



IBL Stave-0B read-out with GBT RCE

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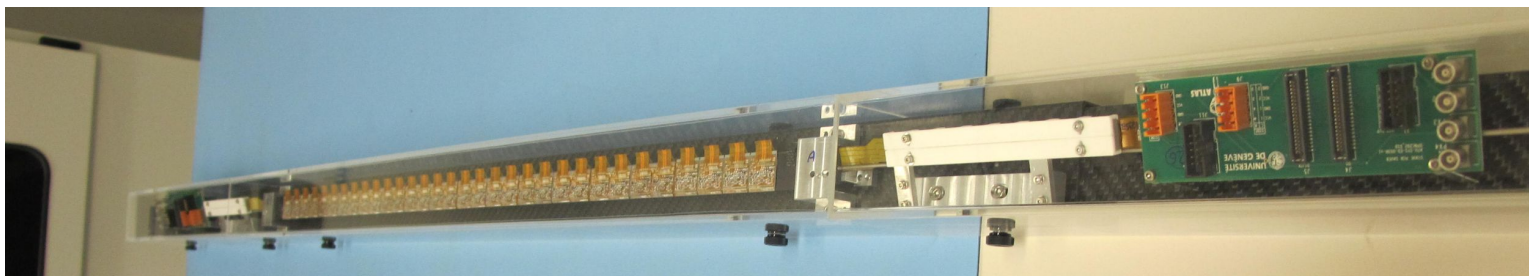
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A bit of History of IBL Stave 0B

- One of the first IBL staves
- Mostly loaded with pre-production modules
 - Not in Geneva production database, info directly from Bonn
- Late 2012
 - Received + loaded + tested in Geneva
 - Successfully tested at SR1
 - All modules + FEs worked
- Affected by corrosion
- 2016: Reworked at Geneva
- 2017: Transported to Wuppertal and connected to services

Lots of documentation - Thanks to Fabian, Didier, Timon for pointers and tables!!

- <https://twiki.cern.ch/twiki/bin/viewauth/Atlas/IBLSr1Stave0B>
- <https://twiki.cern.ch/twiki/bin/viewauth/Atlas/IBLmodFEI4B>
- http://dpnc.unige.ch/atlas/upgrade/IBL/StaveLoading/Stave0B/ElectricalTest_befThCycling.pdf
- <http://dpnc.unige.ch/atlas/upgrade/IBL/StaveLoading/Stave0B/index.htm>
- <https://indico.cern.ch/event/222361/> (SR1 Meeting 17/12/12)

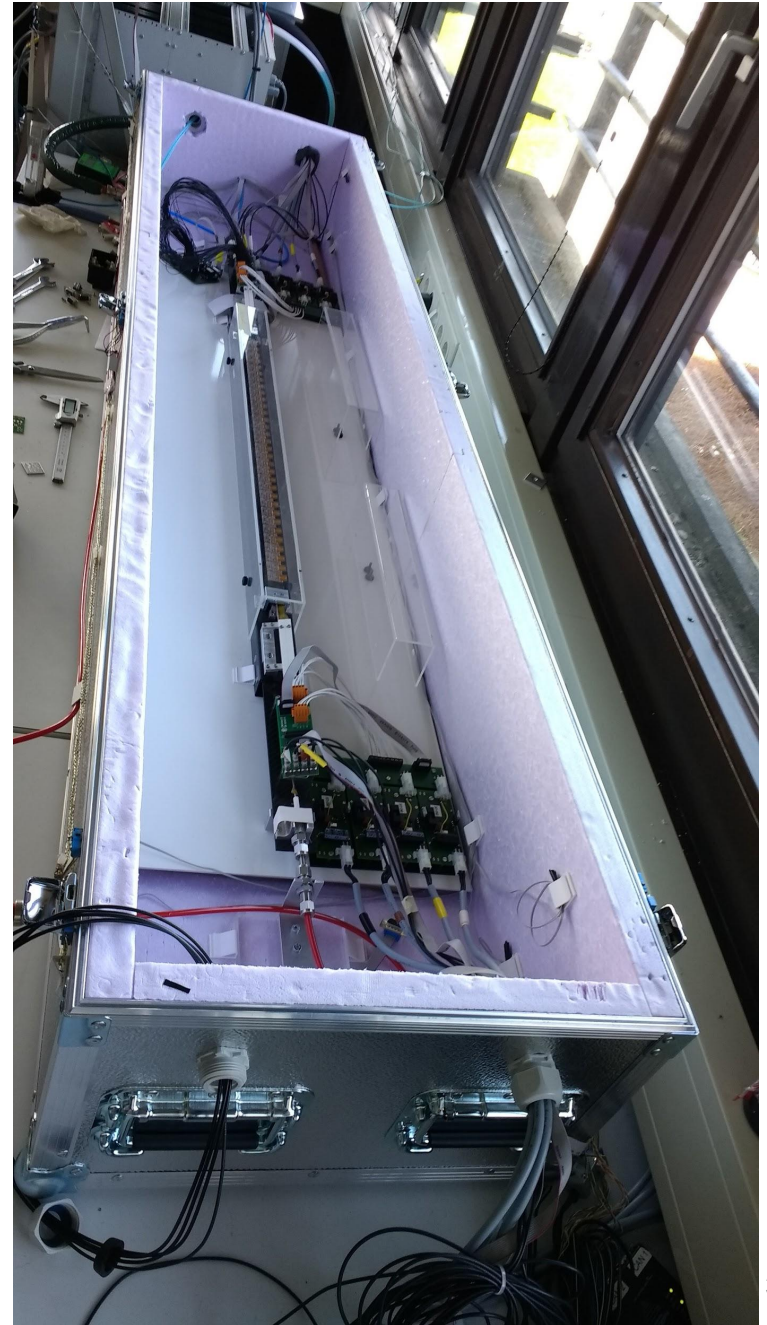


Strategy

- Original Plan:
 - BOC read-out from Side C
 - GBT RCE read-out from Side A
 - Compare Benchmarks (scan times etc.)

- However
 - BOC read-out still under development
 - Stave suffered a lot ... not 100% functional anymore

- What we did instead ...
 - Connect GBT RCE to Side A + test
 - Connect GBT RCE to Side C + test
 - Connect GBT RCE to best responsive FEs from either side

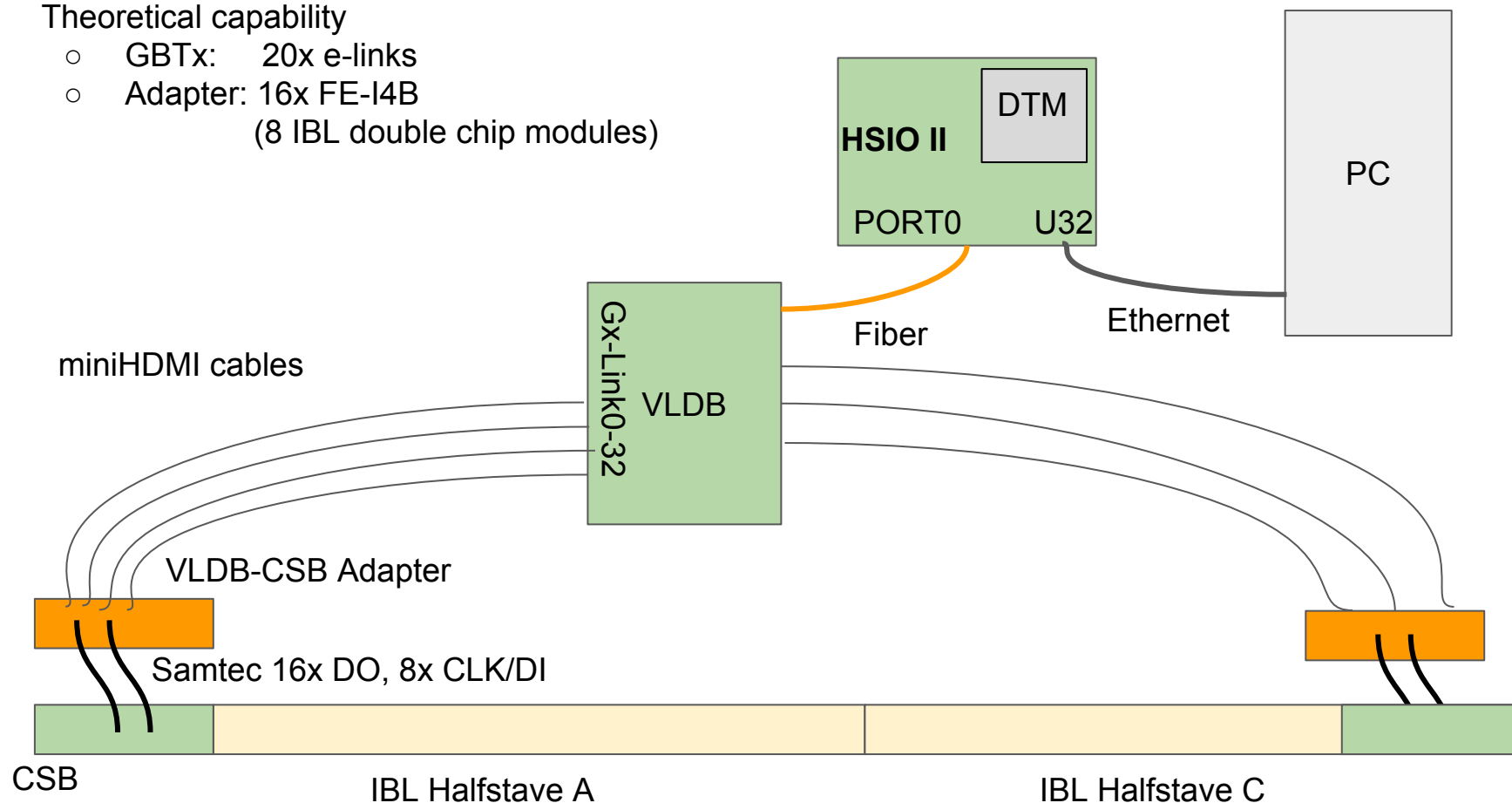


GBT RCE for IBL Stave Setup Overview

- Based on SLAC HSIO II and CERN VLDB (GBTx Demonstrator)

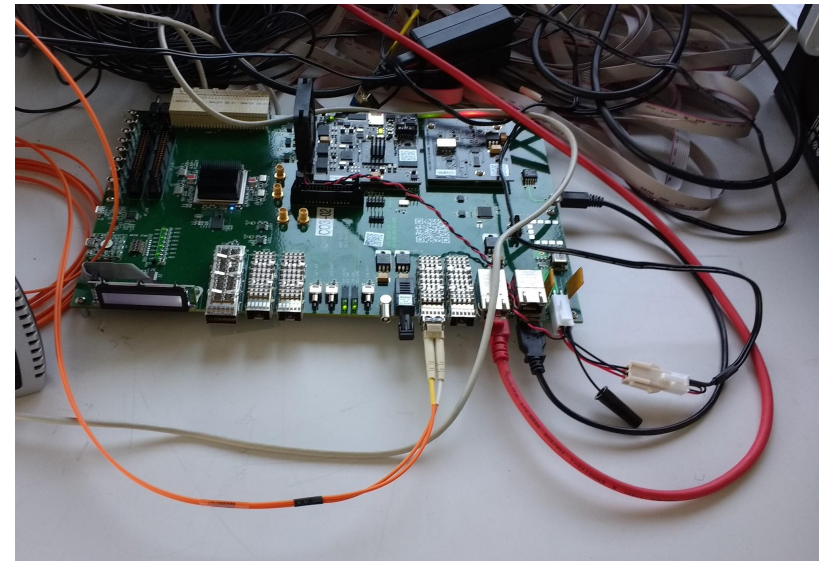
<https://twiki.cern.ch/twiki/bin/viewauth/Atlas/RCEAppGBT>

- Theoretical capability
 - GBTx: 20x e-links
 - Adapter: 16x FE-I4B
(8 IBL double chip modules)



Side A

- Connection mostly without problems
 - Need to fit fiber, HV and USB (for GBT I2C Dongle) through hole in cooling box
 - A bit of Tetris with the HDMI cables in the box
- Göttingen adapter boards worked immediately



Procedure

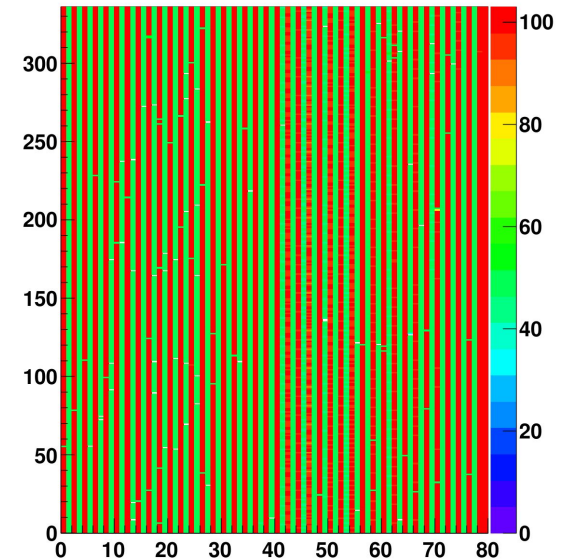
- FE serial numbers are read to test FE communication and verify channel assignment
 - Basic scans (digital, analog, threshold,...) to test FE operation
 - Full threshold and ToT tuning and verification
-
- Documentation on Software Setup etc.:

<https://twiki.cern.ch/twiki/bin/view/Atlas/RCEGBTIBLStaveTest>

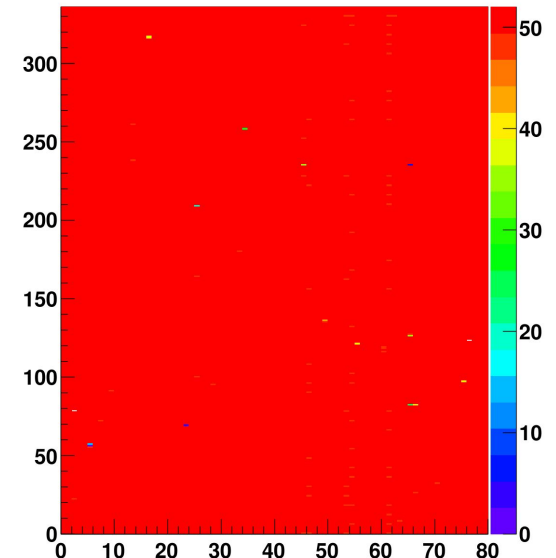
Observations

- Some FEs had problems with default configuration
 - Fixed after switching to conf from SR1 (key 5071)
 - Different digital or analog LDO settings
- Some FEs stop/start responding after power cycling
- Not all FEs have stable communications
 - Should be cross-checked with BOC
 - Damaged FEs or wirebonds?

OCCUPANCY Mod 9 at A5-2



OCCUPANCY Mod 94140144 at A5-2

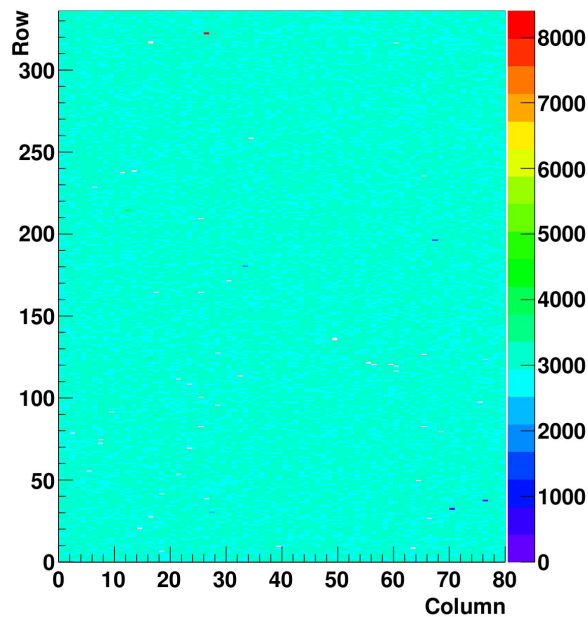


Tuning

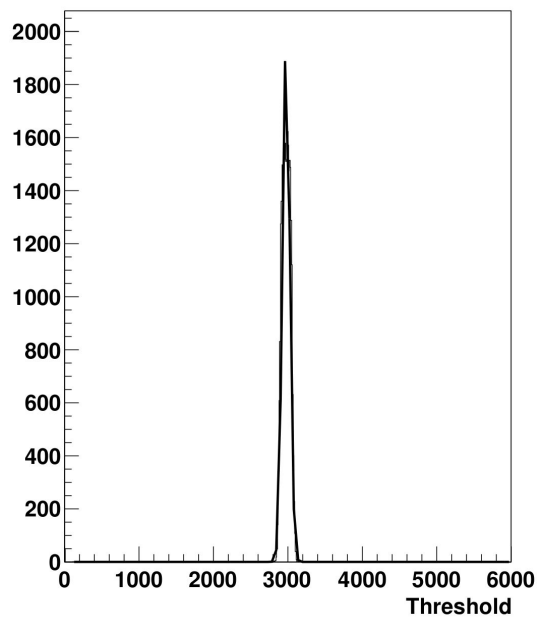
- FEs are tuned to 3ke threshold and 10 ToT at 16ke
- Tuning primlist with 22 scans also serves as stress test

fasttune-3000e-10ToTat16ke-noisemask.pl

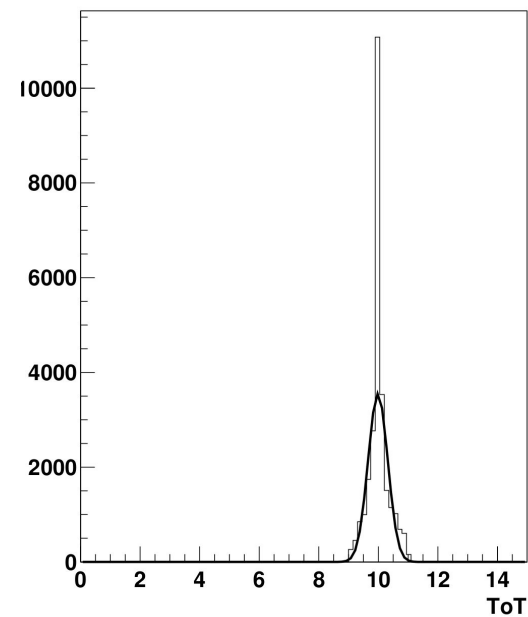
Thresholds Module 94140144 at A5-2



Threshold distribution Module 94140144 at A5-2



ToT Distribution Mod 94140144 at A5-2



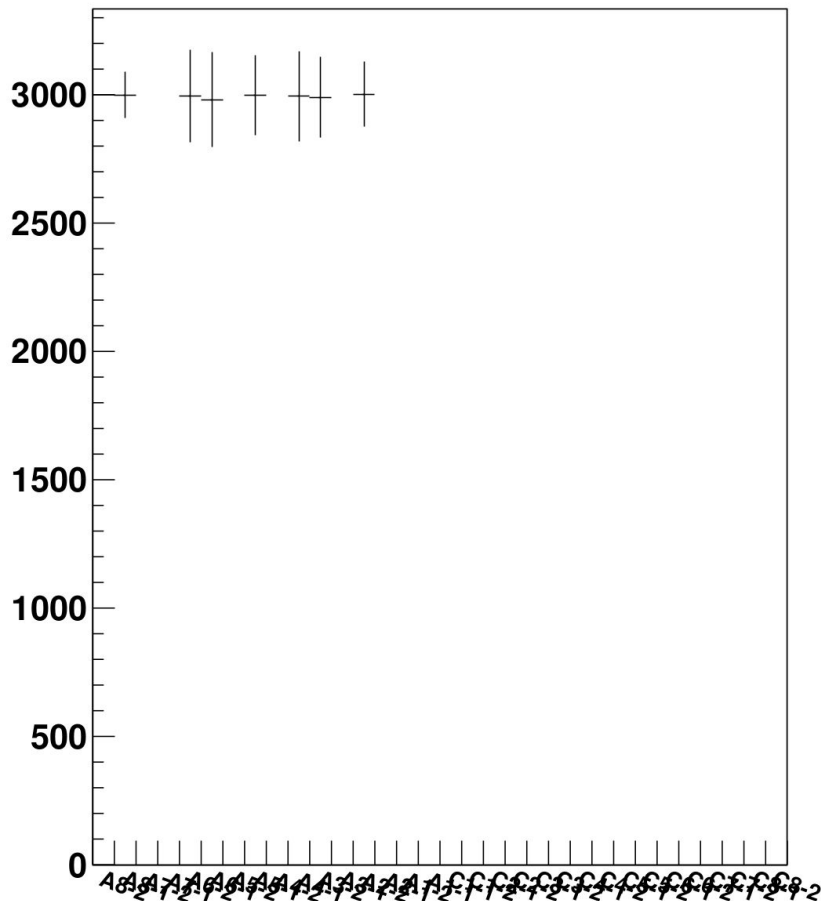
Side A Results Overview

	Module	Quality	S/N	Digital	Analog	Threshold	Prim
A1-1	92-02-03	SEVERE	(172)				
A1-2			(173)				
A2-1	92-02-04	MEDIUM	178	✓	✓	✓	
A2-2			180	✓	✓	✓	✓
A3-1	94-24-02	IBL	334	✓	✓		
A3-2			331	✓	✓	(✓)	✓
A4-1	92-23-01	SEVERE	174	✓	✓	✓	✓
A4-2			175				
A5-1	94-14-01	IBL	364	✓	✓	✓	✓
A5-2			365	✓	✓		
A6-1	94-19-01	IBL	329	✓	✓	✓	✓
A6-2			330	✓	✓	✓	✓
A7-1	10-13-01	IBL	(170)				
A7-2	10-01-08	IBL	(473)				
A8-1	10-04-08	IBL	474	✓	✓	✓	✓
A8-2	10-07-01	SEVERE	(478)				

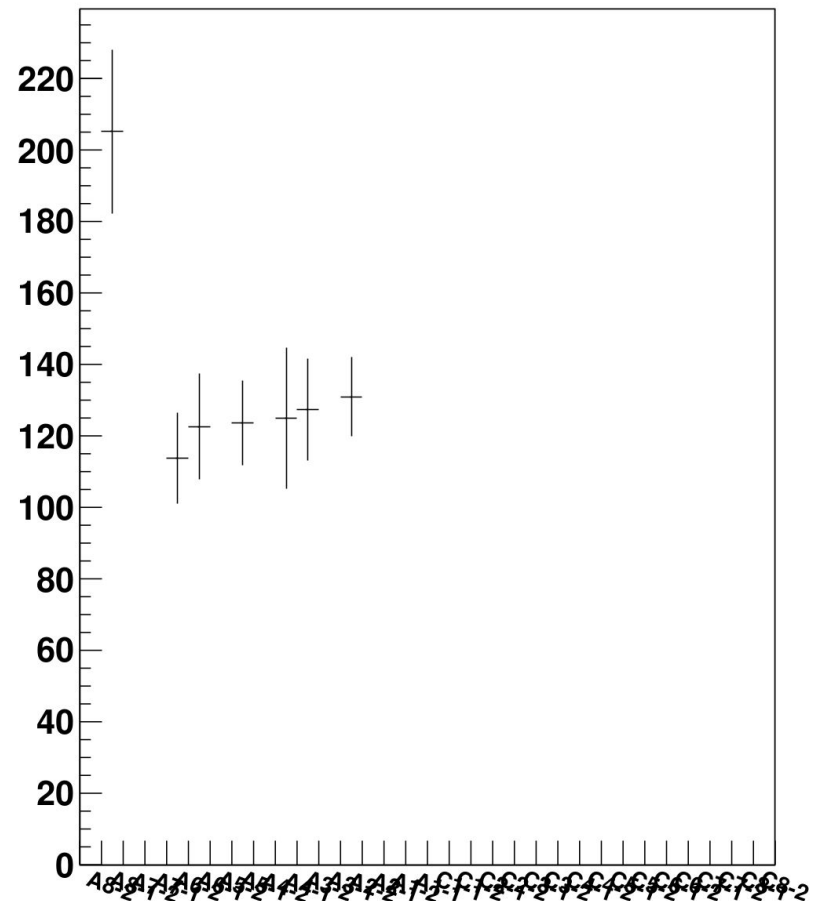
Threshold Tuning - Side A

- Tuned to 3000e threshold
- Noise on undepleted 3D module A8

Thresholds 1st stave



Sigma 1st stave



Side C

- Test all FEs on Side-C
- Normally connected to BOC
 - No scans yet



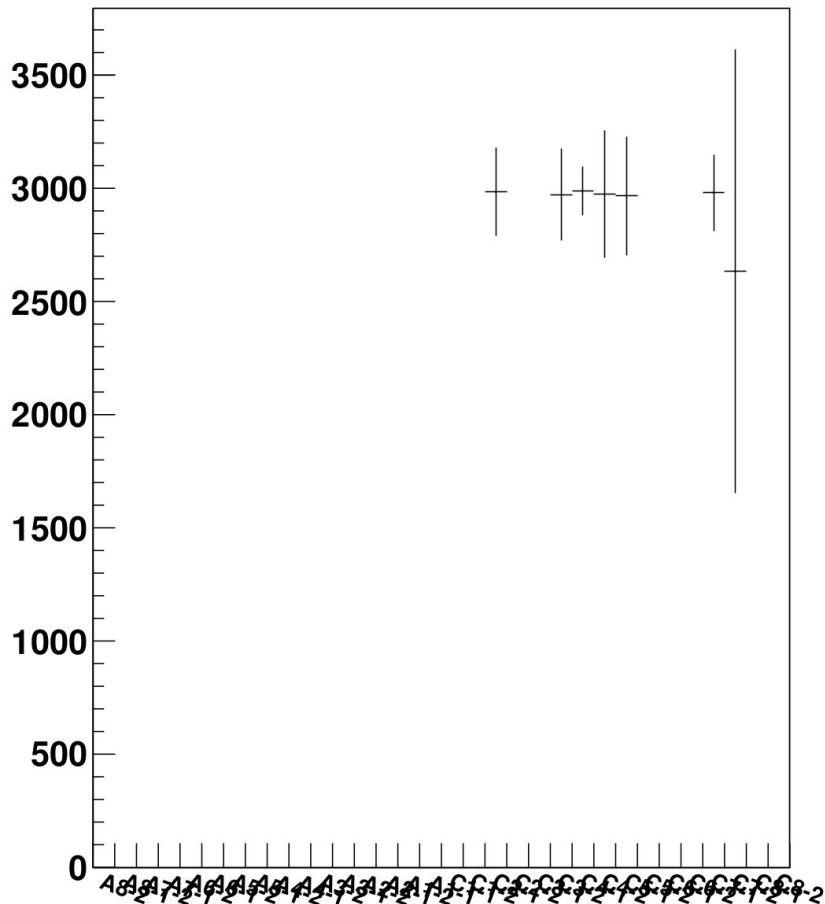
Side C Results Overview

	Module	Quality	S/N	Digital	Analog	Threshold	Prim
C8-2	10-02-08	IBL	145				
C8-1	10-08-06	IBL	(147)				
C7-2	60-17-06	MEDIUM	135	✓	✓	✓	✓
C7-1	10-02-04	IBL	144	✓	✓	✓	✓
C6-2	94-25-02	SEVERE	(354)				
C6-1			352				
C5-2	94-24-03	SEVERE	340				
C5-1			338	✓	✓	✓	✓
C4-2	94-06-04	IBL	367	✓	✓	✓	✓
C4-1			366	✓	✓	✓	✓
C3-2	94-19-02	IBL	(335)	✓	✓	✓	✓
C3-1			337				
C2-2	94-22-04	IBL	344				
C2-1			(345)	✓	✓	✓	✓
C1-2	94-25-03	SEVERE	(358)				
C1-1			(355)				

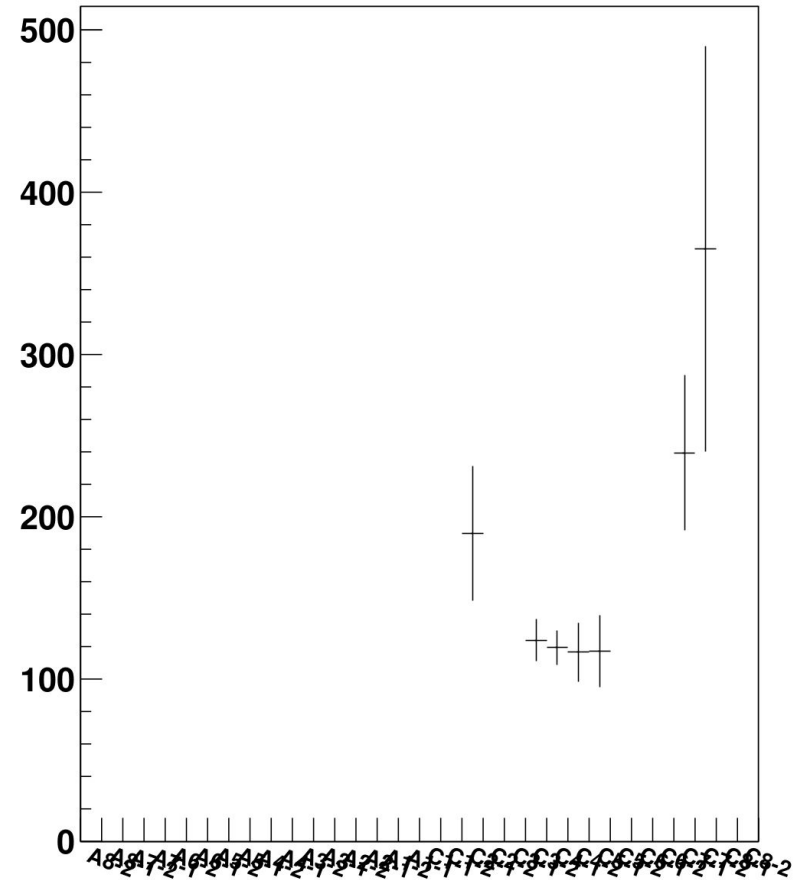
Threshold Tuning - Side C

- Tuned to 3000e threshold
- Noise on undepleted 3D modules C7&C8 but also on C2

Thresholds 1st stave

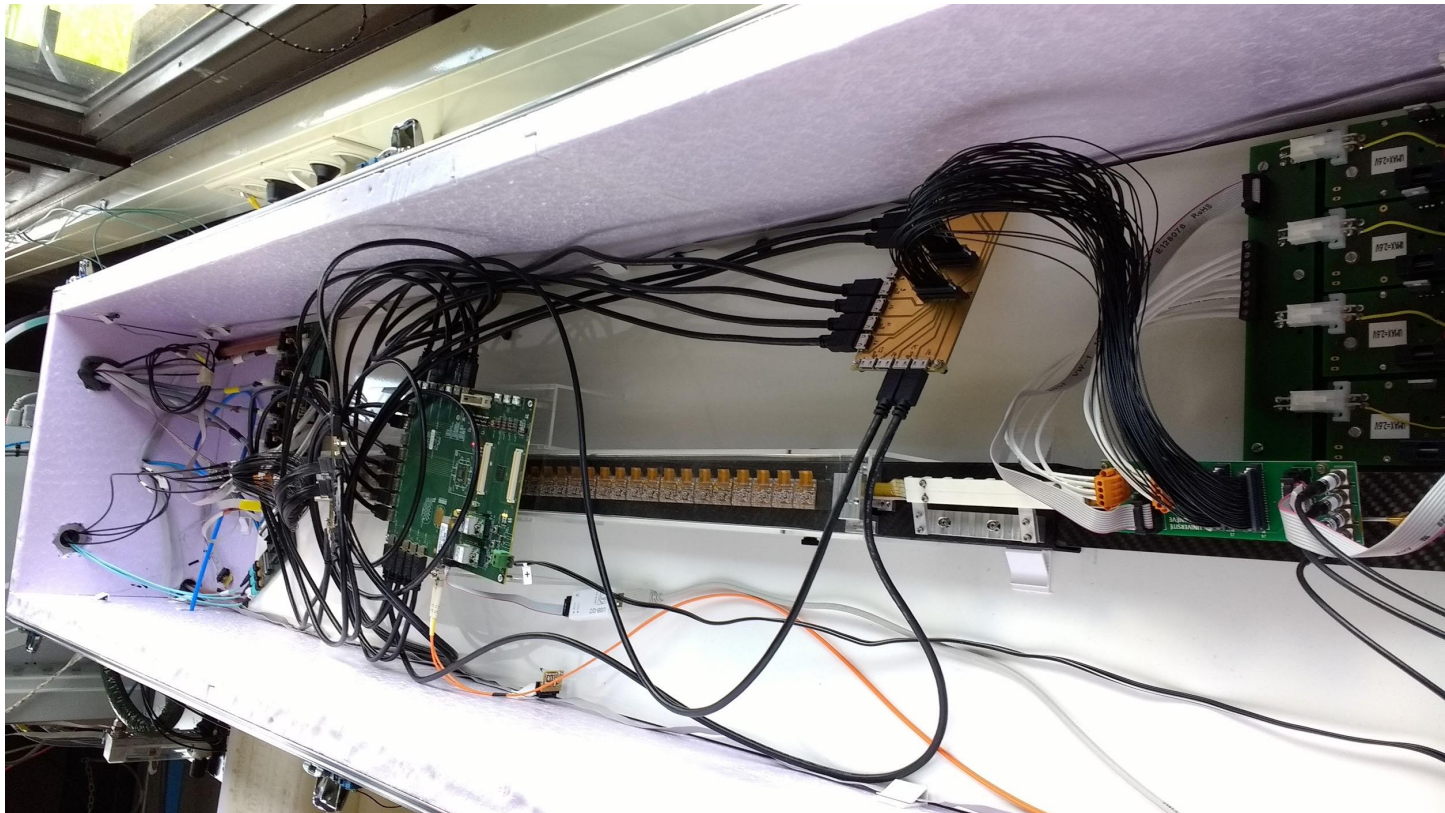


Sigma 1st stave



Selected modules from Side A/C

- Connected 9 modules (18 FEs) from side A / C based on our previous tests
- Expected 15 'responsive' FEs
 - 15 FEs returned SN
 - 14 FEs passed basic tests (digital, analog, threshold)
 - 4 FEs failed at some point during tuning (22 scans/tests for full tuning)

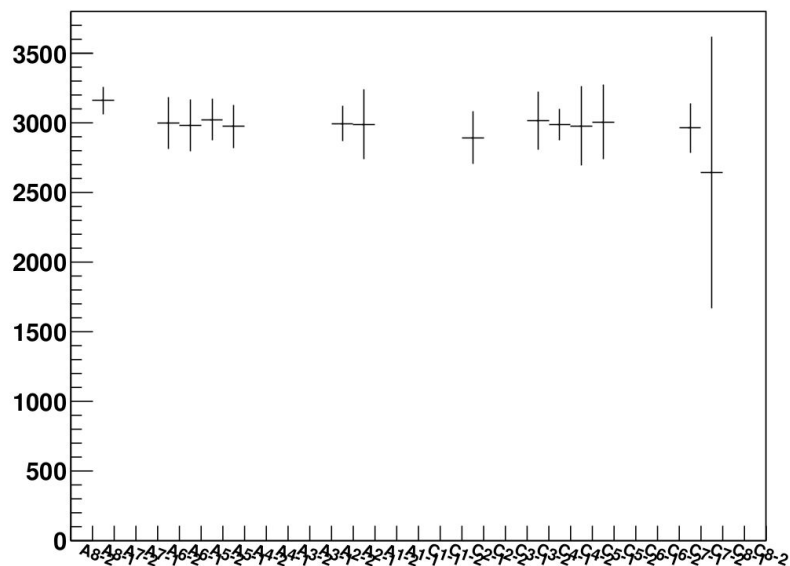


	S/N	Digital	Analog	Threshold	Prim
A2-1	✓	✓	✓	✓	✓
A2-2	✓	✓	✓	✓	✓
A5-1	✓	✓	✓	✓	
A5-2	✓	✓	✓	✓	✓
A6-1	✓	✓	✓	✓	✓
A6-2		✓	✓	✓	✓
A8-1	✓	✓	✓	✓	
A8-2					
C2-1	✓	✓	✓	✓	
C2-2					
C3-1	✓				
C3-2	✓	✓	✓	✓	✓
C4-1	✓	✓	✓	✓	✓
C4-2	✓	✓	✓	✓	✓
C5-1	✓	✓	✓	✓	
C5-2	✓				
C7-1	✓	✓	✓	✓	✓
C7-2	✓	✓	✓	✓	✓

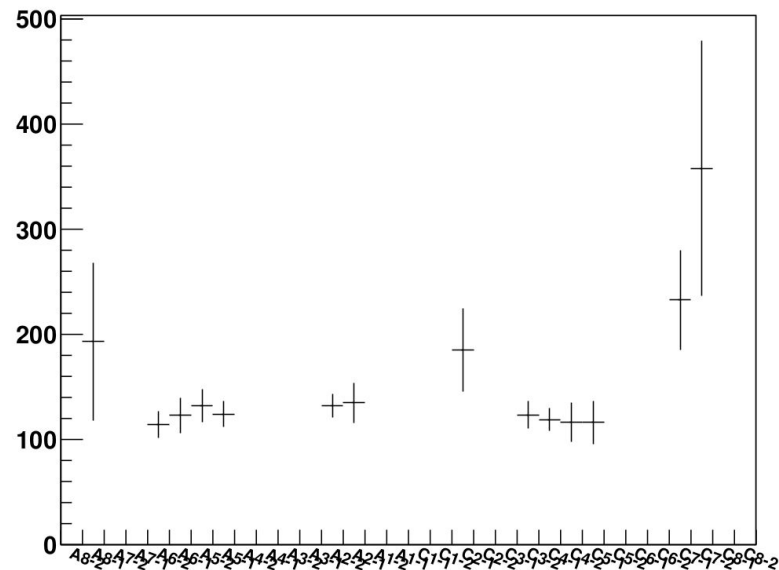
Threshold Tuning

- Tuned to 3000e threshold and 10 ToT at 16000e
- Tuning from SR1 and our own show nearly identical distributions
- Noise on undepleted 3D modules C7&C8, but also on A8&C2

Thresholds 1st stage

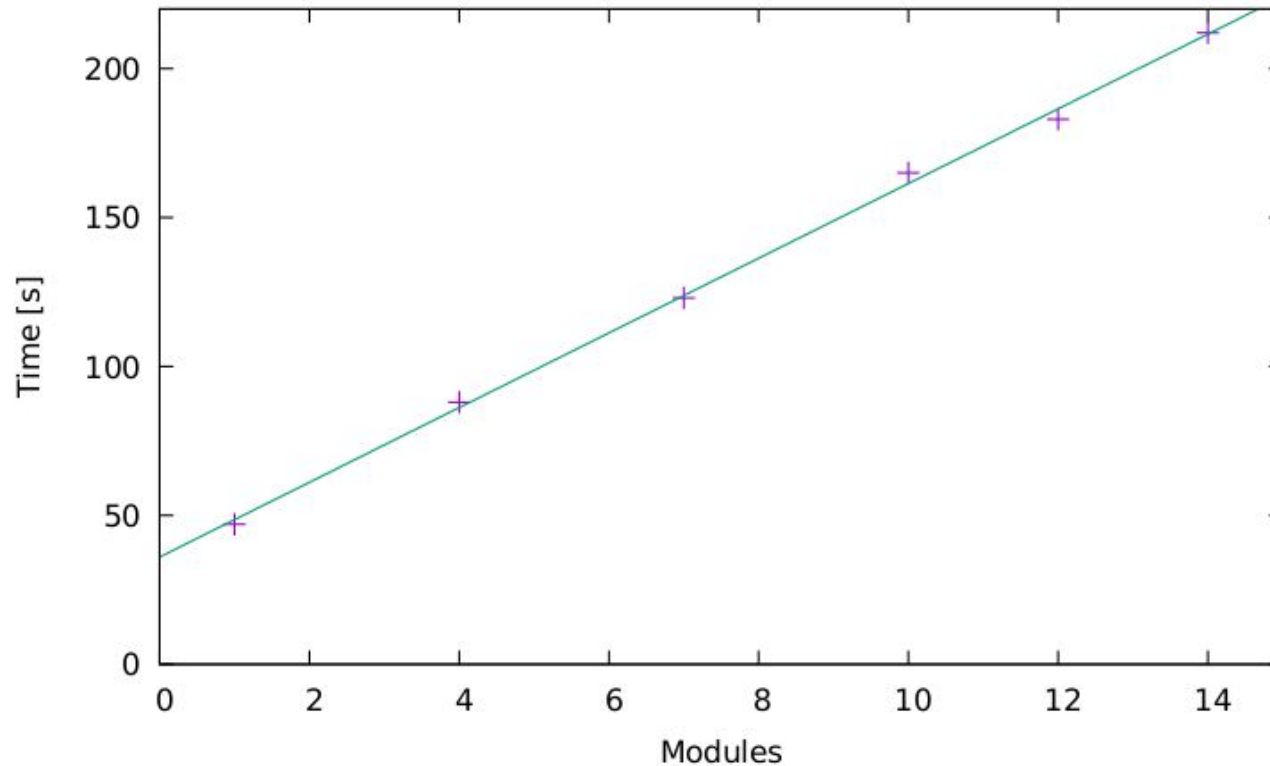


Sigma 1st stage



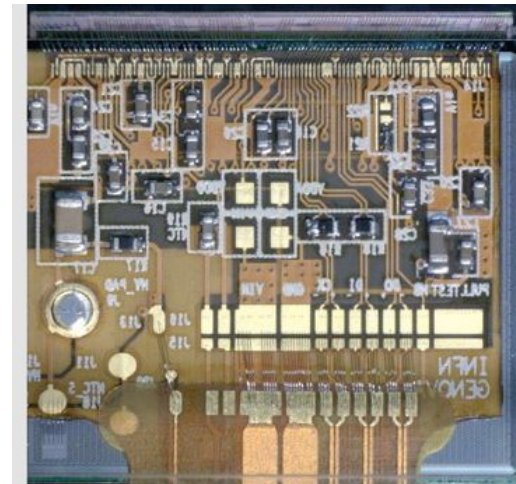
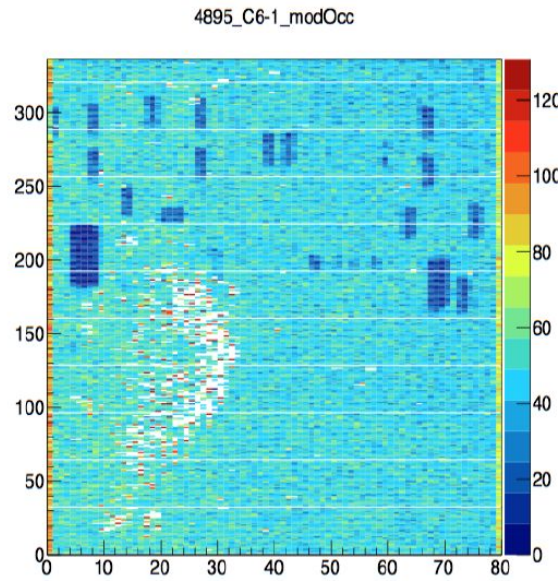
Timing Behaviour

- THRESHOLD_SCAN with 1-14 FEs enabled
- Scan duration scales linearly



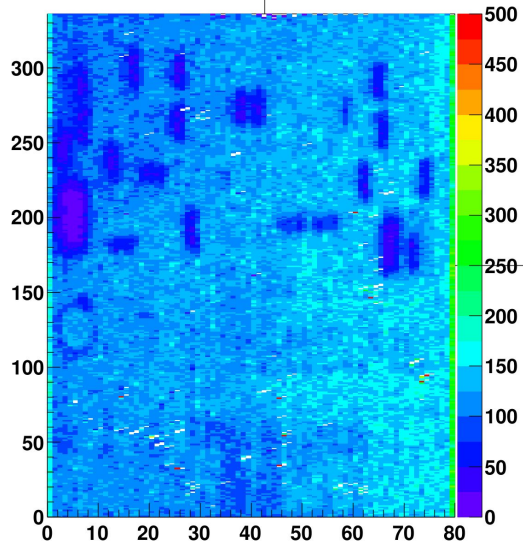
Sr90 Tomography

- Can use self-triggered source scan to produce “photo” of passive components on flex
- Example of Original Tests 2012:

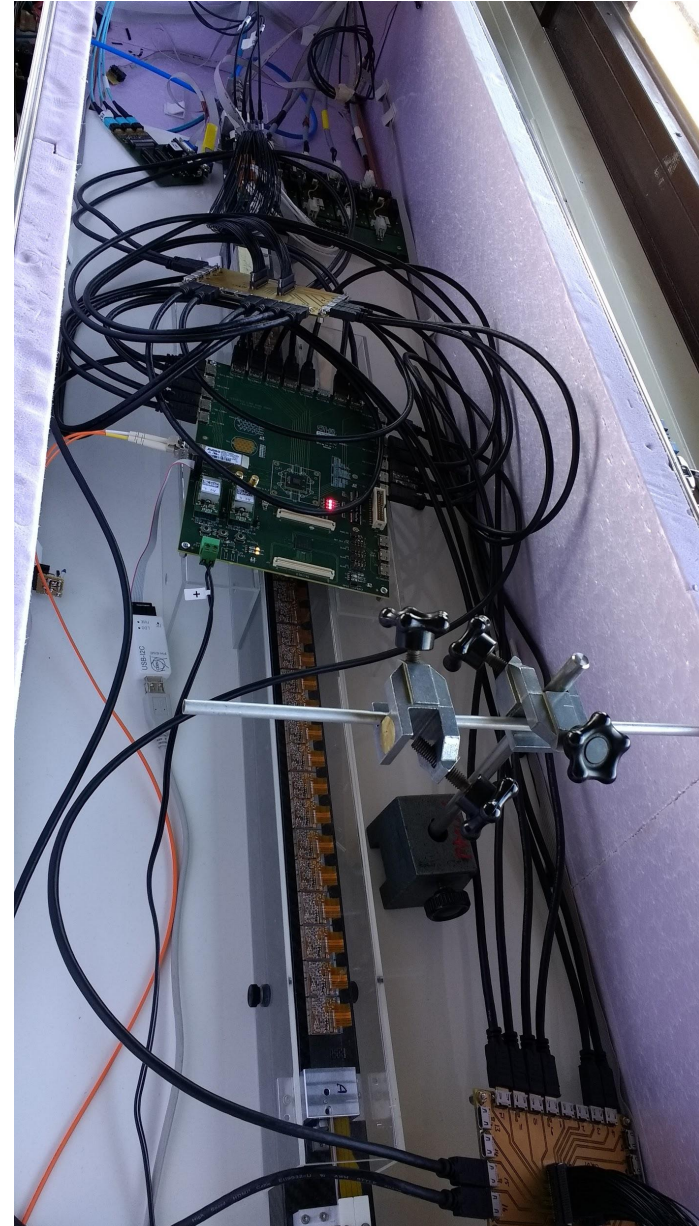
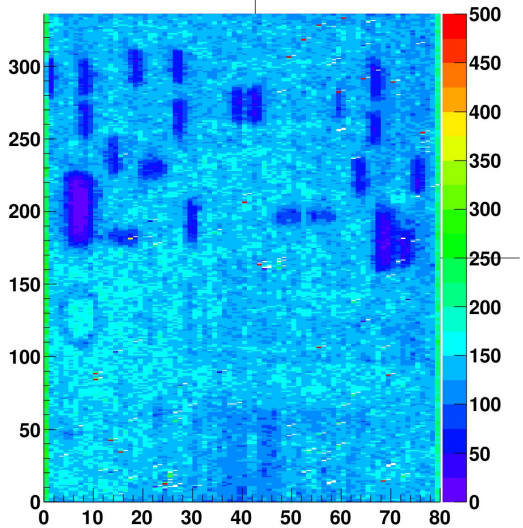


Our Retest

OCCUPANCY Mod 94190110 at A6-1



OCCUPANCY Mod 94190109 at A6-2



Summary

- Largest scale test with RCE GBT so far
 - THRESHOLD_SCAN on up to 14 modules
 - (AFP: Similar setup, 7 FEs)
- Worked very nice and fast with RCE software out of the box
- GBT RCE is an excellent Candidate for demonstrator readout system

Outlook

- RCE Software (calibGui, calibserver, firmware)
 - GUI currently hardcoded for IBL stave layout
 - Modify to support demonstrator structure
- Need more GBTx
 - Buy more VLDBs (+ lots of mini-HDMI cables ...)
 - **OR**
 - Use DESY GBTx Mezzanine (designed for Strips)
 - Obtain the mezzanines (have one)
 - Design carrier PCB
- Need to use COB to attach more than one GBTx (for sure more than 2)
 - Need fixed DTM (clock jitter problem)
 - Need RCE software + firmware ported to DPM
- Further outlook
 - Replace COB by “Wuppertal” ITk DAQ
 - Replace RCE Software by ITKSW