PHOTOTUBE SCANNING SETUP AT THE UNIVERSITY OF MARYLAND

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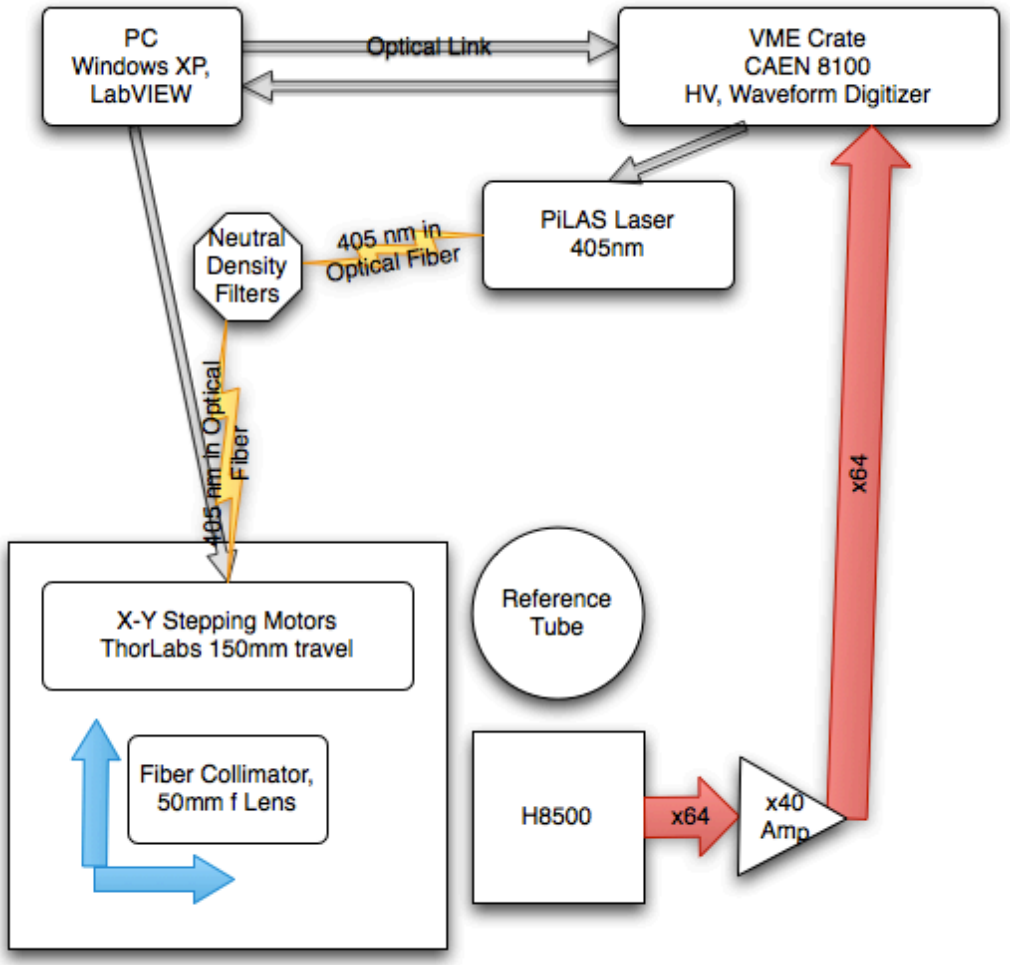
Overview

- We have developed a system for measuring and scanning phototubes for the FDIRC
- Based primarily on being able to measure Hamamatsu H8500, but should be flexible enough to look at other possibilities as well
- Readout is done using a new waveform digitizer VME card from CAEN
  - Just received second card less than two weeks ago, so all results are very preliminary; qualitative not really quantitative

System Schematic

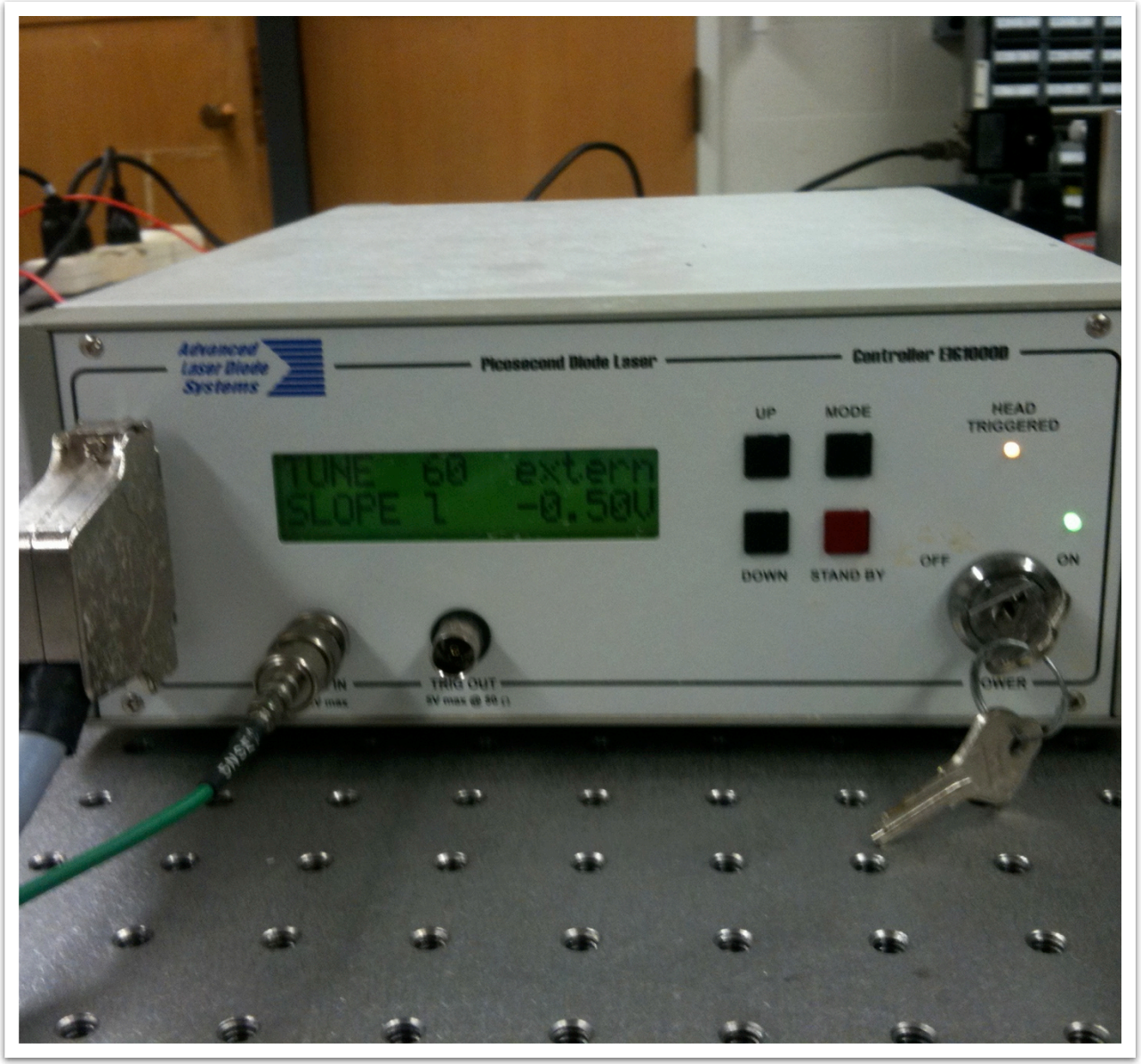


PiLAS Laser

405 nm

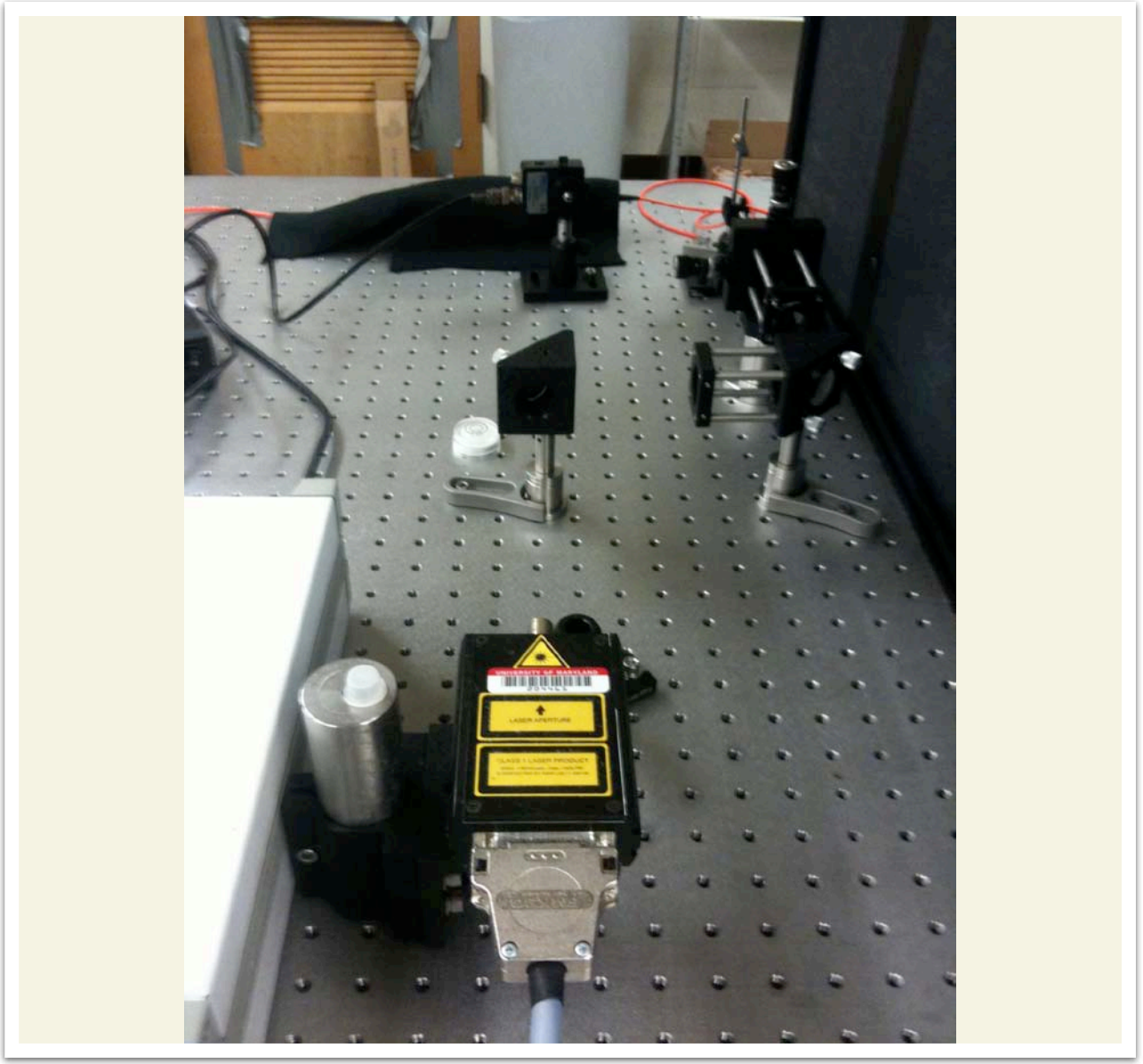
Very fast pulses

Externally triggered by software trigger routed through VME.



Fiber Launch

Free-space laser
coupled to optical fiber



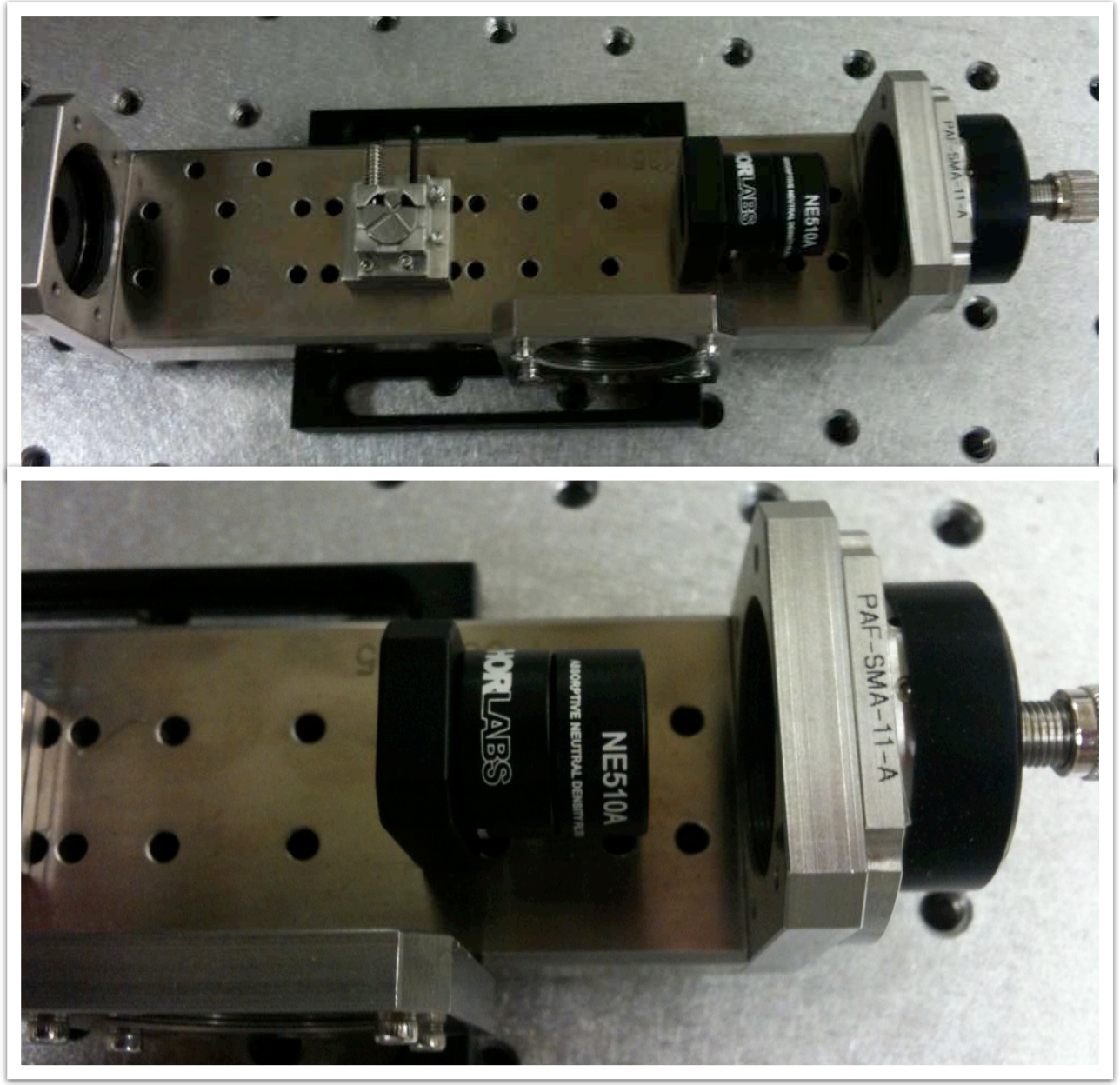
Neutral Density Filters

Collimate laser from optical fiber

Insert ND filters

Tune to single PE level, if desired

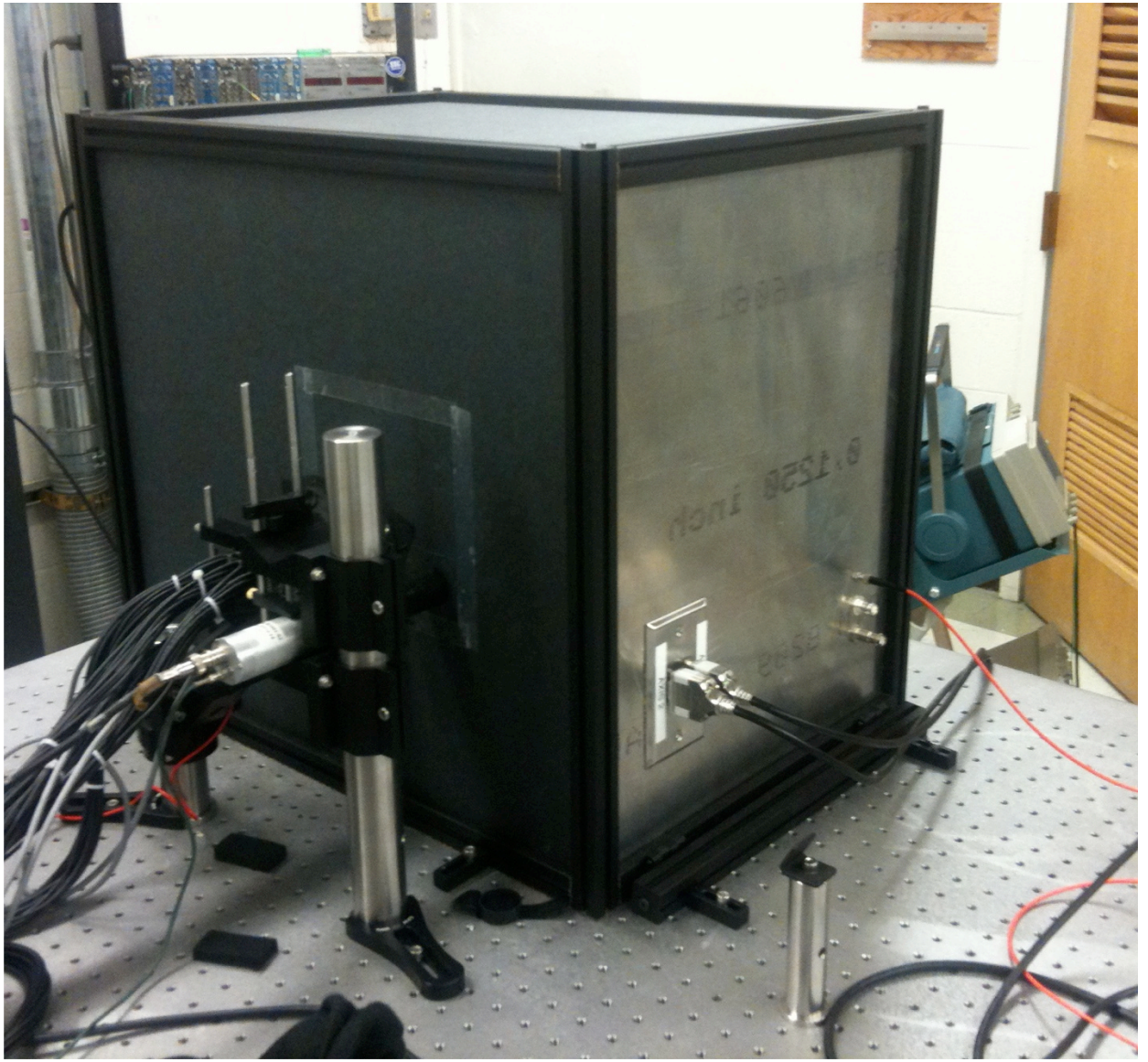
Couple back into optical fiber



Dark Box

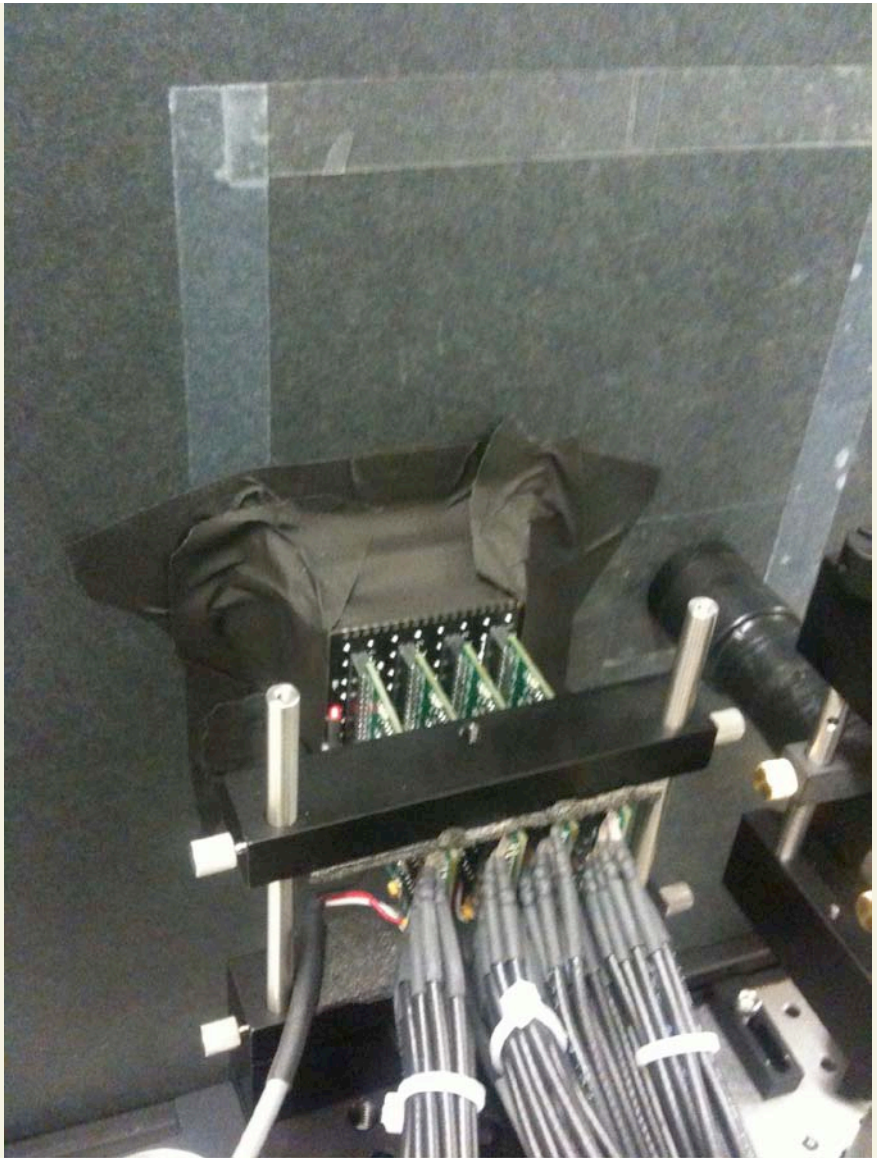
- X-Y Stepper Motors
  - 150 mm travel
- Fiber Collimator
- Focusing Lens on Z-translation stage
- Lens has focal length of 50mm

- Tubes see light through ports in box
  - Keeps connections, cables, preamps (heat) outside of box



H8500

- View of rear of tube and preamps
- Also have a Hamamatsu RXXXX tube to use as a reference
  - ¾” tube
  - High gain, fairly fast
- Could add an additional reference tube

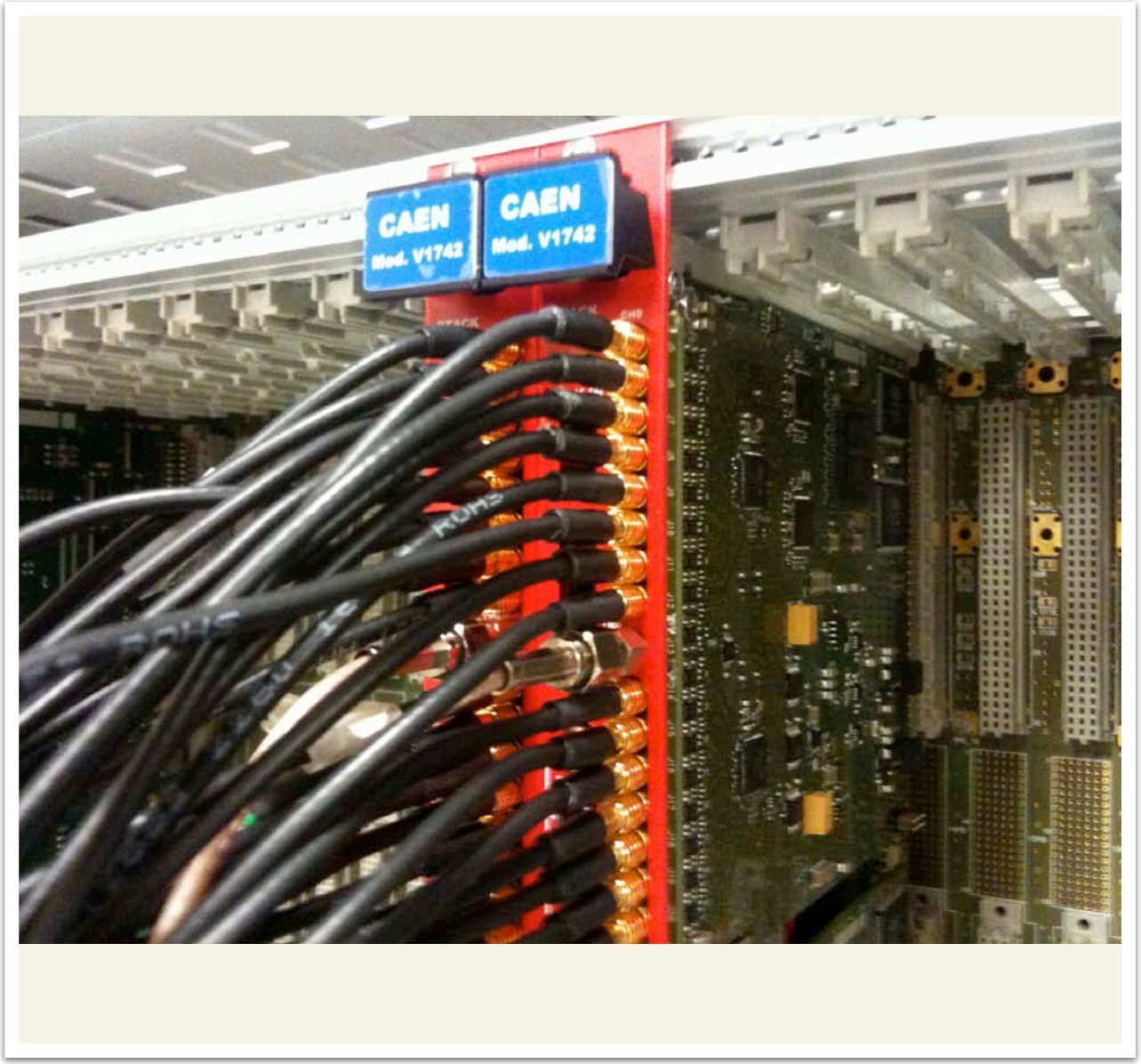


CAEN V1742

2 boards, 32 channels each

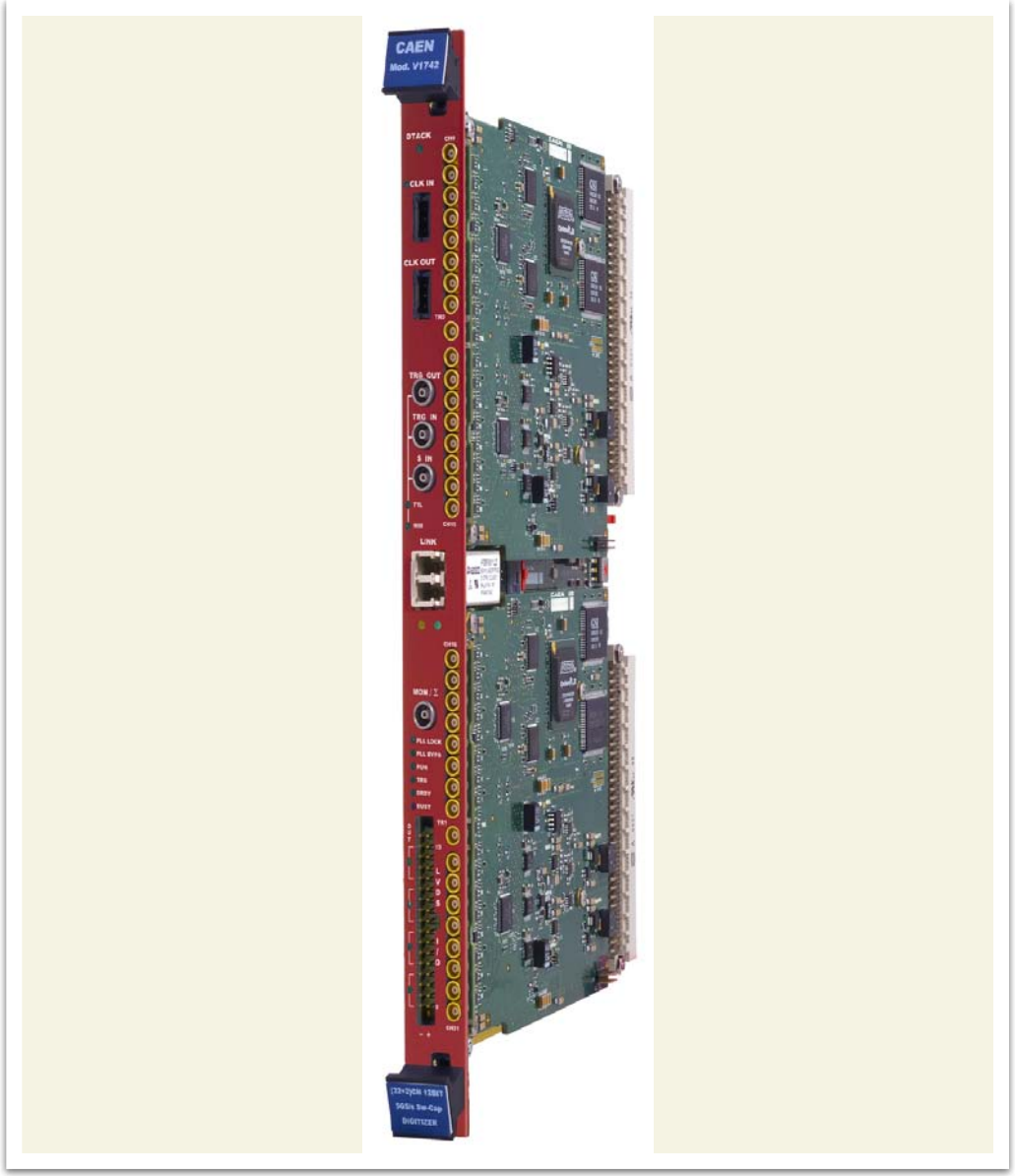
5 GS/s

Digitized trigger signal



CAEN V1742 Waveform Digitizer

- 32+2 channel, 12 bit
- Selectable 5, 2.5, 1 GS/s Switched Capacitor ADC
- 1 Vpp input dynamics, single ended, 50 Ohm, MCX coaxial connectors
- Based on DRS4 chip (Paul Scherrer Institute design)
- 1024 storage cells per channel (200 ns recorded time per event @ 5GSample/s)
- Trigger Time stamps
- Memory buffer: 128 events/ch (optional: 1024 events/ch)
- Dead Time: 110µs Analog inputs only, 181µs Analog inputs + TR0, TR1 inputs



Example Waveform Seen in LabVIEW

Scale:

5 ns / div in X

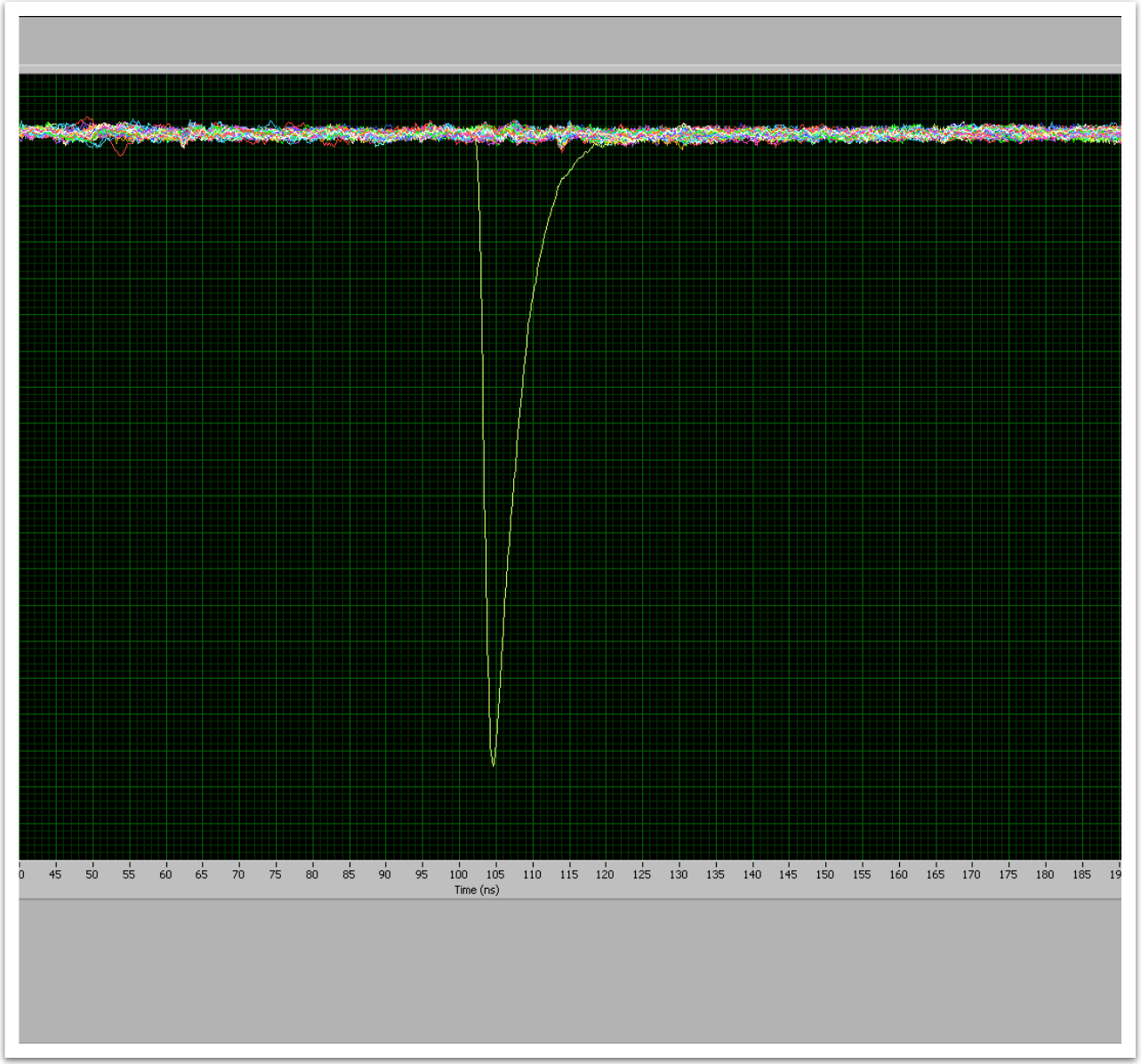
50 ADC counts / div in Y

(~12 mV / div)

This is a larger than average pulse at this light level

Running tube at 1kV

All 64 channels are plotted, give some idea of noise level



Data Collection

- All controlled through LabVIEW
- Trigger generated in software through V1742
- Fanout trigger to laser and delay module
- Fanout delayed trigger to both V1742 modules to start digitization
- Digitized waveforms processed in C then set in to LabVIEW
- Implemented pedestal subtraction, CFD algorithm, and charge integration in LabVIEW
- Basic output: Channel time difference from trigger (also digitized by V1742), total charge

LabVIEW Screen Shot

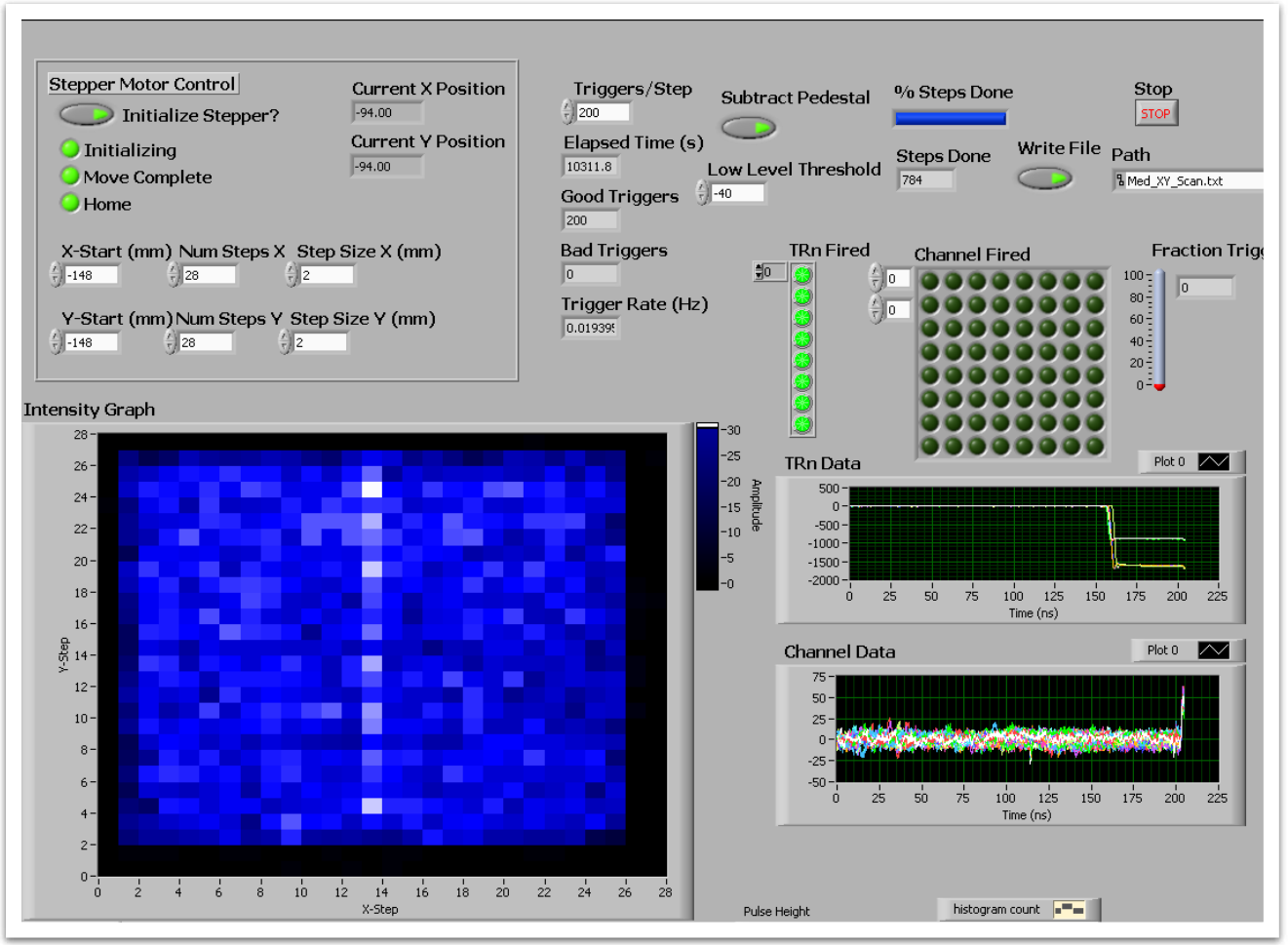
Sample LabVIEW control screen

Control stepper motor position, step size, number of steps, laser pulses per step, etc.

Monitor progress, individual waveforms, trigger lines.

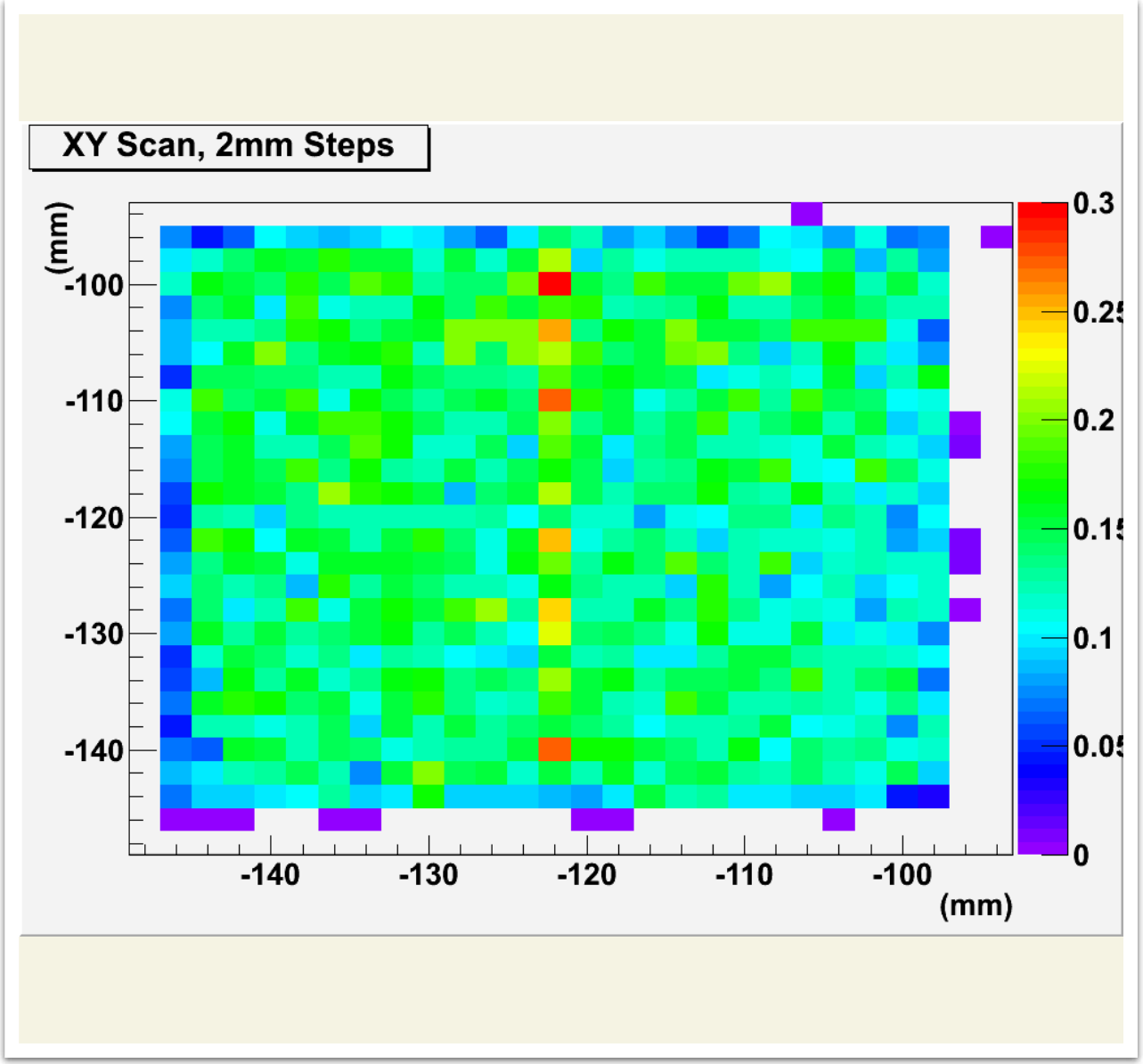
Output data to ASCII file for real analysis

Not outputting samples waveforms, though.



Course X-Y Scan (2mm x 2mm Steps)

- Not fine enough to see details, but just to show system functionality
- Light not quite down to single PE level, would like to get average signal fraction down to ~10%
- 200 trigger per point



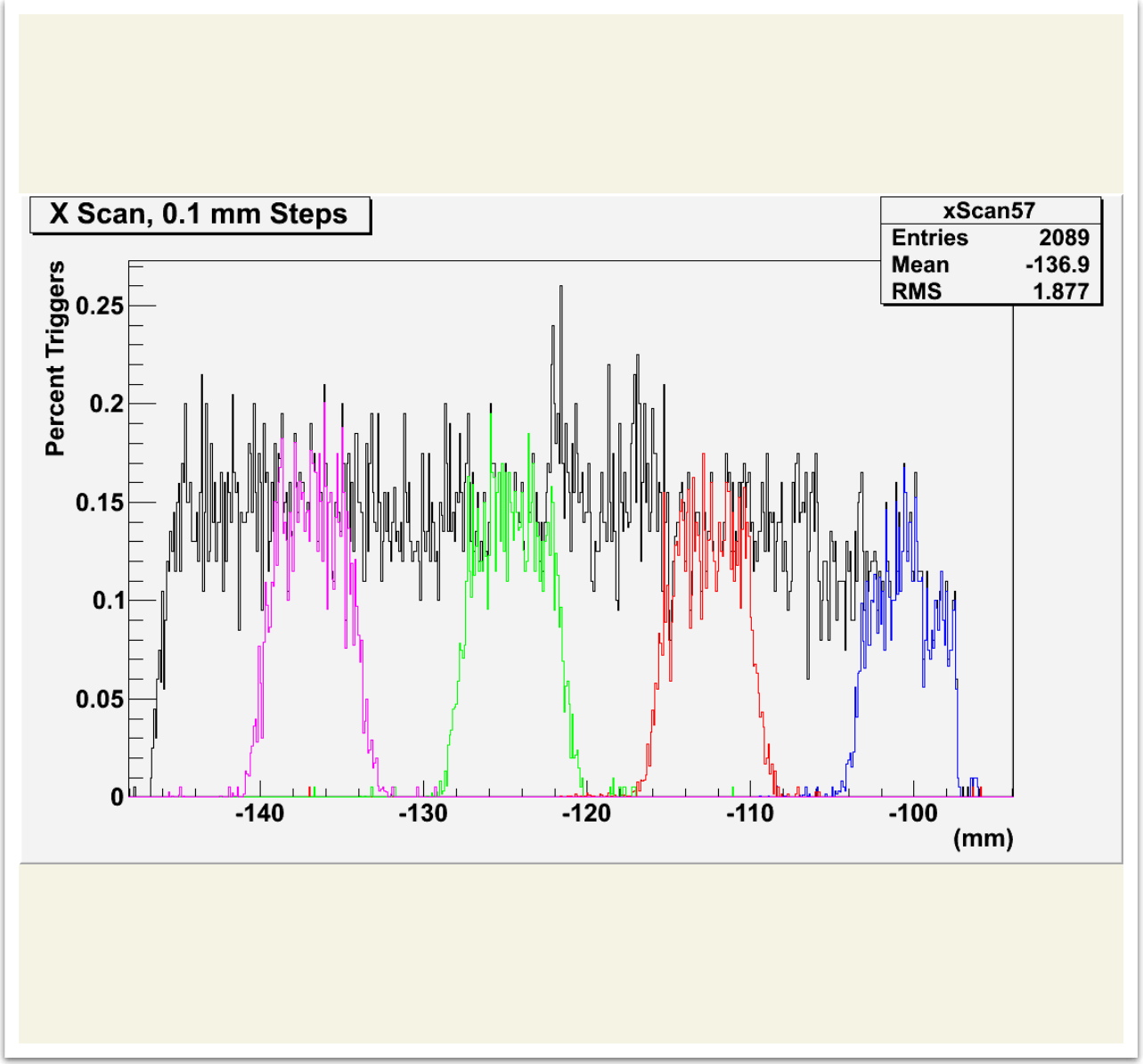
Scan in X, 100um Step Size

Fine step size scan

Need more statistics per step to see real structures

Black, all channels

Different colors show 4 different individual channels



Integrated Charge, Single Channel

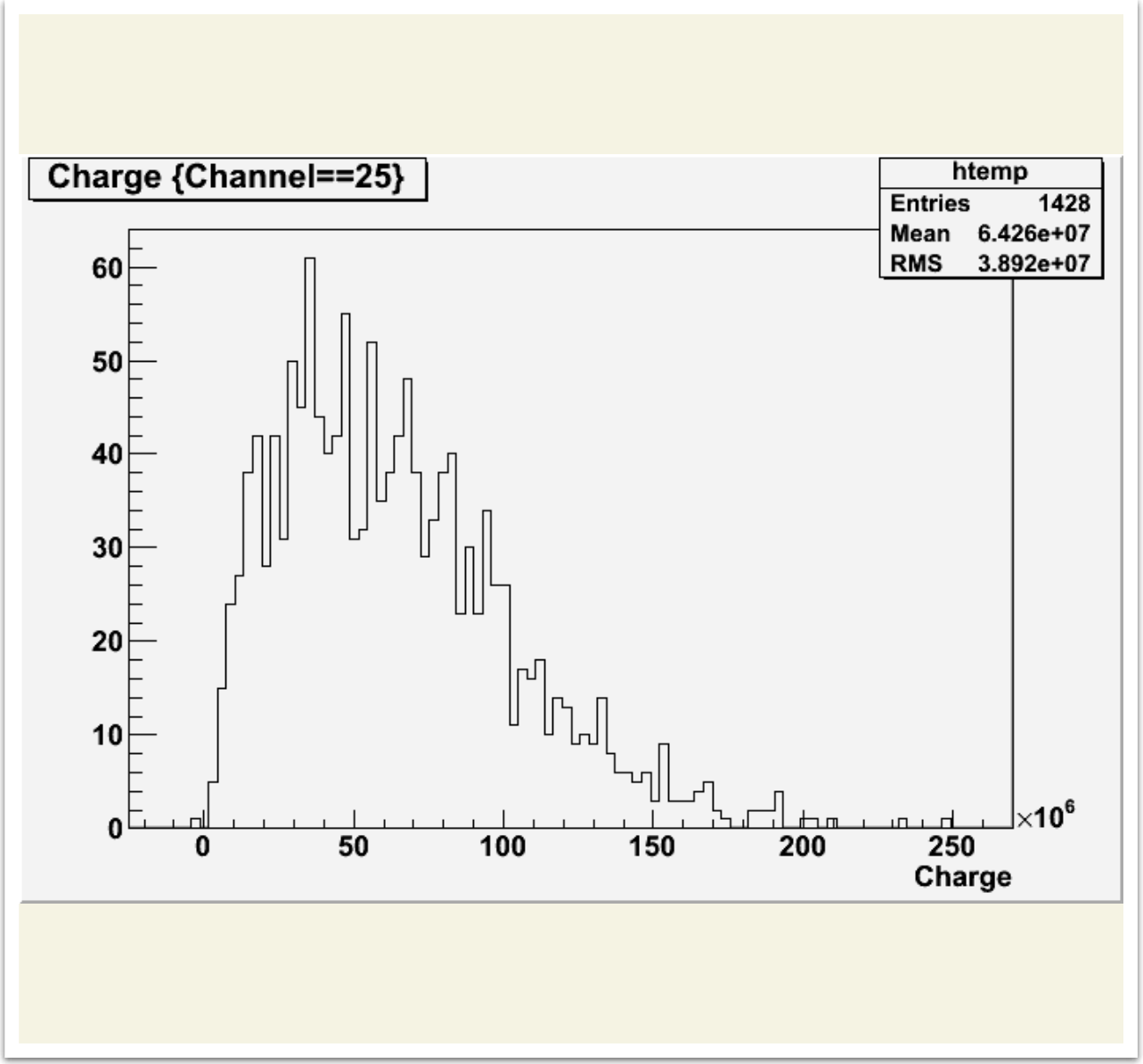
Ran higher statistics run over one channel (10,000 pulses)

Plot shows total charge in electrons

Running tube at 1kV, should have gain ~1.5E6

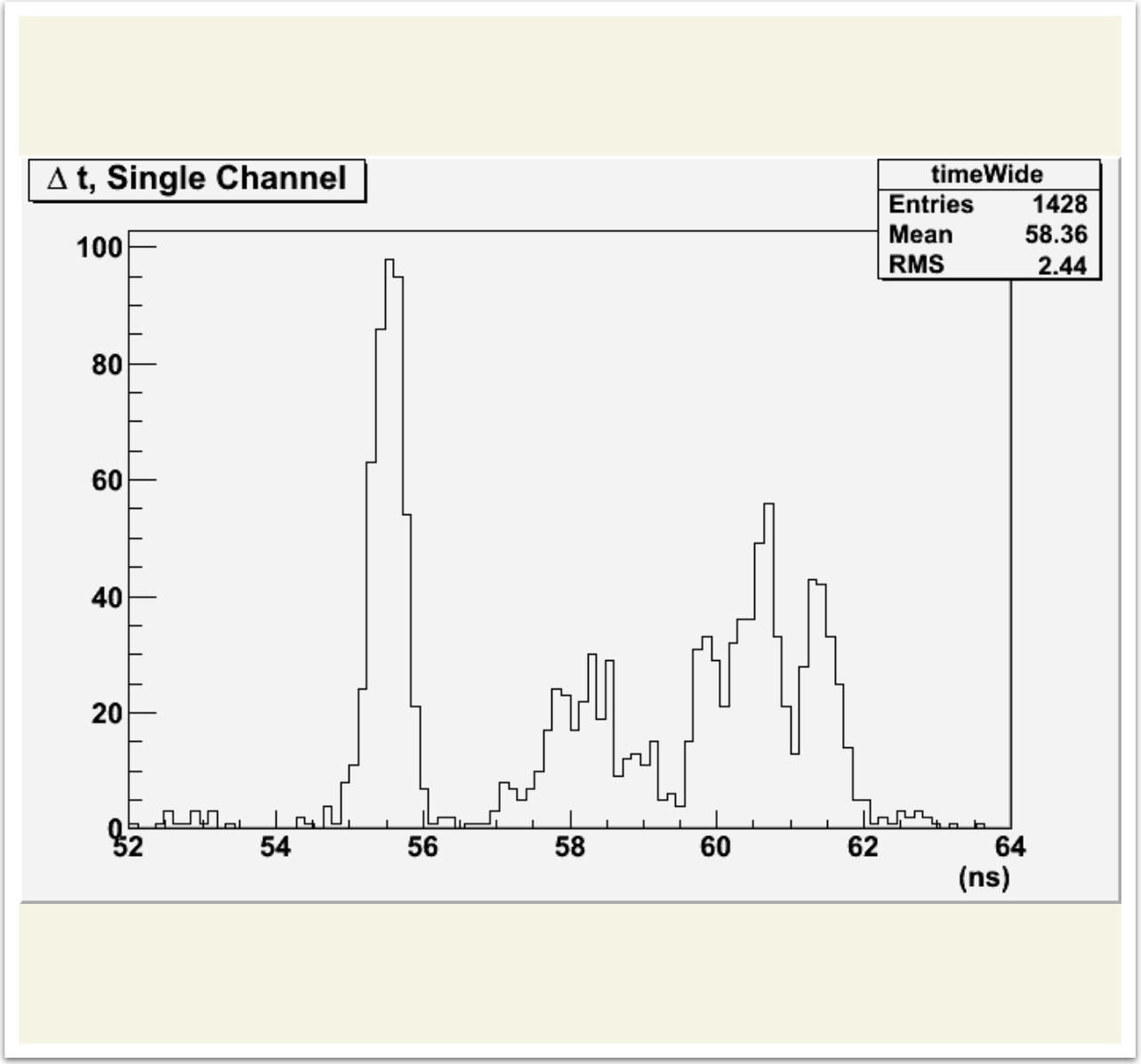
Plus, x40 amplifier

Total gain ~6E7



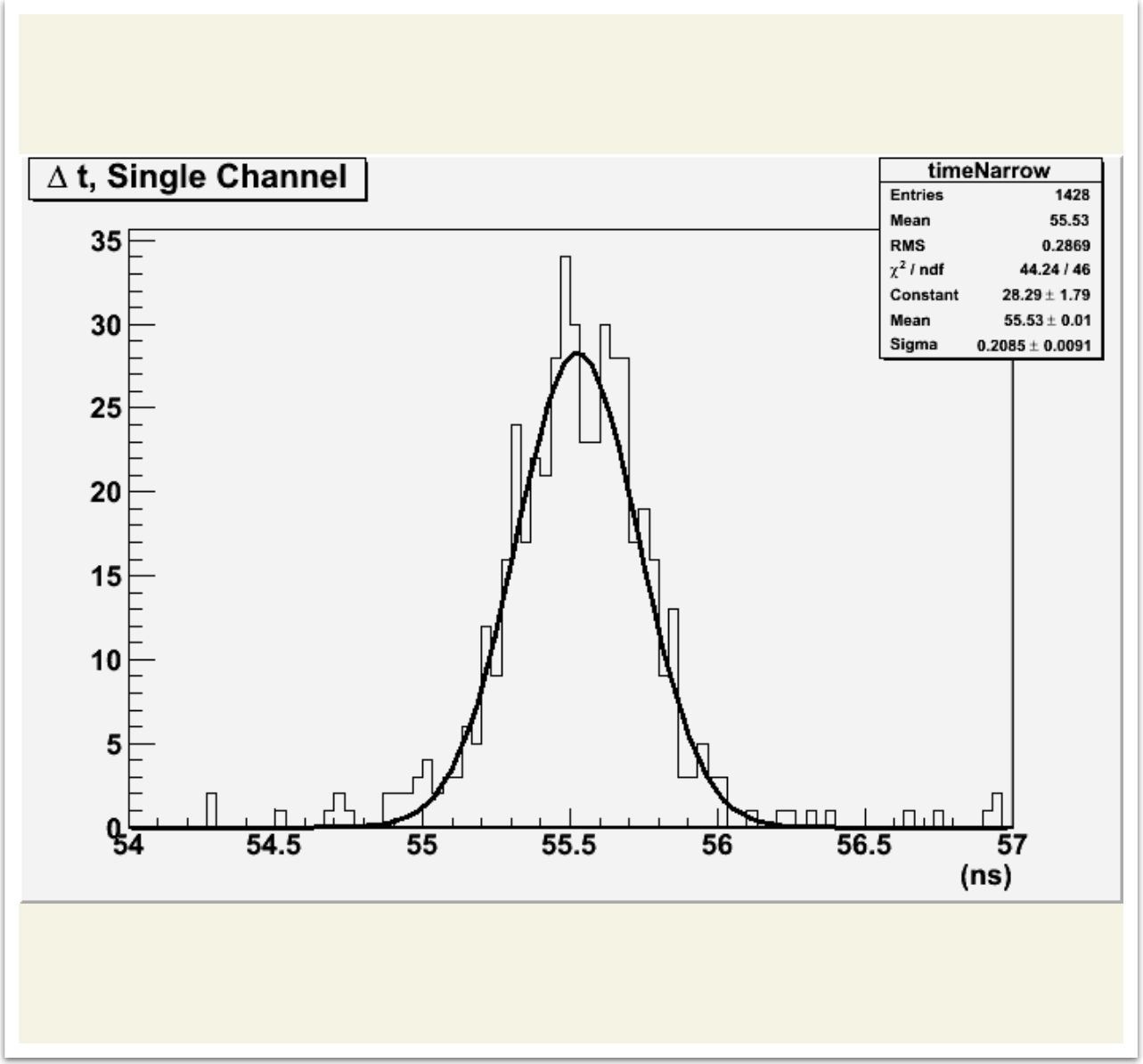
Time Distribution

- Difference between single channel and trigger software CFD output
- Need to investigate the source of apparent quantitized jitter:
  - Trigger?
  - Laser?
  - Software?



Time Distribution

If we pretend that we solve the jitter issue, and focus on the first narrow region from the previous plot, see a nice time peak with sigma around 210 ps.



Things To Do

- We still have a lot to learn about the V1742
  - Trigger timing, syncing both boards
- Other issues
  - Timing resolution and jitter?
  - Some double-firing of adjacent channels
    - Tube, preamp, ?
  - Reduce noise; some seems to come from laser
- Tune and understand our software CFD algorithm
- Need to speed things up
  - Move more code into C instead of LabVIEW?
  - Use event buffer of V1742
    - Each channel has a 128 event-deep buffer. Currently just triggering and reading one event at a time
  - The less LabVIEW has to display, the faster it runs
- Get down to believable single PE level
- Define list of studies to perform and suite of tests
  - Easier once speed and other issues are understood