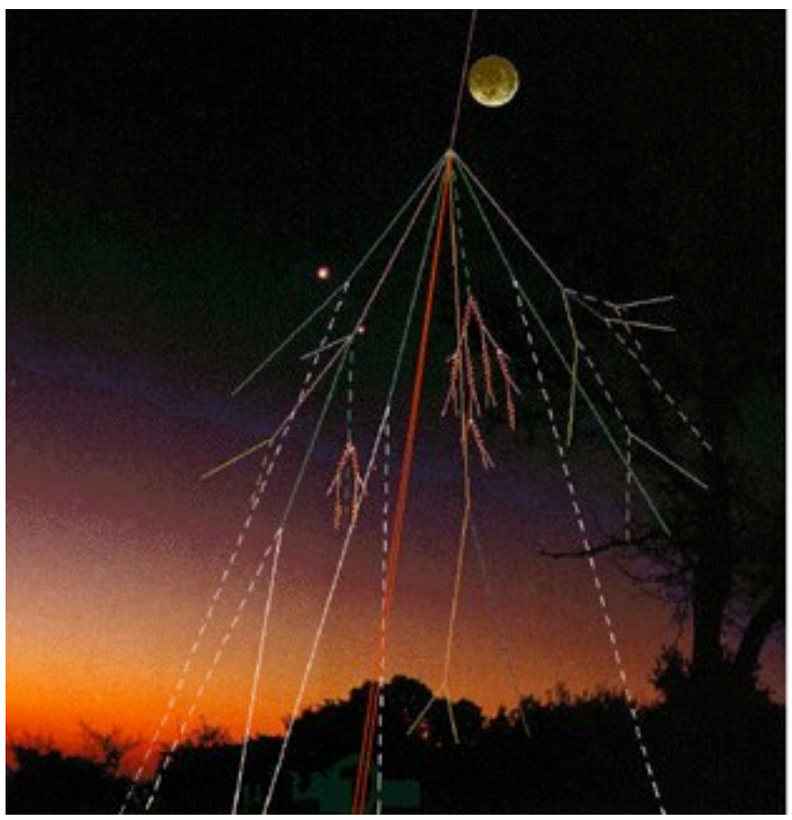
CREAM TEA

Cosmic Ray Extensive Area Mapping for Terrorism Evasion Application

Ryan Nichol



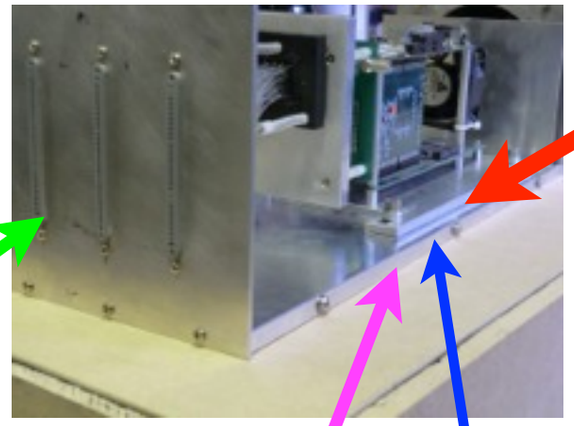
Hardware Status

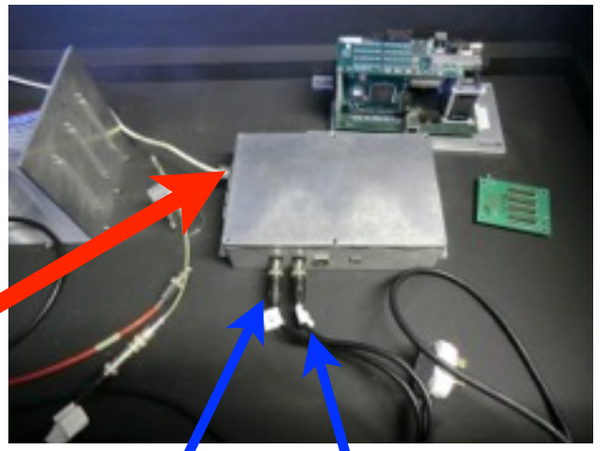
- We have:
  - Enough PMTs
  - 4 x 64 channel TARGET based digitiser boards
  - 1 x clock distribution board
  - 1 x compact-PCI receiver card
  - 1 x compact-PCI crate
  - 1 x compact-PCI CPU
  - 4 x mechanical/optical housing for PMT
  - 5 x 5V power supply (being replaced with 6V models)
  - 1 x 3.3V power supply
  - old 1 channel (negative) HV system
  - MINOS CalDet Scintillator Planes
  - CalDet Readout Cables
  - 4 channel (negative) HV system
  - Minerva-style planes from W&M

System Diagram

x12

x4

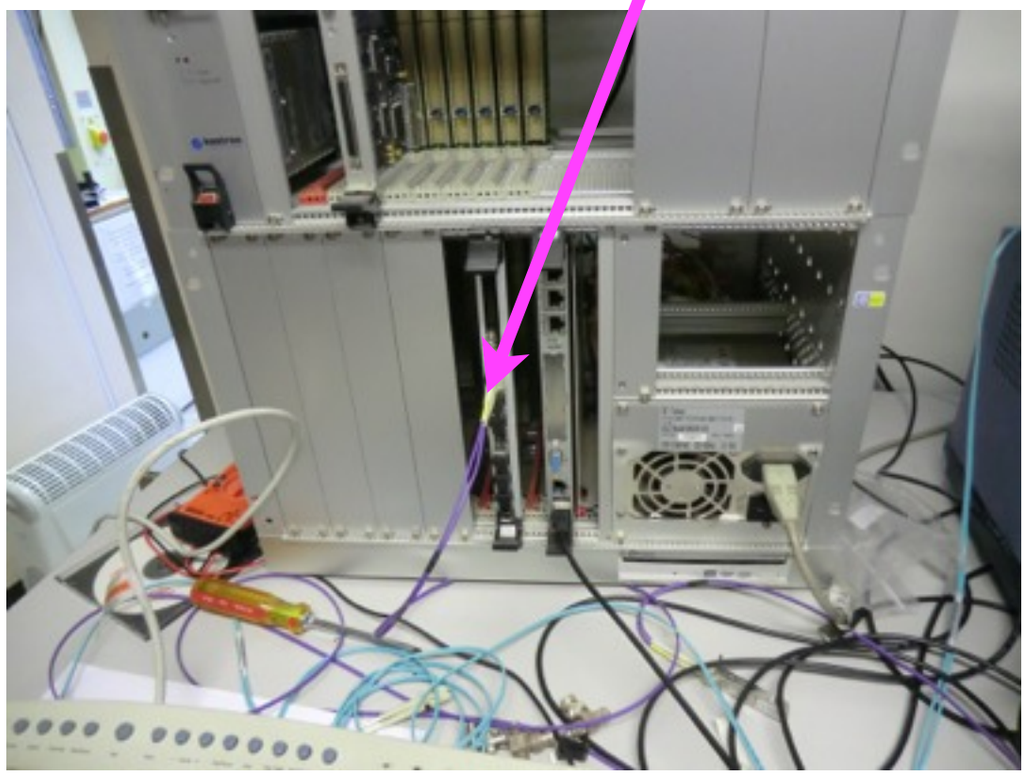




+3.3V

+5V

+5V (well 6V)

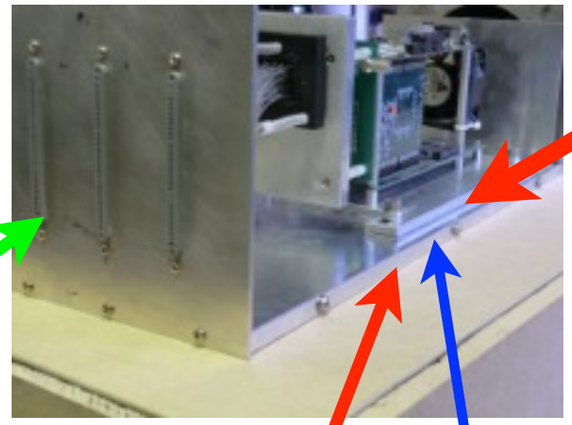


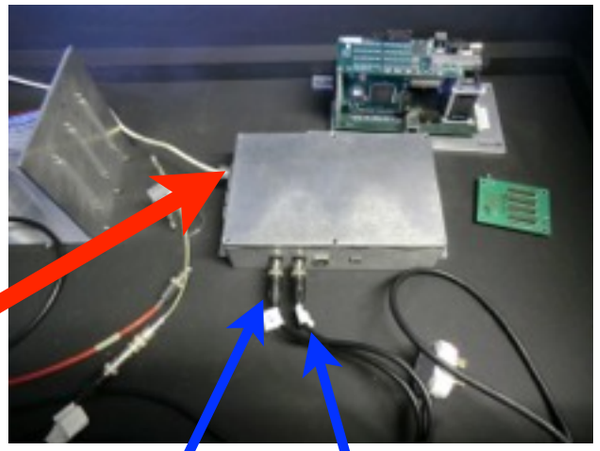
Arrow Key:
Optical Signal
Electrical Connection
Fibre Optic Connection
DC Power

Current System Diagram

x12

x4



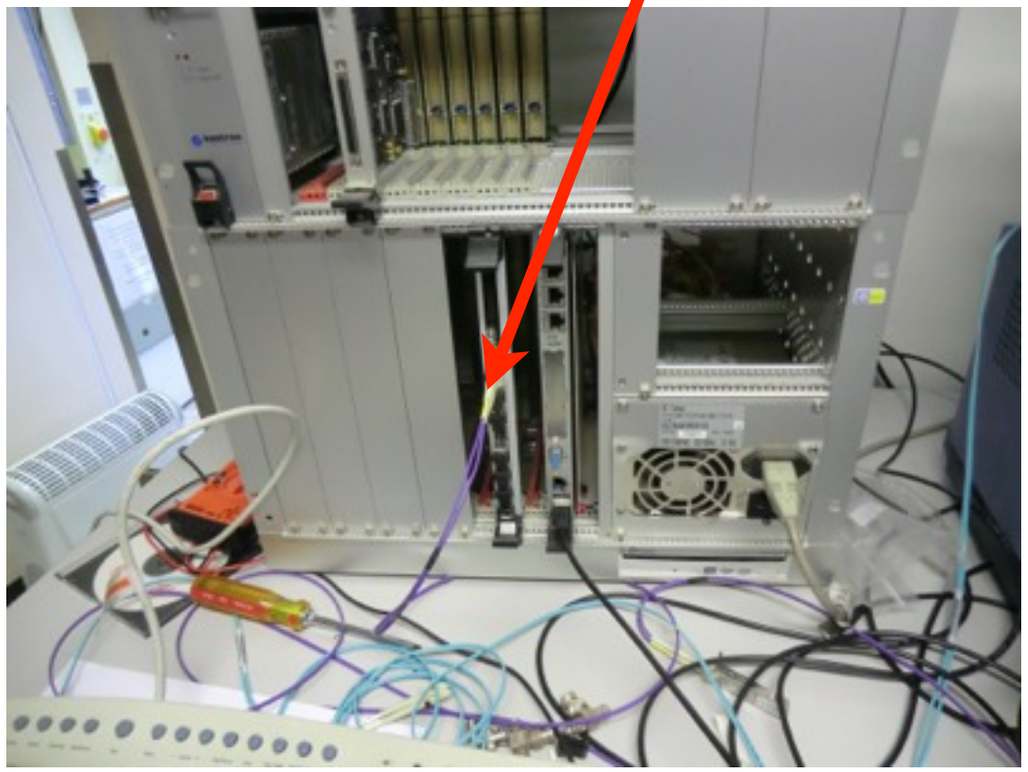


+3.3V

+5V

+5V (well 6V)

USB



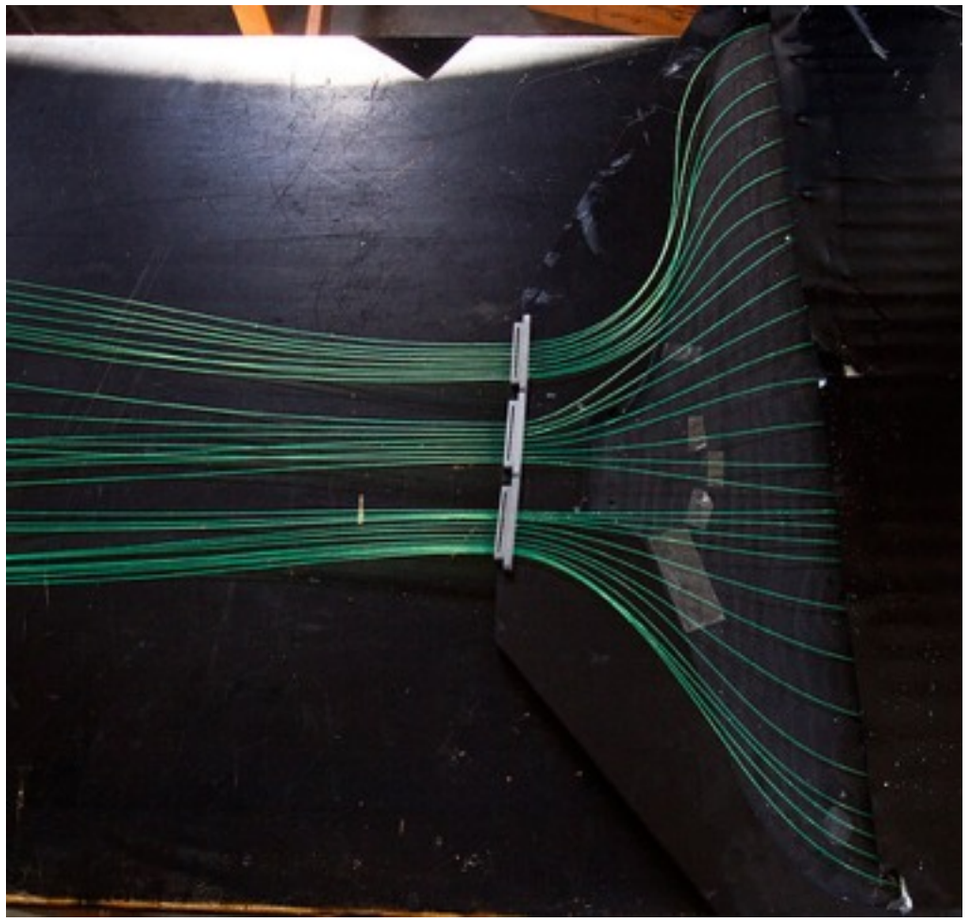
Arrow Key:
Optical Signal
Electrical Connection
Fibre Optic Connection
DC Power

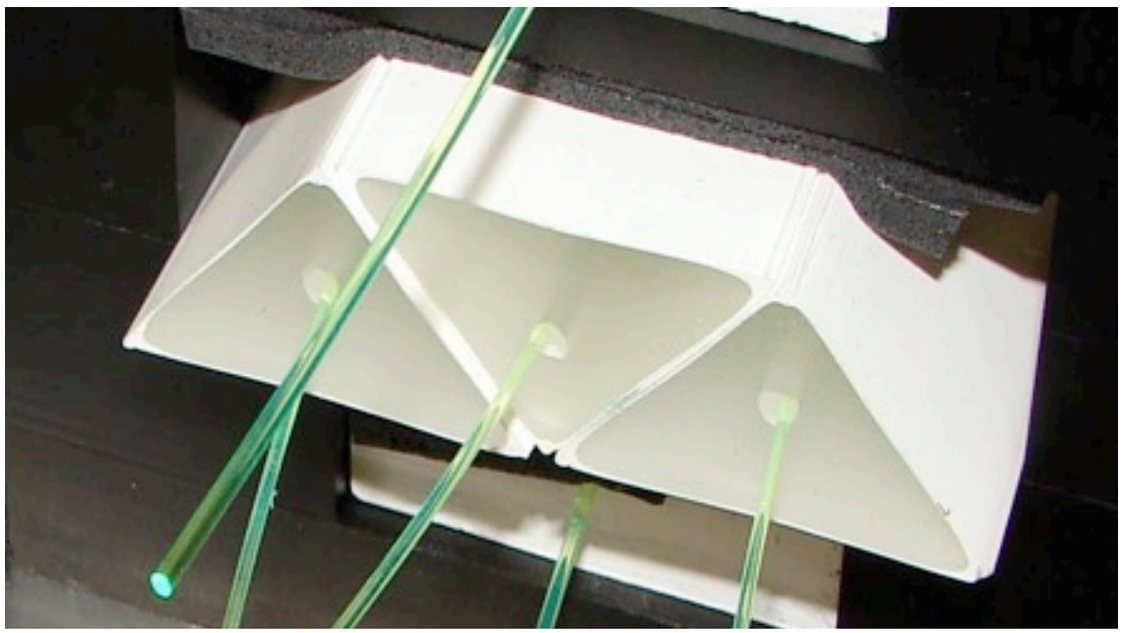
Fine Grain Scintillator

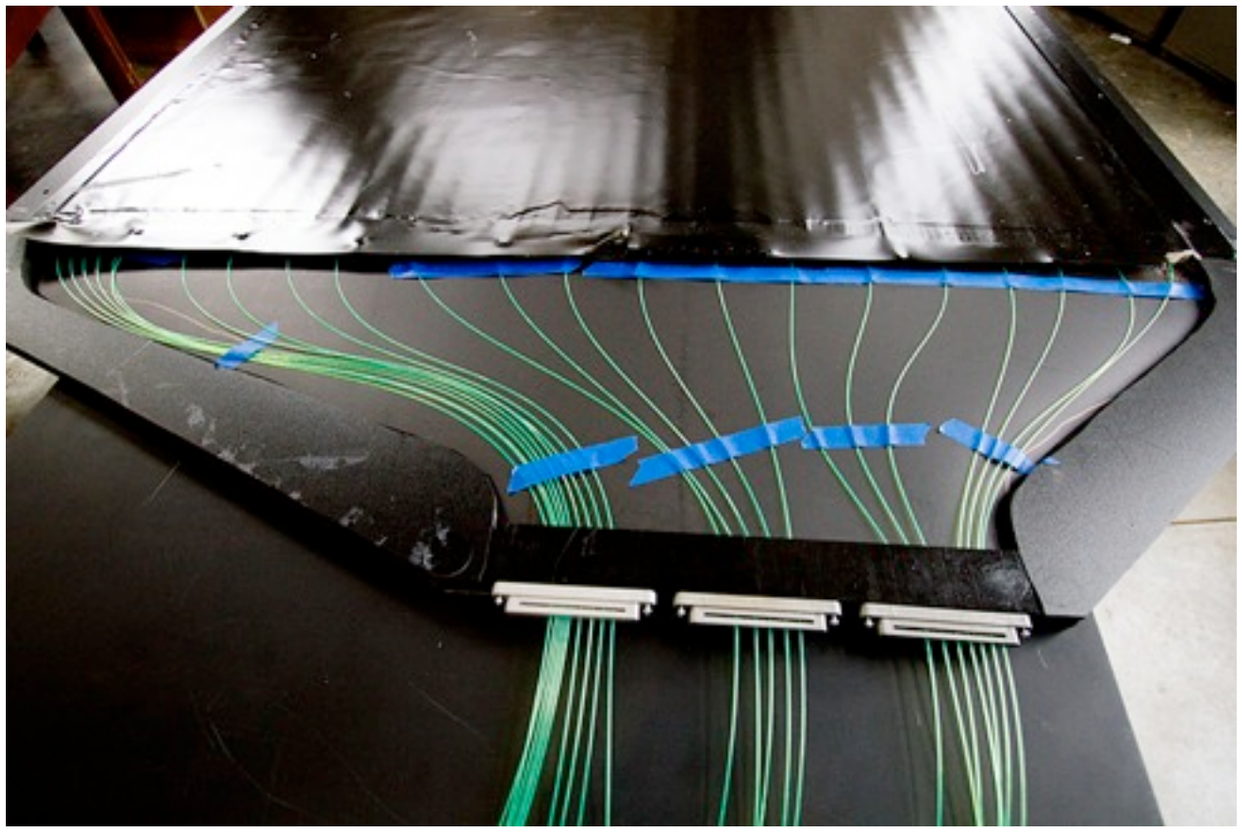
Obtained partial funding from AWE to upgrade the test-stand to use fine grain scintillator.

8 scintillator planes are currently sitting in customs in the UK. Hopefully they will be delivered this week.

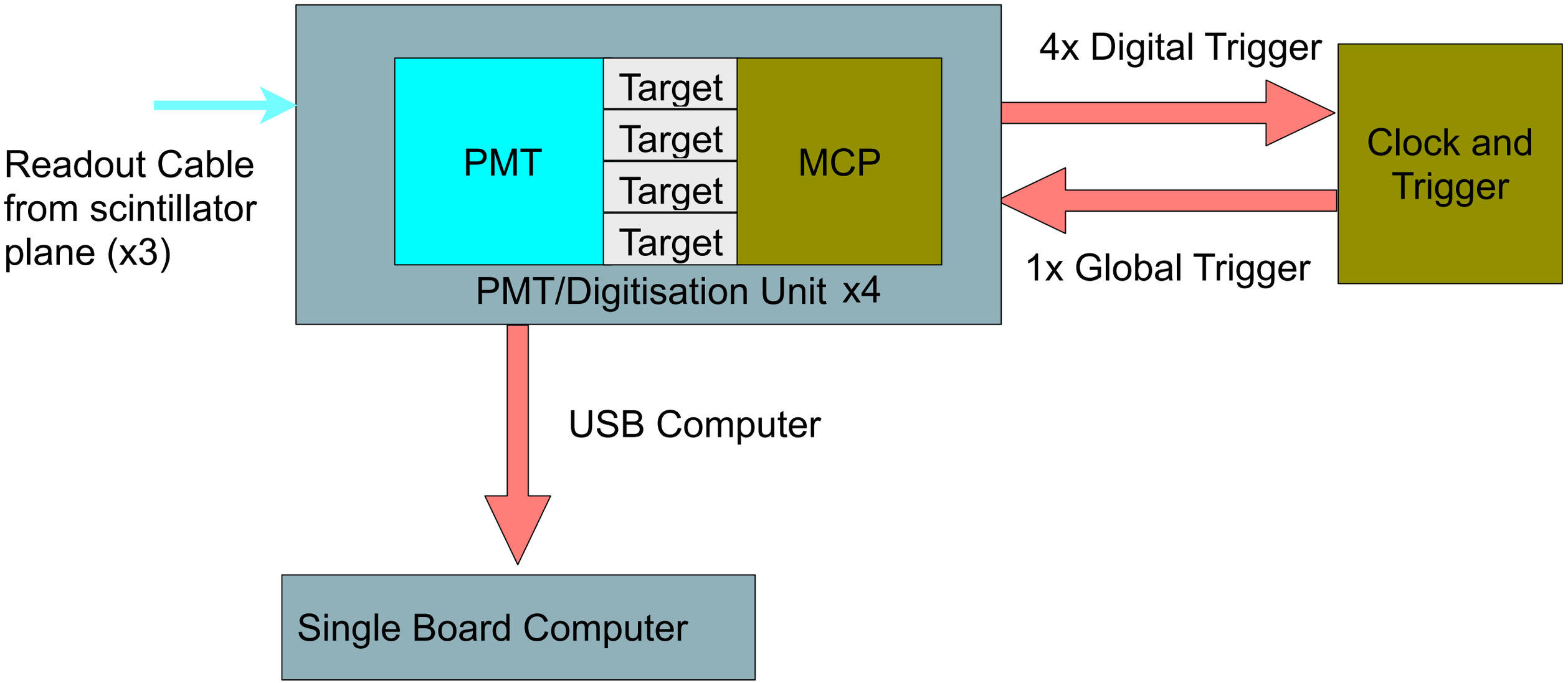
Taken over 18 months to get the scintillator planes constructed in the US.





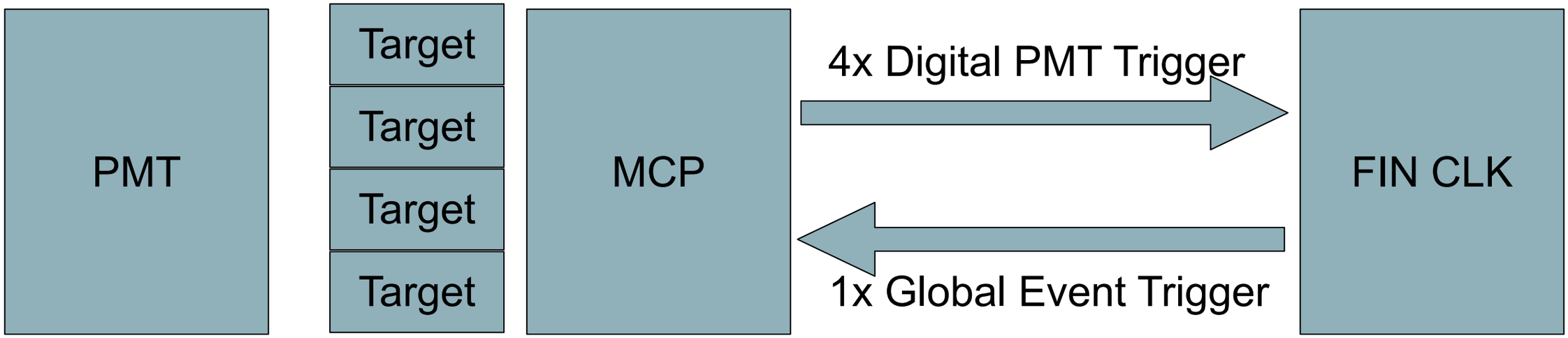


System Setup



See the full system upstairs in Lab C23. It will move down to MSSL next week for in-situ operation and testing.

Trigger Logic

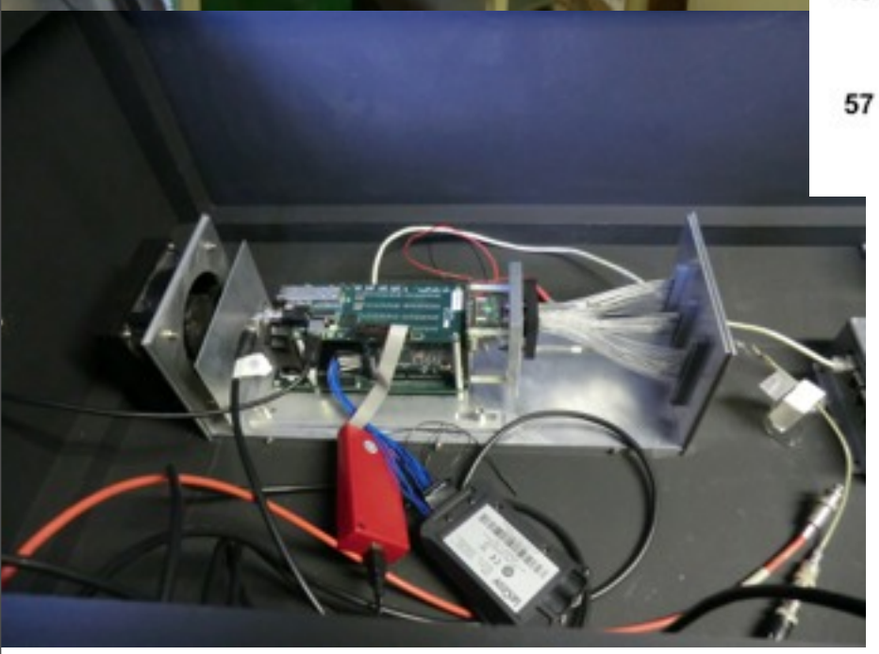


Software tuneable threshold trigger on the sum of the analogue signal in the 16 channels of each TARGET

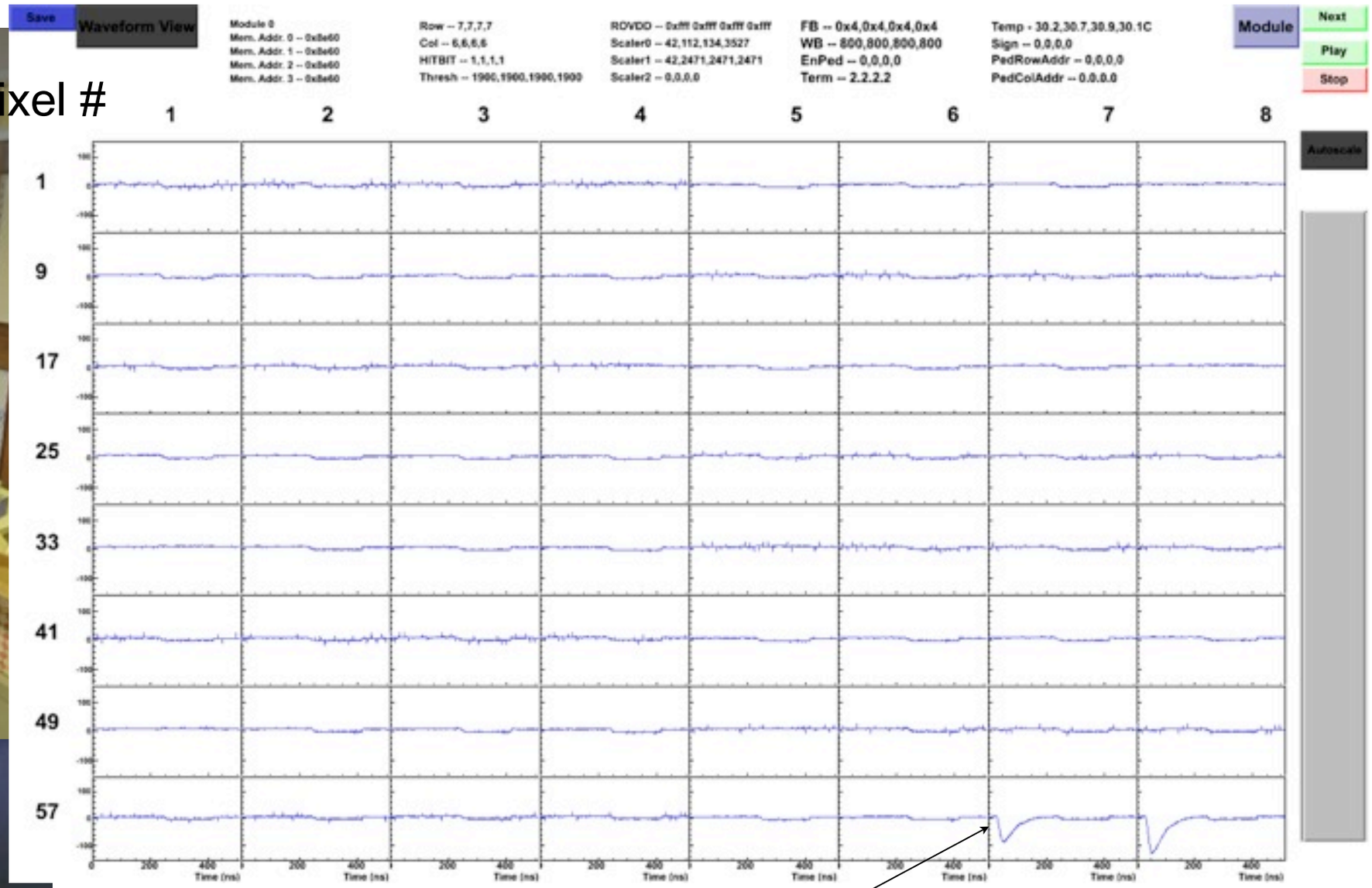
Four digital trigger lines per PMT (one per TARGET). Can perform any logic (i.e 4-way OR, pairwise AND, etc.) to generate one digital trigger per PMT

Four digital trigger lines one per PMT. Can perform any logic (i.e 4-way OR, pairwise AND, etc.) to generate one global event trigger

Dark Box Testing -- Self Triggering Mode

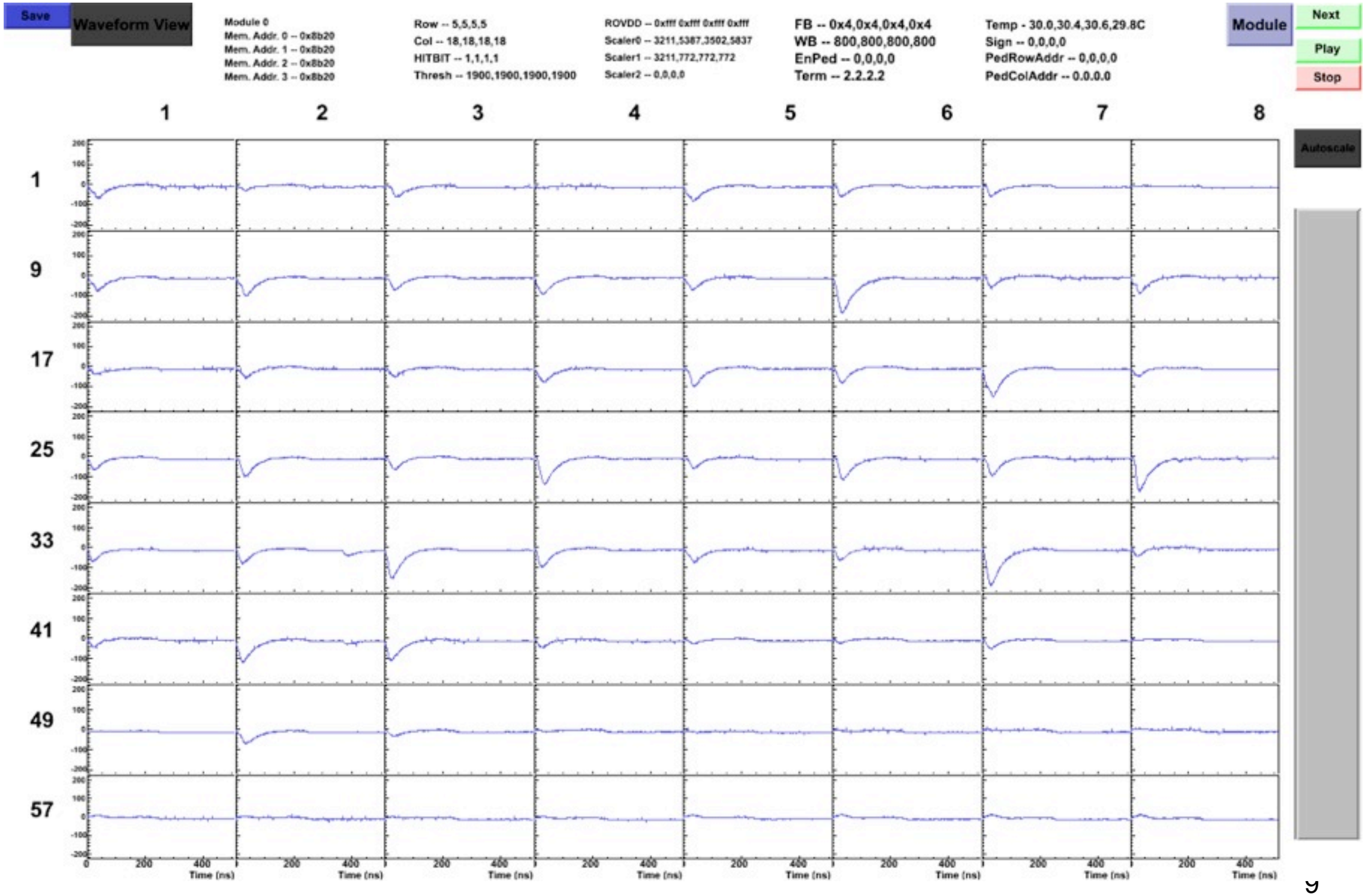


Pixel #



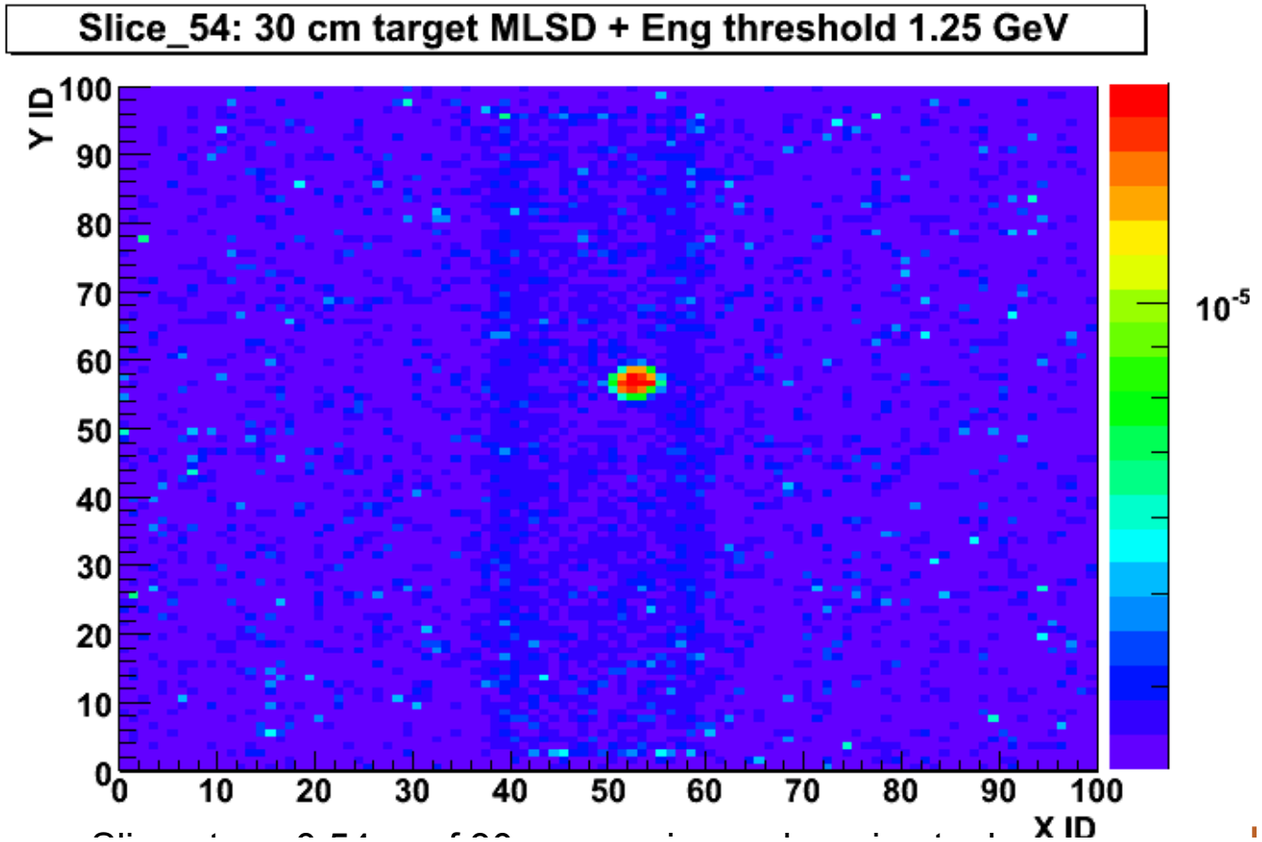
PMT Pulse

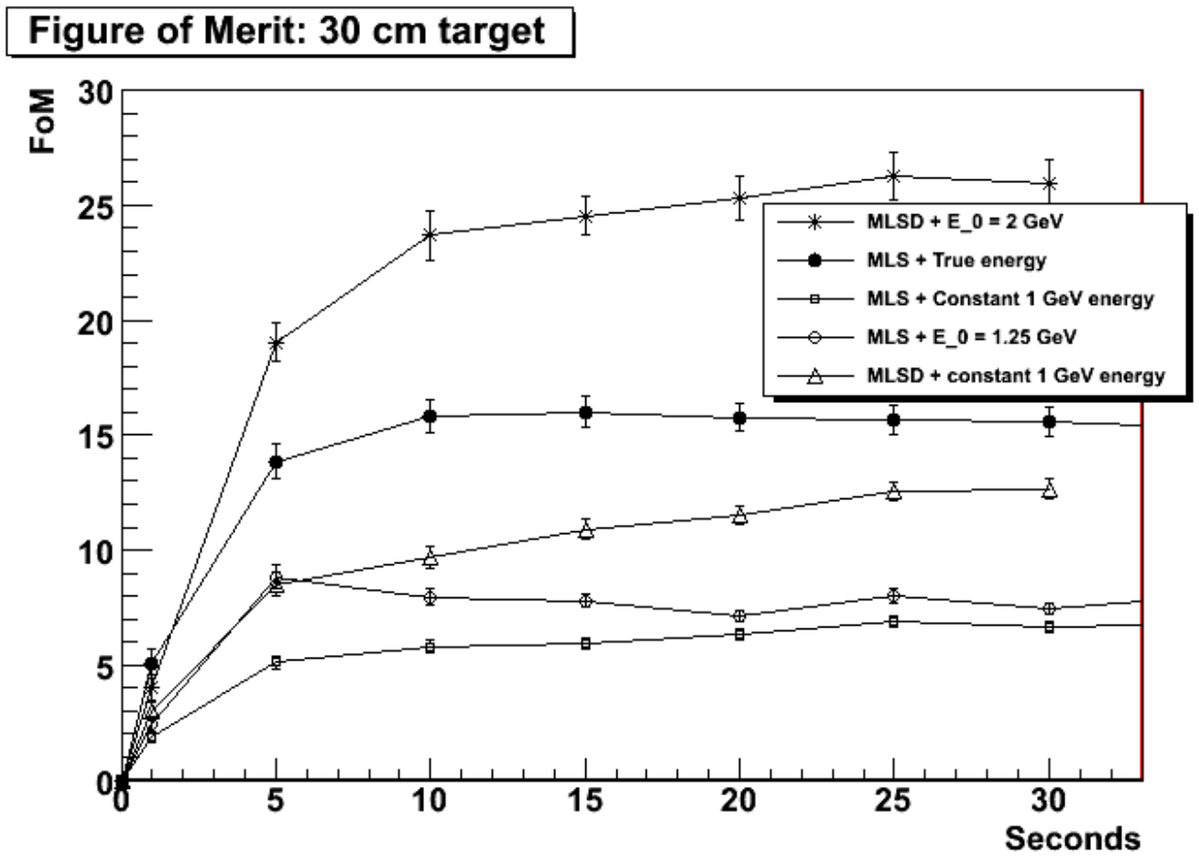
LED Pulser


Save
Waveform View
Module 0
Mem. Addr. 0 -- 0x8b20
Mem. Addr. 1 -- 0x8b20
Mem. Addr. 2 -- 0x8b20
Mem. Addr. 3 -- 0x8b20
Row -- 5,5,5,5
Col -- 18,18,18,18
HITBIT -- 1,1,1,1
Thresh -- 1900,1900,1900,1900
ROVDD -- 0xfff 0xfff 0xfff 0xfff
Scaler0 -- 3211,5387,3502,5837
Scaler1 -- 3211,772,772,772
Scaler2 -- 0,0,0,0
FB -- 0x4,0x4,0x4,0x4
WB -- 800,800,800,800
EnPed -- 0,0,0,0
Term -- 2.2.2.2
Temp - 30.0,30.4,30.6,29.8C
Sign -- 0,0,0,0
PedRowAddr -- 0,0,0,0
PedColAddr -- 0.0.0.0
Module
Next
Play
Stop
Autoscale
1
2
3
4
5
6
7
8
1
9
17
25
33
41
49
57
Time (ns)

Tomography Algorithm Development

- Developed algorithms based on:
  - Maximum likelihood scattering
  - Maximum likelihood scattering+displacement
- Simple muon threshold detector gives 5-fold improvement

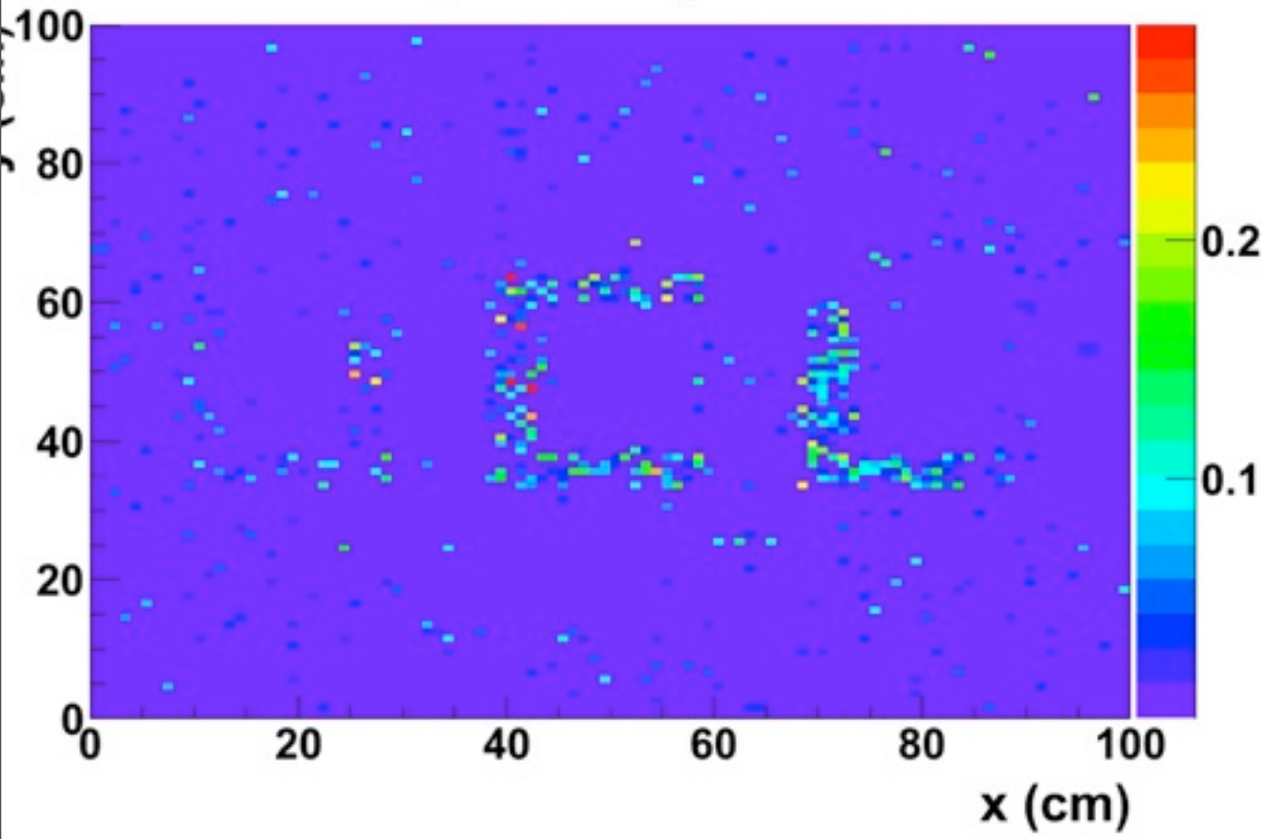


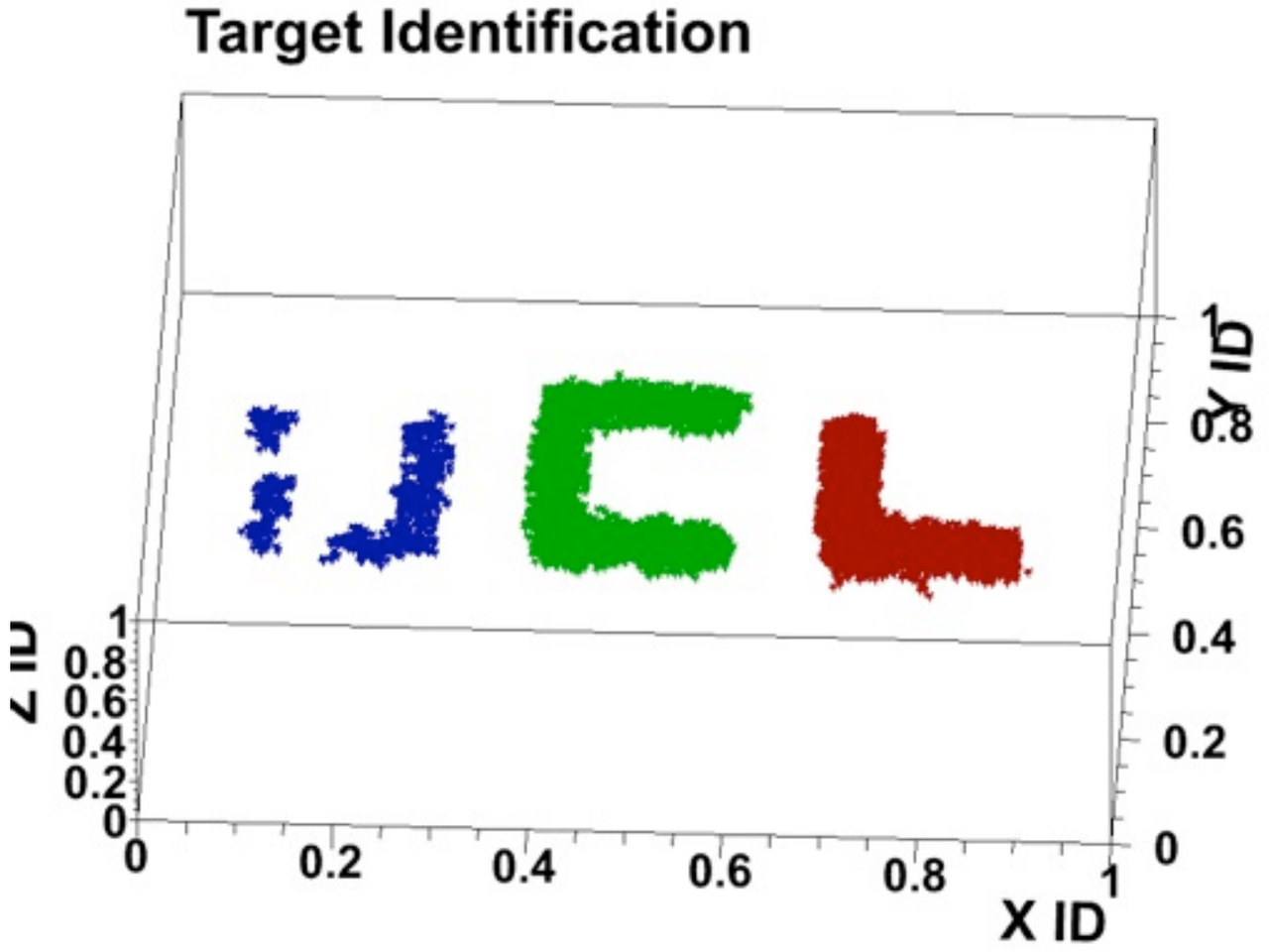


Plots from Linda Cremonesi, MSc thesis

Simulating the 1m test-stand

- Simulate targets made of aluminium, iron and lead
- Developed “hot spot” identification algorithms





To Do List I (from last year)

- Hardware Tasks
  - ~~4 channel (negative) HV system (Justin)~~
  - ~~Get Minerva-style planes from W&M (Ryan to chase up)~~
  - ~~Optical lacing for 3 PMTS (Anna)~~
  - ~~BNC connectors on 6V power supplies (Anna)~~
  - ~~Internal Jumper cables (Fibre optic, HV, Cat5, JTAG, BNC, LEMO) (Justin, Jonathan)~~
  - ~~External HV cables (@MSSL)~~

To Do List II

- Firmware Tasks
  - ~~Fix Fibre Optic Readout (Ryan/Jonathan)~~
    - ~~Change of clock broke things~~
  - Debug digitiser timing
    - Currently have digital glitches and pedestal shifts due to the synchronisation of the sample and hold signals
  - Shorten readout window
    - To increase event bandwidth and reduce data to disk
  - Add a charge integration mode (longer term)
    - To increase event bandwidth and reduce data to disk

To Do List III

- Software Tasks
  - Write intermediate charge integration code ()
  - ~~Modify simulation to mimic real detector geometry (Sam)~~
  - Modify simulation to include angular dependence of energy spectrum ()
  - Test track reconstruction algorithm ()
  - Define offline data structure (require simple class written to a tree that can be accessed with or without libraries) ()
  - Write wrapper code to convert raw data to offline format ()
  - Finalise/Test analysis methods ()
    - Jenny's MLS-EM method (INFN paper)
    - Will/Linda/Sam MLSD-EM method (INFN+LIU paper)
    - Implement Ordered Subsets (basically cutting the data set into chunks of N muons and iterating over each chunk separately... to increase speed)
    - How to use absorbed muons

Web Resources

- http://cvs.hep.ucl.ac.uk/trac/creamtea