

University
of Glasgow

Detector Commissioning

MICE CM42

RAL, 23 June 2014

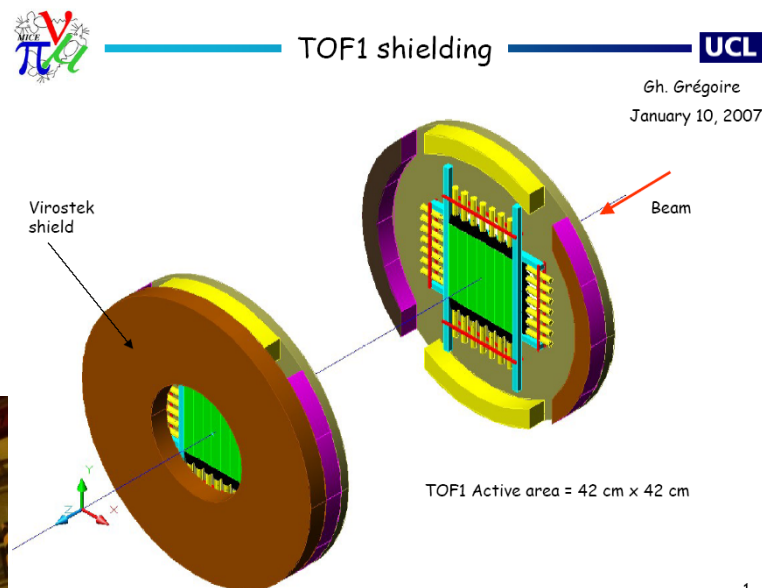
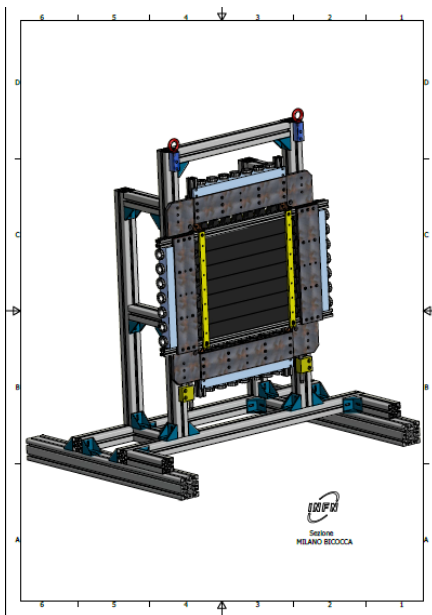
Paul Soler

TOF



- ❑ Local B-field shield for TOF1 fitted in Nov. 2014
 - Box shield with ARMCO

Bonesini

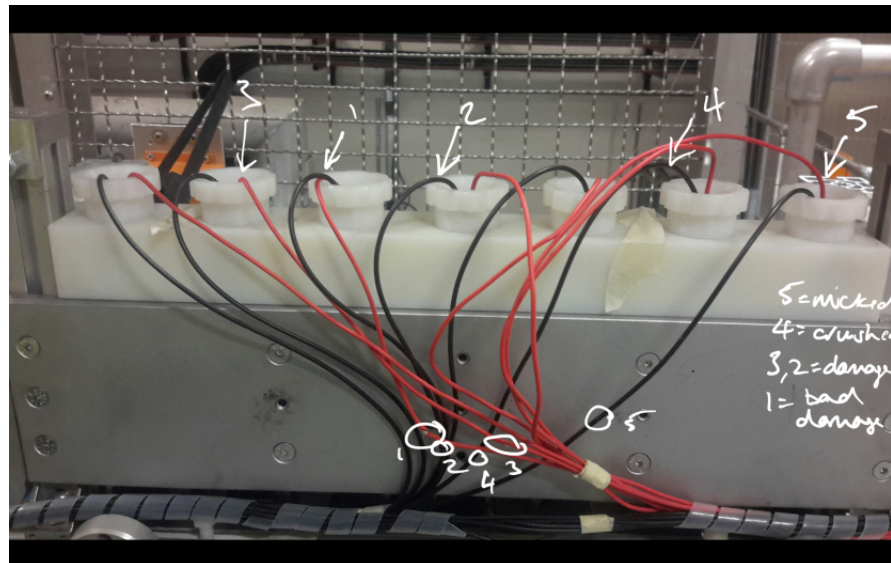


1

Readiness TOF



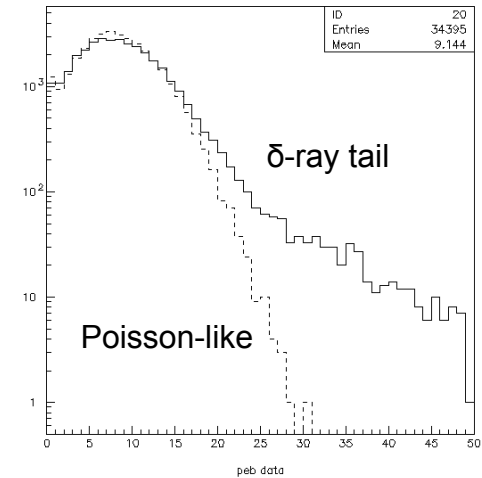
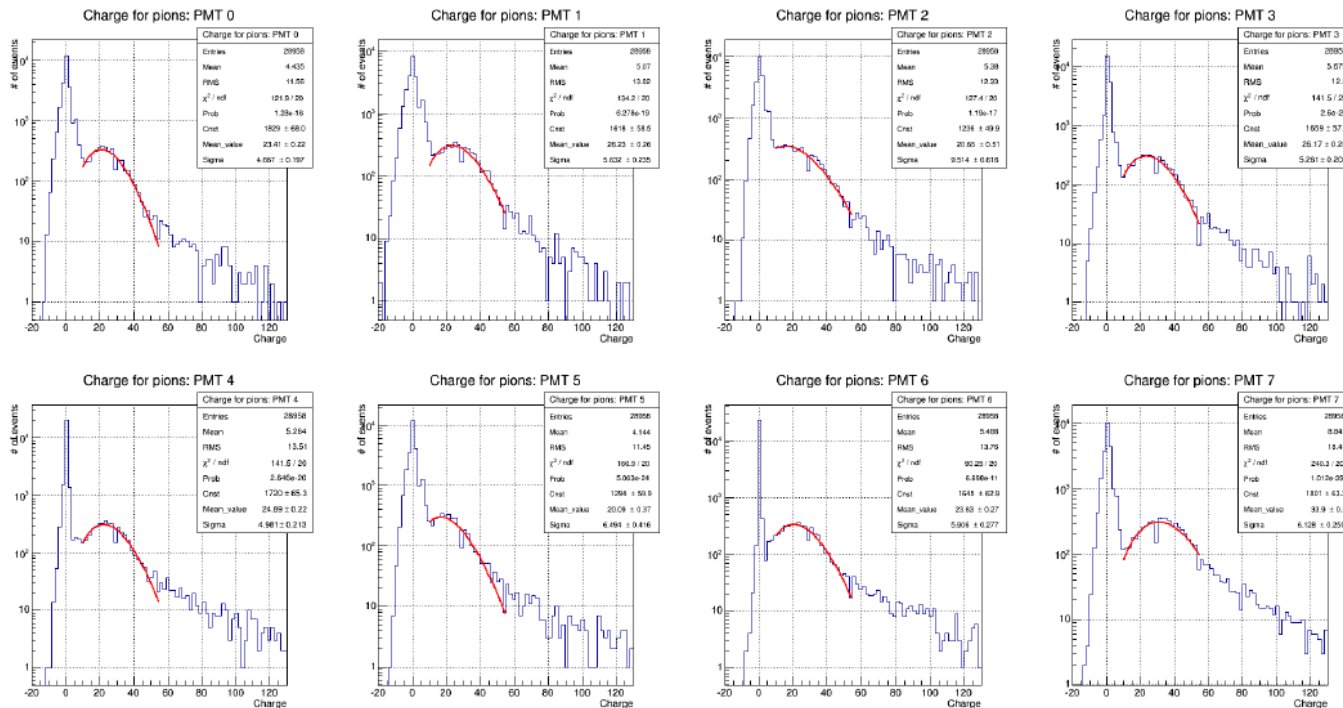
- TOF system (TOF0, TOF1, TOF2) working smoothly since 2009: no foreseen problems for STEP IV
- Need to monitor presence fringe fields from solenoids
- One PMT found broken after TOF1 shielding operation
- During installation of PRY and installation of tracker, some cables were damaged and had to be fixed



Bonesini

Calibration 1 PE distributions as function HV

Cremaldi, Hanlet, Rajaram, Kaplan



Photoelectron modelling to finalise digitisation

- Include Cherenkov, Poisson smearing, δ -rays, and pedestal noise – see Lucien's talk

Further steps in commissioning:

- Verify gains of CKOV channels after first HV scans
- Perform a mini-HV Scan with new CAEN SY4527 +HV module
- Check aerogel Cherenkov thresholds
- Has aerogel density changed?

- Shift in threshold to lower momenta.

muon pion

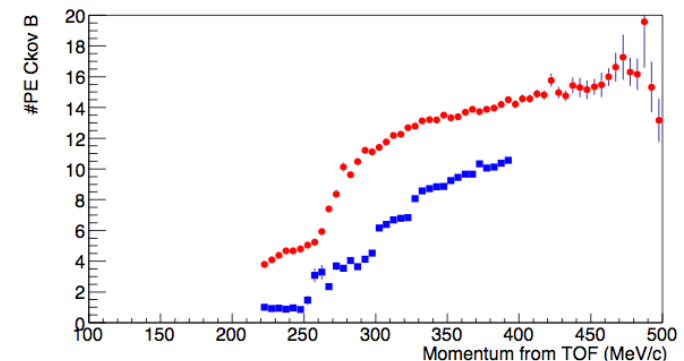
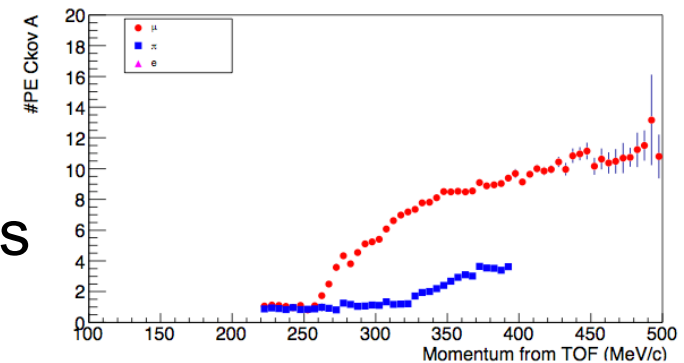
$$P_{th_a} = 260 \text{ MeV/c}, 325 \text{ MeV/c}$$

$$P_{th_b} = 190 \text{ MeV/c}, 260 \text{ MeV/c}$$

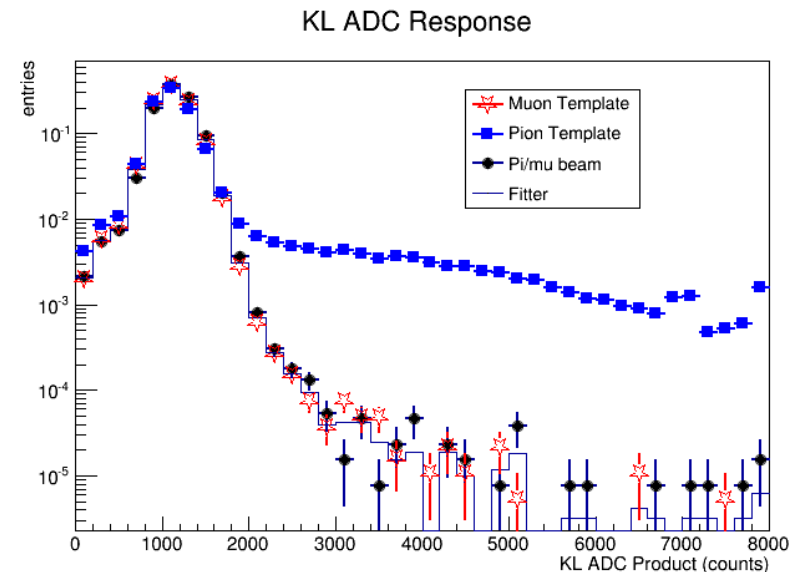
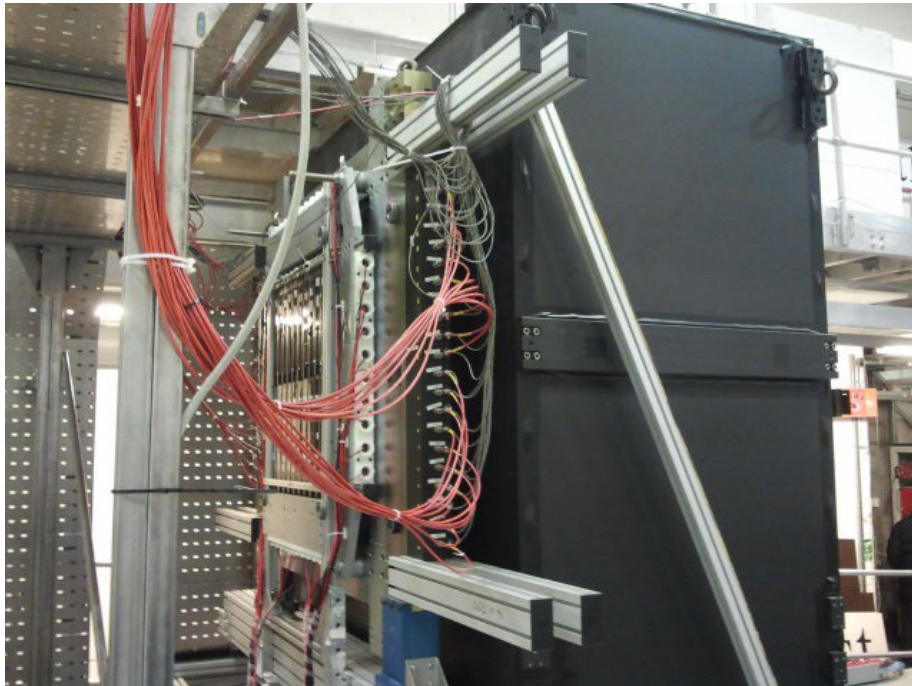
- This corresponds to a change in index

$$n_a: 1.07 \rightarrow 1.09 \quad n_b: 1.12 \rightarrow 1.14$$

- Dedicated momentum scans, with extra low and high momentum runs



- Remaining hardware: **Orestano/Tortora**
- Move to its final Step IV position after PRY installation during shutdown week in July
 - Detector has been working well and was used in pion contamination paper



- ❑ Commissioning KL: **Orestano/Tortora**
- No updates with respect to past CMs
 - Need to collect statistics on all slabs, check all PMTs are alive, check beam profile, check equalisation of gains
 - To collect enough statistics might need local trigger (TOF2) possibly also for cosmics
 - New calibrations to be carried out after movement of KL
 - Currently issues with recent MAUS version in decoding – hope to be able to check things soon
 - Need to revisit the shifter documentation (no significant change expected but need to be here to properly revise it – July 13-19)

EMR



- ❑ October 2014: **Drielsma**
 - EMR hardware extensively upgraded: new Hamamatsu R6427 PMTs, new rack, AC fan system, remote controlled AC power supply, HV PSU (PMTs), LV PSU, new VME and NIM crates
- ❑ Other issues fixed since October 2014:
 - 1 VHDC fails to configure FEBs, HV PSU did not start, LED not working (LV PSU changed), cosmic DAQ code bugs, two noisy FE boards, one single-anode PMT faulty and fixed



EMR



- Other issues fixed since October 2014:
 - HV PSU: 48 channels for SAPMTs (1500 V) and 48 channels for MAPMTs (700 V) remotely controlled

SAPMT				MAPMT			
1500.5 V	314.0 uA	South	PLANE 47 - Y	North	700.0 V	323.0 uA	
1500.5 V	317.0 uA	Bottom	PLANE 46 - X	Top	700.0 V	322.0 uA	
1501.0 V	315.0 uA	South	PLANE 45 - Y	North	700.5 V	322.5 uA	
1500.0 V	314.0 uA	Bottom	PLANE 44 - X	Top	701.5 V	325.0 uA	
1501.0 V	314.0 uA	South	PLANE 43 - Y	North	700.5 V	320.5 uA	
1501.0 V	317.0 uA	Bottom	PLANE 42 - X	Top	700.5 V	324.0 uA	
1500.5 V	314.5 uA	South	PLANE 41 - Y	North	700.0 V	323.5 uA	
0.0 V	0.0 uA	Bottom	PLANE 40 - X	Top	700.5 V	326.0 uA	
1501.5 V	314.0 uA	South	PLANE 39 - Y	North	700.0 V	323.5 uA	
1500.0 V	316.5 uA	Bottom	PLANE 38 - X	Top	700.5 V	323.0 uA	
1500.5 V	315.0 uA	South	PLANE 37 - Y	North	700.5 V	321.5 uA	
1500.5 V	316.5 uA	Bottom	PLANE 36 - X	Top	700.5 V	322.0 uA	
1500.5 V	314.0 uA	South	PLANE 35 - Y	North	700.0 V	321.0 uA	
1501.0 V	317.5 uA	Bottom	PLANE 34 - X	Top	700.5 V	323.5 uA	
1500.5 V	315.0 uA	South	PLANE 33 - Y	North	701.0 V	321.0 uA	
1500.5 V	315.5 uA	Bottom	PLANE 32 - X	Top	700.5 V	322.5 uA	
1500.5 V	314.5 uA	South	PLANE 31 - Y	North	700.0 V	322.0 uA	
1500.5 V	316.0 uA	Bottom	PLANE 30 - X	Top	700.0 V	323.0 uA	
1501.5 V	314.5 uA	South	PLANE 29 - Y	North	700.5 V	320.0 uA	
1500.5 V	315.5 uA	Bottom	PLANE 28 - X	Top	700.0 V	323.0 uA	
1501.0 V	314.5 uA	South	PLANE 27 - Y	North	700.0 V	321.0 uA	
1500.5 V	315.0 uA	Bottom	PLANE 26 - X	Top	700.0 V	322.0 uA	
1501.5 V	317.0 uA	South	PLANE 25 - Y	North	699.5 V	321.0 uA	
1500.5 V	316.5 uA	Bottom	PLANE 24 - X	Top	701.0 V	324.5 uA	
1500.5 V	314.5 uA	South	PLANE 23 - Y	North	700.5 V	323.0 uA	
1500.5 V	318.0 uA	Bottom	PLANE 22 - X	Top	700.5 V	322.5 uA	
1501.0 V	314.5 uA	South	PLANE 21 - Y	North	700.0 V	323.5 uA	
1500.5 V	315.0 uA	Bottom	PLANE 20 - X	Top	701.0 V	323.5 uA	
1501.0 V	313.0 uA	South	PLANE 19 - Y	North	699.5 V	322.5 uA	
1500.0 V	316.0 uA	Bottom	PLANE 18 - X	Top	700.5 V	322.0 uA	
1500.5 V	316.5 uA	South	PLANE 17 - Y	North	700.0 V	323.0 uA	
1500.5 V	316.0 uA	Bottom	PLANE 16 - X	Top	699.5 V	323.5 uA	
1501.5 V	314.0 uA	South	PLANE 15 - Y	North	700.0 V	320.5 uA	
1500.5 V	316.0 uA	Bottom	PLANE 14 - X	Top	700.5 V	321.5 uA	
1501.0 V	314.5 uA	South	PLANE 13 - Y	North	700.5 V	323.0 uA	
1500.0 V	317.0 uA	Bottom	PLANE 12 - X	Top	700.0 V	323.5 uA	
1501.0 V	314.5 uA	South	PLANE 11 - Y	North	700.5 V	323.5 uA	
1500.5 V	317.0 uA	Bottom	PLANE 10 - X	Top	679.5 V	314.0 uA	
1501.0 V	314.0 uA	South	PLANE 09 - Y	North	671.0 V	308.0 uA	
1500.0 V	316.0 uA	Bottom	PLANE 08 - X	Top	700.0 V	323.5 uA	
1501.0 V	315.0 uA	South	PLANE 07 - Y	North	700.0 V	321.5 uA	
1500.0 V	316.0 uA	Bottom	PLANE 06 - X	Top	701.0 V	322.0 uA	
1501.0 V	315.0 uA	South	PLANE 05 - Y	North	700.5 V	324.5 uA	
1500.0 V	308.5 uA	Bottom	PLANE 04 - X	Top	700.5 V	323.0 uA	
1500.0 V	313.5 uA	South	PLANE 03 - Y	North	700.5 V	322.0 uA	
1500.0 V	317.5 uA	Bottom	PLANE 02 - X	Top	700.5 V	322.0 uA	
1501.0 V	315.0 uA	South	PLANE 01 - Y	North	700.5 V	321.5 uA	
1500.5 V	317.0 uA	Bottom	PLANE 00 - X	Top	700.0 V	322.0 uA	

Drielsma,
Hanlet

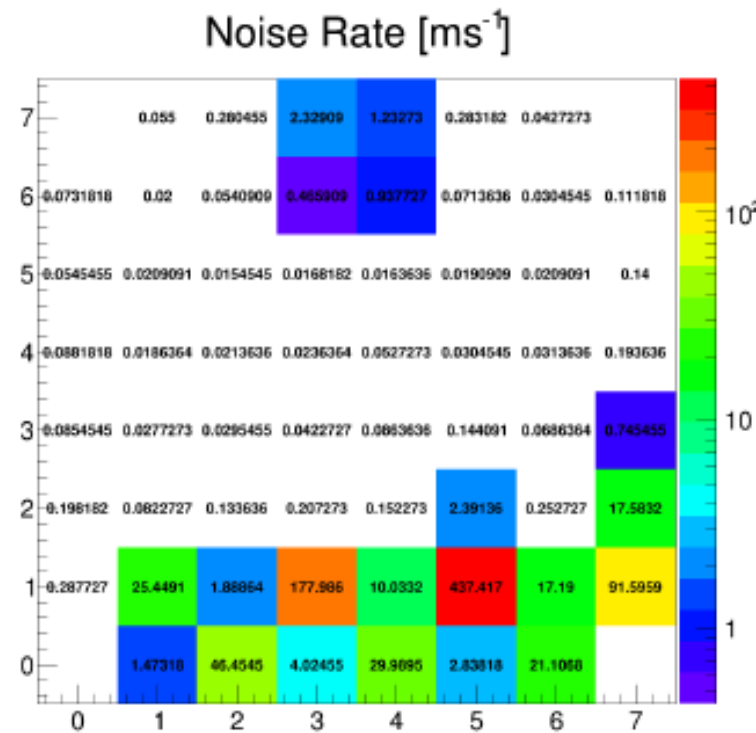
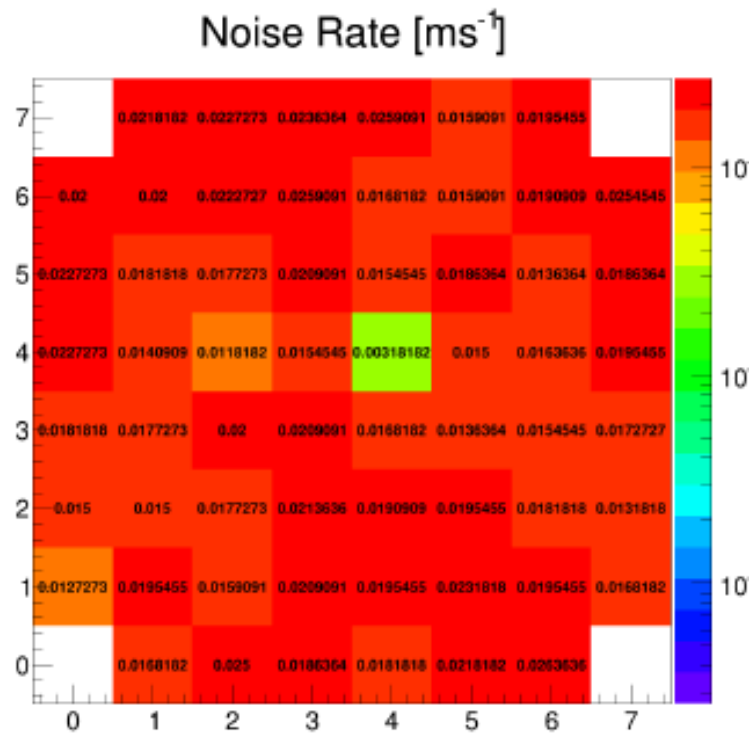
EMR



□ Noise in SAPMTs:

Drielsma

- 39 planes with vey little noise ($< 1 \text{ ms}^{-1}$)
- 7 somewhat noisy planes ($< 100 \text{ ms}^{-1}$)
- 2 very noisy planes ($> 100 \text{ ms}^{-1}$)



EMR



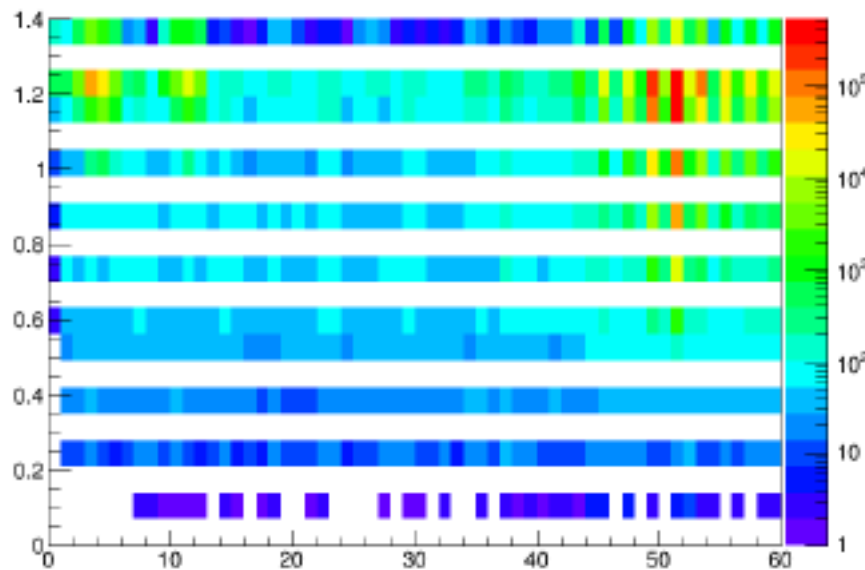
❑ Noise in SAPMTs:

Drielsma

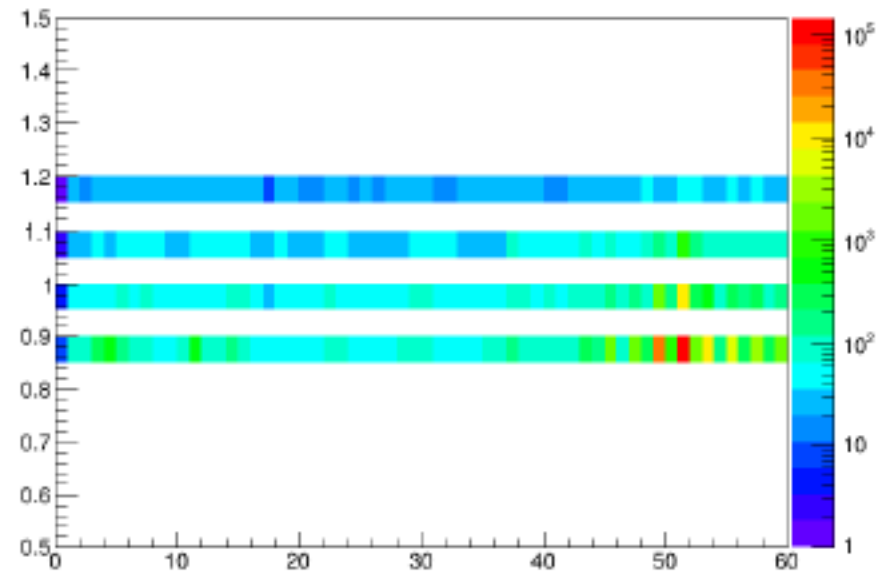
- Reduce gain of noisy MAROC channels ~ 0.75 ($< 50 \text{ ms}^{-1}$)
- Increase discriminator threshold from 0.9 to 1 ($< 50 \text{ ms}^{-1}$)

Secondary hits

Secondary hits



Reduction gain



Increase threshold

- Origin noise unclear (FEB, MAPMT?): noise does not overflow DBB buffer at the moment by reducing gain

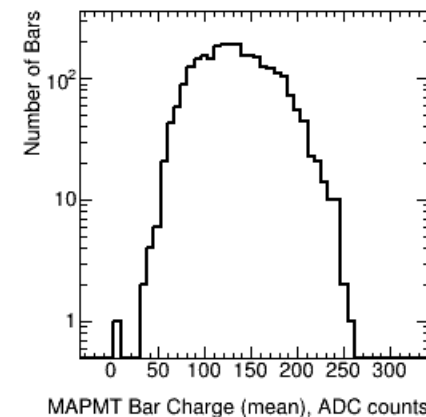
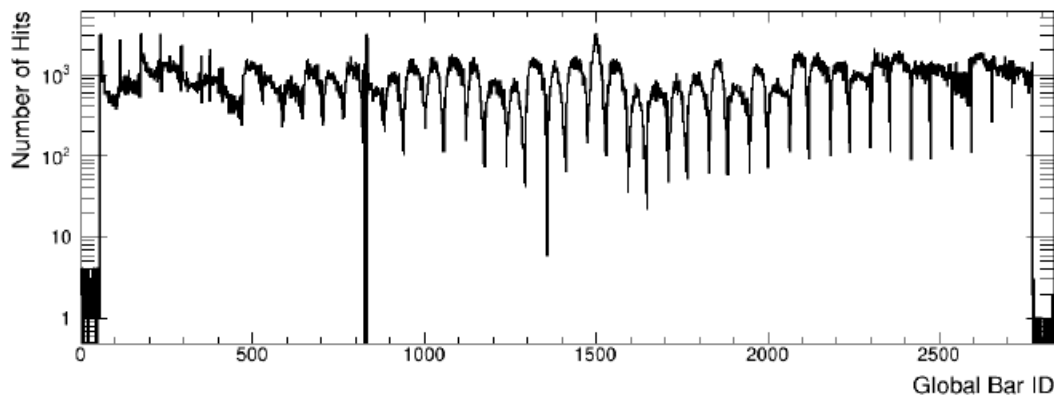
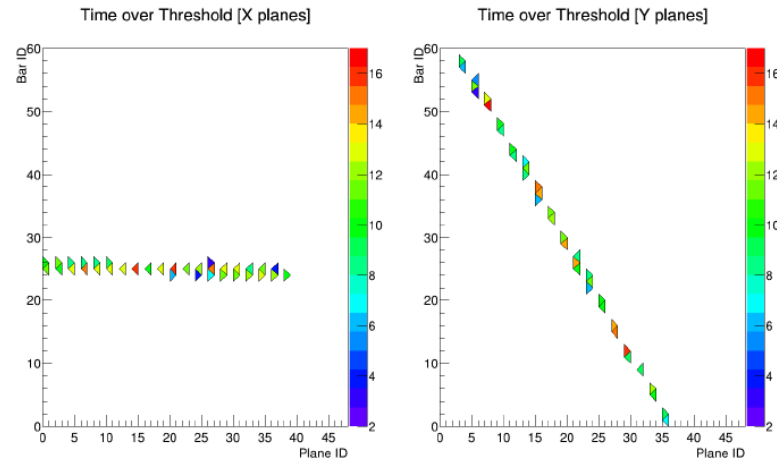
EMR



EMR charge calibration:

Drielsma

- Require ~300k cosmics (~2-3 days)
- Measure mean charge \overline{Q}_{ij} and correction factor: $\varepsilon_{ij} = \frac{\overline{Q}_{ij}}{\overline{Q}}$
- Will require new calibrations after EMR movement in July



EMR



EMR status summary

Drielsma

EMR hardware upgrade **completed** and **commissioned**

- SAPMT commissioned, 48 of them working and efficient (✓)
- HVPSU → fully operational, first control interface produced (✓)
- 2 LVPSUs → fully functional and in final state (✓)
- CAEN VME crate → functional (✓)

EMR software

- Completely functional MC and reconstruction (new data structure)

Outstanding tasks

- Investigate the MAROC on the FEBs further (✗)
- Try replacing the MAPMTs on the noisy plane (✗)
- Produce a reducer and data quality flags (✗)
- Calibrate the detector and output the ϵ_{ij} (1 or 2 week(s) in August)

Ready for Step IV

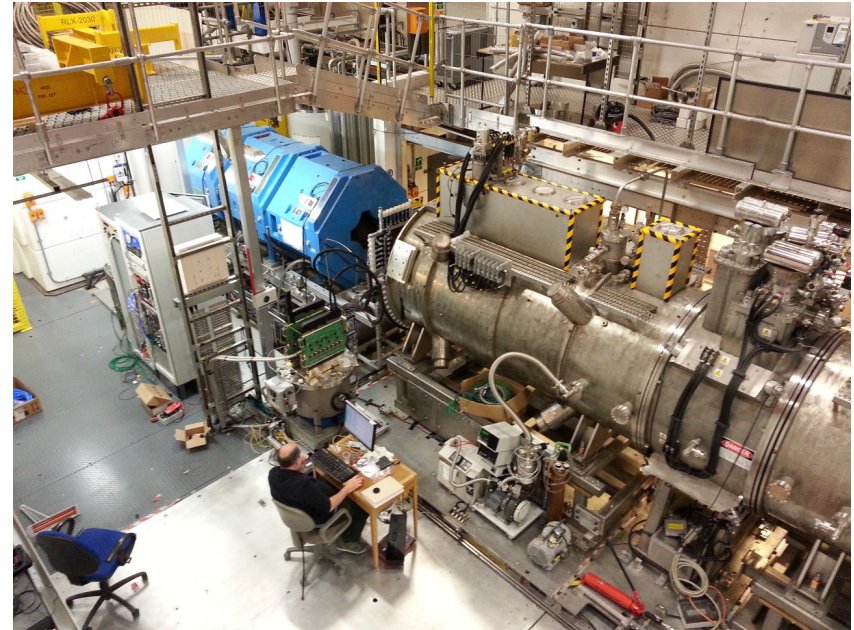
Tracker



❑ Status at CM41:

- Four cold cryostats
- Faulty PSU on Downstream
- Noise on all channels, above
- Triggered and read out noise
- Displayed plots on Online
- Unpacking with MAUS was problematic
- Internal LED was tested with waveguide
- New trigger interface started but incomplete
- Controls and Monitoring was overly complex, slow & prone to crashing

Overton



Tracker



- ❑ Progress since CM41: **Overton**
 - Faulty PSU on Downstream Tracker: loose fuse in the PSU to backplane connections.
 - Noise on all channels, above what was expected:
 - Experimented with a number of grounding schemes
 - Integration gate reduced from 200ns to 180ns (now 190ns on board)
 - Number of boards were diagnosed with faults and swapped: invalidated calibrations from Lab 7 cosmics
 - Controls and Monitoring:
 - Improved code exception safety to prevent common crashes
 - Extended functionality with a new derived class, which wrapped and used the original code base
 - Wrapped hardware Interface code with a new EPICS IOC.

Tracker



□ Progress since CM41:

Overton

– Trigger Integration:

- Yordan reviewed modifications and implemented in firmware
- Tested during Mock Data Run 3 (MDR3) but issues found
- Fixed post MDR3, in a two day post MDR3 debugging period.

– Unpacking issues:

- Good progress on unpacking from MDR3
- Data quality issues caused unpacking exceptions
- Following getting good data from the upstream tracker, data was read correctly into MAUS

Tracker



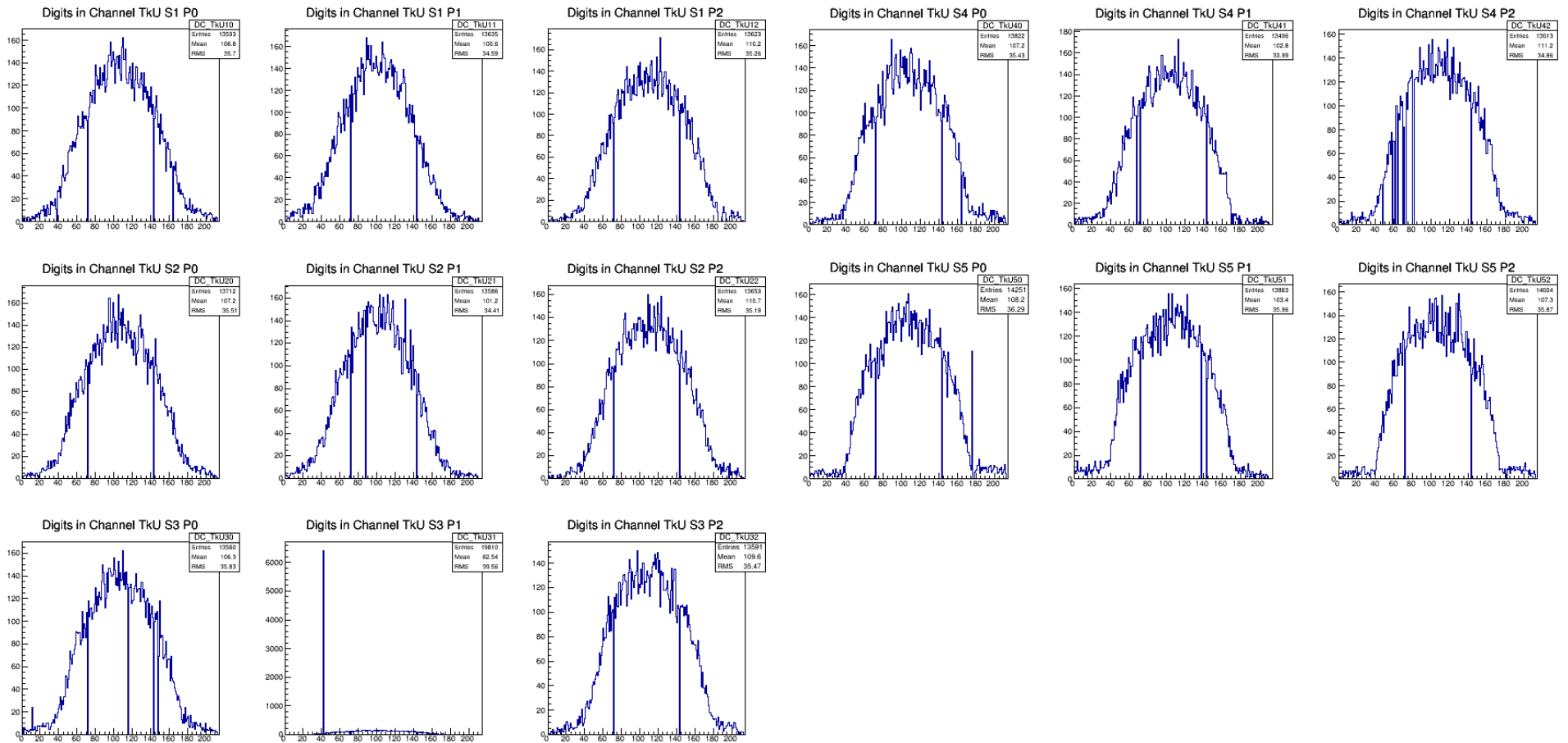
- ❑ Week 1 (1 June): **Overton**
 - Bias calibrations on the upstream tracker (with external pulser)
 - Connected waveguides
 - Bias calibrations on downstream tracker
 - First pass timing using upstream tracker and TOF0
 - Timed in upstream internal LED system
- ❑ Week 2 (8 June):
 - Replaced boards with readout issues on Cryo4, updated firmware, and ran calibration scripts
 - Moved external LED pulser around to complete calibrations
 - Attached downstream waveguides
 - Looked at internal LED on downstream
- ❑ Week 3 (15 June):
 - TOF1 for trigger: retimed to a pion beam @ TOF1
 - Connected upstream tracker and saw digits
 - Connected downstream tracker: GeoIDs were wrong, fixed.
 - Saw Digits!

Tracker



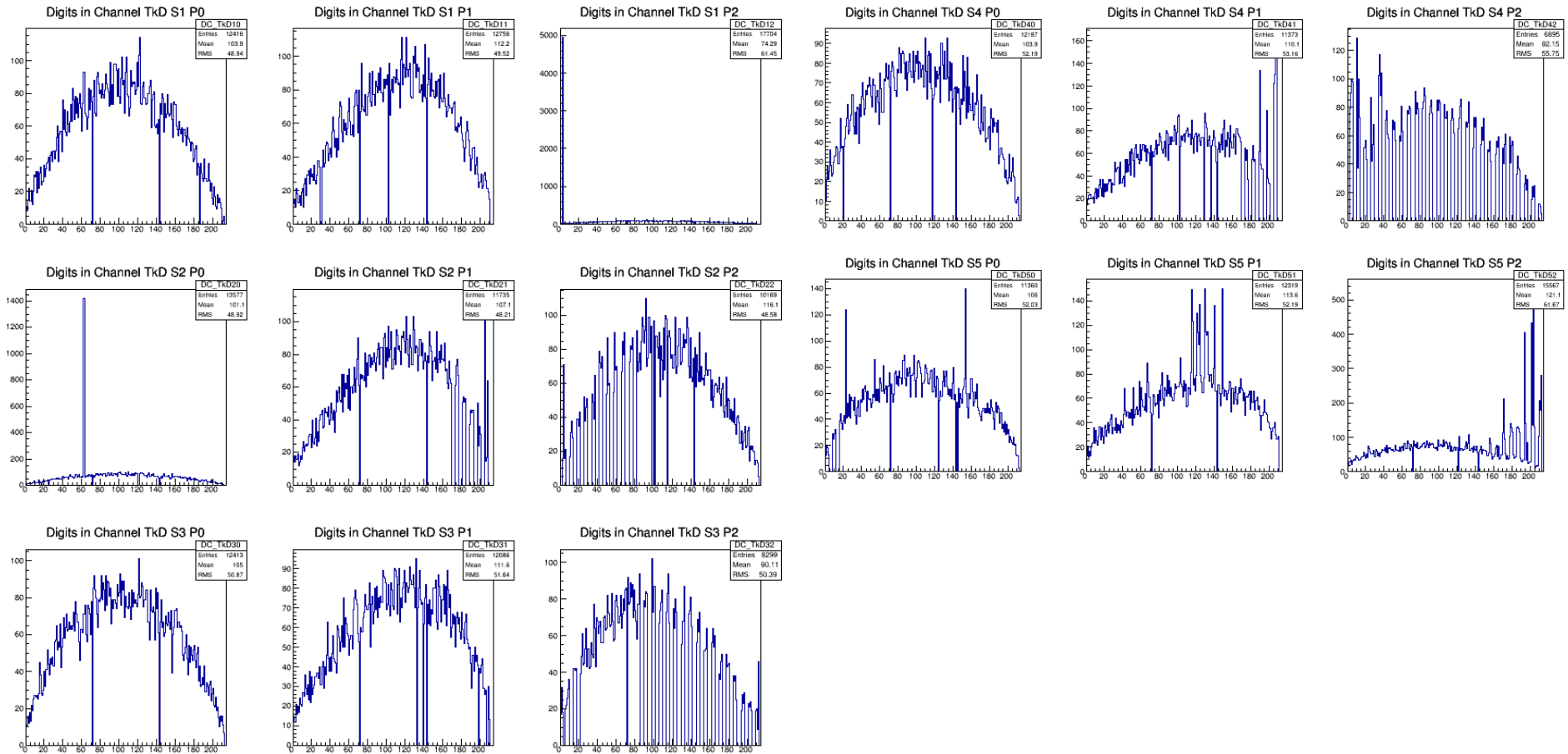
Upstream tracker hits:

Heidt



Downstream tracker hits:

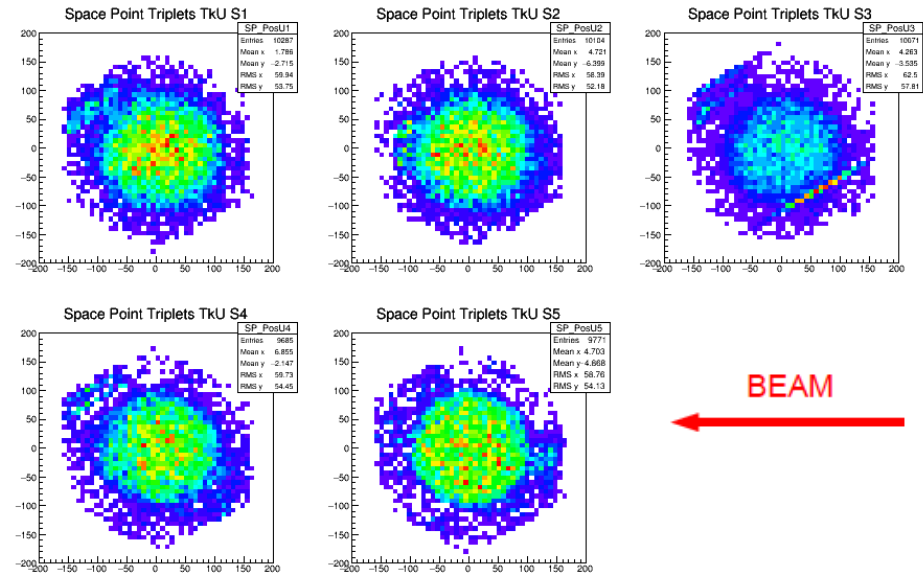
Heidt



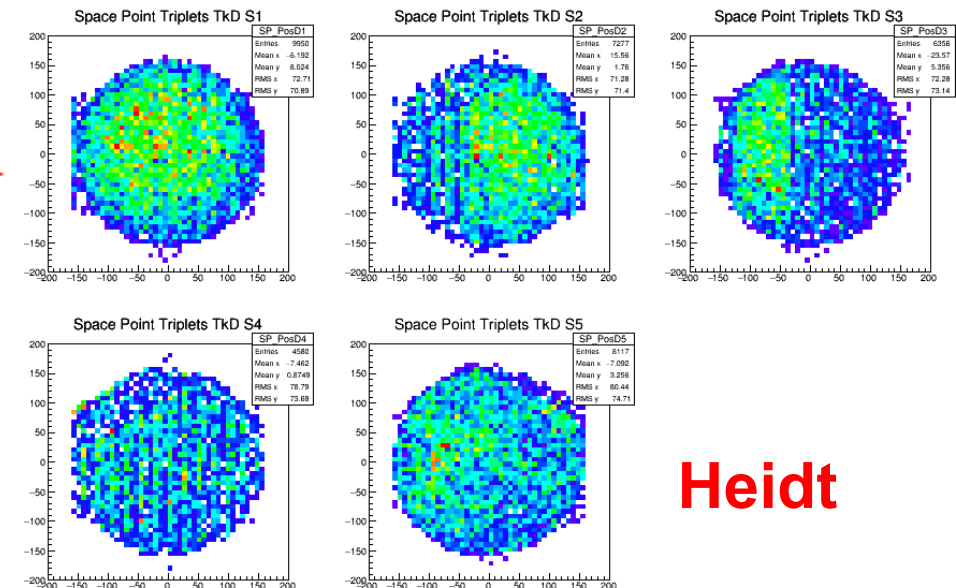
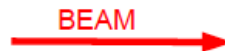
Tracker



Upstream tracker triplets:



Downstream tracker triplets:



Tracker



Overton

❑ Issues remaining:

- Upstream in pretty good shape
- Downstream has known issues:
 - Two banks (256 channels) have readout problems
 - Station 4 probably has mapping or readout issues
- Timing needs to improve to increase space point finding efficiency

❑ Plans:

- Fix readout issues on the two bad banks.
- Understand/fix issues with station 4
- Re-check calibration
- Careful timing studies...
- Efficiency studies along the way...