Update on
Light Readout Tests at UChicago

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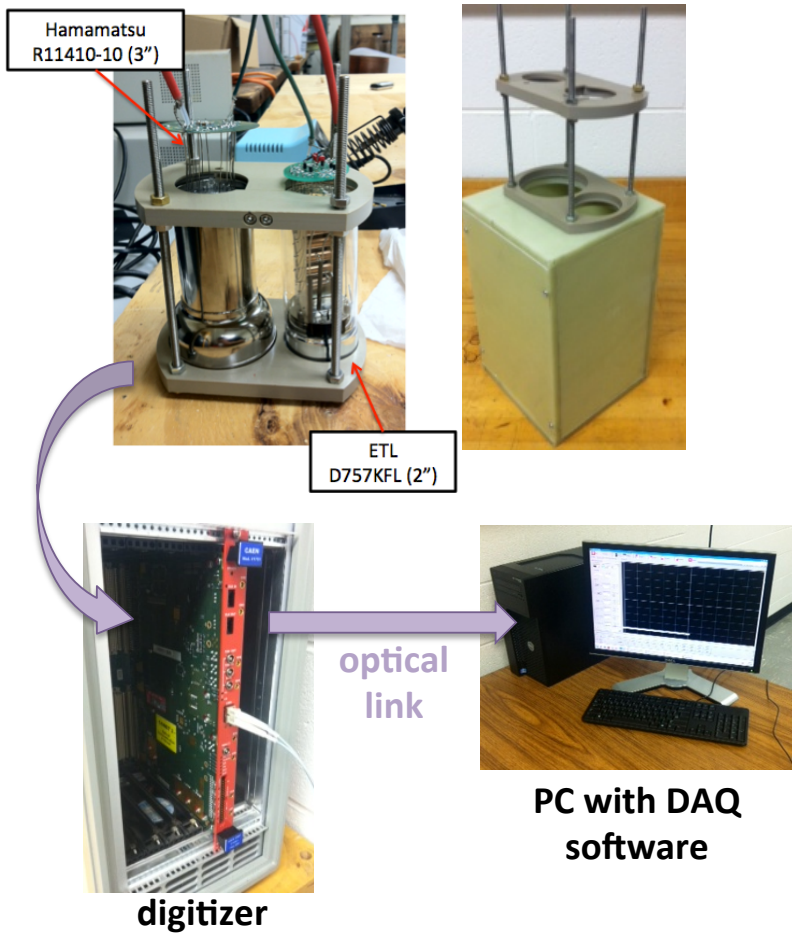
LArIAT Meeting

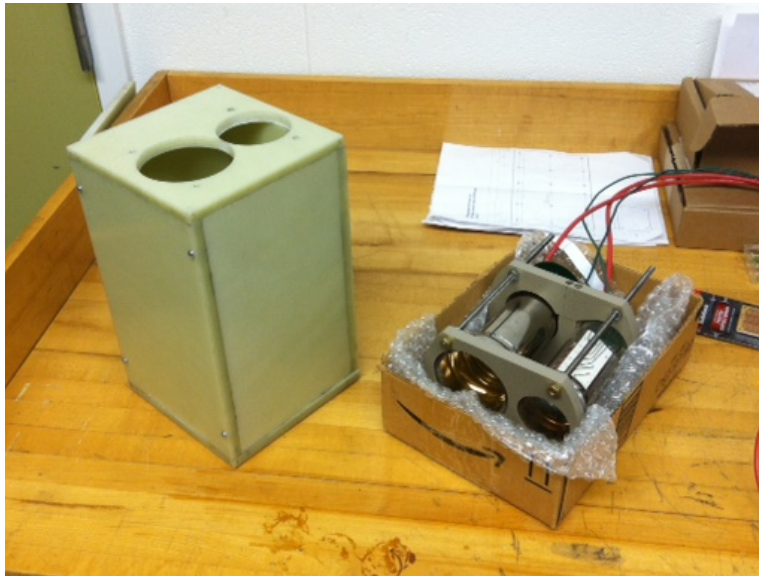
July 18, 2013

Since our last update…

- Feedthroughs have arrived (thanks Flavio!)
- G10 reflectivity results from Cracow U. of Tech (thanks Pawel!)
  - Will send more samples + copper foil sample soon
- Mock-TPC G10 box done
- Have a 240V power supply
  - Still need supply for:
    1 SiPM, 100V
    Level-meter, 25V
- WArP code modified for our needs (Lots of coding wizardry by Andrzej)
  - Average waveforms + pulse integration
  - Single photo-electron response (SER)



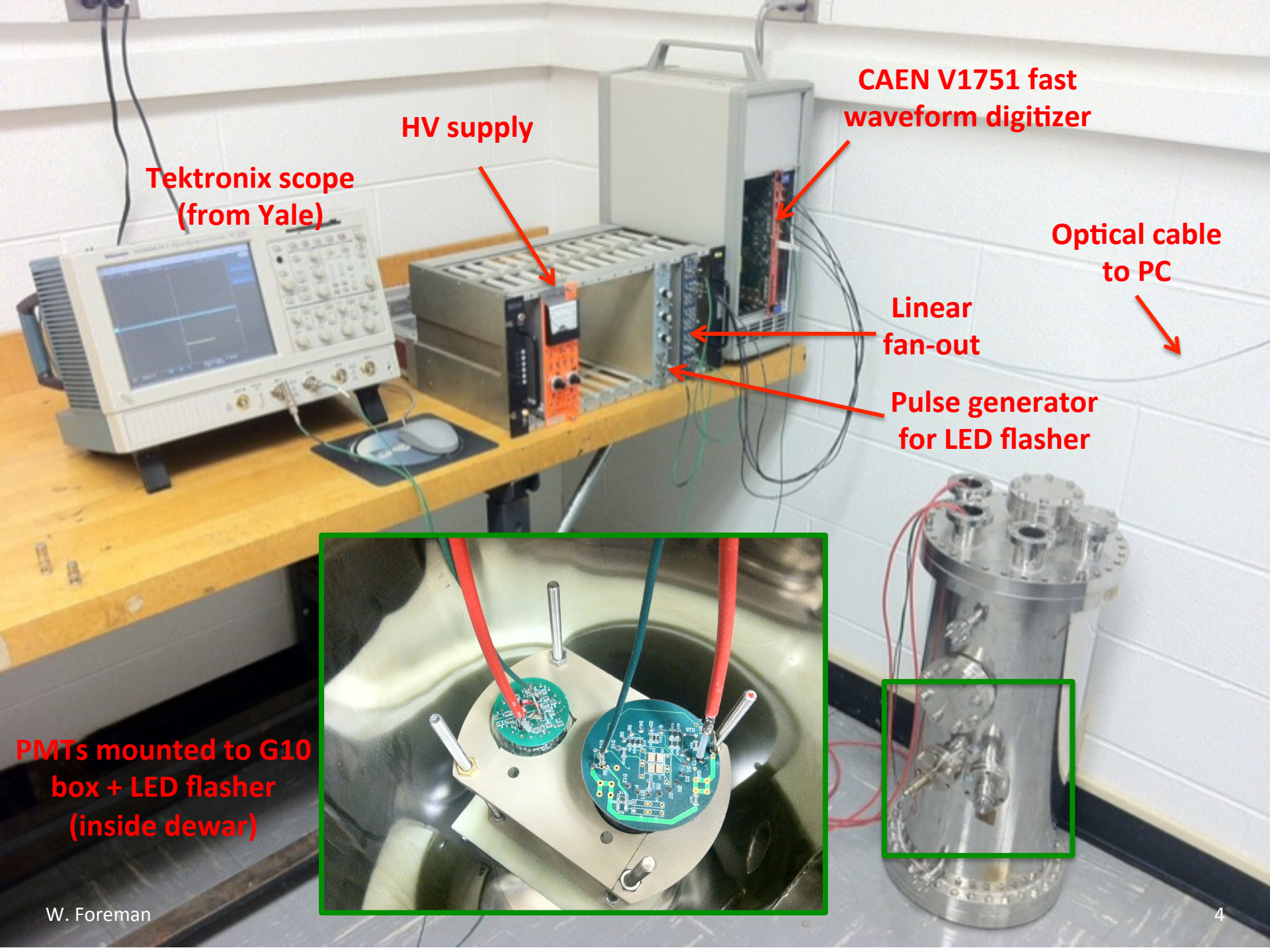
Mock-TPC (aka “The Birdhouse”)



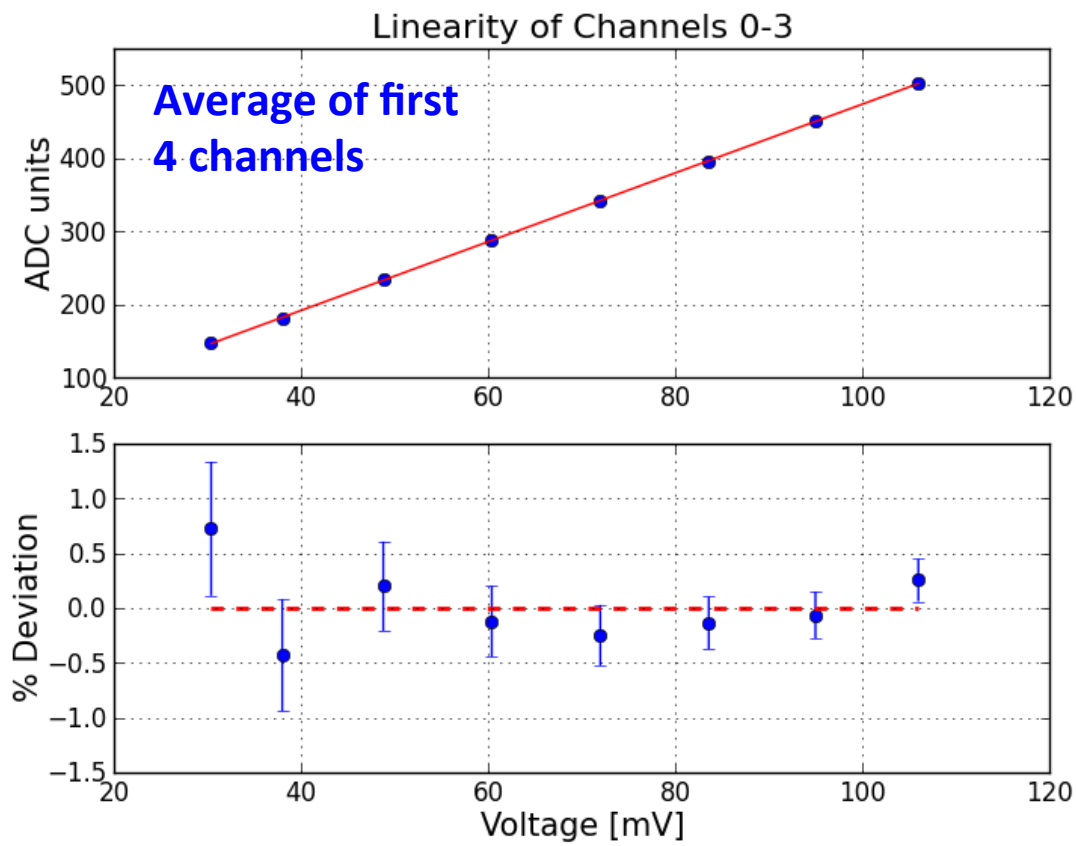
Small 4.7L mock-TPC made of G10 to be submerged in liquid argon

TPB foil will coat inside walls

PMTs and SiPMs mount to lid


CAEN V1751 fast waveform digitizer
HV supply
Tektronix scope (from Yale)
Optical cable to PC
Linear fan-out
Pulse generator for LED flasher
PMTs mounted to G10 box + LED flasher (inside dewar)

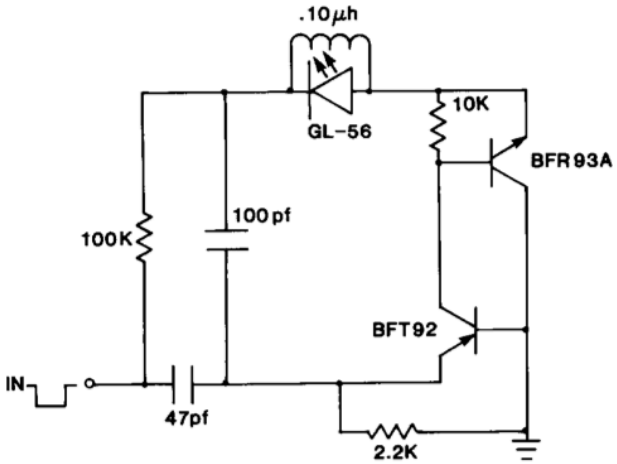
Digitizer linearity

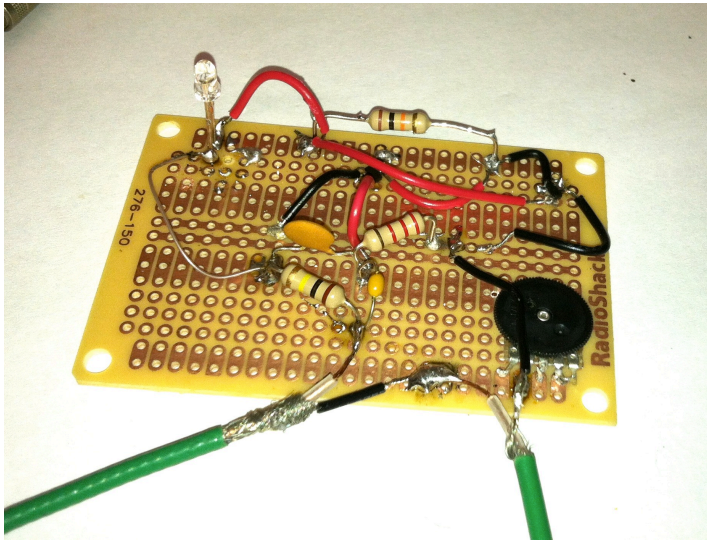


Quick study of digitizer response (in ADC) for input up to 100 mV

- Linear to 100 mV
- Consistent with expected full scale (1024 ADC for 200 mV)

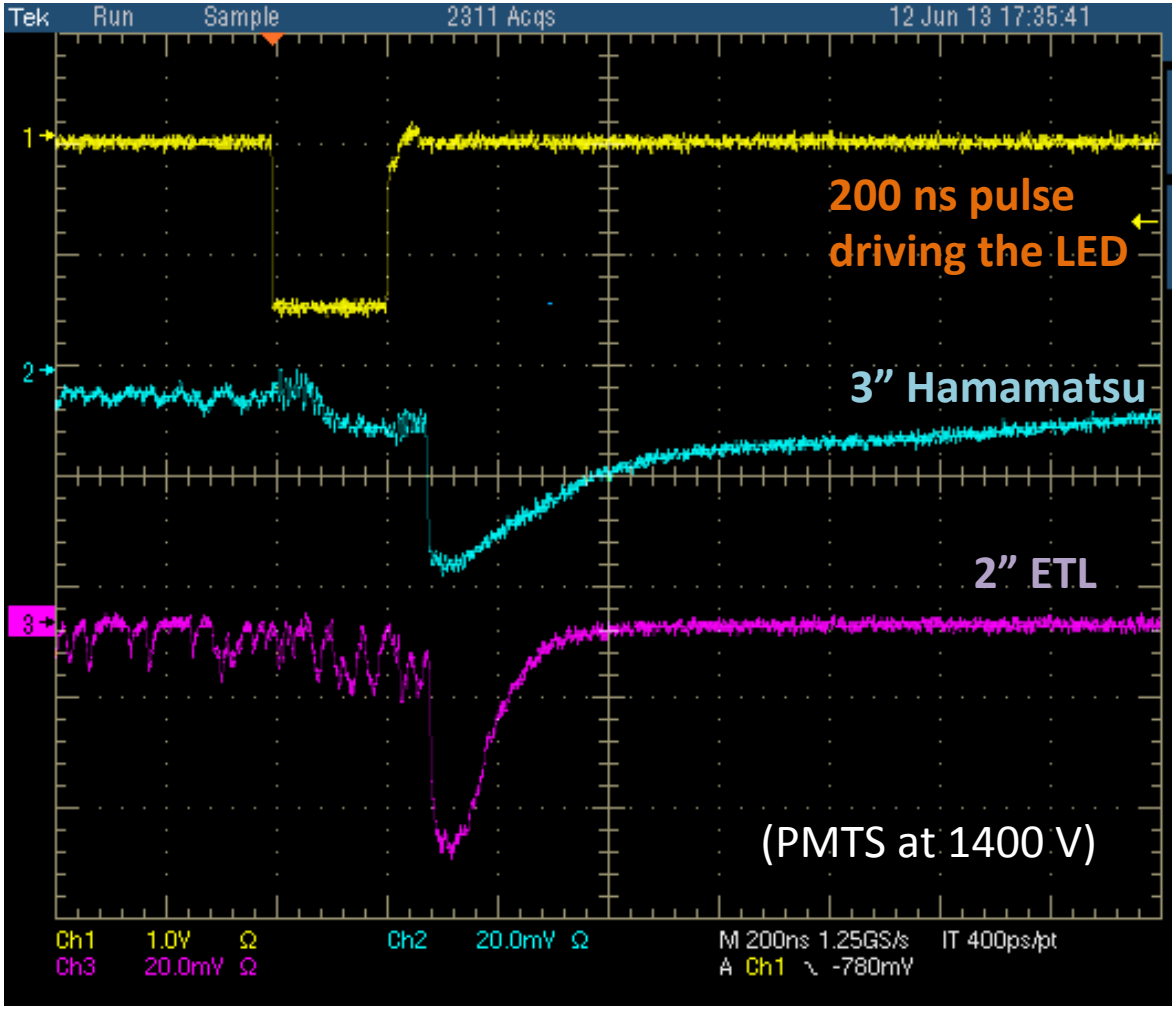
Fast LED Pulser





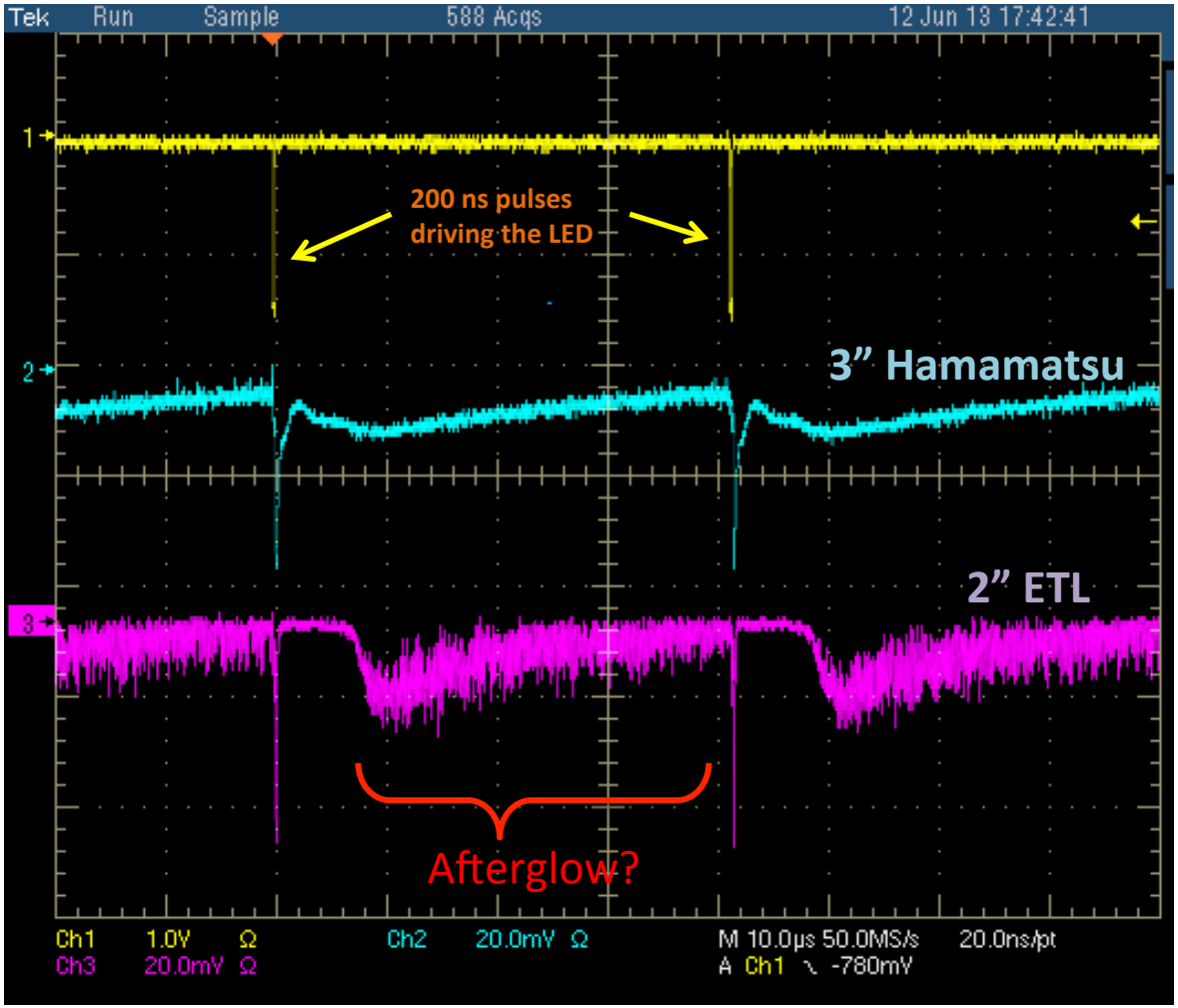
- Pulser from *Kapustinsky* design
  - "A Fast Timing Light Pulser for Scintillation Detectors", 1985
  - Input square pulse (-1.5V) rides on adjustable DC bias (0 to -9 V) to set light intensity
  - Cost of components < $20
- LED: Nichia NSPB300A LED
  - 3mm, 470 nm
- 0.10uH inductor meant to reduce time constant of pulse to ~10 ns

No inductor:



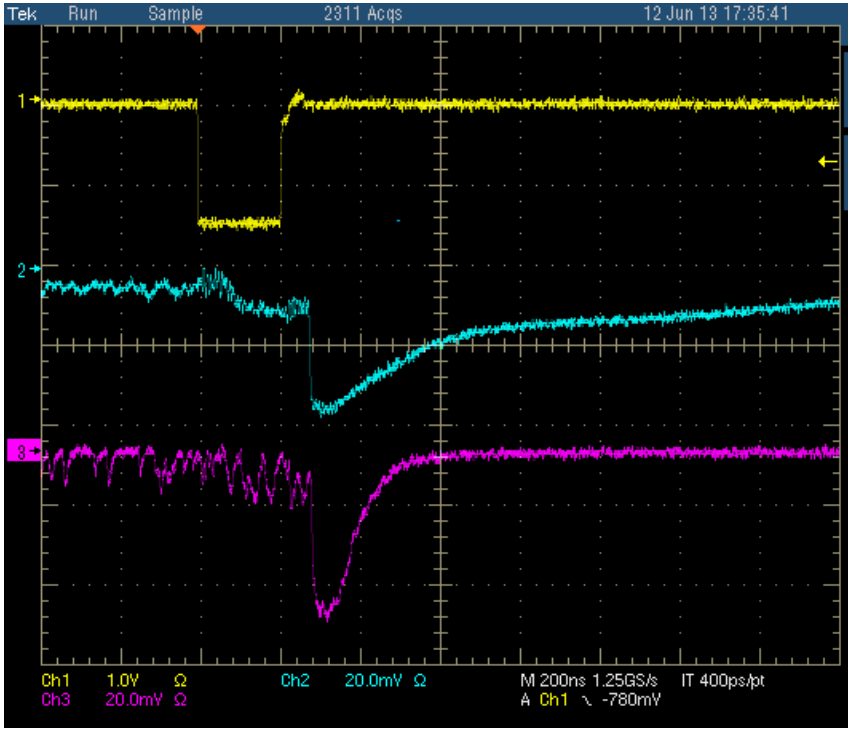
- Long initial pulse (200 ns)

No inductor:

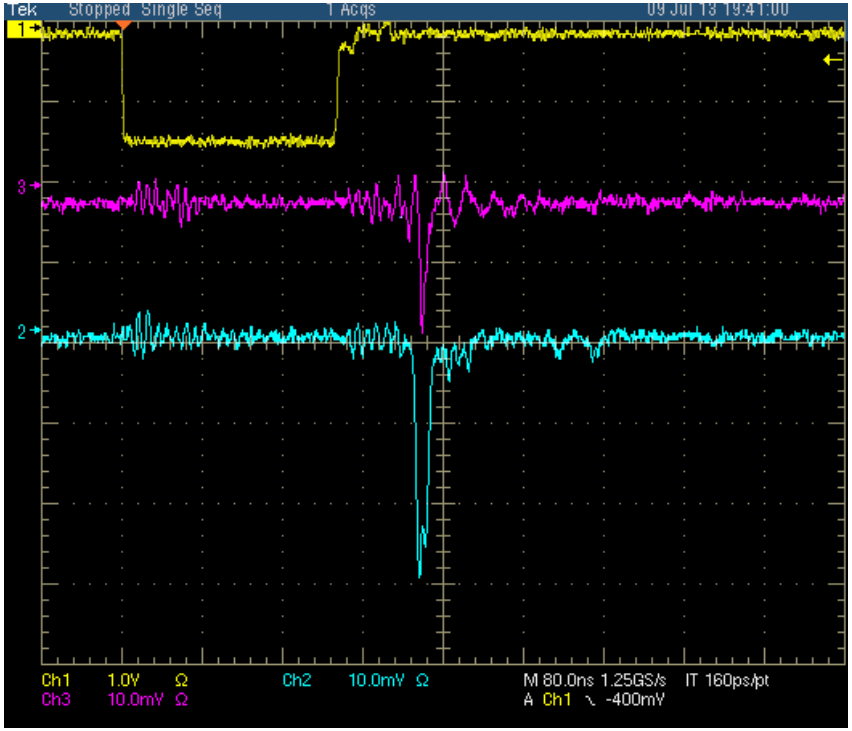


- Long initial pulse (200 ns)
- "Afterglow" photons starting around 7 us

Before:

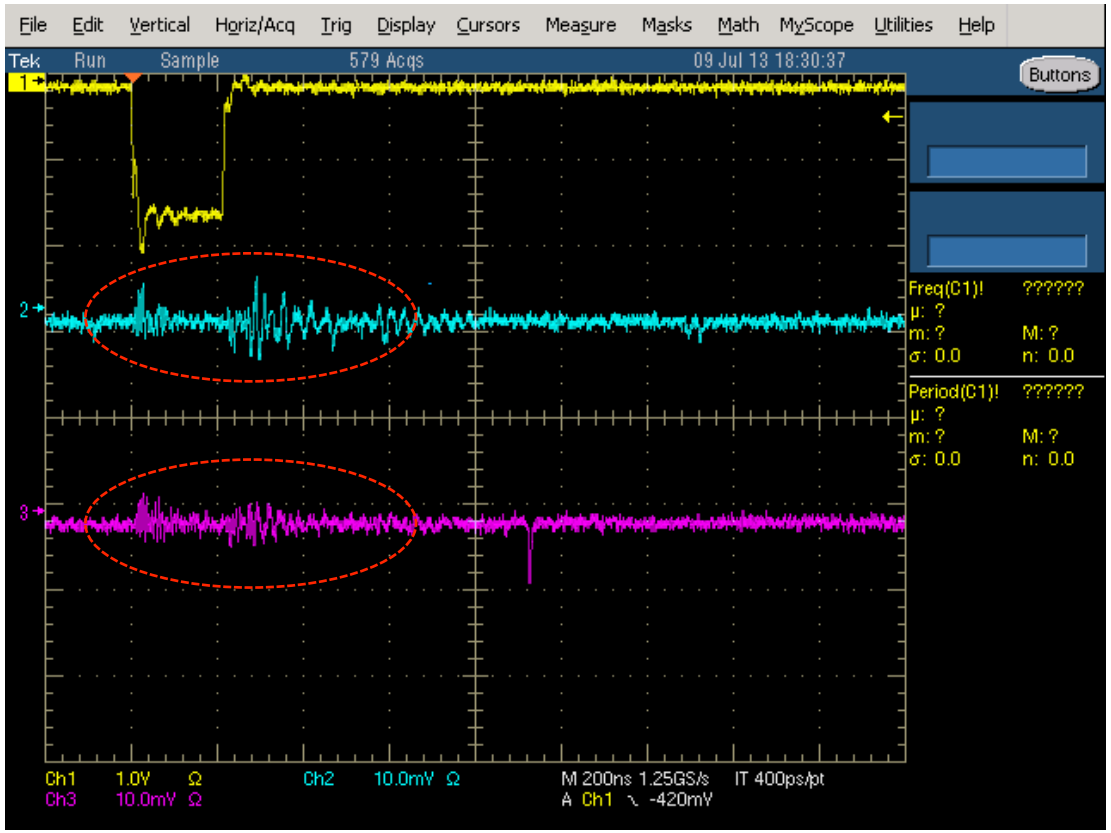


After adding 0.1uH inductor:



Much easier to isolate the LED flash (width reduced to ~20 ns)

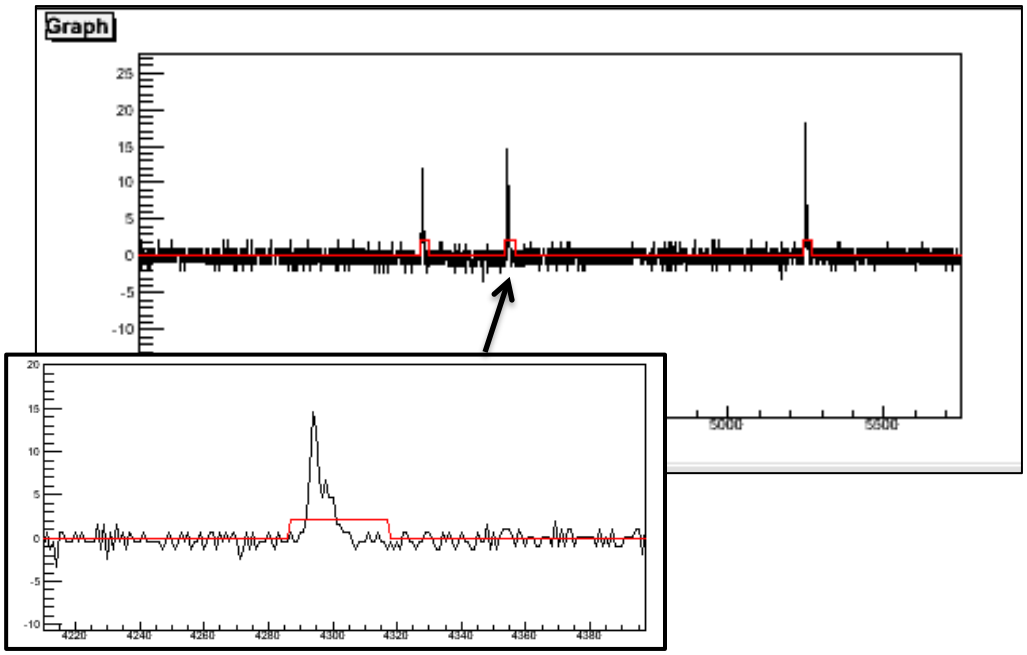
However…



Signal coincides with ringing at edges of driving pulse

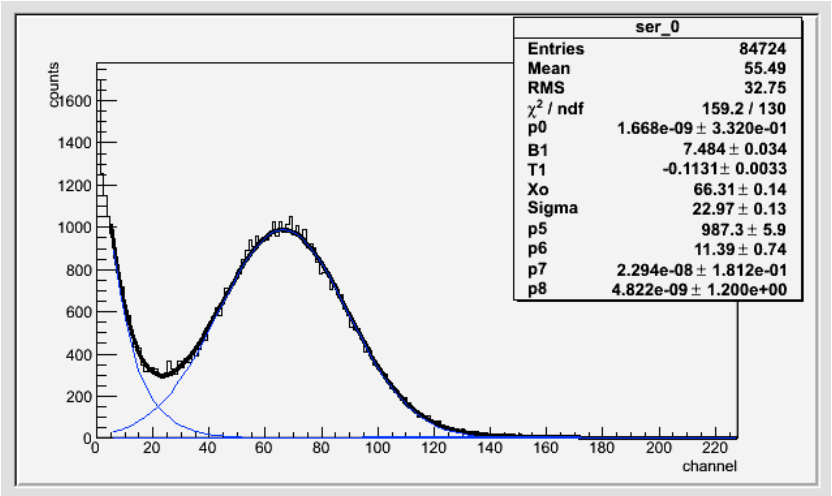
- Likely due to HV power supply + pulser sharing crate
- Could affect SER
- Better to exclude inductor from flasher circuit?
  - Extracting PE's from the tail over longer and more well-behaved timestream

Finding and integrating pulses



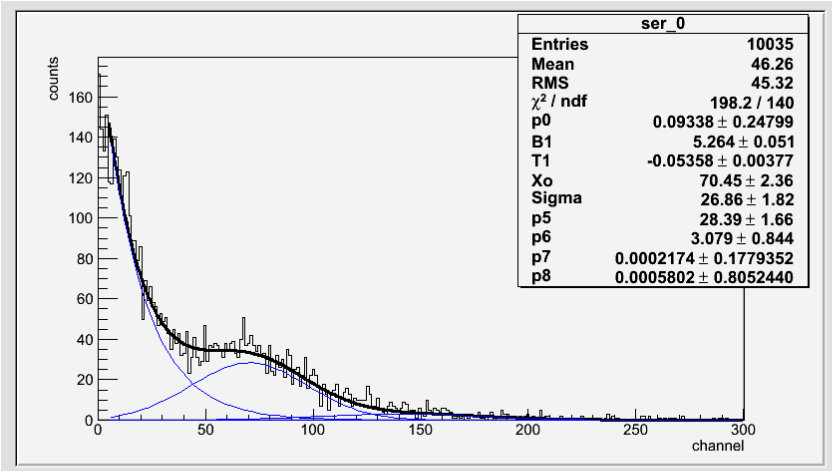
- SER algorithm looks for amplitudes above some threshold over RMS noise
- Corrects for running baseline and integrates pulses → SER histograms

Single photo-electron response (SER)



Long LED flash + afterglow photons

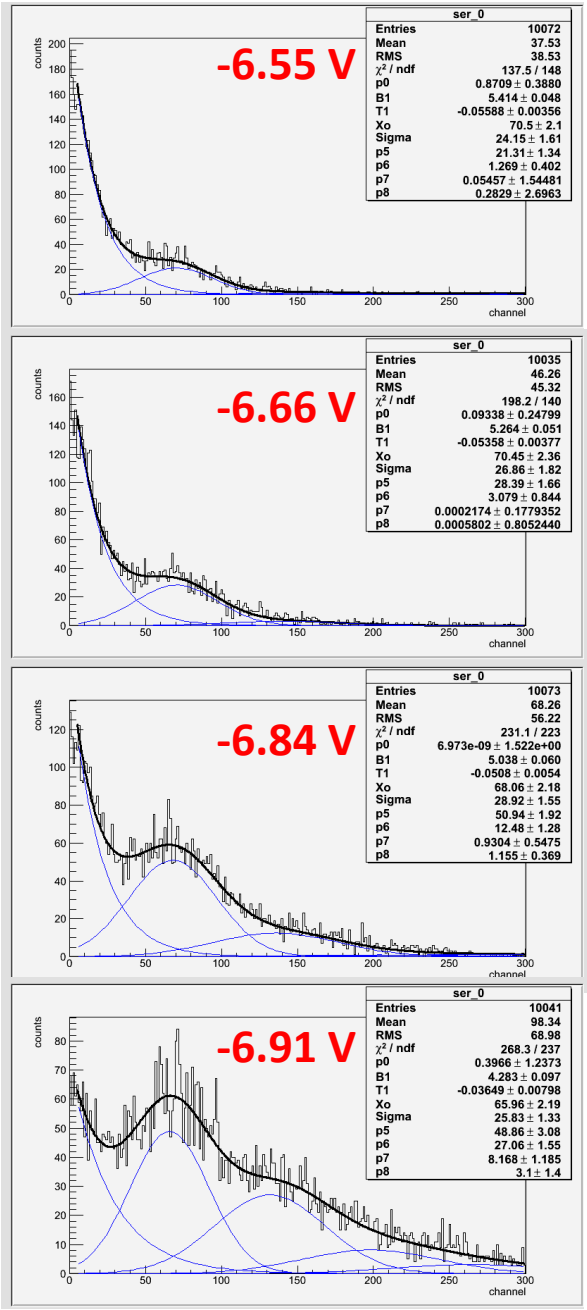
- Wide (7 us) window
- 1PE peak clearly separated from noise



Short LED flash photons

- Narrow (300 ns) window centered on the pulse
- SER noise-dominated from ringing
  - ➢ lots of low-amplitude fake PE entries

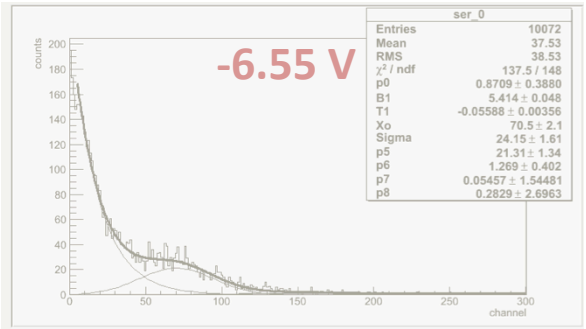
SER vs. light intensity

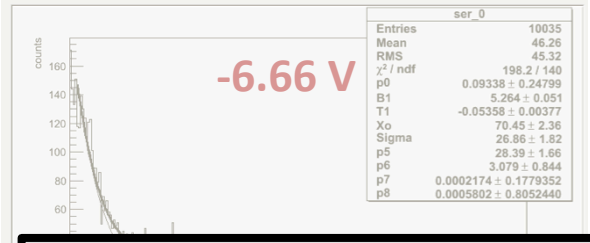


Increasing negative DC bias on input pulse for LED flasher = MORE LIGHT

- 2PE, 3PE, 4PE peaks increase as expected relative to 1PE

SER vs. light intensity





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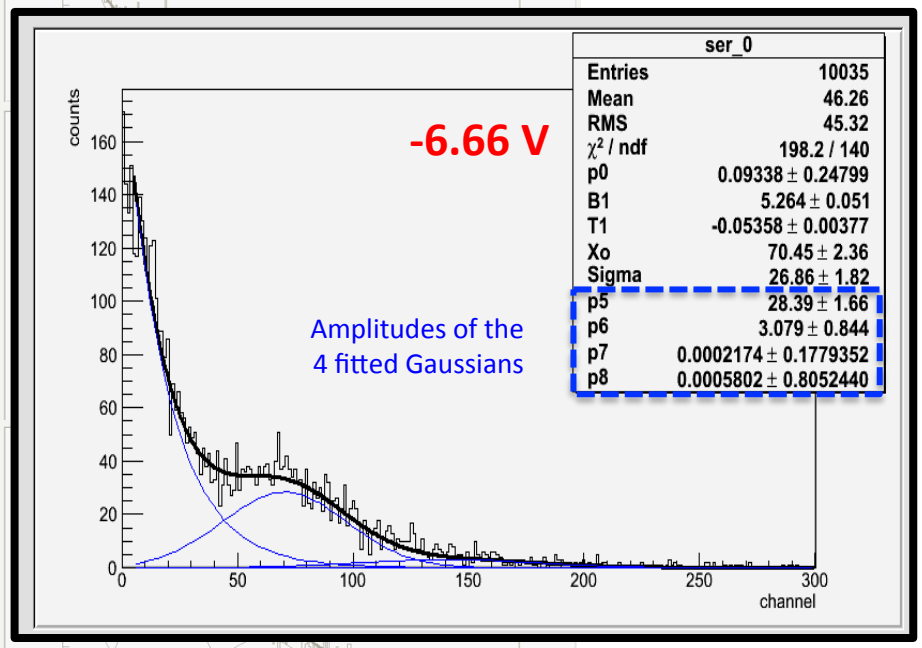
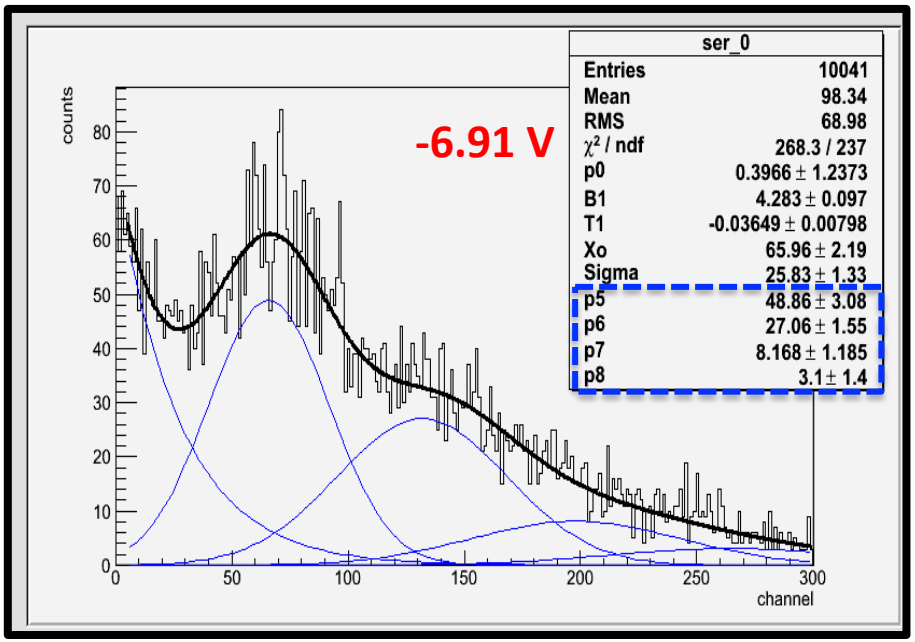
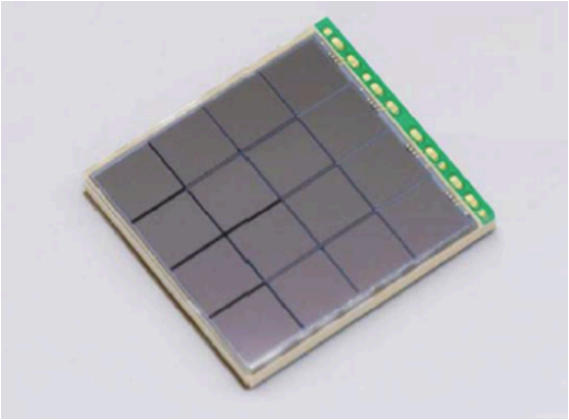


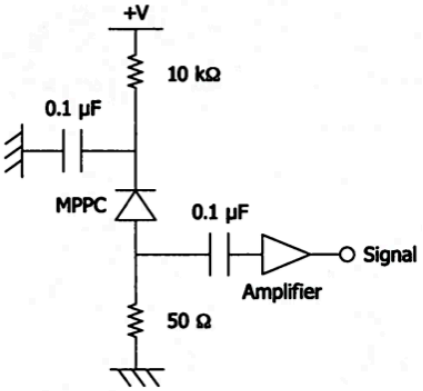


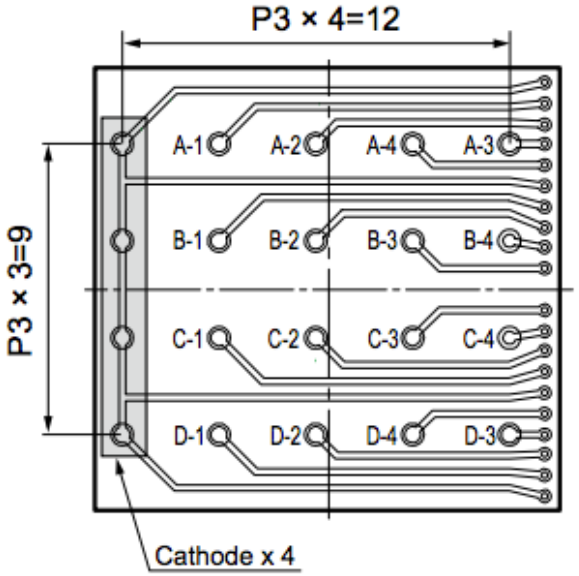
SiPMs

We have 2 SiPMs!! (S11828-3344M)

- 1.4 x 1.4 cm
- Intend to test alongside PMT
- Will connect to separate linear amplifier circuits (design shown here from Nicola)



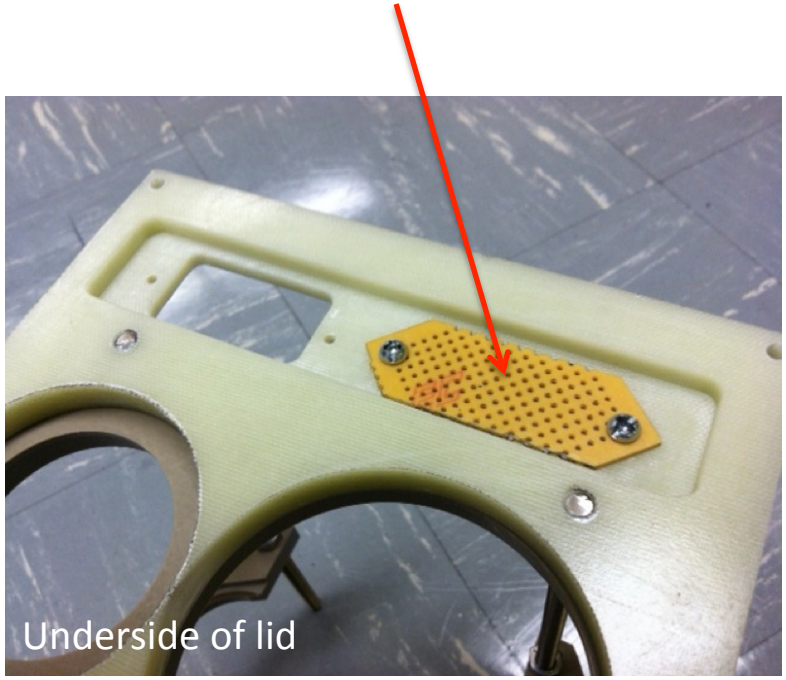




- How should we do this?
- Can anode nodes be connected via horizontal/vertical bridges?

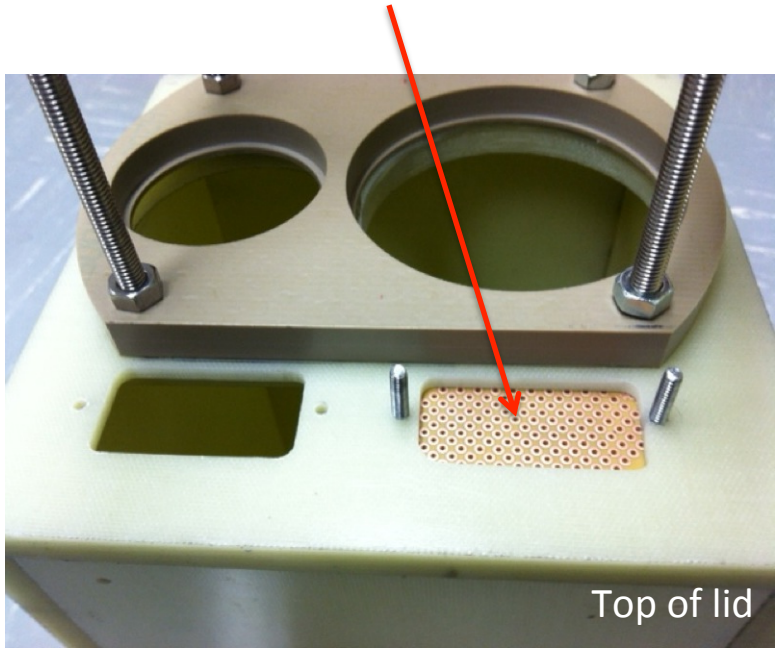
Mounting the SiPM + amp circuit

SiPM goes here



PCB board visible through cutaway

- Leads (signal, HV, ground) to be soldered onto circuit
- Access to SiPM cathode/anode through holes

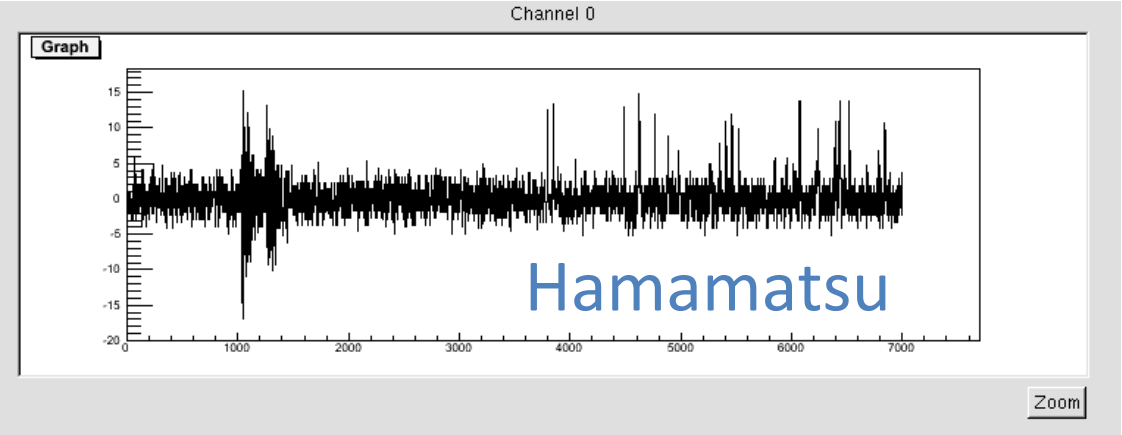


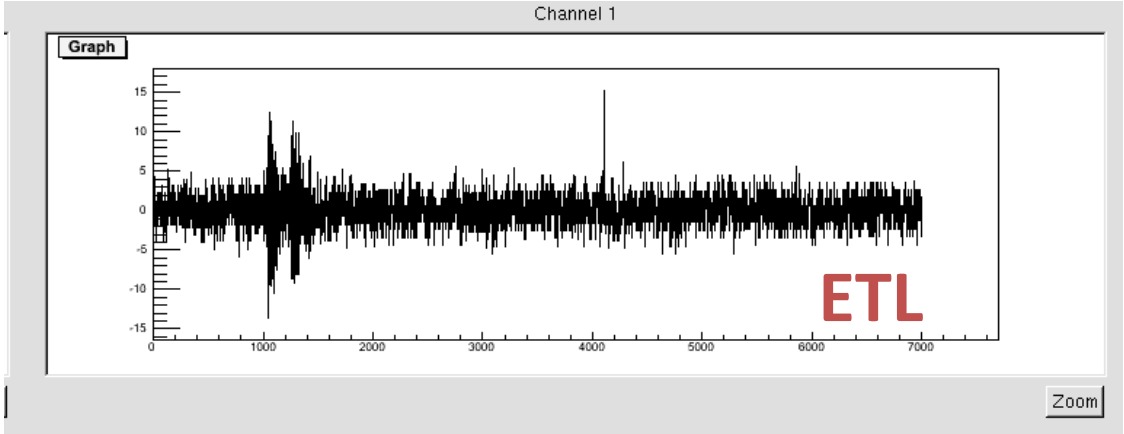
Next steps:

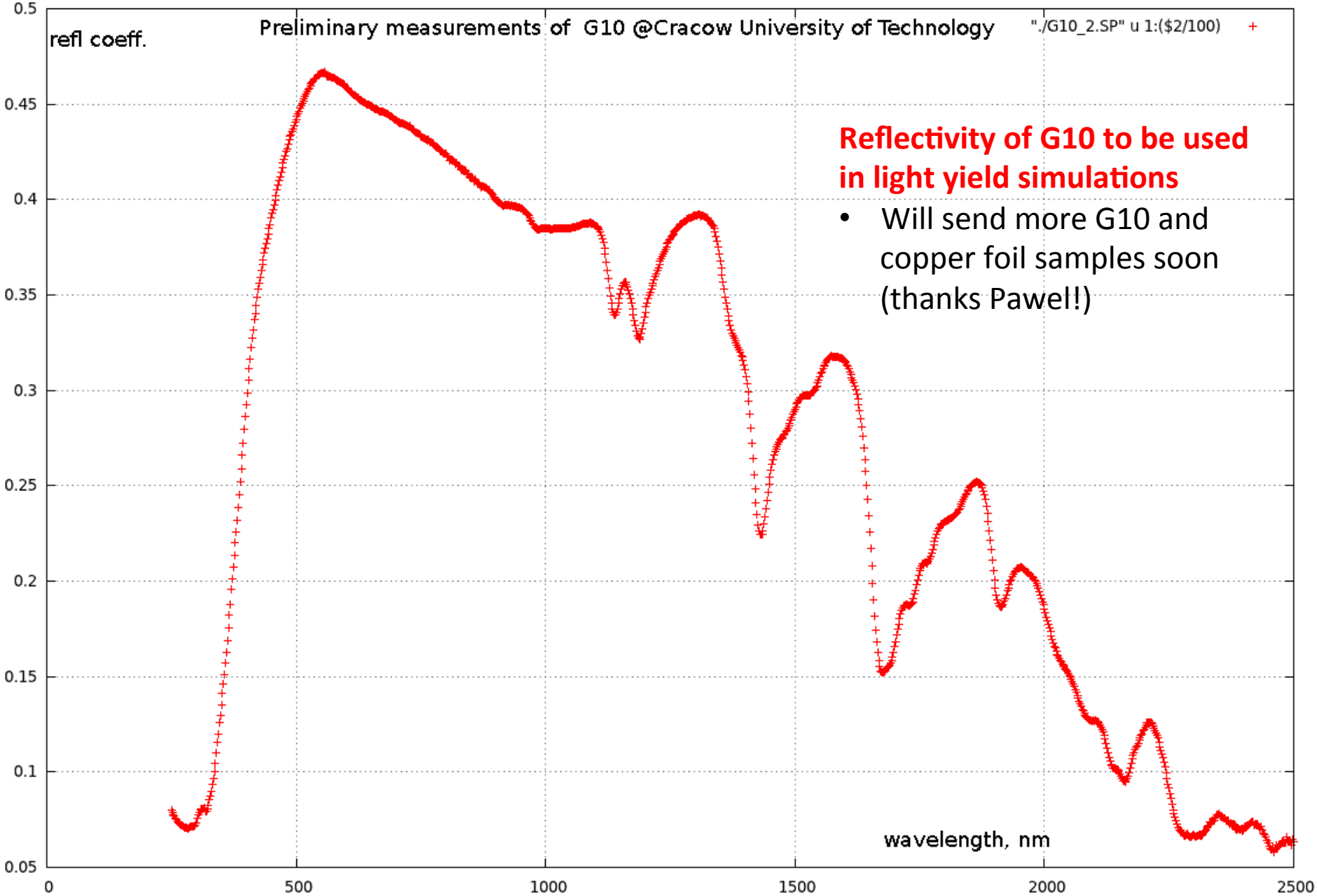
- Gain of PMTs in air
- Test SiPMs in air
- Readout from all four devices (2 PMTs + 2 SiPMs) triggering on cosmic rays in LAr!!
- *Eventually*: integration into full LArIAT DAQ

Bonus material

Some data readout w/ringing







Reflectivity of G10 to be used in light yield simulations

- Will send more G10 and copper foil samples soon (thanks Pawel!)