CLICPIX2+PLANAR UPDATE: ASSEMBLY CHARACTERISATION

Morag Williams

New assemblies from IZM

- 3 new assemblies from IZM :

  - Assembly 18: Advacam (ADV) S5, 100µm, active edge, n-in-p

  - Assembly 19: FBK398-3, 130µm, active edge, n-in-p

  - Assembly 20: FBK-398-4, 130µm, active edge, n-in-p

- So far FBK assemblies (As16 and As14) have been our best performing

Assembly 18: ADVS5

- Initially responsive and pixel hits were seen.

- However, once a bias was applied, no pixel hits have been recorded.

- Can set the value of different DACs and read back that they have been set correctly.

- IV curve up to -70V was taken, and no breakdown was observed up to this limit (max. current 2.5µA).

- This assembly was found in the DSF to have been damaged on the CLICpix2 side between the wire-bonds and the matrix.

- A visual inspection of the wire bonds and the damaged region is required.
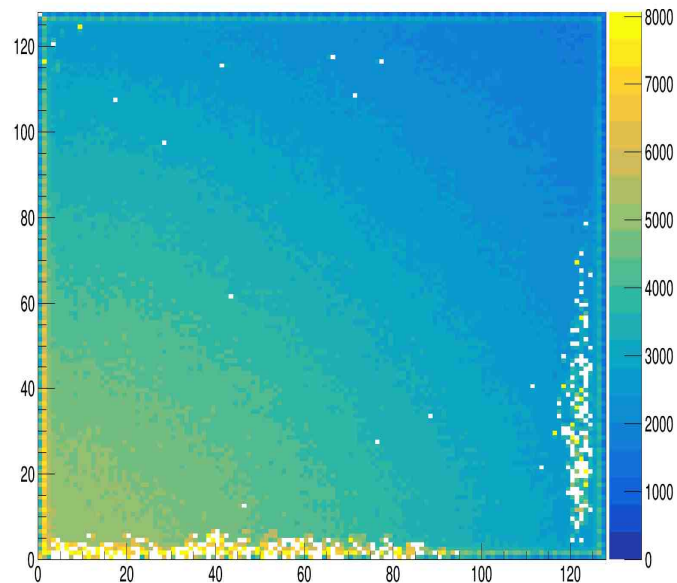
Assemblies 19 and 20: FBK

- **Assembly 19:**

Mean of equalised THL = 1094

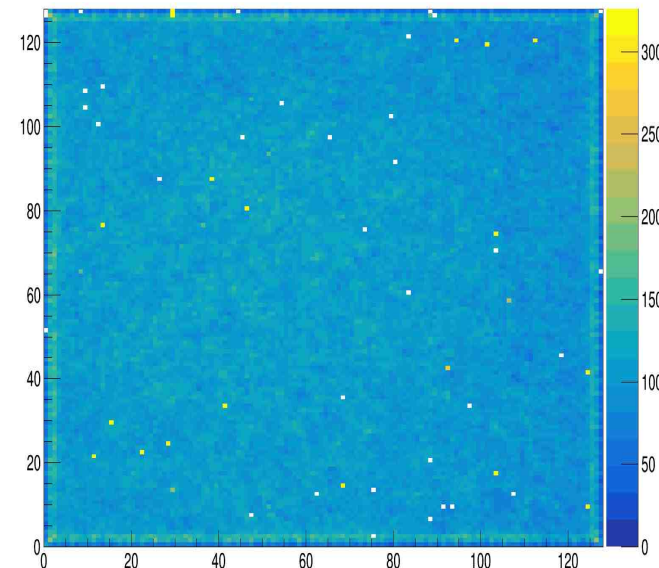Operational threshold = 1190   -> ~1248 electrons

- **Assembly 20:**

Mean of equalised THL = 1241

Operational threshold = 1290   -> ~640 electrons

Source exposure hit maps
(Sr90,>5 hours)

- To better understand the performance of the assemblies, I decided to classify pixels into different categories based on their responses to the different laboratory tests (equalisation, test pulsing, source exposure).

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7 categories

Note: pixel can only be in one category, with preceding categories taking precedence

1. Masked: masked in equalisation or by user due to large noise, no information.

2. Dead: pixel responded less than 10% of the time to being test pulsed, pixel therefore has problems on the ASIC side.

3. Shorted: pixel responds when not pulsed >=90% of the time (i.e. in 100 frames it records a hit 90 times or more). Sub-ranked by frequency and average no. of counts.

4. Bonding or sensor issues: pixel shows strong test pulse response but no or weak response to source measurement, compared to other pixels in the matrix.

5. Weakly responding: pixel responds weakly to test pulses or weakly during source measurement, compared to other pixels in the matrix.

6. Strongly responding: pixels responds strongly during source measurement, compared to other pixels in the matrix.

7. Normal/expected response: Expected responses seen (strong test pulse response, normal source measurement response, no shorts or other issues).

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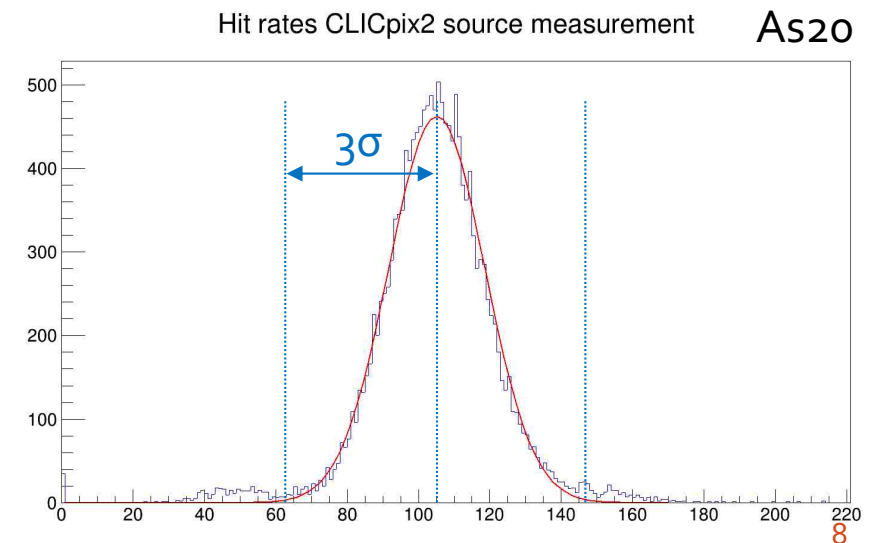
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Definitions

Test pulse strength

THL
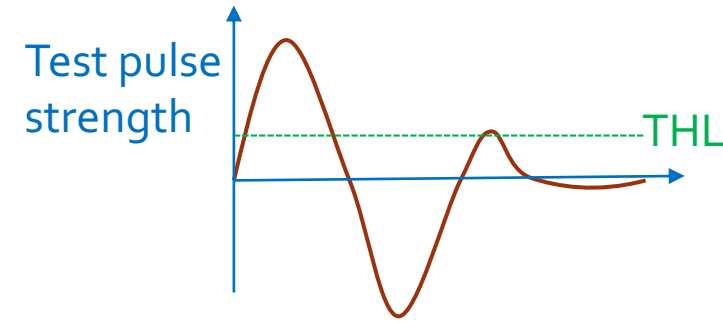
- 'Strong' test pulse response = average counts of the pulsed pixel is between 2 – 1.5 inclusive. This is the expected behaviour, due to the large test pulse magnitude used.

- 'Weak' test pulse response = average counts of the pulsed pixel is between 1.5 – 0 exclusive.

- 'Strong' source response = pixel total number of hits > mean of Gaussian fit to total number of hits 1D histogram + 3 sigma

- 'Weak' source response = pixel total number of hits < mean of Gaussian fit to total number of hits 1D histogram - 3 sigma

- 'Normal' source response = expected behaviour (within 2 sigma of Gaussian mean)

Hit rates CLICpix2 source measurement   As20

3σ

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Results:

1 = masked   2 = dead
3 = shorted   4 = bonding/sensor issue
5 = weak   6 = strong
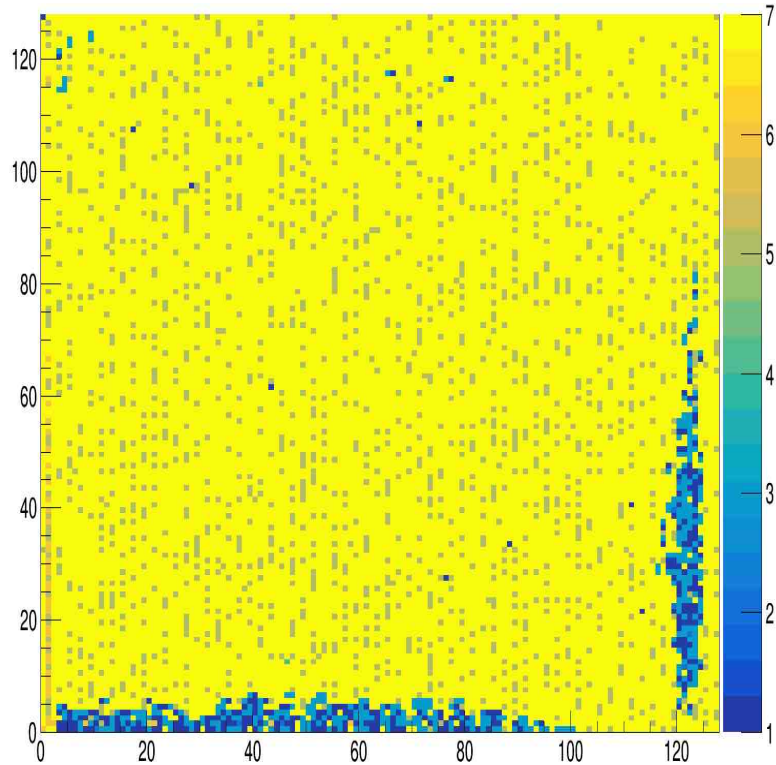7 = normal / expected
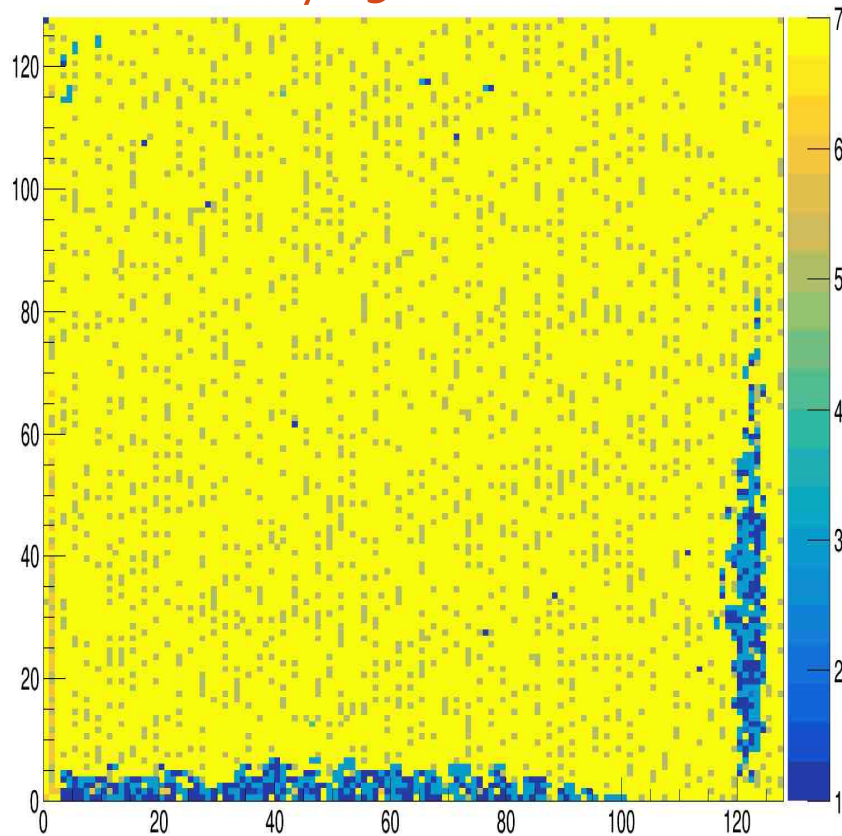
- Assembly 19:

- Assembly 20:
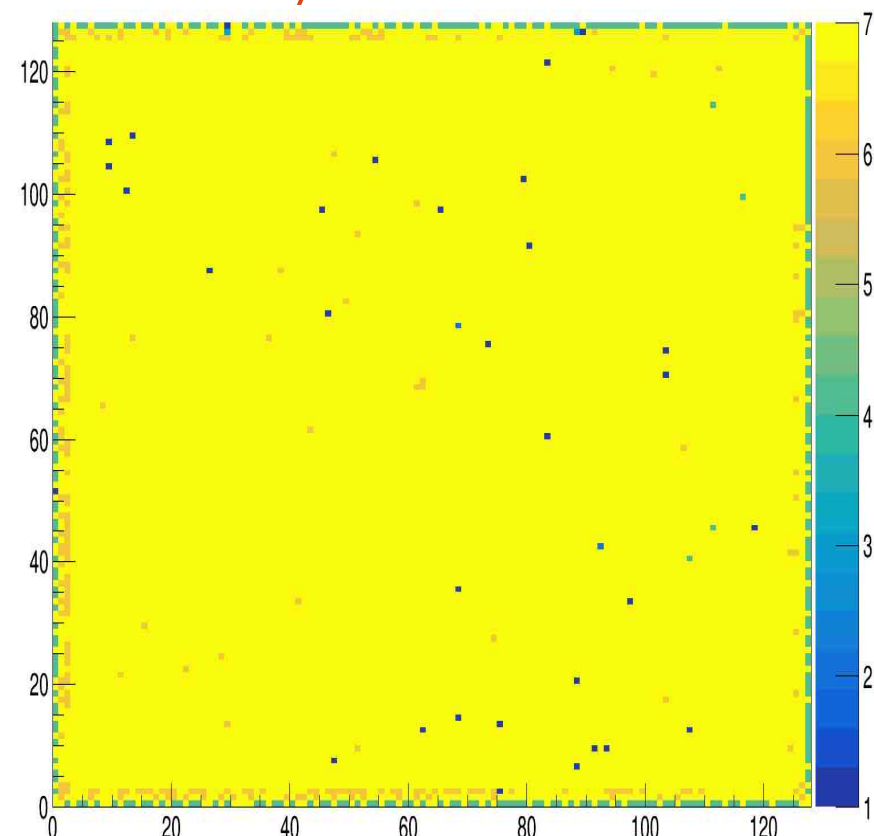
1) Masked and 2) Dead

- Assembly 19

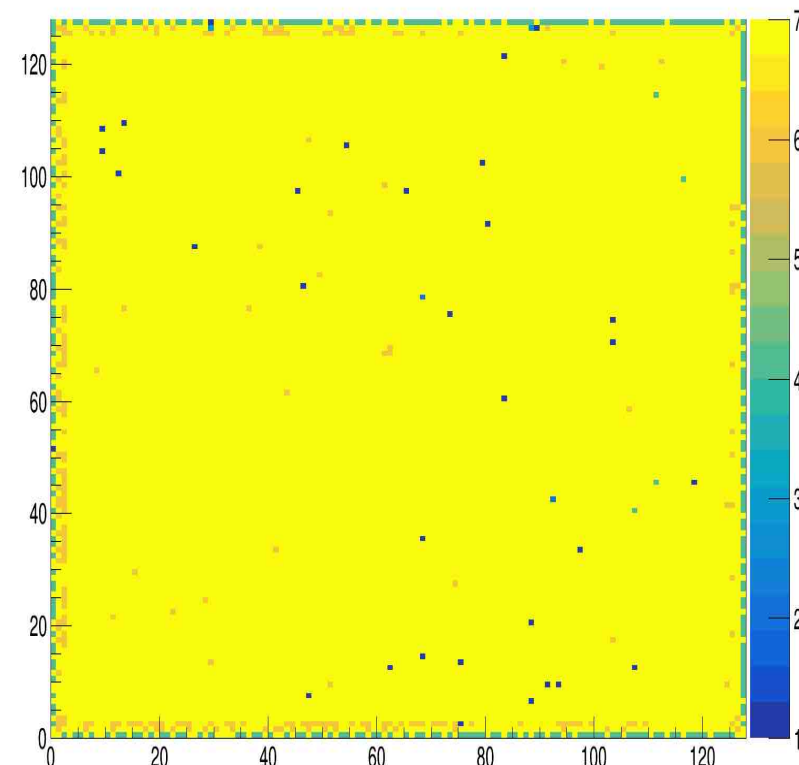No. masked = 270,   mostly in 2 regions

No. dead = 10,   ~random across matrix

- Assembly 20

No. masked = 32,   random across matrix

No. dead = 2,   random across matrix

3) Shorted

Definitions:
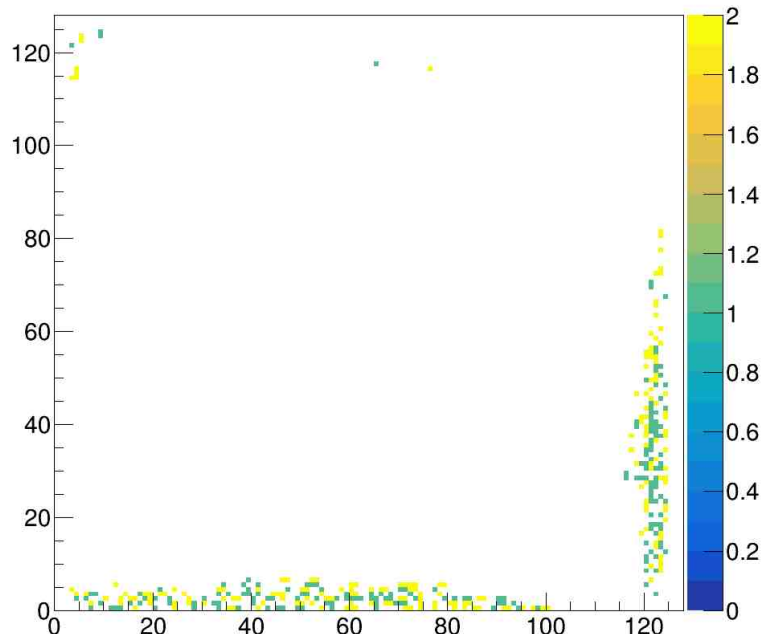'always' = hit present for 90% of the total number of frames
'strong' = average counts >=1.5
'weak' = average counts <1.5

- Assembly 19:

No. of shorts = 359
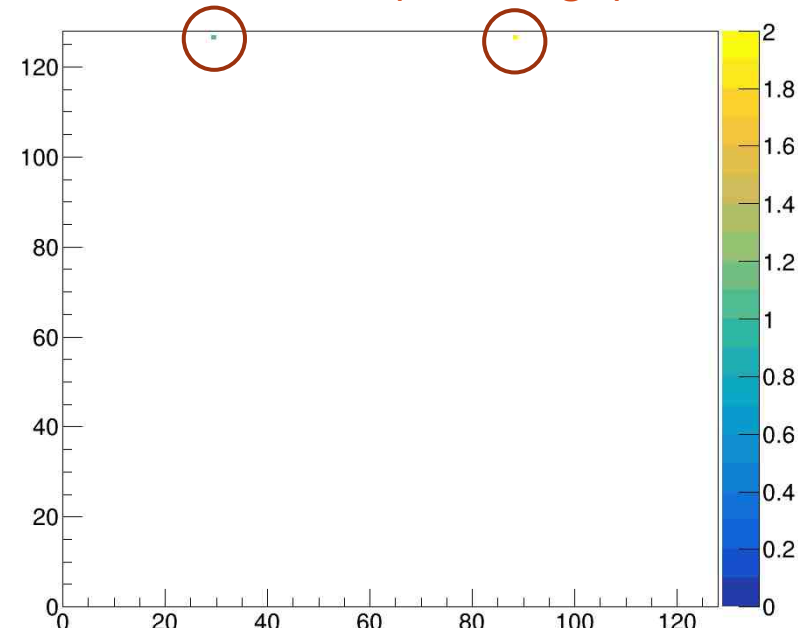
174 always, weak (green)

185 always, strong (yellow)

- Assembly 20:

No. of shorts = 2

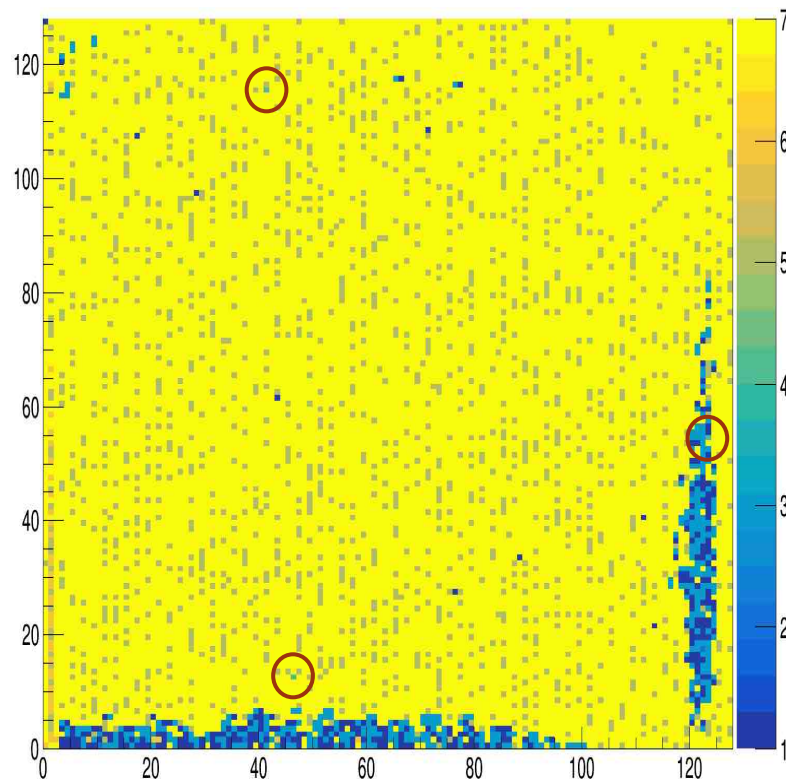1 always, weak (green)

1 always, strong (yellow)

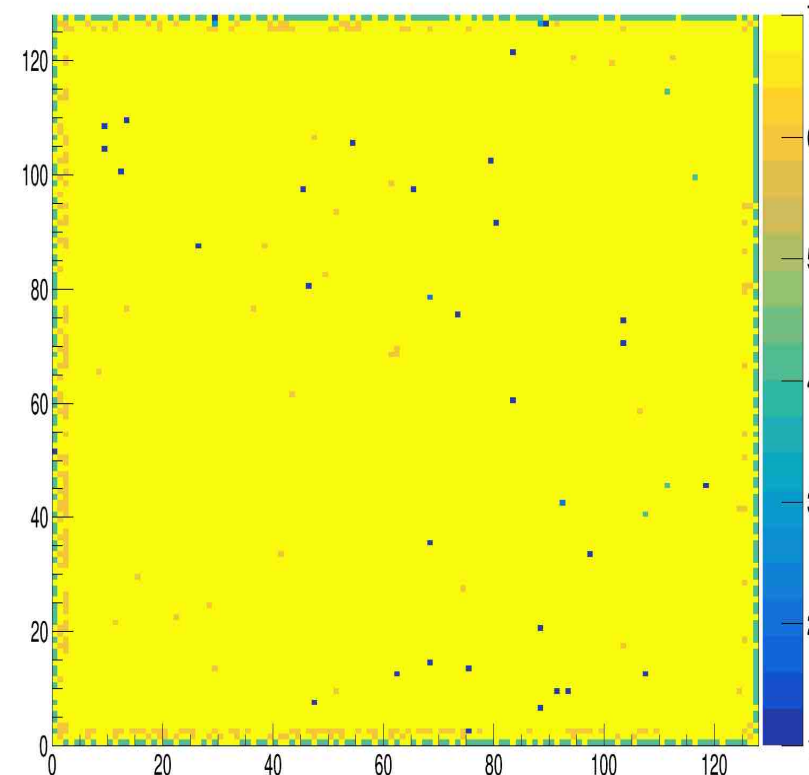Most likely noisy pixels that should have been masked.

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4) Bonding or sensor issues

1 = masked   2 = dead
3 = shorted   4 = bonding/sensor issue
5 = weak   6 = strong
7 = normal / expected

- Assembly 19:

No. with bonding/sensor issues = 3

- Assembly 20:

No. with bonding/sensor issues = 344

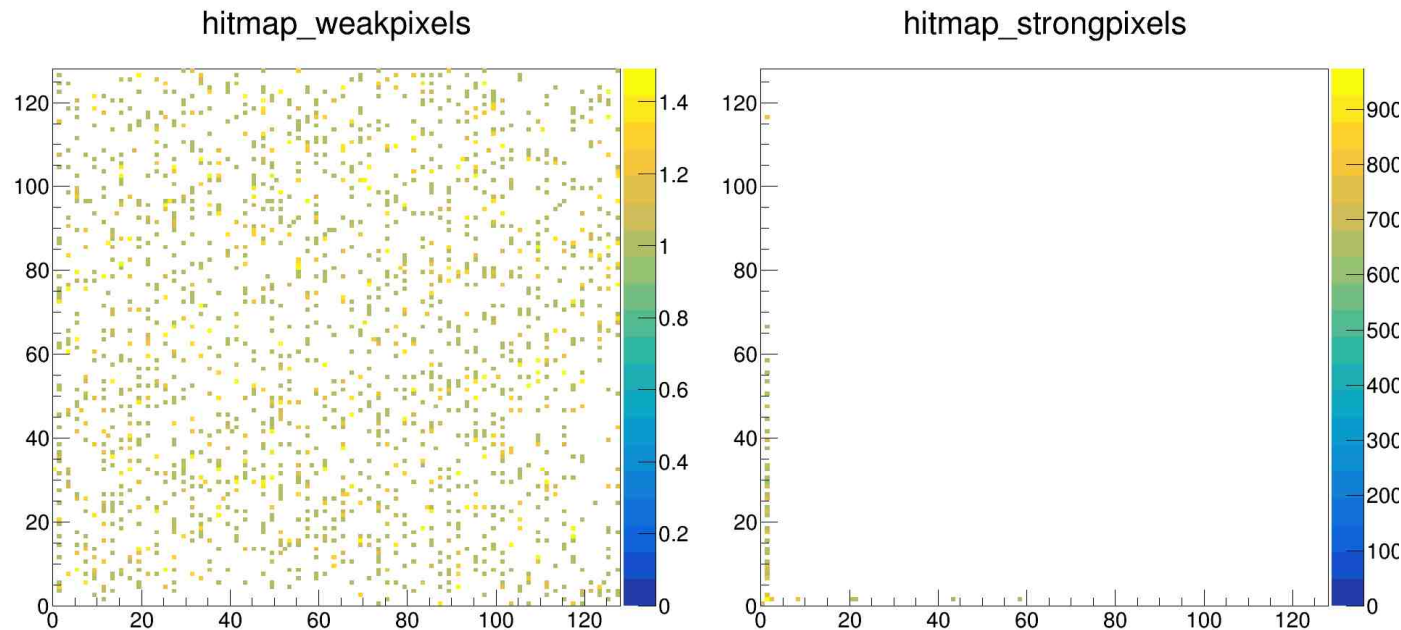High number is due to edge pixels -> to be investigated

5) Weakly and 6) strongly responding

- Assembly 19:

No. weakly responding pixels = 1691, random distribution

No. strongly responding pixels = 40,

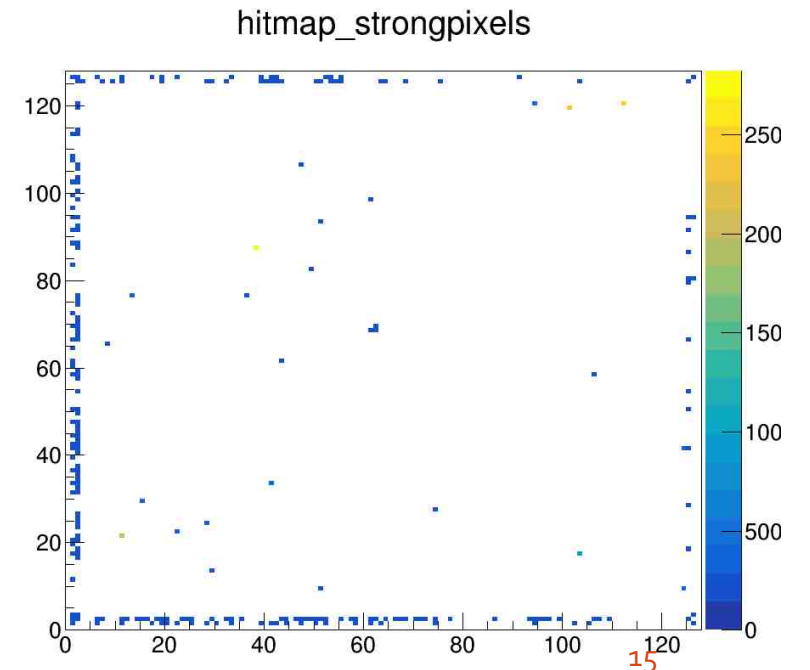In bottom left corner due to source placement -> to redo

- Assembly 20:

No. weakly responding pixels = 0

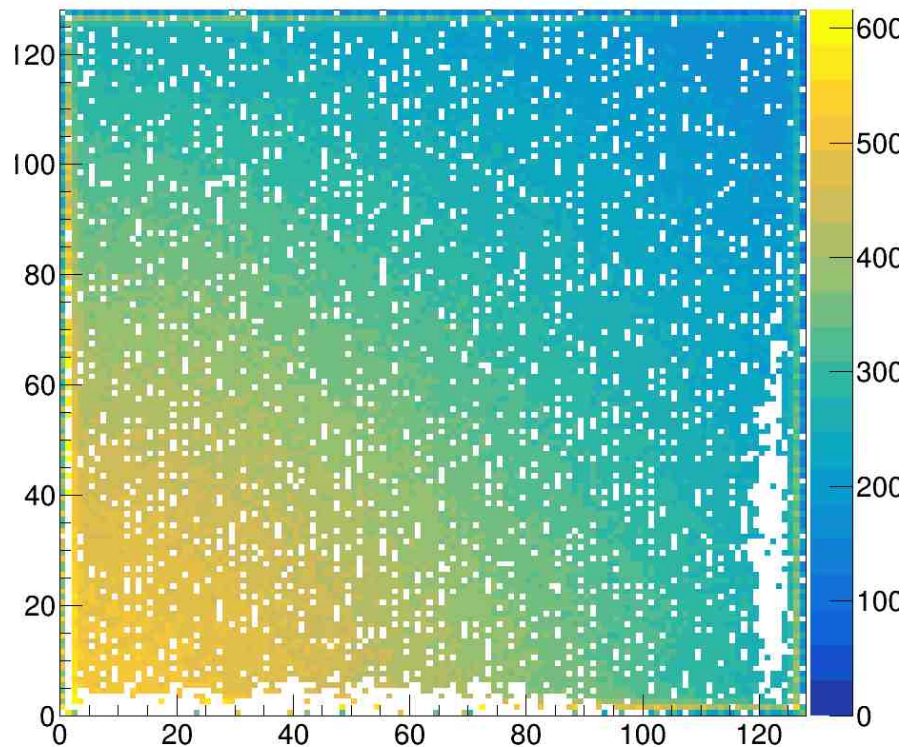No. strongly responding pixels = 247

2nd and 3rd rows and columns from the edge

hitmap_weakpixels

hitmap_strongpixels

hitmap_strongpixels
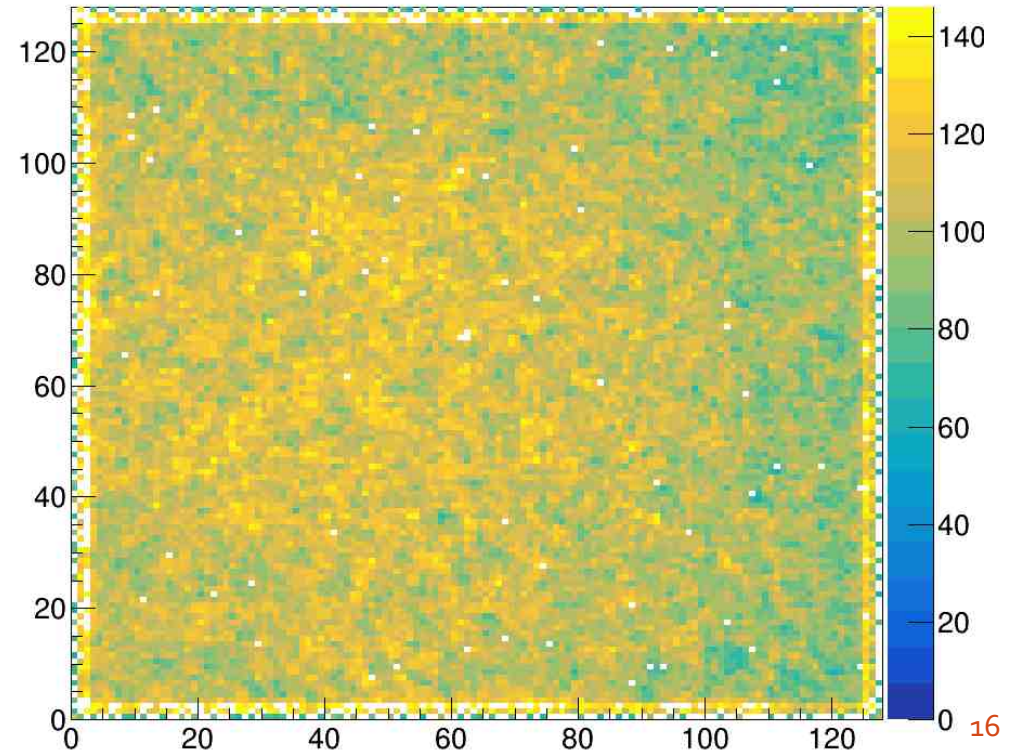
7) expected/normal response

- Assembly 19:

No. normally responding pixels = 14011

- Assembly 20:

No. normally responding pixels = 15757

Summary

- Advacam sensor is unresponsive after bias voltage -> to be investigated.

- 2 FBK assemblies: one has 2 very noisy regions, one has good performance bar an edge effect.

- Edge effects have also been seen in assembly 16 and this will be investigated further.

- Laboratory analysis of new assemblies:

    - much more complex

    - have data-driven categories and cuts

    - analysis can be performed in less than 2 minutes