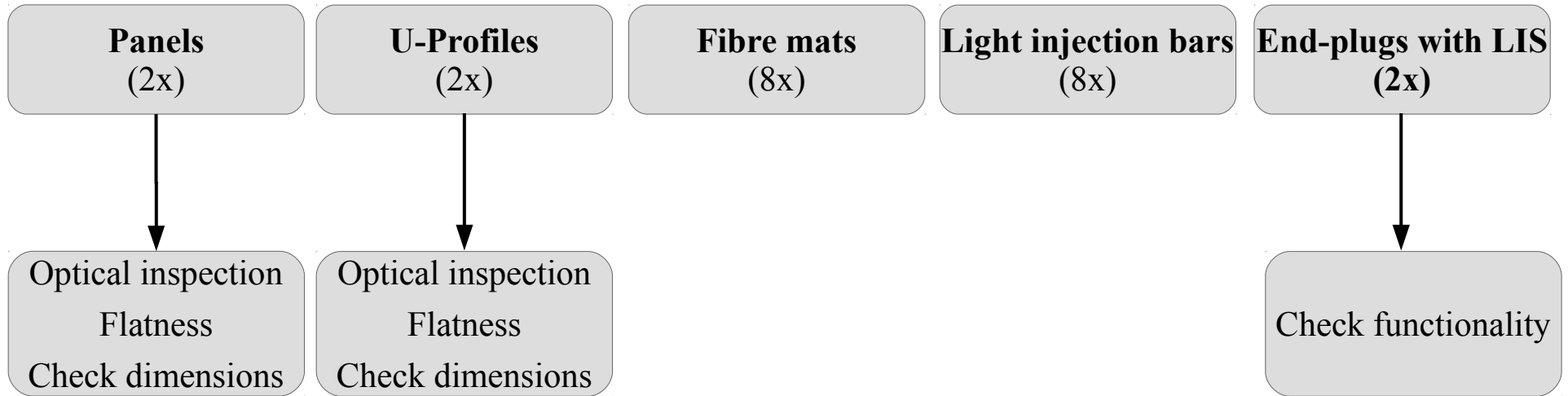


Quality Assurance For Modules & Production DB

- QA of parts
- QA of module
- Production DB

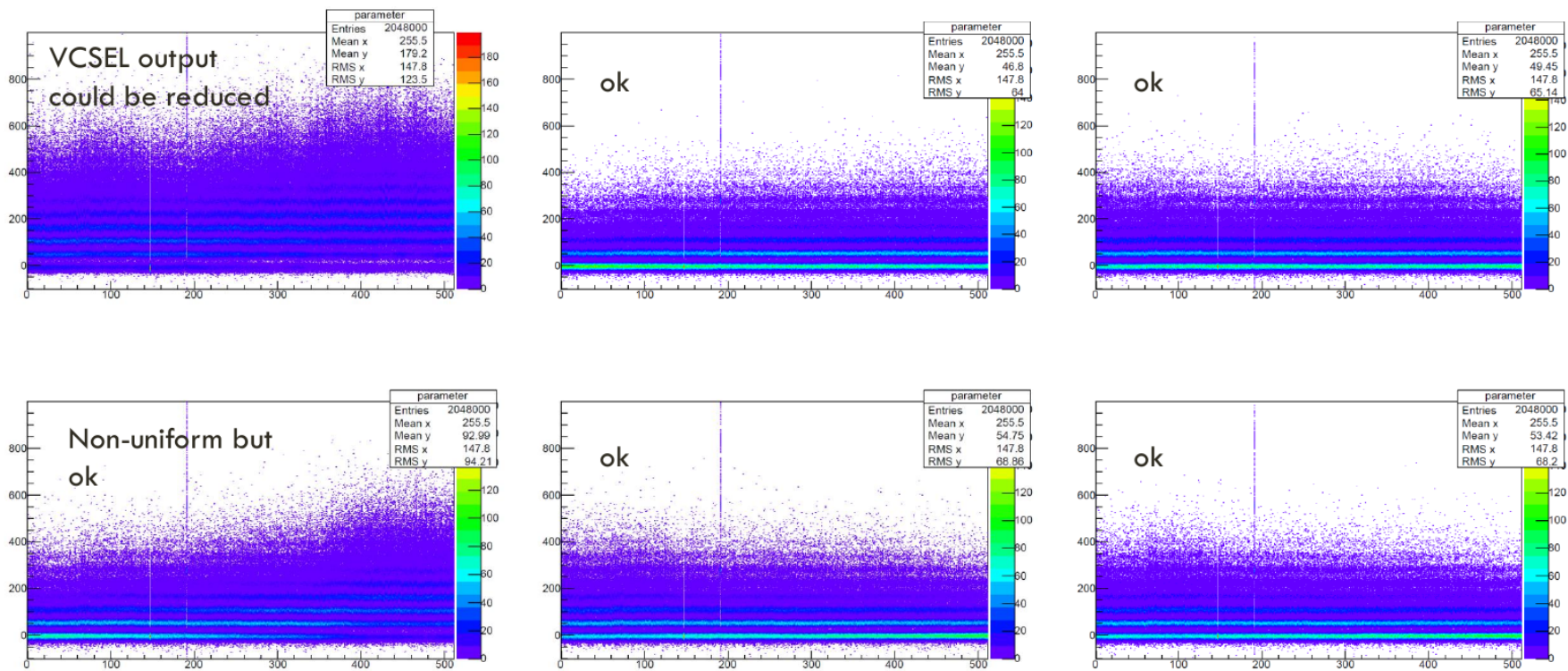
Sebastian Bachmann
Physikalisches Institut
Heidelberg University

QA of parts



QA light injection bars

- Light injection bars need to be tested for sufficient light yield and uniformity.
- Currently they are tested with fibre mat test set-up, but this is time consuming.
 - Simplified set-up using commercial photo-diode array is under construction.

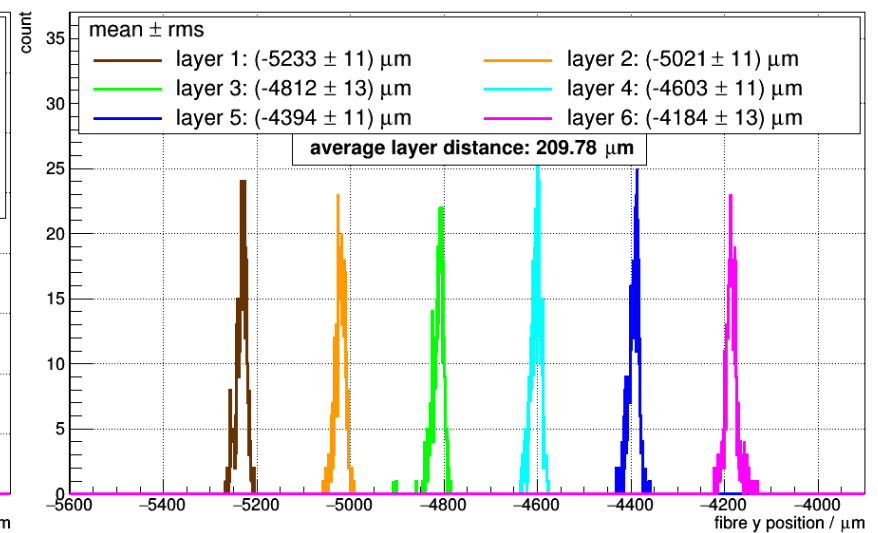
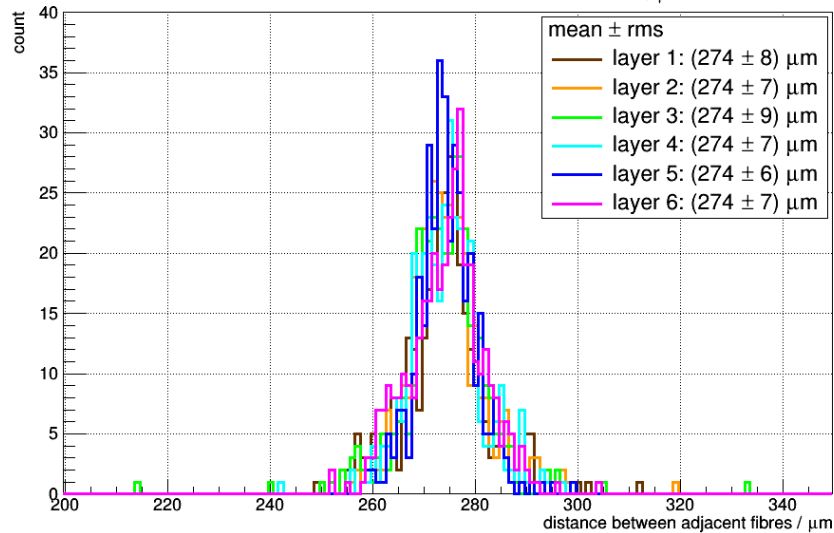
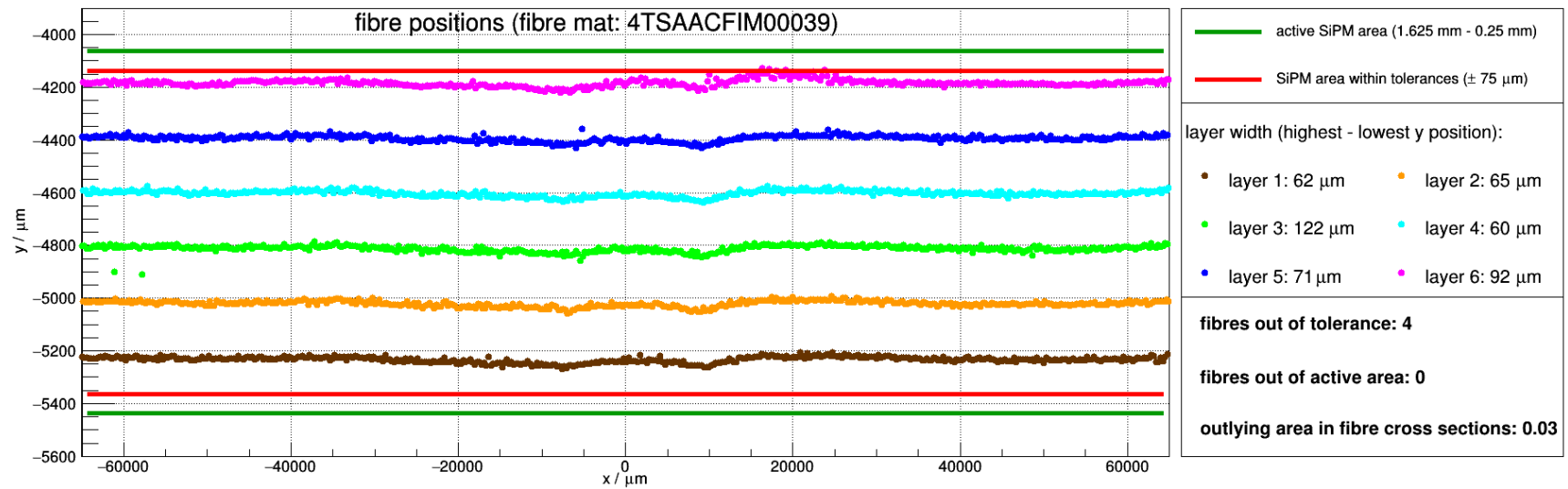


- We want the 1 p.e. peak = 0 p.e. peak (too much light draws too much current)
- Still want to be able to see the 5 p.e. peak.

QA of fibre mats at winding centre:

- Fibre mats are tested at winding centres, but longitudinal cut is missing.

Results from optical survey:



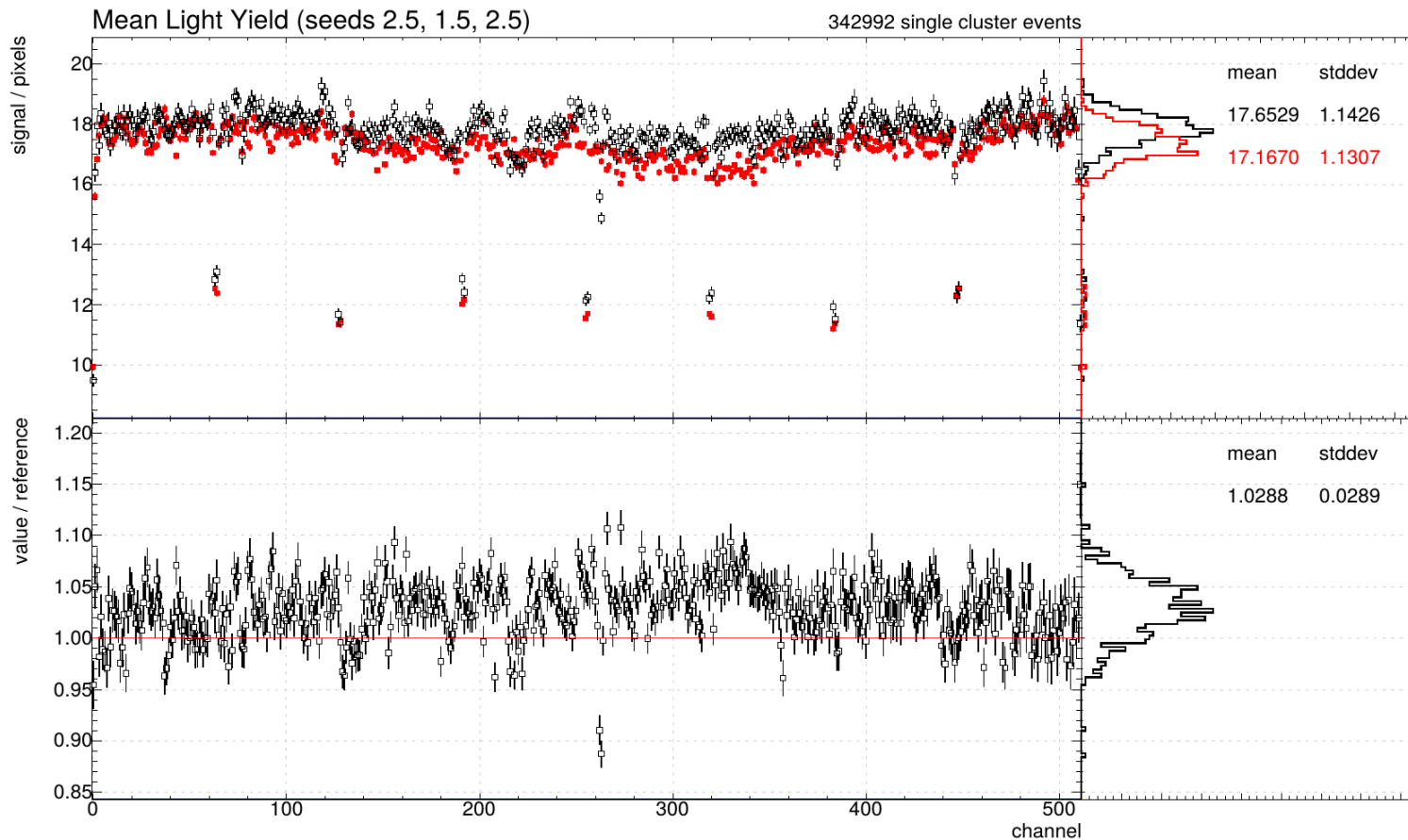
QA of fibre mat at winding centre:

Results from beta-source test:

$^{90}_{38}\text{Sr}$ Test for 4TSAACFIM00039

analyzed 2016_07_05_17_54_08

- + reference mat properties
- mat properties from all runs
- reference calibration
- 1467204154_2016_06_29_14_42_34



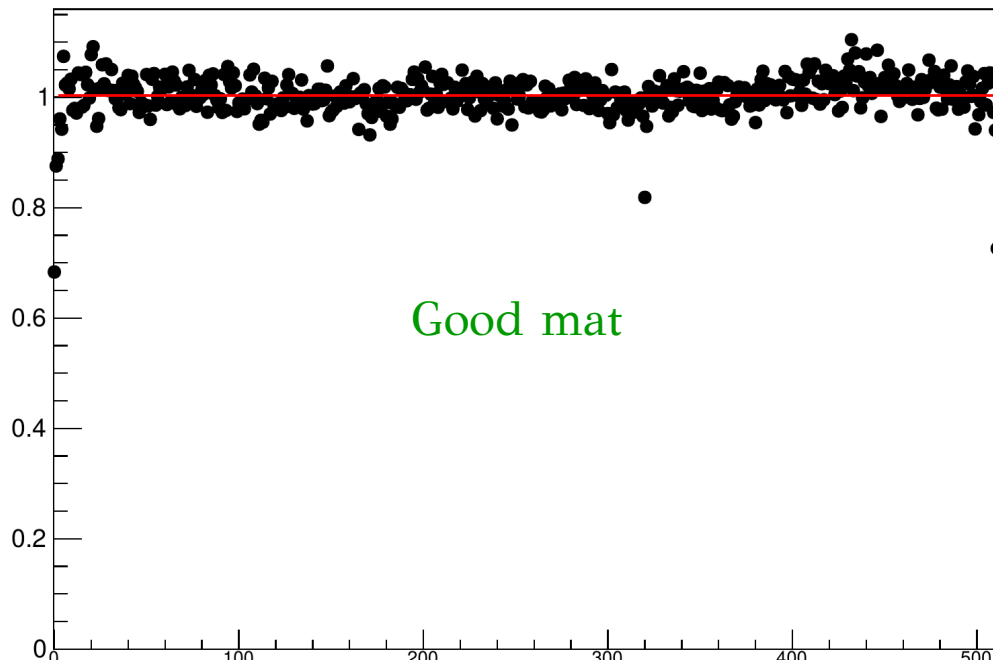
QA of fibre mats at module assembly centre:

We have to guarantee, that the longitudinal cut does not harm the fibre mat/mirror.

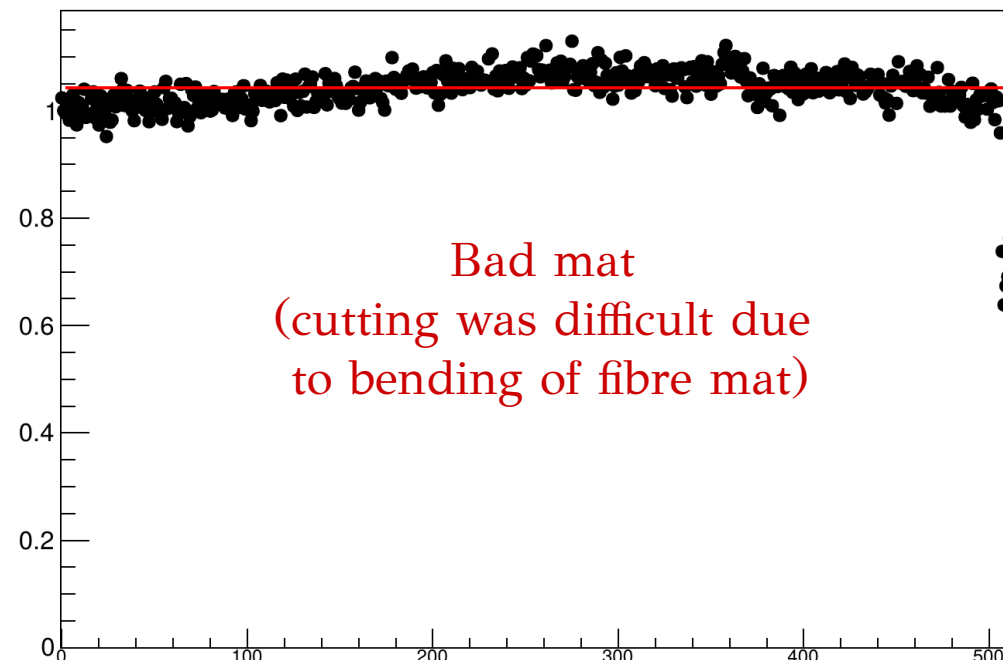
Test procedure:

- › Take reference measurement for light yield with beta-source set-up.
- › Perform optical inspection (e.g. check for glue residuals)
- › Check geometry by fitting mat to template/cutting device.
- › Perform longitudinal cut
- › Optical inspection
- › Remeasure and produce ratio plot:

Ratio FIM00040 uncut/cut



Ratio FIM00043 uncut/cut



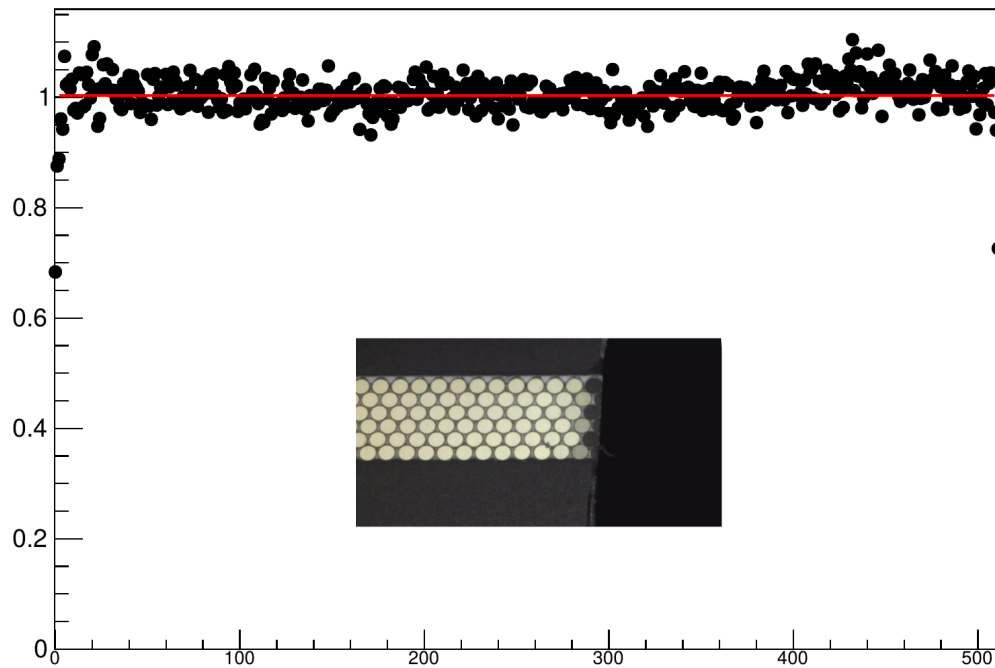
QA of fibre mats at module assembly centre:

We have to guarantee, that the longitudinal cut does not harm the fibre mat/mirror.

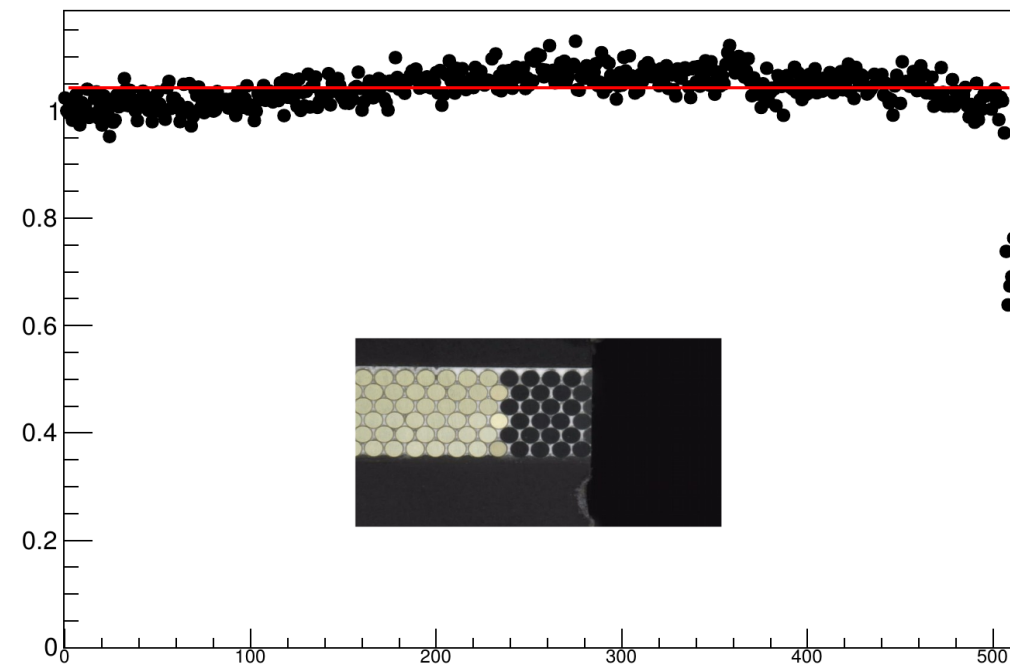
Test procedure:

- › Take reference measurement for light yield with beta-source set-up.
- › Perform optical inspection (e.g. check for glue residuals)
- › Check geometry by fitting mat to template/cutting device.
- › Perform longitudinal cut
- › Optical inspection
- › Remeasure and produce ratio plot:

Ratio FIM00040 uncut/cut



Ratio FIM00043 uncut/cut



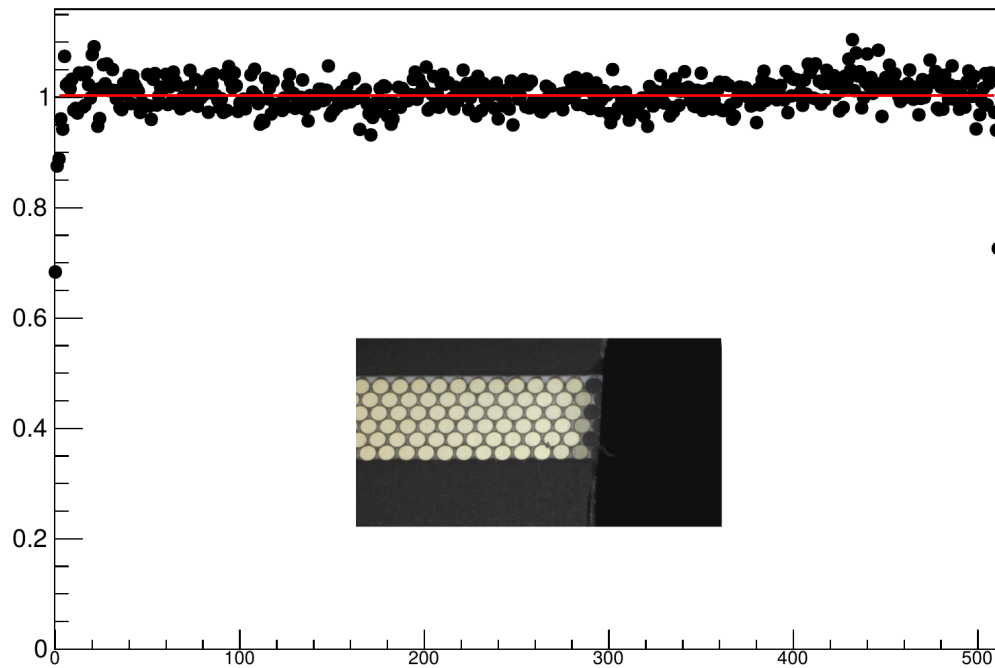
QA of fibre mats at module assembly centre:

We have to guarantee, that the longitudinal cut does not harm the fibre mat/mirror.

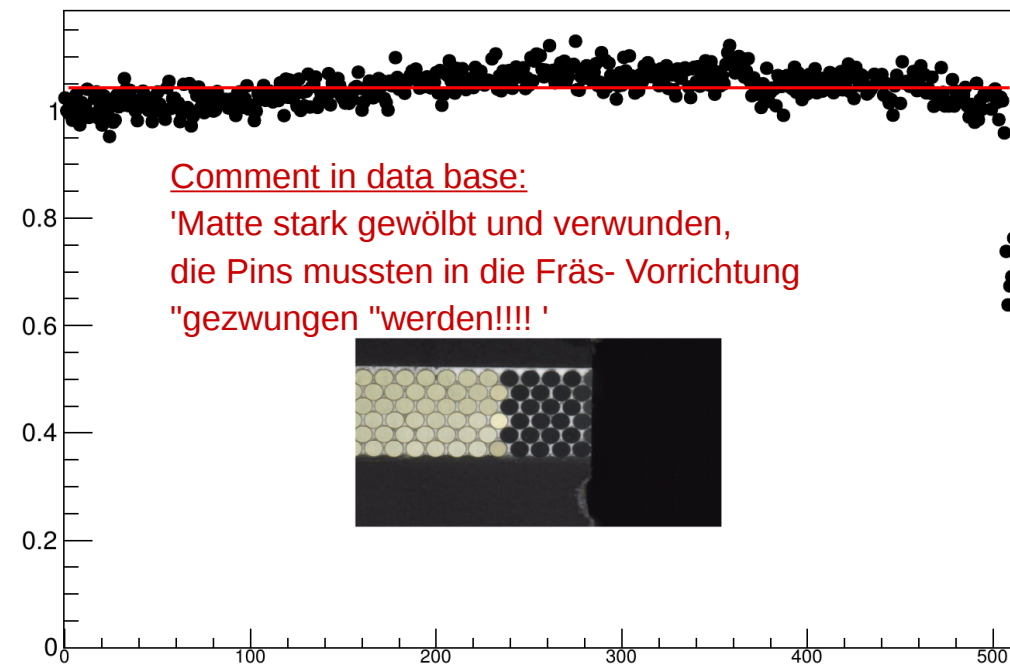
Test procedure:

- › Take reference measurement for light yield with beta-source set-up.
- › Perform optical inspection (e.g. check for glue residuals)
- › Check geometry by fitting mat to template/cutting device.
- › Perform longitudinal cut
- › Optical inspection
- › Remeasure and produce ratio plot:

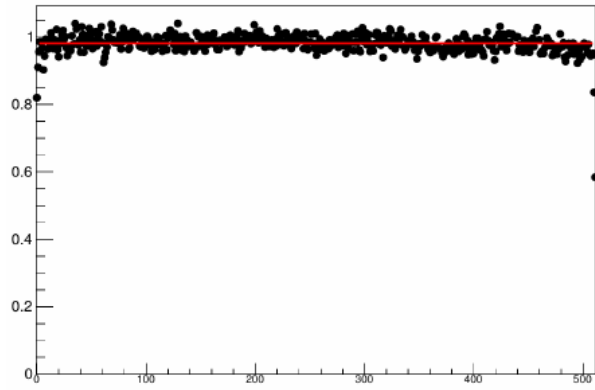
Ratio FIM00040 uncut/cut



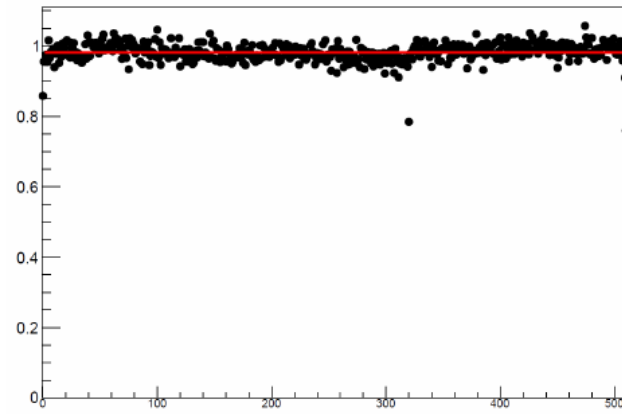
Ratio FIM00043 uncut/cut



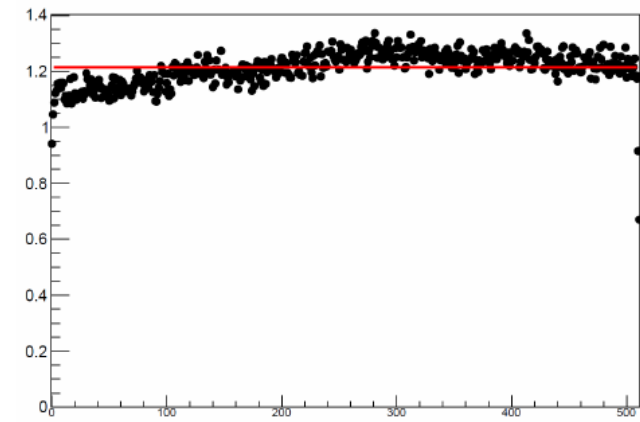
Ratio FIM00037 uncut/cut



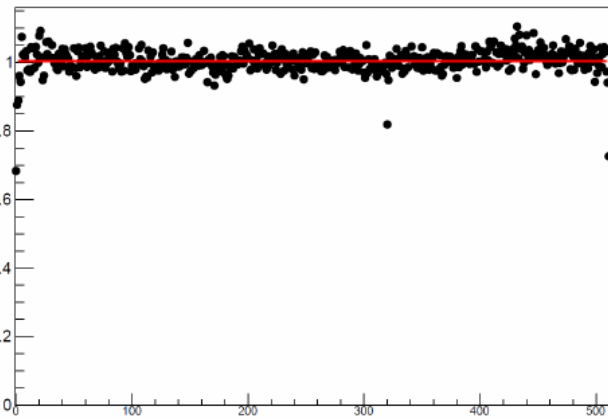
Ratio FIM00038 uncut/cut



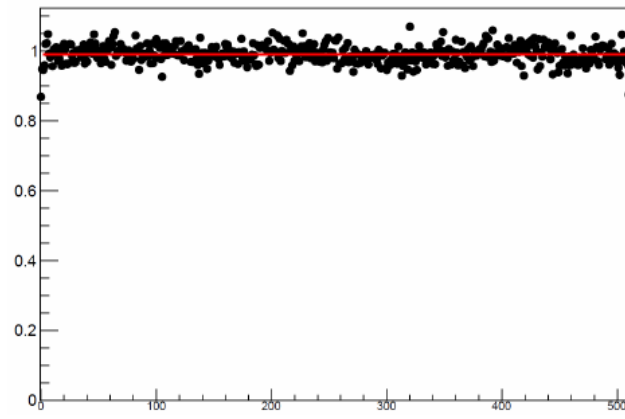
Ratio FIM00039 uncut/cut



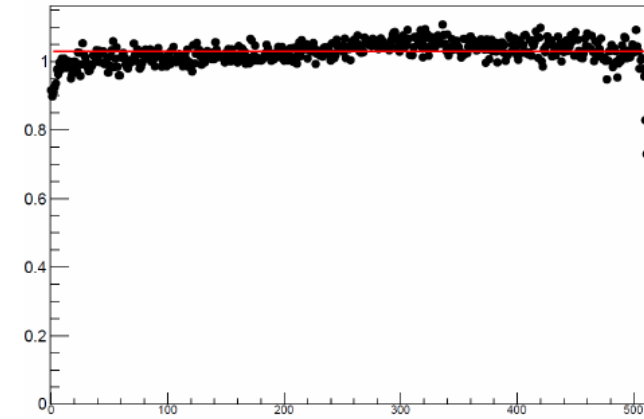
Ratio FIM00040 uncut/cut



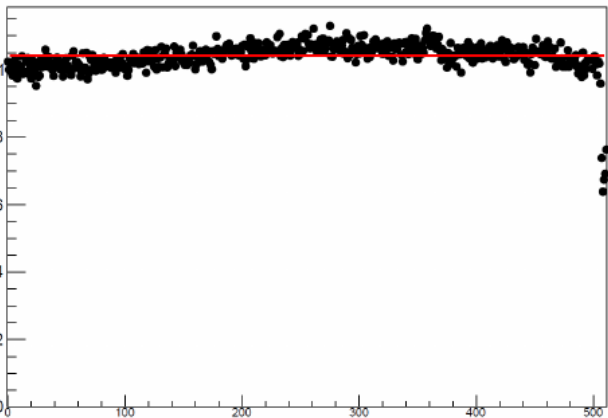
Ratio FIM00041 uncut/cut



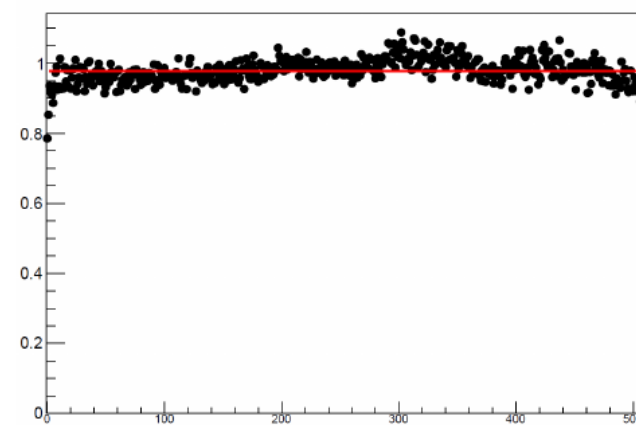
Ratio FIM00042 uncut/cut



Ratio FIM00043 uncut/cut



Ratio FIM00046 uncut/cut



Conclusion on longitudinal cut

- Longitudinal cut of fibres seems ok
- Mirror might be damaged → light loss in the outer most channels
- Optimization will be performed
 - e.g. change sense of rotation of milling head
 - fix mirror during cutting

QA of fibre mats at module assembly centre:

Finally, fibre mats are categorized (e.g. A-D) based on these measurements and cross-check of tolerances, e.g.:

- geometry (dimensions, excess of glue...)
- # of pins & quality of pins
- uniformity in thickness
- alignment pins wrt. centre of endpieces

Based on the starting serial production we are currently developing criteria for the different categories.

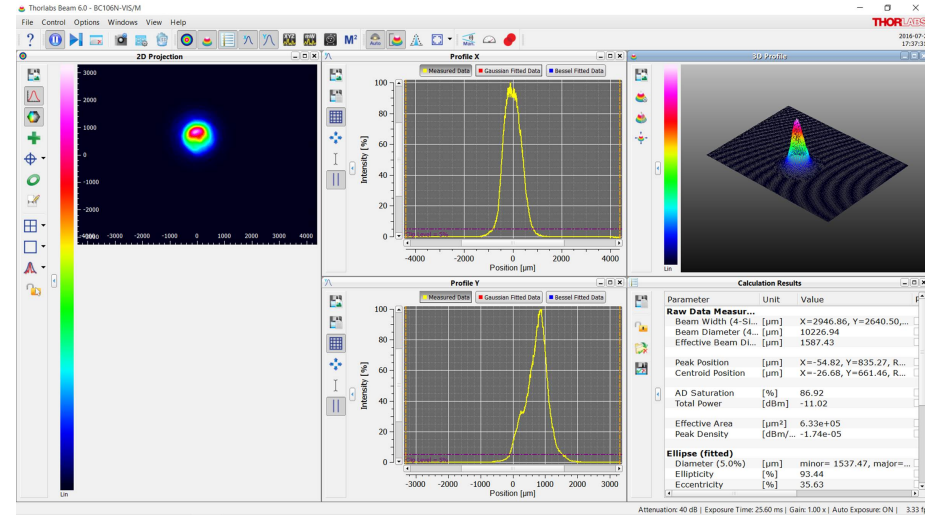
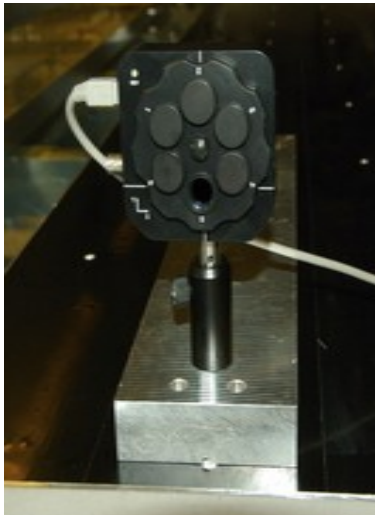
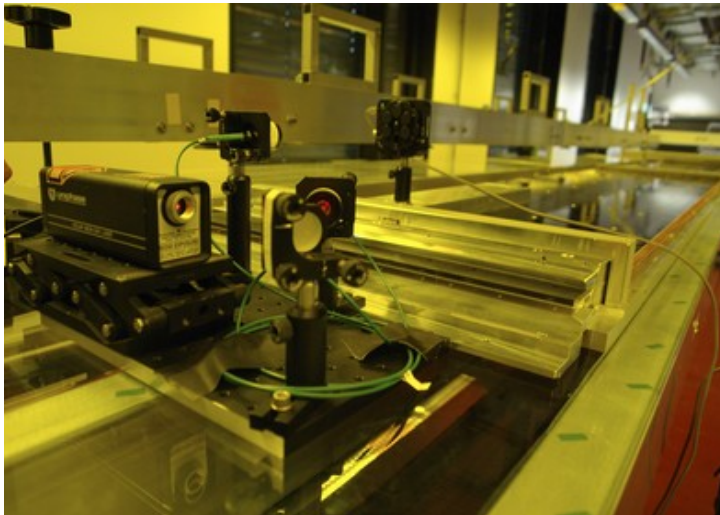
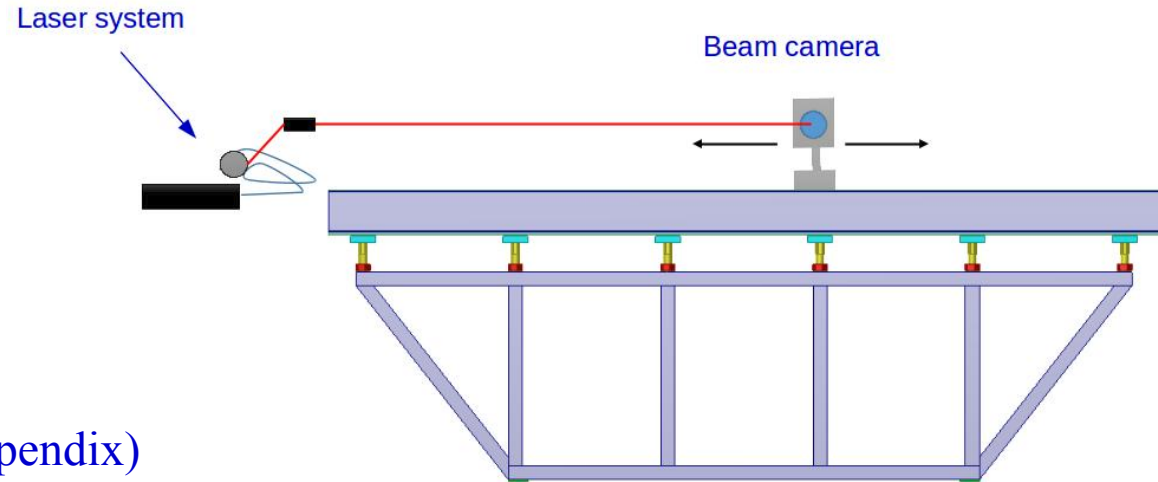
Module QA: Survey of linearity/flatness

Versatile laser/beam camera set-up to measure over the entire length of 5m

- flatness of table, panels & half modules
- linearity of template grooves & pins on half module

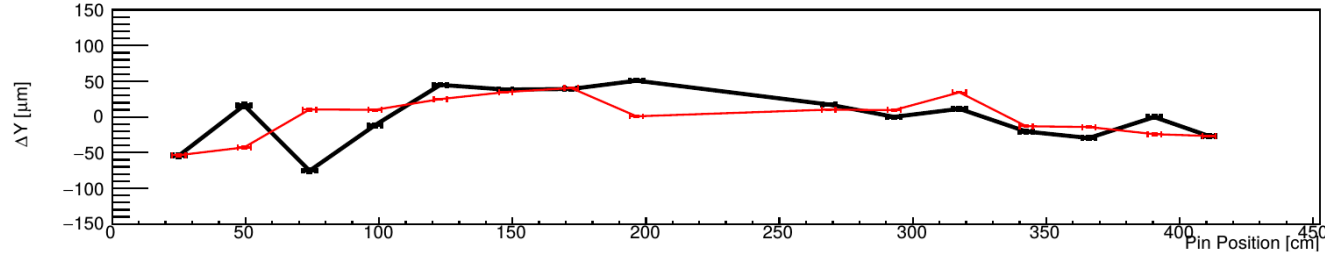
→ Intrinsic resolution: $\sim 12\mu\text{m}$ (see appendix)

→ Flatness of half module and linearity of fibre mats is measured initially for every module, later periodically.



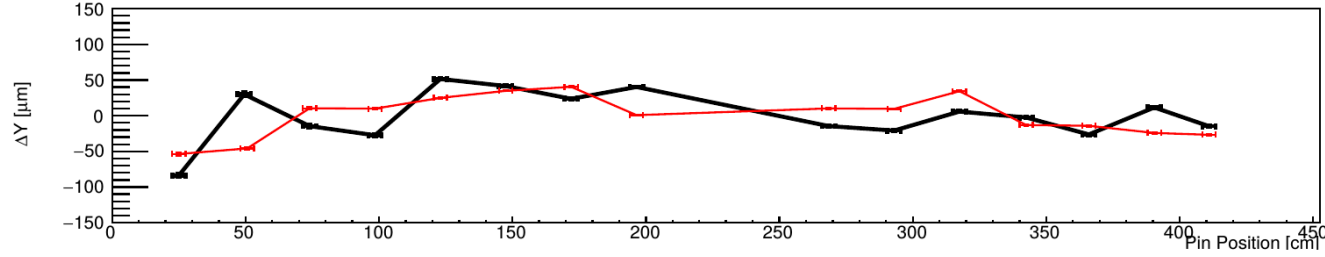
Survey module 0: Flatness

Mats 1 A & B

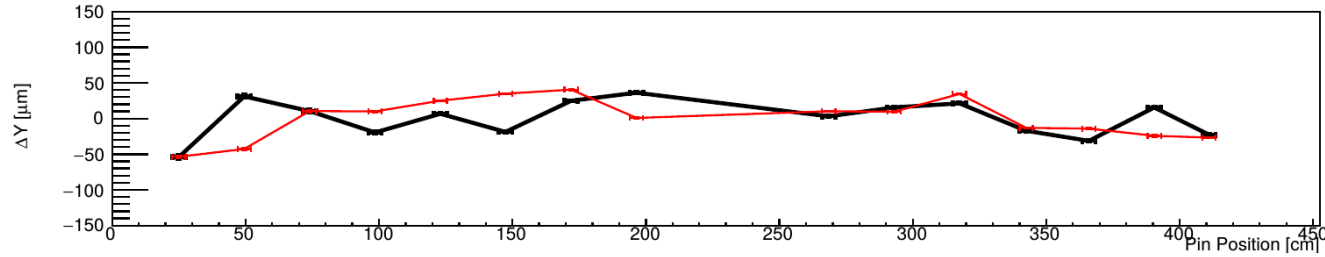


— half module
— table

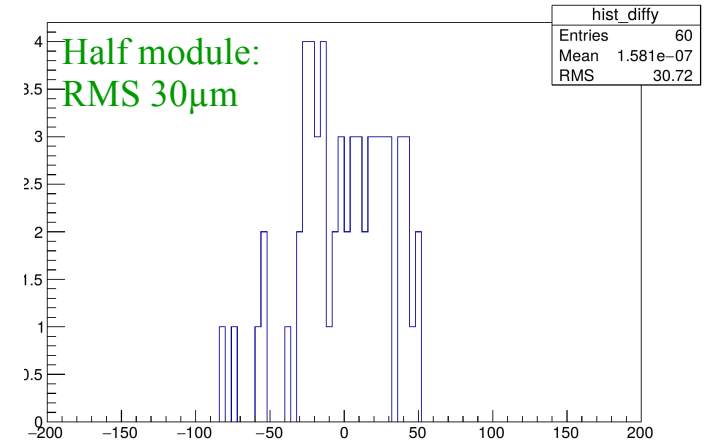
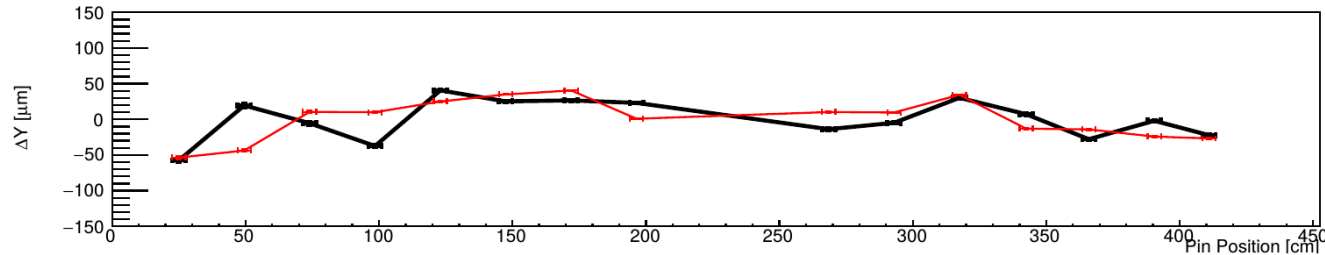
Mats 2 A & B



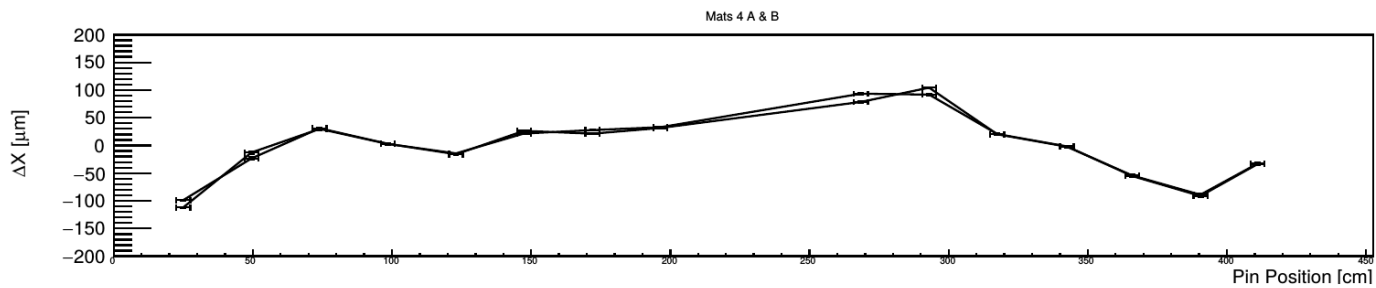
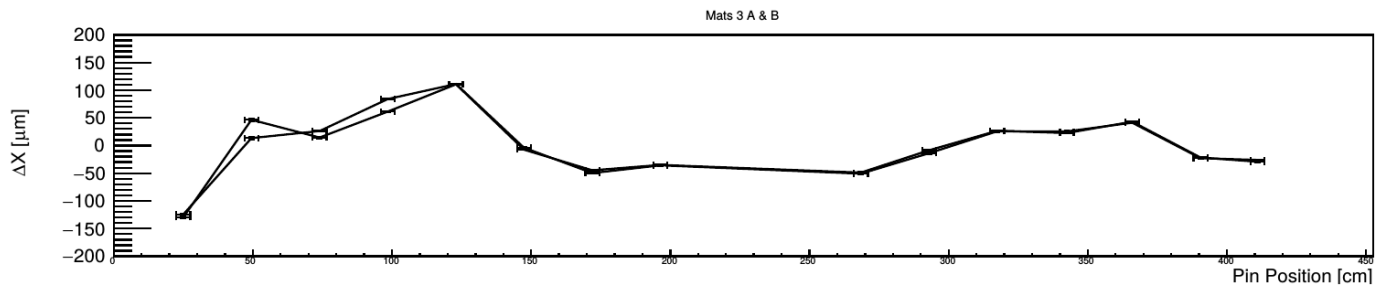
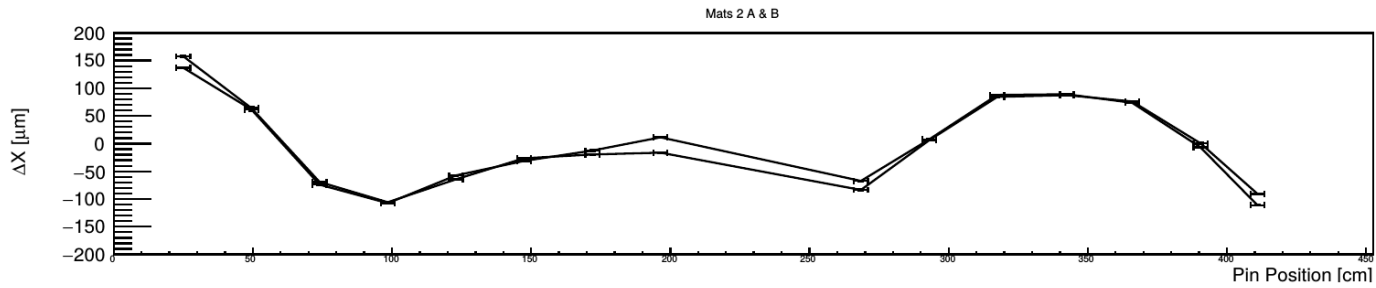
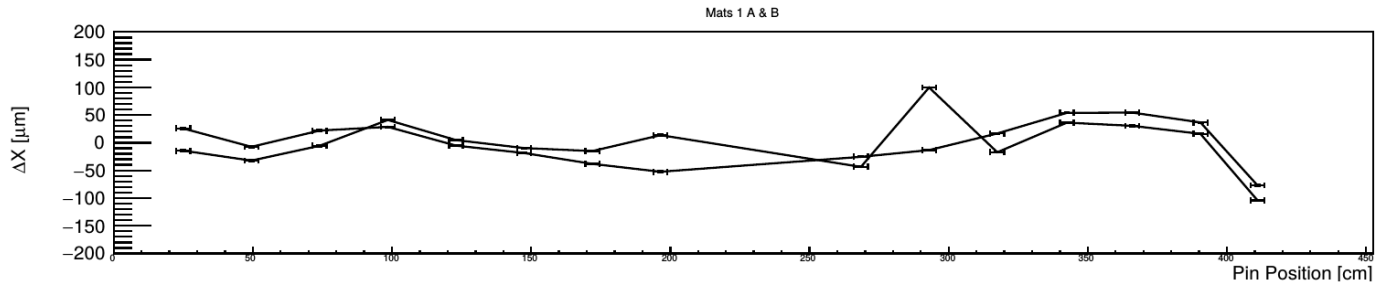
Mats 3 A & B



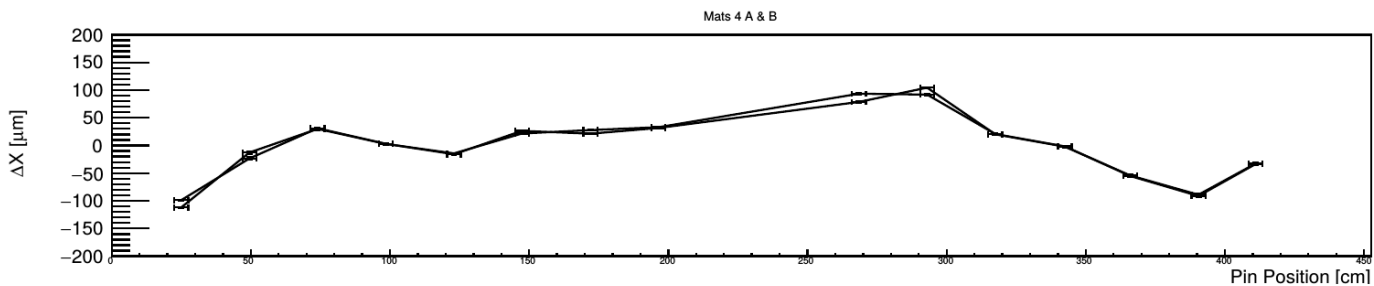
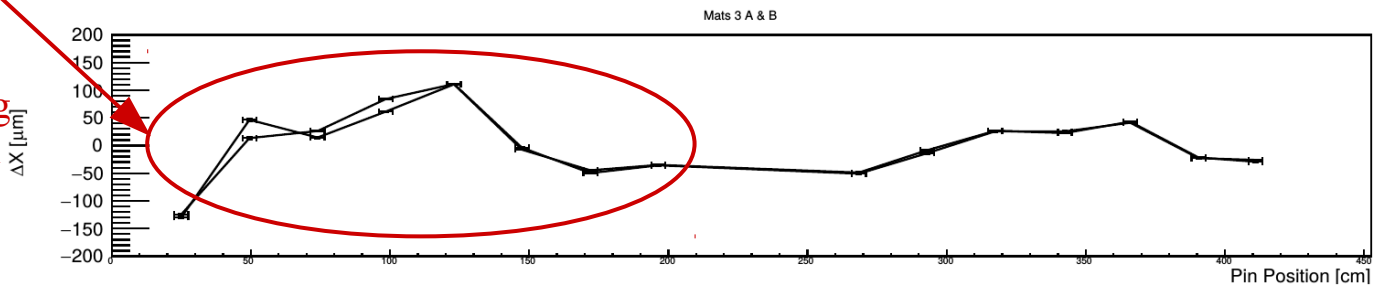
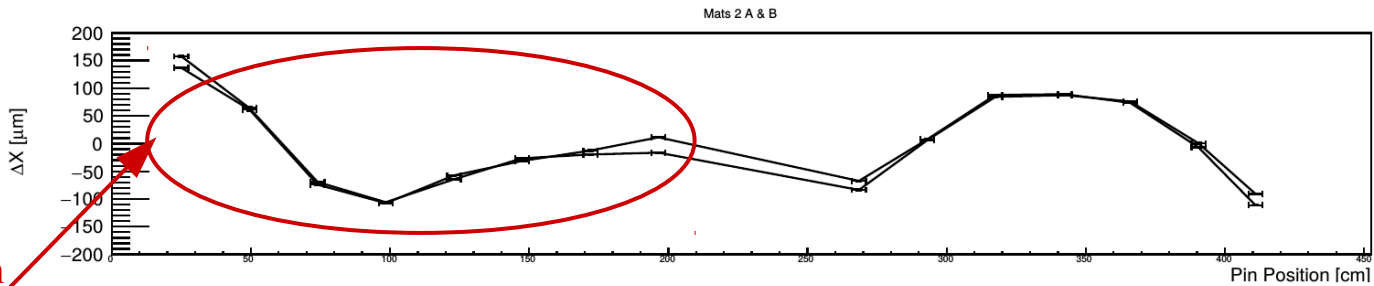
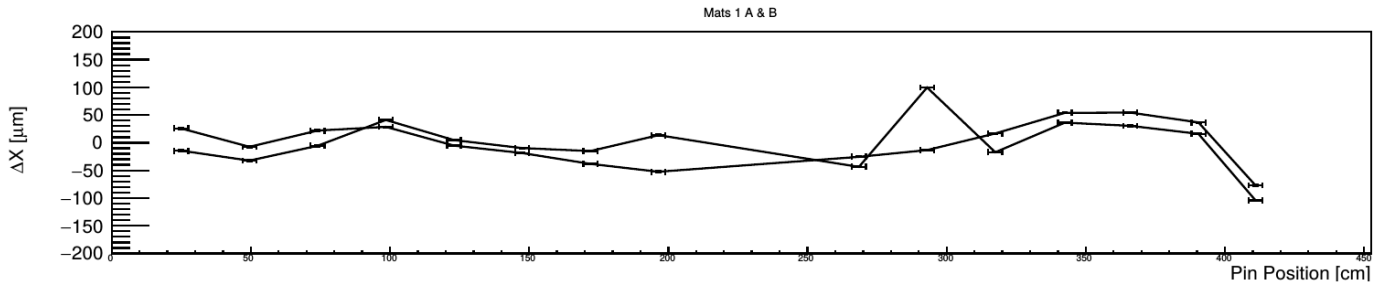
Mats 4 A & B



Survey 0: Linearity of pins

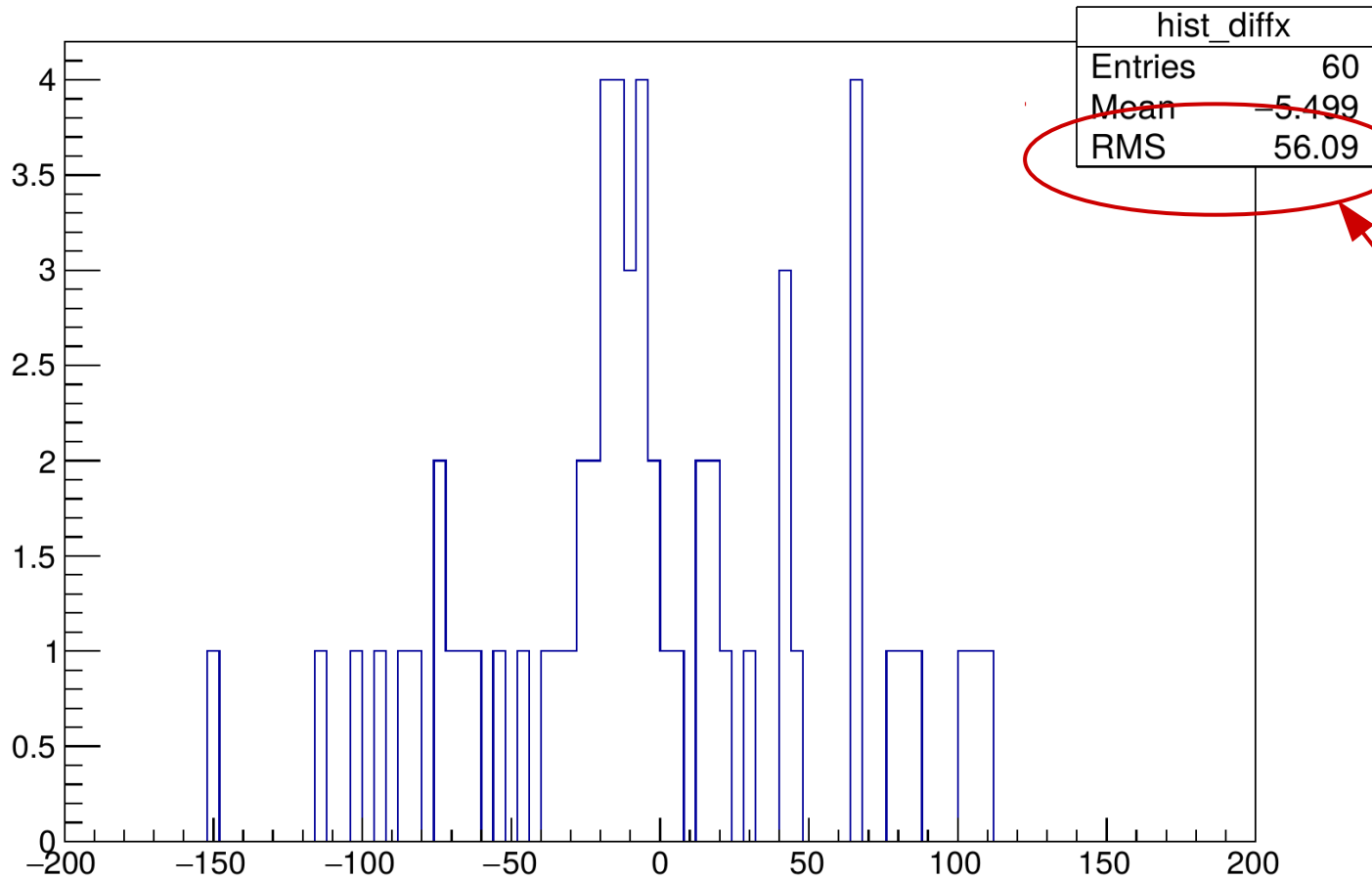


Survey 0: Linearity of pins



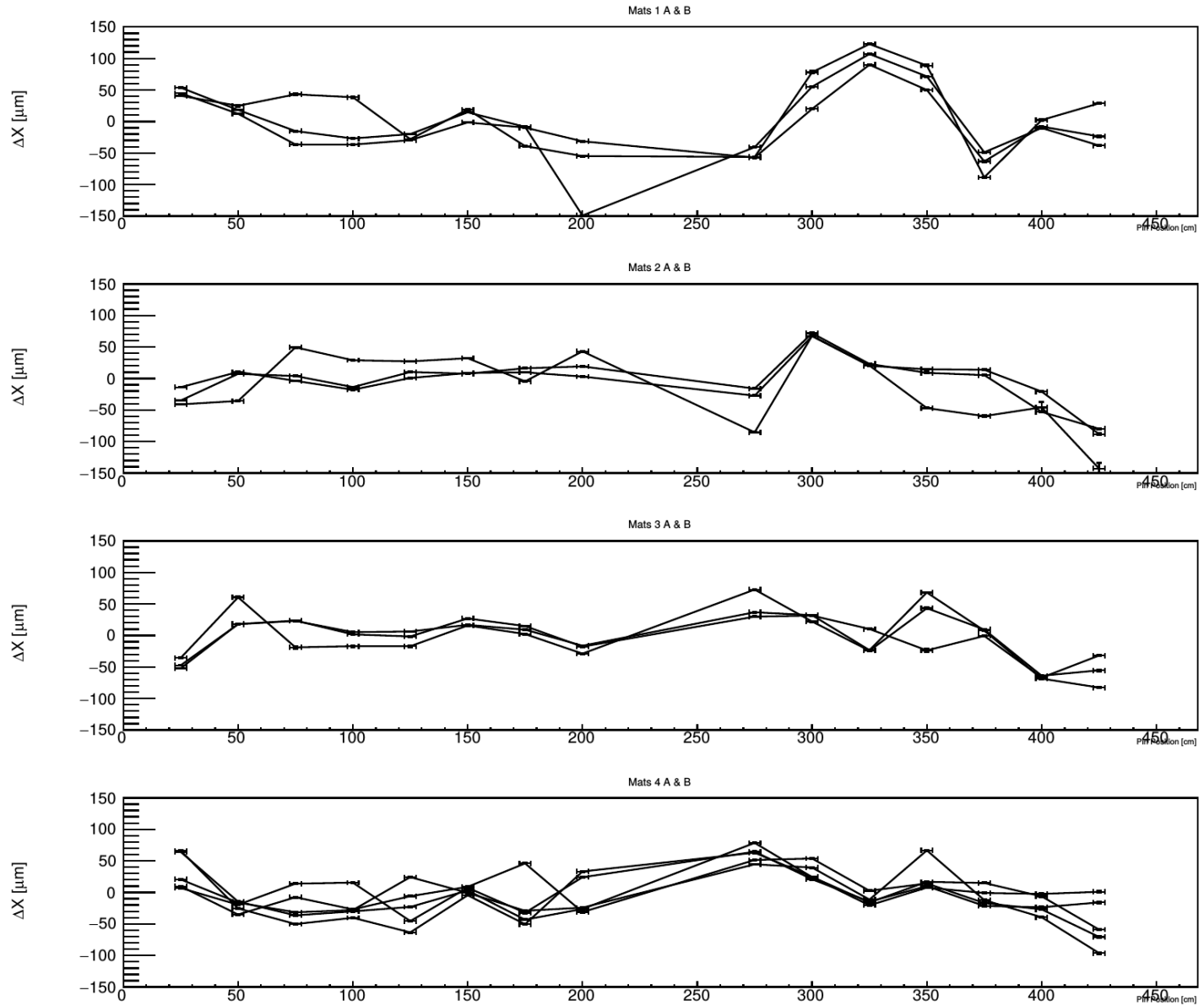
Mats with known Problems:
 1. Crack
 2. Strong bending
 → see slide on long. cut

Survey 0: Linearity of pins

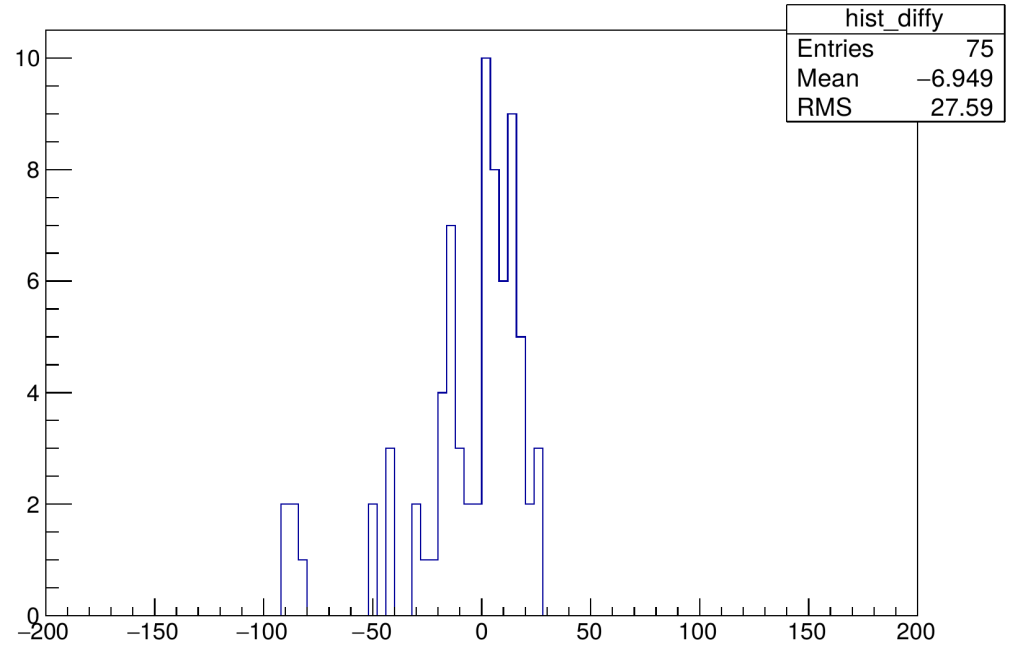
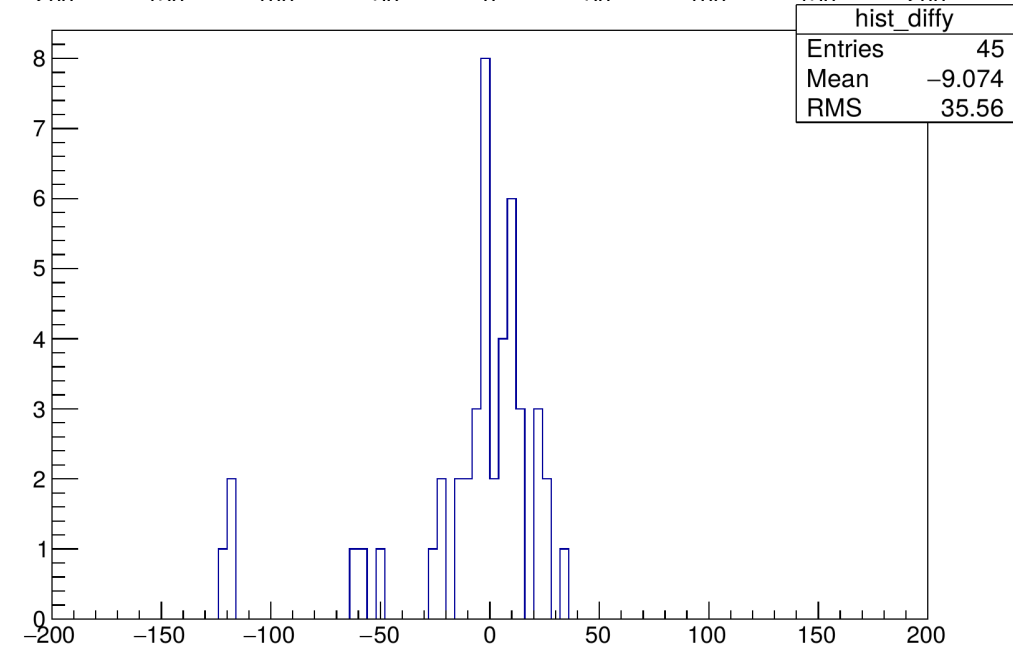
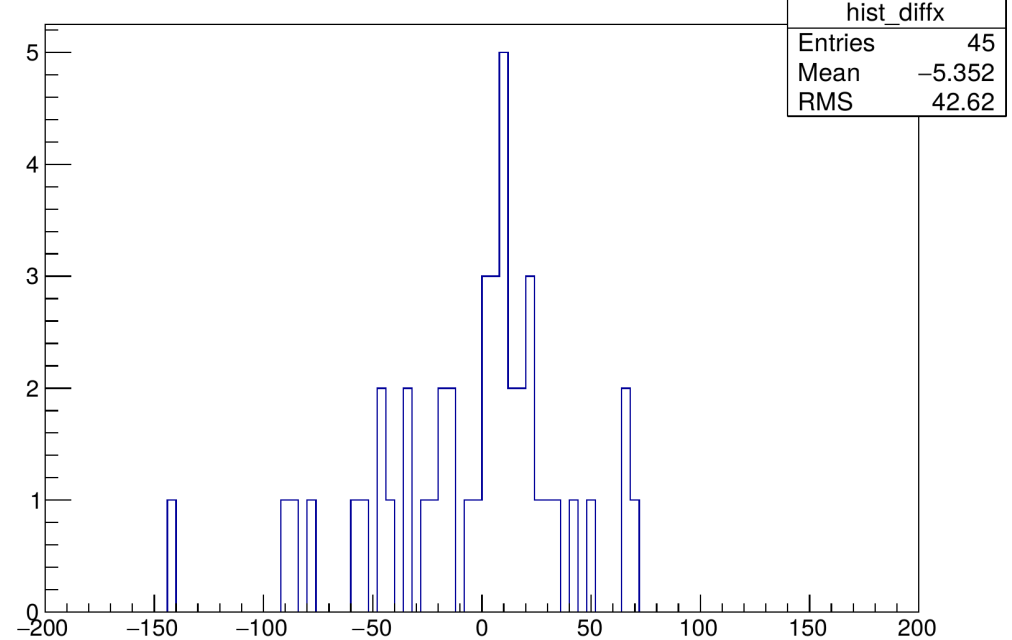
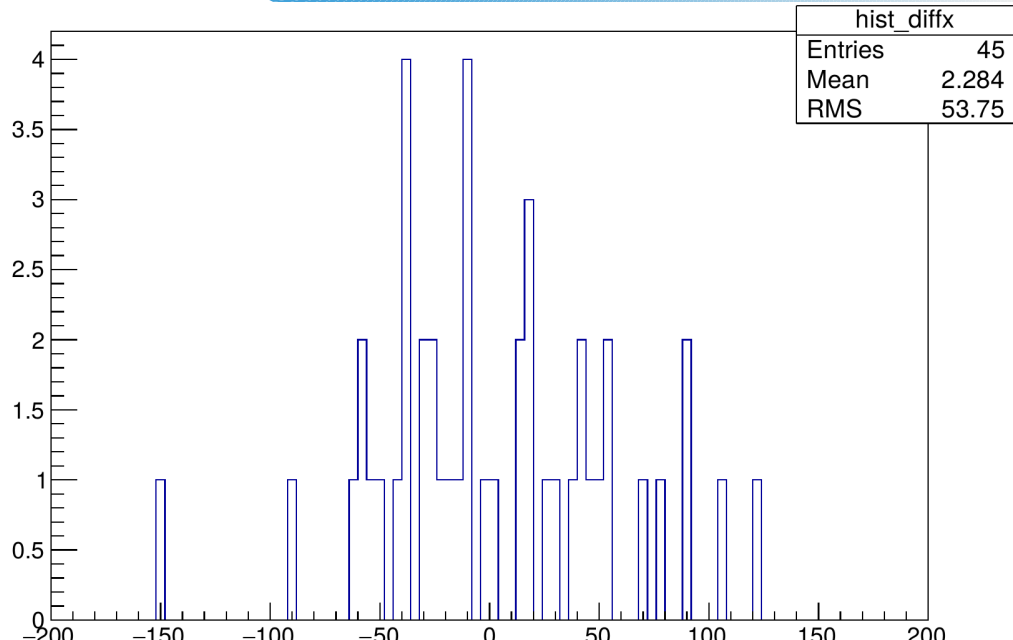


Still ok but we try to improve

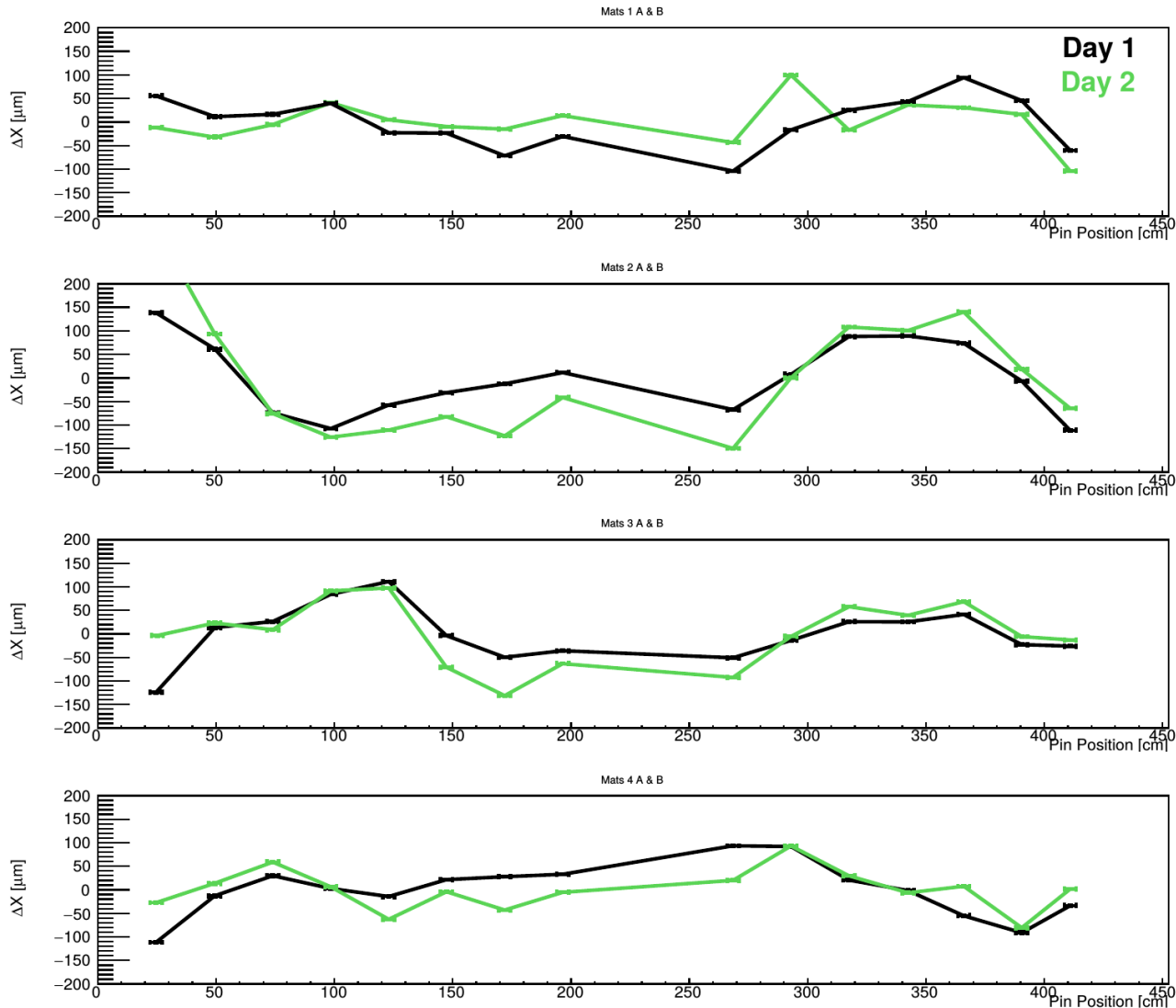
Survey Module -1: Linearity of pins



Survey Module -1: Linearity of pins



Module 0: Reproducibility



Module has been removed from template and re-aligned between both measurements!

Light tightness

To check the module light tightness we measure

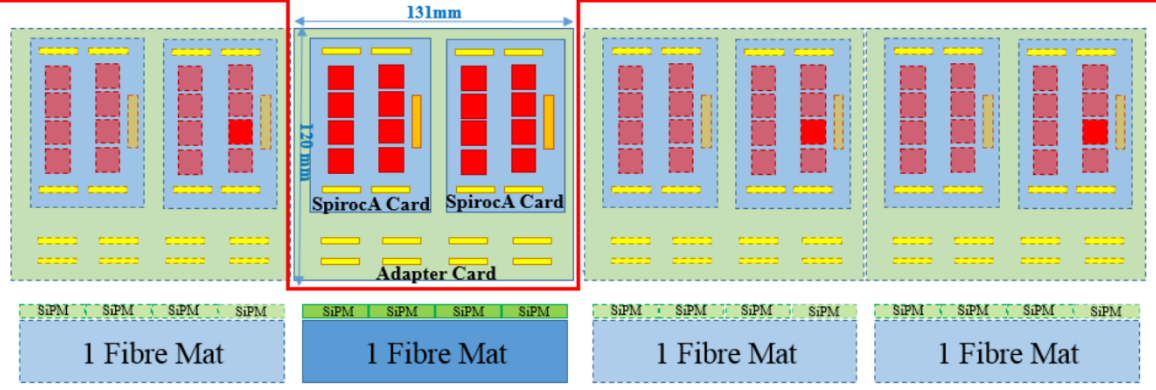
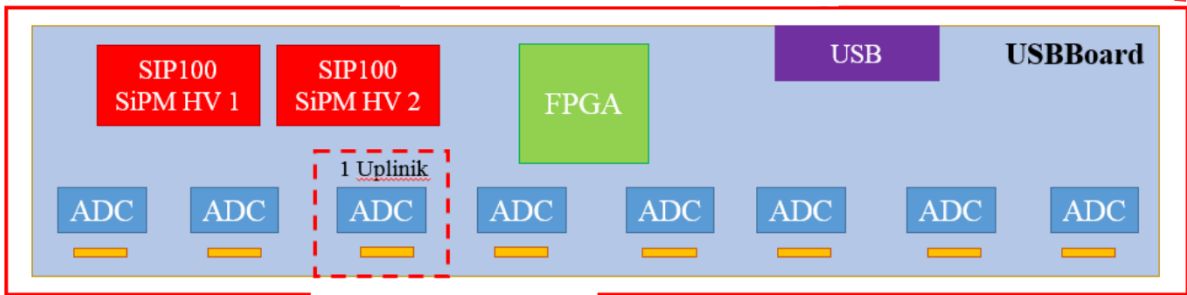
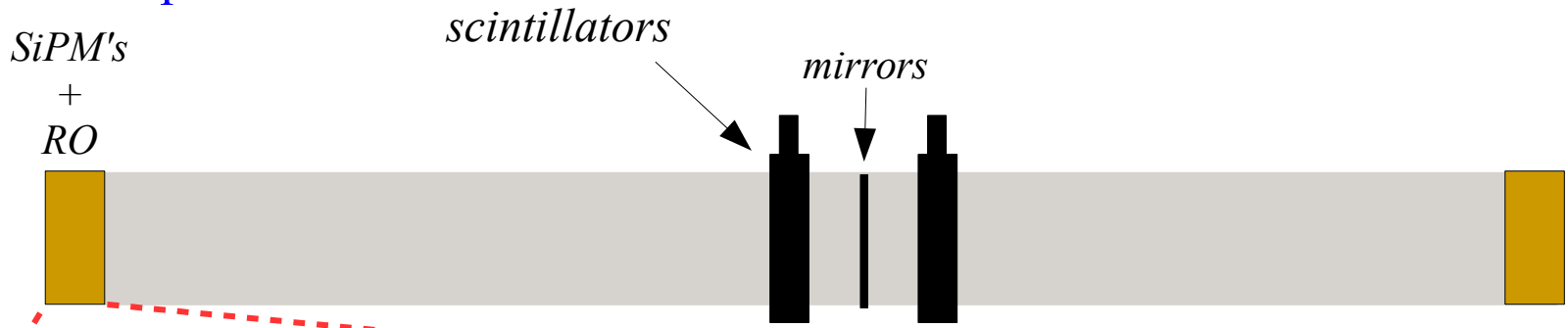
- Dark current
- Dark count rate

from SiPMs.

→ Still limited experience/statistics.

Module QA: Cosmic test set-up

Principle:



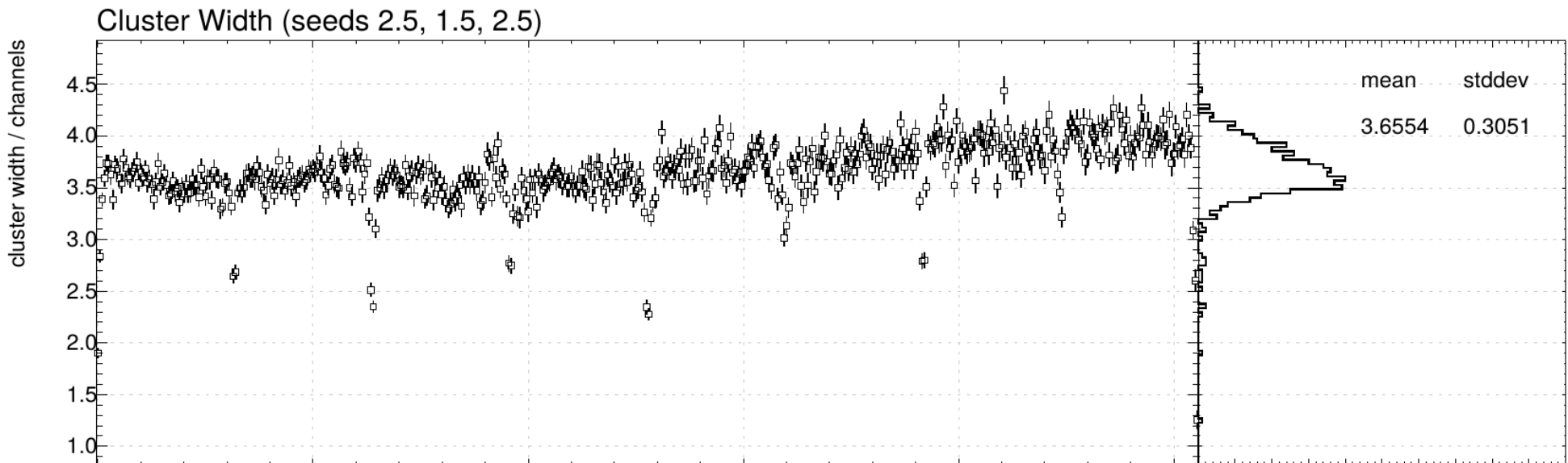
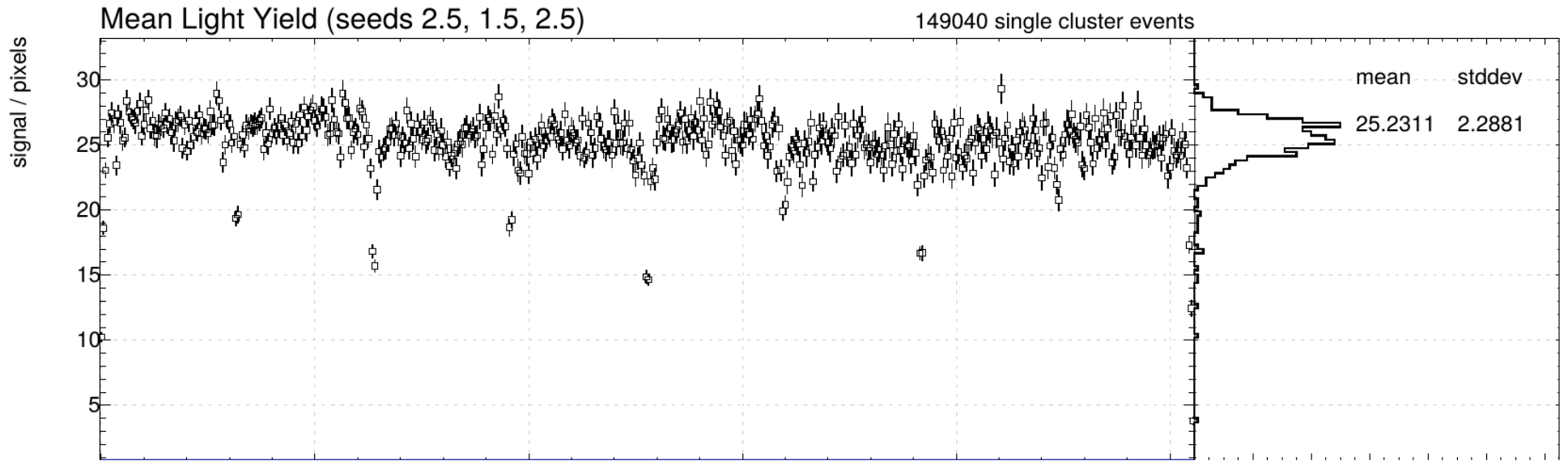
- RO system for one fibre mat:
- 1 adapter card
 - 2 Spiroc cards
 - 1 USB card
 - 1 power supply unit



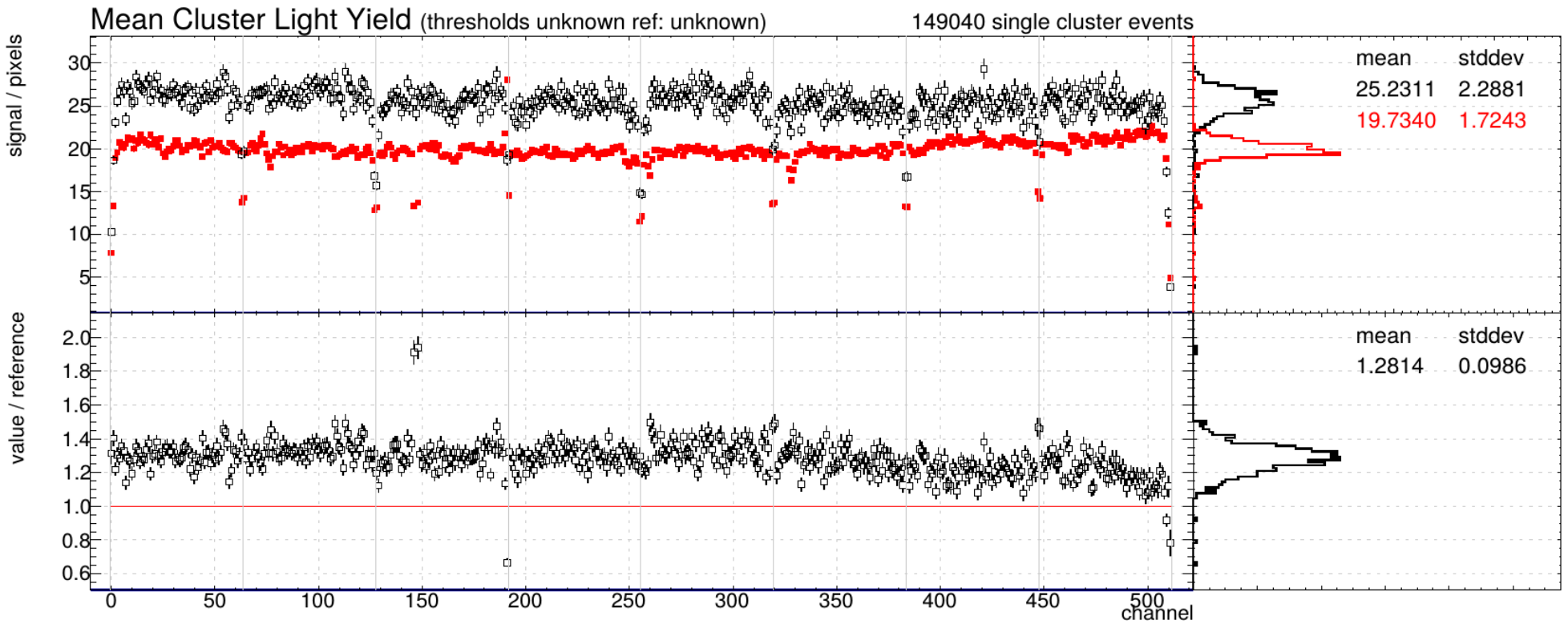
Module QA: Cosmic test set-up



Cosmic test set-up: Results from 3-day run for module -1



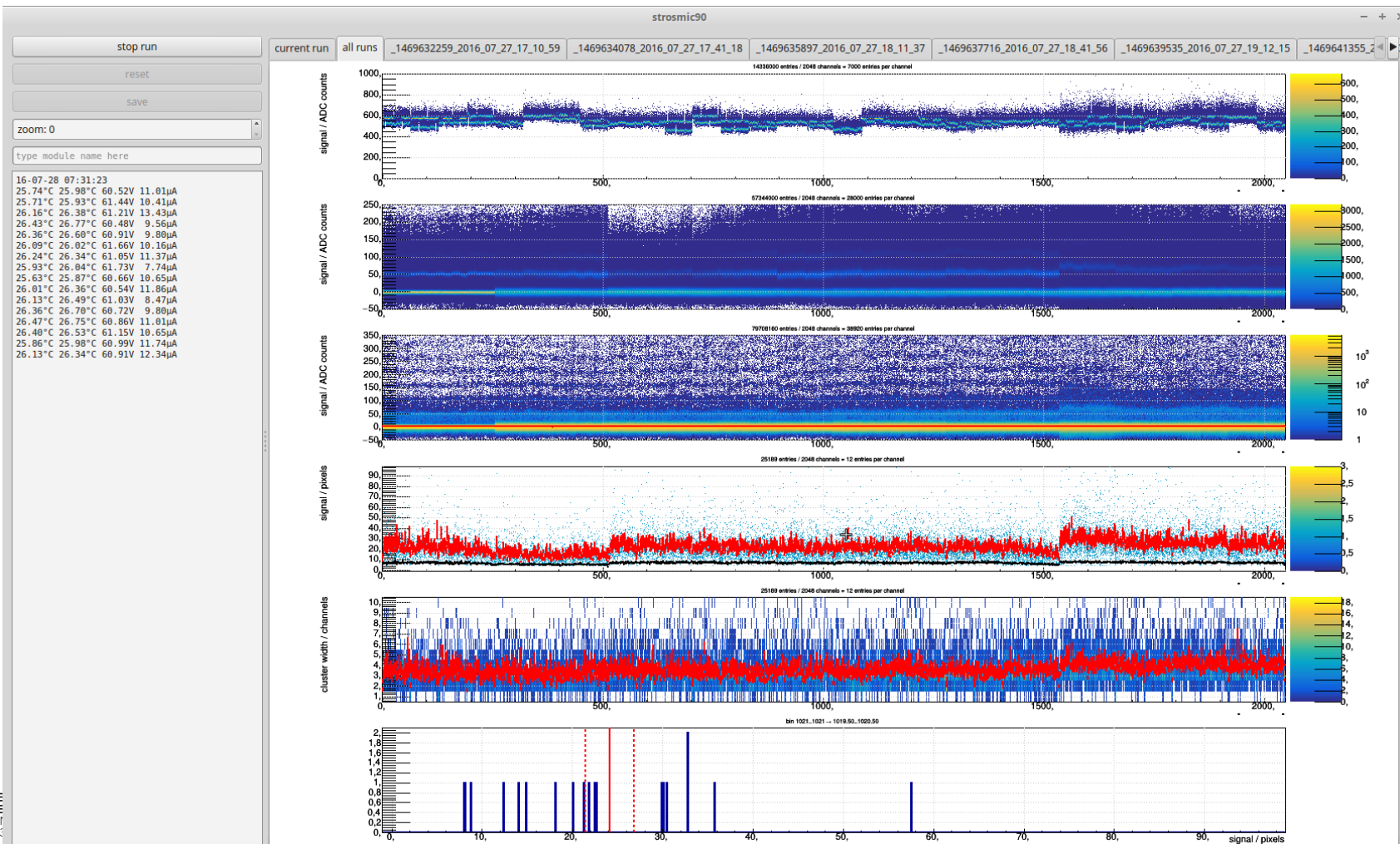
Cosmic test set-up: Comparison with fibre mat QA (Sr⁹⁰ test)



Cosmic test set-up: First results from fully assembled half module

Very preliminary!

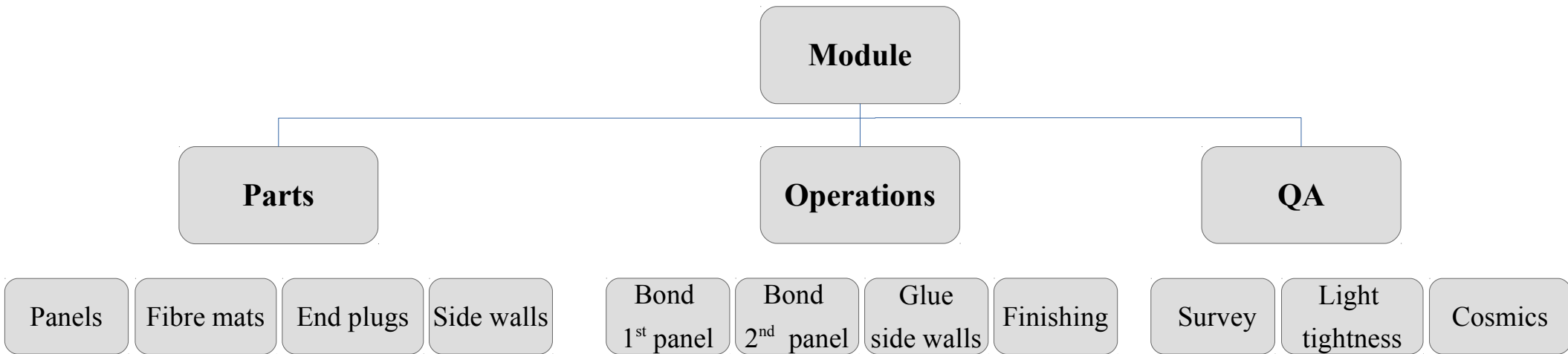
- No calibration of SiPM break-down voltage
- Coarse alignment of SiPMs



Production Data Base

Production DB is used for

- inventory of parts
- electronic process slip for operations
- storage for QA results



Production Data Base: Inventory

Example:

Panel producer ADCO enters the production data directly into SciFi DB:

[<< Back to the Panels list](#)

View Panel					
Origin	ADCO				
Batch No.					
ID					
Company	ADCO				
Bonding date	2016-07-20	Temperature	26	Humidity	52
Capton Bonding date	2016-07-25	Temperature	24	Humidity	56
Package date	0000-00-00	Temperature		Humidity	
Honeycomb	Schütz	Batch No.	1014804695-0003247726-005		
Carbonfibre producer	Cramer	Batch No.	F40030014 0023 / 0203455711020100		
Glue	L160 Exo	Batch No.	LS370392 EG6CS0151	Hardener	H203
				Batch No.	LS366527 EG6BS0047
Remark	# ITS A LI # HC: Schütz C2, 19.8, dusty!				



Production Data Base: Inventory

Example:

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[<< Back to the Panels list](#)

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Package date	0000-00-00	Temperature		Humidity	
Honeycomb	Schütz	Batch No.	1014804695-0003247726-005		
Carbonfibre producer	Cramer	Batch No.	F40030014 0023 / 0203455711020100		
Glue	L160 Exo	Batch No.	LS370392 EG6CS0151	Hardener	H203
				Batch No.	LS366527 EG6BS0047
Remark	# ITS A LI # HC: Schütz C2, 19.8, dusty!				



“Ist eine schöne Sache die Datenbank. Ich füttere Sie zum Teil mit meinem Handy, diese langen Würmer von Batchnummern lese ich per Barcode und Wifi direkt ein, da gibt es dann keine Fehler. Die physischen Batchzettel archiviere ich noch als Scan. “

Production DB: Process slip

<< Back to the Bond LIS panel (1st) for full size modules list

Related documents: [A/B \(Heidelberg\)](#)

New Bond LIS panel (1st) for full size module

Origin	PI	
Panel	(select)	Scan
Full size module Nickname	<input type="text"/>	
Operator	(select)	(select)
Date	-	Today
Fibre mat A1	FIM00044	Scan
Fibre mat A2	(select)	Scan
Fibre mat A3	(select)	Scan
Fibre mat A4	(select)	Scan
Fibre mat B1	(select)	Scan
Fibre mat B2	(select)	Scan
Fibre mat B3	(select)	Scan
Fibre mat B4	(select)	Scan
Glue for panel	(select)	Scan
Batch No. 1	<input type="text"/>	Expiry date 1
Batch No. 2	<input type="text"/>	Expiry date 2
Hardener for panel	(select)	Scan
Batch No. 1	<input type="text"/>	Expiry date 1
Batch No. 2	<input type="text"/>	Expiry date 2
Glue for endplug	(select)	Scan
Batch No. 1	<input type="text"/>	Expiry date 1
Batch No. 2	<input type="text"/>	Expiry date 2







Production DB: Process slip

View Bond LIS panel (1st) for full size module

Origin	PI							
Panel	PAN00003							
Module	FSM00002							
Operator	Andrea Anjam , Tobias Herold							
Date	2016-06-07							
Fibre mat A1	FIM00025							
Fibre mat A2	FIM00024							
Fibre mat A3	FIM00036							
Fibre mat A4	FIM00026							
Fibre mat B1	FIM00028							
Fibre mat B2	FIM00027							
Fibre mat B3	FIM00031							
Fibre mat B4	FIM00032							
Glue for panel	Araldite 116	Batch No. 1	ADD0207000	Expiry date 1	2020-04-17	Batch No. 2	Expiry date 2	0000-00-00
Hardener for panel	Araldit HV953 U BD	Batch No. 1	ADD0168300	Expiry date 1	2020-01-21	Batch No. 2	Expiry date 2	0000-00-00
Glue for endplug	Araldite 116	Batch No. 1	ADD0207000	Expiry date 1	2020-04-17	Batch No. 2	Expiry date 2	0000-00-00
Hardener for end plug	Araldit HV953 U BD	Batch No. 1	ADD0168300	Expiry Date 1	2020-01-21	Batch No. 2	Expiry date 2	0000-00-00
Date for unforming	2016-06-07							
Operator for unforming	Andrea Anjam , Tobias Herold							
Remarks								
Status	Done							

Production DB: Module QA

[Show filter](#)

<u>Inventory</u>	<u>Origin</u>	<u>Comment</u>	<u>File</u>	<u>Date</u>	<u>Module</u>	<u>QA process</u>		
00001	PI	Cosmic test with 1 mat incl. comparison to Sr90	logicbox_posA_Summary_1469429570_2016_07_25_08_52_50_Summary.pdf 2016-07-27 19:06:58 by Sebastian Bachmann 	2016-07-27	FSM00002	Cosmic test	Modify	Delete
00002	PI	Cosmic test with 1 fibre mat	Cosmic_weekendRun_Summary_1469429570_2016_07_25_08_52_50_Summary.pdf 2016-07-27 19:10:52 by Sebastian Bachmann 	2016-07-27	FSM00002	Cosmic test	Modify	Delete
00003	PI	Survey module flatness	Module0_diffy_repeat.pdf 2016-07-27 19:20:47 by Sebastian Bachmann 	2016-07-27	FSM00003	Survey	Modify	Delete
00004	PI	Survey module flatness Histogram	Module0_diffy_hist_repeat.pdf 2016-07-27 19:21:19 by Sebastian Bachmann 	2016-07-27	FSM00003	Survey	Modify	Delete
00005	PI	Survey Pins	Module0_diffx_repeat.pdf 2016-07-27 19:22:19 by Sebastian Bachmann 	2016-07-27	FSM00003	Survey	Modify	Delete
00006	PI	Survey Pins Histograms	Module0_diffx_hist_repeat.pdf 2016-07-27 19:23:09 by Sebastian Bachmann 	2016-07-27	FSM00003	Survey	Modify	Delete

Categorization of modules

Similar to fibre mats modules will be categorized based on QA results:

→ High quality modules will be used close to beam pipe while modules of lower quality are used in outer region of detector.

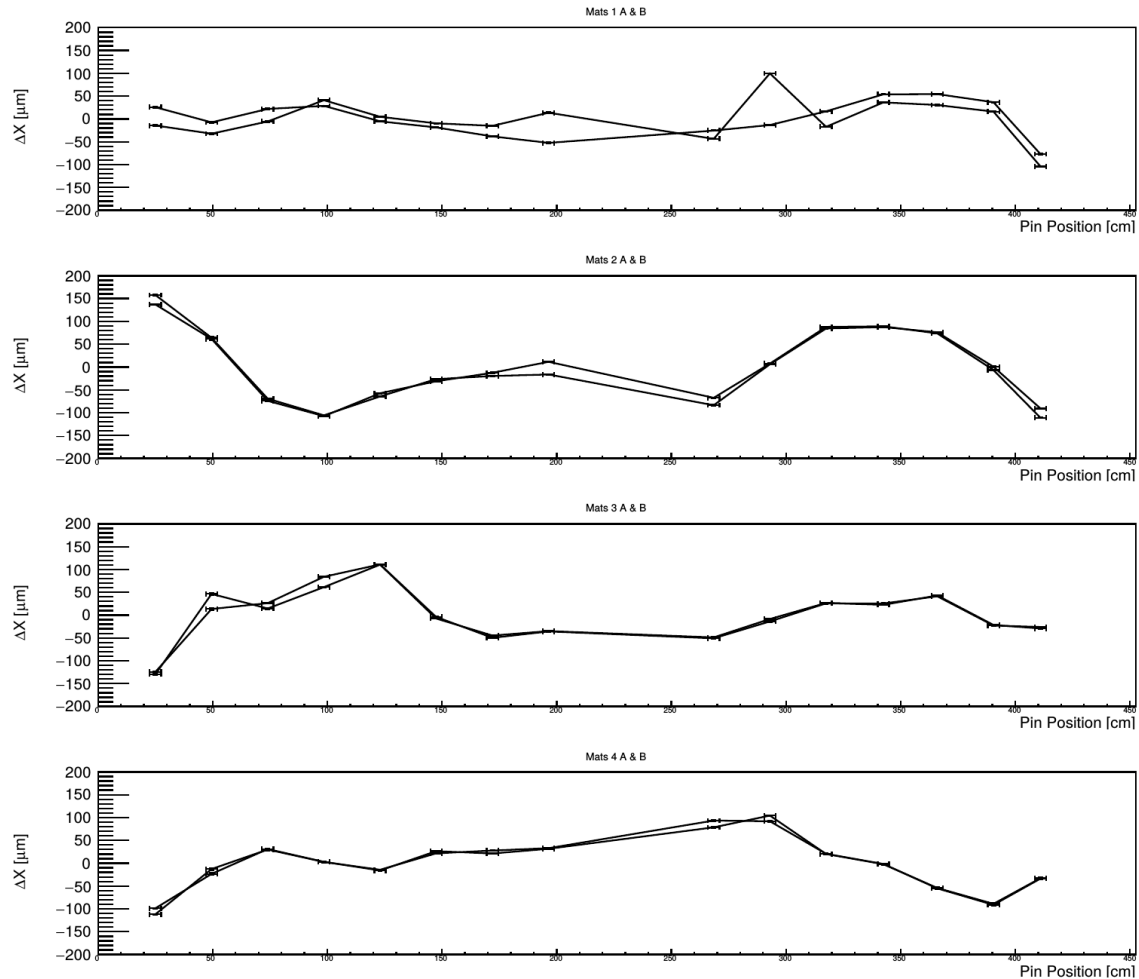
Summary

- QA processes for SciFi modules have been developed and commissioned.
- Still on learning curve, but already now results helped us to identify and solve problems in the module assembly.
- Production DB has been proven to be a versatile and useful tool
 - for inventory
 - as electronic process slip
 - file system for QA results
- Modules will be categorized for use in the experiment based on QA results.

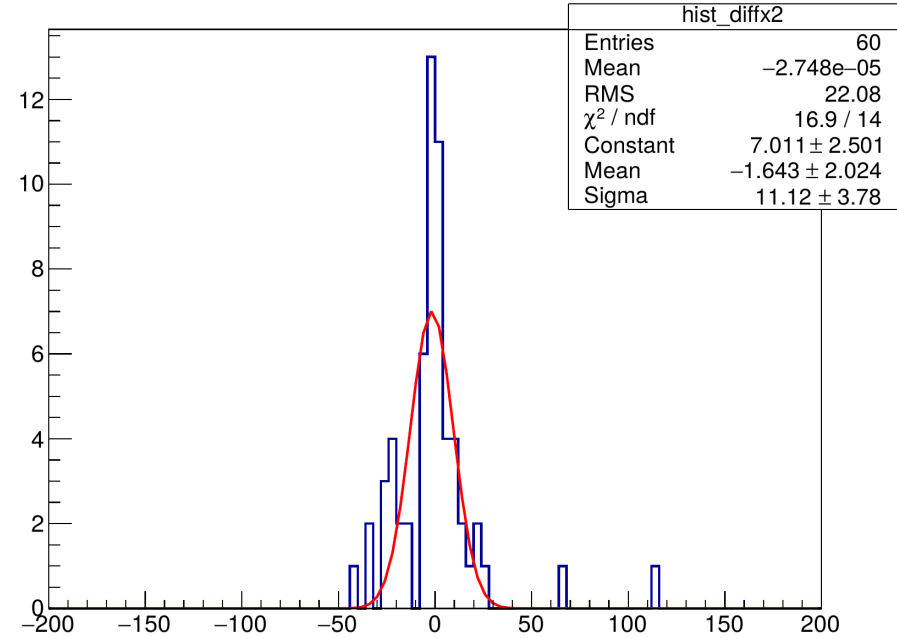
Appendix

Laser set-up: Resolution

Two consecutive measurements of linearity of pins:



Difference of both measurements:



Laser set-up: Raw data

