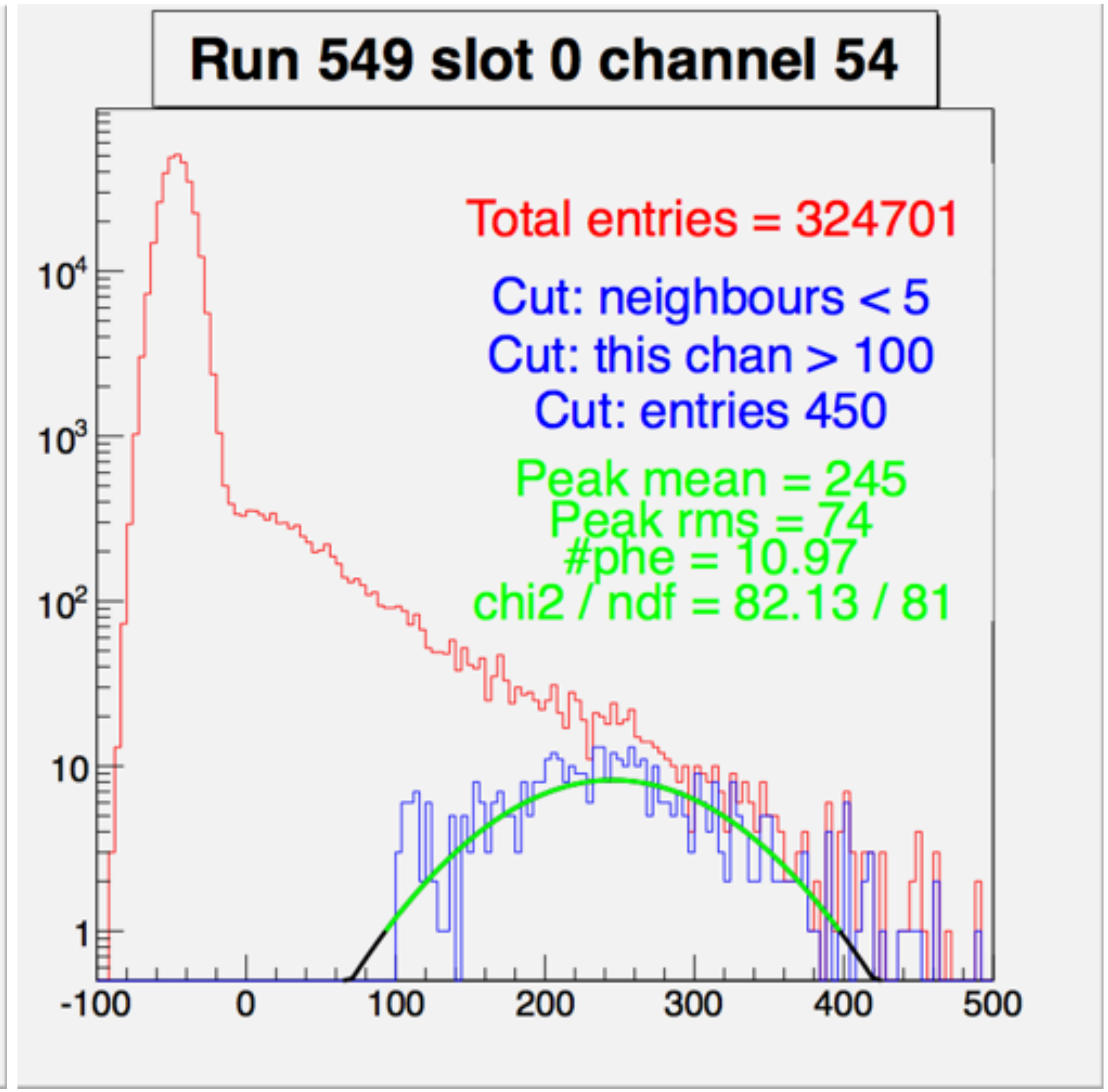
p1 is related to the width

No. of phe calculation

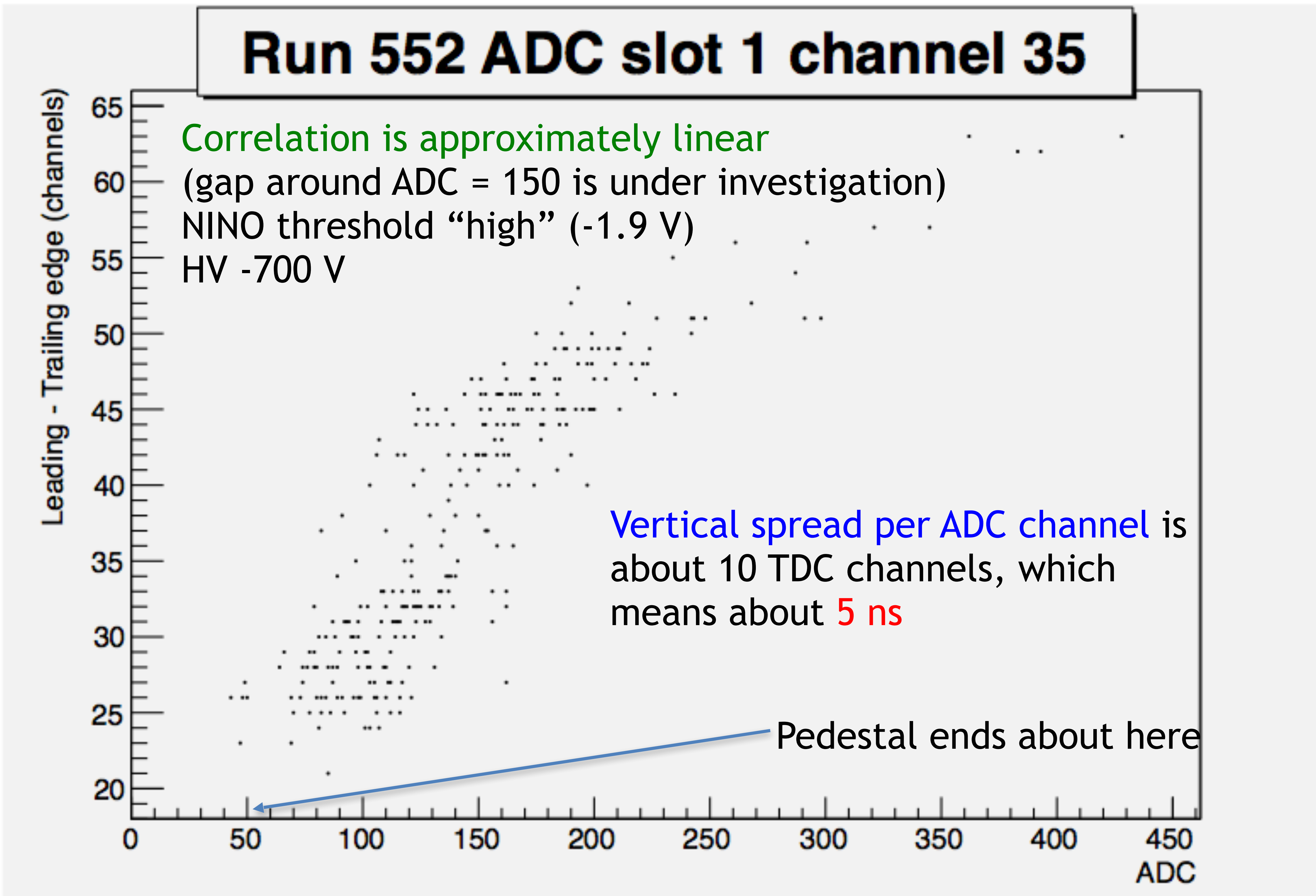
- Also this tool acts on a given ADC channel
- First, we select vertical tracks by demanding
  - Above pedestal ADC for current channel
  - Low ADC for neighbouring channels
- Gaussian fit of the signal peak
  - Retrieve mean and rms
- Number of photoelectrons = $(\text{mean}/\text{rms})^2$

No. of phe calculation





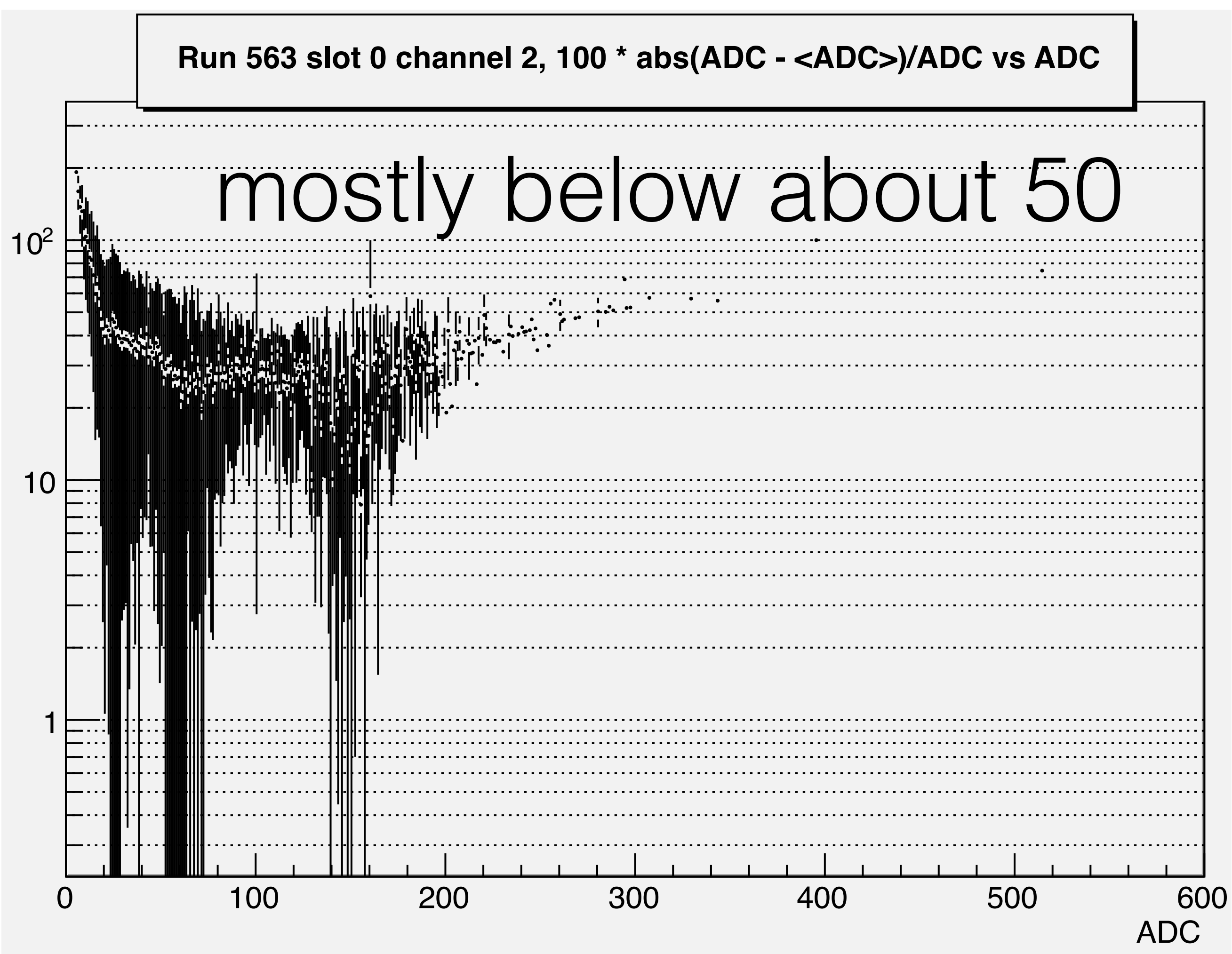
Duration vs amplitude

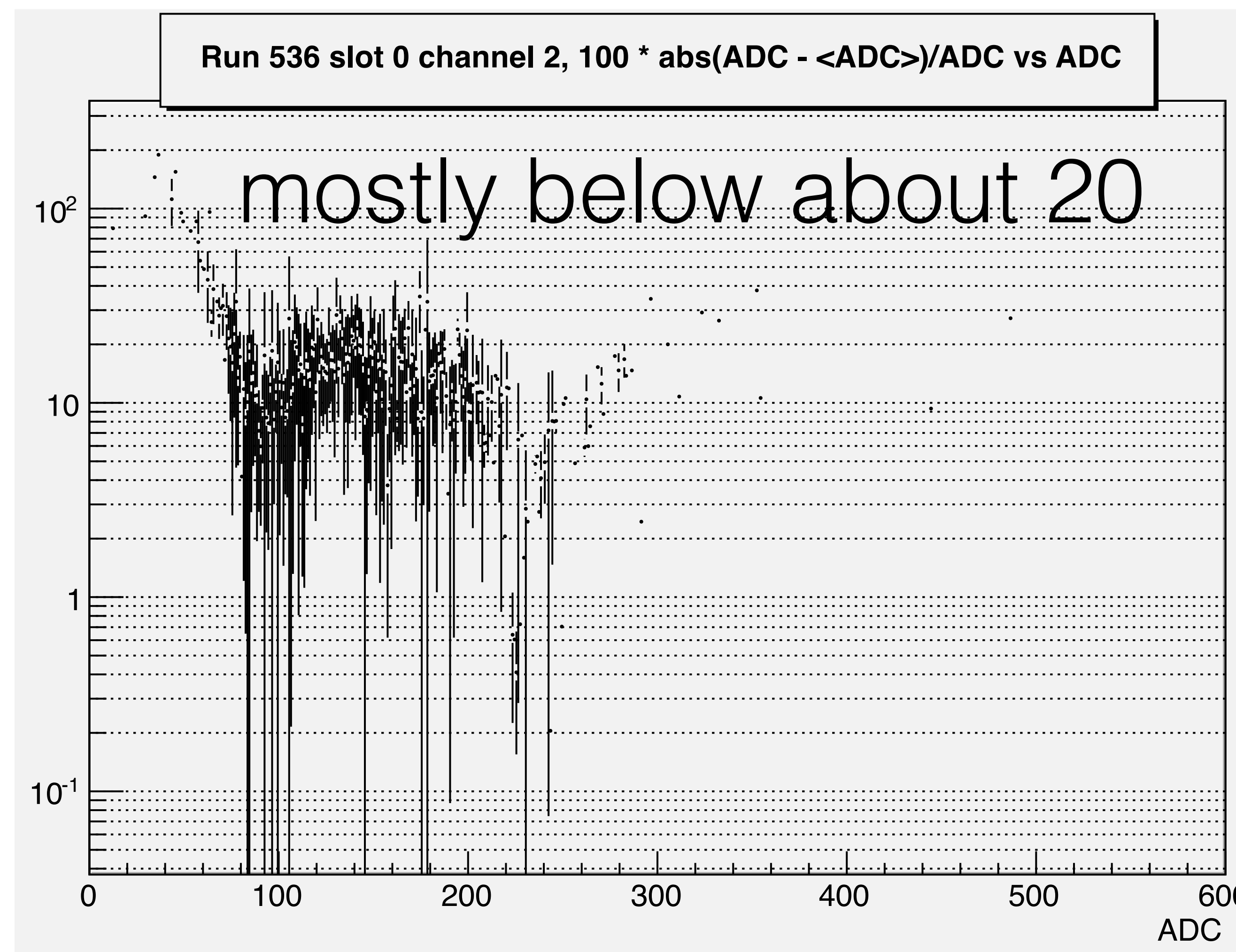


ADC Walk

Walk = 100 abs(ADC - <ADC>) / ADC

Walk for NINO threshold = -1.4 V (left) and -1.9 V (right)





Summary

- Commissioning is about measuring times and amplitudes from cosmic signals
- Hardware tested:
  - One PMT (16 channels / 14 used)
  - Two NINO cards
  - Four ADC modules (4 x 64 channels)
  - One level translator (16 channels)
  - One TDC module (96 channels)
- Developed software for
  - Read out of ADC and TDC data from CODA output to ROOT files
  - Data analysis
    - Cut efficiency
    - Number of photoelectrons
    - Duration of pulse vs amplitude
    - Walk

Thank you