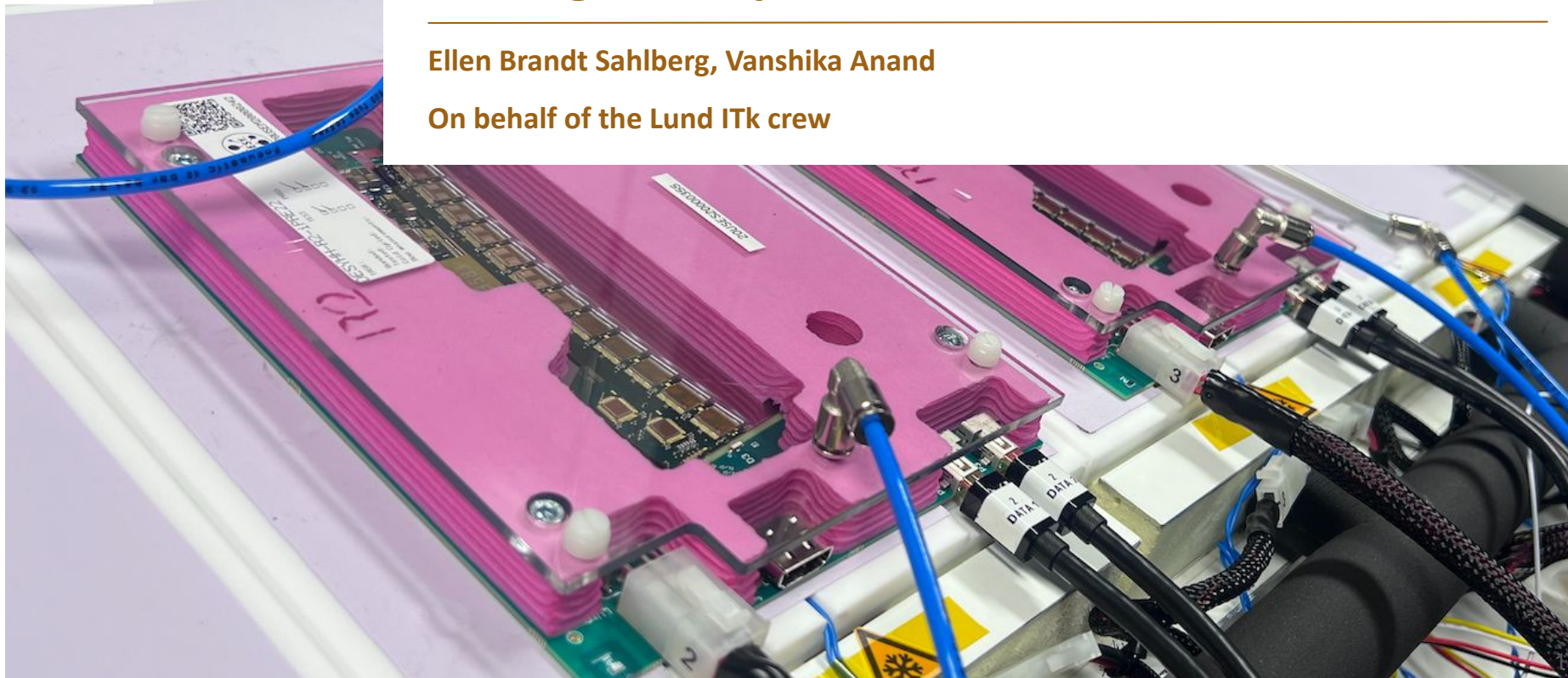


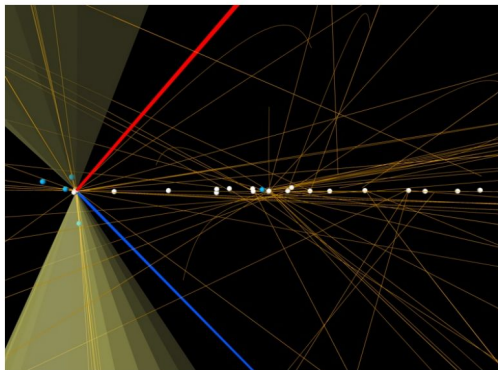
Testing Endcap Modules for ATLAS-ITk

Ellen Brandt Sahlberg, Vanshika Anand

On behalf of the Lund ITk crew

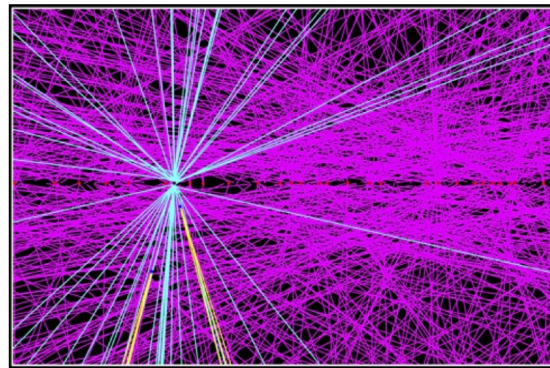


ATLAS upgrade

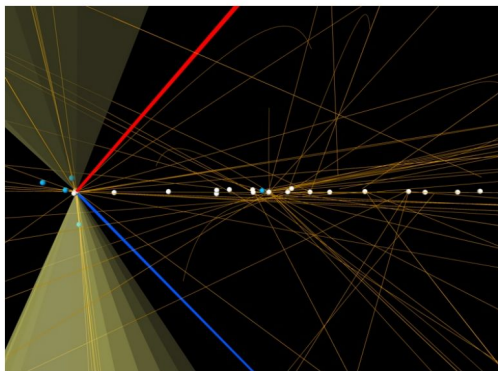


Source: [Link](#)

**x10 Intensity,
Collisions/Bunch-crossings**

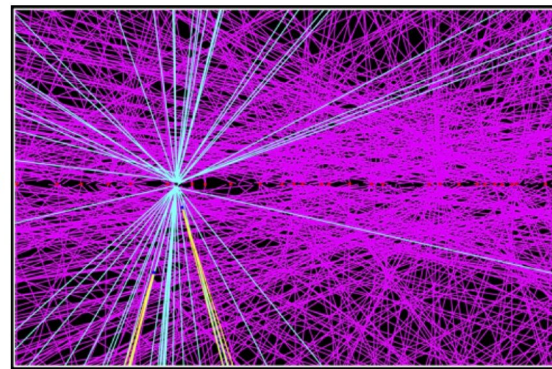


ATLAS upgrade



Source: [Link](#)

x10 Intensity,
Collisions/Bunch-crossings

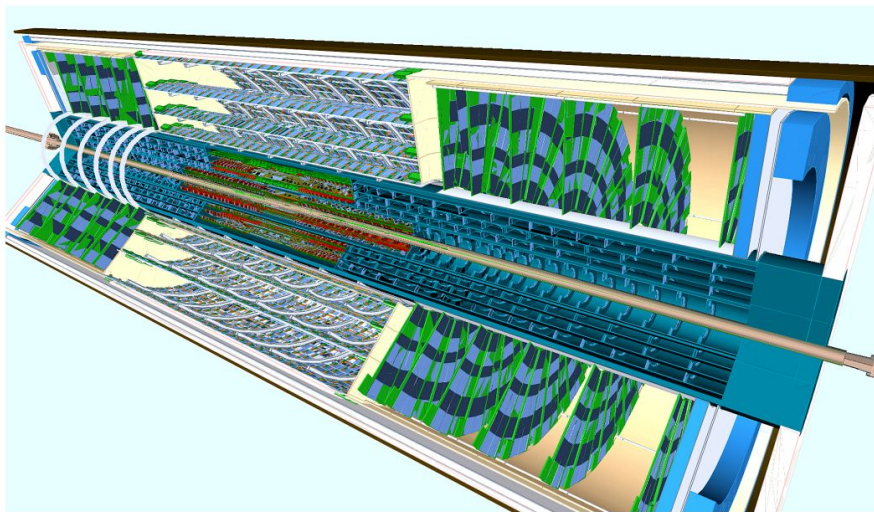


Faster
response

Segmentation

Radiation
tolerance

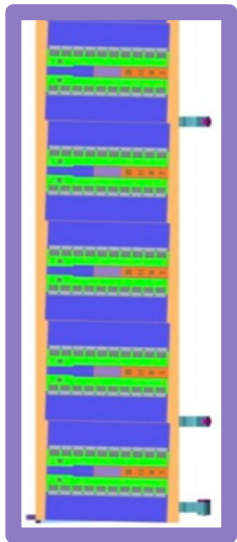
ATLAS Inner Tracker (ITk)



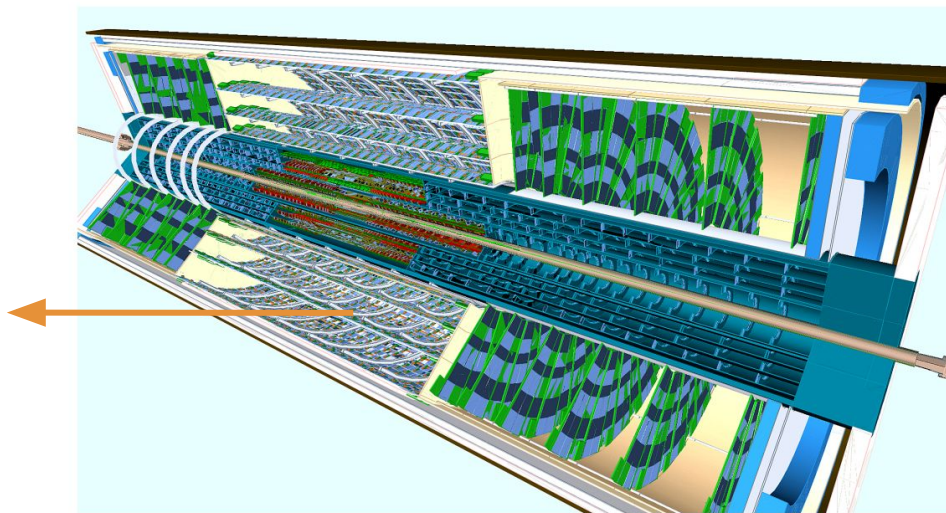
Source: ATLAS-TDR-025

ATLAS Inner Tracker (ITk)

Barrel



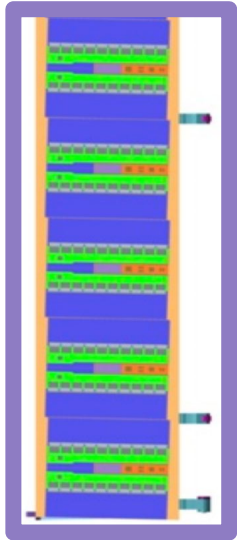
Source: [Link](#)



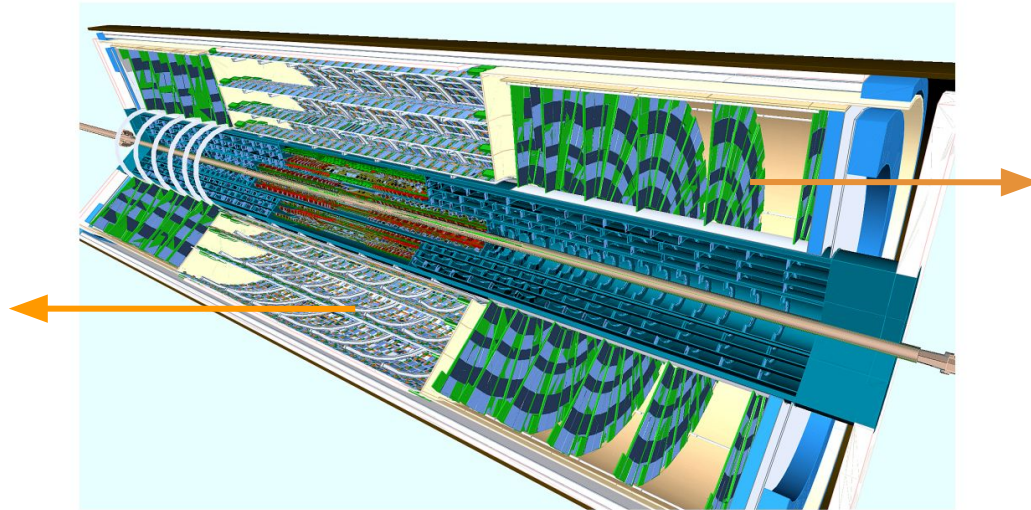
Source: ATLAS-TDR-025

ATLAS Inner Tracker (ITk)

Barrel

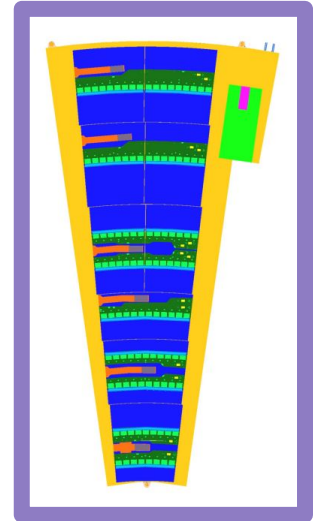


Source: [Link](#)



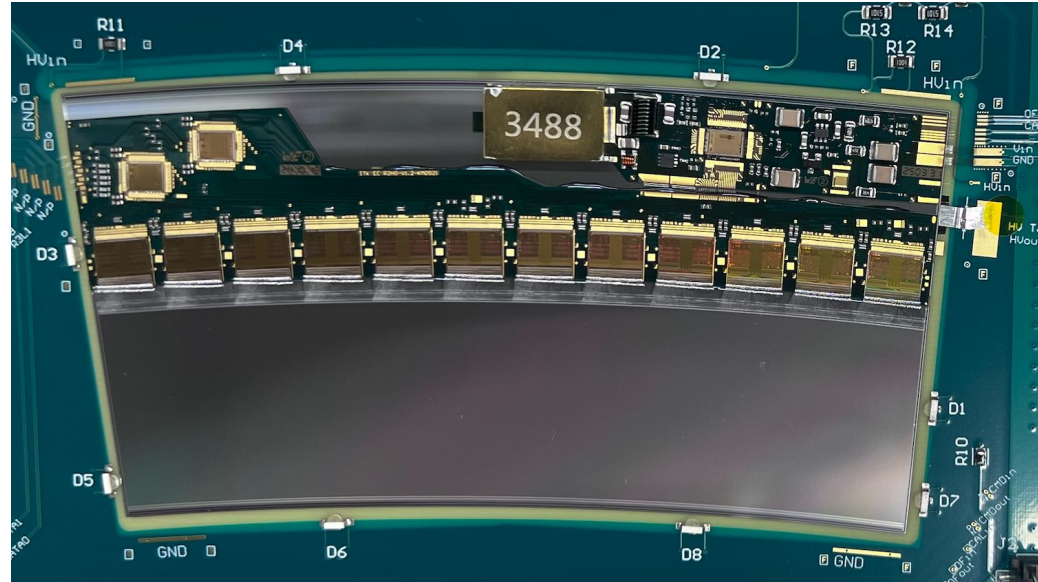
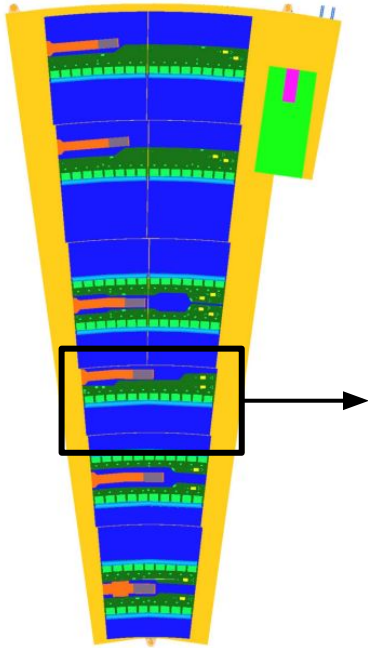
Source: ATLAS-TDR-025

Endcap



Source: [Link](#)

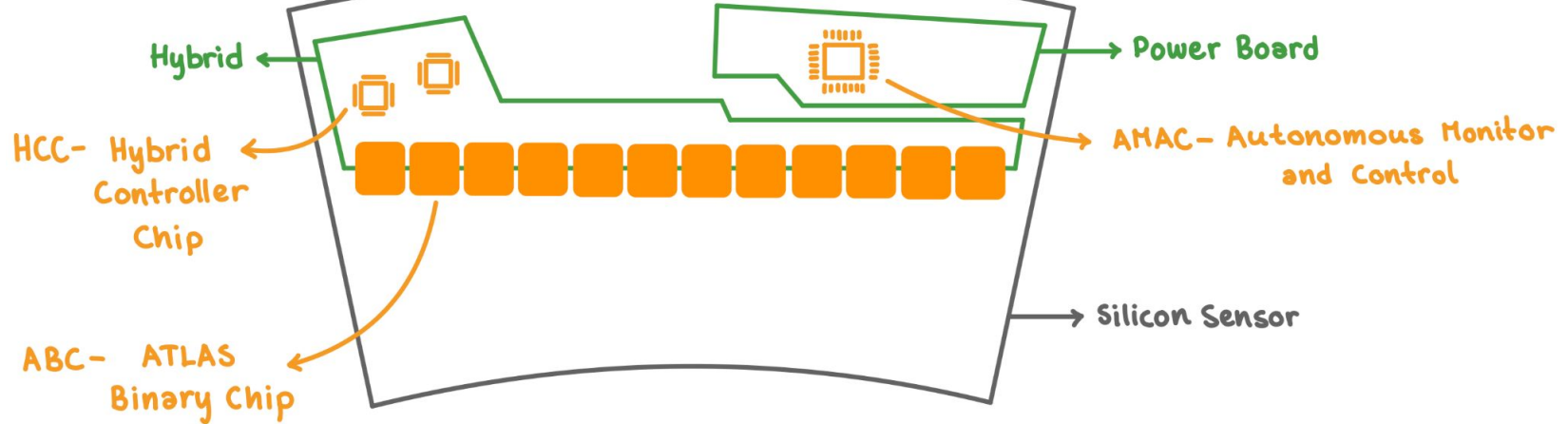
Endcap Module Structure



Source: [Link](#)

Endcap Module Schematic

R2 module

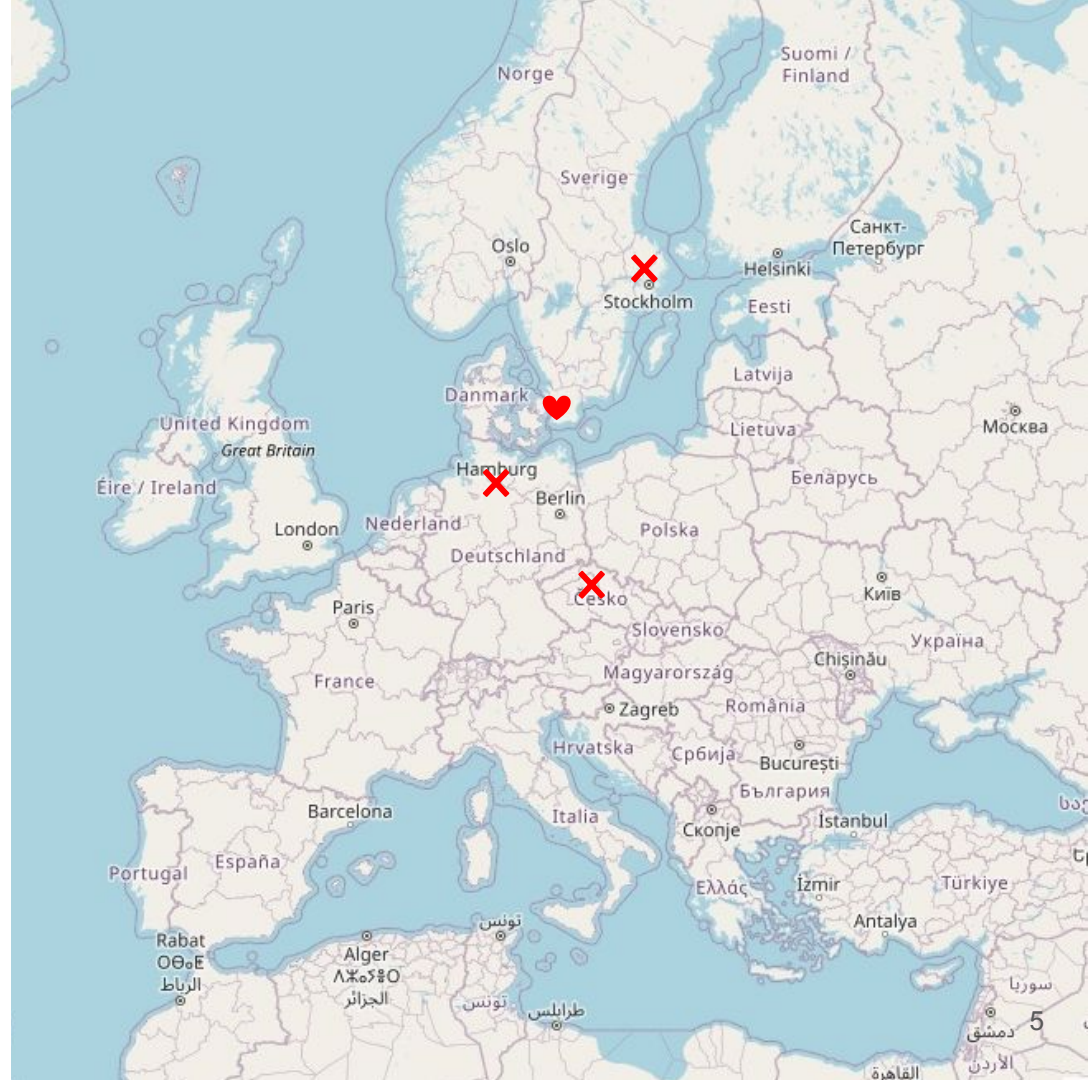


Where does the modules tested in Lund come from?

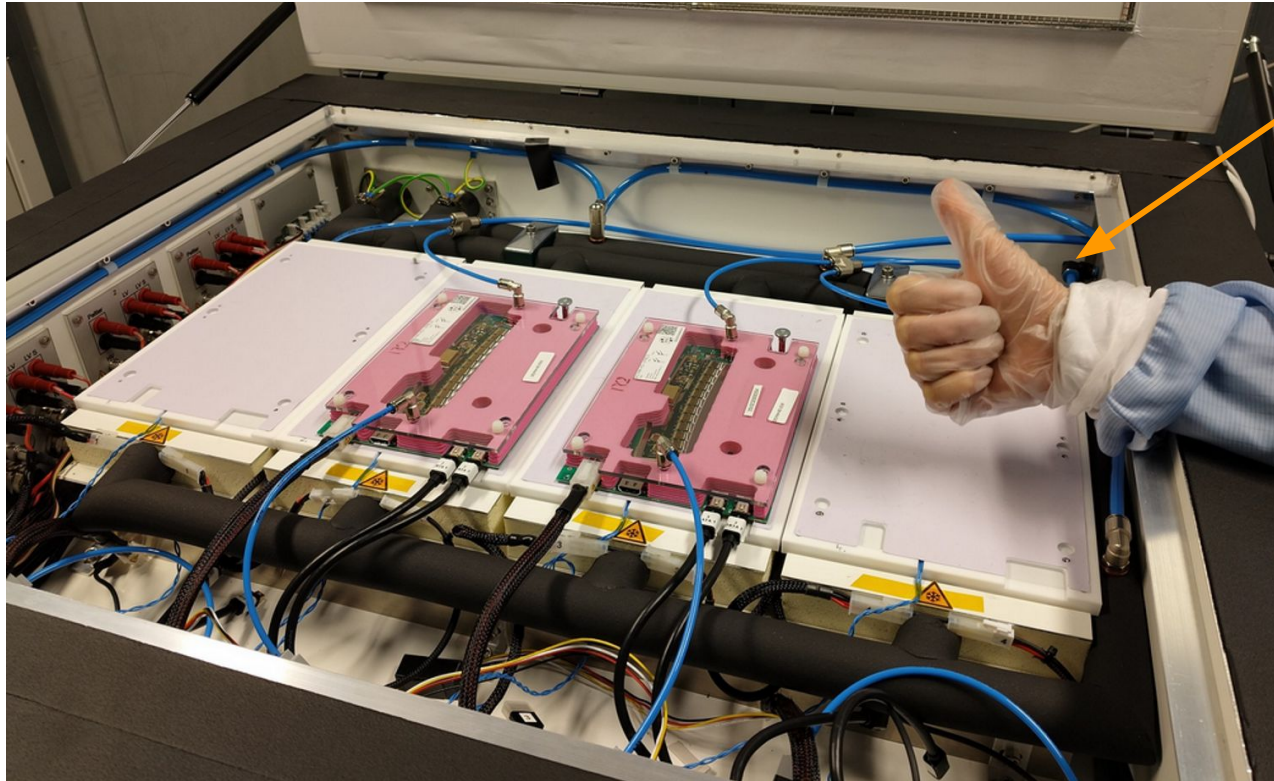
Uppsala - Producing Hybrids

DESY (Hamburg) - Producing Modules

Prague - Producing Modules

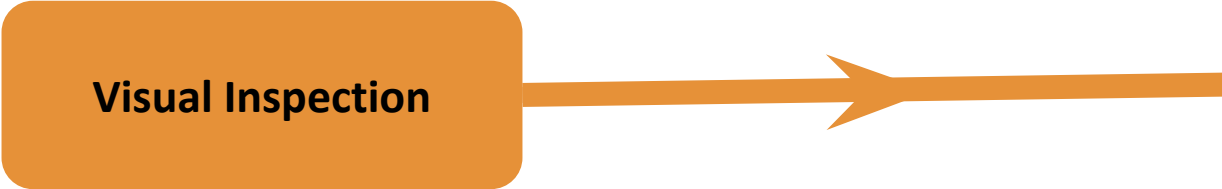


QUALITY TEST PROTOCOL AT LUND

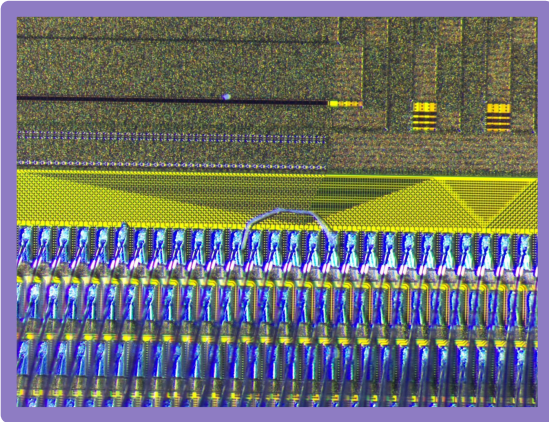


Ellen's
thumb

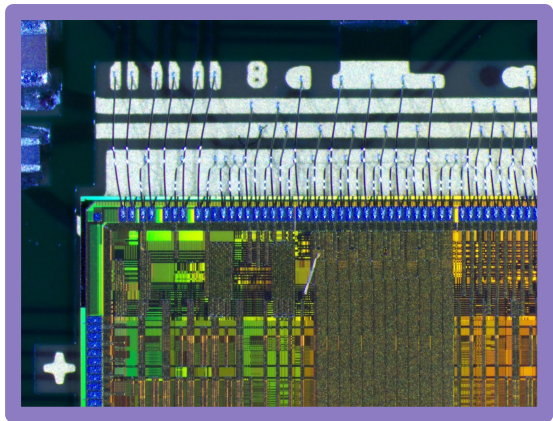
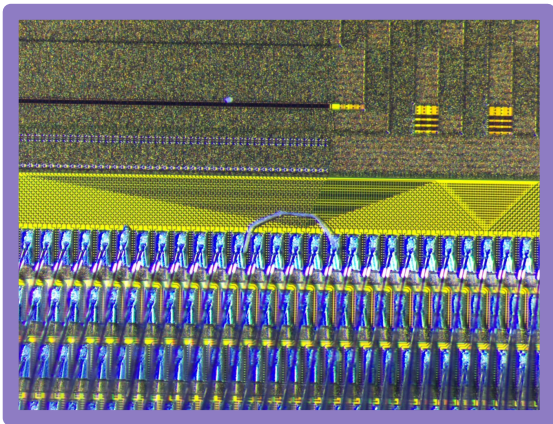
Visual Inspection



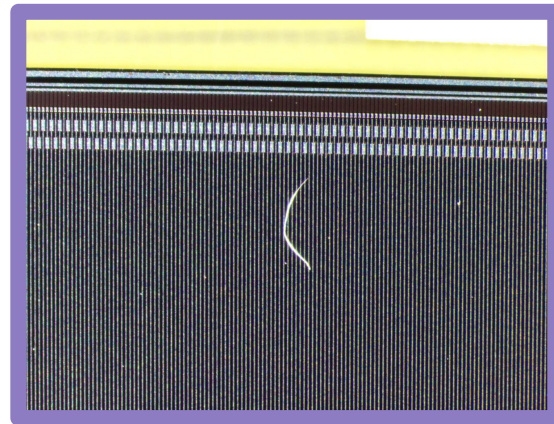
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graph LR; A[Visual Inspection] --> B[ ]
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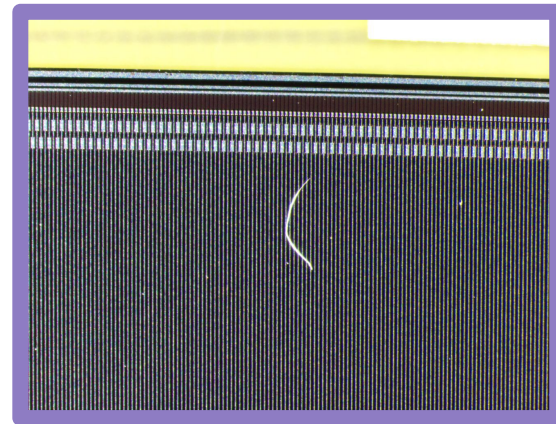
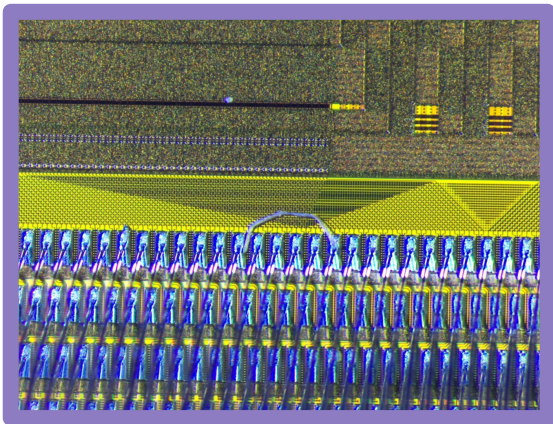


Visual Inspection

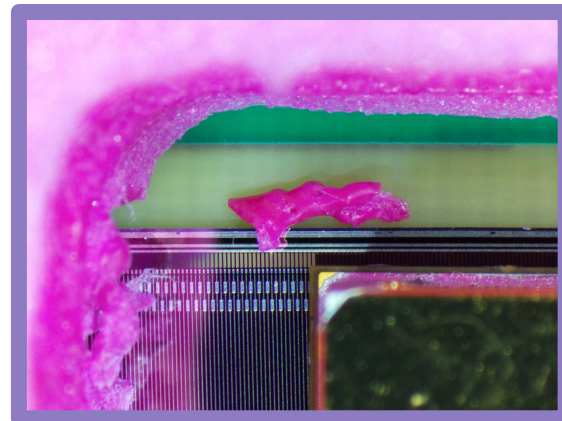
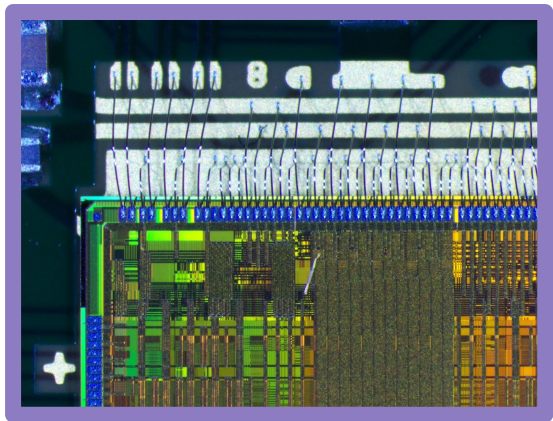


Visual Inspection





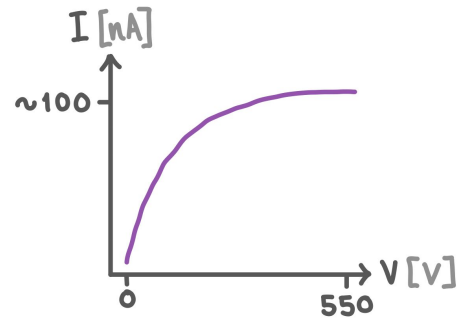
Visual Inspection





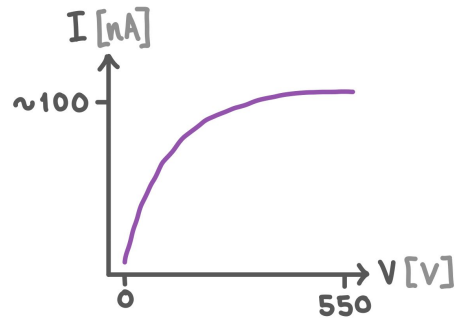
Electrical Tests

IV Scan



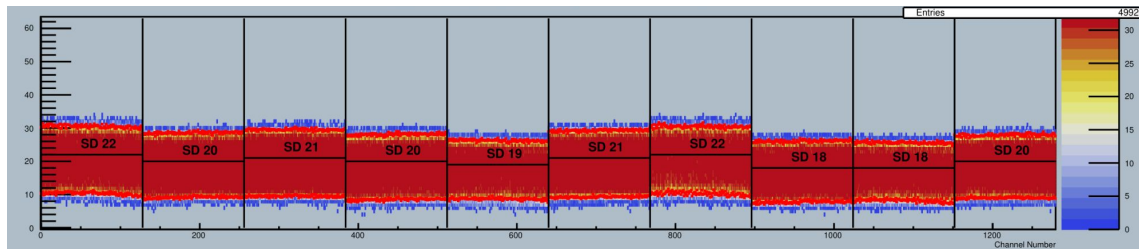
Electrical Tests

IV Scan

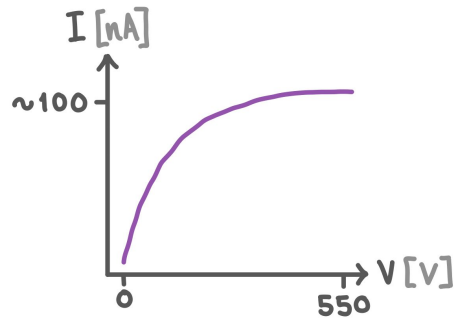


Electrical Tests

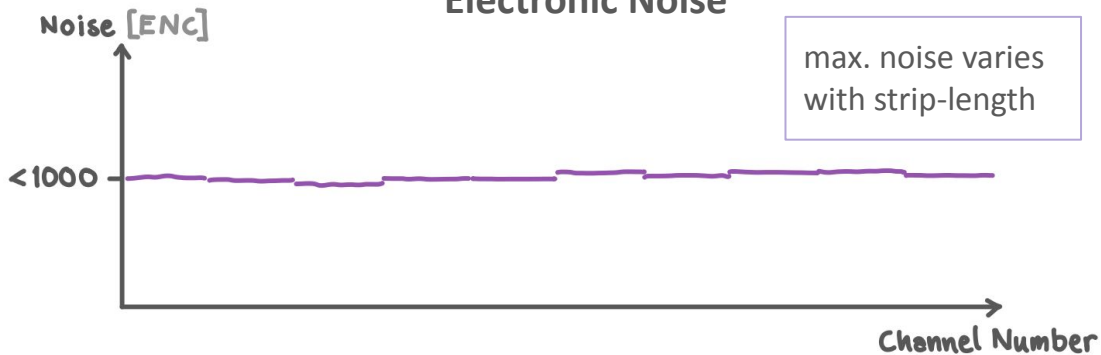
Timing delay calibration



IV Scan

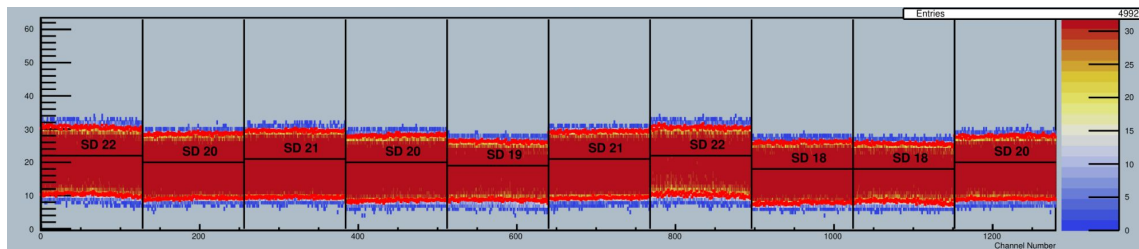


Electronic Noise

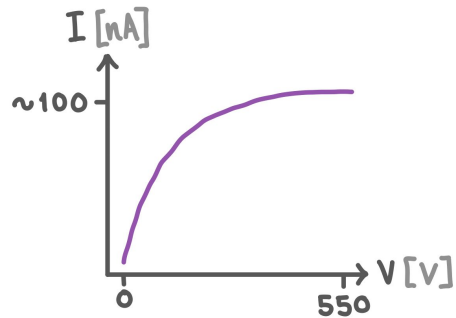


Electrical Tests

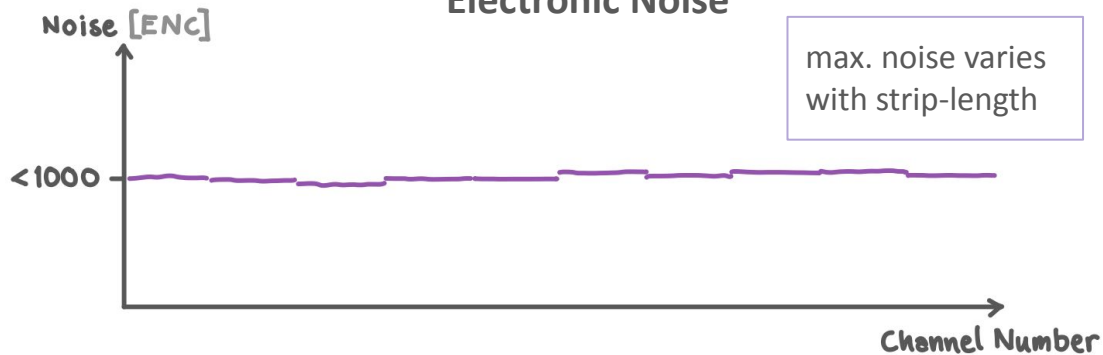
Timing delay calibration



IV Scan

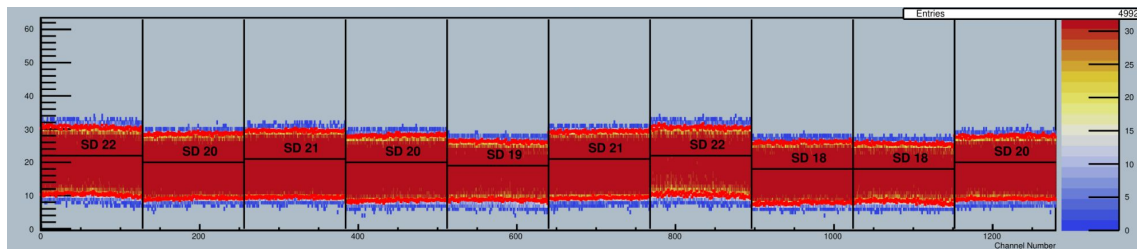


Electronic Noise

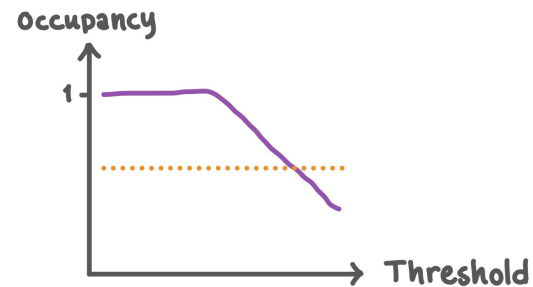


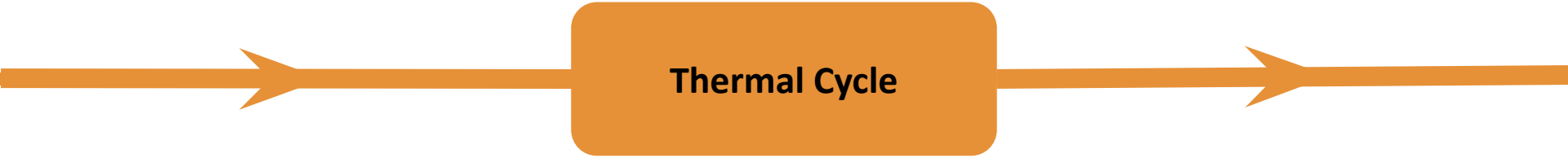
Electrical Tests

Timing delay calibration

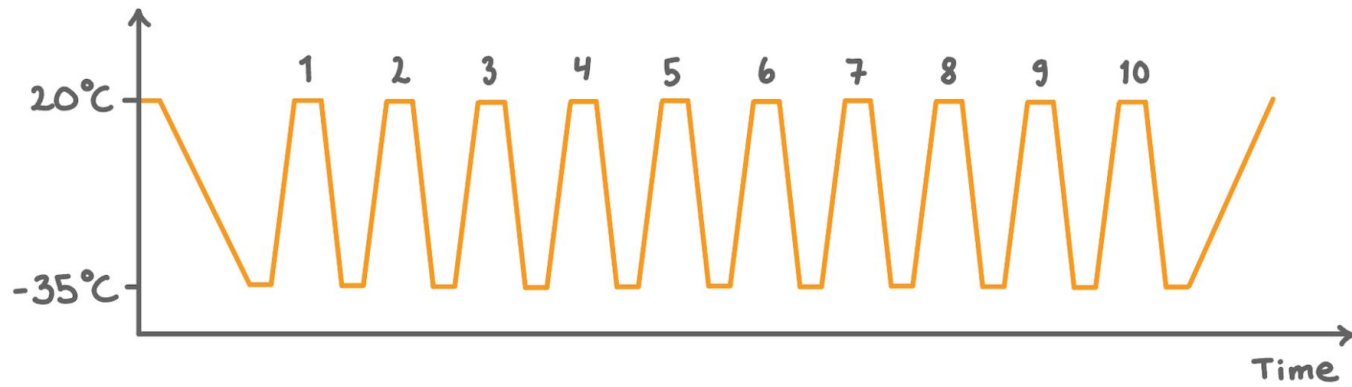


Noise Occupancy

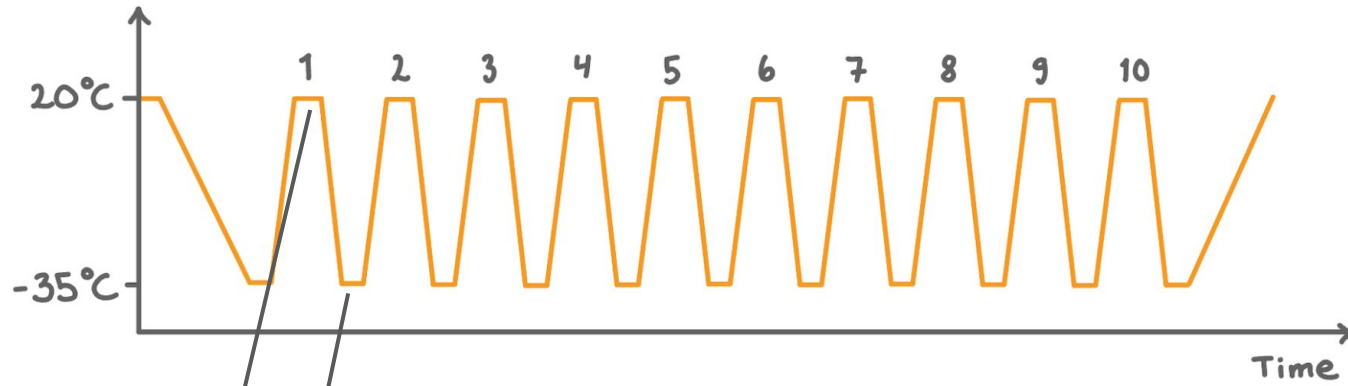




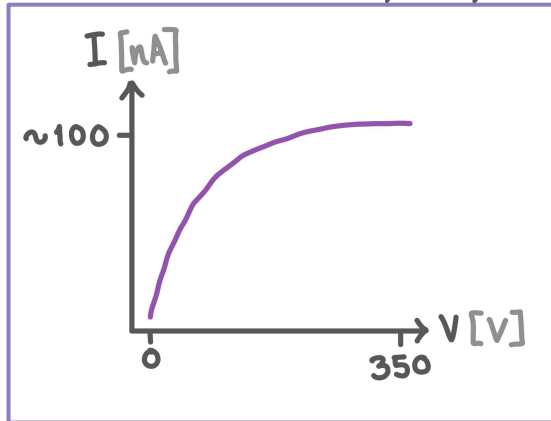
Thermal Cycle

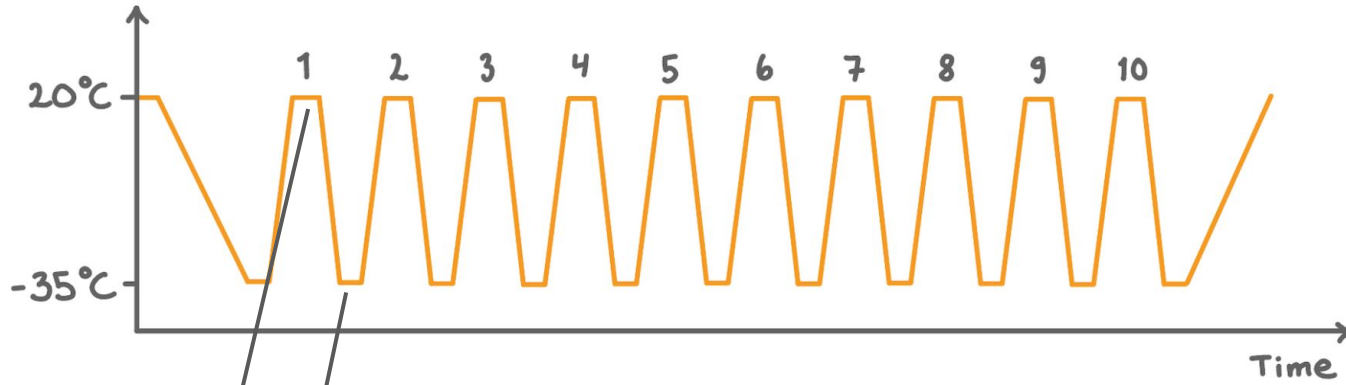


Thermal Cycle



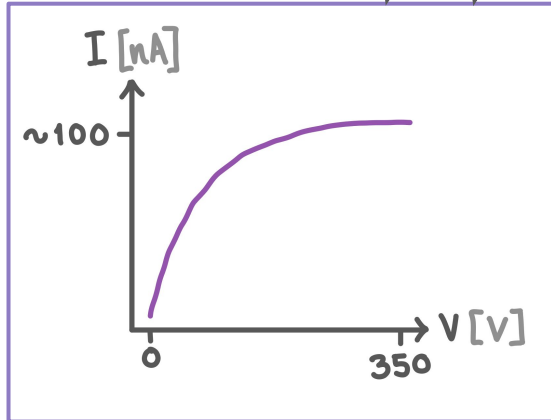
Thermal Cycle

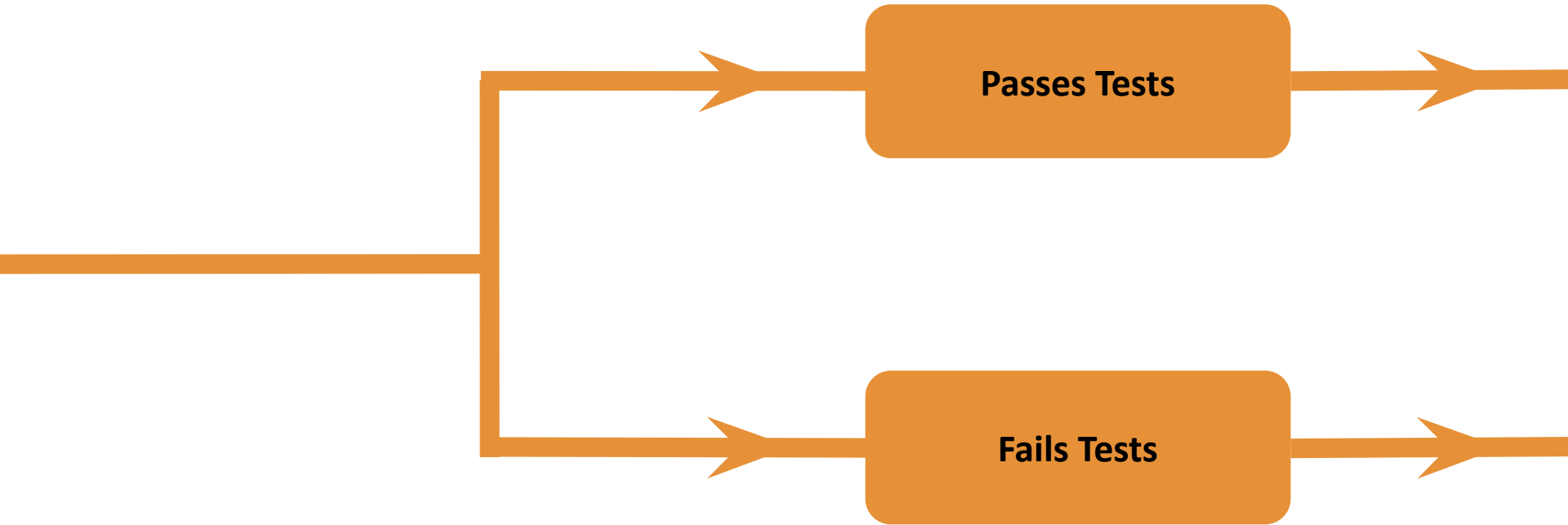




Thermal Cycle

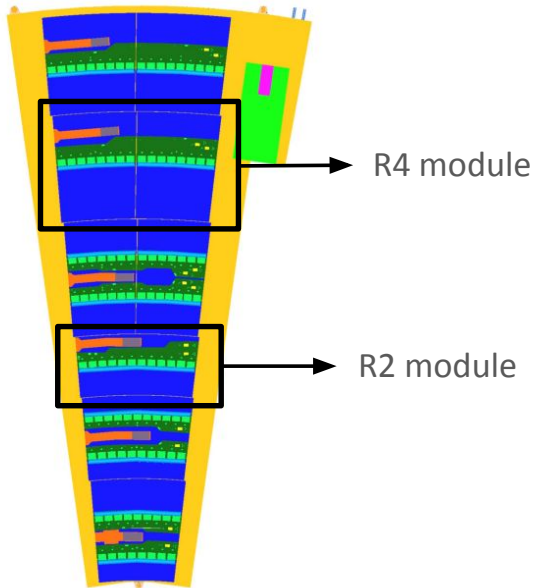
Full thermal cycle takes around 20-24 h





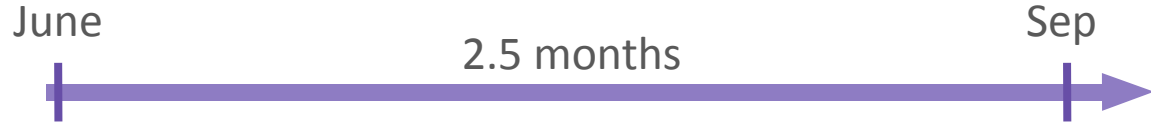
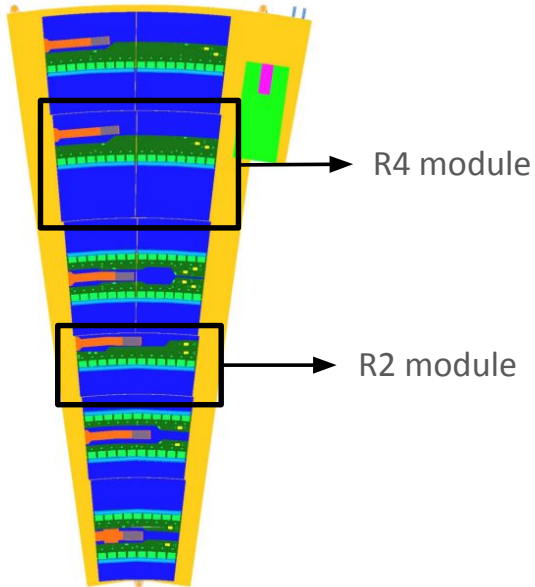
What happens when modules have passed?

Passes Tests



What happens when modules have passed?

Passes Tests



22 modules have been thermal cycled

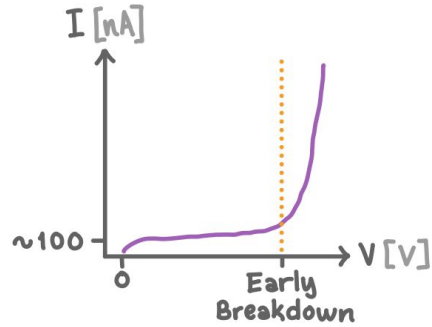
- 8 R4s
- 14 R2s

11 modules are on petals and ready for the detector

What happens when modules have failed?

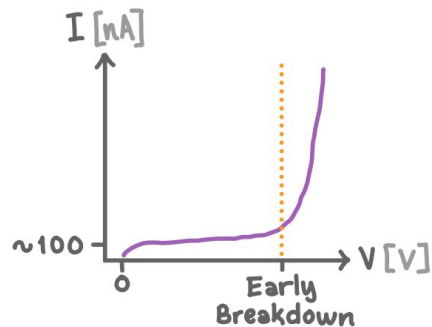
Fails Tests

What happens when modules have failed?

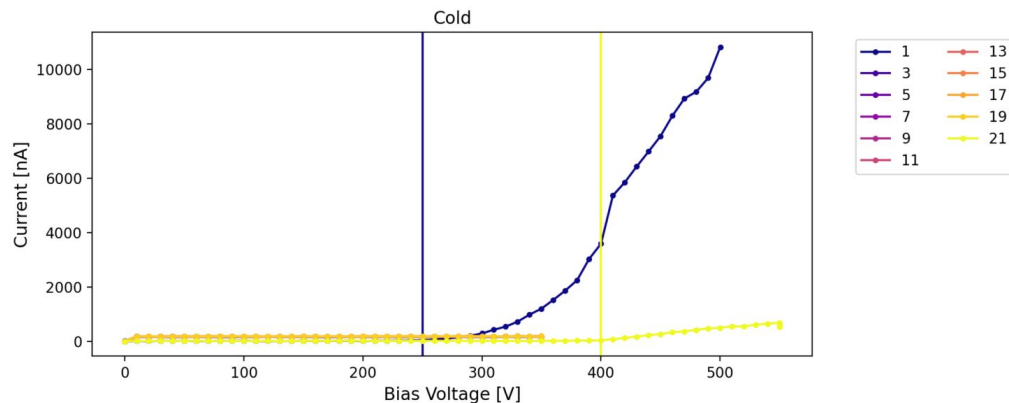
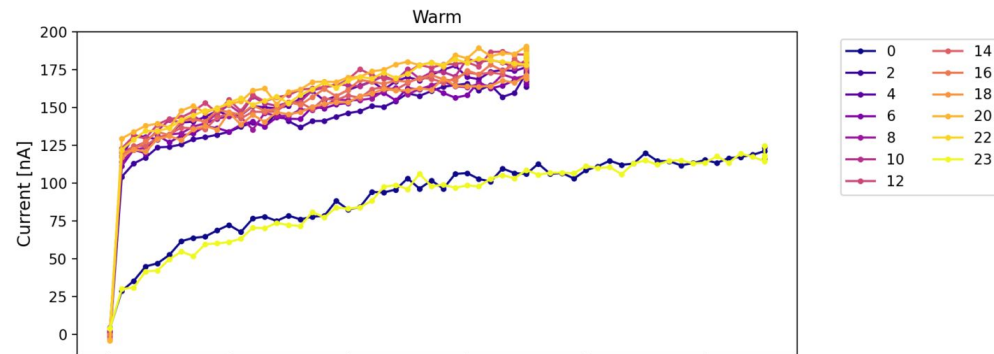


Fails Tests

What happens when modules have failed?

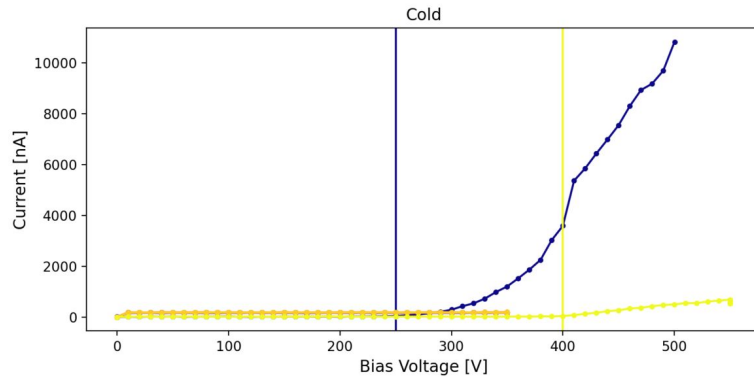


Fails Tests



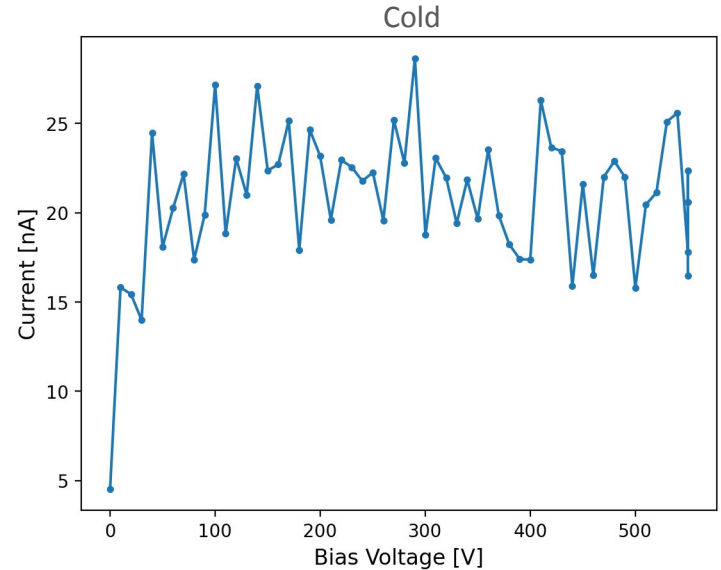
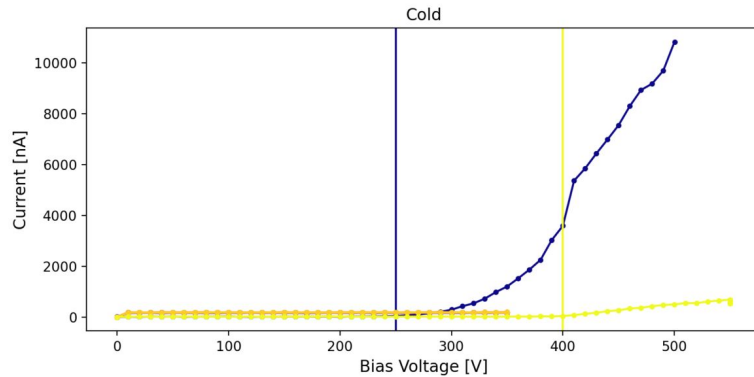
What happens when modules have failed?

Left in dry environment



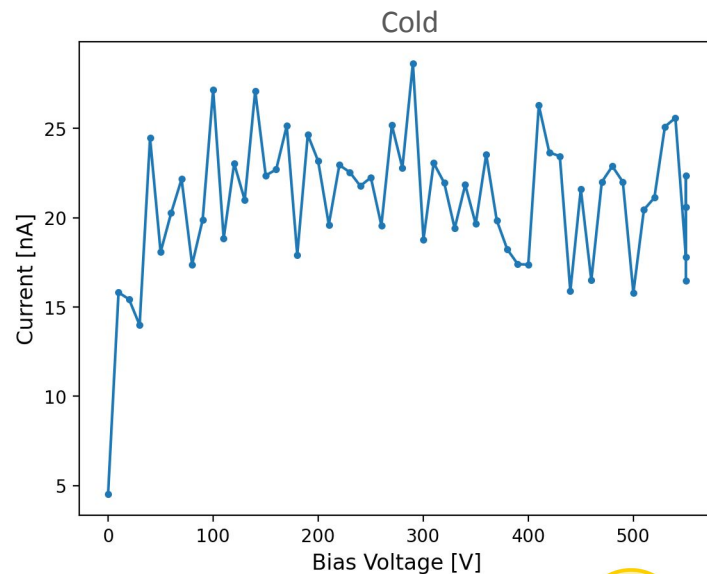
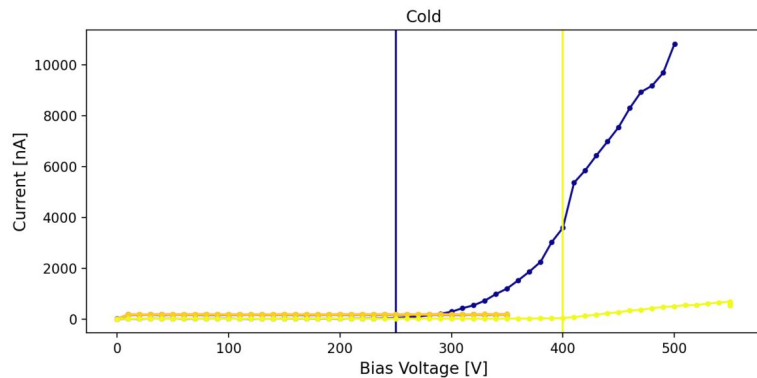
What happens when modules have failed?

Left in dry environment



What happens when modules have failed?

Left in dry environment



Outlook

Outlook

Continue thermal cycling of production modules

Outlook

Continue thermal cycling of production modules

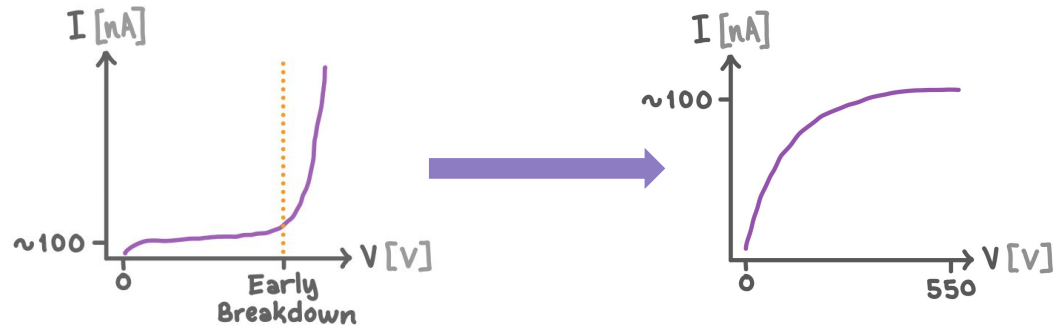
Treating modules showing odd behavior

Outlook

Continue thermal cycling of production modules

Treating modules showing odd behavior

Curing early IV-breakdowns



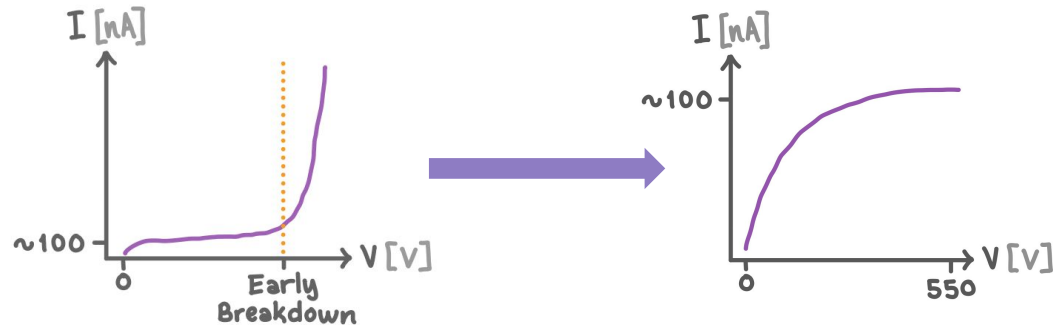
Outlook

Continue thermal cycling of production modules

Treating modules showing odd behavior

- Exploring techniques tried at other locations

Curing early IV-breakdowns



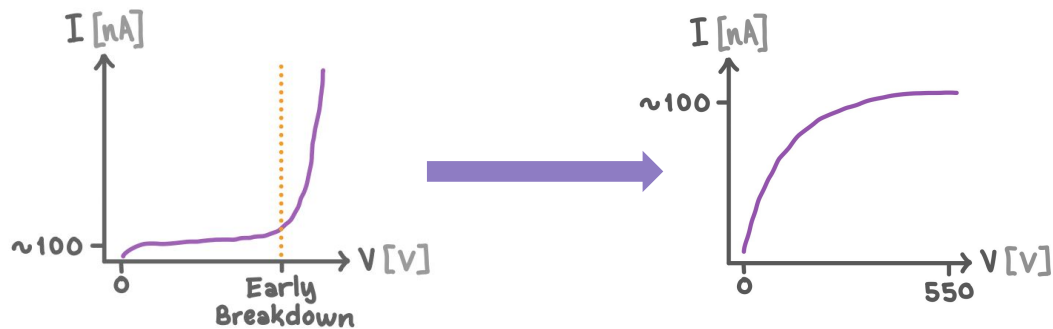
Outlook

Continue thermal cycling of production modules

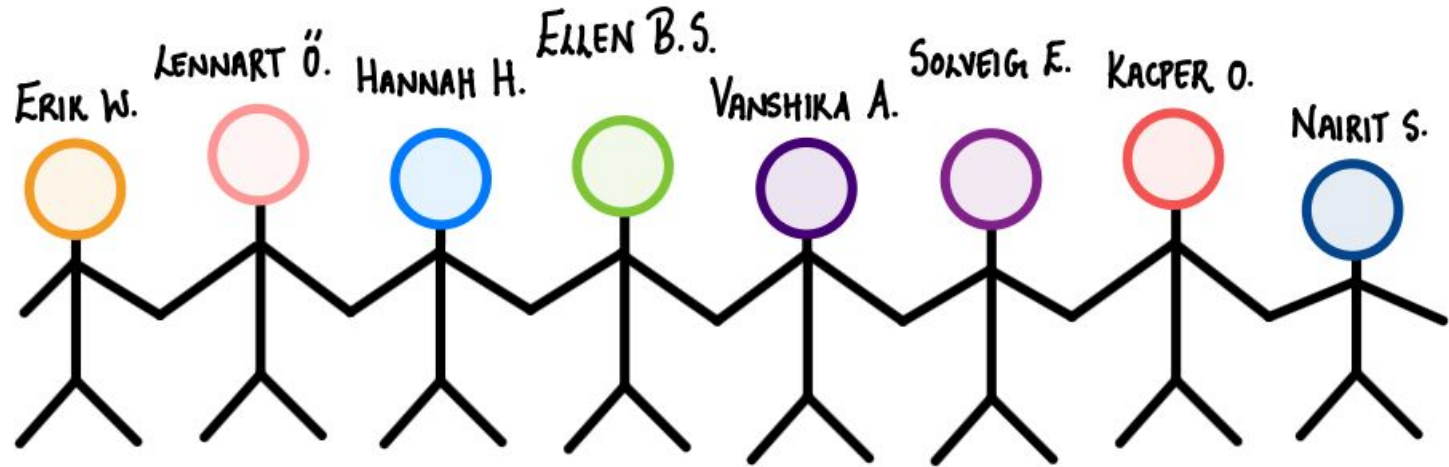
Treating modules showing odd behavior

- Exploring techniques tried at other locations

Curing early IV-breakdowns

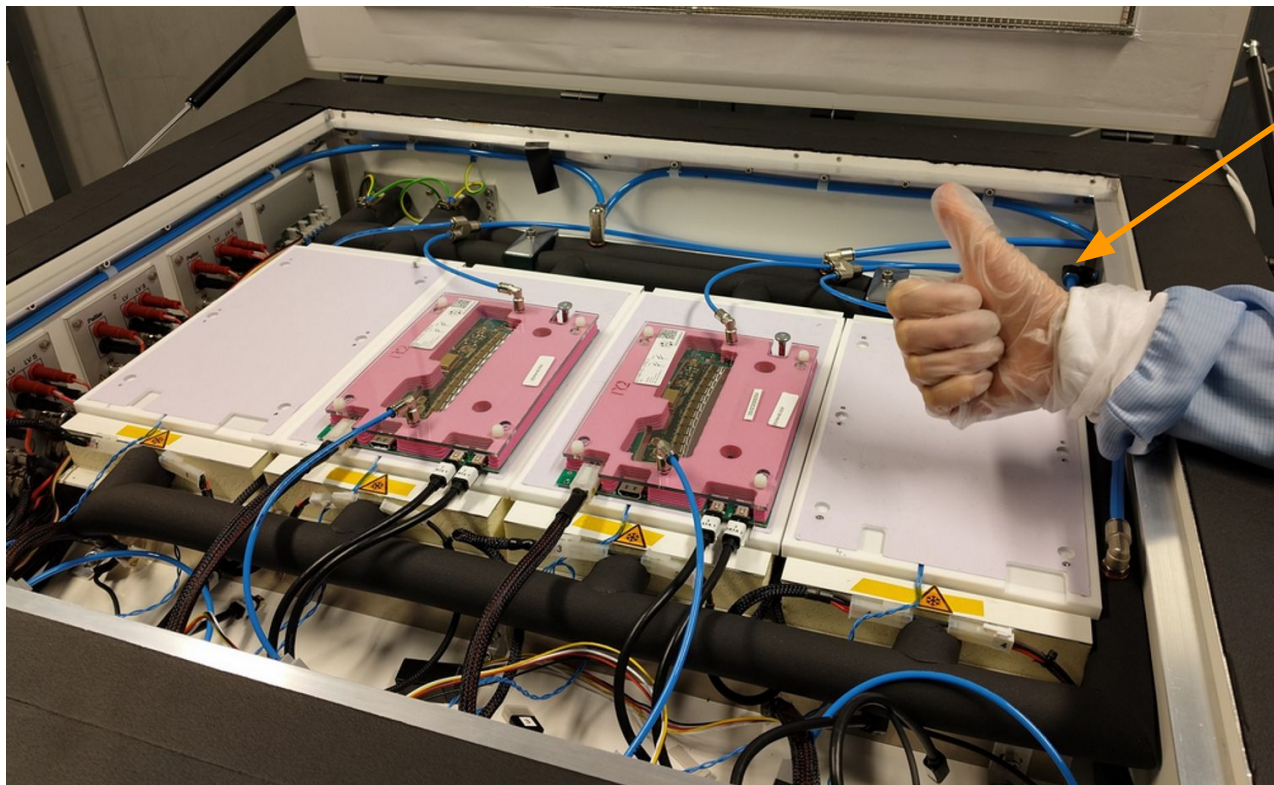


Thanks for listening



Thanks to the Lund ITk team for your work!

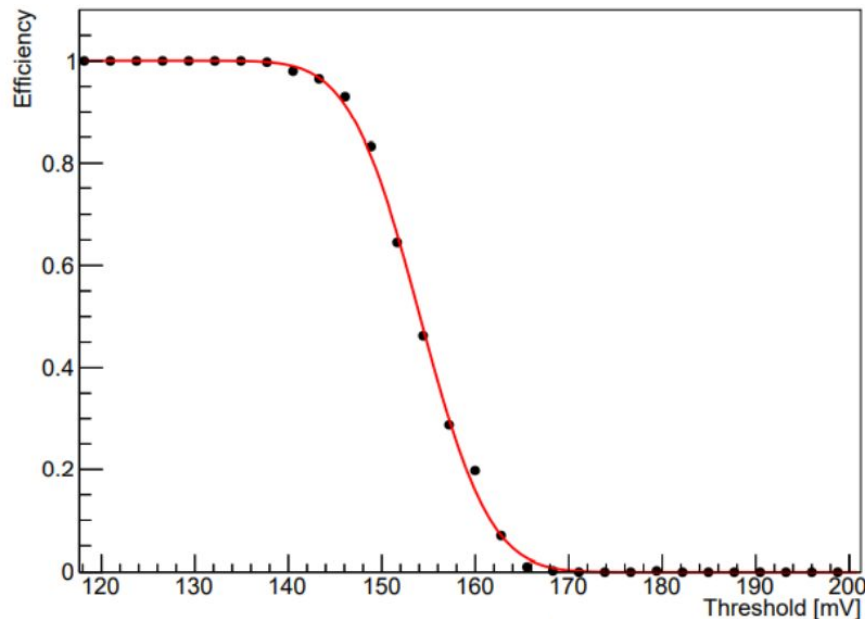
Backup slides



Ellen's
thumb

Pedestal Trim

- The average hits across a voltage threshold sweep are recorded.
- The median threshold value (VT50) is equalised across all channels.

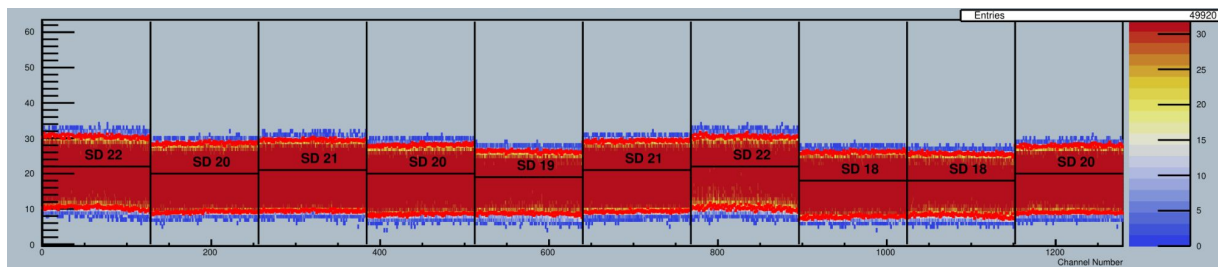


From: CLHCP2020

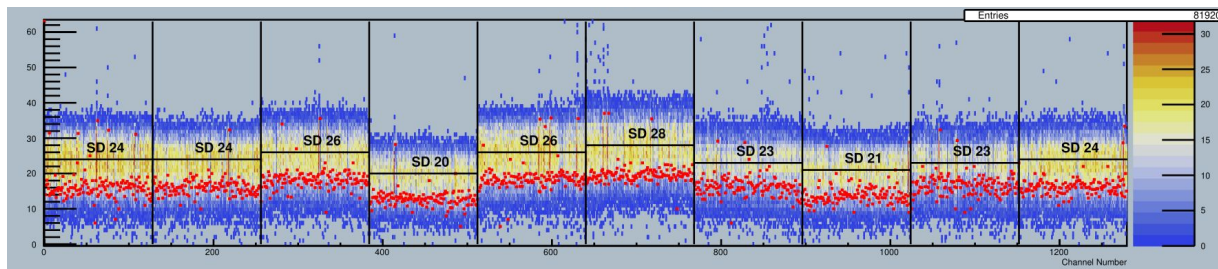
Strobe delay

Calibrates the timing delay between the discriminator clock frequency and the charge injections.

Good

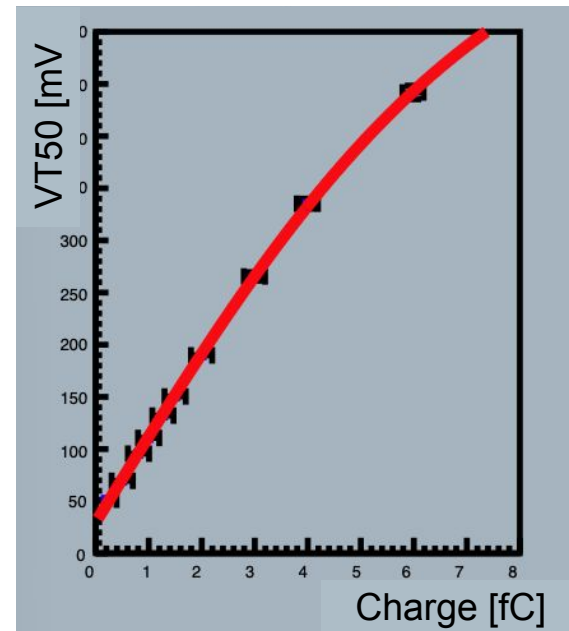
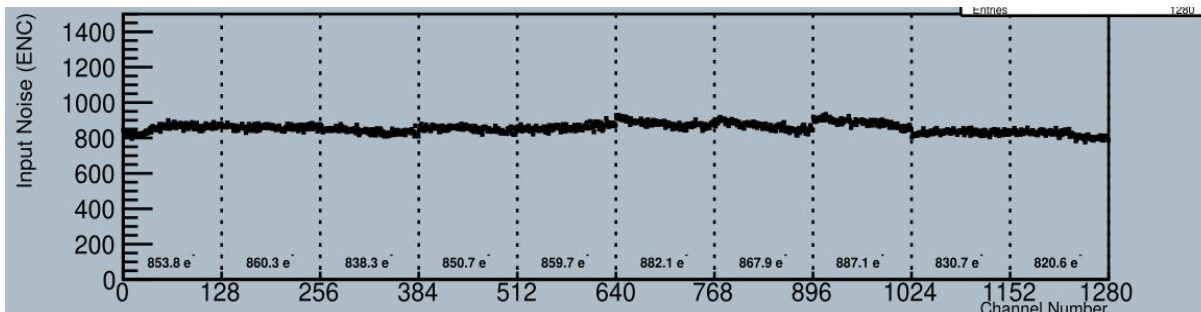


Bad



Response Curve

- Several charge injections are made and the electronic response is measured:
 - Pedestal (VT50)
 - Gain
 - Noise



Noise Occupancy

- Records the noise counts for different thresholds
- Should be lower than 10^{-3} ENC (at VT50)

