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# MODULE TESTING FOR LOADED LOCAL SUPPORT (LLS) FDR

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Lecce team

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# MODULE INVENTORY

**Digital Quad Module:** ANL 5, assembled in Argonne (Vallary Shashikant Bhopatkar)

**PCB:**

**Bare Module:** **20UPGBQ0100027**

**FE chips (RD53A):**

20UPGFC0017751  
20UPGFC0017750  
20UPGFC0017749  
20UPGFC0017748

## ANL5

GA1 20UPGFC0017751	GA4 20UPGFC0017748
GA2 20UPGFC0017750	GA3 20UPGFC0017749

**Quad Module:** **20UPGM20025142** (Carl Gwilliam) assembled in Liverpool (Jon Taylor)

**PCB:** 20UPGPQ0025142

**Bare Module:** 20UPGB40100063

**FE chips (RD53A):**

20UPGFC0015426  
20UPGFC0015428  
20UPGFC0015430  
20UPGFC0015429

## LIVTHK5

GA1 20UPGFC0015426	GA4 20UPGFC0015429
GA2 20UPGFC0015428	GA3 20UPGFC0015430

**Module:** **20UPGM20025032** (Carl Gwilliam) assembled in Liverpool (Jon Taylor)

**PCB:** 20UPGPQ0025032

**Bare Module:** 20UPGB40100066

**FE chips (RD53A):**

20UPGFC0015400  
20UPGFC0015401  
20UPGFC0015258  
20UPGFC0015402

## LIVTHK8

GA1 20UPGFC0015400	GA4 20UPGFC0015402
GA2 20UPGFC0015401	GA3 20UPGFC0015258

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# SET OF SCAN

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- Set of scans
- 4.6 A in cc mode (V limit 5 V) for all of them

[std\\_digitalscan/](#)  
[lindiff\\_analogscan/](#)  
[syn\\_analogscan/](#)  
[diff\\_thresholdscan/](#)  
[lin\\_thresholdscan/](#)  
[syn\\_thresholdscan/](#)  
[diff\\_totscan/](#)  
[lin\\_totscan/](#)  
[syn\\_totscan/](#)  
[lin\\_discbumpscan/](#)  
[diff\\_discbumpscan/](#)  
[syn\\_discbumpscan/](#)

In some cases

[lin\\_crosstalkscan/](#)  
[diff\\_crosstalkscan/](#)  
[syn\\_crosstalkscan/](#)

## Yarr v 1.3.1 master

commit 123035bda82a1d6aae76cf0c39bd99c2bcd53318

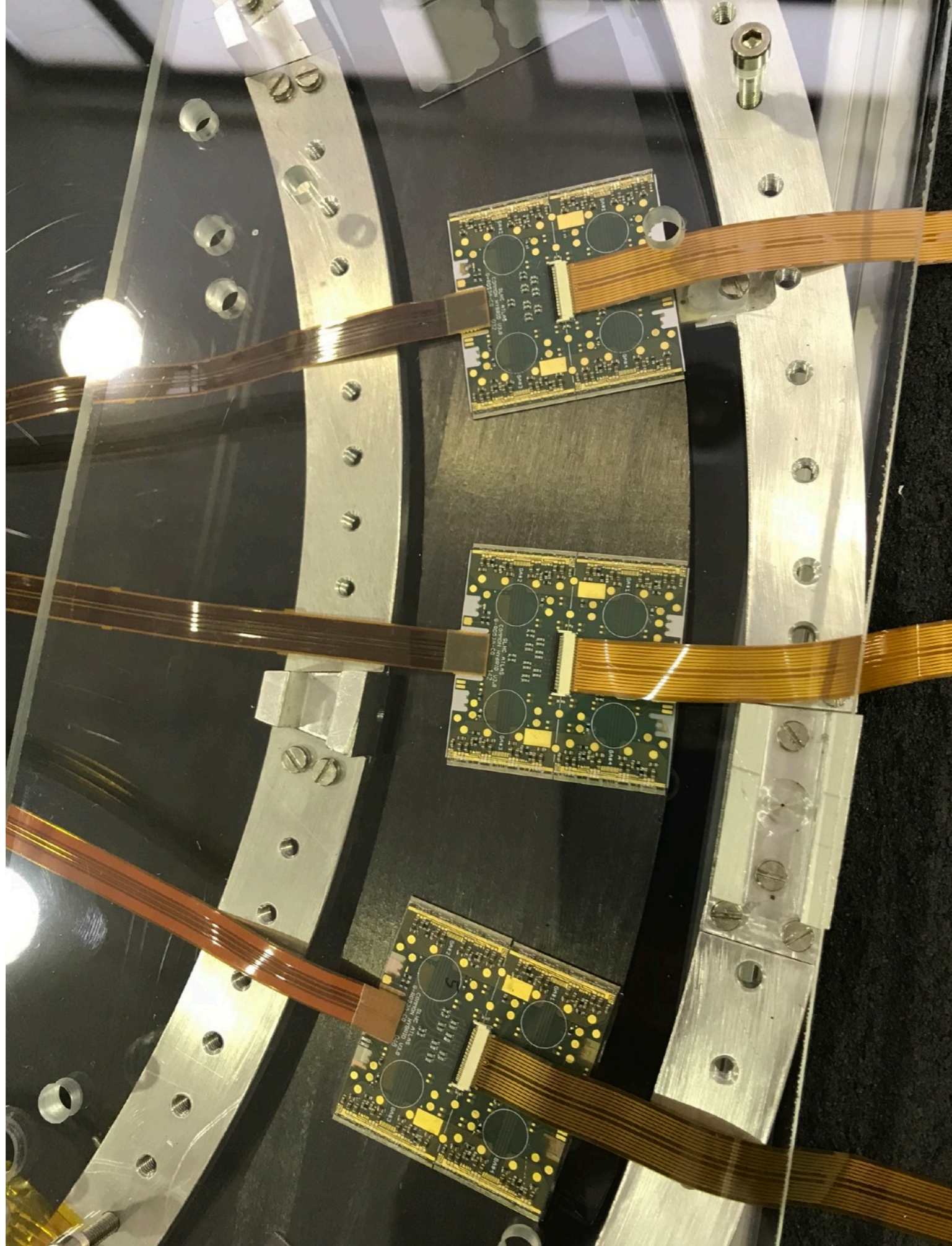
Merge: dcb5420 e46aa70

Author: Timon Heim <timon.heim@cern.ch>

Date: Fri Feb 4 21:45:01 2022 +0100

Merge branch 'rc\_v1.3.1' into 'master'

V1.3.1 Release

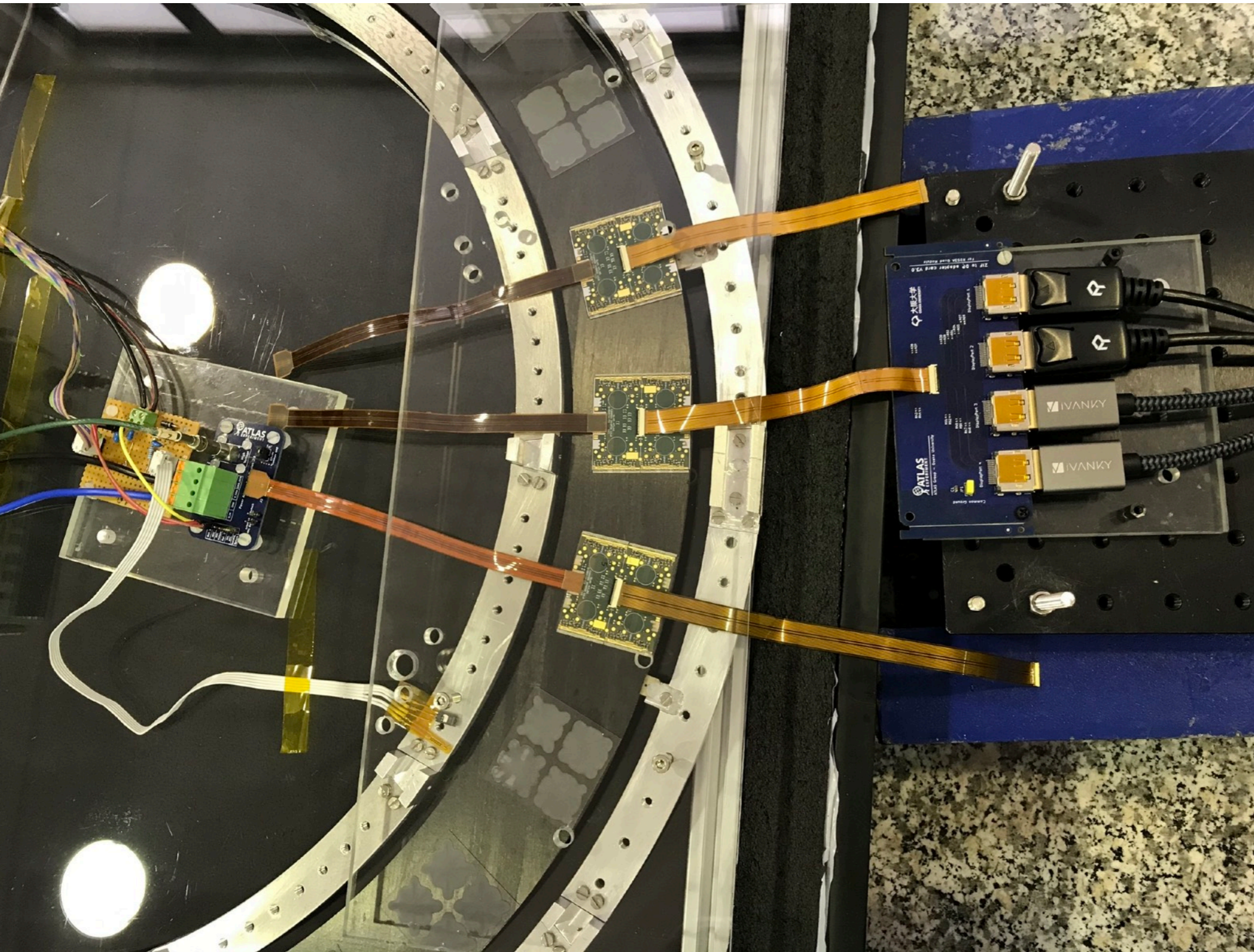


LIVTHK8

LIVTHK5

ANL5

LIVTHK8



LIVTHK5

ANL5

# DIGITAL QUAD MODULE: ANL5

- 4 sets of scans - *pre loading*
- 4.6 A in cc mode (V limit 5 V) for all of them

GA1 20UPGFC0017751	GA4 20UPGFC0017748
GA2 20UPGFC0017750	GA3 20UPGFC0017749

1. fullScan\_20UPGBQ0000027\_20230111\_1202\_UK4DPcard\_4.6A/ 11-Jan-2023 13:14 -
  2. fullScan\_20UPGBQ0000027\_20230112\_1126\_UK4DPcard\_4.6A/ 12-Jan-2023 12:37 -
  3. module\_scan\_20UPGBQ0000027\_20230127\_1016/ 27-Jan-2023 11:02 -
  4. module\_scan\_20UPGBQ0000027\_20230127\_1126/ 27-Jan-2023 11:47 -
- blessed **Japan 4DPcard**

[std\\_digitalscan/](#)  
[lindiff\\_analogscan/](#)  
[syn\\_analogscan/](#)  
[diff\\_thresholdscan/](#)  
[lin\\_thresholdscan/](#)  
[syn\\_thresholdscan/](#)  
[diff\\_totscan/](#)  
[lin\\_totscan/](#)  
[syn\\_totscan/](#)  
[lin\\_discbumpscan/](#)  
[diff\\_discbumpscan/](#)  
[syn\\_discbumpscan/](#)

2 vs 1: diff\_20UPGBQ0000027\_20230112-1126\_vs\_1202-UK4DPcard.html  
1 vs 3: diff\_20UPGBQ0000027-20230111UK4DPcard\_vs\_20230127\_1016Japan.html  
3 vs 4: diff\_20UPGBQ0000027\_20230127-1016\_vs\_1126-Japan4DPcard.html

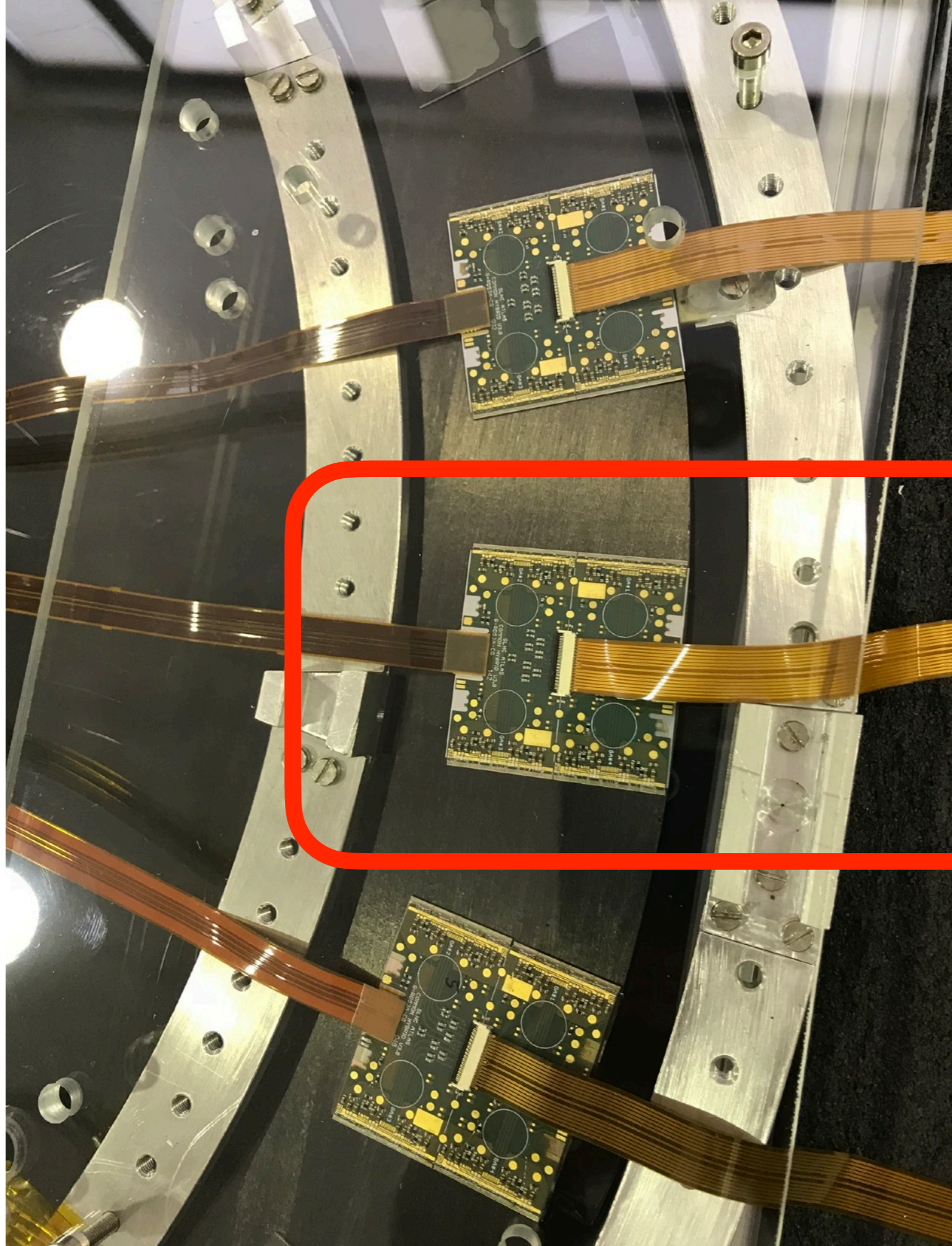
# DIGITAL QUAD MODULE: ANL5

- 4 sets of scans - **POST loading**
- 4.6 A in cc mode (V limit 5 V) for all of them

GA1 20UPGFC0017751	GA4 20UPGFC0017748
GA2 20UPGFC0017750	GA3 20UPGFC0017749

1. std\_digital -> 8979
2. lindiff\_analog -> 8980 **syn\_analog -> 8981(L1Dist at 0 ) and 8982**
3. lin\_threshold -> 8983 e 8984 thresholds seem to be wrong ... low n.. of pixels responding
4. Resetting FE config with starting config from lin\_threshold scan of fullScan\_20UPGBQ0000027\_20230111\_1202\_UK4DPcard\_4.6A
5. Std\_digital 8987
6. Lindiff\_analog 8988
7. syn\_analog 8989 **(L1Dist at 0 )**
8. lin\_threshold 8990
9. diff\_thresholdscan 8993
10. syn\_thresholdscan 8995
11. tot\_scan 8996, 8997, 8998
12. discbump\_scan 8999, 9000, **9001**

comparison after before



LIVTHK8

LIVTHK5

ANL5



# QUAD MODULE: LIVTHK5

- 5 sets of scans - *pre loading*
- 4.6 A in cc mode (V limit 5 V) for all of them

GA1 20UPGFC0015426	GA4 20UPGFC0015429
GA2 20UPGFC0015428	GA3 20UPGFC0015430

1. module\_scan\_20UPGM20025142\_20230130\_1154/ 30-Jan - Liverpool trimming HV off; FE2 off
2. module\_scan\_20UPGM20025142\_20230130\_1249/ 30-Jan - Liverpool trimming HV=-100 V; FE2 off
3. module\_scan\_20UPGM20025142\_20230130\_1634/ 31-Jan - Wafer prob. trimm. HV=-100 V; FE2 off
4. module\_scan\_20UPGM20025142\_20230201\_1020/ 01-Feb - Wafer prob. trimm. HV=-100 V; 4 FE enabled
5. module\_scan\_20UPGM20025142\_20230201\_1121/ 07-Feb - Liverpool trimming HV=-100 V; 4 FE enabled

## *5. misses syn\_analog\_scan*

[std\\_digitalscan/](#)  
[lindiff\\_analogscan/](#)  
[syn\\_analogscan/](#)  
[diff\\_thresholdscan/](#)  
[lin\\_thresholdscan/](#)  
[syn\\_thresholdscan/](#)  
[diff\\_totscan/](#)  
[lin\\_totscan/](#)  
[syn\\_totscan/](#)  
[lin\\_discbumpscan/](#)  
[diff\\_discbumpscan/](#)  
[syn\\_discbumpscan/](#)

- 1 vs 2: diff\_20UPGM20025142\_20230130-LivHVoff\_vs\_LivHVm100\_3FE.html
- 2 vs 3: diff\_20UPGM20025142\_20230130-LivHVm100\_vs\_WPDHVm100\_3FE.html
- 4 vs 3: diff\_20UPGM20025142\_20230130-WPDHVm100\_4FE\_vs\_3FE.html
- 4 vs 5: diff\_20UPGM20025142\_20230201\_WPDHVm100\_vs\_LivHVm100\_4FE.html

# QUAD MODULE: LIVTHK5

GA1 20UPGFC0015426	GA4 20UPGFC0015429
GA2 20UPGFC0015428	GA3 20UPGFC0015430

- after loading**

-100 V, 33 nA @ 10% humidity

(runaway current at the PS when FE powered, reaching stable max with T on the sensor)

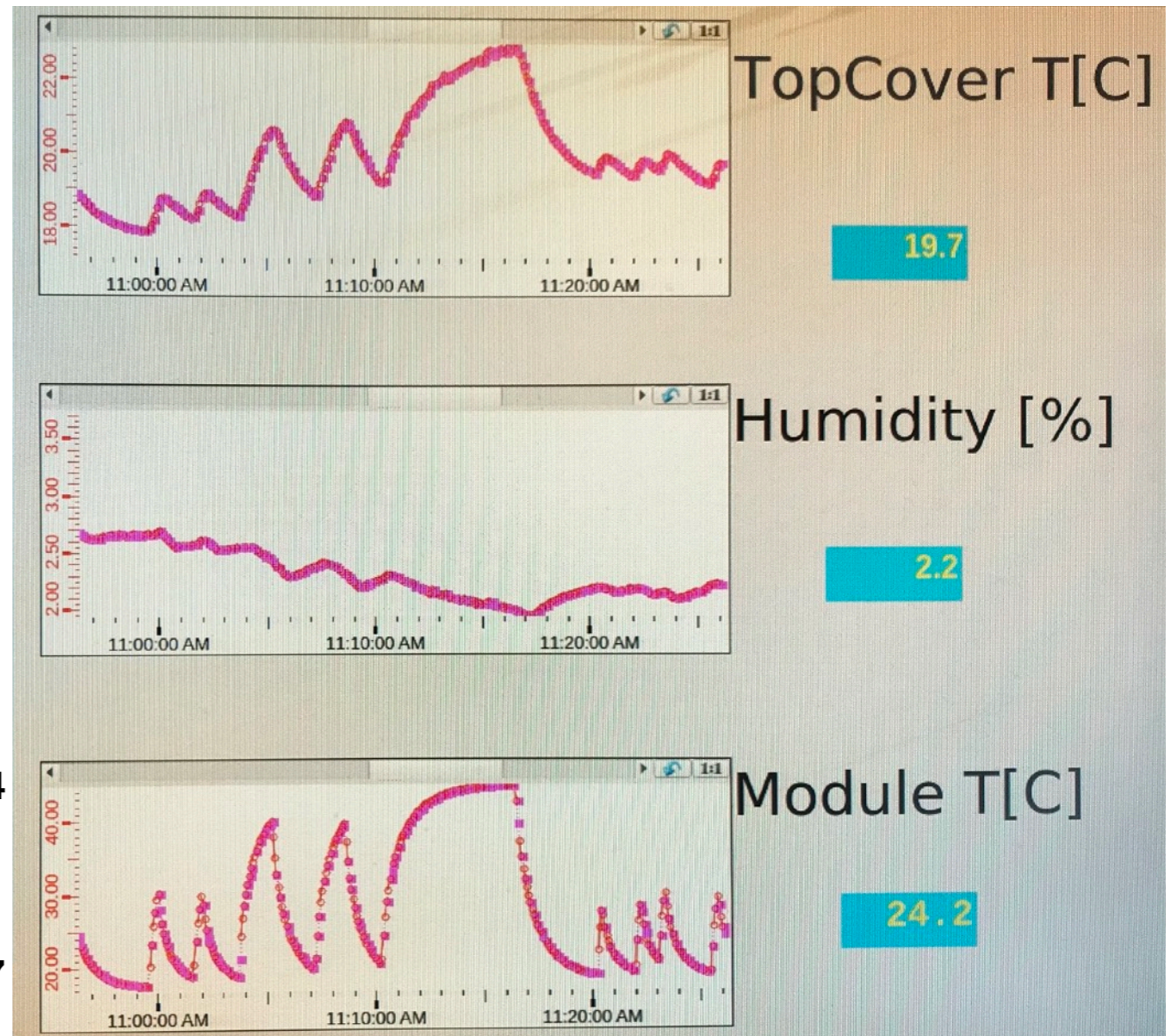
*No active cooling*

LV on only during each scan, off in between scans

- 4.6 A in cc mode (V limit 5 V) for all of them
  - Monitored LV ~ 1.95 V

- FE Configuration as in WPD**

- Feb 15 12:17 009003\_std\_digitalscan
- Feb 15 12:18 009004\_lindiff\_analogscan
- Feb 15 12:19 009005\_syn\_analogscan
- Feb 15 12:22 009006\_lin\_thresholdscan
- Feb 15 12:26 009007\_diff\_thresholdscan
- Feb 15 12:35 009008\_syn\_thresholdscan
- Feb 15 12:36 009009\_diff\_totscan
- Feb 15 12:37 009010\_lin\_totscan
- Feb 15 12:39 009011\_syn\_totscan
- Feb 15 12:41 009012\_lin\_discbumpscan
- Feb 15 12:42 009013\_diff\_discbumpscan
- Feb 15 12:43 009014\_syn\_discbumpscan



009003  
009004  
009005  
009006  
009007  
009008  
009009  
009010  
009011  
009012-3-4

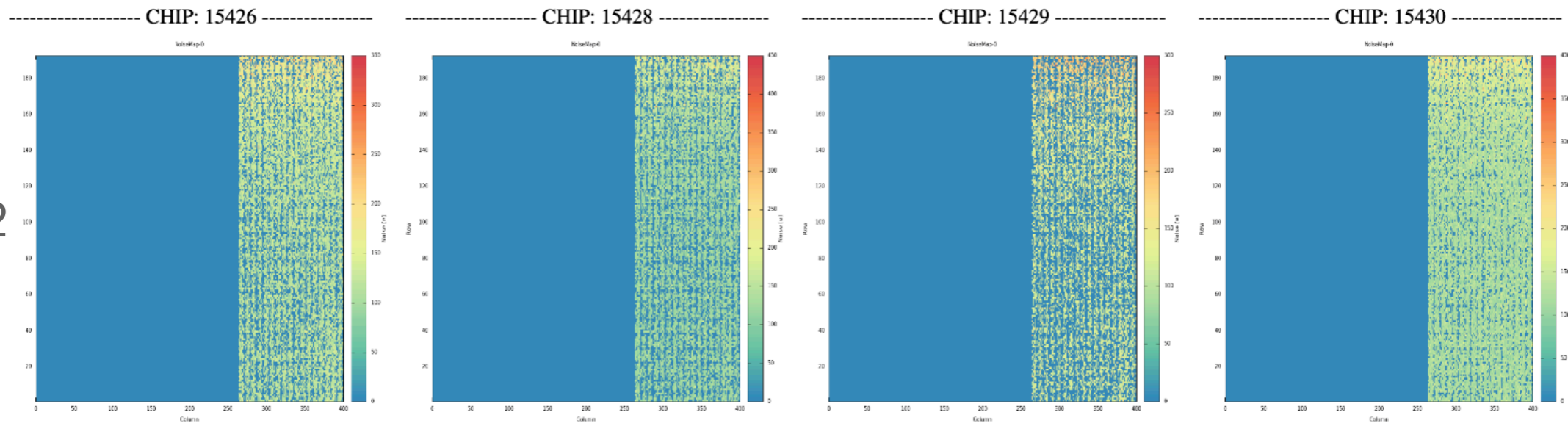
# LIVTHK5 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

- [http://www.le.infn.it/itk/forWEB/LLSfdr/diff\\_20UPGM20025142\\_20230215\\_1217\\_WPDHVm100\\_afterLoading\\_20230201\\_1020.html](http://www.le.infn.it/itk/forWEB/LLSfdr/diff_20UPGM20025142_20230215_1217_WPDHVm100_afterLoading_20230201_1020.html)

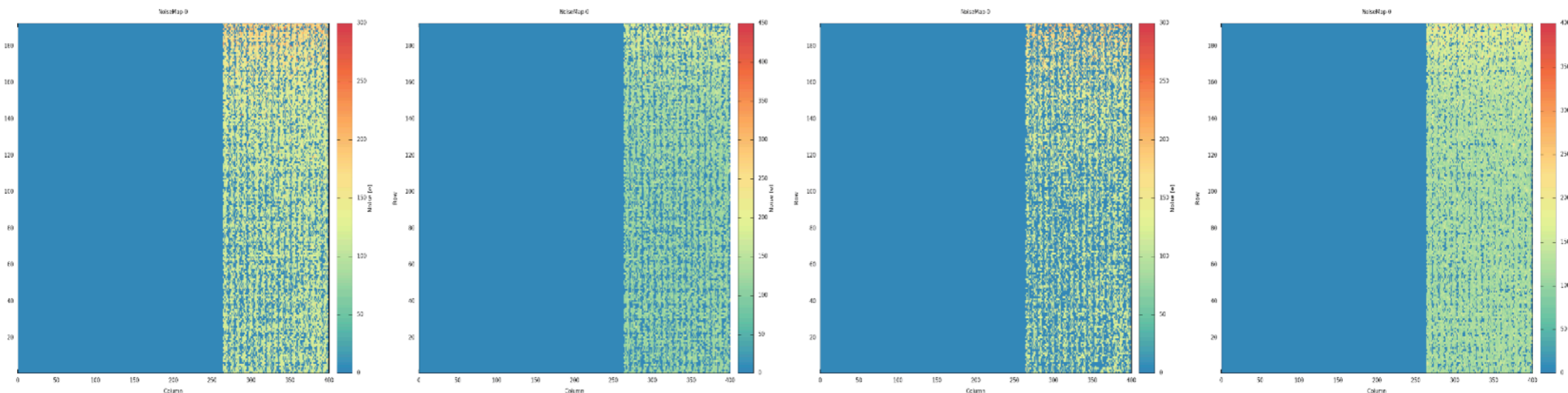
GA1 20UPGFC0015426	GA4 20UPGFC0015429
GA2 20UPGFC0015428	GA3 20UPGFC0015430

NoiseMap diff\_thresholdscan

Stage 2



Stage 1



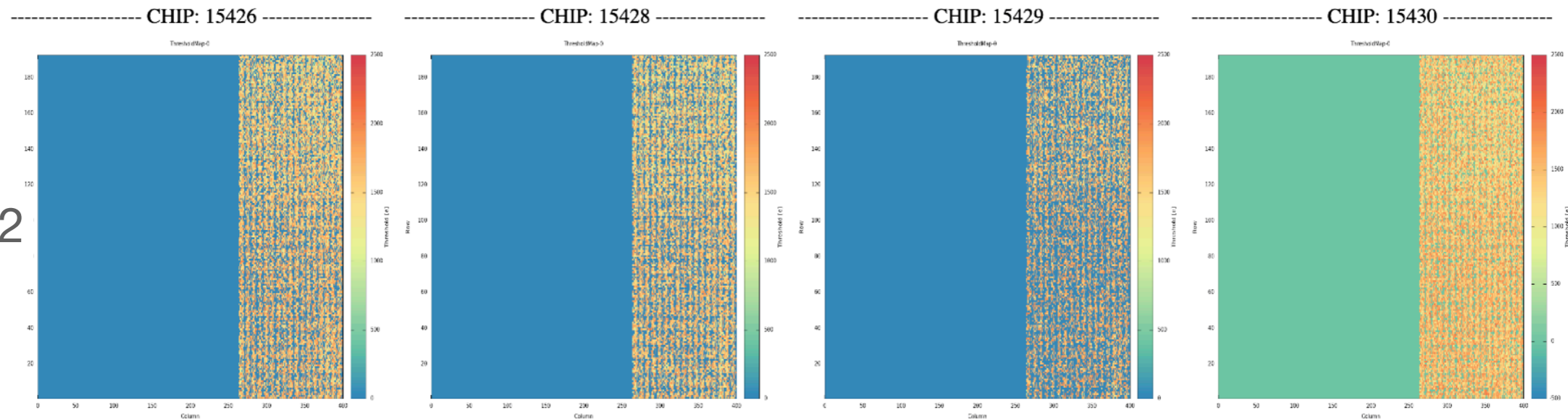
# LIVTHK5 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

- [http://www.le.infn.it/itk/forWEB/LLSfdr/diff\\_20UPGM20025142\\_20230215\\_1217\\_WPDHVm100\\_afterLoading\\_20230201\\_1020.html](http://www.le.infn.it/itk/forWEB/LLSfdr/diff_20UPGM20025142_20230215_1217_WPDHVm100_afterLoading_20230201_1020.html)

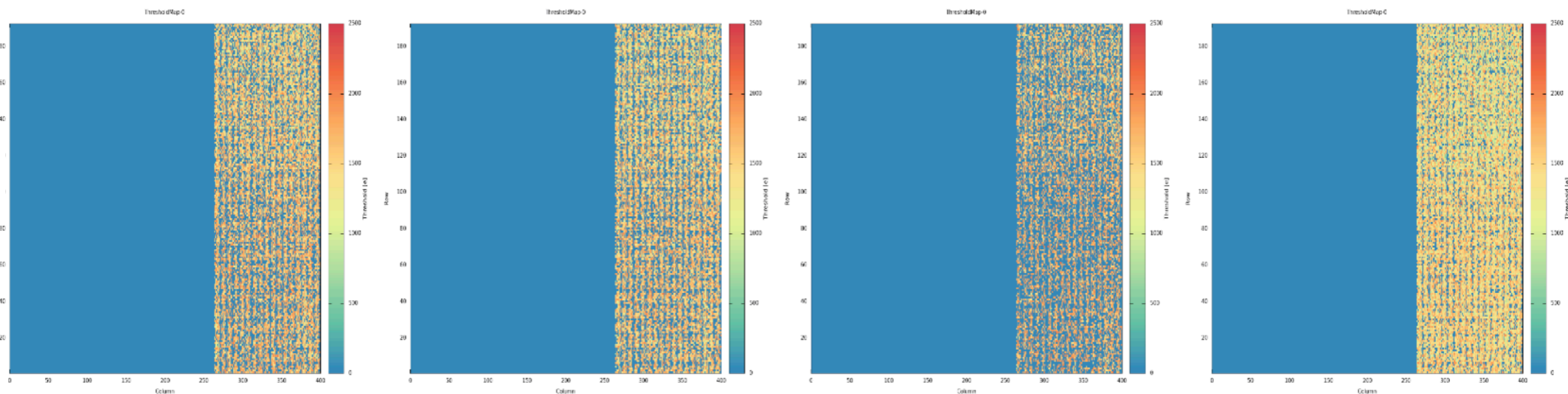
GA1 20UPGFC0015426	GA4 20UPGFC0015429
GA2 20UPGFC0015428	GA3 20UPGFC0015430

ThresholdMap diff\_thresholdscan

Stage 2



Stage 1



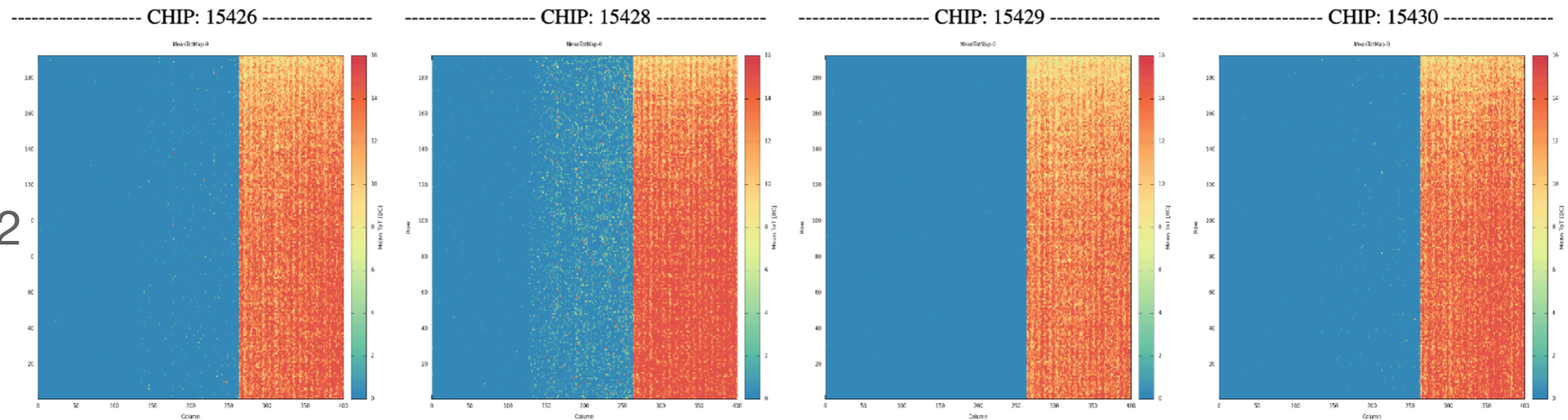
# LIVTHK5 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

- [http://www.le.infn.it/itk/forWEB/LLSfdr/diff\\_20UPGM20025142\\_20230215\\_1217\\_WPDHVm100\\_afterLoading\\_20230201\\_1020.html](http://www.le.infn.it/itk/forWEB/LLSfdr/diff_20UPGM20025142_20230215_1217_WPDHVm100_afterLoading_20230201_1020.html)

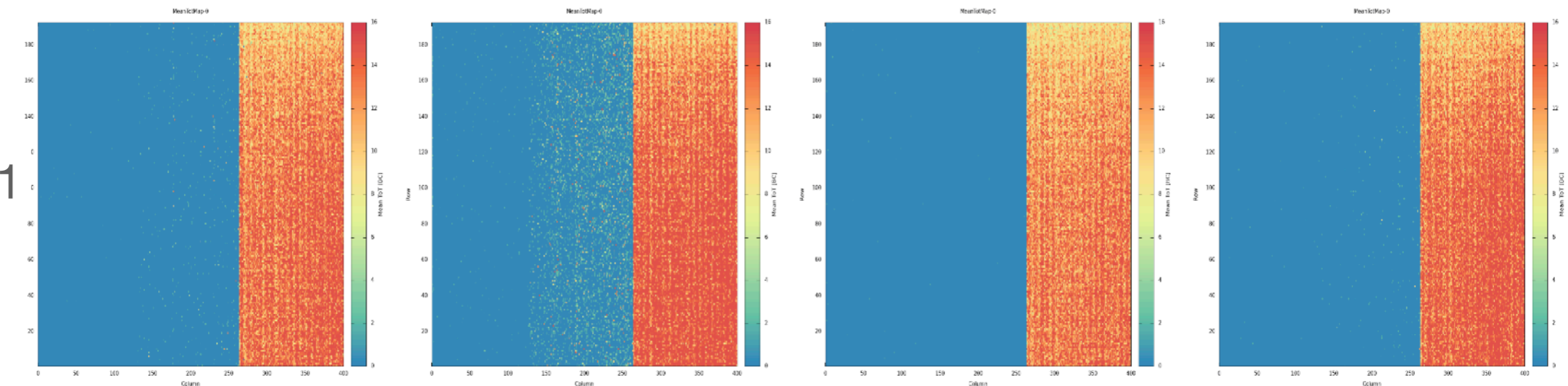
GA1 20UPGFC0015426	GA4 20UPGFC0015429
GA2 20UPGFC0015428	GA3 20UPGFC0015430

MeanTotMap    diff\_totscan

Stage 2



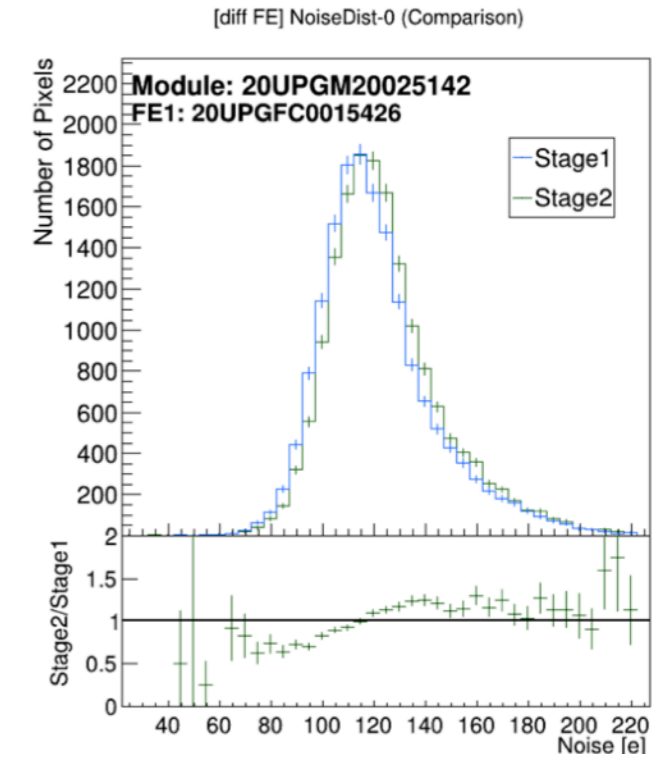
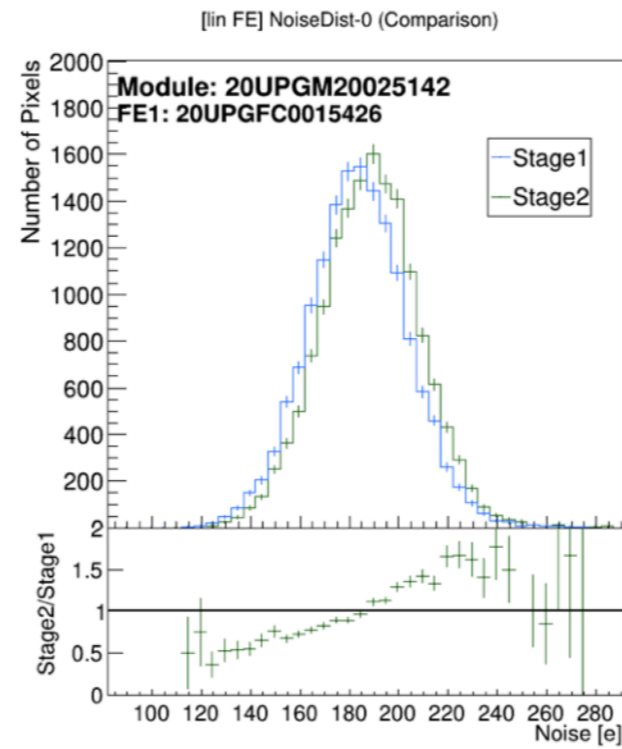
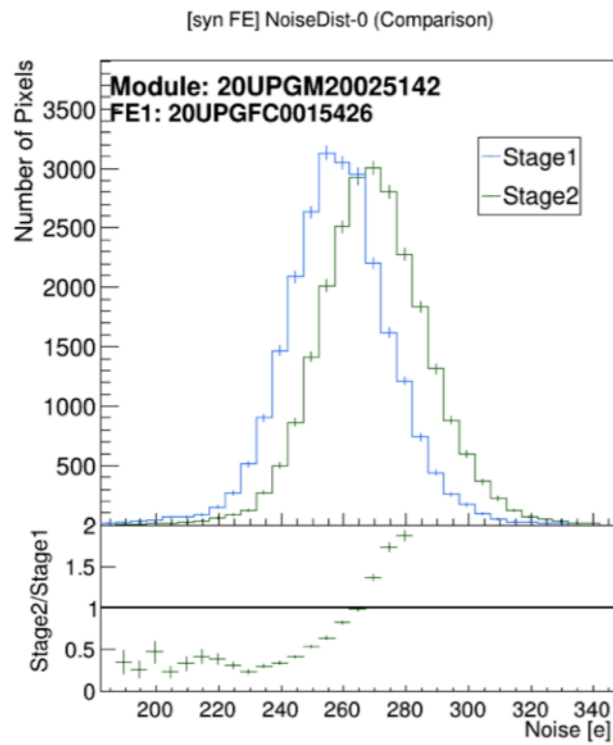
Stage 1



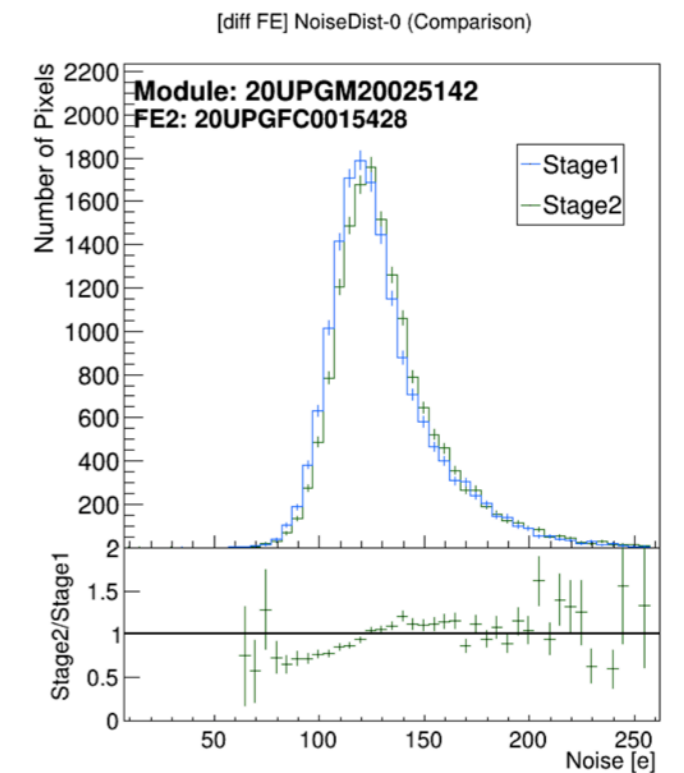
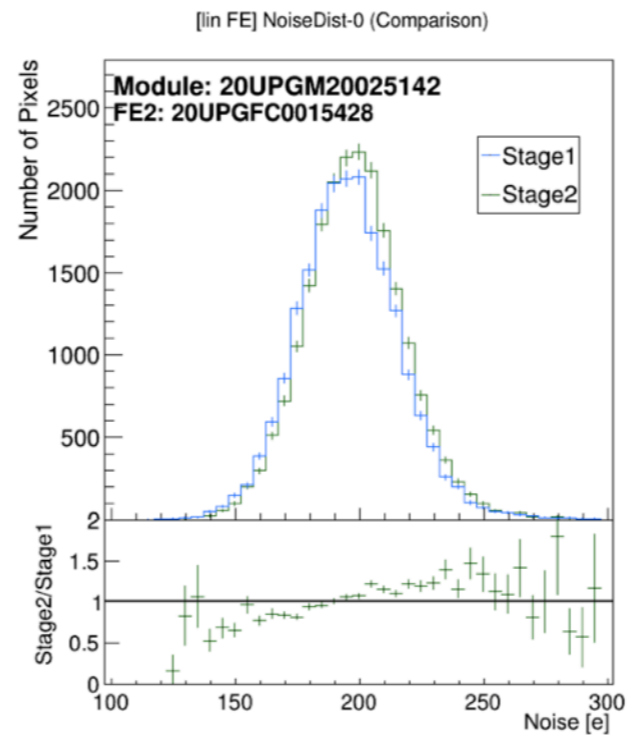
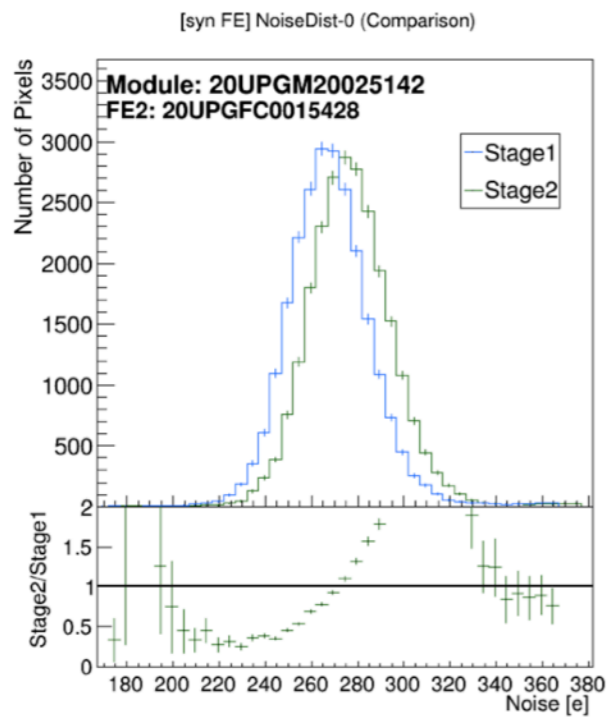
# LIVTHK5 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

## NOISE

### GA1



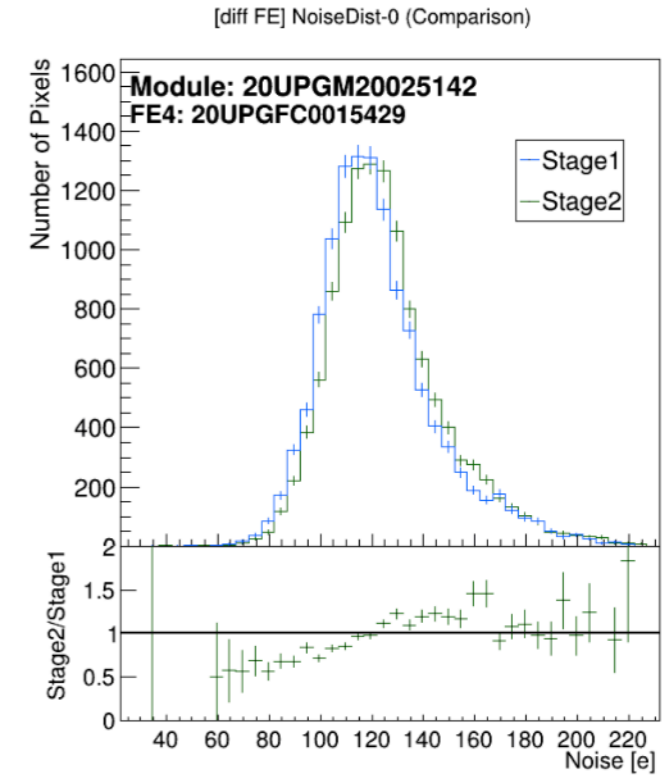
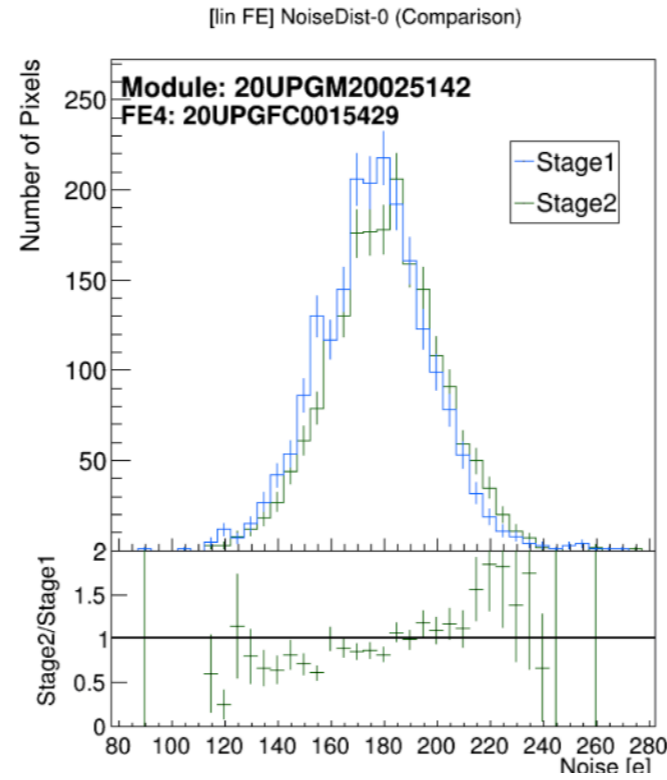
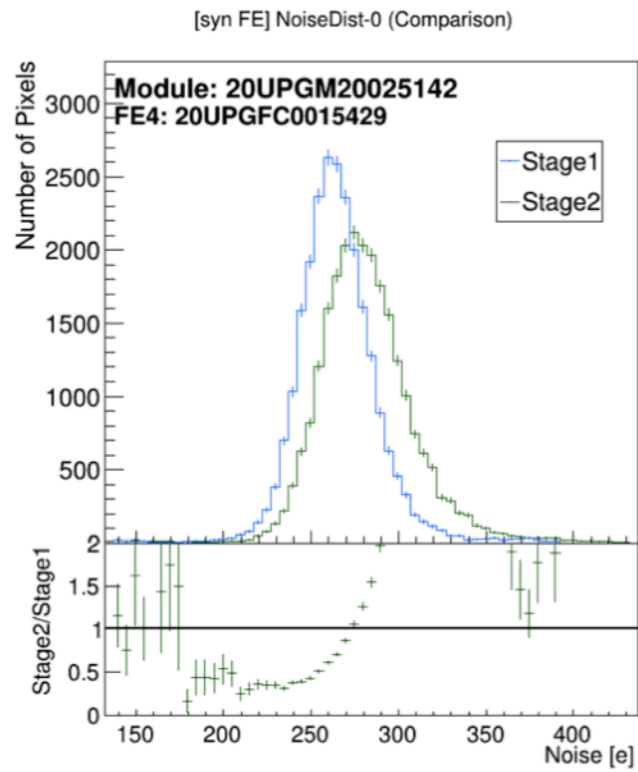
### GA2



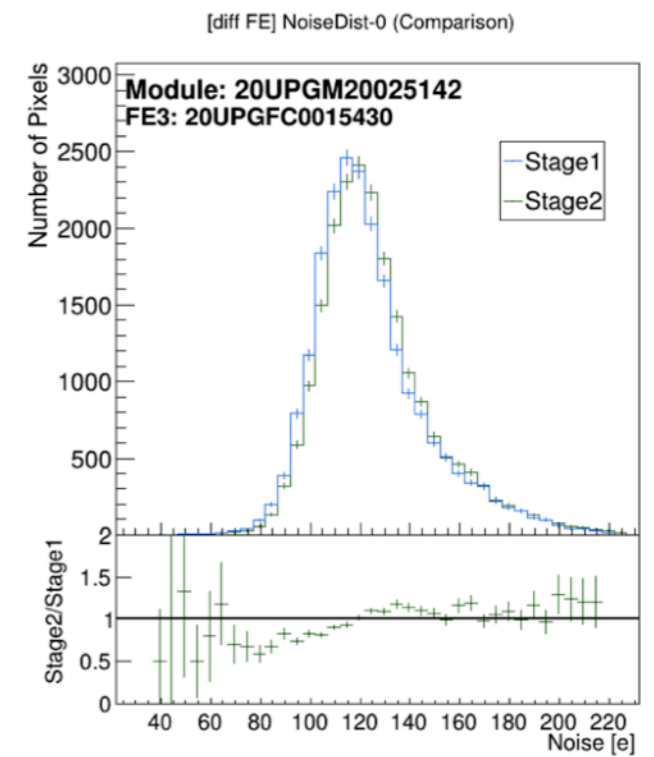
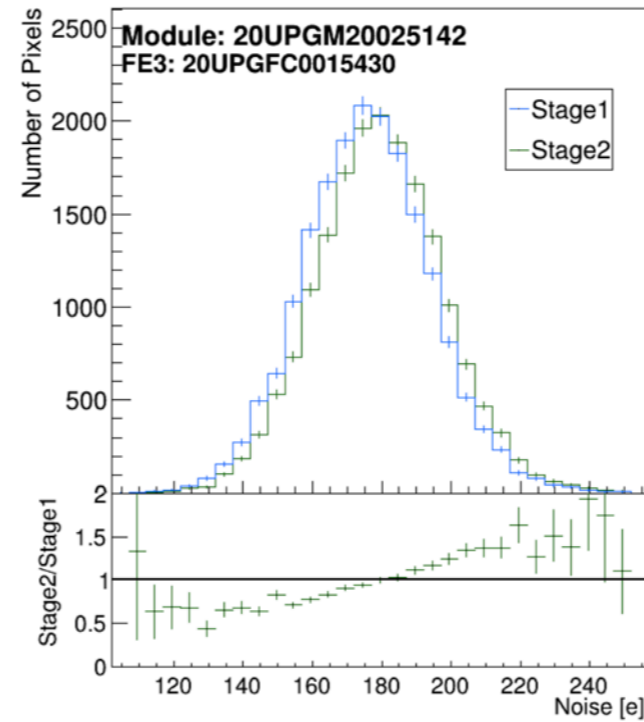
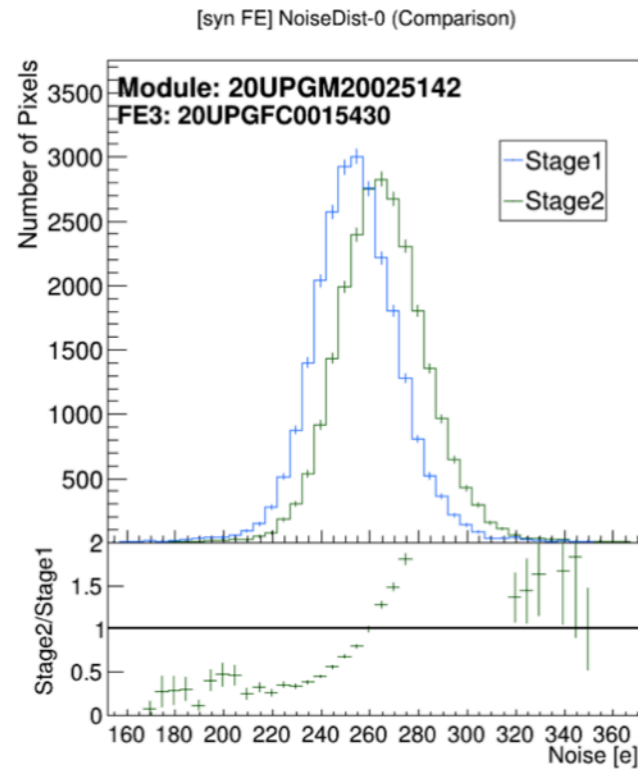
# LIVTHK5 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

## NOISE

■ GA4

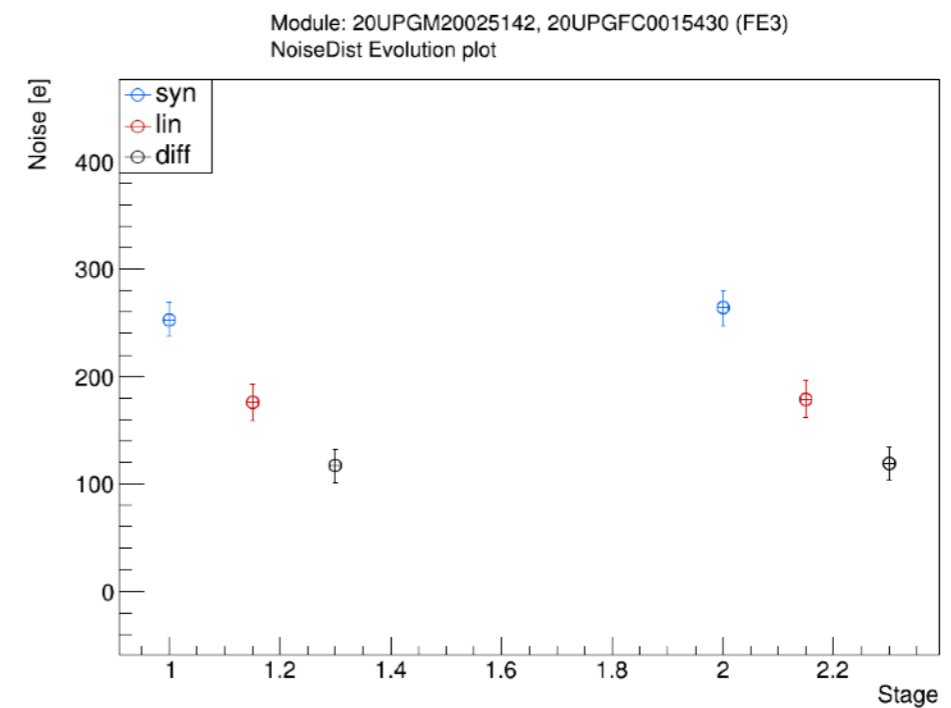
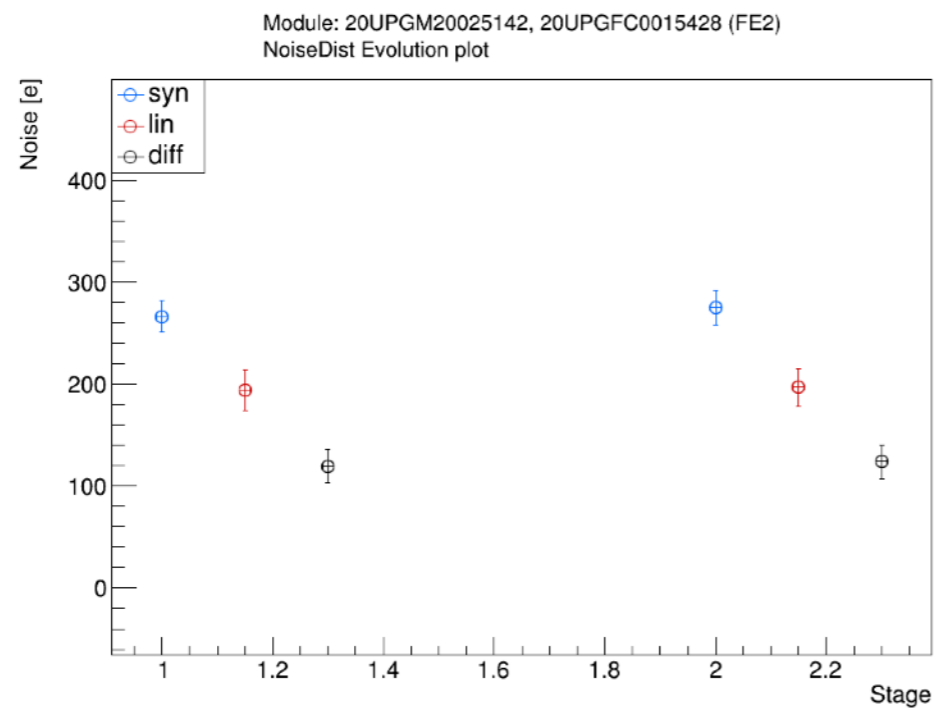
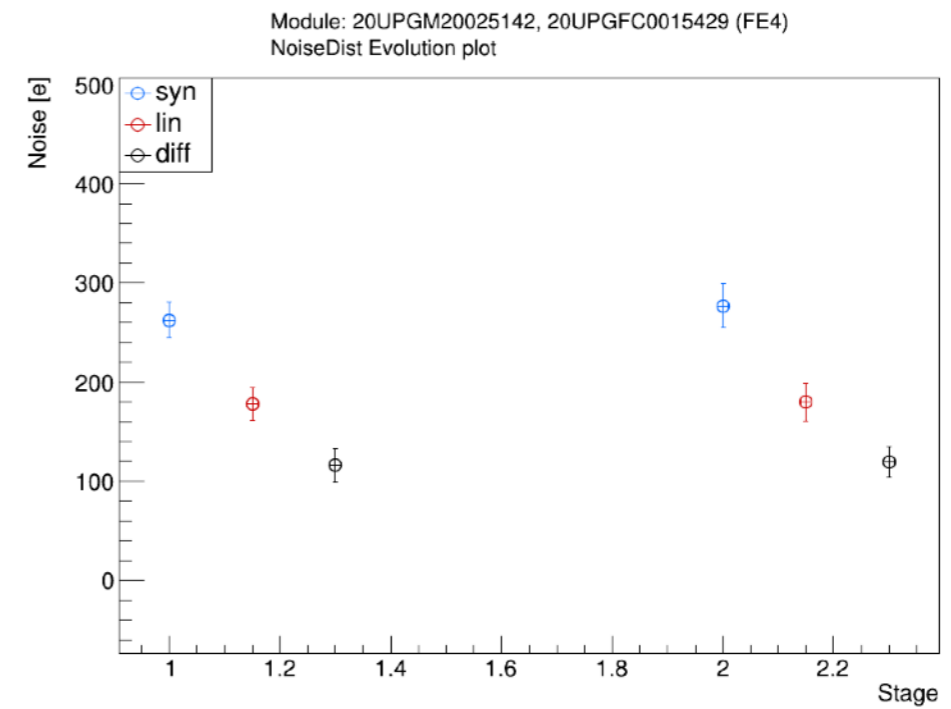
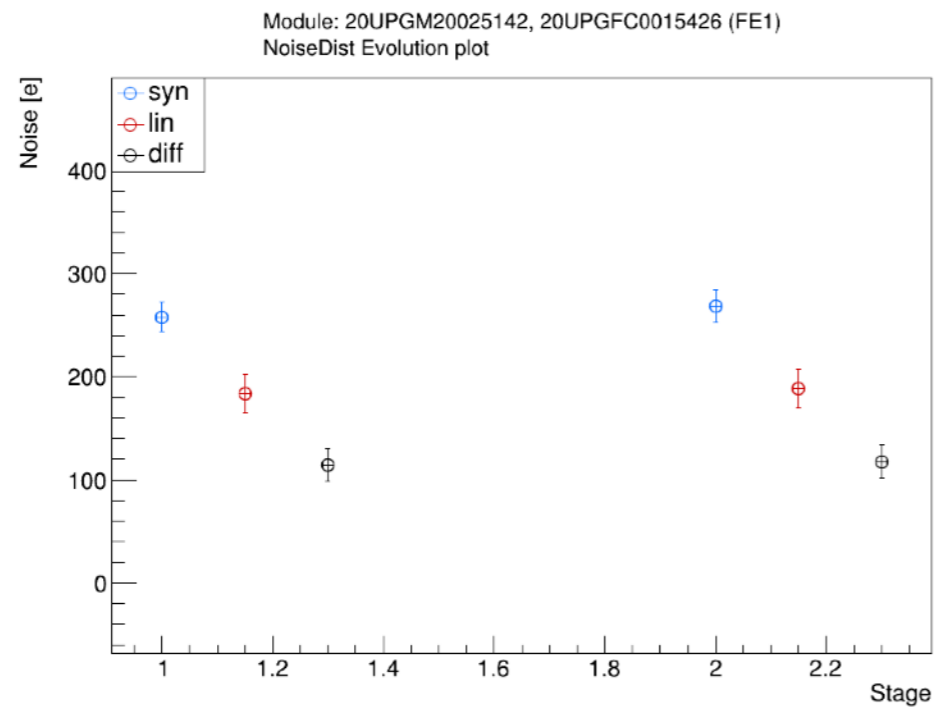


■ GA3



# LIVTHK5 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

## NOISE

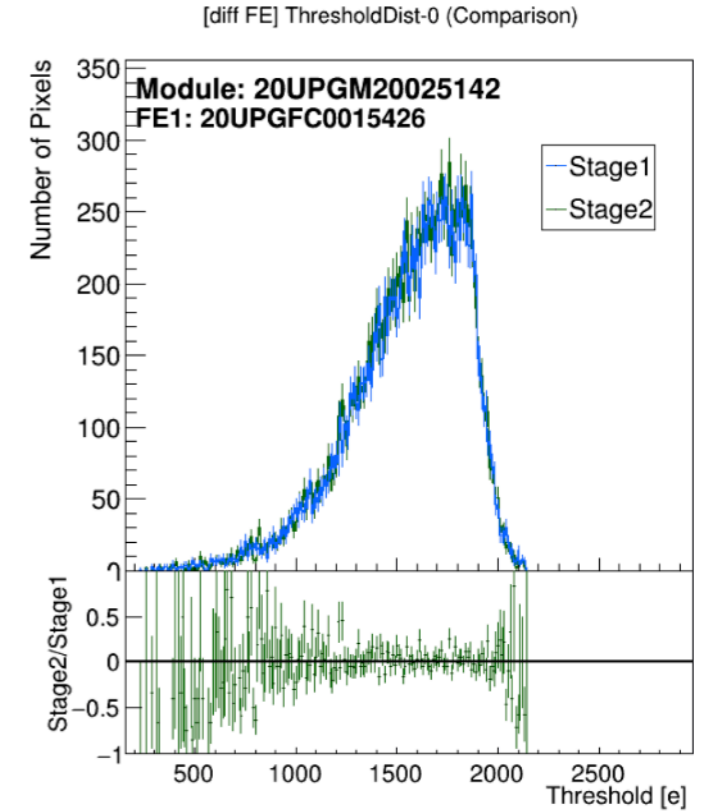
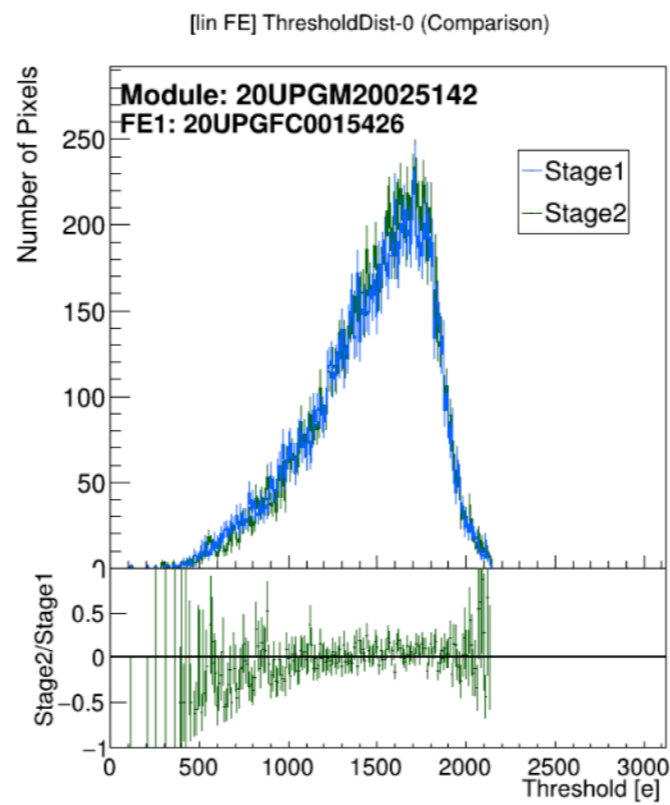
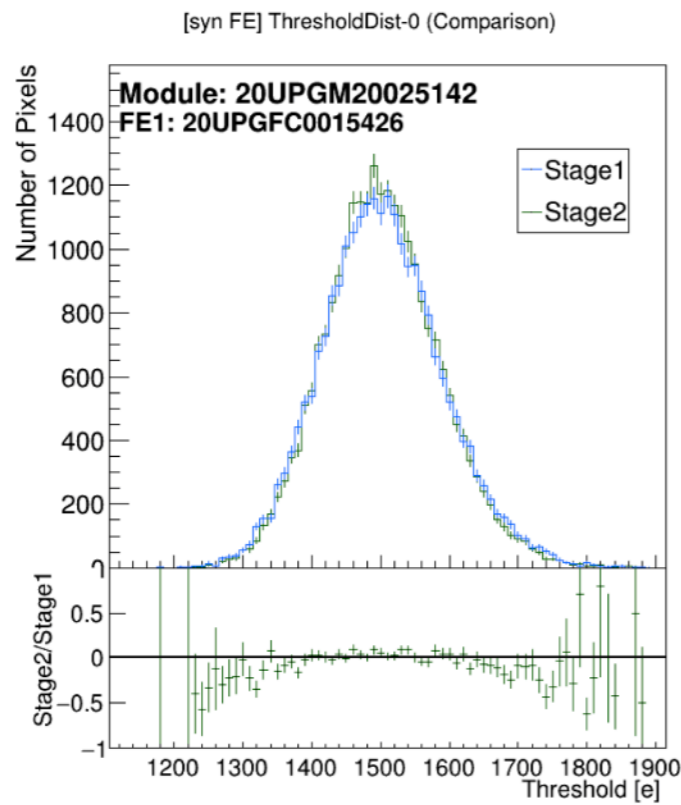




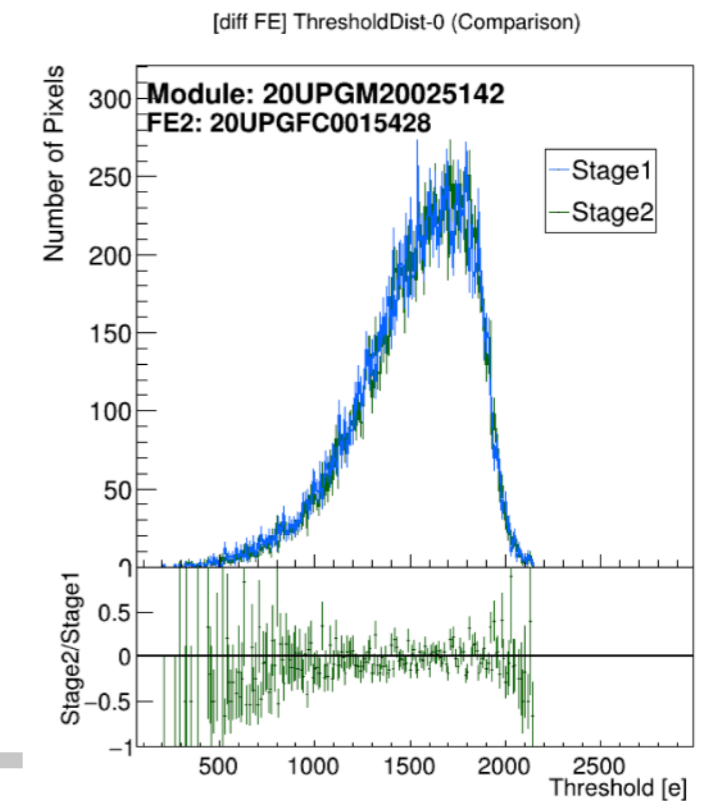
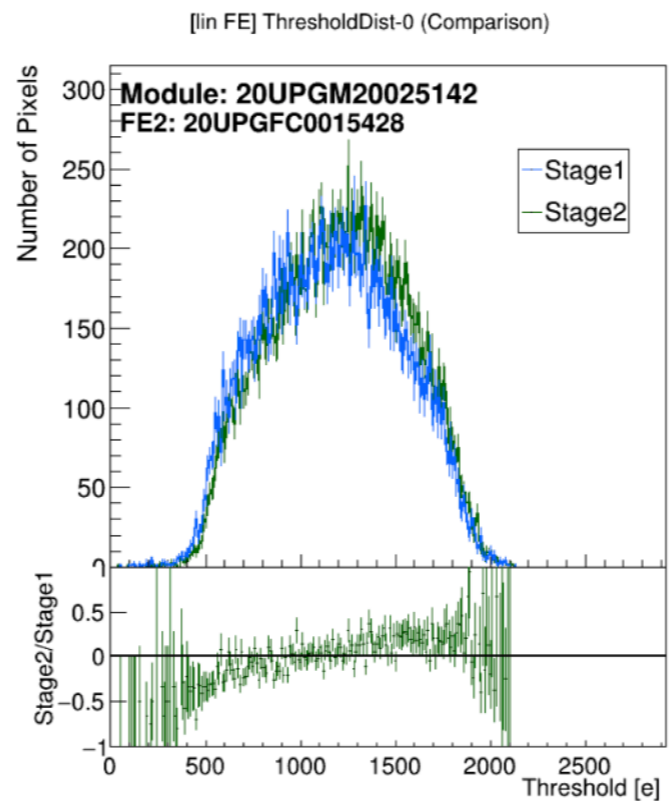
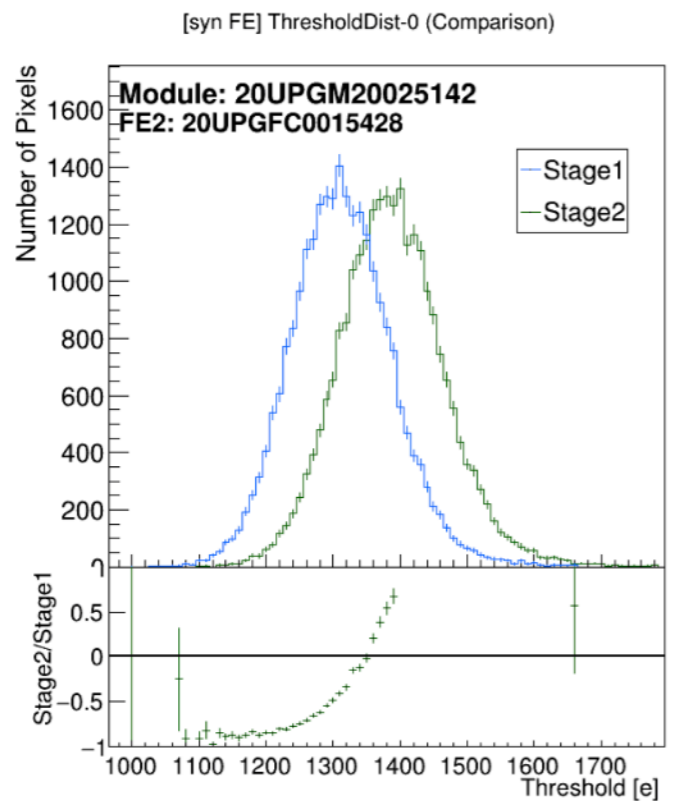
# LIVTHK5 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

## THRESHOLD

GA1



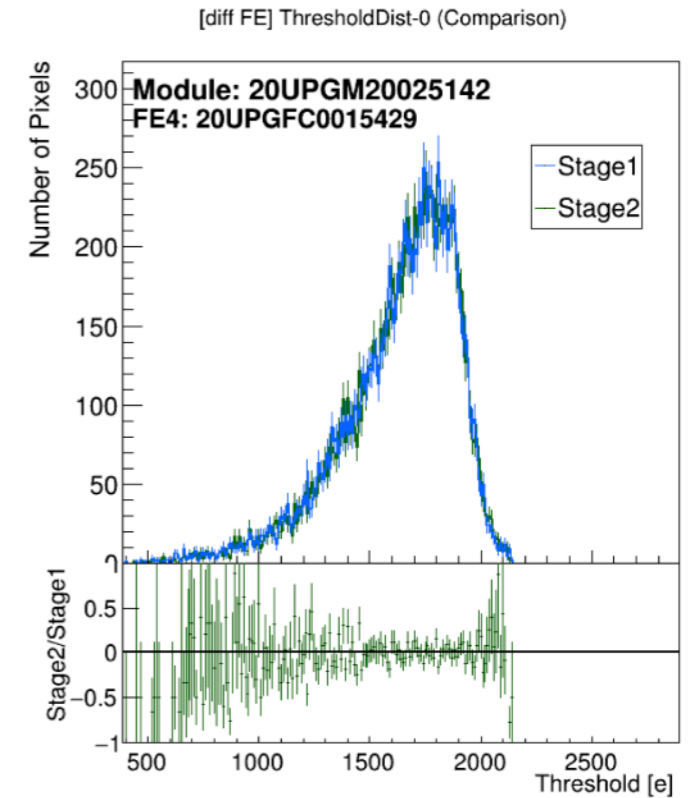
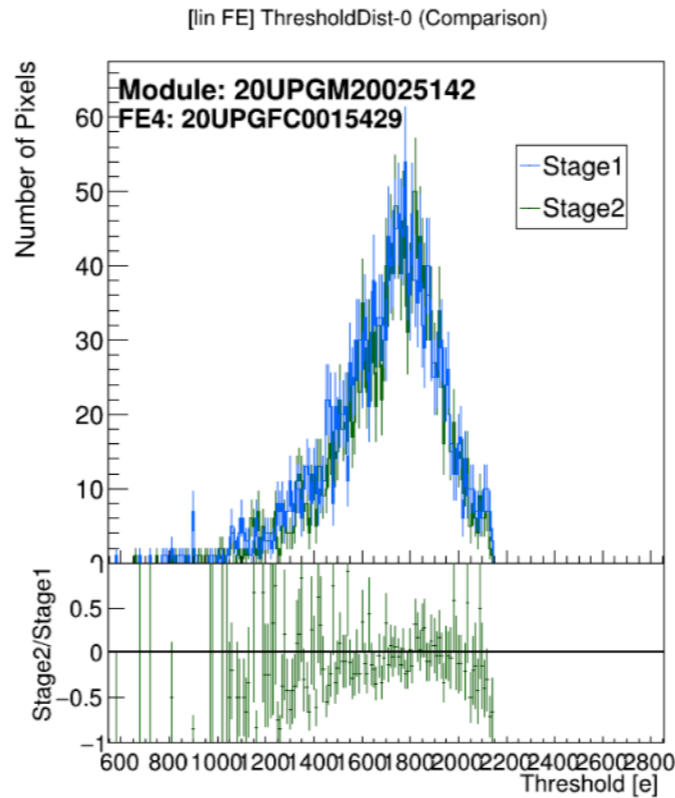
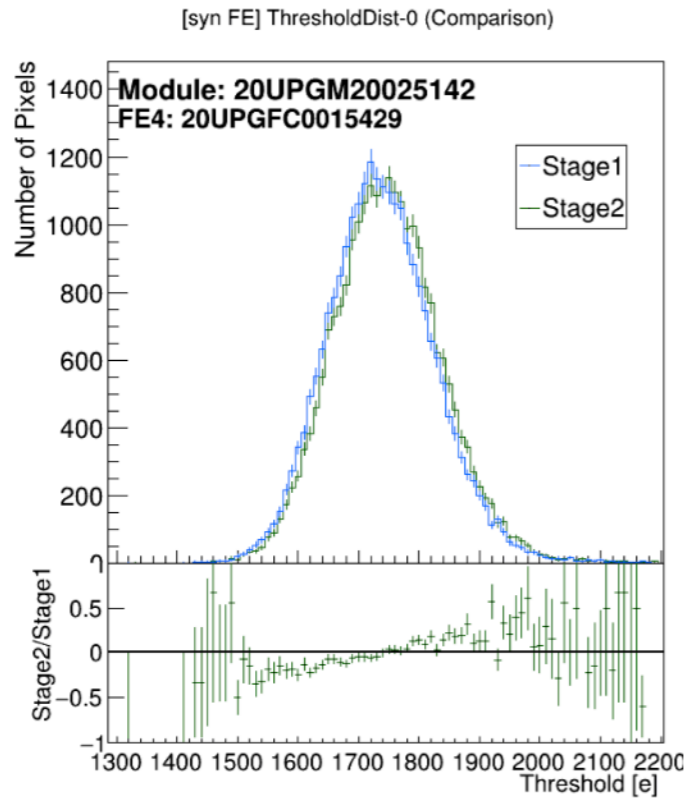
GA2



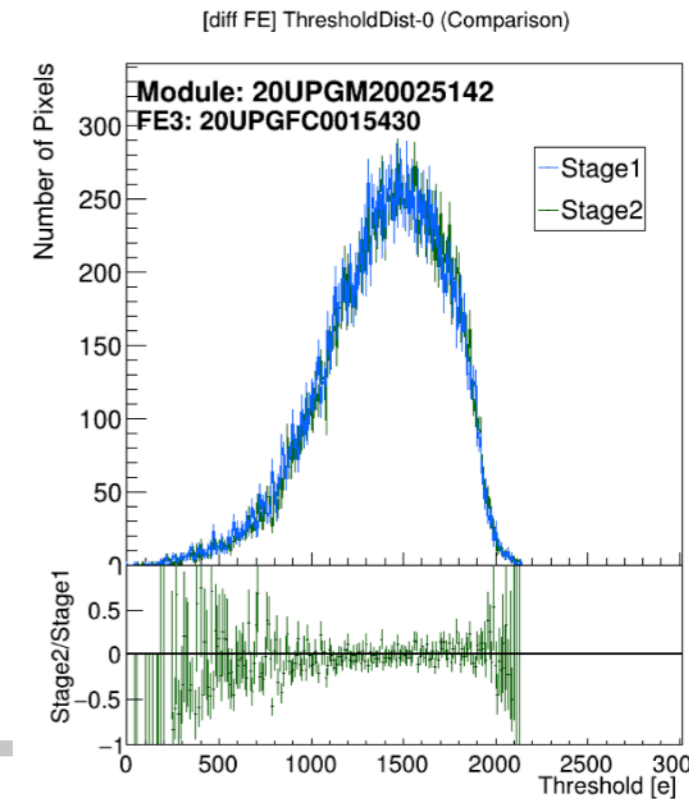
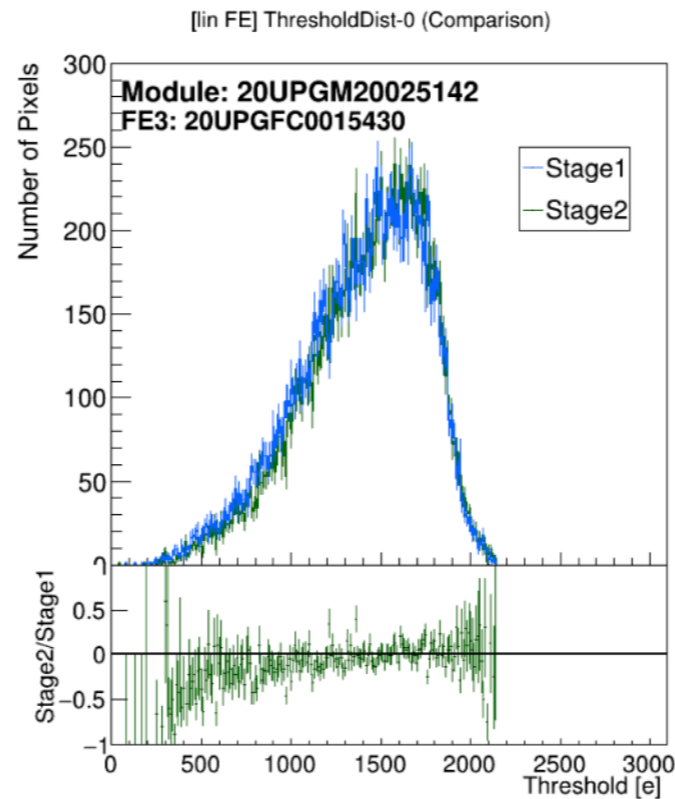
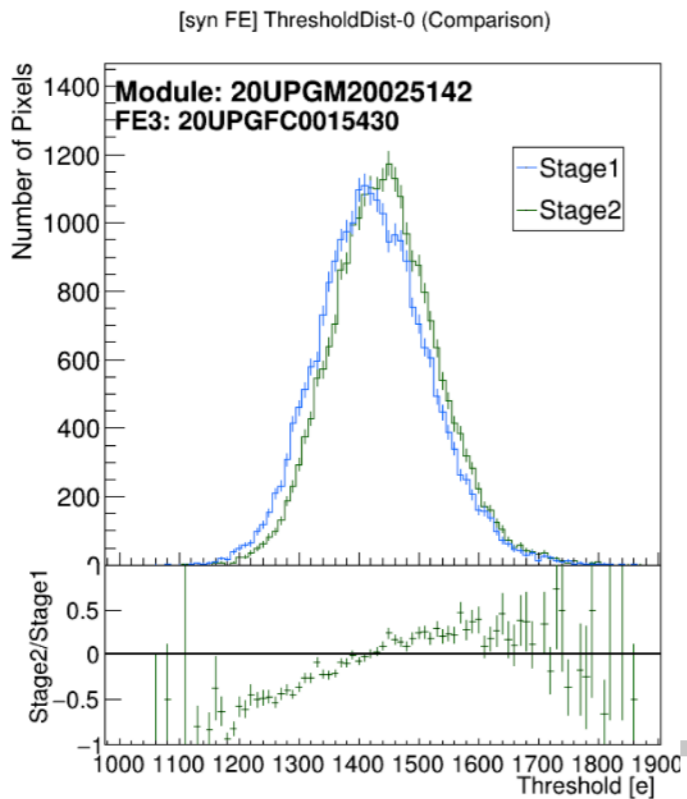
# LIVTHK5 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

## THRESHOLD

GA4

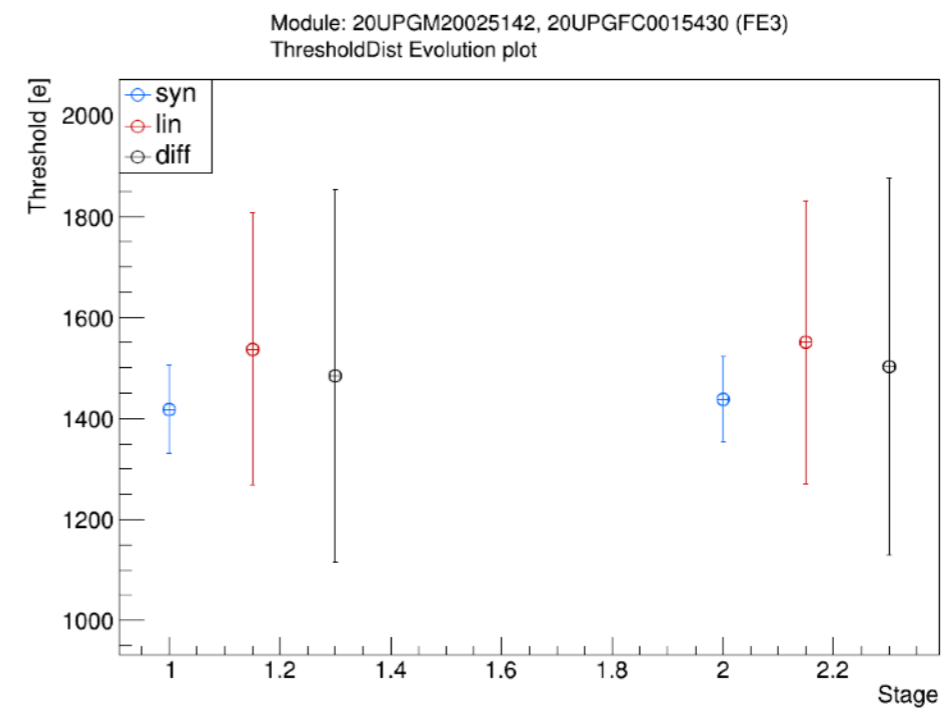
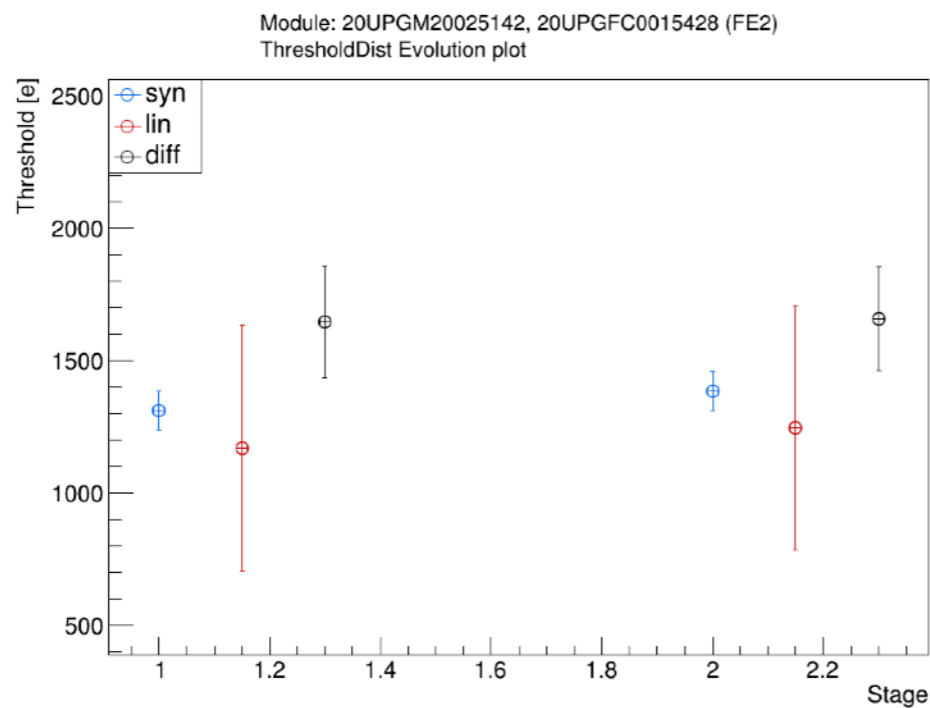
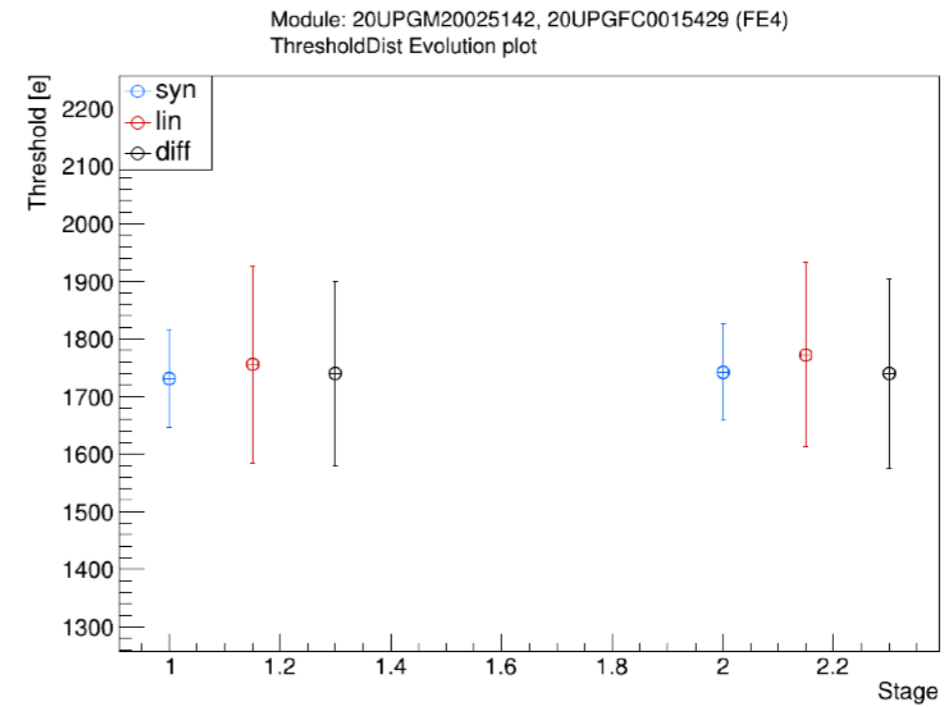
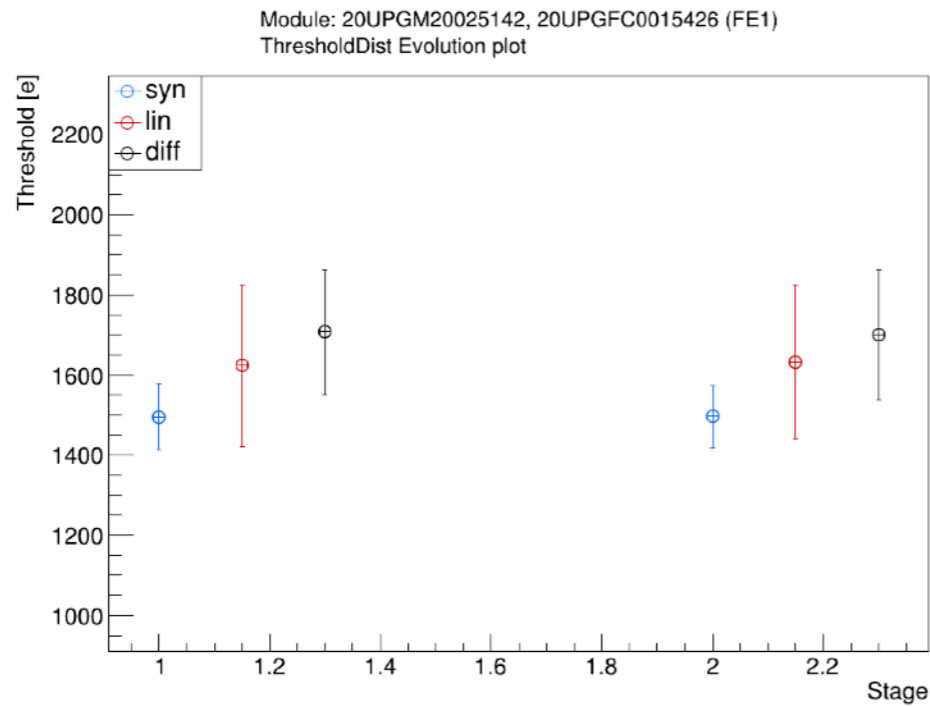


GA3



# LIVTHK5 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

## THRESHOLD



# LIVTHK5 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

- [http://www.le.infn.it/itk/forWEB/LLSfdr/GenConfig\\_LivThkX\\_BA2D/20UPGM20025142overview\\_DiscBump.pdf](http://www.le.infn.it/itk/forWEB/LLSfdr/GenConfig_LivThkX_BA2D/20UPGM20025142overview_DiscBump.pdf)

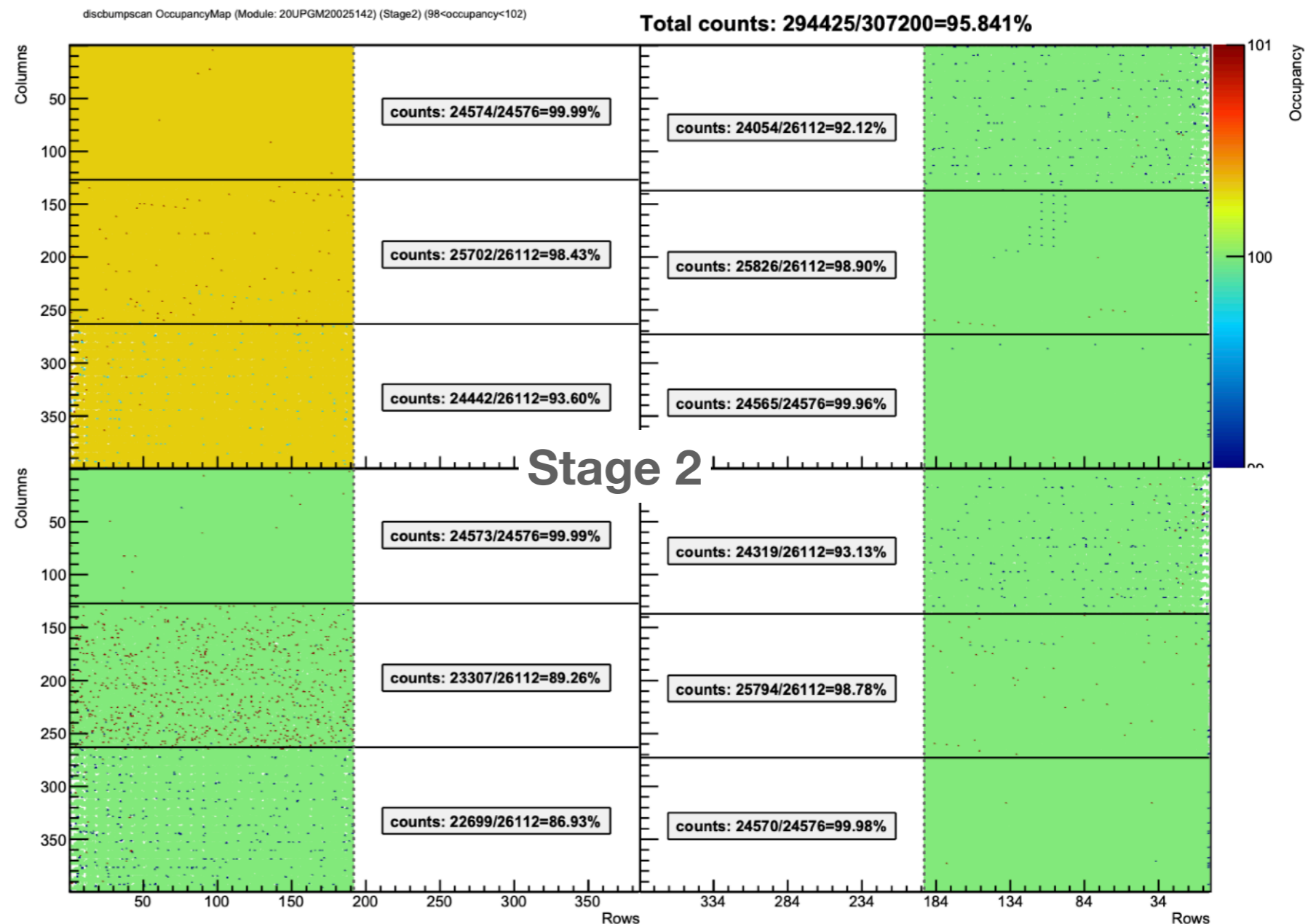
- discbumpscan  
OccupancyMap  
Module:  
**20UPGM20025142**  
(98 < occupancy < 102):

- **Stage2:**

- 294425/307200

- **Stage1:**

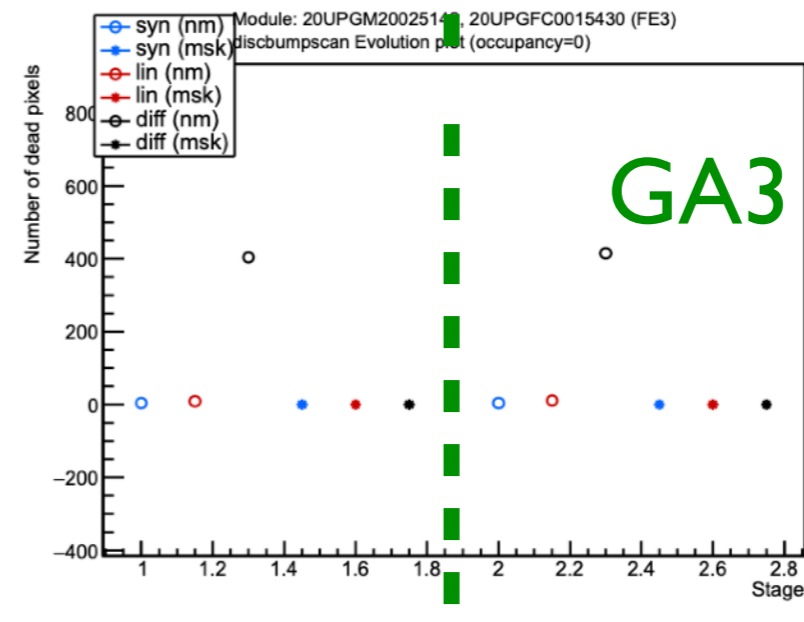
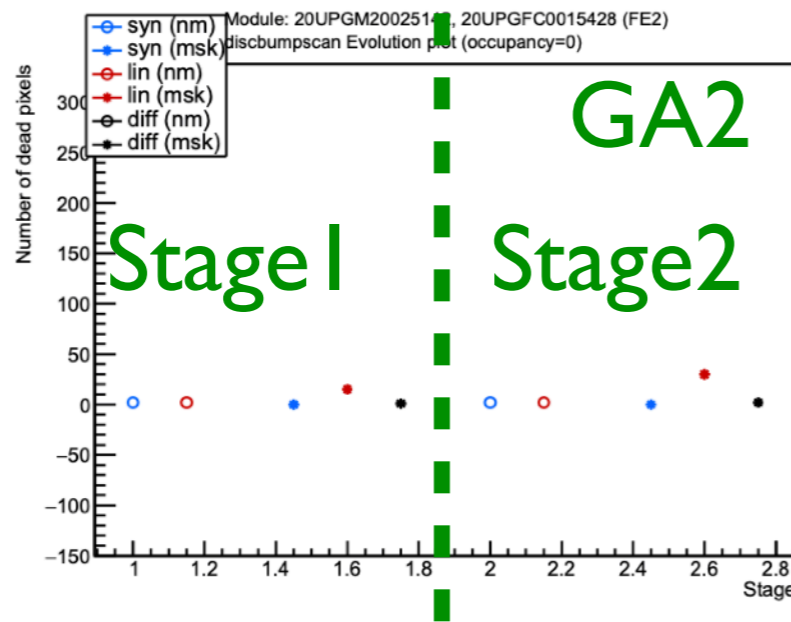
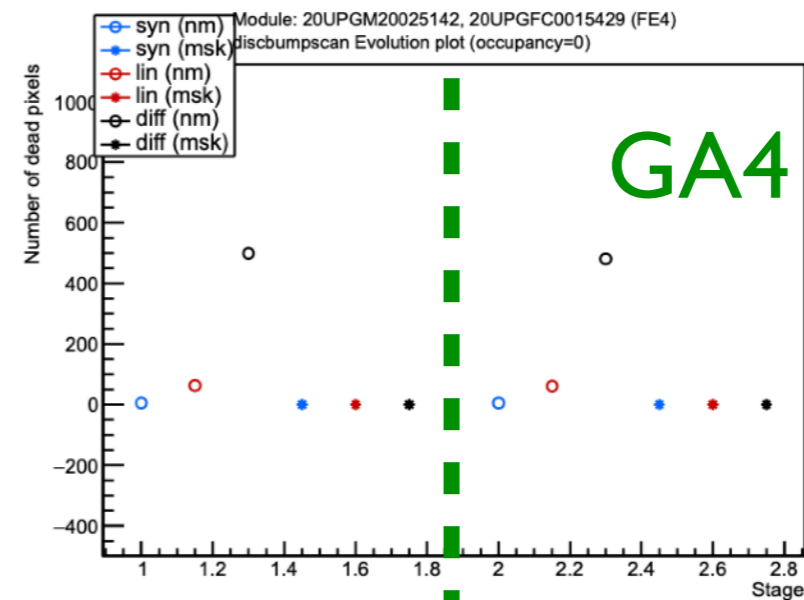
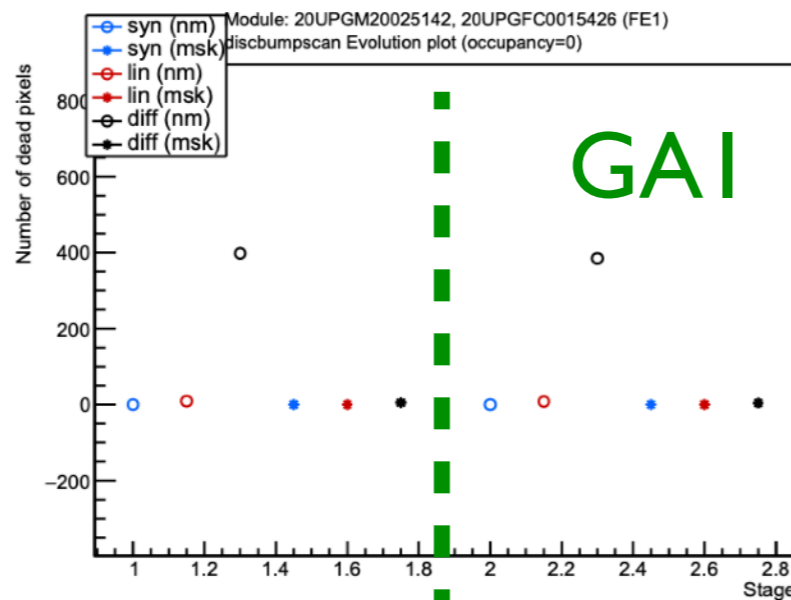
- 294824/307200



# LIVTHK5 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

- [http://www.le.infn.it/itk/forWEB/LLSfdr/GenConfig\\_LivThkX\\_BA2D/20UPGM20025142overview\\_DiscBump.pdf](http://www.le.infn.it/itk/forWEB/LLSfdr/GenConfig_LivThkX_BA2D/20UPGM20025142overview_DiscBump.pdf)

Number of dead pixels  
vs stage



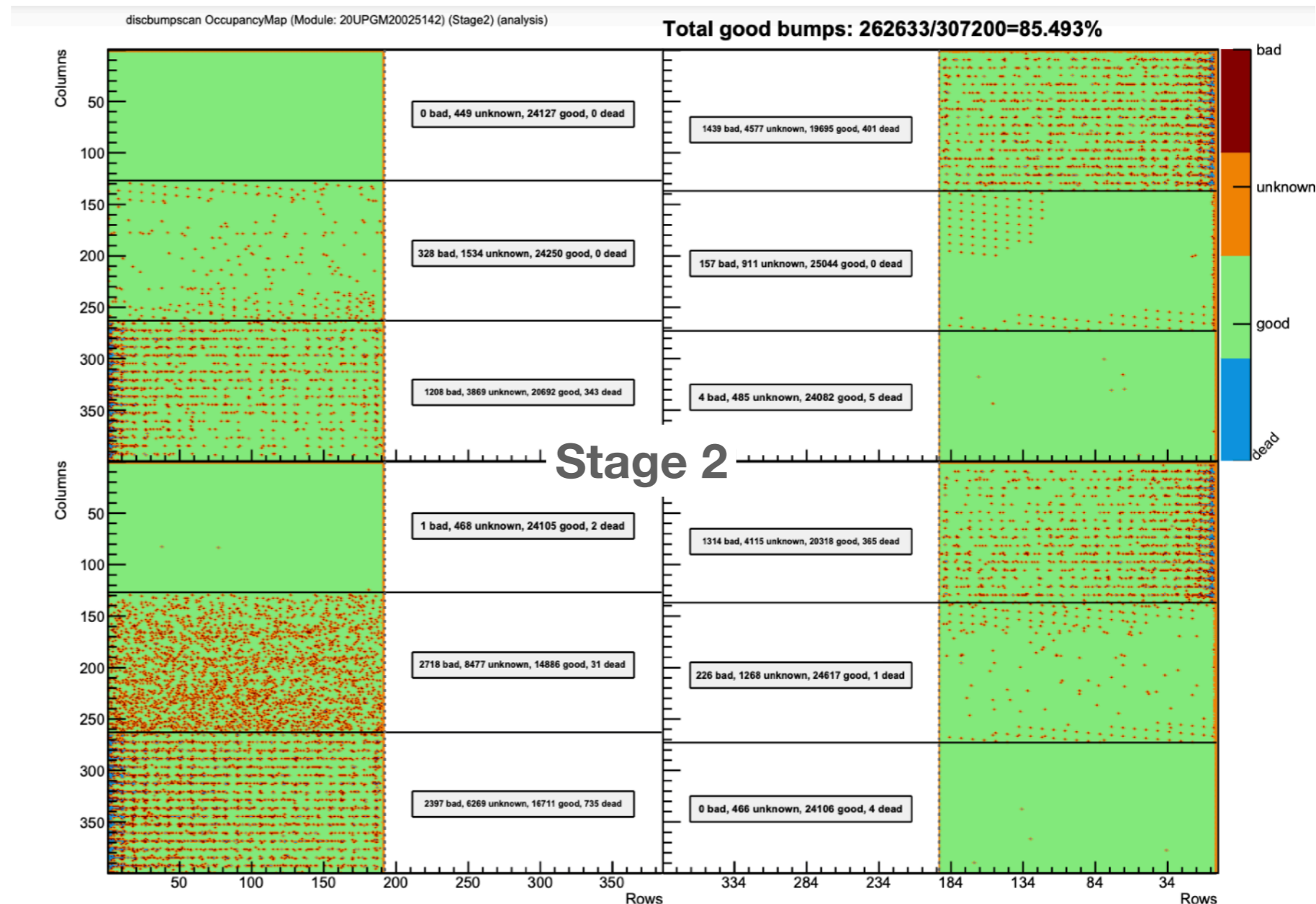
# LIVTHK5 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

- [http://www.le.infn.it/itk/forWEB/LLSfdr/GenConfig\\_LivThkX\\_BA2D/20UPGM20025142overview\\_DiscBump.pdf](http://www.le.infn.it/itk/forWEB/LLSfdr/GenConfig_LivThkX_BA2D/20UPGM20025142overview_DiscBump.pdf)

- discbumpscan  
OccupancyMap  
Module:  
**20UPGM20025142**

- Total good bumps:
  - **Stage2:**
    - 262633/307200
  - **Stage1:**
    - 264725/307200

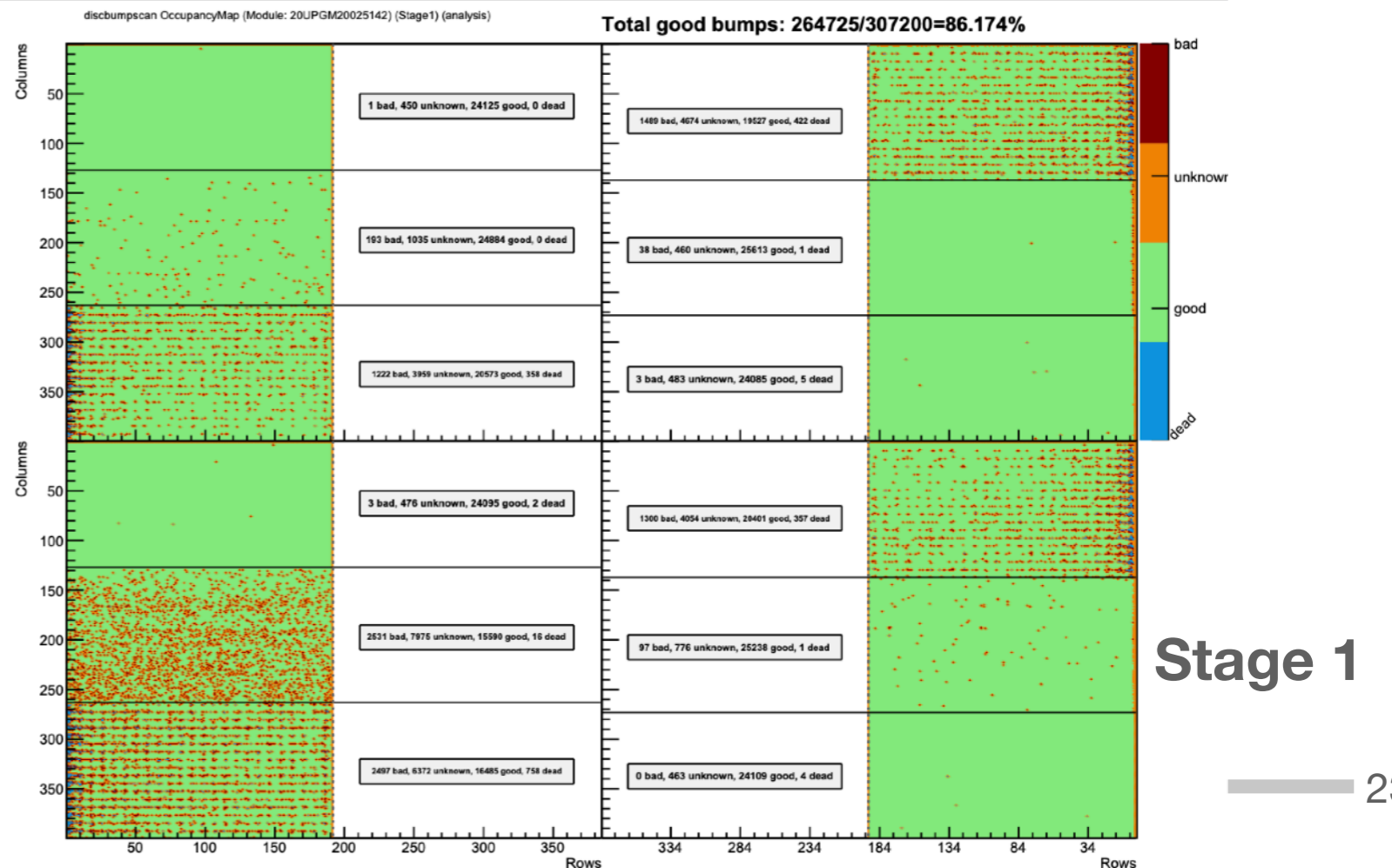
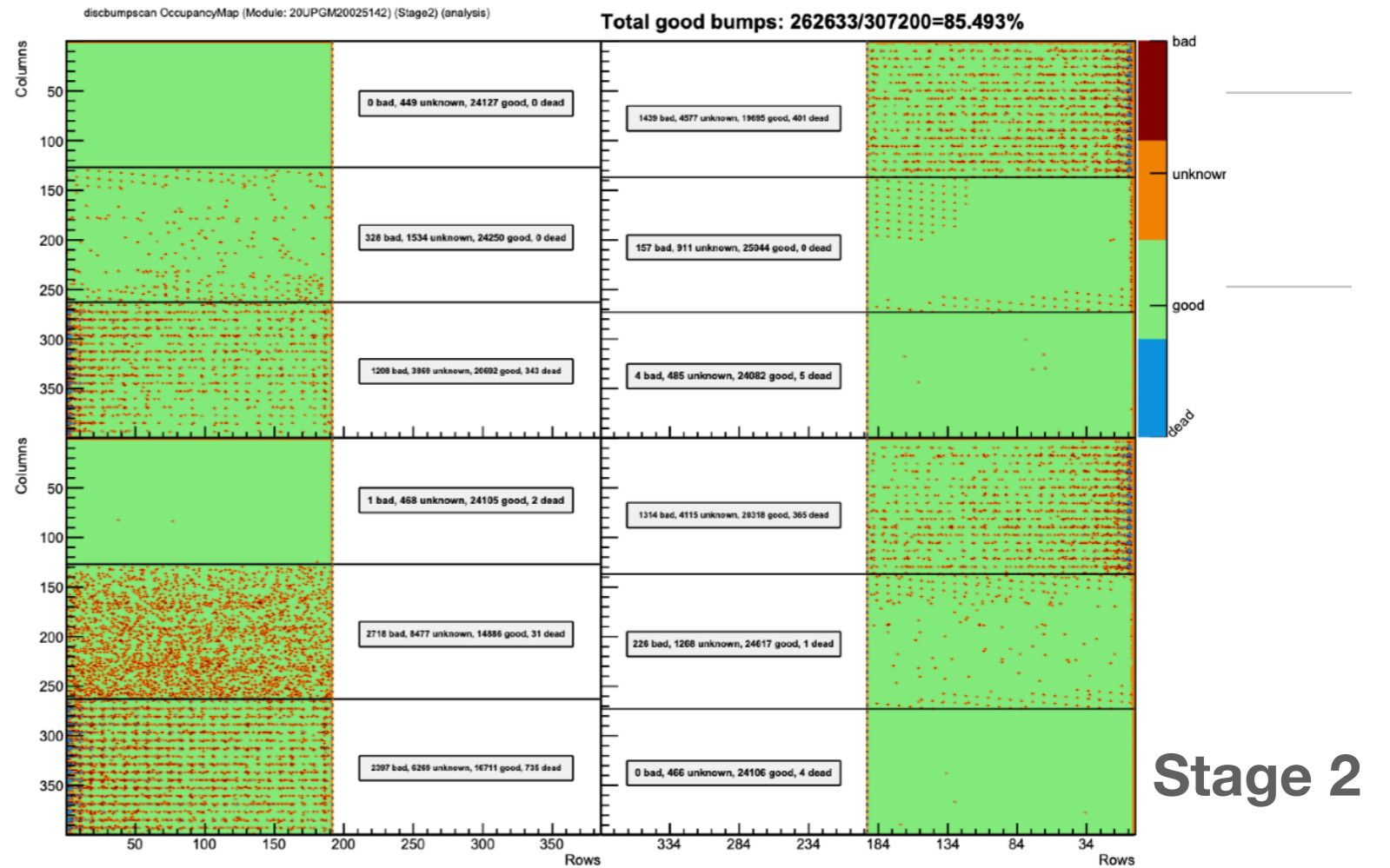
*A few bonds (1%)  
damaged ??*

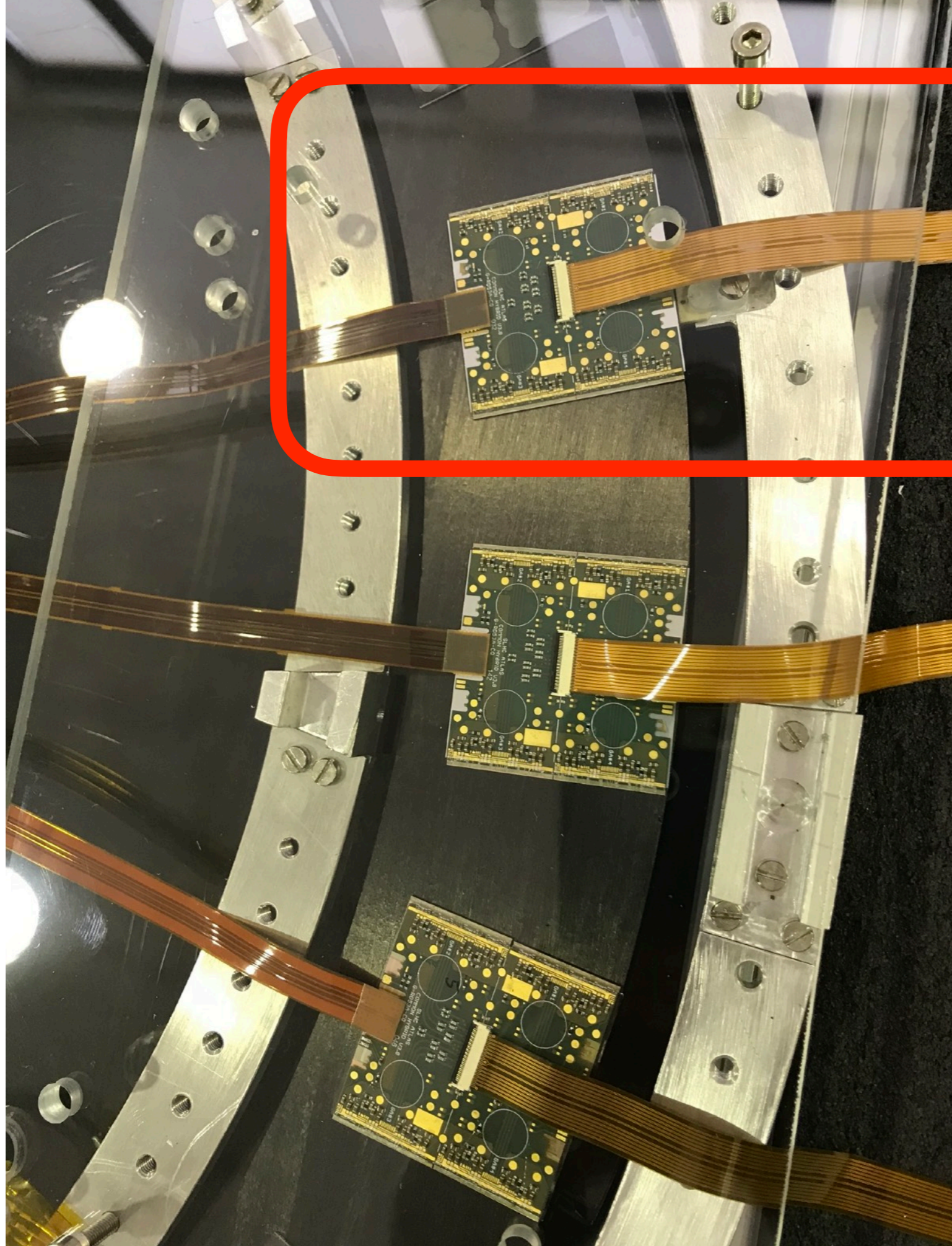


# LIVTHK5 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

- [http://www.le.infn.it/itk/forWEB/LLSfdr/GenConfig\\_LivThkX\\_BA2D/20UPGM20025142overview\\_DiscBump.pdf](http://www.le.infn.it/itk/forWEB/LLSfdr/GenConfig_LivThkX_BA2D/20UPGM20025142overview_DiscBump.pdf)

- Total good bumps:





LIVTHK8

LIVTHK5

ANL5



# QUAD MODULE: LIVTHK8

- 4 sets of scans - *pre loading*
- 4.6 A in cc mode (V limit 5 V) for all of them

GA1 20UPGFC0015400	GA4 20UPGFC0015402
GA2 20UPGFC0015401	GA3 20UPGFC0015258

1. module\_scan\_20UPGM20025032\_20230127\_1321/ 27-Jan - Liverpool trimming HV off; FE2 bad
2. module\_scan\_20UPGM20025032\_20230127\_1353/ 27-Jan - Wafer prob. trimm. HV off; FE2 bad
3. module\_scan\_20UPGM20025032\_20230127\_1425/ 27-Jan - Liverpool trimming HV=-100 V; FE2 bad
4. module\_scan\_20UPGM20025032\_20230127\_1450/ 27-Jan - Wafer prob. trimm. HV=-100 V; FE2 bad

## *4. misses std\_digital\_scan*

### *1. and 2. miss discbumpscan*

[std\\_digitalscan/](#)  
[lindiff\\_analogscan/](#)  
[syn\\_analogscan/](#)  
[diff\\_thresholdscan/](#)  
[lin\\_thresholdscan/](#)  
[syn\\_thresholdscan/](#)  
[diff\\_totscan/](#)  
[lin\\_totscan/](#)  
[syn\\_totscan/](#)  
[lin\\_discbumpscan/](#)  
[diff\\_discbumpscan/](#)  
[syn\\_discbumpscan/](#)

1 vs 2: diff\_20UPGM20025032\_20230127\_LivHVoff\_vs\_WPDHVoff.html  
2 vs 4: diff\_20UPGM20025032\_20230127\_WPDHVoff\_vs\_WPDHVm100.html  
3 vs 4: diff\_20UPGM20025032\_20230127\_LivHVm100\_vs\_WPDHVm100.html  
1 vs 3: diff\_20UPGM20025032\_20230127\_LivHVoff\_vs\_LivHVm100.html  
3 vs 1: diff\_20UPGM20025032\_20230127\_LivHVm100\_vs\_LivHVoff.html

# QUAD MODULE: LIVTHK8

GA1 20UPGFC0015400	GA4 20UPGFC0015402
GA2 20UPGFC0015401	GA3 20UPGFC0015258

- **post loading**

-100 V, 33 nA @ 10% humidity

(runaway current at the PS when FE powered, reaching stable max with T on the sensor)

*No active cooling*

LV on only during each scan, off in between scans

- 4.6 A in cc mode (V limit 5 V)

- LV = 1.99 V

Liverpool trimming HV=-100 V; **CHIP2 bad** - only 3 chips enabled

Feb 15 13:11 009020\_std\_digitalscan

Feb 15 13:13 009021\_lindiff\_analogscan

Feb 15 13:14 009022\_syn\_analogscan

Feb 15 13:17 009023\_lin\_thresholdscan

Feb 15 13:19 009024\_diff\_thresholdscan

Feb 15 13:28 009025\_syn\_thresholdscan

Feb 15 13:31 009026\_diff\_totscan

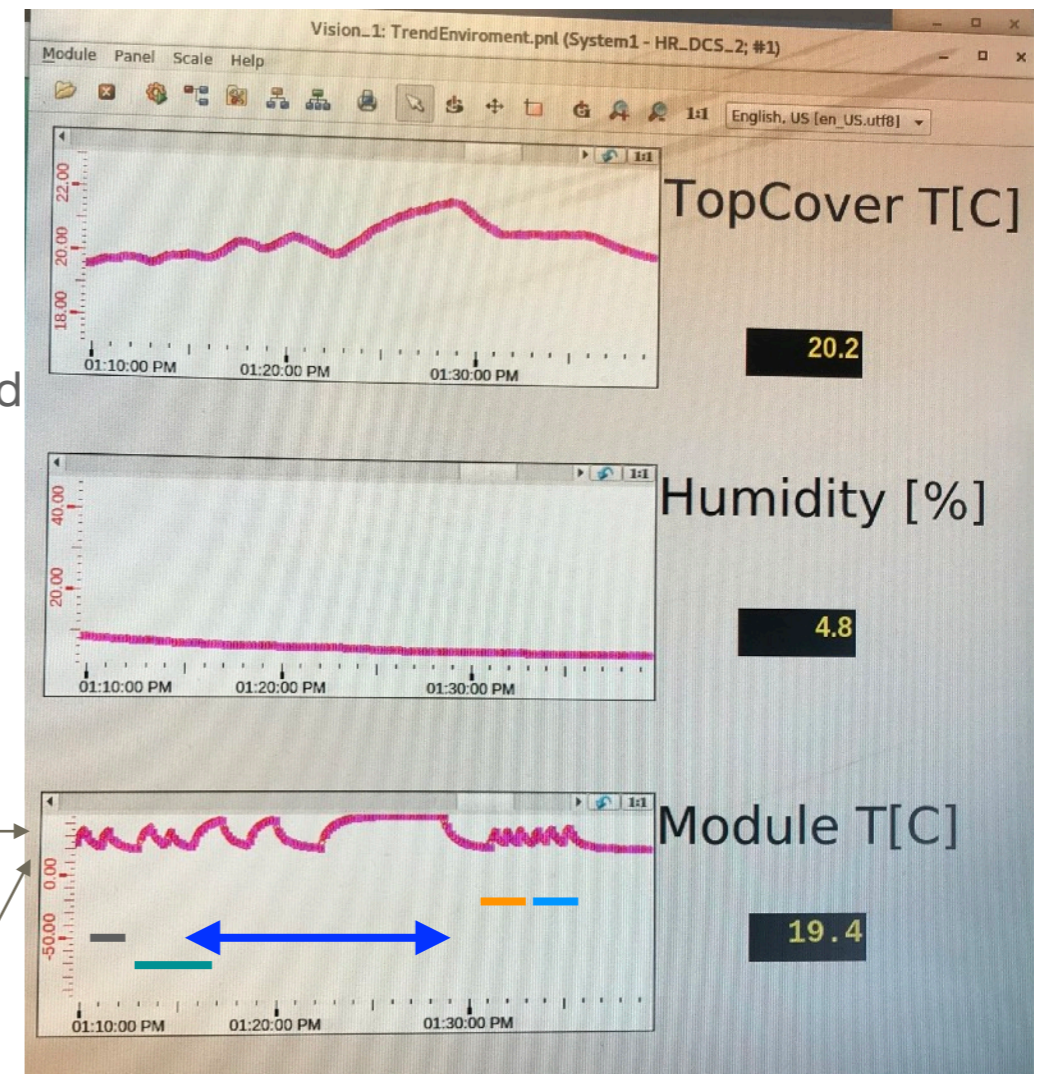
Feb 15 13:32 009027\_lin\_totscan

Feb 15 13:32 009028\_syn\_totscan

Feb 15 13:33 009029\_lin\_discbumpscan

Feb 15 13:34 009030\_diff\_discbumpscan

Feb 15 13:35 009031\_syn\_discbumpscan



module\_scan\_20UPGM20025032\_20230215\_1312\_LivHVm100\_afterLoading

comparison after before

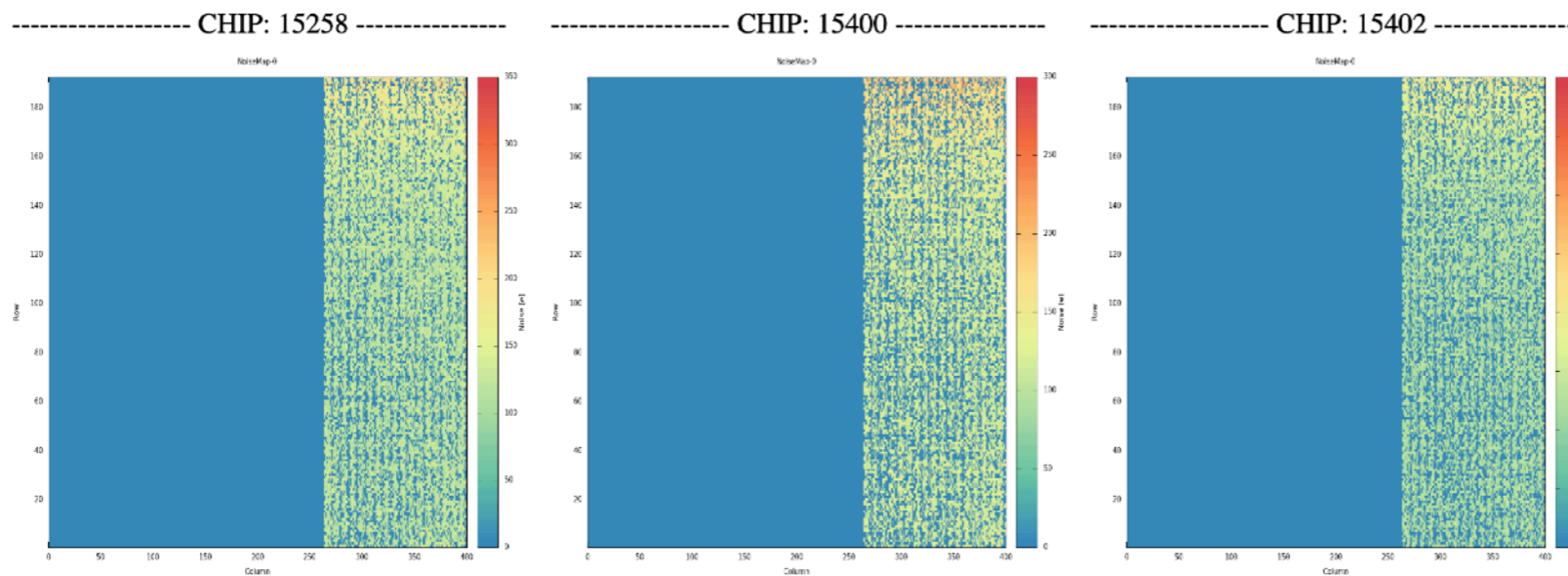
# LIVTHK8 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

- [http://www.le.infn.it/itk/forWEB/LLSfdr/diff\\_20UPGM20025032\\_20230215\\_1312\\_LivHVm100\\_afterLoading\\_20230127\\_1425.html](http://www.le.infn.it/itk/forWEB/LLSfdr/diff_20UPGM20025032_20230215_1312_LivHVm100_afterLoading_20230127_1425.html)

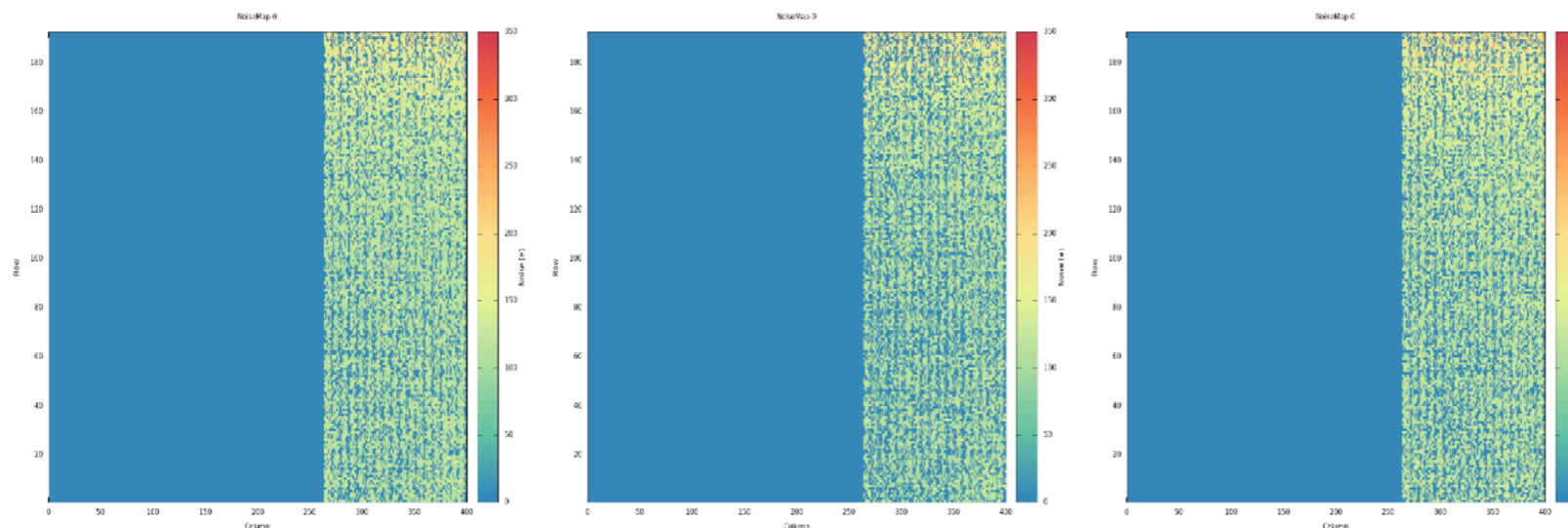
GA1 20UPGFC0015400	GA4 20UPGFC0015402
GA2 20UPGFC0015401	GA3 20UPGFC0015258

## NoiseMap diff\_thresholdscan

Stage 2



Stage 1



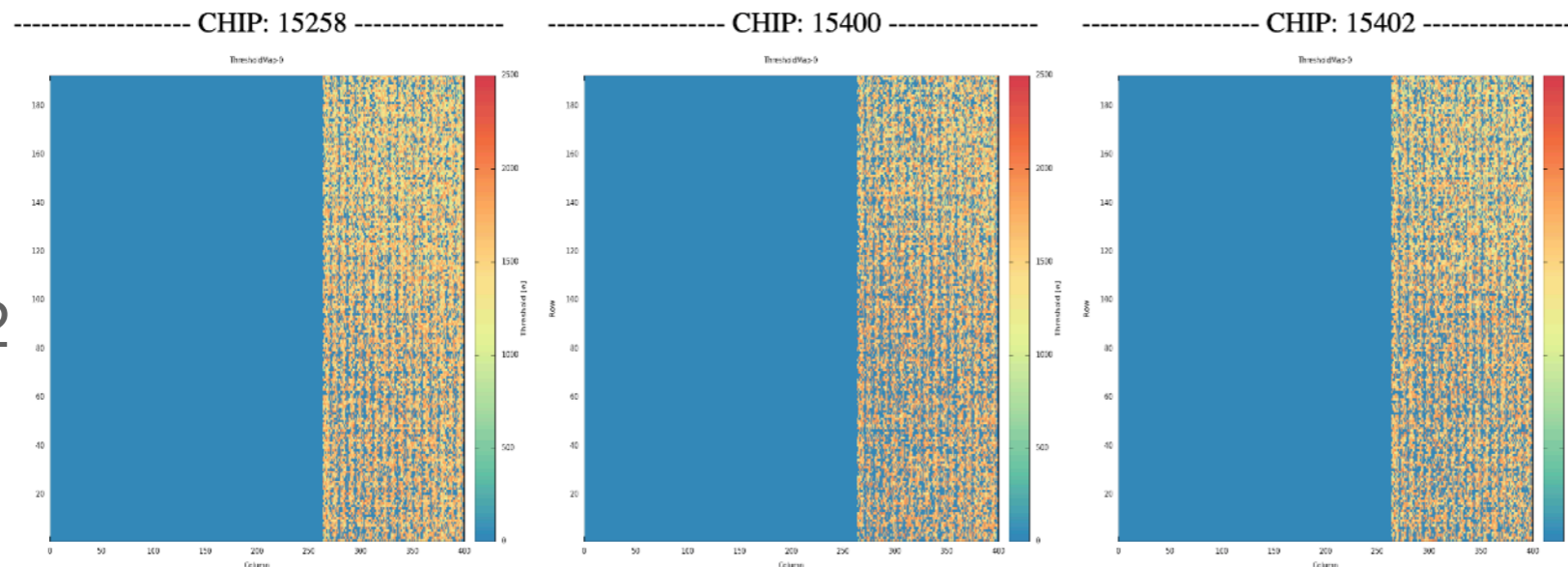
# LIVTHK8 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

- [http://www.le.infn.it/itk/forWEB/LLSfdr/diff\\_20UPGM20025032\\_20230215\\_1312\\_LivHVm100\\_afterLoading\\_20230127\\_1425.html](http://www.le.infn.it/itk/forWEB/LLSfdr/diff_20UPGM20025032_20230215_1312_LivHVm100_afterLoading_20230127_1425.html)

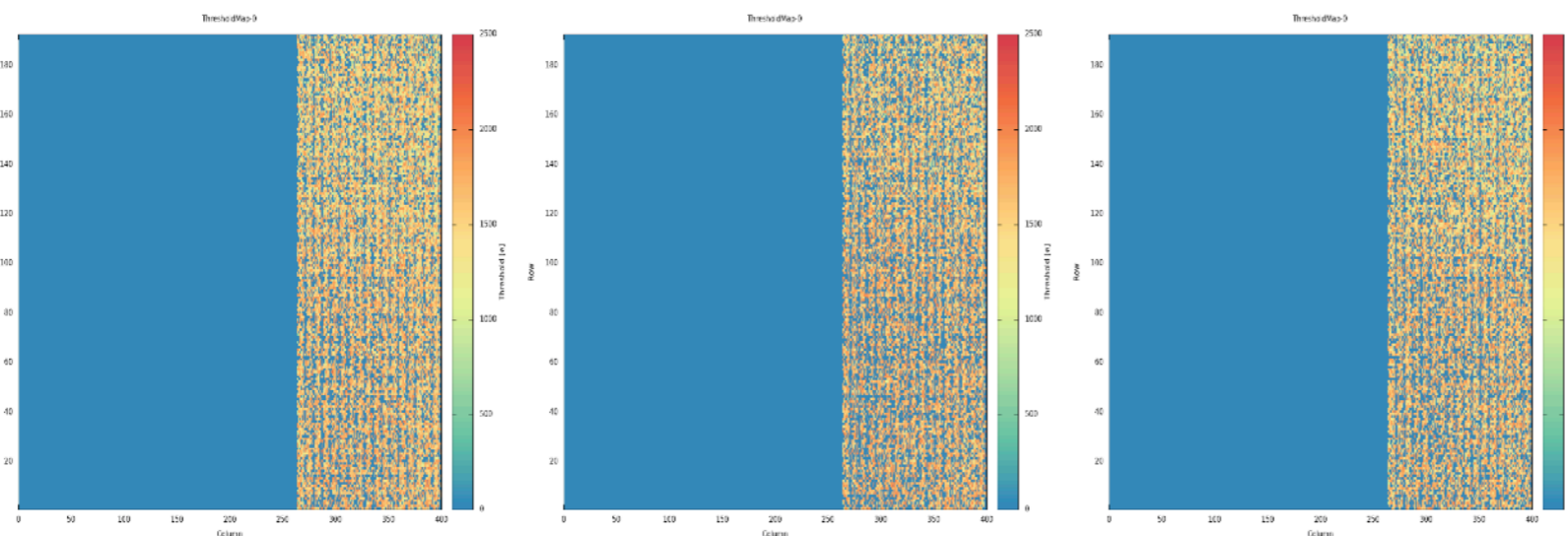
GA1 20UPGFC0015400	GA4 20UPGFC0015402
GA2 20UPGFC0015401	GA3 20UPGFC0015258

**ThresholdMap**      **diff\_thresholdscan**

Stage 2



Stage 1



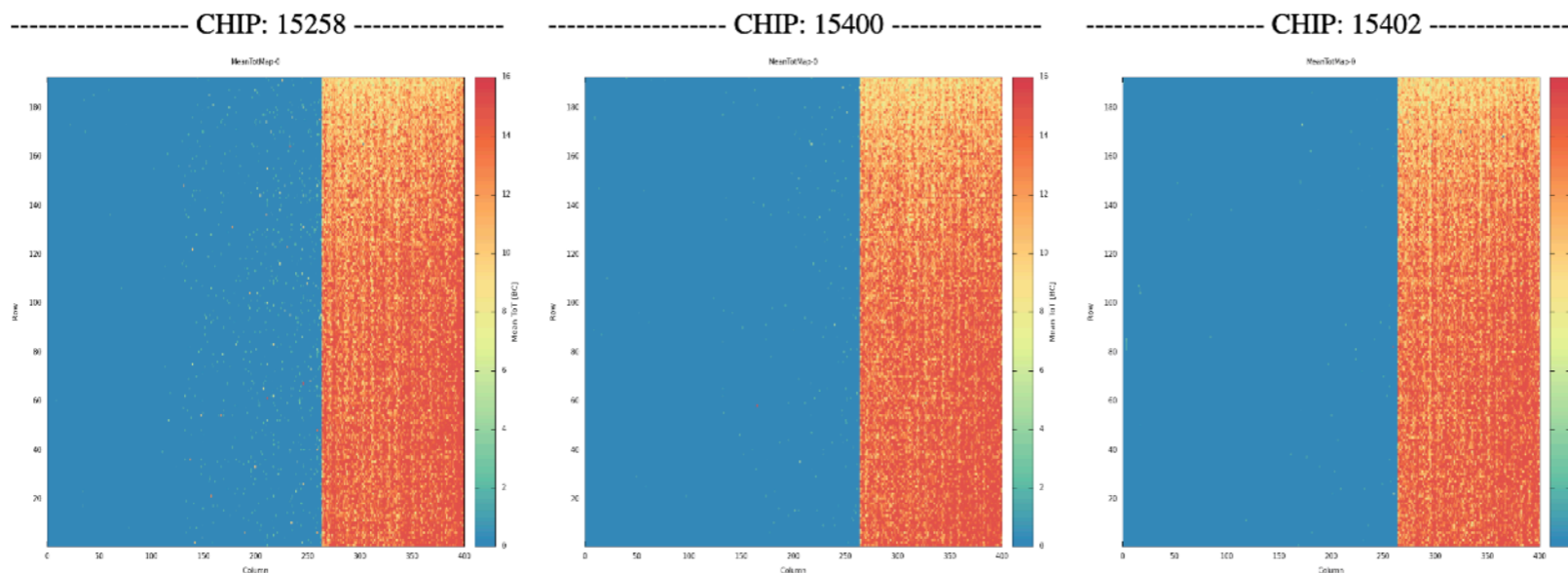
# LIVTHK8 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

- [http://www.le.infn.it/itk/forWEB/LLSfdr/diff\\_20UPGM20025032\\_20230215\\_1312\\_LivHVm100\\_afterLoading\\_20230127\\_1425.html](http://www.le.infn.it/itk/forWEB/LLSfdr/diff_20UPGM20025032_20230215_1312_LivHVm100_afterLoading_20230127_1425.html)

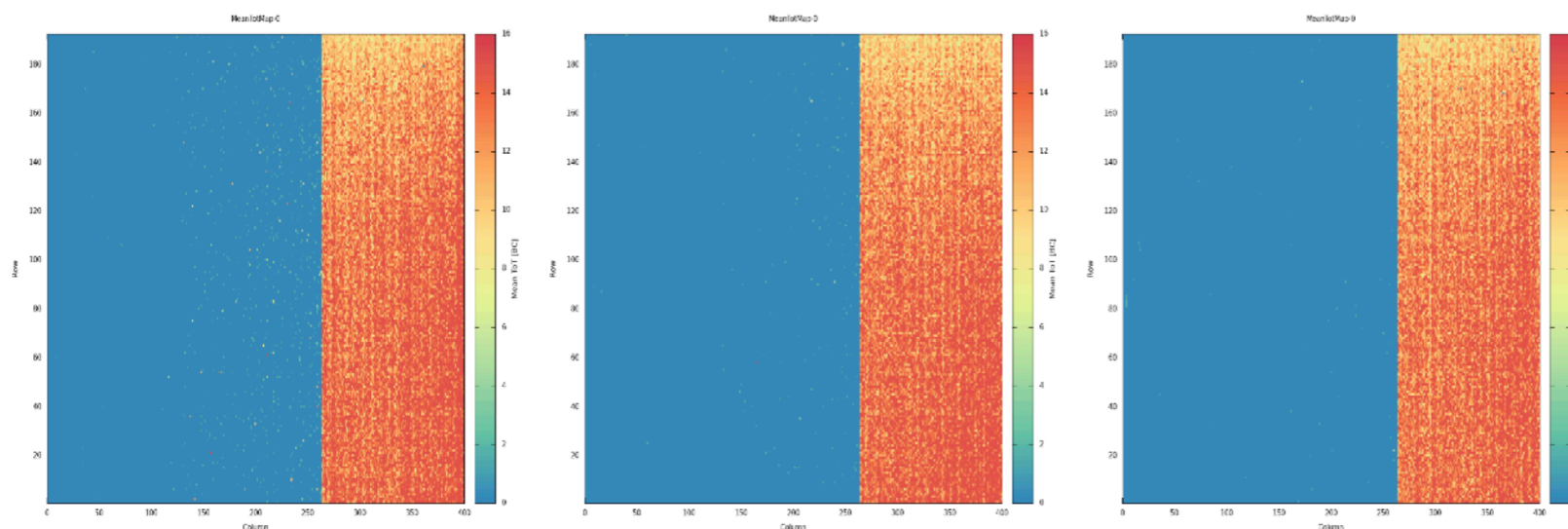
GA1 20UPGFC0015400	GA4 20UPGFC0015402
GA2 20UPGFC0015401	GA3 20UPGFC0015258

MeanTotMap    diff\_totscan

Stage 2



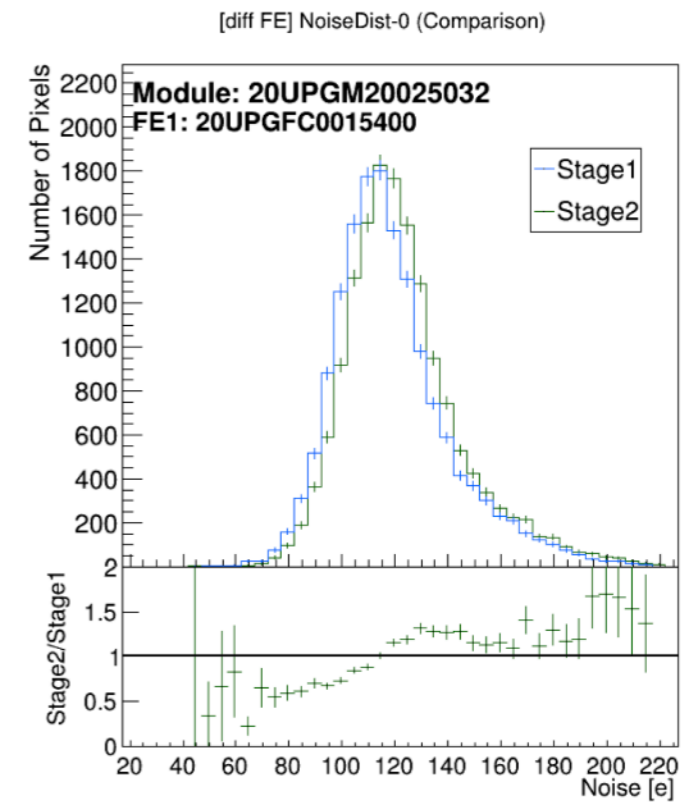
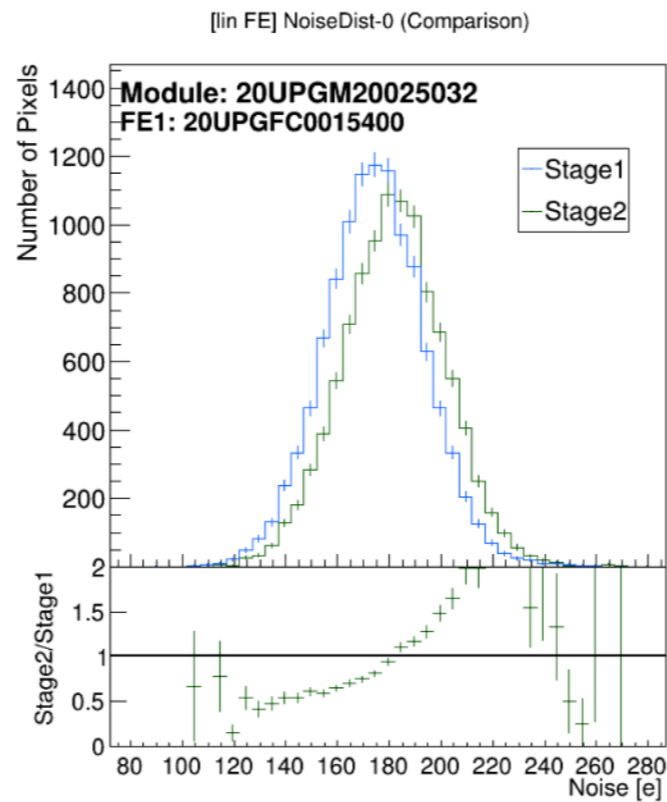
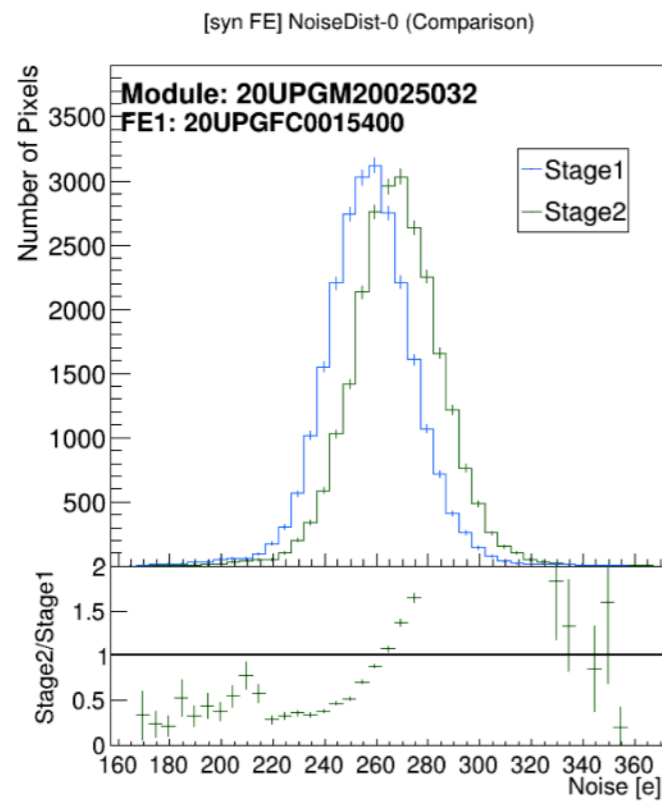
Stage 1



# LIVTHK8 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

## NOISE

### GA1

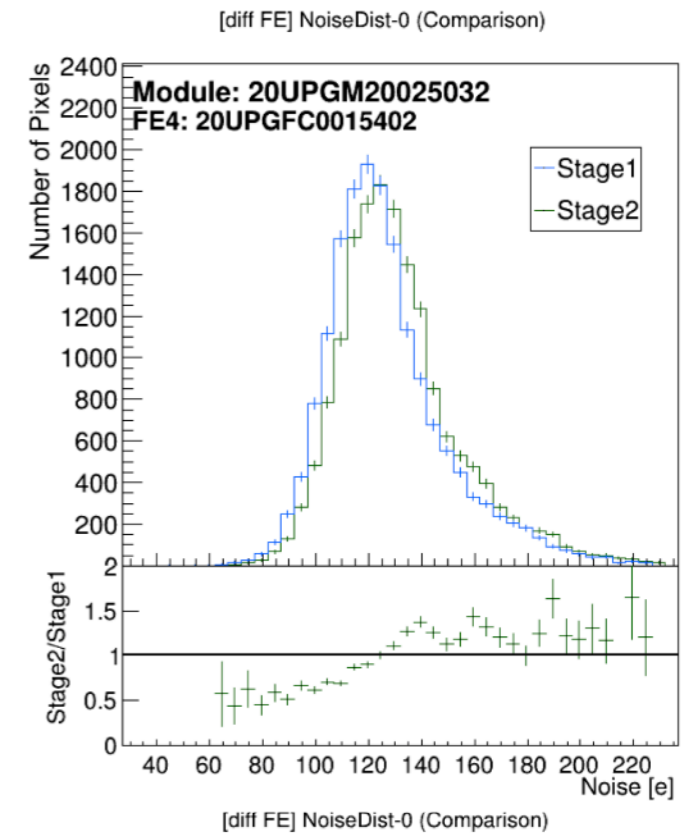
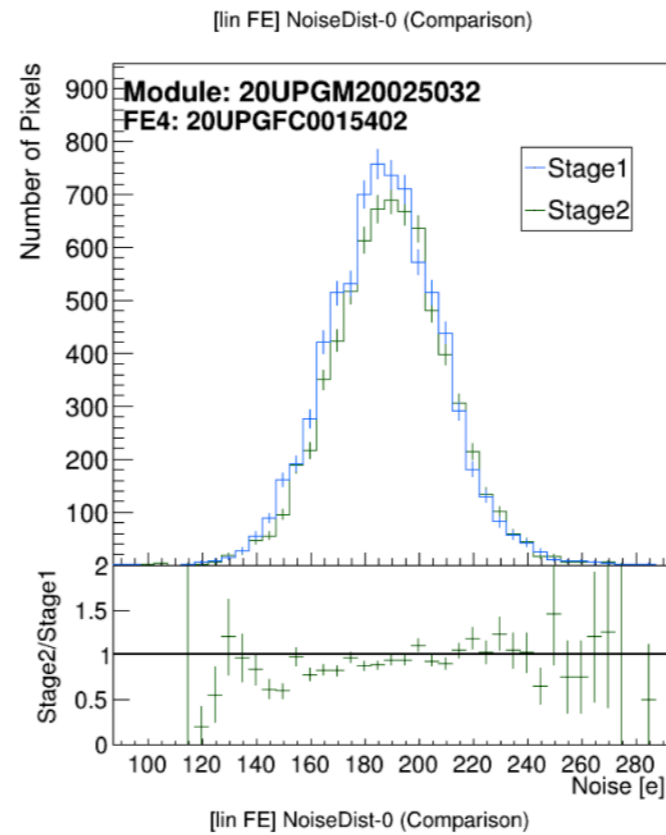
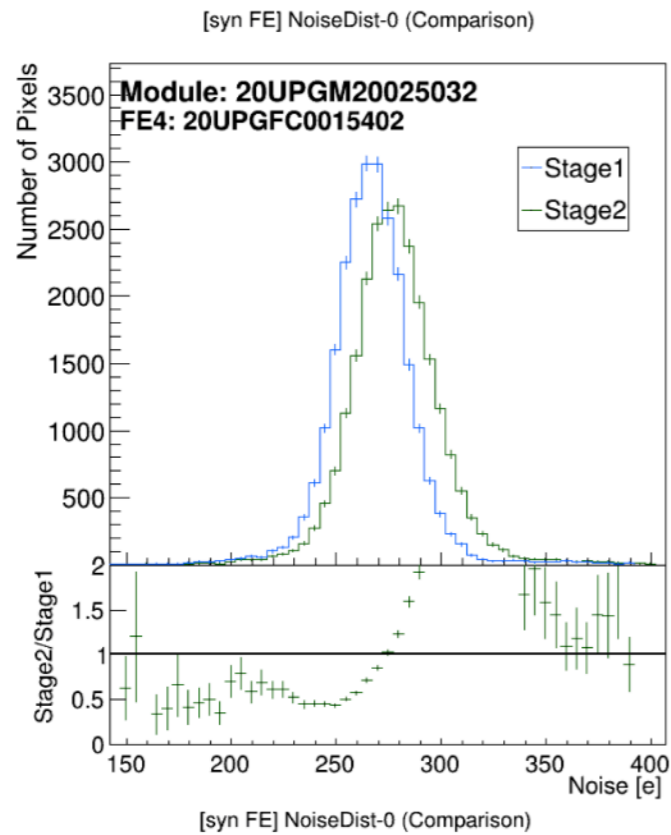


### GA2

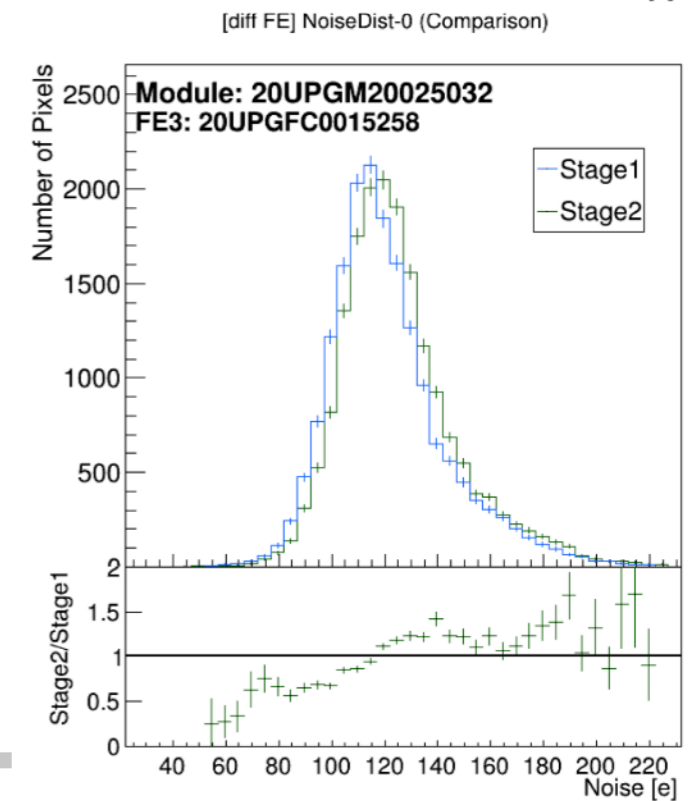
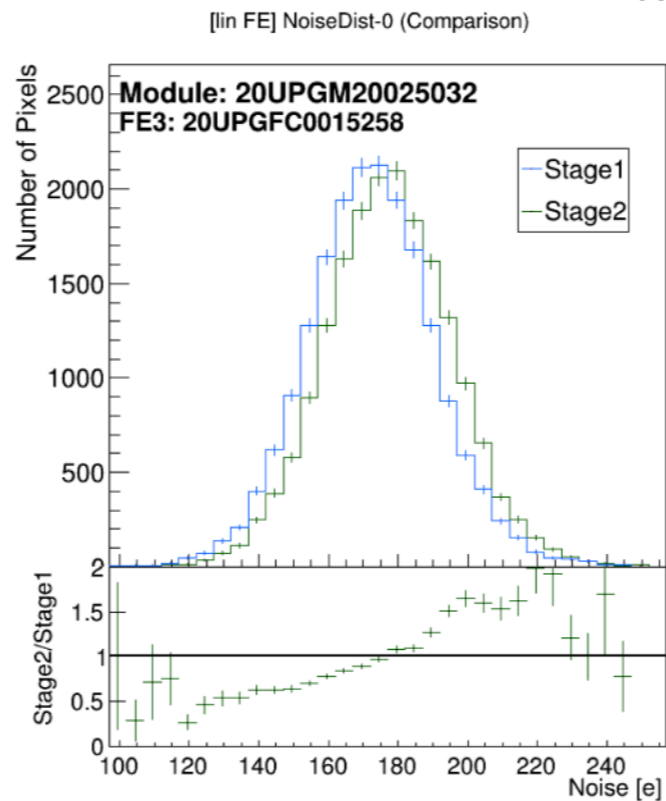
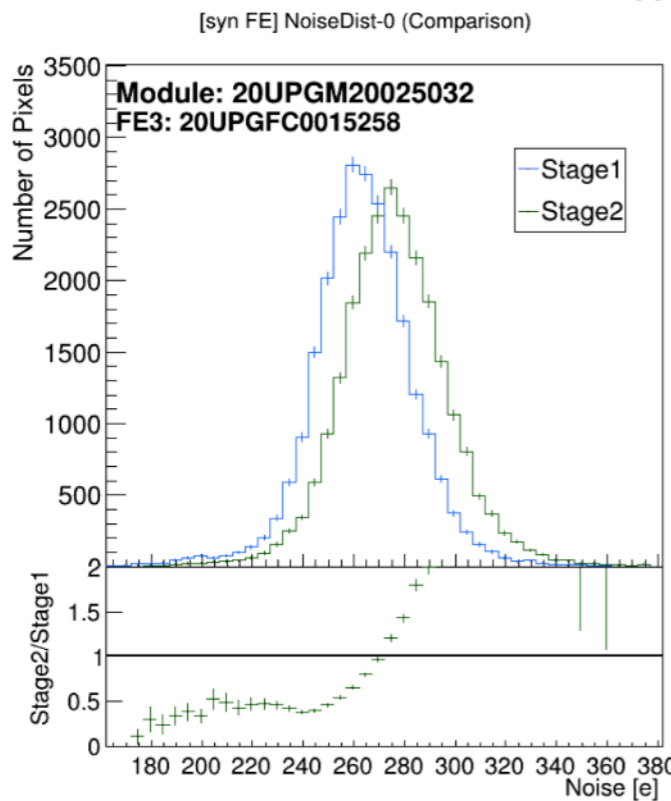
# LIVTHK8 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

## NOISE

GA4

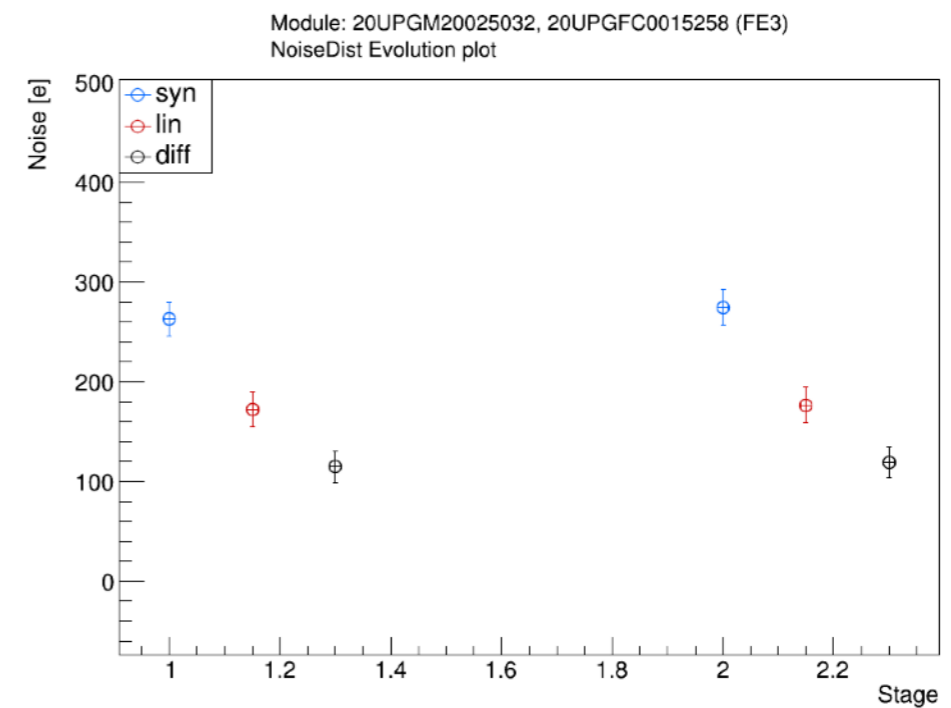
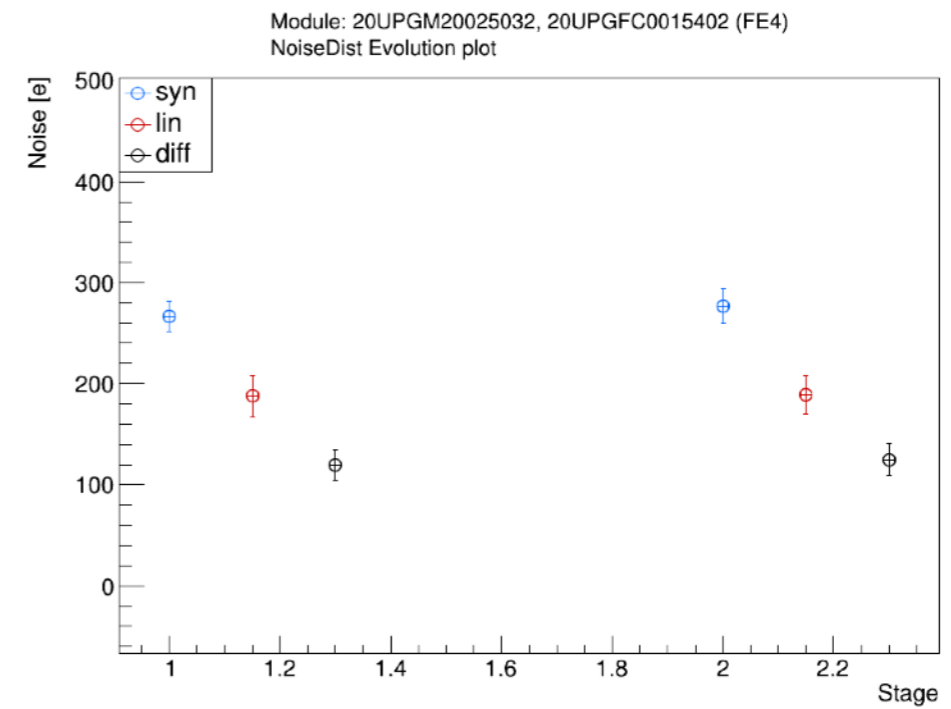
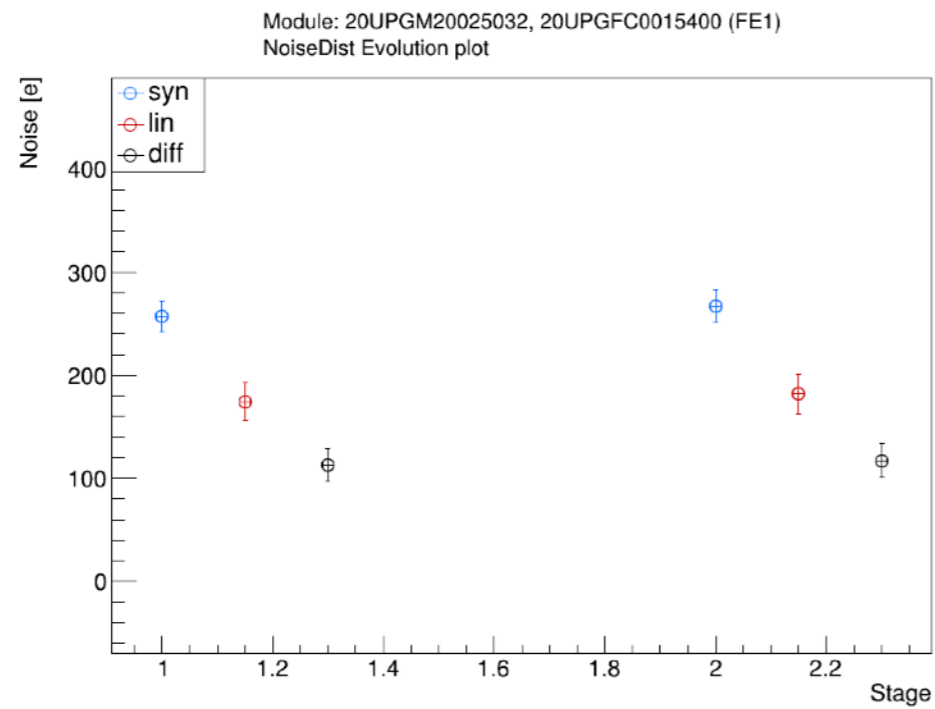


GA3



# LIVTHK8 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

## NOISE

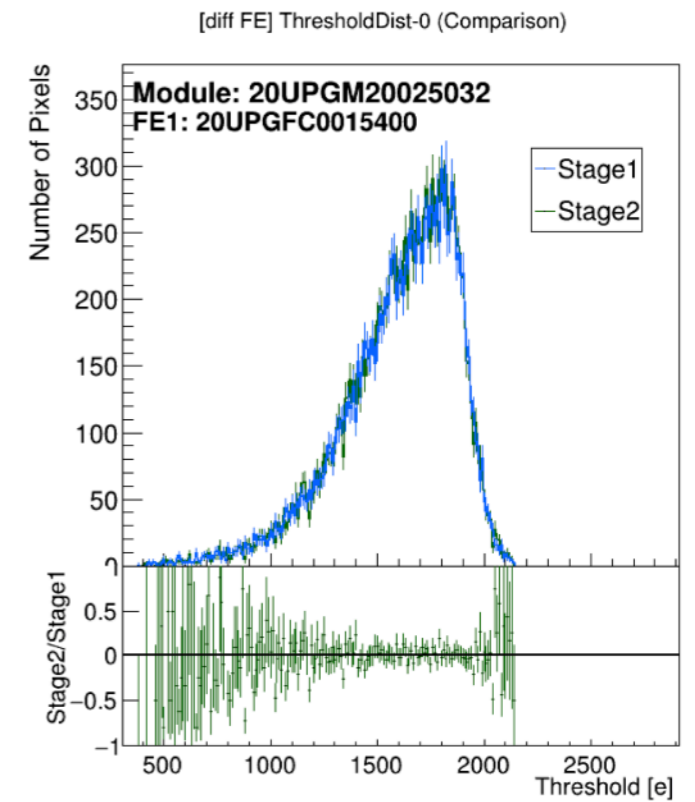
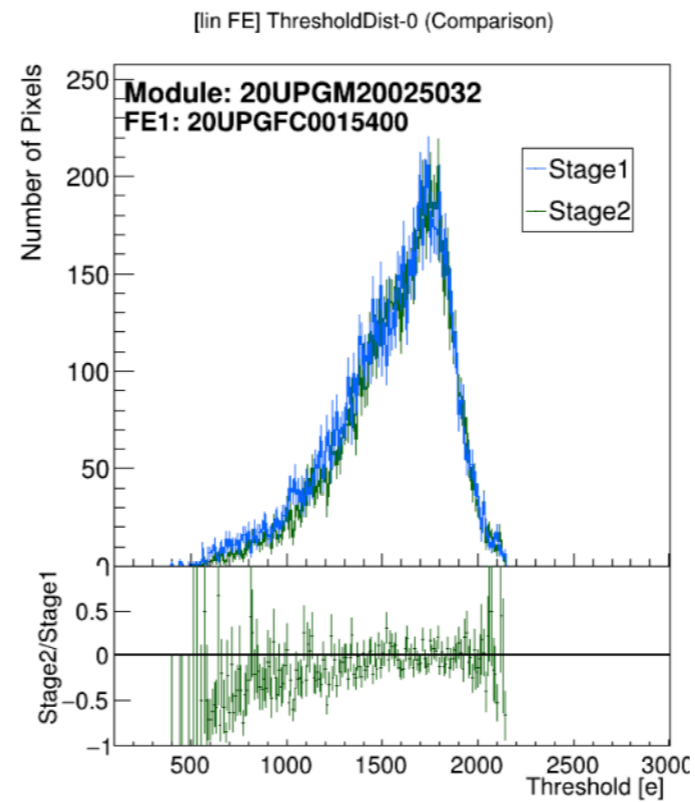
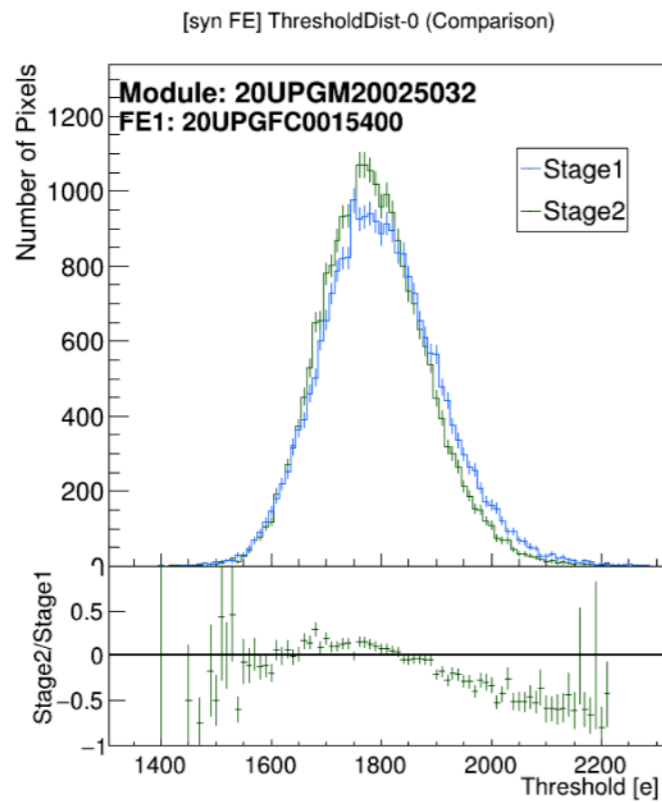




# LIVTHK8 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

## THRESHOLD

### GA1

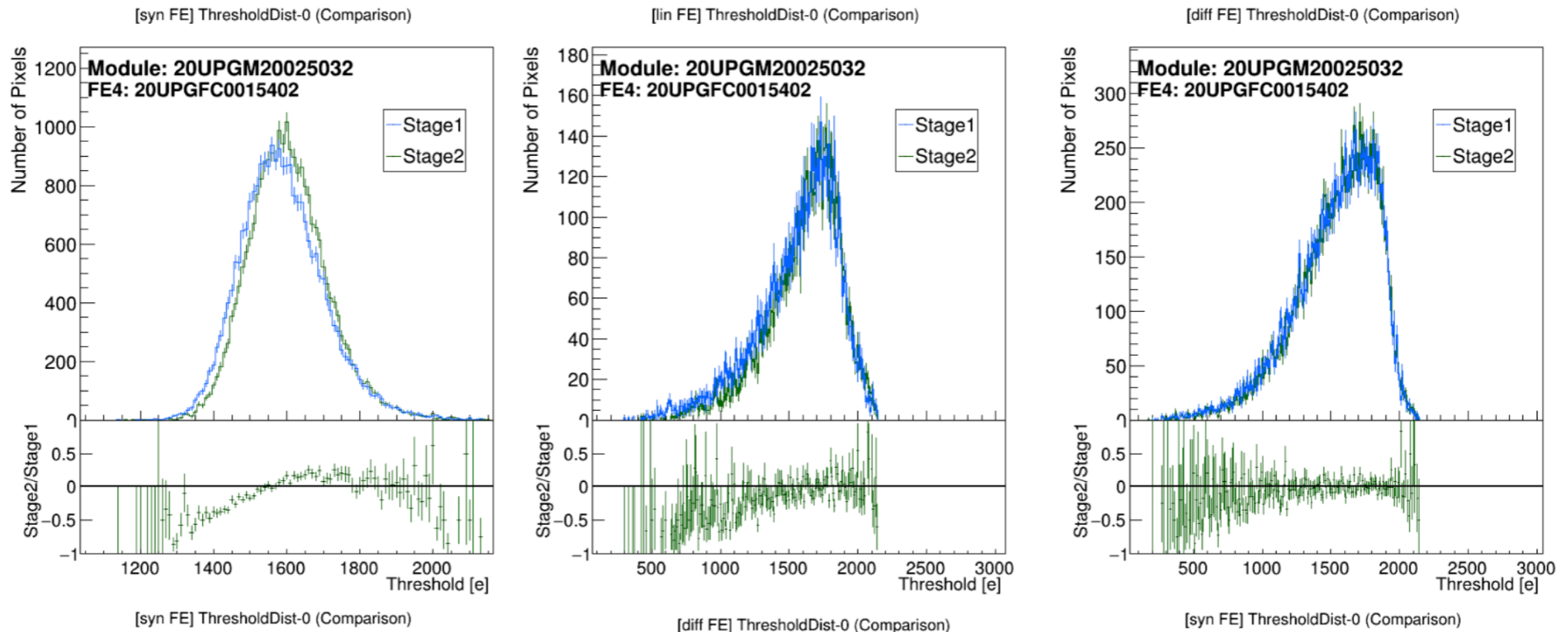


### GA2

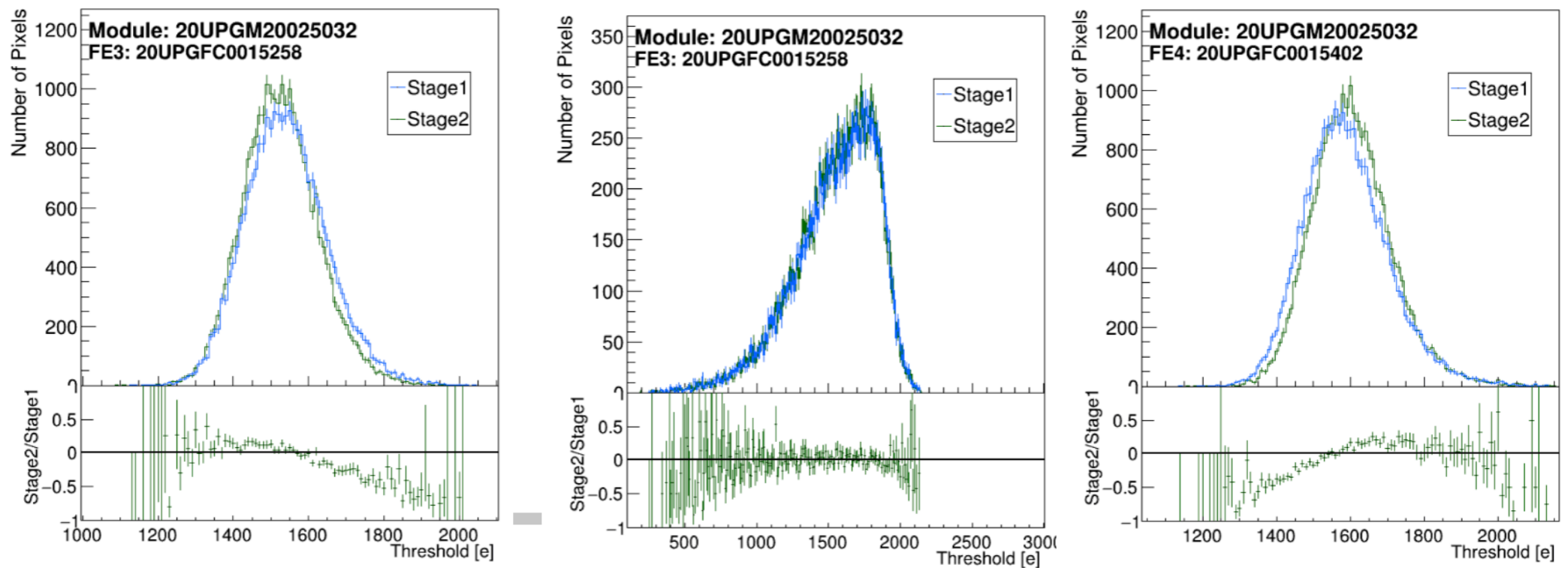
# LIVTHK8 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

## THRESHOLD

GA4

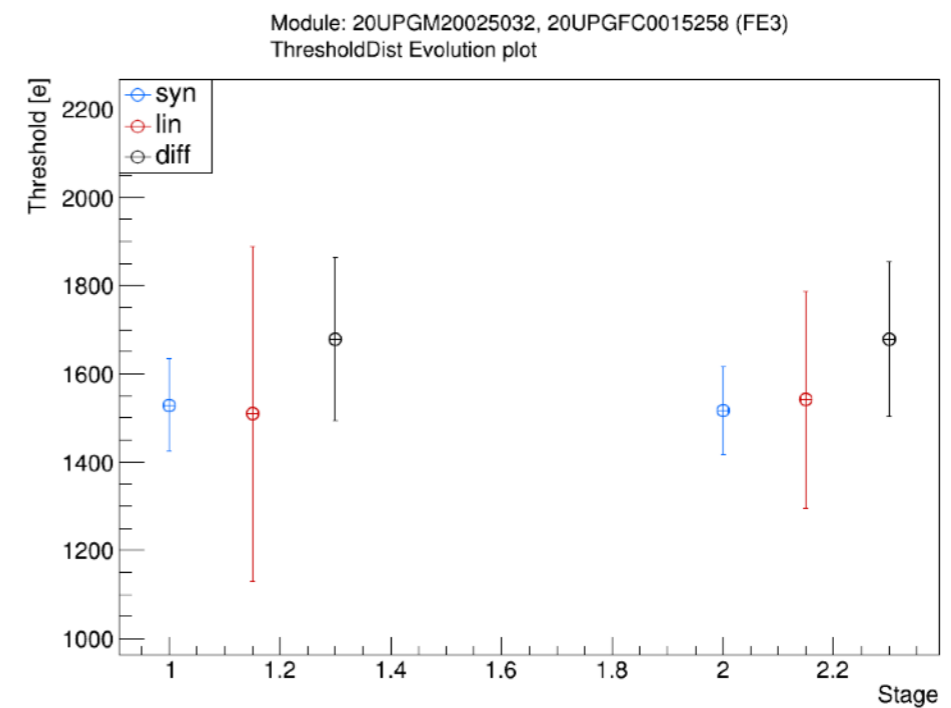
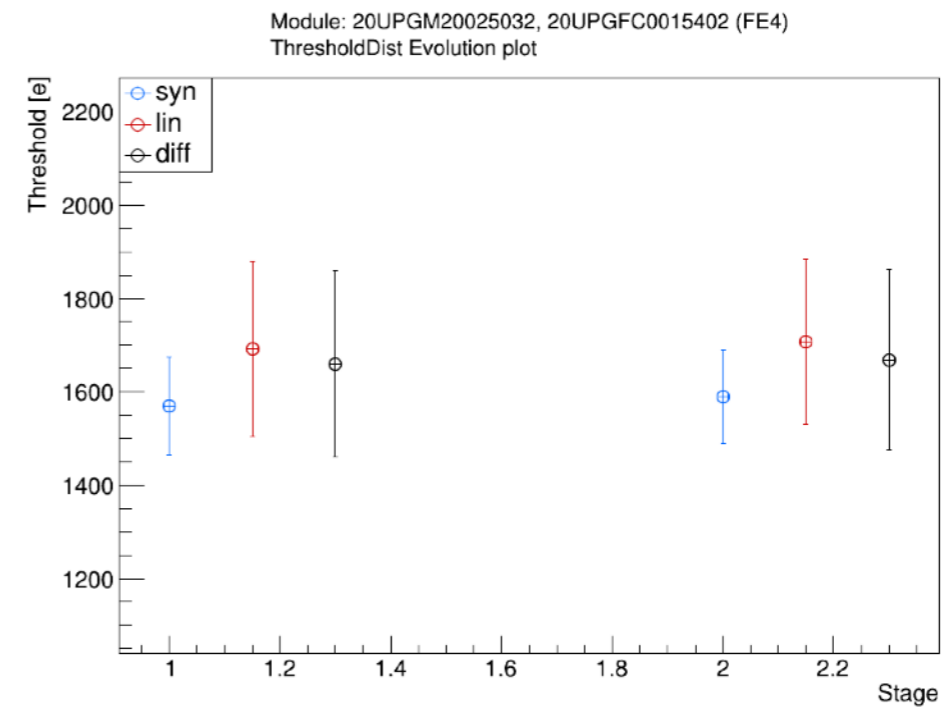
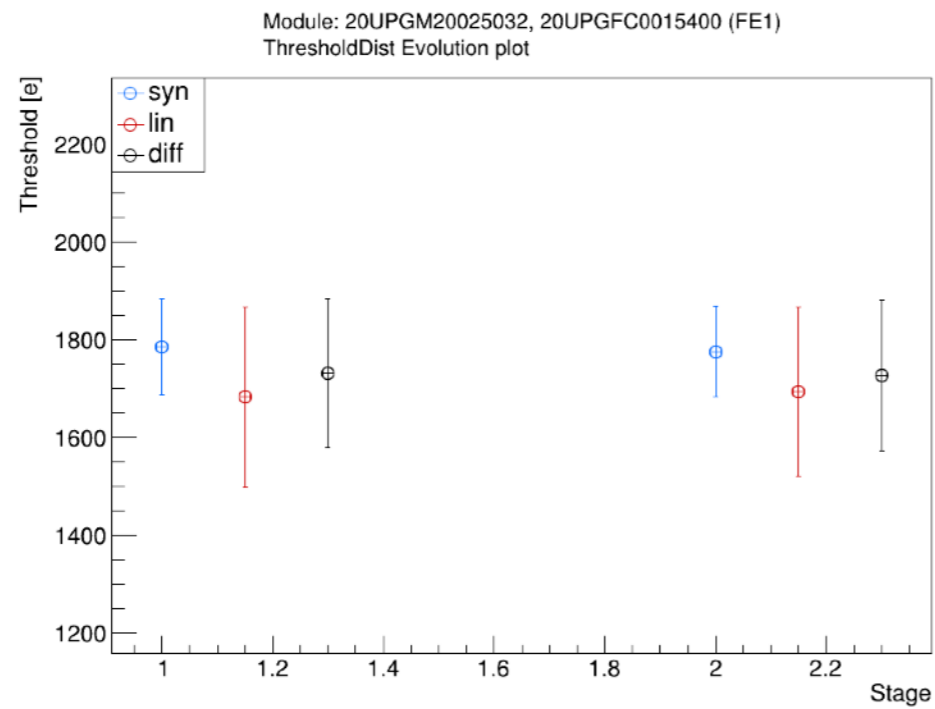


GA3



# LIVTHK8 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

## THRESHOLD



# LIVTHK8 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

- [http://www.le.infn.it/itk/forWEB/LLSfdr/GenConfig\\_LivThk6\\_BA2D/20UPGM20025032overview\\_DiscBump.pdf](http://www.le.infn.it/itk/forWEB/LLSfdr/GenConfig_LivThk6_BA2D/20UPGM20025032overview_DiscBump.pdf)

- discbumpscan  
OccupancyMap  
Module:  
**20UPGM20025032**  
(98 < occupancy < 102):

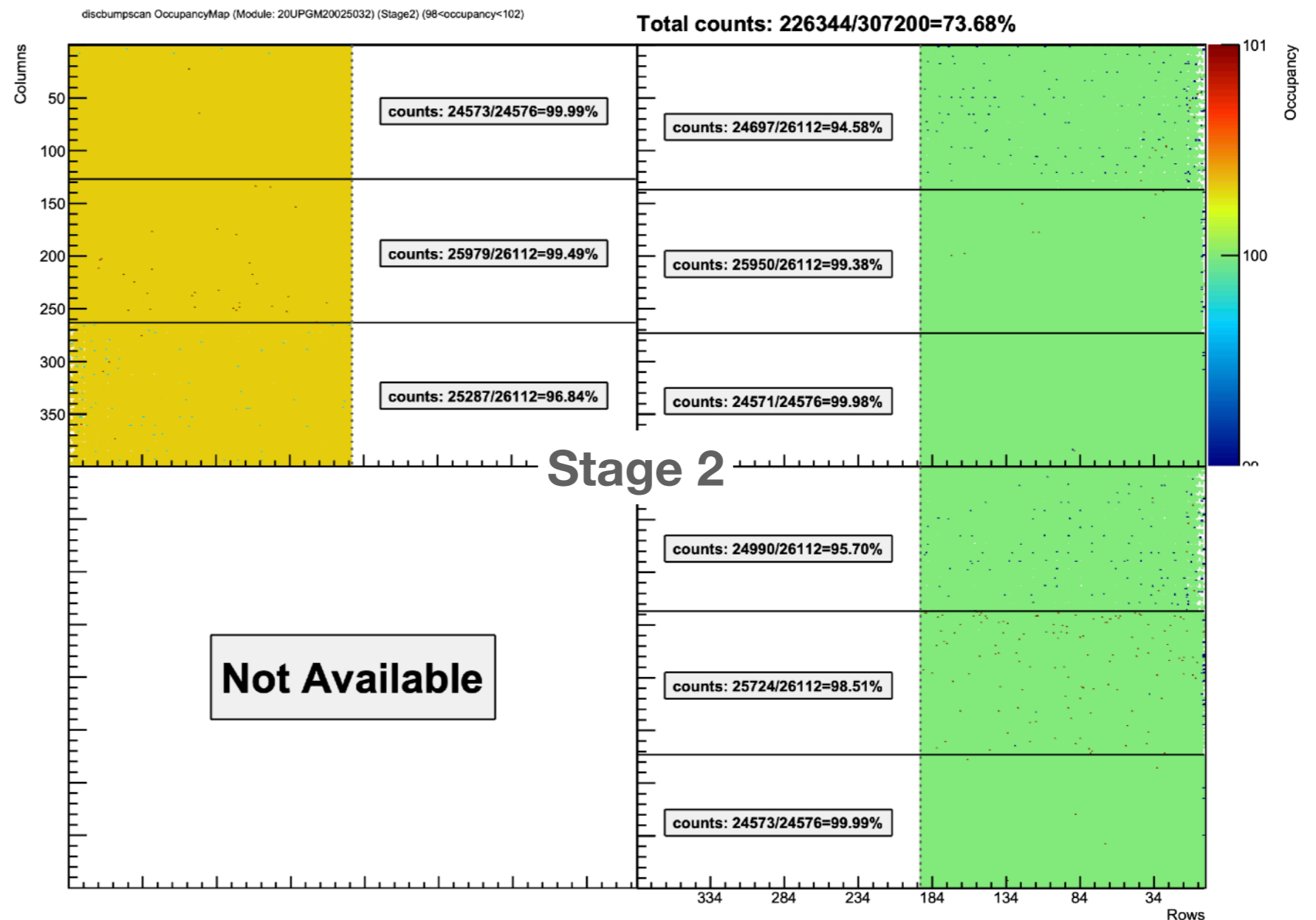
- **Stage2:**

- 226344/307200

- **Stage1:**

- 226356/307200

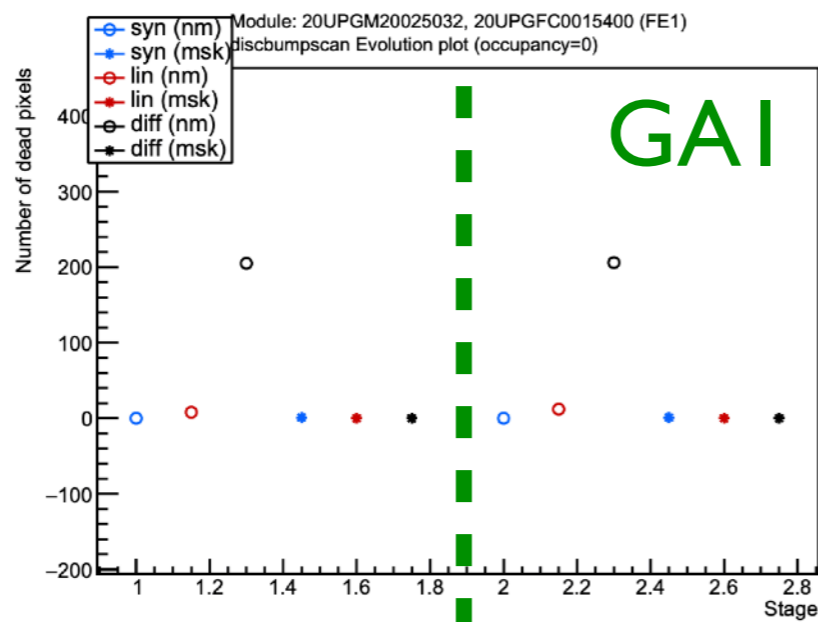
No bond damage  
within precision of the  
analysis



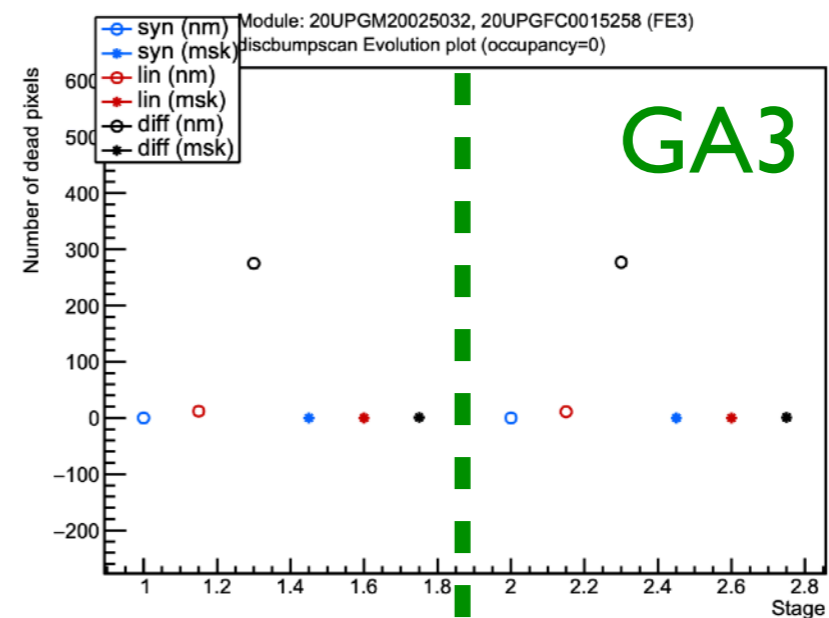
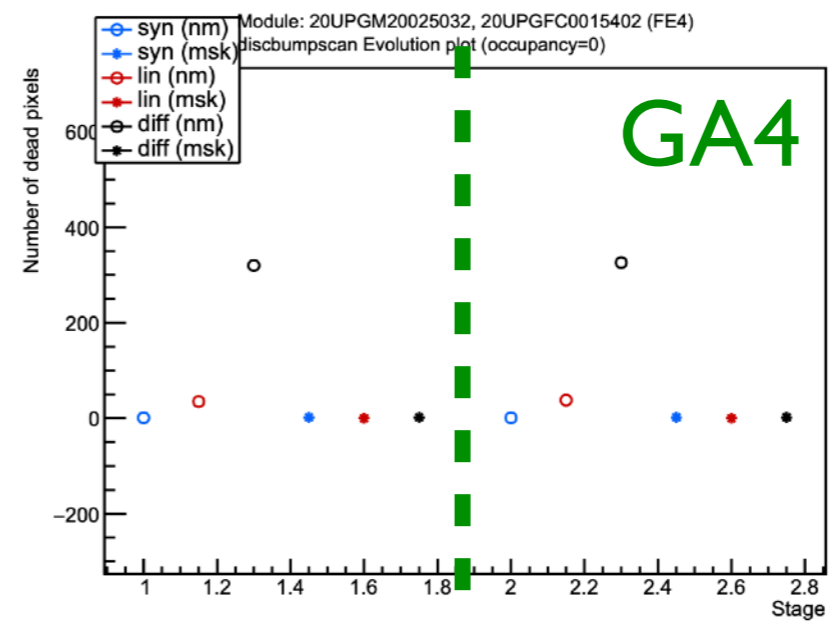
# LIVTHK8 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

Number of dead pixels  
vs stage

- [http://www.le.infn.it/itk/forWEB/LLSfdr/GenConfig\\_LivThk6\\_BA2D/20UPGM20025032overview\\_DiscBump.pdf](http://www.le.infn.it/itk/forWEB/LLSfdr/GenConfig_LivThk6_BA2D/20UPGM20025032overview_DiscBump.pdf)



Stage 1 Stage 2



# LIVTHK8 BEFORE (STAGE1) VS AFTER LOADING (STAGE2)

## Number of dead pixels vs stage

- [http://www.le.infn.it/itk/forWEB/LLSfdr/GenConfig\\_LivThk6\\_BA2D/20UPGM20025032overview\\_DiscBump.pdf](http://www.le.infn.it/itk/forWEB/LLSfdr/GenConfig_LivThk6_BA2D/20UPGM20025032overview_DiscBump.pdf)

- discbumpscan OccupancyMap Module: **20UPGM20025032**
- Total good bumps:
  - Stage2:**
    - 215199/307200
  - Stage1:**
    - 215097/307200

No bond damage within precision of the analysis

