Sensor module assembly for the prototype of the PANDA Luminosity Detector

by Niels Boelger

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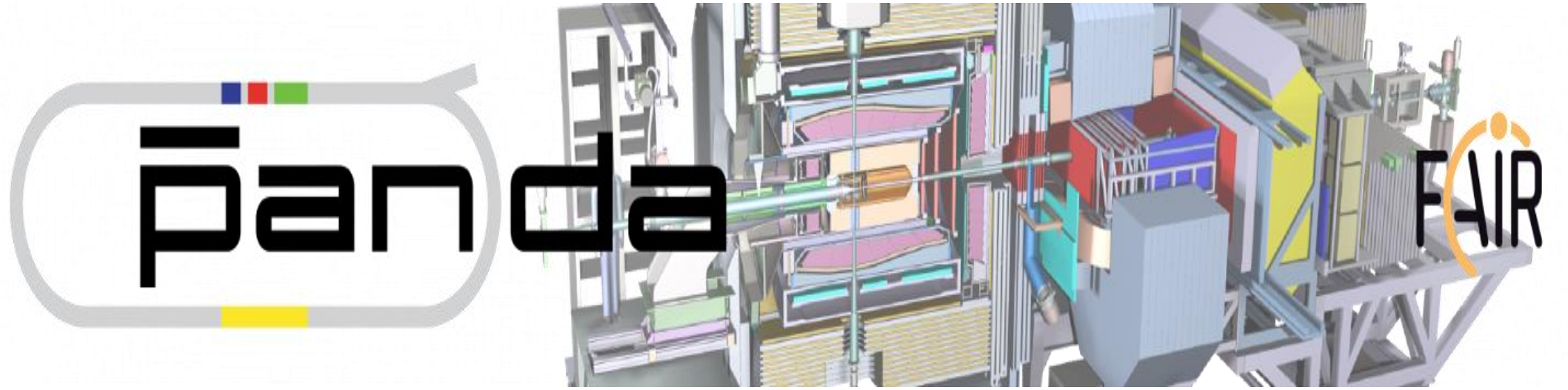


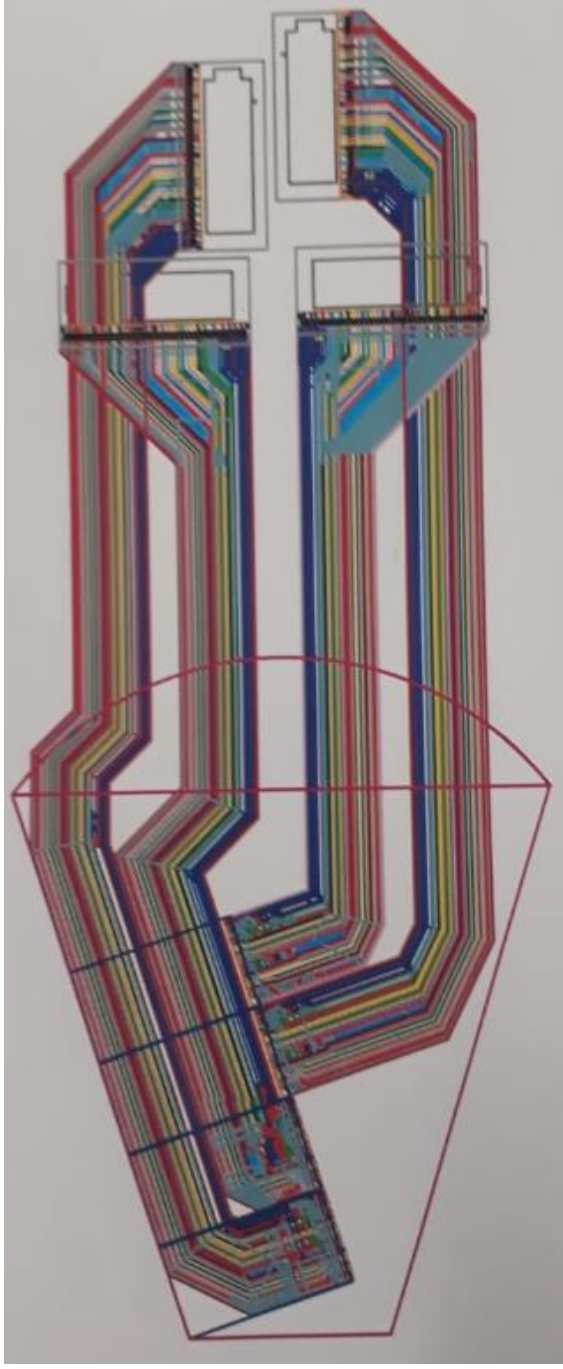
Prototype Sensor Modules

- 1 module formed by 4 MuPix Sensors on a diamond wafer

- Connection to readout via aluminum flex cables

- Getting the production process running: MuPix8

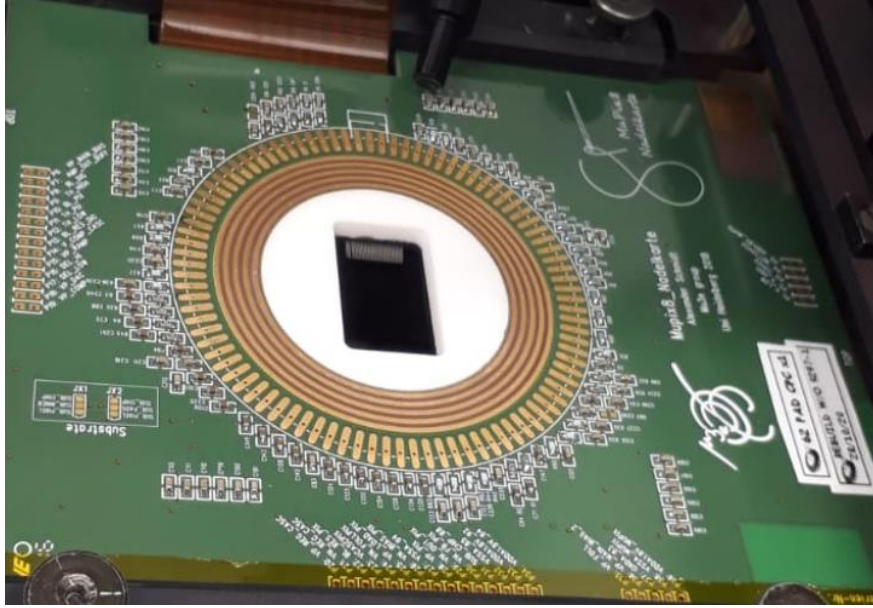
- Prototype Sensors: MuPix10

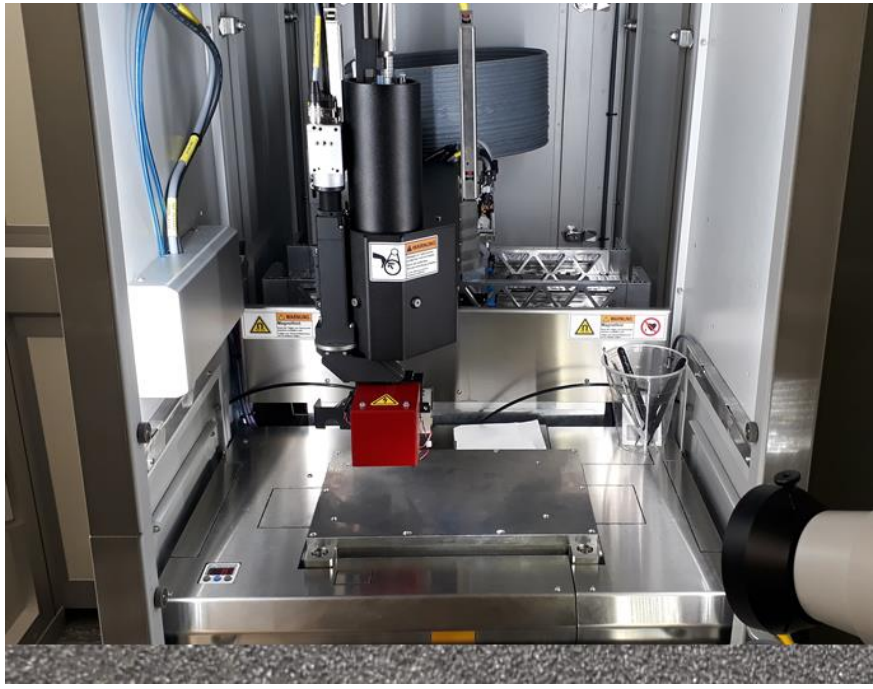


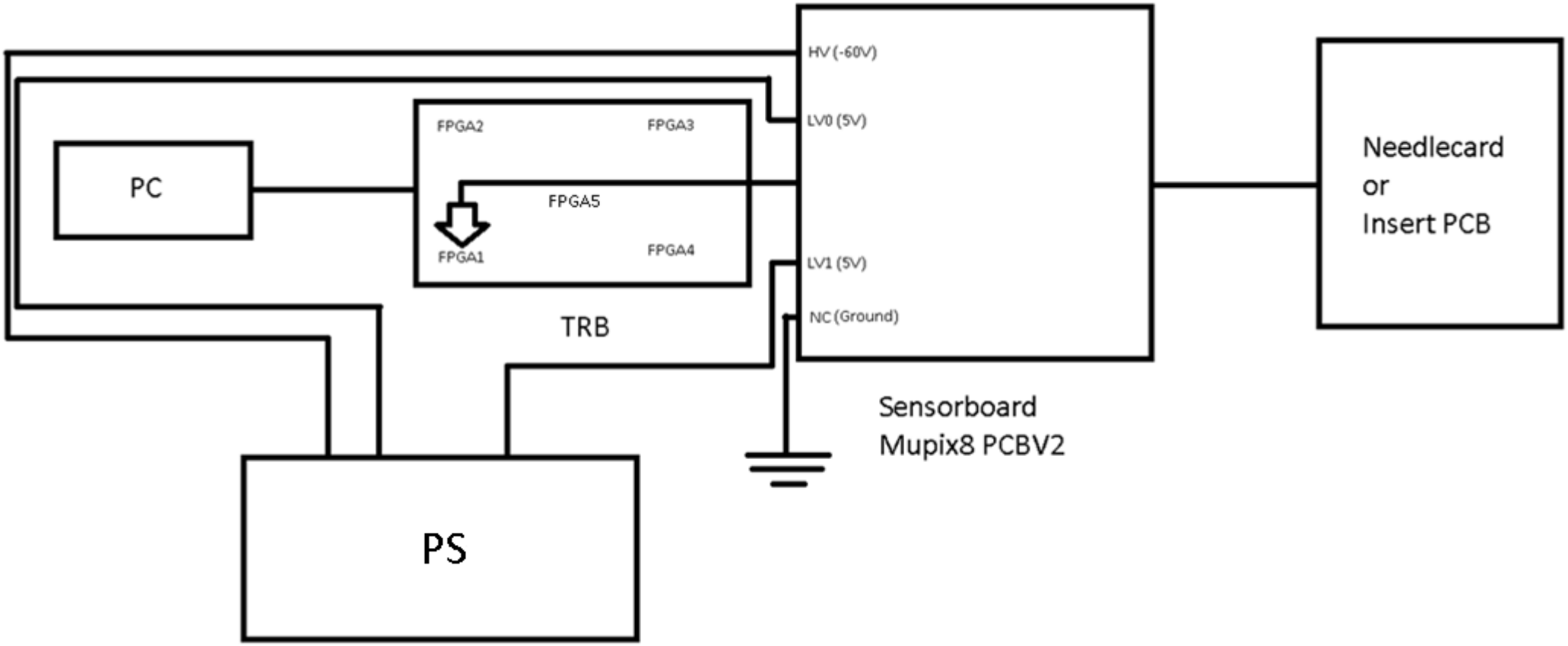
Sensor Module Assembly

Setting up a production process for sensor modules in our clean-room lab involves:

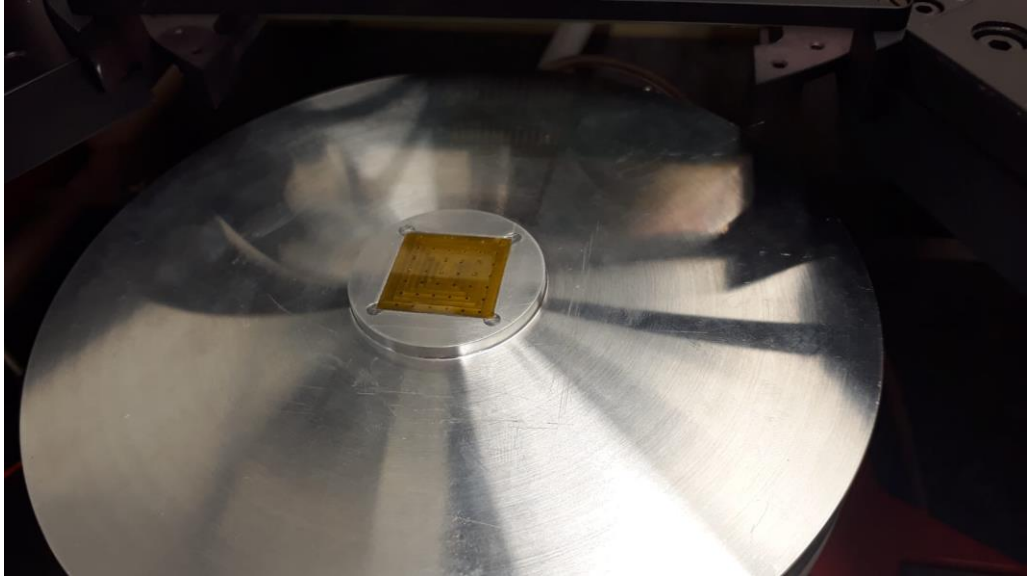
- Testing 26 MuPix8 (50 µm thickness) sensors from Heidelberg
- Evaluating and selecting best MuPix sensors
- Gathering experience with bonding, especially to TAB-bond MuPixes to flex cables
- Glueing bonded MuPixes on diamond wafers



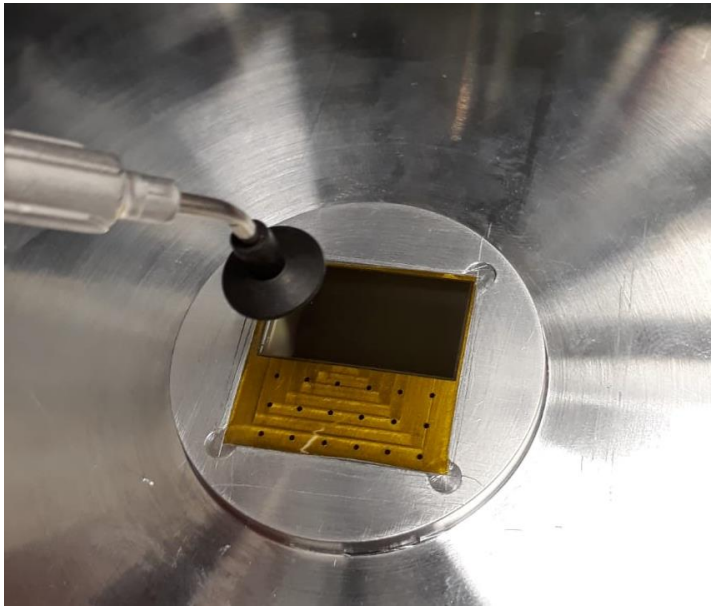


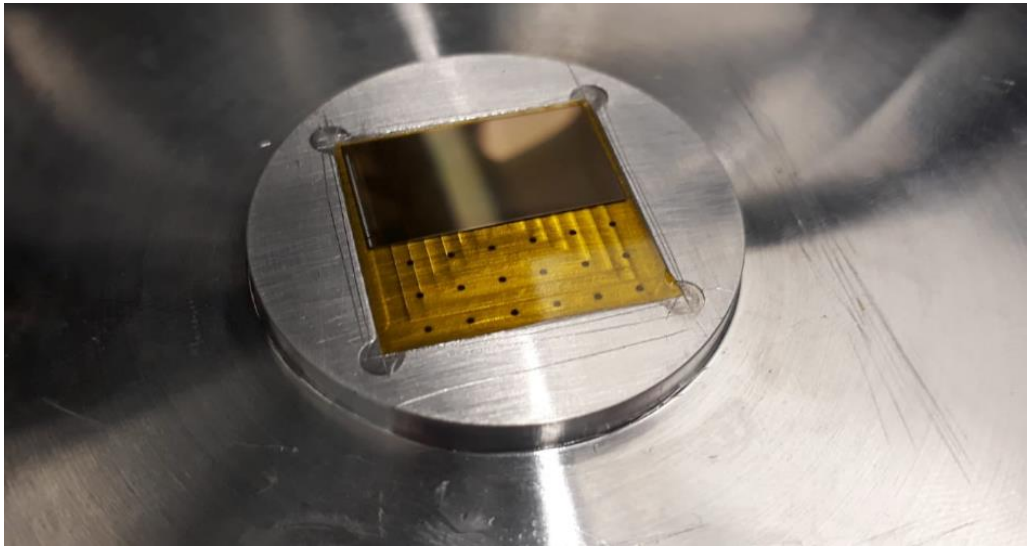

HV (-60V)
LV0 (5V)
LV1 (5V)
NC (Ground)
PC
FPGA2
FPGA3
FPGA5
FPGA1
FPGA4
TRB
PS
Sensorboard
Mupix8 PCBV2
Needlecard
or
Insert PCB

Probestation: Holder

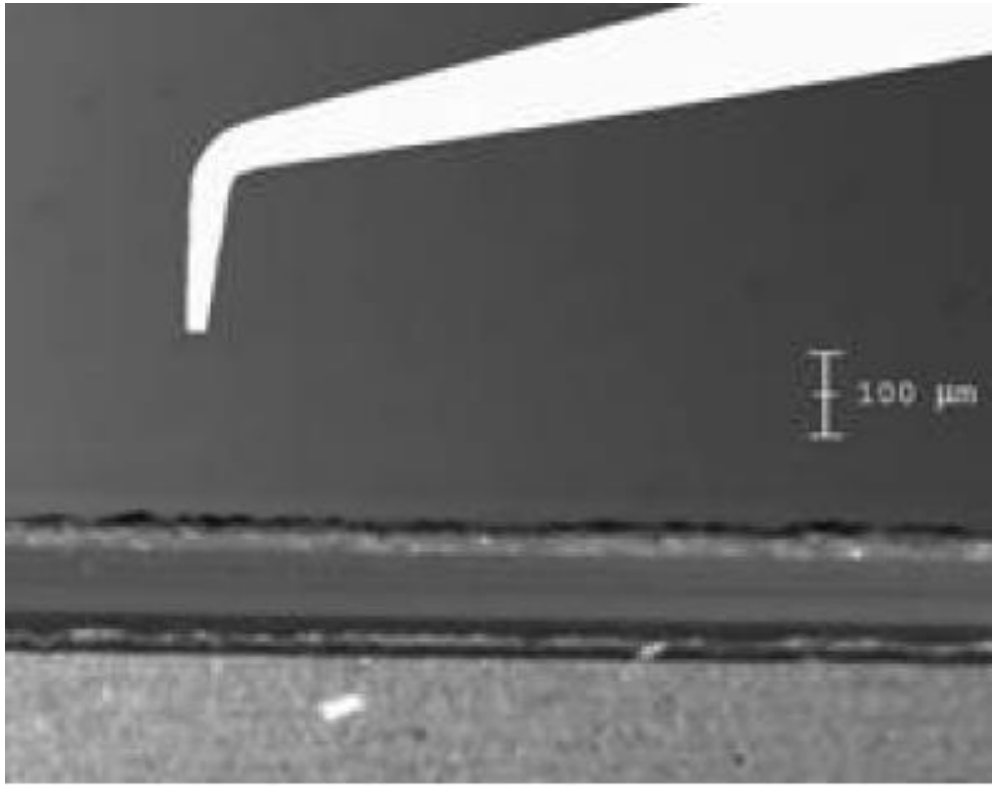


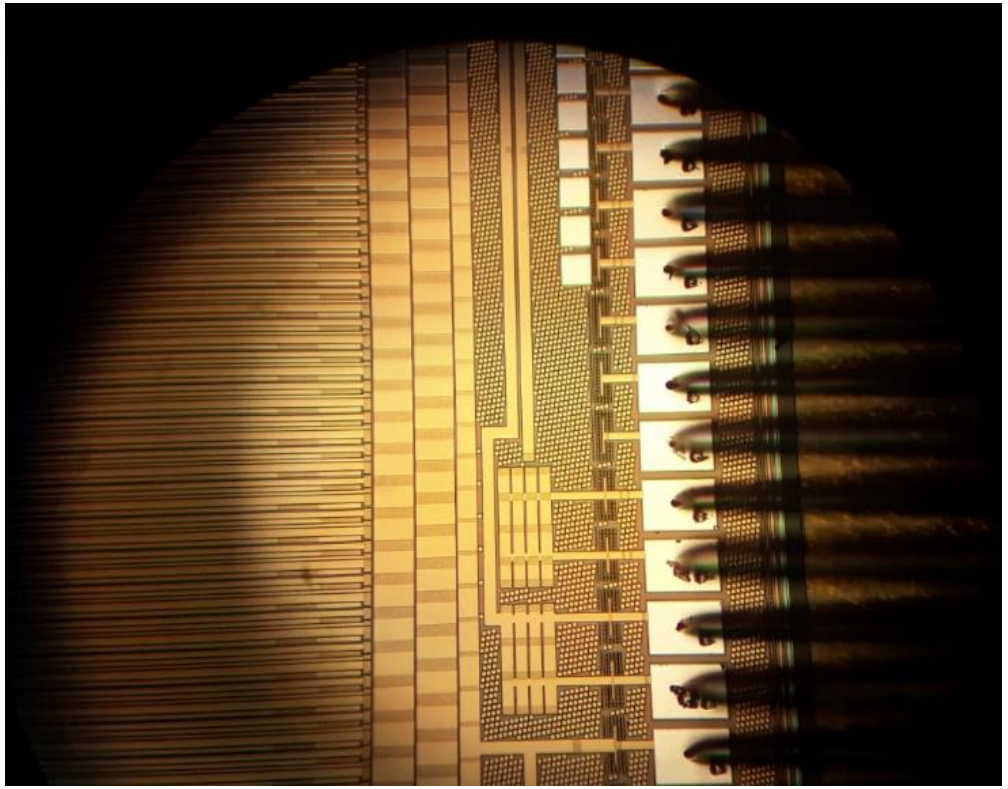
- Isolated by 60 µm thick Kapton foil
- Vaccum applied through holes within the holder





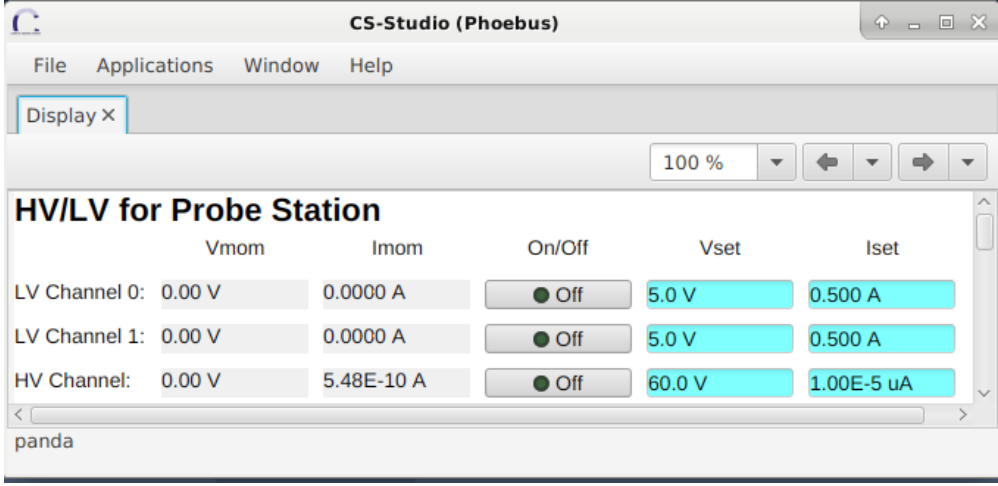
Applying needles to MuPix-Pads

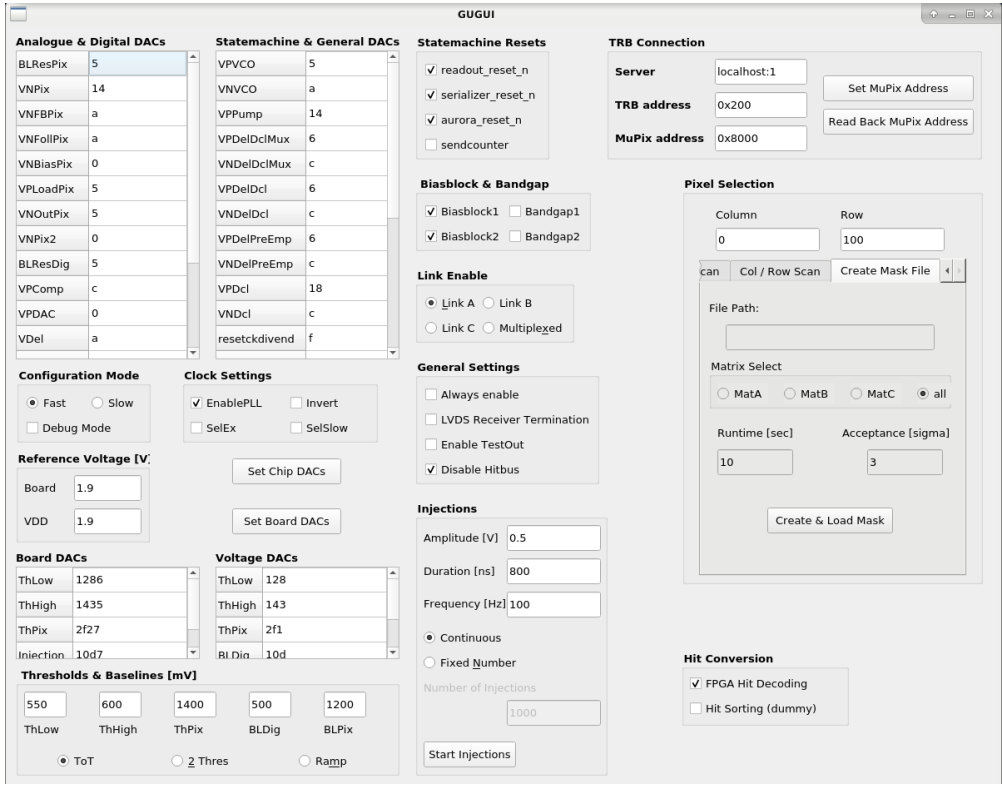




Software

- Phoebus: set voltages and currents
  - LV_0: Chip-electronics power supply
  - LV_1: Sensorboard power supply
  - HV: high reverse bias voltage (causing depletion layer)
- DAQ: configuration of MuPix DACs





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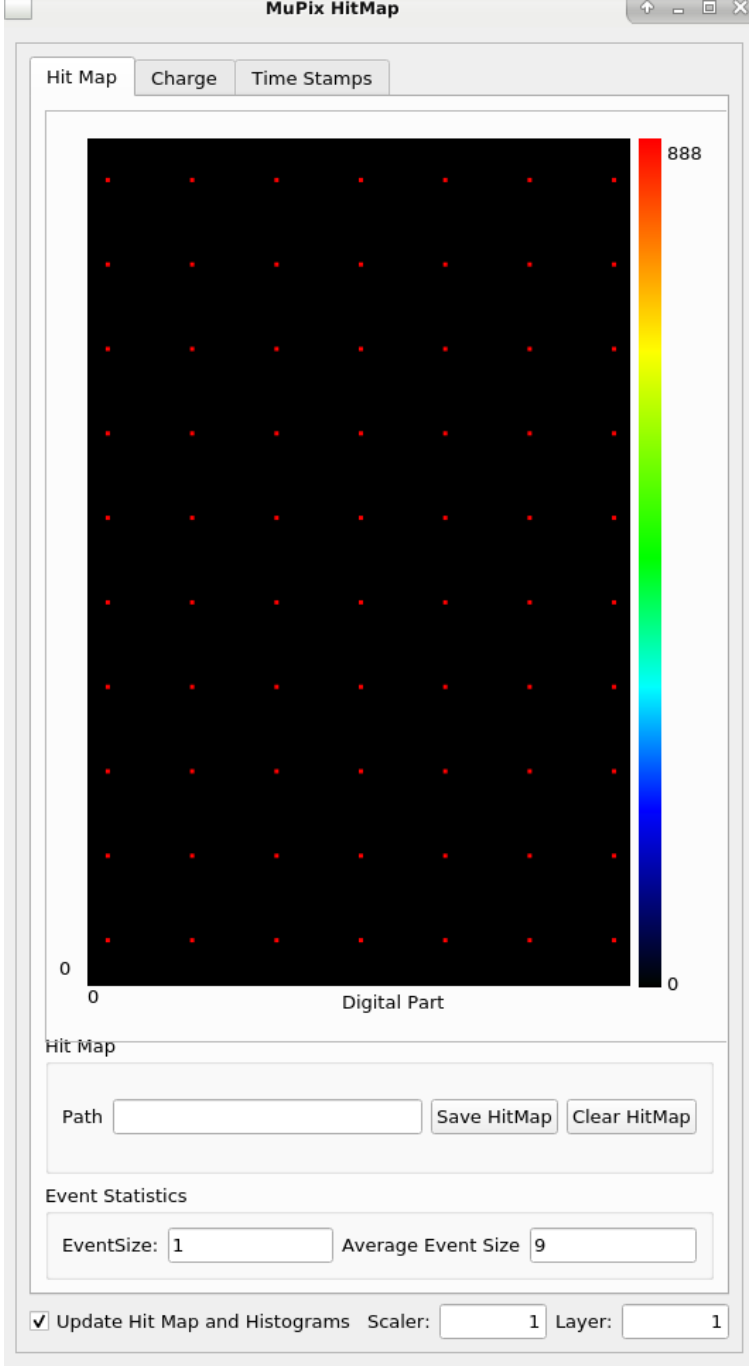
MuPix8 DAQ: Hitmap and injections

- Injection grid
- 70 pixels all over the sensor
- Used for s-curve measurements
  - Raising threshold until pixel stops to react to injections



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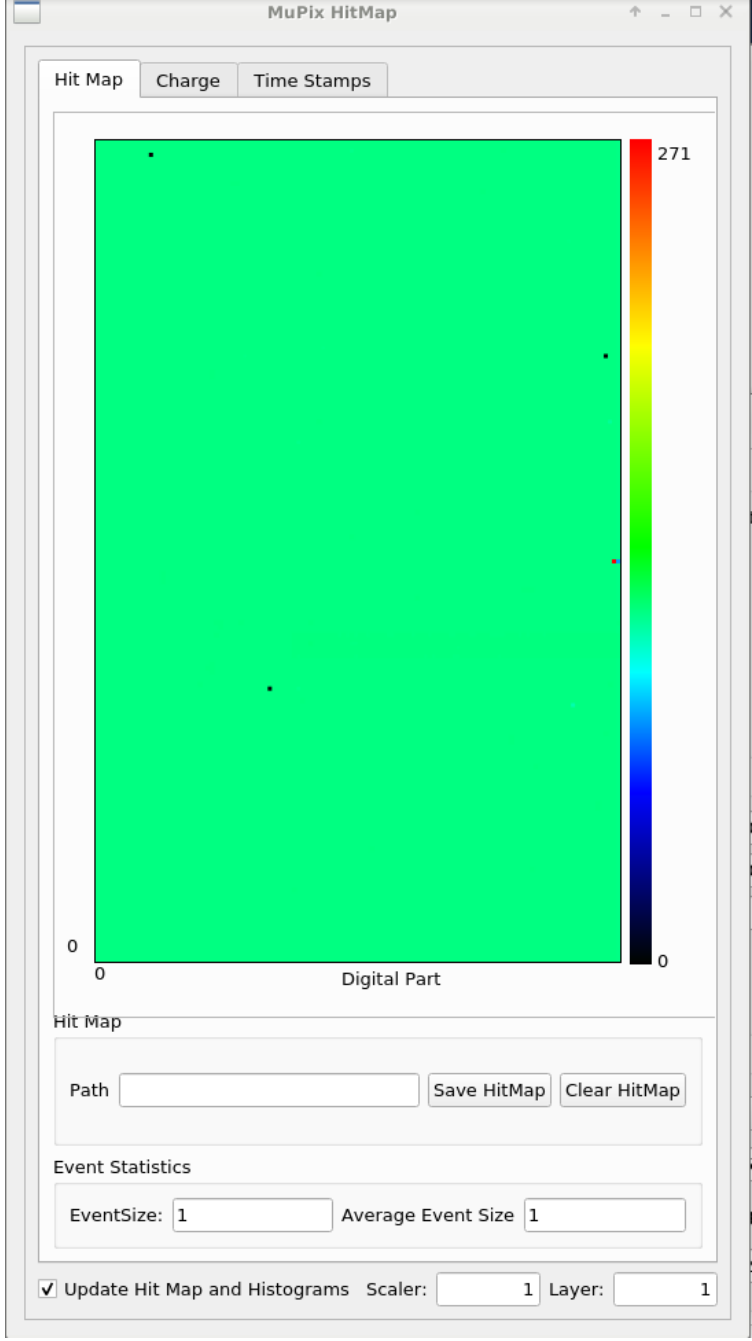
MuPix8 DAQ: Hitmap and injections

- Pixelscan to find dead pixels
- Inject over whole sensor
- Impossible to inject every pixel at once



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MuPix8 specs

- HV – 60V

Breakdown is definitly reached if the current exceeds 10 µA

- Sensors vary in their maximum reachable HV, depending on their production batch

Sensors from older batches should be run at a maximum of 50 V

Chip: LV_0 (unset DACs): 70mA or slightly higher LV_0 (set DACs): 380-400 mA

Board: LV_1: 350 mA

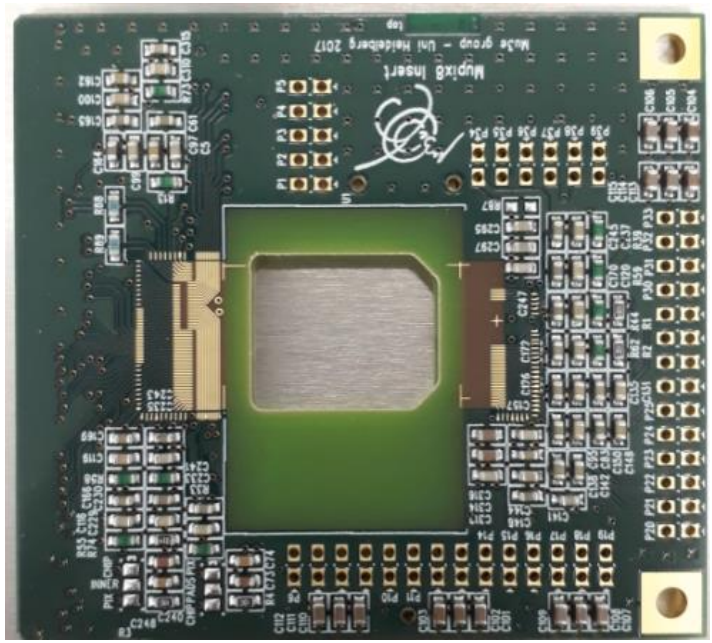
MuPix8 Production DB

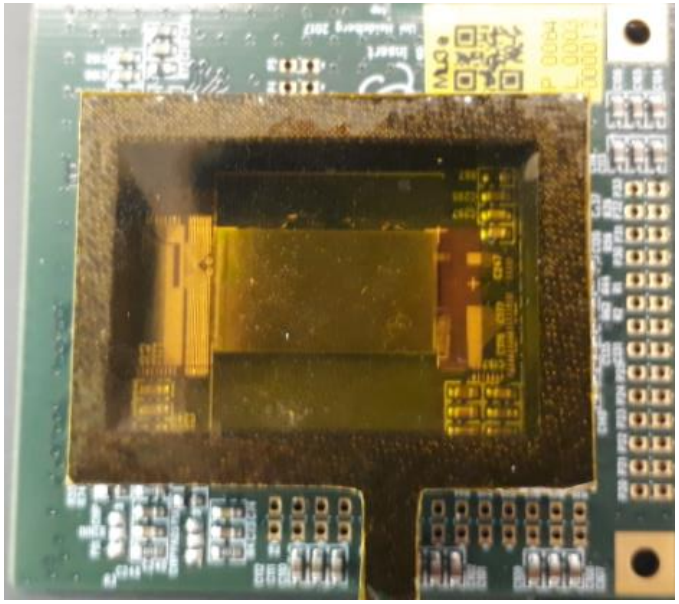
Send

ID	MuPix ID	LV0 before [mA]	LV1 [mA]	HV before [V]	LV0 after [mA]	HV after [V]
1	0	87	324	50	367	50

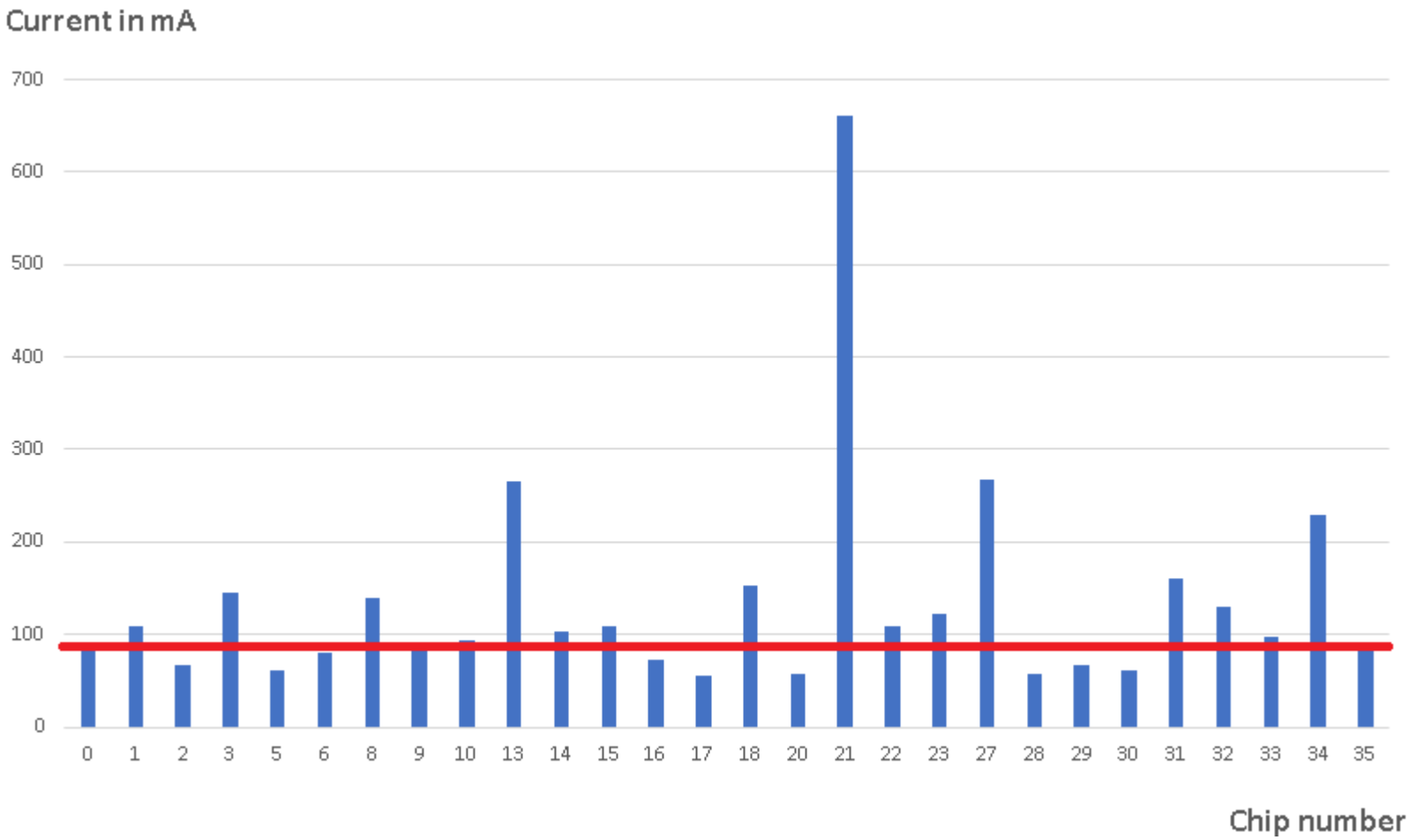
Telescope MuPix8 bonded to Carrier

- Carrier: Insert PCB
- Reference Sensor 0 from Telecope with thickness of 625 µm

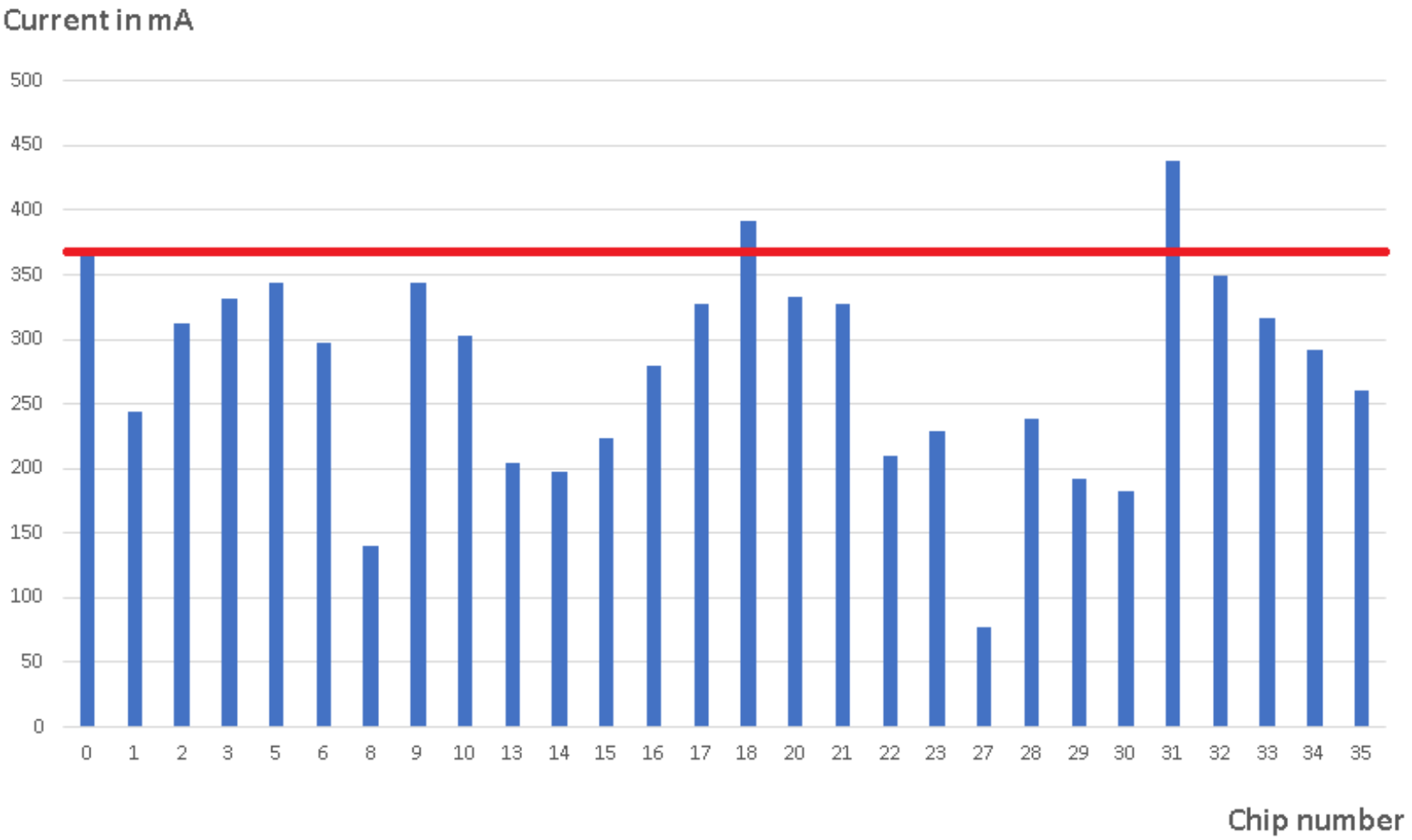




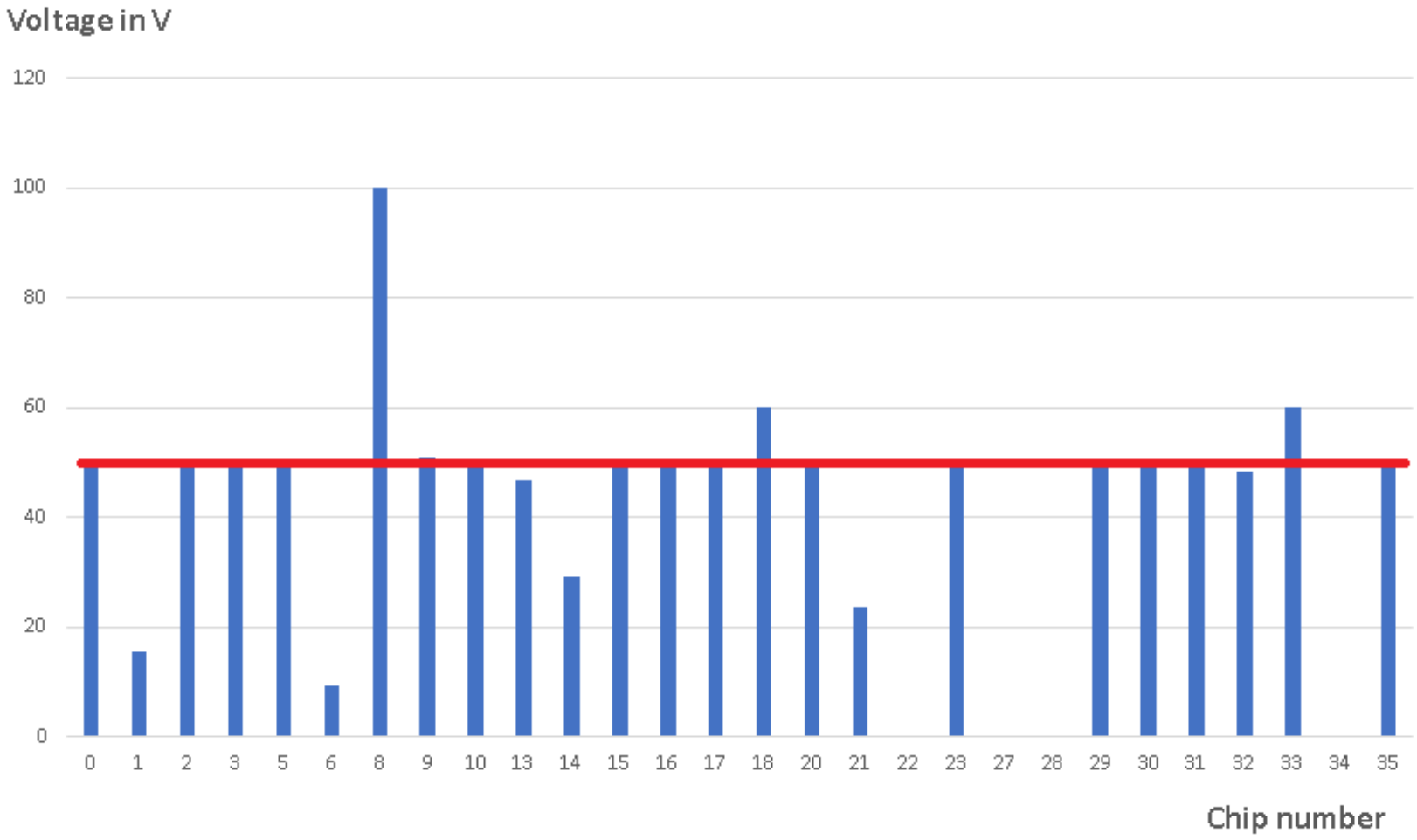
Results from MuPix8 tests: LV_0 DACs unset



Results from MuPix8 tests: LV_0 DACs set



Results from MuPix8 tests: HV DACs set



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Results from MuPix8 tests

- Most sensors get a connection to the DAQ-system
- About one half reacts to laserpointer
- Only two react to injections

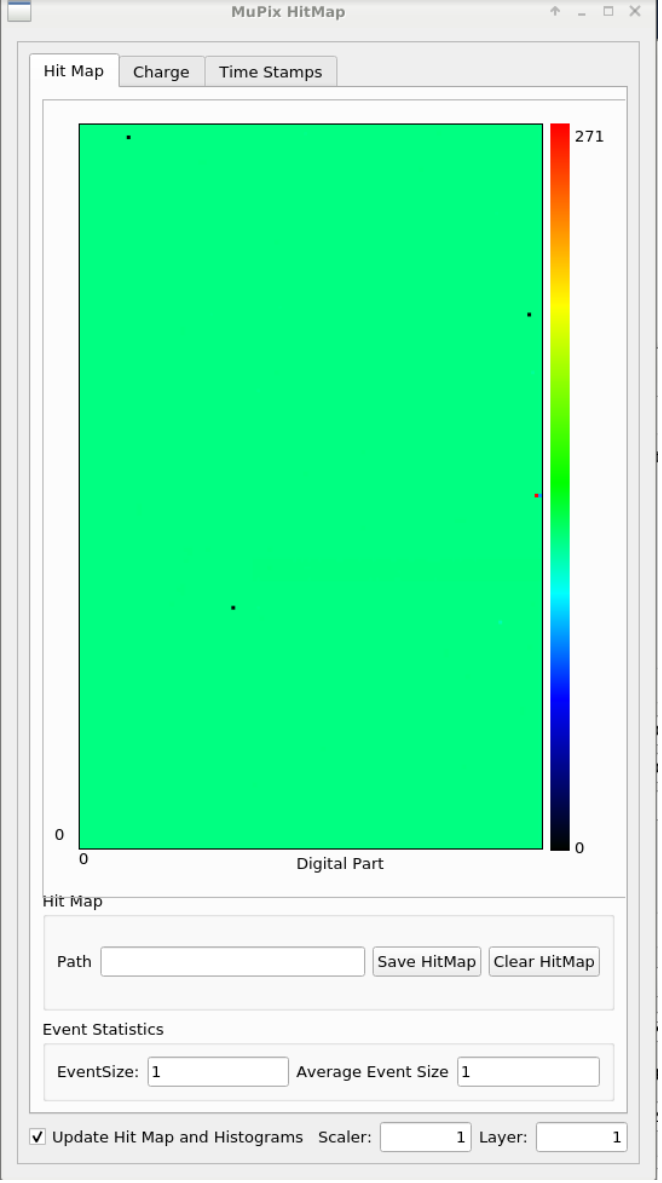
- Crosschecked results by:
  - Testing Referencesensor 0 with needlecard

  =>injections became impossible, noisy (unmaskable) pixels and freezing hitmap
  - Testing Sensor 17 via carrier

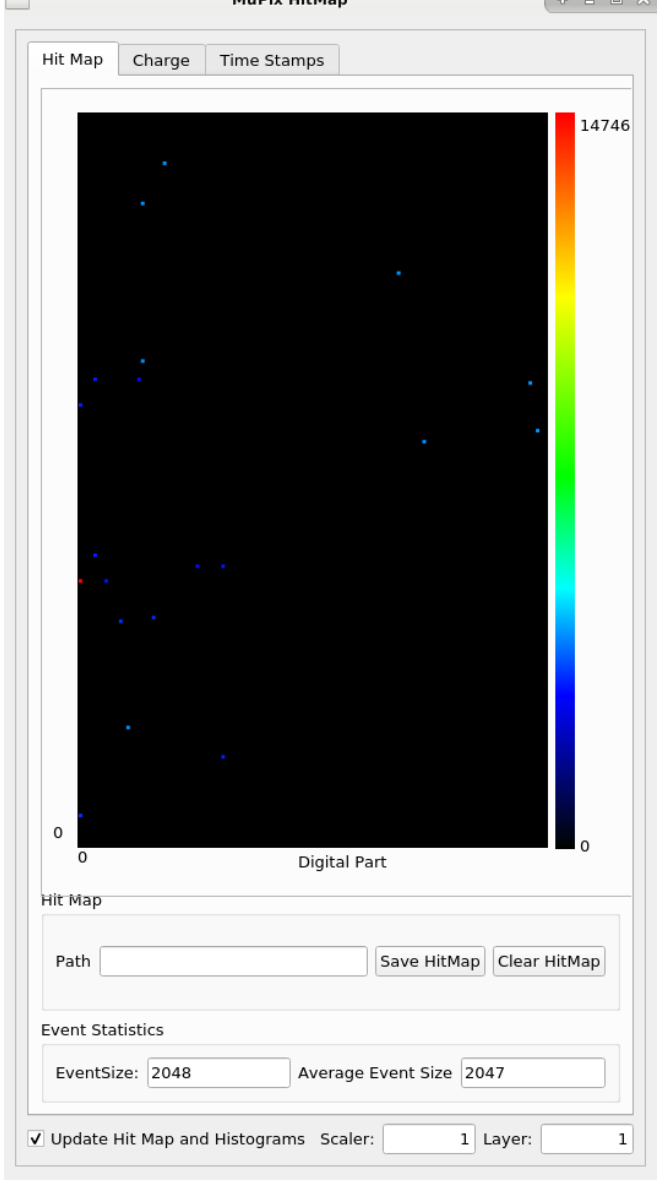
  => works well

=>Bad sensor behaviour is somehow related to needlecard, so just connect MuPix to cable and test one after another

Sensor 0 Pixelscan

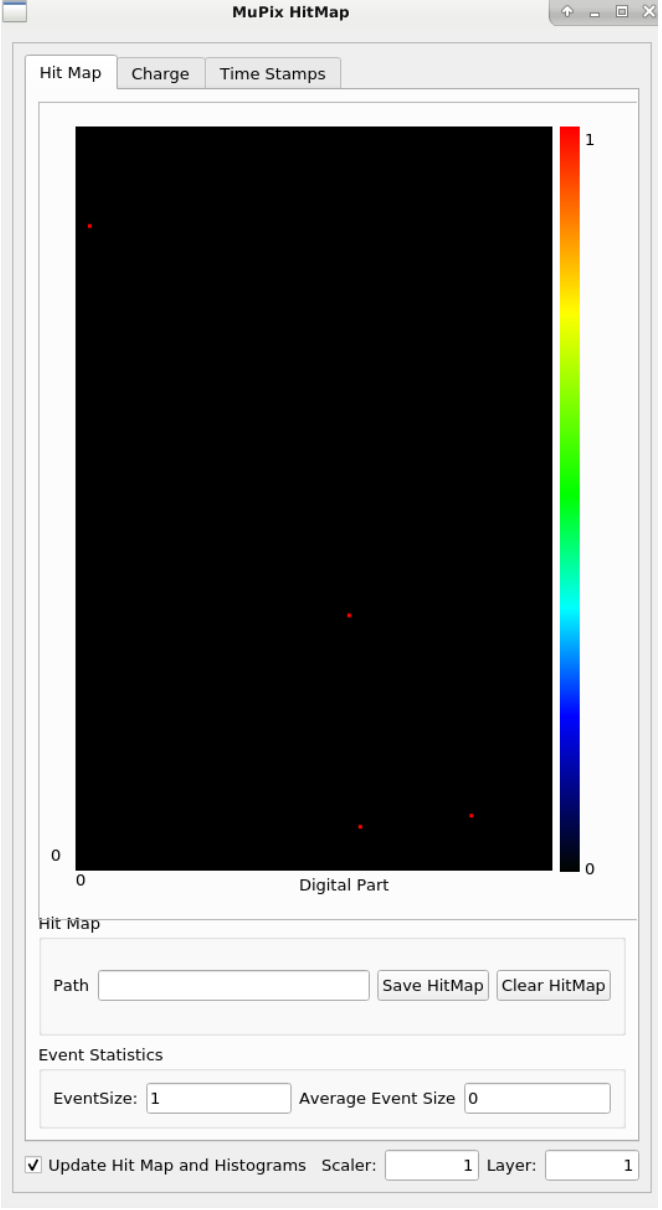


Connection via Carrier

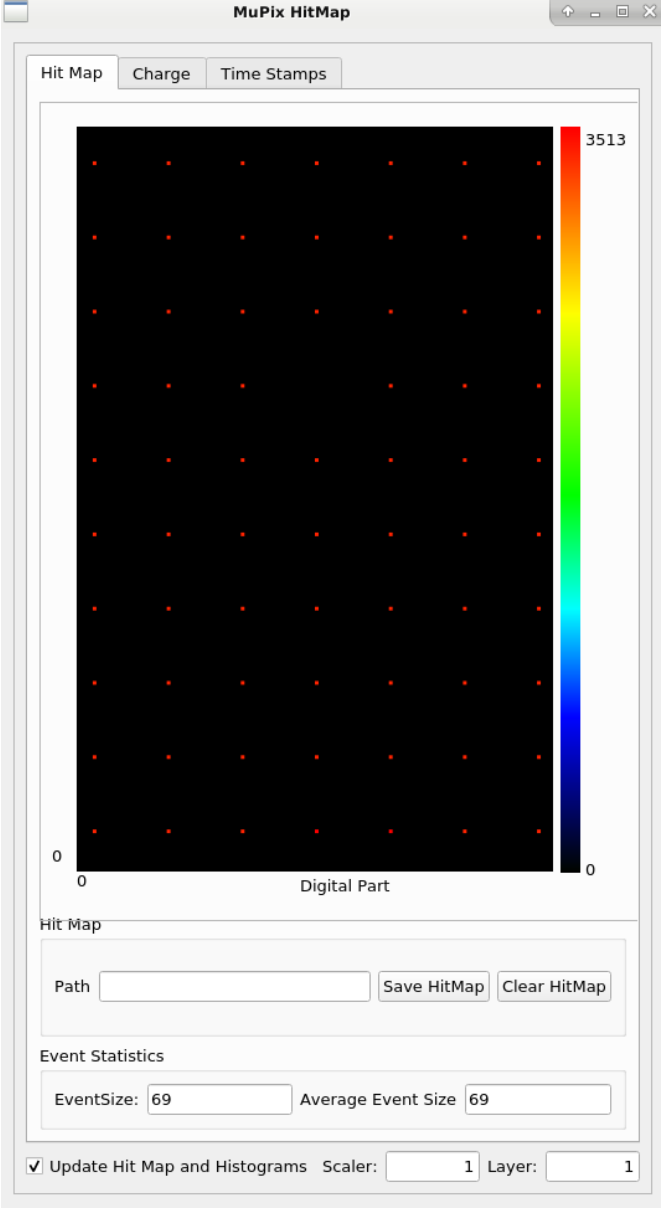


Connection via needlecard

Sensor 17 Injections



Connection via needlecard



Connection via carrier

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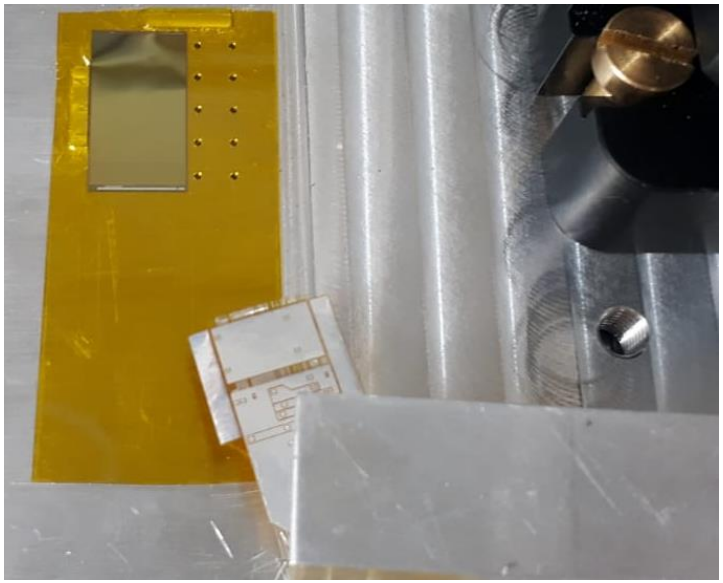
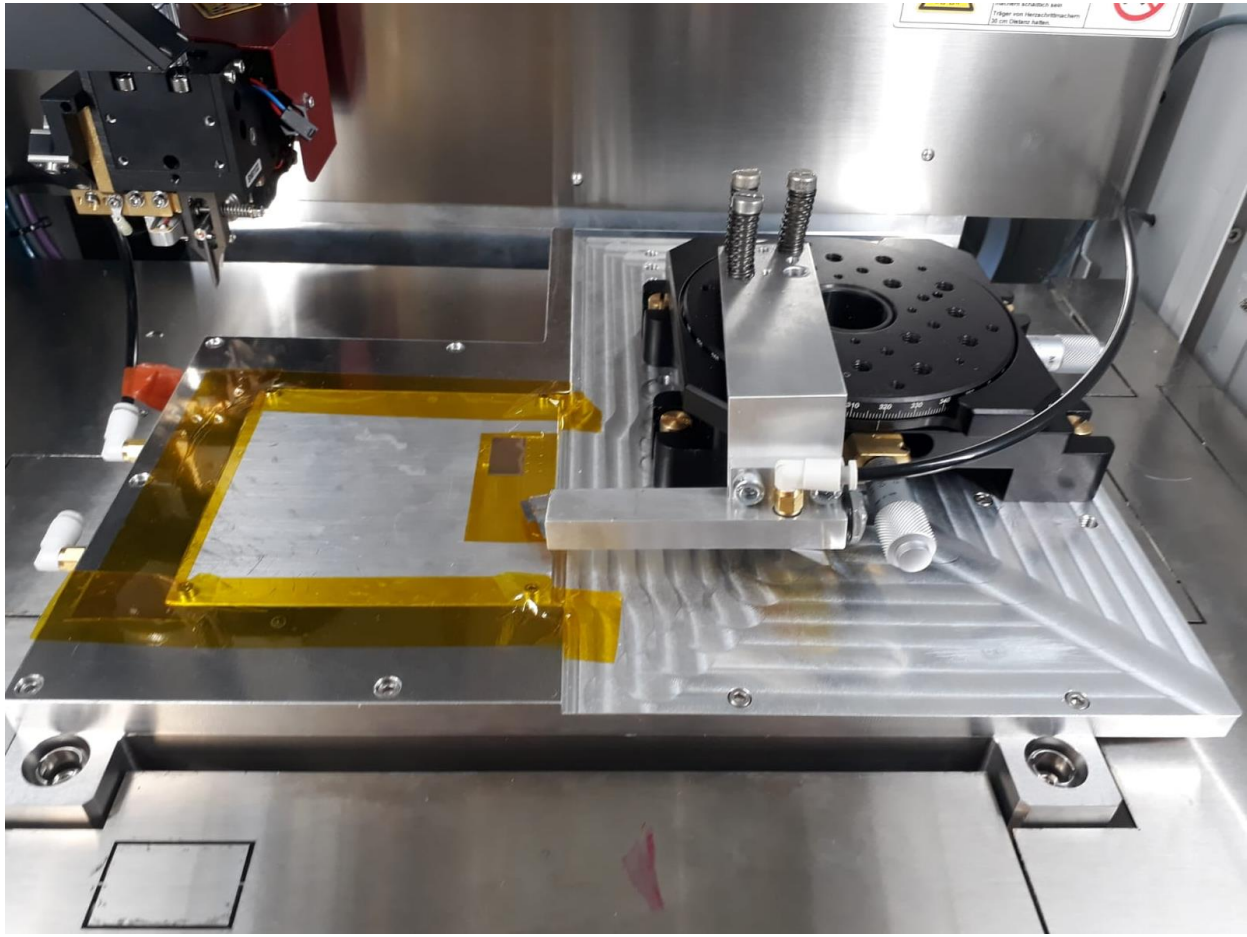
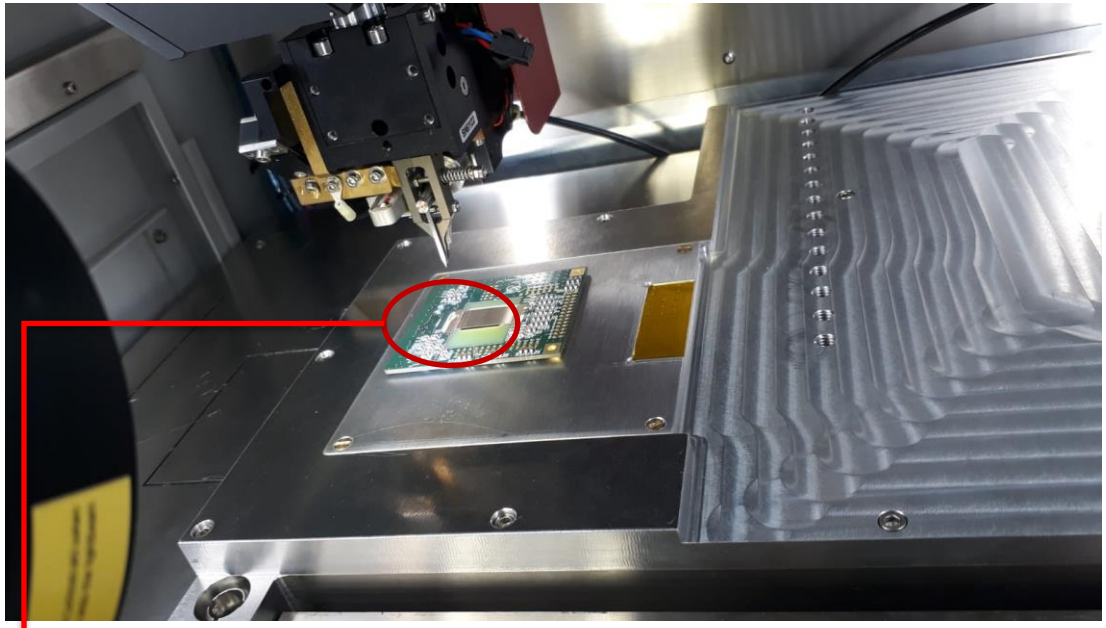
TAB-setup: MuPix to flex calbes

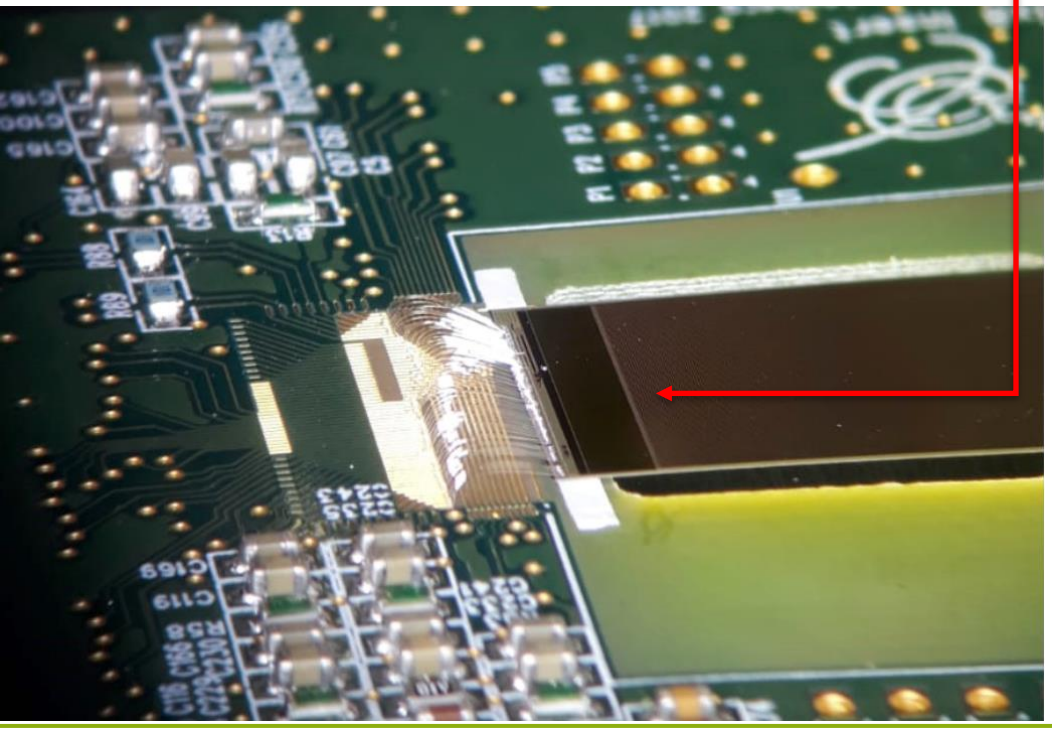
- Vacuum arm allows precise positioning of flex cables above MuPix pads
- MuPix held in position by vacuum





Wirebonding Carrier





25 µm aluminum wire

Summary

- 26 Mupix8 were tested and not a single one is 100% working as intended (BUT reliable test?)
- Testing with needlecard shows hugh problems
- Bondingprocess works well, MuPix tested via Insert-PCBs show much more stable behaviour
- First Combination of MuPix8-Cables-Plug was produced

Outlook

- MuPix8s tab-bond to wire → improvment of measurements?
  - But Kintex-based DAQ is needed
- Atleast form 1 module out of 4 working sensors
- Glueing to diamond wafer

- Focus on MuPix10s: new flexcables, software etc.

Thank you for your attention!