I CPT July 2014 Testbeam

Formula to convert attentuation in db to amplitude factor
amplitude factor = sqrt(10^(attentuation/10))

Friday July 25, 2014

Artur and Si are at SiDet to perform measurement of DRS electronic time resolution. Laser shooting into Photek MCP. signal is splitted and goes to 2 different channels on DRS board. Trigger using the laser trigger signal.

REMINDER FOR LATER: TRIGGER THRESHOLDS ON THE CRATE IS BETWEEN 0.5 AND 1.0 V. 400 EVENTS PER SPILL AT 12 GEV ELECTRON BEAM ON SCALERS AND 70-80 EVENTS IN DRS4 SCOPE.

drs4_v4_2216_run004.dat
DRS used for the previous testbeam
channel2 gave lower amplitude for the same splitted signal relative to channel1. testing it on channel 4 gave the same amplitude as channel1. we conclude that there is maybe some damage on channel2.

time resolution shows 2 peaks. main peak has resolution of about 6ps. RMS including both peaks is about 9-10ps

drs4_v5_2439_run007.dat
one of our new DRS's 2439

also see 2 peaks. main peak has resolution of about 4.5-5 ps. secondary peak is a bit smaller compared to DRS2216. RMS is about 6ps when including both peaks.

found channel4 has half of the amplitude of the splitted signal in ch1. ch2 and ch3 gives the same amplitude.

drs4_v5_2442_run008.dat

one of our new DRS's 2442

same structure with shoulder (2 peaks). main peak resolution is 4ps. with shoulder, the RMS is 5.5ps.
all channels show the same amplitude on the splitted signal

drs4_v5_2422_run009.dat
one of our new DRS's 2422
worse resolution than other DRS boards. about 10.5ps. there are hints of 2 peaks, both of the same height.
all channels show the same amplitude on the splitted signal

Wednesday July 30, 2014

laptop ip address: 131.225.170.228

ORC inspection passed yesterday. There is a problem with the Main Injector, and we do not have any beam as a result. Waiting now for this problem to be fixed.

Preliminary Run Plan
1) **Commission TOF setup** with beam going through → PhotekA PhotekB HamA HamB

* reproduce 15ps resolution in photeks, 20ps resolution in Ham's
* commission the cherenkov signal

2) **Shashlik TOF** with Y11 fibers.

* Scan in energies. Measure TOF resolution vs Energy to understand what is the ultimate time resolution limitation in the shashlik fiber setup
* Study TOF resolution for different fibers (BCF-92, DSB-1)

3) **Solid Crystal Measurements**

PhotekA

|
(4GeV electron) --> HamA | Radiator | 1.7cm cube
|
PhotekB

* Study pulse shape
    * understand if there are direct hits on Photeks from showers upstream (by having a run without putting any crystal in the middle and seeing the rate of direct hits)
    * possibility to use veto counters to understand occurrence of showers upstream - in situ
* Reproduce 30ps TOF resolution from last testbeam
* Lead radiator in front to have the cube sample different shower depths
    * see if TOF resolution depends on shower depth
* do the same runs but using SiPMs as photodetectors.
    * compare rise time and TOF resolution with Photek's.

4) **Two long crystal setup**

20cm crystal < HamA
Electron Beam---> Photek (ref)
20cm crystal < HamB

* measure relative time difference between 2 adjacent crystals (ala CMS time resolution measurement)
* vary beam energies to study dependence of time resolution on energy

5) Measure energy resolution in Lead-tungstate crystal and compare with LYSO to understand the reasons why we did not always get good energy peak in previous testbeams

6) Study pulse shapes in front and back of long crystal
(4GeV electron) HamA PhotekA > 10cm crystal < PhotekB
* study pulse shapes in front and back of crystal, compare with GEANT4 simulation
* can we see energy peak?
* TOF

Thursday July 31, 2014

CH1: PhotekA
CH2: PhotekB
CH3: HamA
CH4: HamB

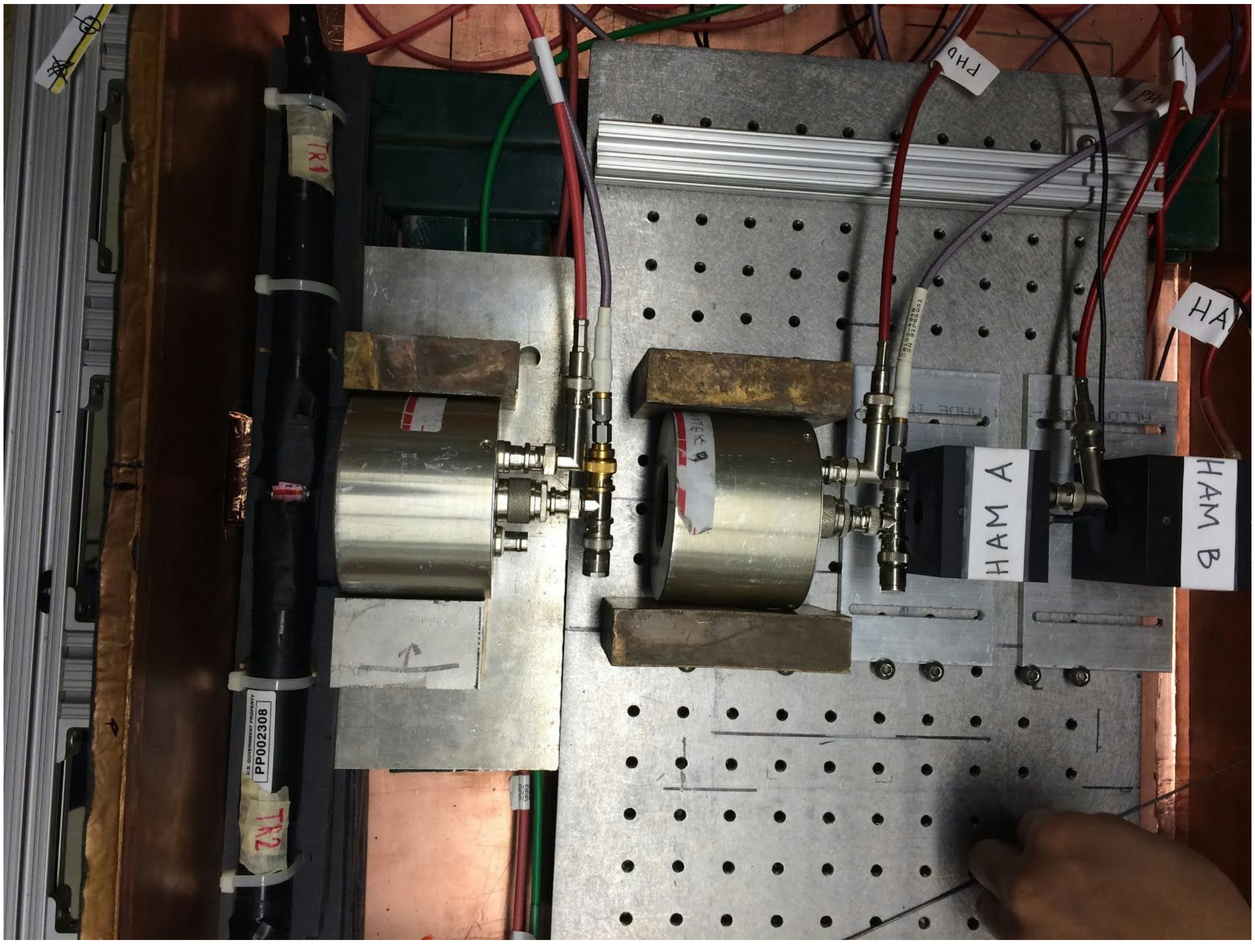
August 1

Run 001 (2 AM): Photek A was not in the beam, had PhoB -> Ham 1-> Ham 2. Obtained resolution between Ham 1 and Ham 2 around 20 psec. Trigger rate is about 1500 events per spill.

Went into controlled access to put Photek A back into beam.

Run 002: Photek A and B are now plugged into CH3 and CH4, and Ham 1 and 2 are plugged into CH1 and 2 respectively. CH2 is a known bad channel on this DRS.

Go into CA to replace the DRS with V5, 2:58 AM. We will put the DRS with serial number 2442. Setup is below:



Run 003 (3:10 AM): replaced DRS4 with 2442. Channels are Pho A Pho B Ham A Ham B. Collected 10k events, found the resolutions to be the same with Photek and Hamamatsu pairs as with 2216.

Run 004: collect 50K protons same setting

Stop the run 004 around 12K events. We observe strange double-peaked distribution for TOF(CH1, CH3) and other pairs between Ham and Pho. Decide to do CA to swap detectors in CH2 and CH3, keeping the same channels in DRS4, to see if this is an instrumental effect.

Run 005:
swapped the second and third photosensors: Photek B and Hama A. NOw the setup is Pho A -> Ham A -> Pho B -> Ham B.

Still see the double peaked structure among Pho A and Ham A, and similar for Pho B and Ham B.

CA at 4:30. Removed the metallic plate under DRS board, tightened the trigger cable going into DRS, changed the SMA cable inside box for Ham A from black one to blue one. Measured the terminators on Photeks, both were 50 Ohm.

Run 006: Still see double peak structure

CA at 5:00AM Changed the feedthroughs for Hama, moved Ham B a bit off axis, and removed the L-bars from Pho A and Ham A high voltage cables.

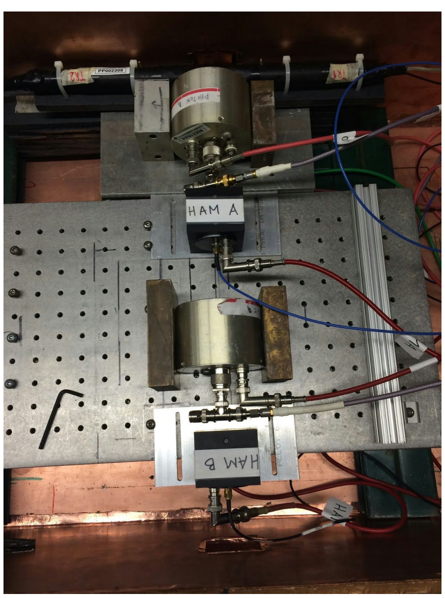
Run 007: take 5K events with protons in the configuration above. Goal to see the double peak structure in TOF(CH1, CH3) to be gone. Not the case/….

Run 008: take 2K events with one Ham 2 turned off. Still see the double peaks
Run 009: trigger on Pho 2, see if the double peak disappears.

CA at 6:30 AM: realign the trigger and photosensors, raise the threshold on trigger logic to 1V, swap CH 2 and 3 on DRS4

CH1: Pho A
CH2: Ham A
CH3: Pho B
CH4: Ham B

Setup is below:



Run 010: trigger on Ch2. Still double peak

Run 011: trigger on Ext trigger. Very low rate. Still double peak between Pho and Ham

CA at 7:15: remove Photek A from the beam, move the box towards “alleged” best position.

CA at 7:40: change the DRS4 board t SN 2439. Goal is to see if the double structure disappears or not.

Run 013:

CH1: Pho A
CH2: Ham A
CH3: Cher1
CH4: Cher2

August 2

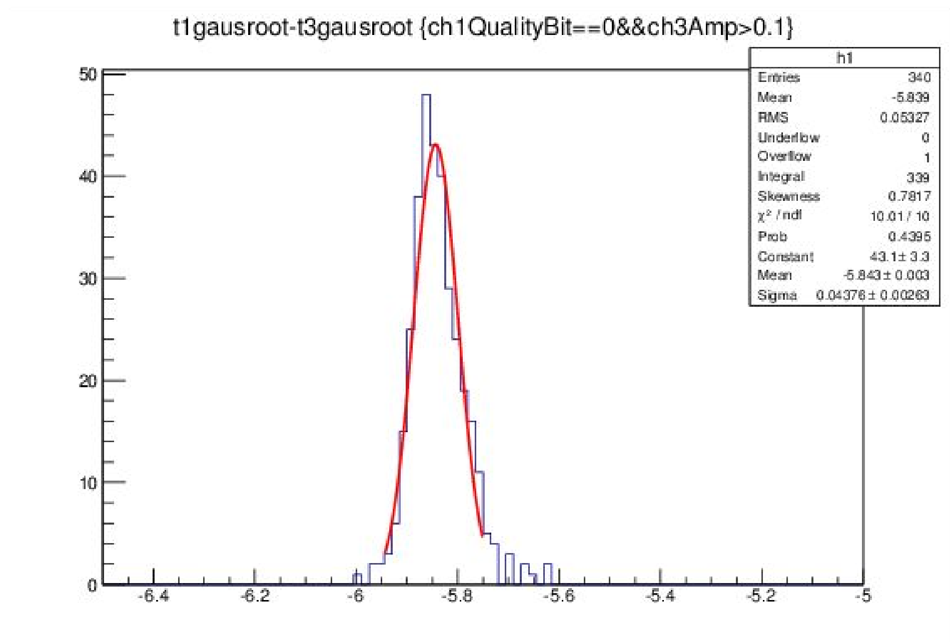
Verified that Cherenkov works, but only the outer Cherenkov. Timed the trigger with Cherenkov signal. Channle mapping is

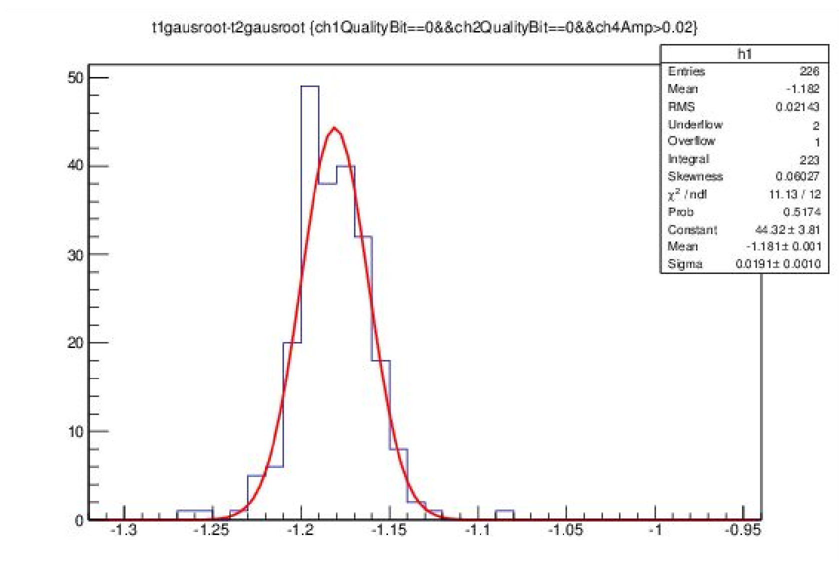
CH1: Pho A
CH2: Photonis
CH3: Pho B
CH4: CherO

Run 017: electron 8GeV data with mapping above. Photonis and Photek B saturate. CA to put 20dB attn on Photonis and Photek B.

CH1: Pho A
CH2: Pho B
CH3: Photonis
CH4: CherO

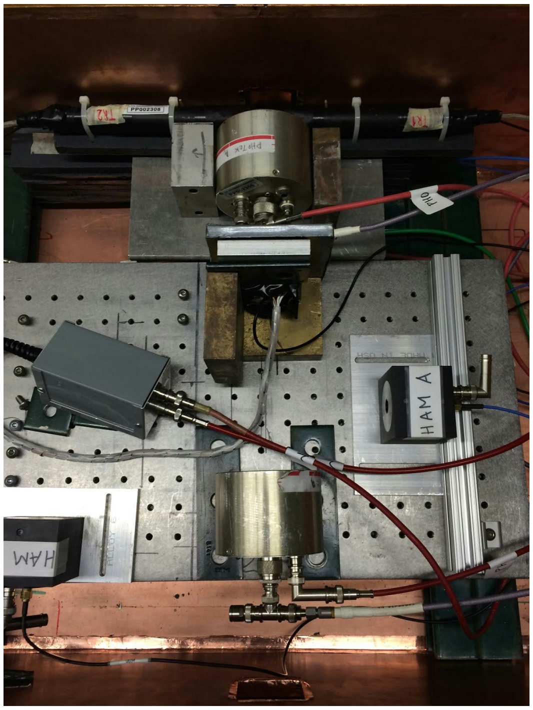
Run 018: electron 8 GeV with mapping above. We get ~40pses, and ~19 psec between PhoA and PhoB.





Run 019: Change HV to 2K on Photonis to check if we don't saturate. Amplitude is not too bad, mean around 0.2.

Setup is below

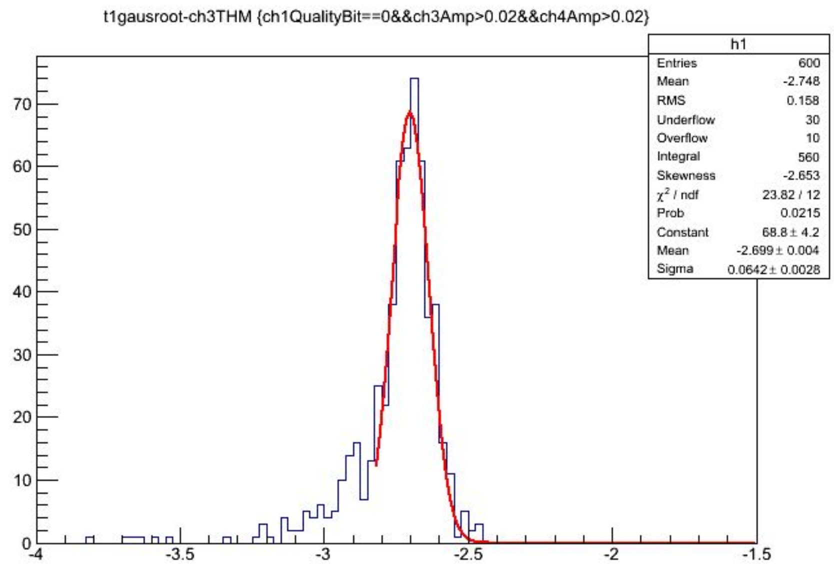


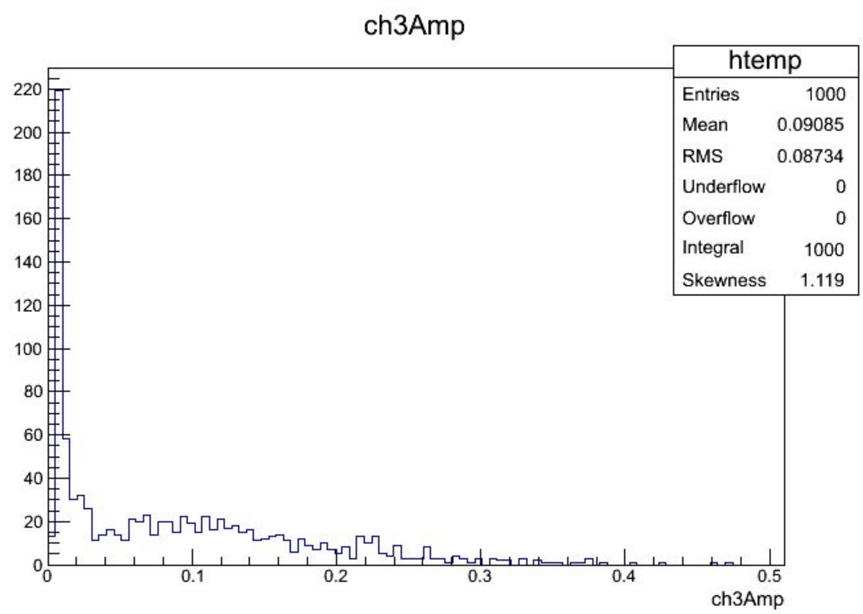
Run 020: Change HV on Photonis to 2.1 kV and will take 1000 events with 8 GeV electron beam.

Run 021: Turn off Photocathode on Photonis. Take 1000 events with 8 GeV electron beam. Discovered that Photonis signal is too small. Tried increasing the HV to 2.4kV but signal is still too small.

CA at 2:40 AM: remove attenuator from Photonis.

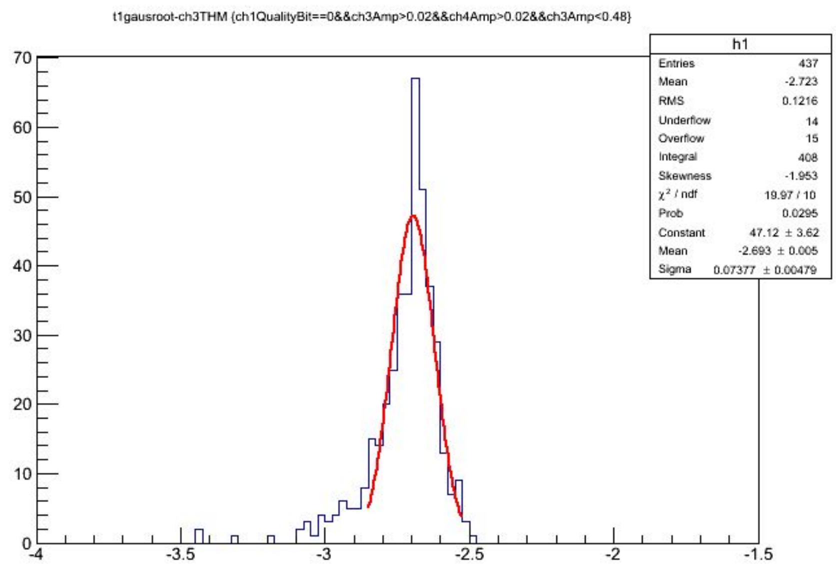
Run 022: Running Photonis at 2.5 kV. Amplitude seems fine. Timing resolution around 60 psec, amplitude mean around 0.1 V.

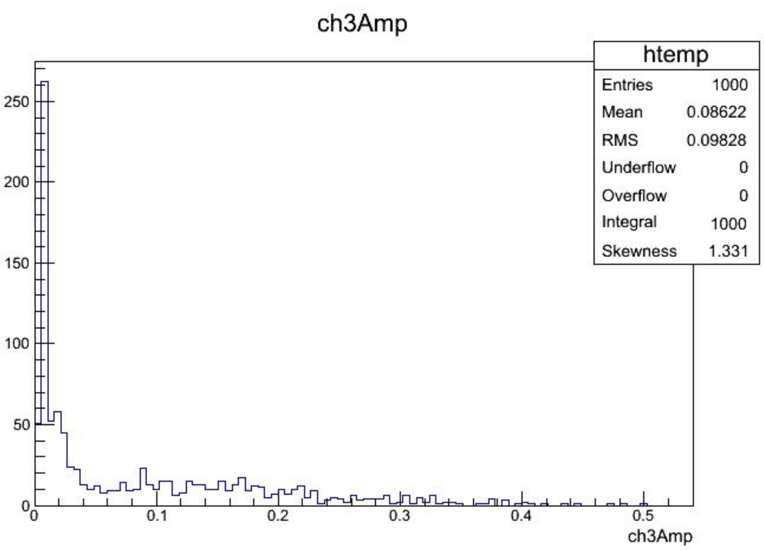




Run 023: Running 12 GeV. Same HV settings as the above. Photocathode turned off.

Resolution didn't improve, amplitude increased a little bit





CA at 3:30 AM: Turn Photocathode on, run Photonis at 2.1 kV, and put 20dB attenuator on Photonis.

Run 024: Take 1000 events with 12 GeV electron with Photocathode turned off. HV is at 2.1kV. We decide that in order to compare we should take 2.5kV, but that would saturate the DRS. We finish this run and will go into access to put the attenuator on.

CA at 4:09 AM: put another 20 dB attenuator on Photonis in order to go to 2.5kV.

Run 025: electron 12 GeV beam with 2.5kV on Photonis and photocathode turned on. Amplitudes are too low. Stopped the run.

CA at 4:20 AM: replace second 20 dB on Photonis into 10 dB.

Run 026: electron 12 GeV beam with 2.5kV on Photonis and photocathode turned on. Photonis attenuator is 30dB. Amplitude is still low. We finish the run and will go into access to make the Photonis signal 20 dB only.

CA at 4:40 AM: Photonis signal attenuated to 20dB only, removed the 10dB from before.

Run 027: electron 12 GeV beam with 2.5kV on Photonis and photocathode turned on. Photonis attenuator is 20dB.

Run 028: electron 12 GeV beam with 2.1kV on Photonis and photocathode turned on. Photonis attenuator is 20dB. Confused by Photonis amplitude distribution in Run 027 we repeat with 2.1 kV. We see now that the energy peak is more peaky. we decide to increase the HV to 2.3 kV.

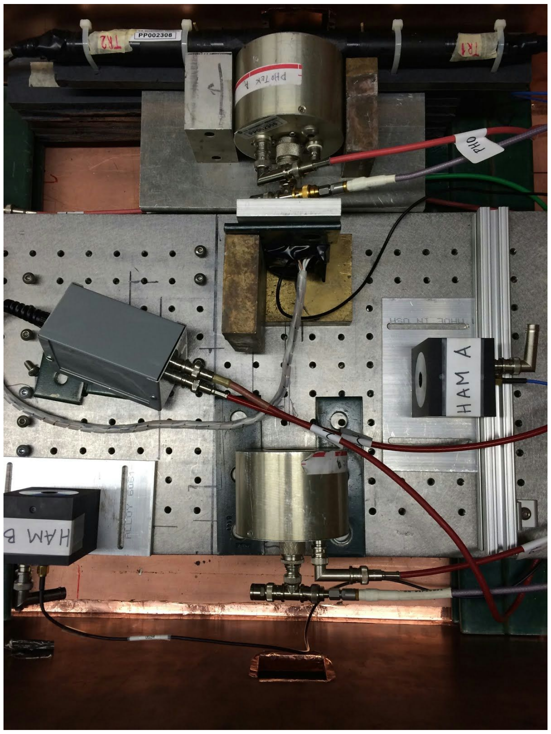
Run 029: electron 12 GeV beam with 2.3kV on Photonis and photocathode turned on. Photonis attenuator is 20dB. Amplitude increased, around 0.3 and saturating a lot.

Run 030: electron 12 GeV beam with 2.5kV on Photonis and photocathode turned on. Photonis attenuator is 20dB. Amplitude seems similar to 2.3kV.

CA at 5:30 AM: put another 10 dB attenuator on Photonis signal. Hypothesis is that in the previous attempt the switch to switch ON the photocathode didn't engage, and that is why we had small signals.

Run 031: electron 12 GeV beam with 2.5kV on Photonis and photocathode turned on. Photonis attenuator is 30dB.

CA at 6 AM: remove the lead in front of Photonis and attenuators from both Photek and Photonis. Change the HV on Photonis to 2.4 kV. Setup is below:



Run 032: proton run with setup above.

Turn off photocathode on Photonis detector.

Run 033: repeat proton run with photocathode off, all is the same. We see the amplitude on Photonis is very low now. Finish the Photonis program. Next move on to Crystals

CA at 6:45 AM: go in to change the setup into crystal. Small cube. Same time try the SiPM.

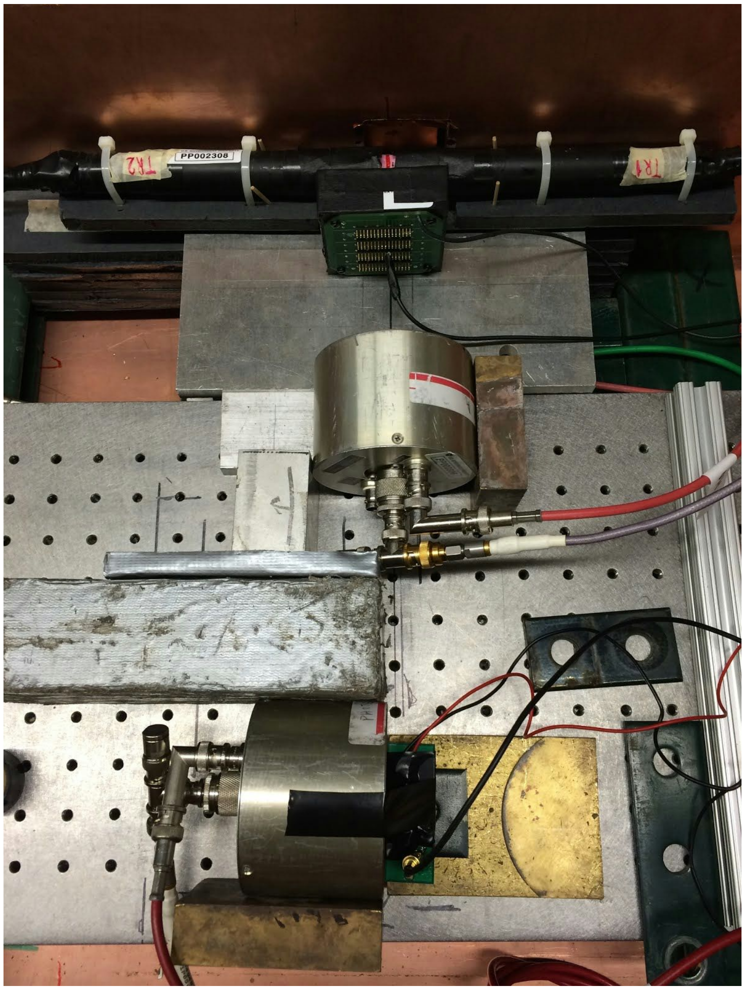
sipm at 2A-127
photonis at ham1 (2A-125)

ch1 photek a
ch2 photek b
ch3 photonis
ch4 sipm

Run 035: proton run. Main goal is to collect data with SiPM signal for later comparison.

SiPM rising edge is very slow. Will ask Aashrita to clip it more, is now at 100pF. SiPM is at 70V. At the end of the run Si noticed that HV on Photonis was not on. Repeat the run.

Setup is below:



Run 036: same run as 035 but with Photonis HV ar 2.4kV connected.

Run 037:

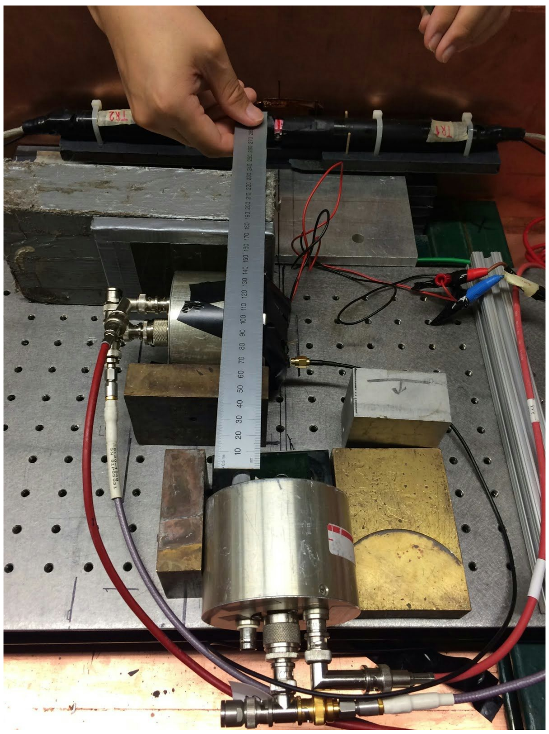
Run 038:

- CH1: Photek A but is in the back of everything
- CH2: Photek B moved closer to trigger, but still behind the lead brick
- CH3: SiPM on 1.7 cm crystal
- CH4: Cherenkov O

Run 39: (same as 038)

Run 40: same as 038 & 039, but with 12GeV electrons. We observe about 4% of events have ch2Amp>0.02, which indicates that in this setup the contamination on the rising edge of Photek LYSO from direct hits is very small..

CA at 11:20AM: install the amplifier on SiPM output, attach LYSO to Photek A.

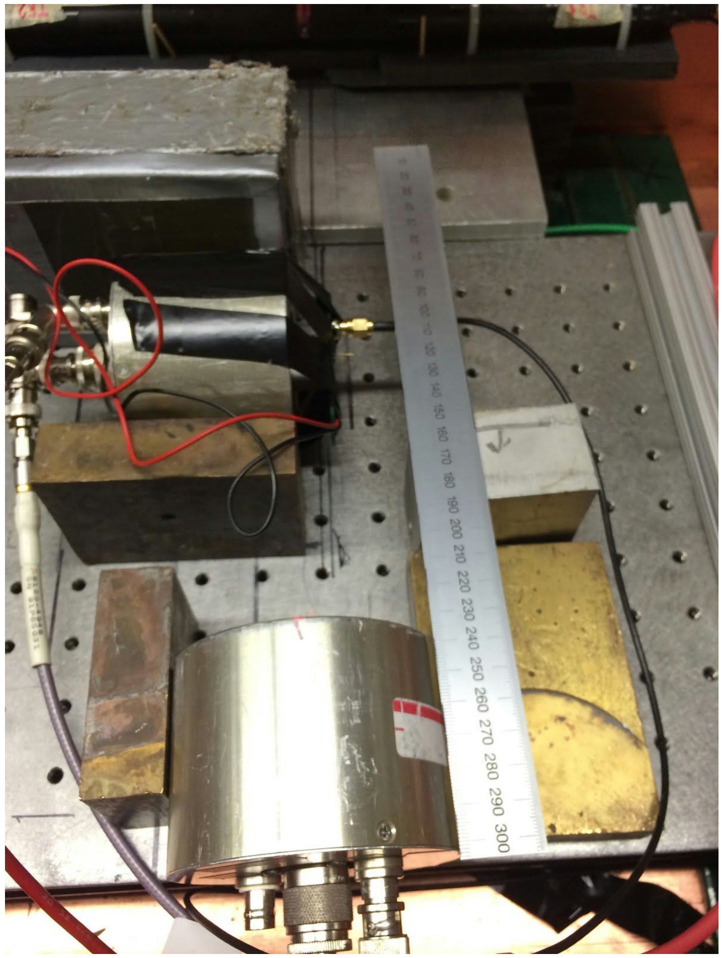


Run 041: trigger on CH3 AND CH4, SiPM at 67.5V. This is more of a commissioning run to see how the pulses from the SiPM and amplifier look.

Aug 3

We start with a LYSO attached to the Photek and 1mm^2 SiPM with 27 nF capacitance. Need to align the LYSO with trigger, seem like we were out of the beam in the last shift.

CH1: Photek A in the back of everything
CH2: Photek B attached to 1.7 cm LYSO
CH3: 1mm^2 SiPM on 1.7 cm crystal, 27 nF
CH4: Cherenkov O



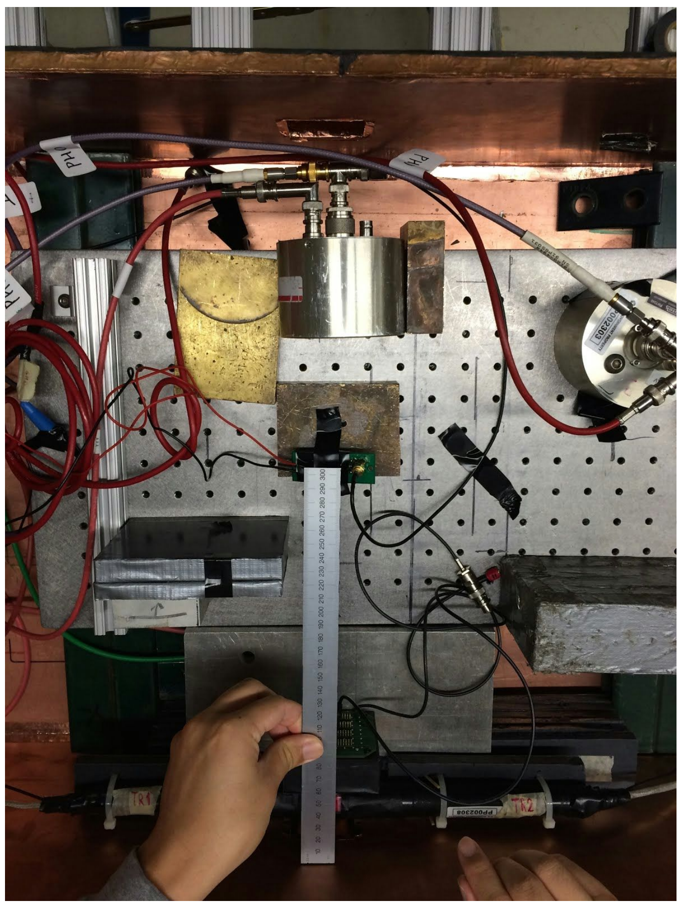
Run 042: electron 12 GeV beam, triggering on SC counters, as normal. Collect some data with this, and then change the SiPM capacitance to 10pF again, seems that produced the best rising edge. We get TOF resolution between PHO A and B around 50 psec. We hypothesize that in May TB we had the reference upstream of LYSO, and could have had showers hitting the LYSO producing more light. We will test this hypothesis next CA.

CA at 1:00 AM: Change the setup to test direct hits after lead brick, to test the hypothesis from paragraph above. We place two lead pages from Anatoly's book, removed the LYSO from Photek. We want to see if there are direct hits on Photek A. If there are not, we can mount the LYSO on Photek A and will have more light from showers. Otherwise, we cannot disentangle the direct hits from shower in LYSO.

3:00 AM …. Still no beam (since 1:00 AM), some problems they are investigating…

3:34 AM: Beam is back

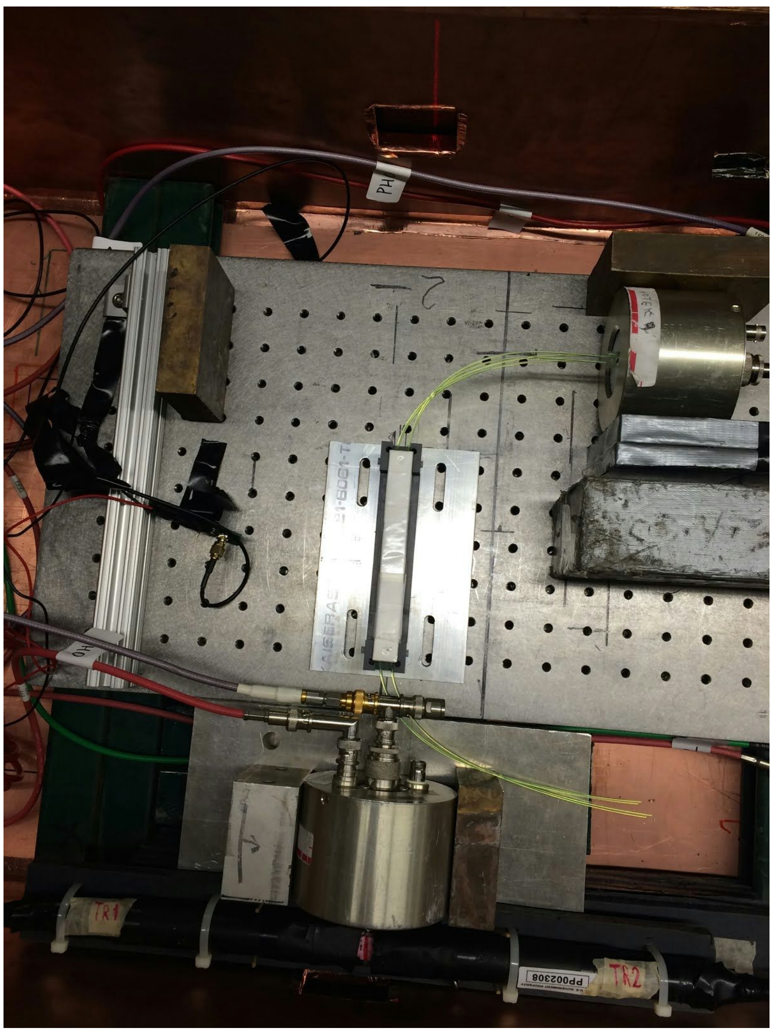
CA at 4:20 AM: connect the 1mm^2 SiPM with 50pF on the1.7cm2 LYSO. Place Photonis upstream of SiPM to reproduce the conditions of run 036. Goal is to compare resolution in this run to 036. Signal from SiPM is split in two. CH2 is direct output from SiPM and CH3 is amplified by 36dB and attenuated by 20dB.



Run 044: electron 12 GeV. We seem to be still not aligned with the trigger. Continue taking events triggering on CH3. SiPM HV = 70 V.

Run 045: electron 12 GeV. Continue taking events triggering on CH3. SiPM HV = 71 V.
Run 046: electron 12 GeV. Increased trigger threshold on CH3. SiPM HV = 71 V.
Run 047: electron 12 GeV. PhotekA HV changed to 4.4kV. SiPM HV = 71 V.

CA at 5:50 AM: start the shashlik program. Start with the new Y11 fibers from Jason to establish the previous result. Will connect Y11 fibers to Photek, with reference upstream of it.



CH1: reference Photek A
CH2: Photek B no Attenuator
CH3: Photek B 10 dB
CH4: Cherenkov

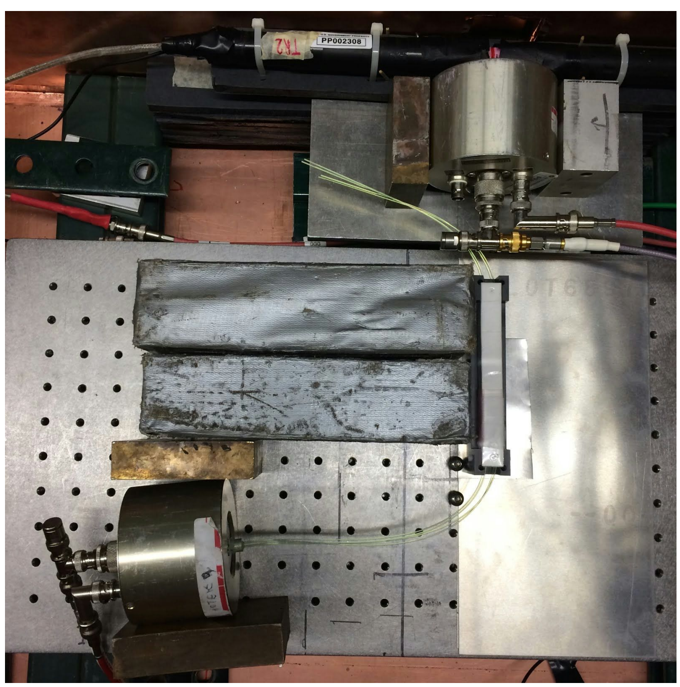
Run 048: electron 12 GeV, Shashlik cell with Y11 fibers. Photek B at 5.0 kV.

CA at 7AM: replace Y11 with DSB1 fibers. Also, change channel mapping as below:

CH1: reference Photek A
CH2: Cherenkov
CH3: Photek B
CH4: empty

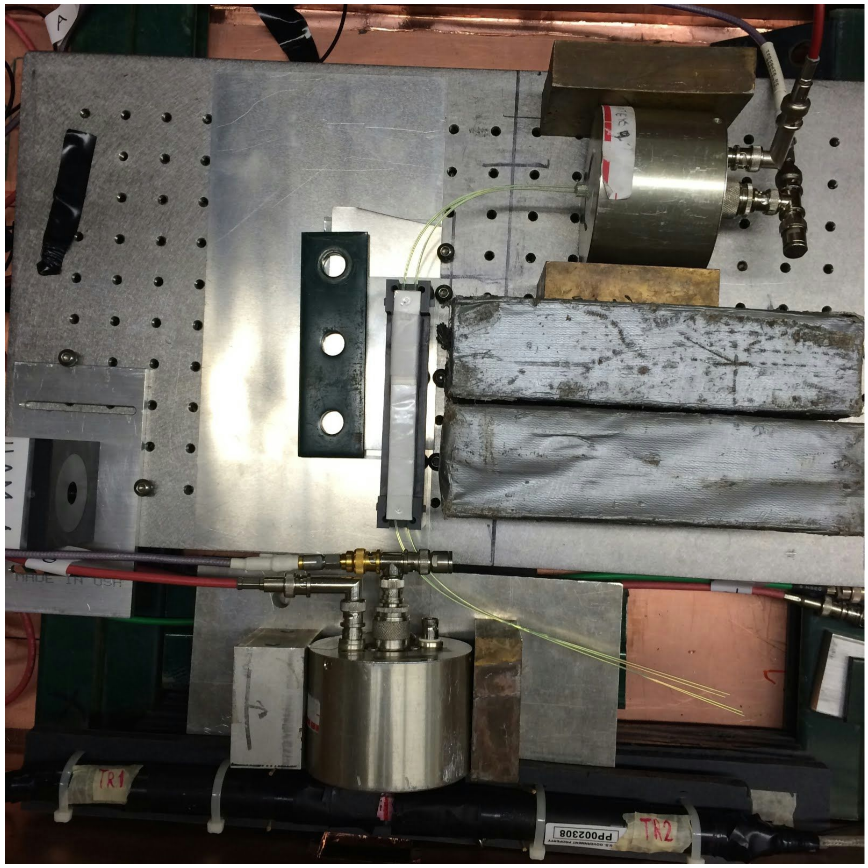
Run 049: electron 12 GeV, Shashlik cell with DSB1 fibers. We notice pulses have spike on the rise edge, seemingly from direct hits. Looking at May events they were also there, maybe a bit less.

CA at 9:AM: put lead bricks in front of Photek and also move Photek further away from the beam axis, as shown below.

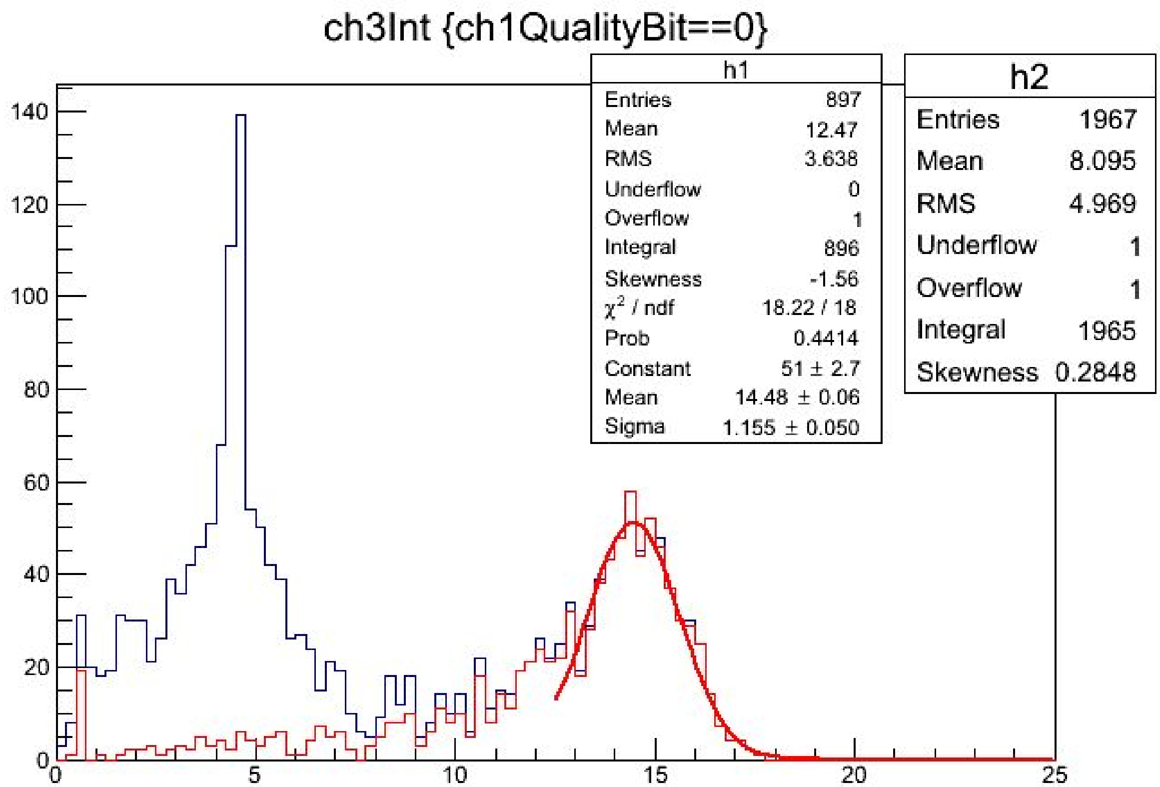


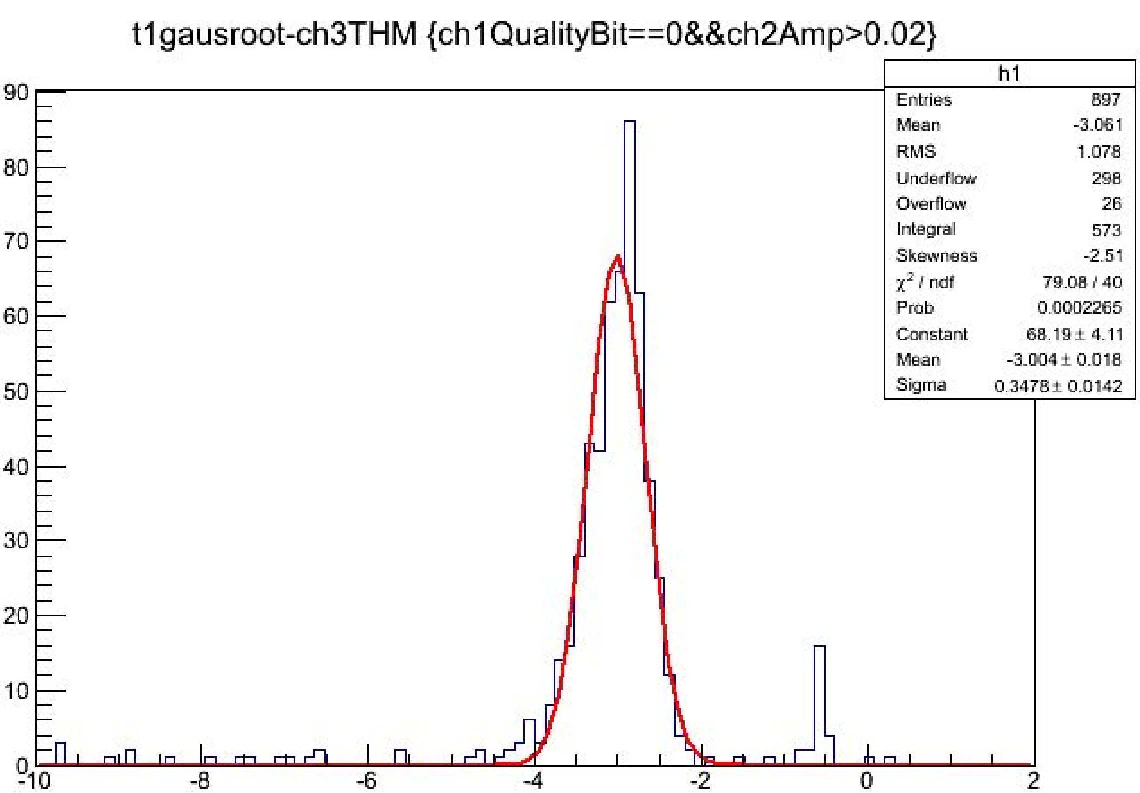
Run 049: electron 12 GeV with the setup above. Goal is to see if the spike on rising edge is removed.

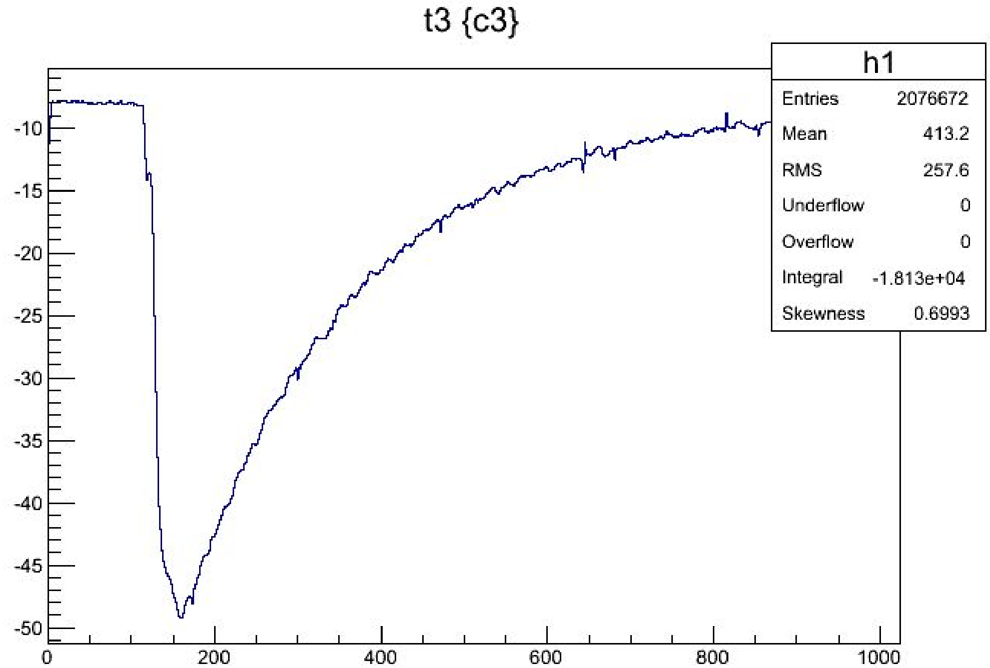
CA at 10AM: move the Photek closer to the beam axis, make tighter styro cookie to mount fibers.



Run 051: setup as shown above, DSB1 fibers. Electrons @12 GeV. We get decent energy peak (~8%) and ~350 psec time resolution, shown below. The run declared a very good run.

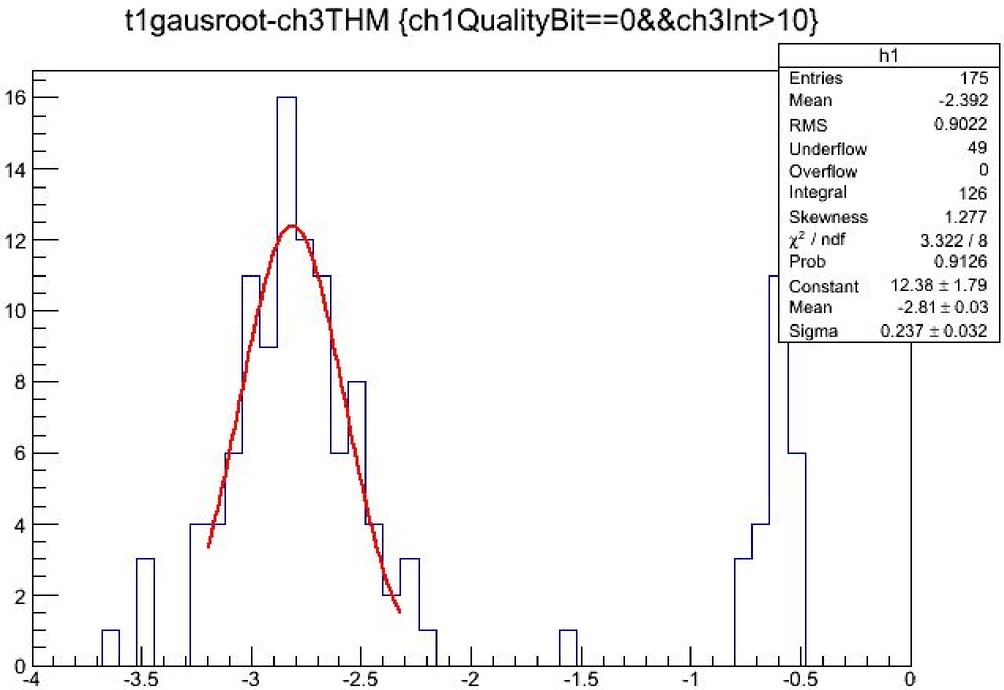

ch3Int {ch1QualityBit==0}
h1
Entries 897
Mean 12.47
RMS 3.638
Underflow 0
Overflow 1
Integral 896
Skewness -1.56
χ² / ndf 18.22 / 18
Prob 0.4414
Constant 51 ± 2.7
Mean 14.48 ± 0.06
Sigma 1.155 ± 0.050
h2
Entries 1967
Mean 8.095
RMS 4.969
Underflow 1
Overflow 1
Integral 1965
Skewness 0.2848
0 20 40 60 80 100 120 140
0 5 10 15 20 25


t1gausroot-ch3THM {ch1QualityBit==0&&ch2Amp>0.02}
h1
Entries 897
Mean -3.061
RMS 1.078
Underflow 298
Overflow 26
Integral 573
Skewness -2.51
χ² / ndf 79.08 / 40
Prob 0.0002265
Constant 68.19 ± 4.11
Mean -3.004 ± 0.018
Sigma 0.3478 ± 0.0142
0 10 20 30 40 50 60 70 80 90
-10 -8 -6 -4 -2 0 2



Accelerator has some problems around 11:00AM, no beams… At 11:30 we stop the run and go to 32 GeV setting on Cherenkov. Hope to get some data with 32 GeV before end of shift.

Run 052: After long delay finally beam around 12:00PM. We take some data before Shashlik starts. Cherenkov is not fully at the proper pressure yet, beware of wrong signals in Cherenkov. We select electron events with cut on Ch3Int>10. Not good energy resolution, pretty crappy actually, maybe too much showers not contained… Last time we had the same. Will try lower energy in the next shift.



End of shift…

Aug 4:

We start the new shift. Continue with the same setup as above, asked for 4 GeV electron beam. Photek B HV is 4.95 kV.

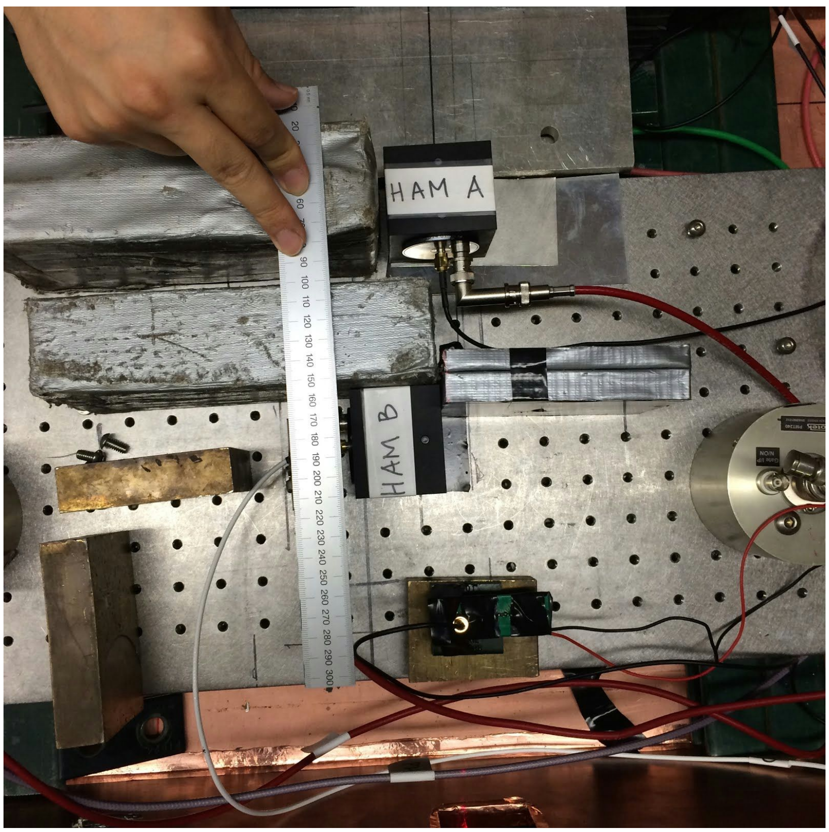
Run 053: electron at 4 GeV, DSB1 fibers. A minute into the run MCR calls to say that they have problems, no ETA when they will have it fixed… Nothing happened in this run, ignore this run.

Around 1:30 AM without any beam we decide that we change the setup into cube.

CA at 2:20:
we change back to cube setup

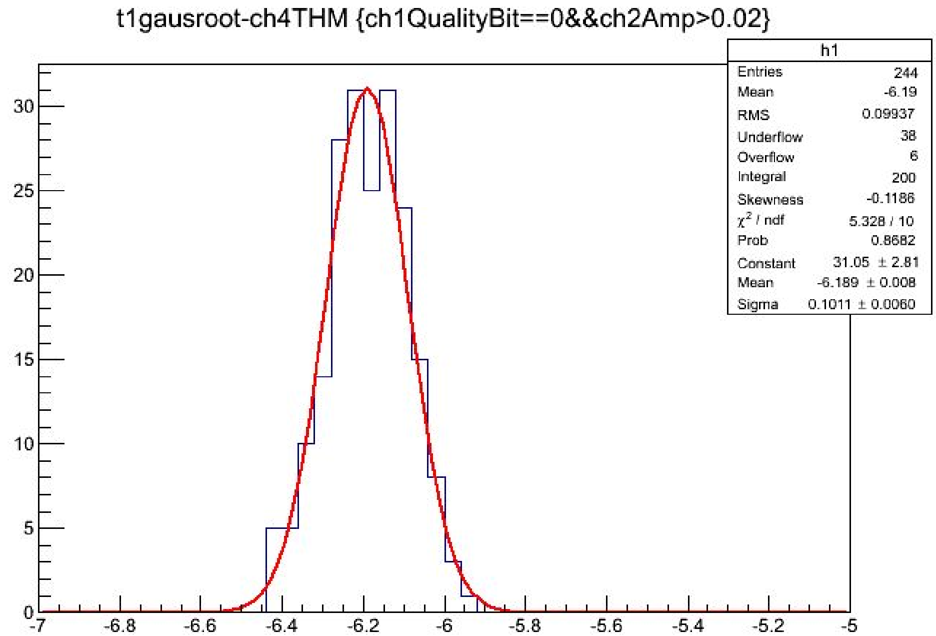
- CH1: reference Ham A
- CH2: Cherenkov
- CH3: HamB with nothing on it
- CH4: SiPM on LYSO cube

Goals of this setup is to check if HamB gets lots of hits from shower in lead book, and also 3mm^2 SiPM signals from LYSO.



2:29 AM: still no beam, MCR hopes maybe in an hour we'll have beam…

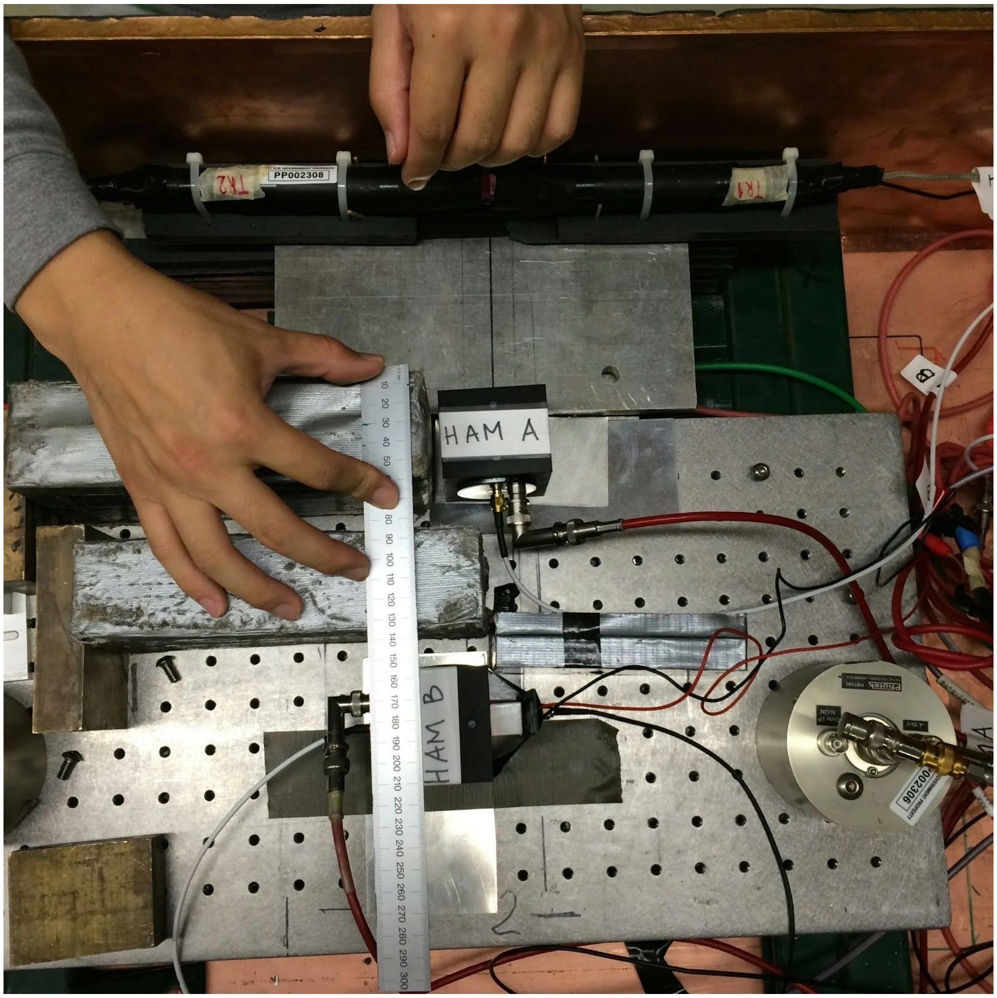
Run 054: electron 8 GeV taking data with 1.7cm LYSO with 3mm2 SiPM. SiPM HV at 69.1V. SiPM pulses look sweet. TOF resolution ~100psec. Decide to go a bit higher in HV of SiPM.



Run 055: electron 8 GeV taking data with 1.7cm LYSO with 3mm2 SiPM. SiPM HV at 71 V. Seems like the signal on reference Ham is too small, may affect the resolution. Decide to increase the HV to 3.0 kV. Stop the current run and move Ham A up.

Run 056: electron 8 GeV taking data with 1.7cm LYSO with 3mm2 SiPM. SiPM HV at 71 V, Ham A HV = 3.0kV, Ham B HV = 2.8 kV

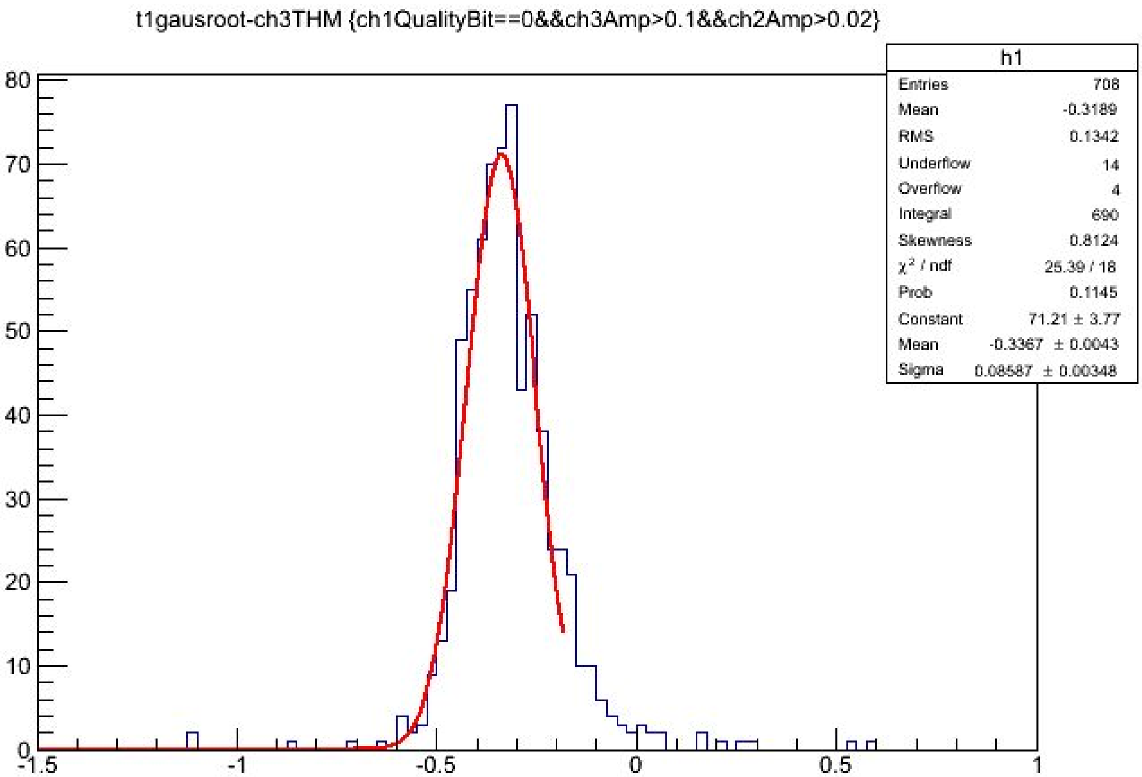
CA at 4:00 AM: mount LYSO 1.7 cm2 on Ham B and 1mm2 SiPM with 50 pF. Put 10dB on Ham B. Setup is shown below.



Goal is to measure energy dependance of time resolution and SiPM.

Run 057. electron 8 GeV. SiPM HV = 71 V. Ham A HV = 3.0kV, Ham B HV = 2.8 kV. 1.7 cm2 LYSO on SiPM and Ham B. 10dB attenuator on Ham B

We get TOF resolution between Ref and Hama around 80-100 psec.



Run 058. electron 16 GeV. SiPM HV = 71 V. Ham A HV = 3.0kV, Ham B HV = 2.8 kV. 1.7 cm2 LYSO on SiPM and Ham B. 20 dB attenuator on Ham B. We get aroun 70 psec resolution for Ham B. SiPM didn't really improve.

Run 059. electron 32 GeV. SiPM HV = 71 V. Ham A HV = 3.0kV, Ham B HV = 2.8 kV. 1.7 cm2 LYSO on SiPM and Ham B. 20 dB attenuator on Ham B. Cherenkov pressure not set properly in the beginning, but we were close to proper pressure, so maybe ok. We were below pion threshold, so maybe the Cher signal is fine.

Run 060. electron 32 GeV. SiPM HV = 71 V. Ham A HV = 3.0kV, Ham B HV = 2.8 kV. 1.7 cm2 LYSO on SiPM and Ham B. 20 dB attenuator on Ham B. Cherenkov pressure is now set correctly. We get around 60psec resolution selecting Cherenkov.

Run 061. electron 4 GeV. SiPM HV = 71 V. Ham A HV = 3.0kV, Ham B HV = 2.8 kV. 1.7 cm2 LYSO on SiPM and Ham B. 6 dB attenuator on Ham B.

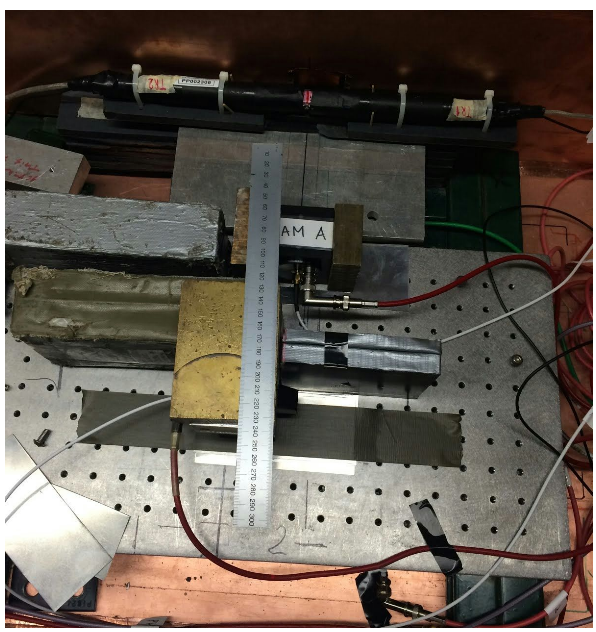
CA 9:30 AM: replace the LYSO crystal with single tile. All setup is the same as above. Requesting 4 GeV electron beam. Also, removed the 6dB attenuator from Ham B output.

Run 062. electron 4 GeV with LYSO tile. Ham A HV = 3.0kV, Ham B H 2.8 kV.no attenuator on Ham B. Pulses too small, increase the HV on Ham B

Run 063. electron 4 GeV with LYSO tile. Ham A HV = 3.0kV, Ham B HV = 3.0 kV., no attenuator on Ham B.

Aug 9:

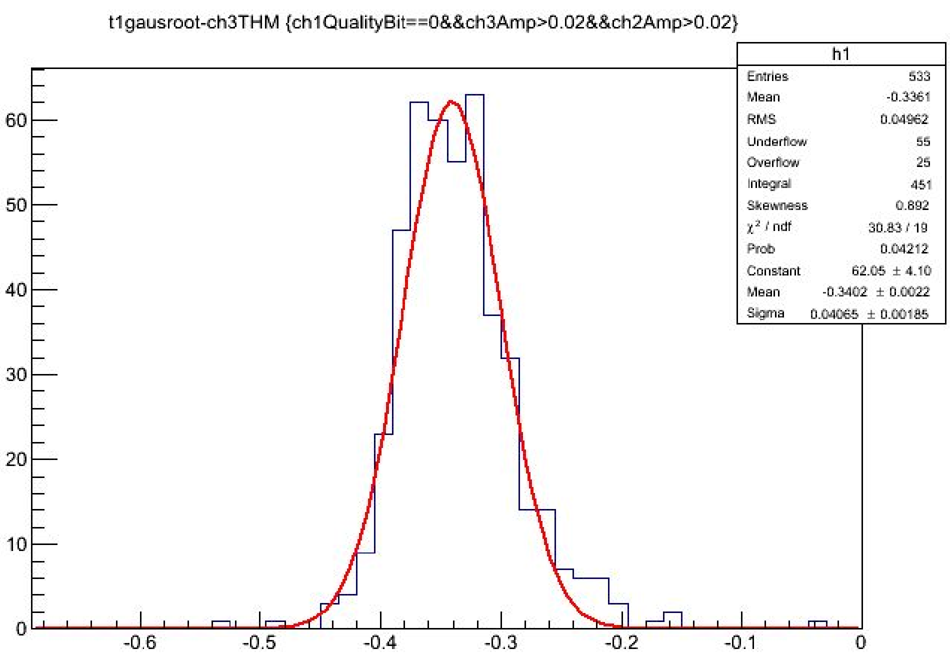
Setup the box with LYSO cube, trying to reproduce the setup how we left it off. We will now run 16 GeV electron beam. Once all is reproducible, we will move on to LFS. Setup is below.



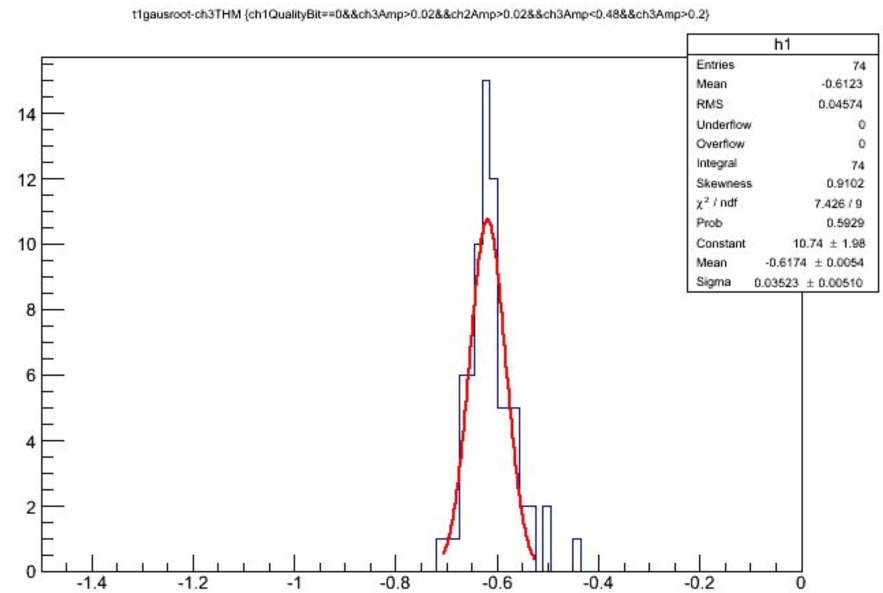
CH1: reference Ham A
CH2: Cherenkov
CH3: HamB with LYSO cube with 20 dB
CH4: Nothing

10:45 PM: After a lot of CAs and struggles to find the beam or triggers turns out the absorber was in the beam. We called MCR to check and they said that both absorbers are in the way. We asked them to remove them, and immediately got the triggers.

Run 064: 16 GeV electrons, Ham B 20 dB attenuator. Ham A HV = 3.0kV, Ham B HV = 2.8 kV. 1.7 cm2 LYSO Ham B. We get around 40psec. Pressure is put at at 2.0 psia



Run 065: 32 GeV electrons, Ham B 20 dB attenuator. Ham A HV = 3.0kV, Ham B HV = 2.8 kV. 1.7 cm2 LYSO Ham B. Pressure is put at 1.25psia. We get around 35 psec.



We finish this run to move to a better pressure setting on Cherenkov

Run 066: 32 GeV electrons, Ham B 20 dB attenuator. Ham A HV = 3.0kV, Ham B HV = 2.8 kV. 1.7 cm2 LYSO Ham B. Pressure is put a t0.5 psia. We don’t see any Cherenkov signals. Stopped the run around 700 events to change the pressure.

Run 067: 32 GeV electrons, Ham B 20 dB attenuator. Ham A HV = 3.0kV, Ham B HV = 2.8 kV. 1.7 cm2 LYSO Ham B. We get around 40psec. Pressure is put a t0.5 psia. We don’t see any Cherenkov signals. Stopped the run around 200 events, too much saturations.

12:41 AM: CA to add 6 dB attenuator on Ham B.

Run 068: 32 GeV electrons, Ham B 20+6 dB attenuator. Ham A HV = 3.0kV, Ham B HV = 2.8 kV. 1.7 cm2 LYSO Ham B. Pressure is 0.7 psia.

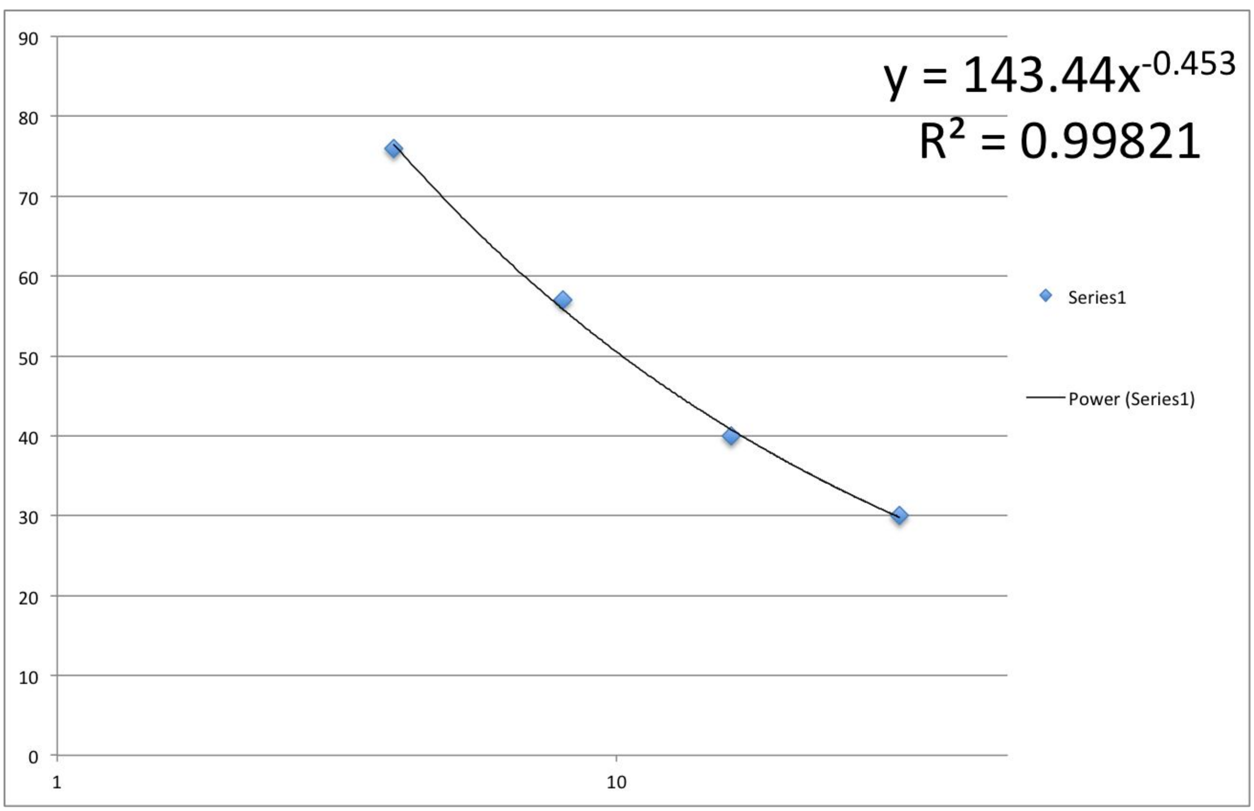
1:04 AM: CA to change the attenuator to 10 dB. Also, moved the Cherenkvo signal to CH4.

CH1: reference Ham A
CH2: Nothing
CH3: HamB with LYSO cube with 10 dB
CH4: Cherenkov

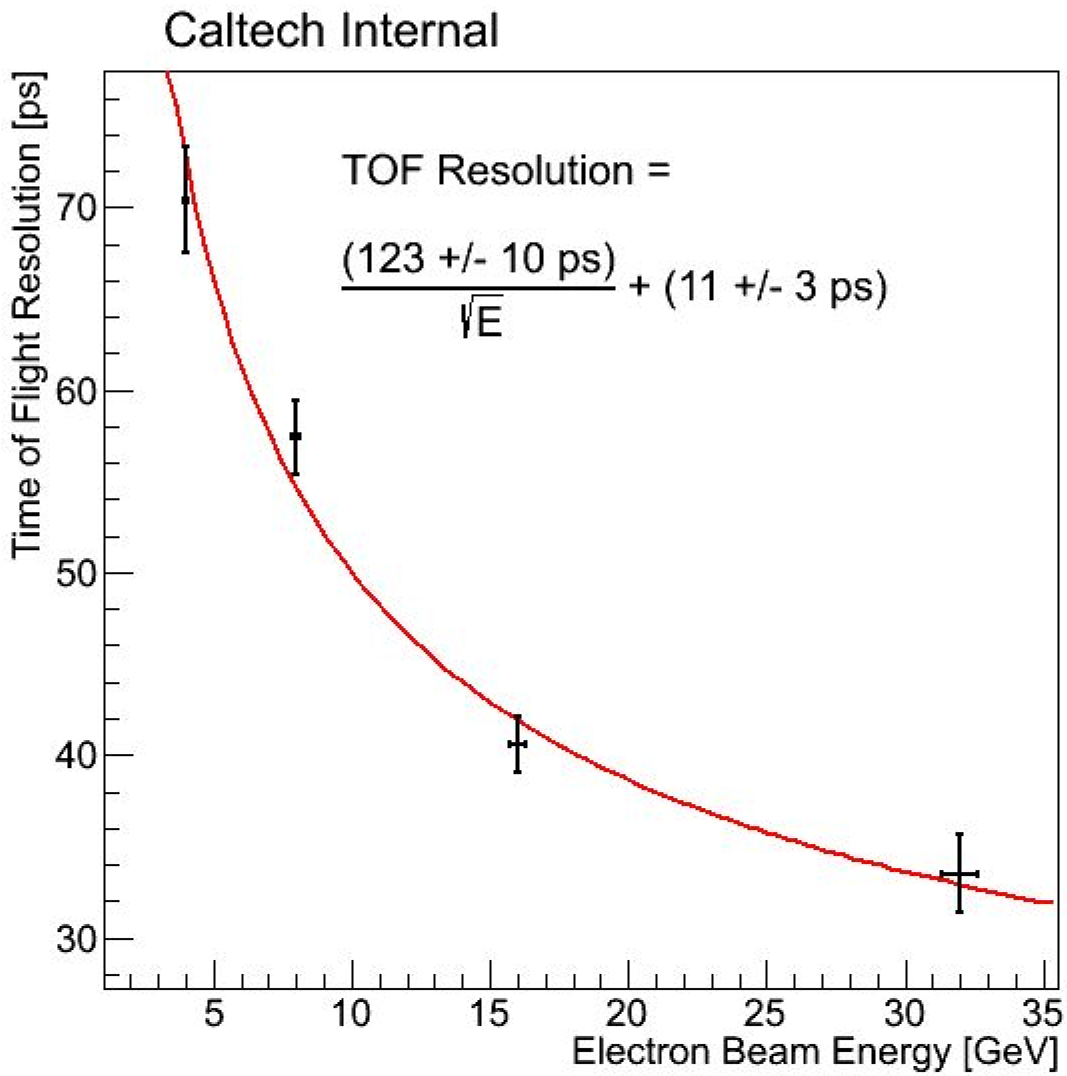
Run 069: 8 GeV electrons, Ham B 10 dB attenuator. Ham A HV = 3.0kV, Ham B HV = 2.8 kV. 1.7 cm2 LYSO Ham B. Pressure is 0.7 psia.

Run 070: 4 GeV electrons, Ham B 10 dB attenuator. Ham A HV = 3.0kV, Ham B HV = 2.8 kV. 1.7 cm2 LYSO Ham B. Pressure is 0.7 psia. We get around 76 psec.

Energy dependence of the 1.7cm3 LYSO. **We declare victory!**

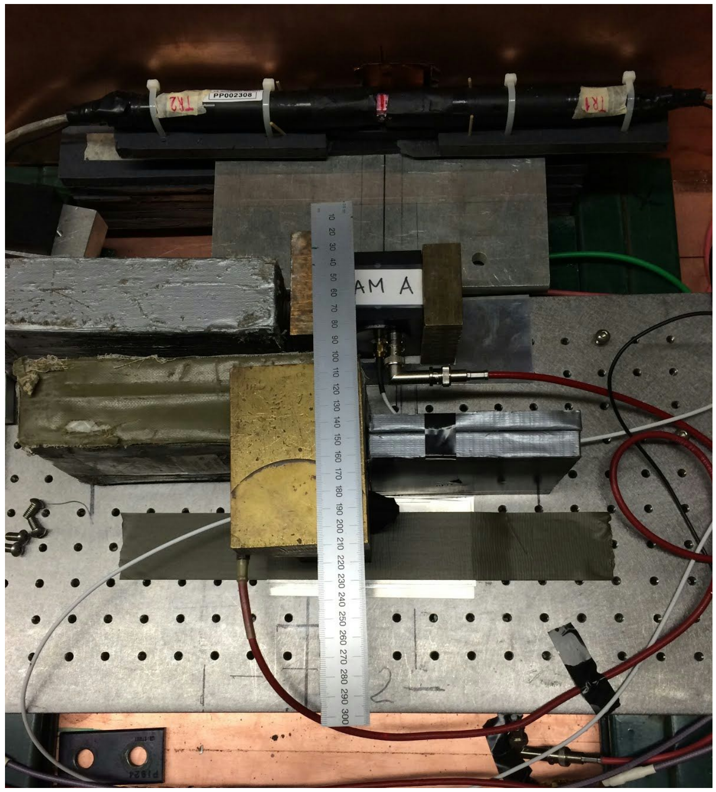


here's a better plot and fit to stochastic + constant term

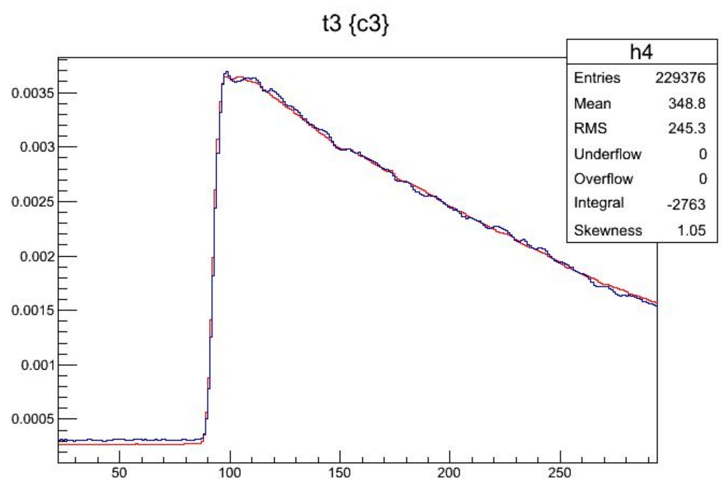


Aug 10

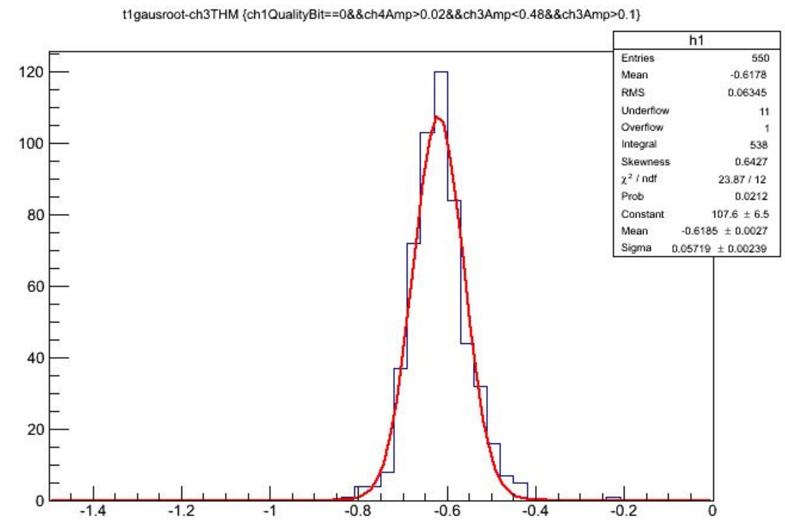
Installed LFS crystal, Ham B 10 dB attenuator. Ham A HV = 3.0kV, Ham B HV = 2.8 kV. 1.7 cm2 LYSO Ham B. Pressure is 1.0 sia.



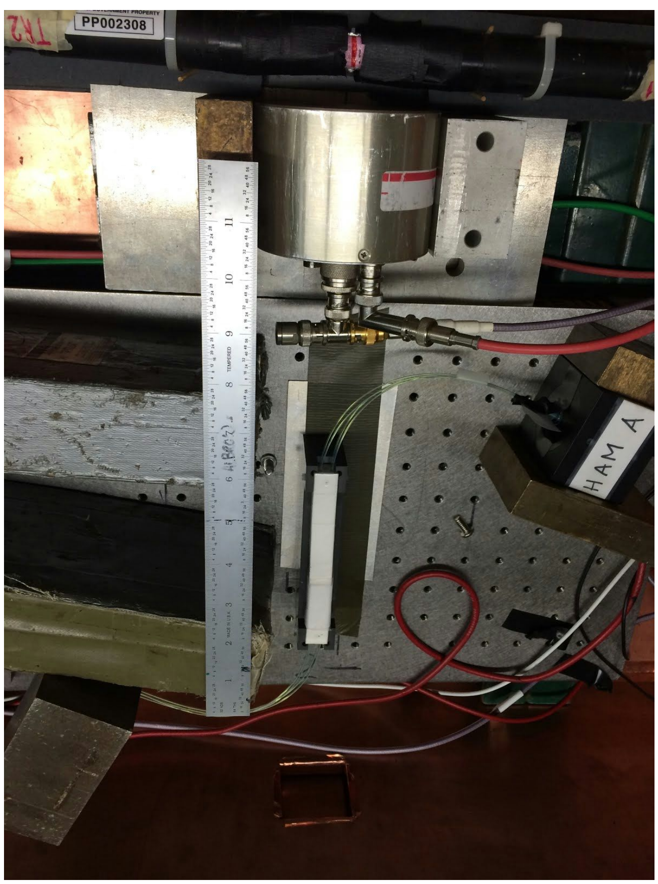
Pulse shapes look very similar compared to run 064 which was a 16 GeV run with LYSO



Run 071: LFS with 16 GeV. We get resolution around 60 psec.



CA at 11:00PM: install Shashlik cell with dual end readout. Photek A used for reference



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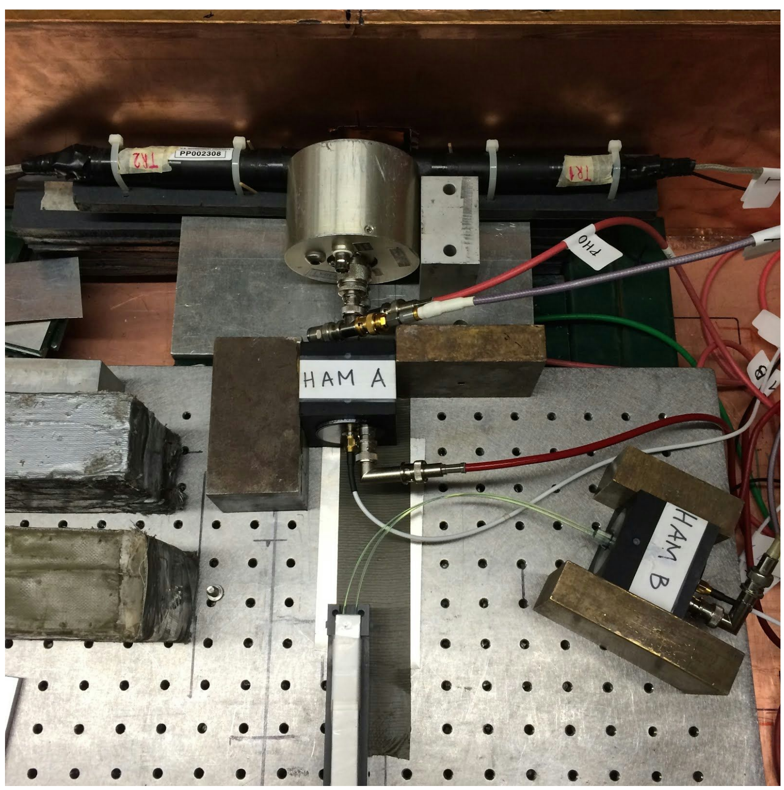
New channel mapping

CH1: Ham A
CH2: Cherenkov
CH3: HamB
CH4: Photek A

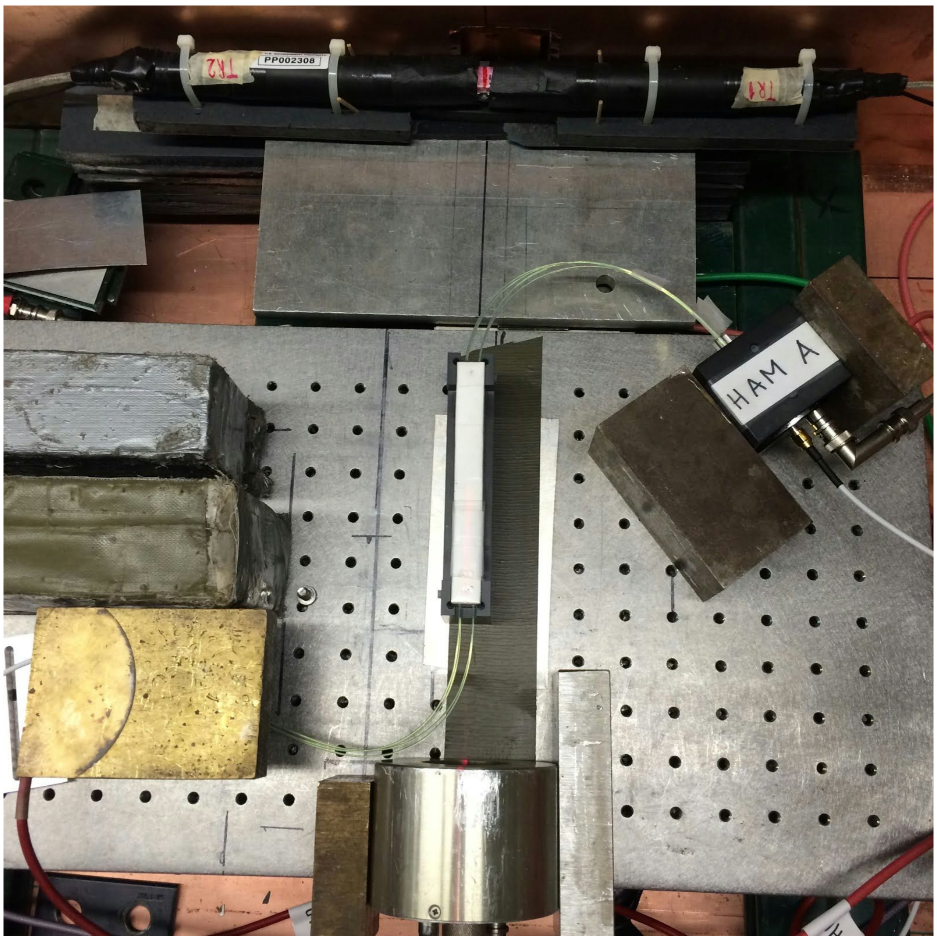
Run 072: Shashlik cell with dual readout. Ham A and B HV = 2.8 kV. Pressure is 1.0 psia. Photek A HV = 4.9 kV. We observe around 200 psec time resolution, and quite washed out energy peak. 200 psec is when taking the average of two ends, and about 300 psec when taking single end of fibers.

CA at midnight: we re-arrange thhe box to test whether the Photek and Hama pairing indeed creates the double-peak structure in time resolution, as observed earlier in the August campaign. If it does, we should now see a major improvement in resolution. Setup is below, channel mappings are the same.



Run 073: Shashlik cell with single readout. Ham A and B HV = 2.8 kV. Pressure is 1.0 psia. Photek A HV = 4.9 kV. We observe that there is no dual peak between Photek and Hamamatsu A, so Photek can be used a reference detector. TOF resolution between Ham A and Ham B is ~300 psec, similar results for Photek, consistent with previous run.

CA at 12:30 AM: put the Shashlik dual readout configuration again, Photek reference is now behind the Shashlik cell.



Channel mapping:

- CH1: Ham A
- CH2: Cherenkov
- CH3: HamB
- CH4: Photek A

Run 074: Shashlik cell with dual readout, 16 GeV electrons. Ham A and B HV = 2.8 kV.

Pressure is 1.0 psia. Photek A HV = 4.5 kV. We get time resolution of 200 psec with average. With front one we ~240 psec resolution, and with back one 300 psec. Energy resolution is washed out.

Run 075: Shashlik cell with dual readout, 8 GeV electrons. Ham A and B HV = 2.8 kV. Pressure is 1.0 psia. Photek is at 4.5 kV. Energy peak is still washed out, around 15% now. Time resolution around 300 psec with average.

CA at 2:30AM to make sure the alignment is OK, since the energy peak is washed out. We find that Hama B cookie was dislodged. We tighten it with a rubber band. otherwise things seem to be all fine.

Run 076: Shashlik cell with dual readout, 8 GeV electrons. Ham A and B HV = 2.8 kV. Pressure is 0.5 psia. Photek at 4.8 kV. We still get around 300 psec resolution with average. Energy peak is still around 15%.

Run 077: Shashlik cell with dual readout,32 GeV electrons. Ham A and B HV = 2.8 kV. Pressure is 0.7 psia. Photek at 4.9 kV. Stopped the run around 700 events, around 50% of events in CH3 were saturating.

CA at 3:30AM: put a 6dB attenuator on CH3.

Run 078: Shashlik cell with dual readout,32 GeV electrons. Ham A and B HV = 2.8 kV. Pressure is 0.7 psia. Photek at 4.9 kV. Photek with 10dB and Ham B with 6 dB. We get 120-140 psec with average.

CA at 5:10AM: remove attenuator from CH3 to start 4 GeV electron beam

Run 079: Shashlik cell with dual readout,4 GeV electrons. Ham A and B HV = 2.8 kV. Pressure is 0.7 psia. Photek at 4.97 kV. Photek with 10dB. We get TOF resolution around 480 psec from average.

CA at 6:11AM: move the table to the position it was a week ago, to try to find a good energy peak, reproducing last week’s result.

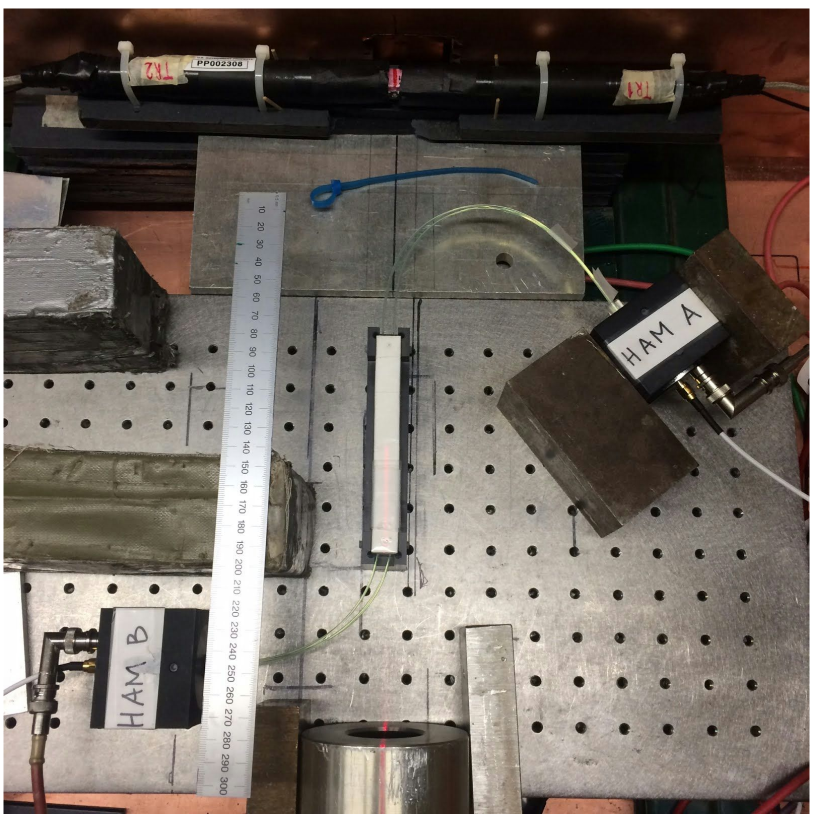
Run 080: Shashlik cell with dual readout,4 GeV electrons. Ham A and B HV = 2.8 kV. Pressure is 0.7 psia. Photek at 4.97 kV. Photek with 10dB. Goal is to get energy resolution peak. We don’t get any better resolution.

CA at 6:30AM: move Ham B closer to Shashlik cell, making the fibers shorter. The end on Ham A side is loosely attached to Ham A. Photek is left behind the Shashlik cell.

Run 081: Shashlik cell with dual readout,4 GeV electrons. Ham A and B HV = 2.8 kV. Pressure is 0.7 psia. Photek at 4.97 kV. Photek with 10dB. Goal is to get a nice energy resolution peak. We now get around 14% on Ham B and 11% on Ham A. We ask to go to 12 GeV to see if resolution goes up.

Run 082: Shashlik cell with dual readout,12 GeV electrons. Ham A and B HV = 2.8 kV. Pressure is 1.0 psia. Photek at 4.97 kV. Photek with 10dB. Goal is to get a nice energy resolution peak. We get worse energy resolution…

CA at 7:30AM: move Shashlik cell lower removing the plates from under it. Maybe Shashlik was too high. The rest of the setup is the same.

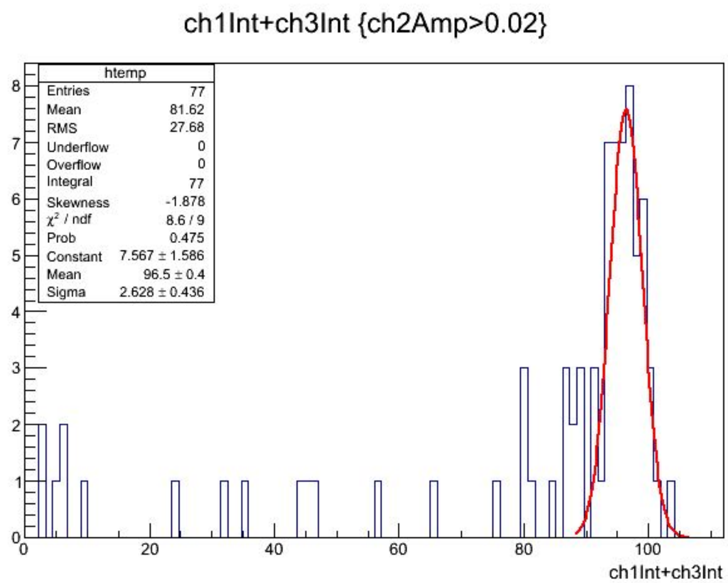


Run 083: Shashlik cell with dual readout,12 GeV electrons. Ham A and B HV = 2.8 kV.

Pressure is 1.0 psia. Photek at 4.97 kV. Photek with 10dB. Goal is to get a nice energy resolution peak. We see very few pulses in Shashlik, probably we are below the beam now.

CA at 7:50AM: put the base of the Shashlik holder to elevate the Shashlik.

Run 084: Shashlik cell with dual readout,12 GeV electrons. Ham A and B HV = 2.8 kV. Pressure is 1.0 psia. Photek at 4.97 kV. Photek with 10dB. Goal is to get a nice energy resolution peak. We found the peak!!!!



CA at 8:15 AM to remove the attenuator from Photek.

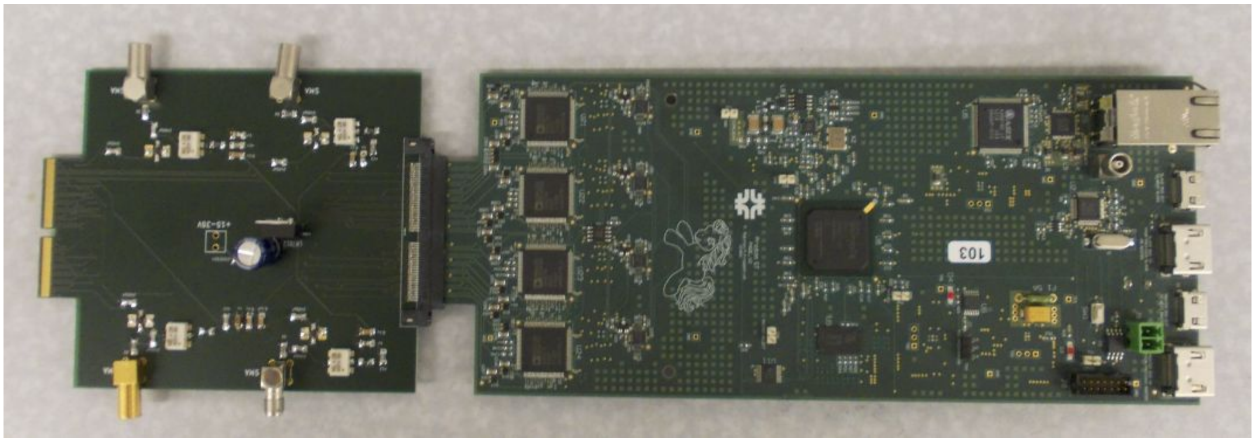
Run 085: Shashlik cell with dual readout,12 GeV electrons. Ham A and B HV = 2.8 kV. Pressure is 1.0 psia. Photek at 4.97 kV.

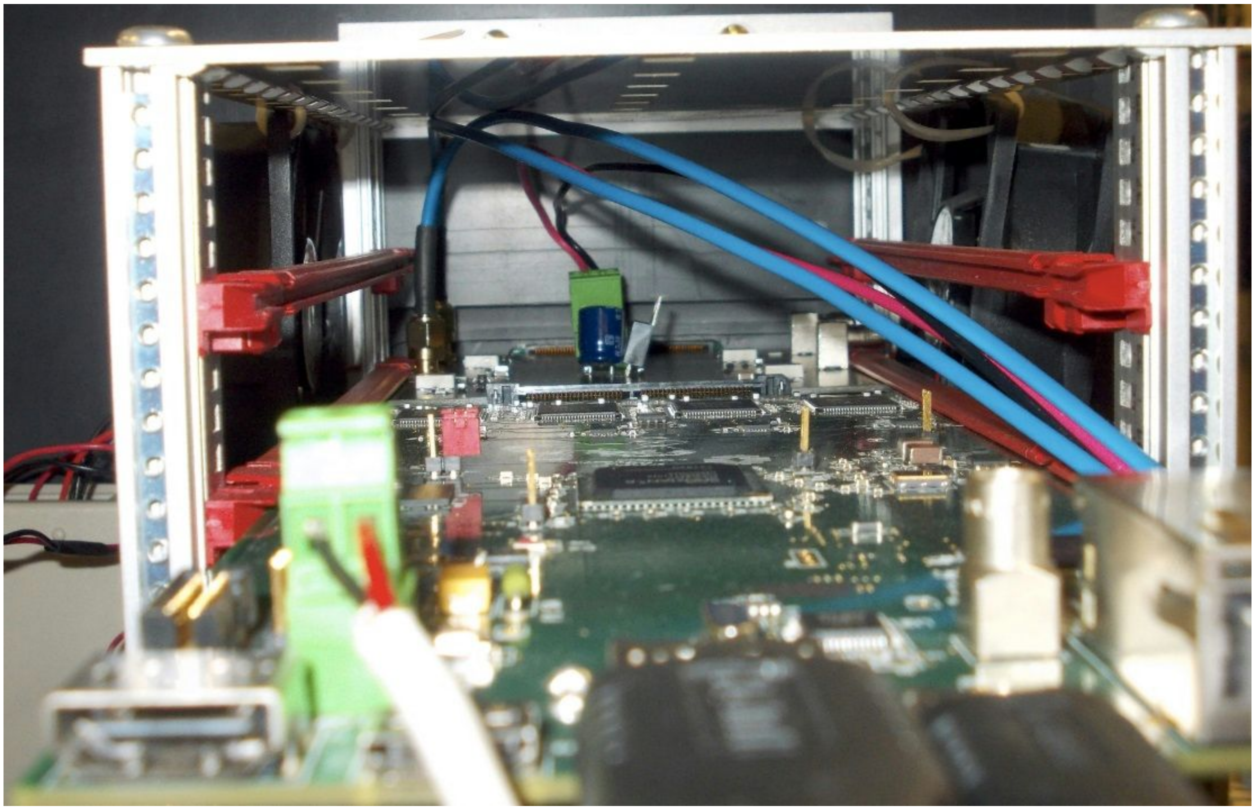
Finished with good energy peak, and slightly better timing resolution. If we get more beam time, we can finish off this beast.

Aug 15

14:00
We attempt to read out the CMS shashlik prototype matrix using a board attached

before the PADE board which splits the SiPM signal to allow us to read it out using the DRS.
=> Later we learned that the board actually diverts the signal completely, it does not split it.
Singel is applified with a MAR-1SM amplifier.
www.minicircuits.com/pdfs/MAR-1SM+.pdf





Run 001: Default laser settings, tune at 90%. took data using 2442. No ND filter inside lase box.
Run 002: Default laser settings, tune at 90%. took data using 2216.No ND filter inside

lase box.
Run 003: Laser tune at 70%.No ND filter inside lase box.
Run 004: Laser tune at 50%. No ND filter insde box. Laser used is the 355 nm.

All above data taken at 1GS/s

Run 005: Laser tune at 50%. No ND filter insde box. Laser used is the 355 nm. Take data at 5GS/s, also recalibrated the DRS.

Run 006: Laser tune at 70%. No ND filter inside box. Laser used is the 425 nm. Take data at 5GS/s.

Run 007: Laser tune at 100% with large attenuator. Shooting 425nm. Take data at 5GS/s.

Run 008: Put in the third cable read out from the shashlik detector. Laser tune at 100% with large attenuator. Shooting 425nm. Take data at 5GS/s.

Run 009: Laser tune at 100%. Increased light attentuation on the wheel attentuator - almost near maximum. Shooting 425nm. Take data at 5GS/s.

Run 010: Laser tune at 100%. Put in ND=1 filter inside the laser box. added additional attentuation from the wheel at around 90 degrees. Shooting 425nm. Take data at 5GS/s.

Run 011: Laser tune at 100%. Put in ND=1 filter inside the laser box. tried to increase the attenuation a bit more with the wheel attentuator. Shooting 425nm. Take data at 5GS/s.

Run 012: Laser tune at 100%. Put in ND=1 filter inside the laser box. tried to increase the attenuation even more with the wheel attentuator. Shooting 425nm. Take data at 5GS/s.

Run 013: Use 355nm laser. Laser tune at 100%. No ND filter inside laser box. Take data at 5GS/s.

Run 014: Use 355nm laser. Laser tune at 100%. Use ND filter on wheel inside laser box to go down in amplitude by about factor of 2. Take data at 5GS/s.

Run 015: Use 355nm laser. Laser tune at 100%. Use ND filter on wheel inside laser box to go down in amplitude by another factor of 3.   Take data at 5GS/s.

Aug 16

9:00
We're waiting for shashlik to finish muon runs before starting timing studies.

Summary of goals for Shashlik matrix test:
1) Study pulse shapes
    * what is rise time of Y11 + clear transport fibers on SiPM?

2) study effect of transverse shower fluctuations
    * read out crystals separated by 2 crystal spacings, compare to the result from laser at the same amplitude

CH1: shashlik card (inside sma connector)
CH2: cherenkov
CH3: shashlik card (inside sma connector)
CH4: shashlik card (outside sma connector)

Run 016: 16 GeV electrons, trigger on CH1
Run 017: 16 GeV electrons, trigger on CH1

We moved to table to align vertically with the cell that we are reading out (upper left corner)

Run 018: 16 GeV electrons, trigger on CH1

We ask for 4GeV electrons now.

the last run may have included some 4GeV events because we forgot to end the last run.

Run 019: 4 GeV electrons, trigger on CH1

we move the trigger slight to the right because some pulses had the baseline cut off on the left side

Run 020: 4 GeV electrons, trigger on CH1

Run 021: 4 GeV electrons, trigger on CH1, asked to reduce beam intensity to 50K per spill

CA at 11:40: connect two cells in Shashlik matrx with boards. The cells are shown below:

0 1 2 3
4 5 6 7
8 9 10 11

we are reading out channels 0 and 8, from the same side. mapping is

CH1 and CH2 are cell 0 and CH3 and CH4 are cell 6

Run 022: 4 GeV electrons, trigger on CH1. Reading out two cells from the matrix.

Run 023: 4 GeV electrons. Reading out two cells from the matrix. Changed the trigger to AND between CH1 and CH3.

12:00 AM: Evan discovered that the mapping of the Shashlik cells is not correct, the board would need to re-designed. Turns out we are reading out cells 0 and 11.

CA at 12:40 to move one of the boards and see if the mapping gets better. The idea is that cells mapping should now become 0 and 3.

Run 024: 4 GeV electrons. Test if the channel mapping is moved as expected.

CA at 1:15AM: went in to put our setup inside the beam. and turned on the HV on amplifier in the Shashlik matrix. Now the setup is the following:

Shashlik single cell, Photek reference in the back, and behind all is the Shashlik matrix.

Channel mapping in our box is the same as we ended:

CH1 is Photek
CH2 is Cher
CH3 is Ham 1
CH4 is Ham 2

Run 086: our shashlik cell, 16 GeV electron. Stopped at ~300 events

Take some data with Matrix.

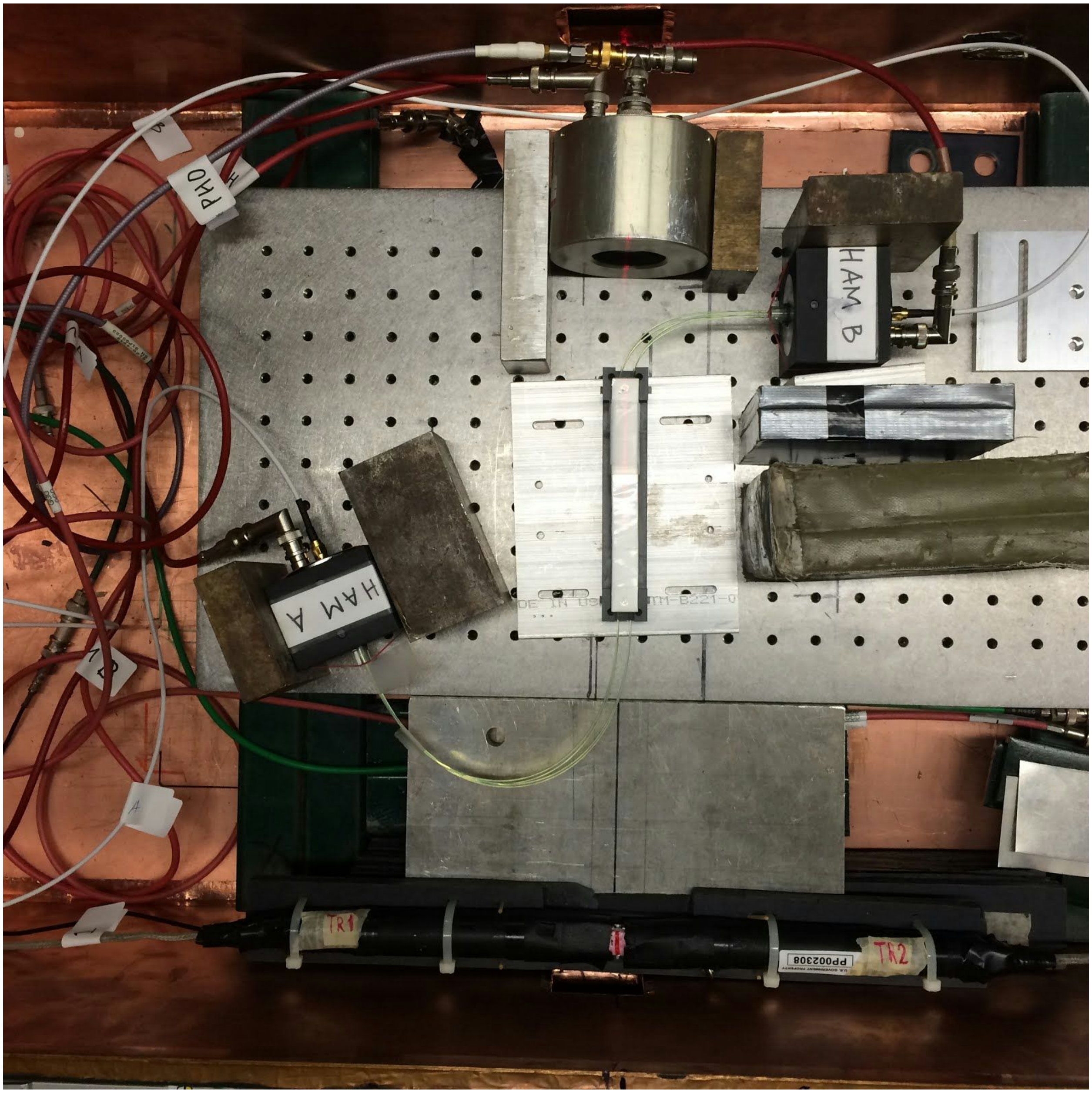
Run 025: 16 GeV electrons. DRS4 here is 2439

Run 087: our shashlik cell, 16 GeV electron, take as much as we can.

Aug 17

CH1: Photek
CH2: Cherenkov
CH3: Ham1
CH4: Ham2

Picture of our GOLDEN SHASHLIK setup. Faint red laser trace is visible on Shashlik, showing that thingy is aligned with beam.



Run 088: our shashlik cell, 16 GeV electron. We get energy peak around 5-7%

Run 089: our shashlik cell, 8 GeV electron.

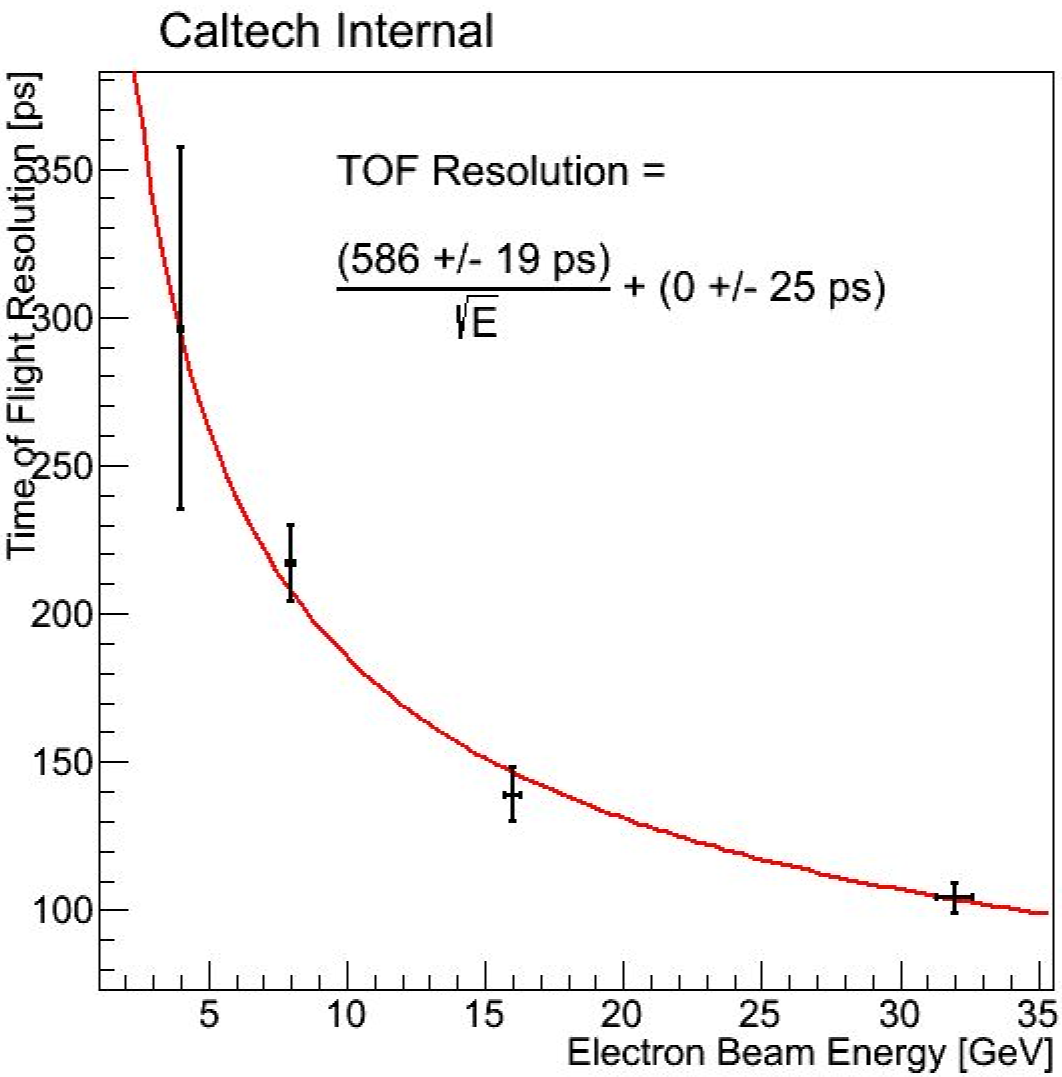
CA at 5:20 AM: place the lead brick and also attenuators on all DRS4 channels

Run 090: our shashlik cell, 32 GeV electron. Stopped the run around 900 events, because cherenkov setting finalized. CHerenkov at 0.5 psia

Run 091: our shashlik cell, 32 GeV electron. CHerenkov at 0.7 psia

Run 092: our shashlik cell, 4 GeV electron. CHerenkov at 0.7 psia

Here's the resolution vs energy plot from this morning's data:



c

Aug 19

12:00
We rewire the shashlik matrix fiber mappings to get 2 adjacent cells.
Also rewired trigger logic to be able to trigger on cherenkov signal on the DRS

CH1: sma connector on front bottom PADE board : we think this it's the upper left corner cell
CH2: lemo connector on front bottom PADE board
CH3: inner sma connector (attached at top of the board) on top PADE board : we think this is the cell just to the right of the upper left corner cell
CH4: inner sma connector (attached at top of the board) on top PADE board

laptop ip address changed : 131.225.171.232

We verify using the laser that the channel mapping is what we think it is.
But channel 2 sees no signal. maybe we broke the lemo connector when we connected the cable. there was some tension applied on the connector during the process.

tried to trigger on the cherenkov, but the signal appears to be just slightly off the 200ns window. we start with triggering on CH1.

Run 026: 8 GeV electrons, trigger on CH1.

we see very few events that have signal in both cells.

Run 027: 8 GeV electrons, trigger on CH1 AND CH3.

we get pretty low rate. about 10-15 events per spill.
we get TOF resolution of about 3ns.

Run 028: 8 GeV electrons, trigger on cherenkov. use 4GS/s sampling to get the signals inside the window.

Run 029: repeat above run wit high stats

still low number of events with signals in both cells.

Run 030: 8 GeV electrons, trigger on cherenkov AND CH1 AND CH3

With rising edge fit, we get TOF resolution of 1.8ns between different cells, and 0.9ns between the fibers of the same cell.

Run 031: 12 GeV electrons, trigger on cherenkov AND CH1 AND CH3 got only 10 events before our shift expired.

Run 032: Take a laser run with the same setup. trigger on CH1. 425 nm laser. ND=1 attenuator inside the box.