

PANIC-4k

Detector upgrade



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... plus people from Calar Alto & IAA (Granada)



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- Project Overview
- The Detector
- The Detector Mount
- Readout Electronics
- Software
- AIV & First results
- Status & Outlook

No science

Project Overview

A rough background summary about PANIC to understand the motivation

- PANIC was operated at Calar Alto since 2014
- Common project of Calar Alto, IAA (Granada) & MPIA
- Poor detector performance, at the end 2 detectors unusable
- Strong wish to exchange the detectors
- Suggestion to upgrade with HAWAII-4RG
- Remaining 2 detectors sold to AIP Potsdam
- PANIC back to Heidelberg

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Short side glance to finances & work distribution:

- CSIC pays the detector
- MPIA contribute the ROE, detector software, detector mount, cables, connectors & AIV
- IAA responsible control software, commissioning & science verification

Project Overview

First steps

- Transport back to Heidelberg



Project Overview

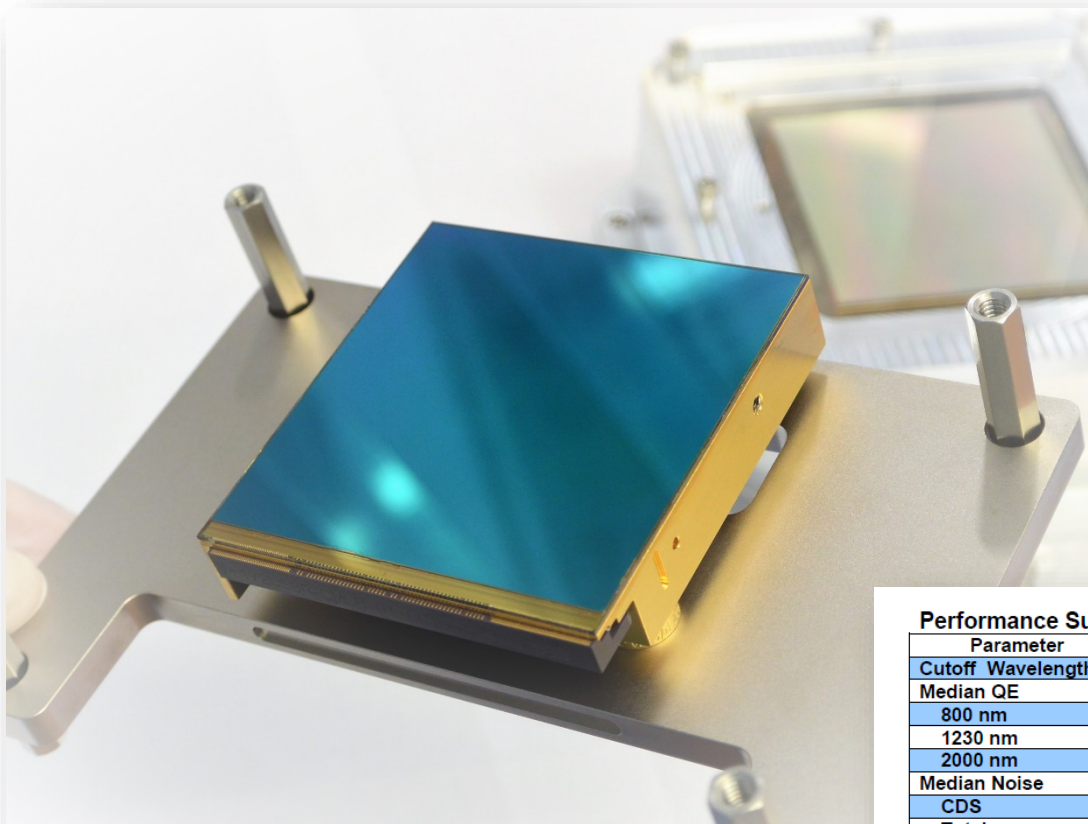
First steps

- Transport back to Heidelberg
- Old detectors
 - The deal: sold to AIP, shipment via MPIA to do acceptance tests



Precondition to finance the detector

The Detector



- First test reports in 2012 by Don Hall
- Delivery of our detector in 2019
- SPIRou @ CFHT ??
- Any other instrument?

Will we be first?

Performance Summary

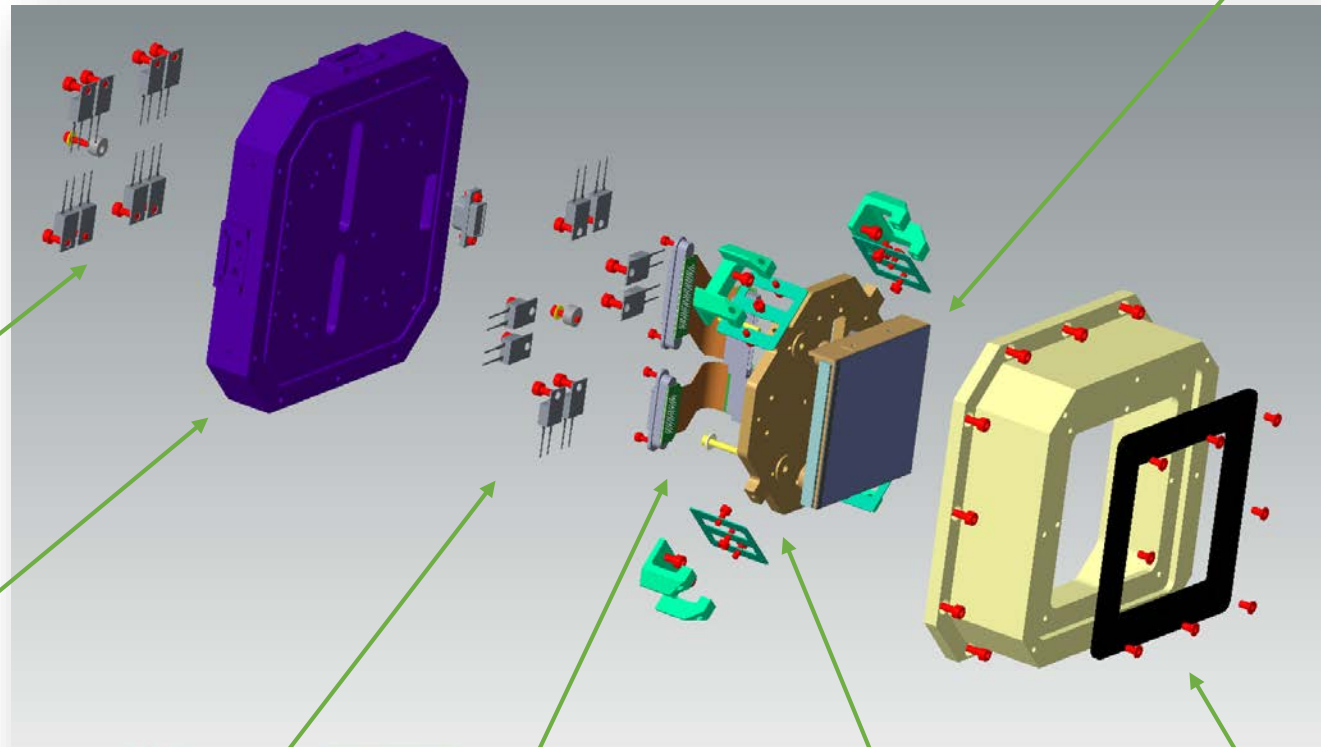
Parameter	Measured	Requirement	Units	Pass / Fail
Cutoff Wavelength	2.40	~2.5	μm	Pass
Median QE				
800 nm	82	≥ 50	%	Pass
1230 nm	86	≥ 50	%	Pass
2000 nm	88	≥ 50	%	Pass
Median Noise				
CDS	13.8	≤ 30	$\text{e}^- \text{ rms}$	Pass
Total	8.5	N/A	$\text{e}^- \text{ rms}$	N/A
Fowler-16 ³	4.7	≤ 5	$\text{e}^- \text{ rms}$	N/A
Median Dark Current	0.022	≤ 0.1	e^- / s	Pass
Well Depth	99627	$\geq 50,000$	e^-	Pass
Power Dissipation	5.15	$\leq \text{N/A}$	mW	N/A
Operability 2000 nm	99.35	≥ 93	%	Pass
Cluster 2000 nm	0.04	≤ 3	%	Pass
Transimpedance Gain ²	6.25	N/A	$\mu\text{V}/\text{e}$	N/A
Cross Talk (CRH)	1.6	≤ 3	%	Pass
Persistence	158	N/A	e^-	N/A
SCA Flatness ¹	11.92 / 2.21	≤ 25	μm	Pass

The Detector Mount

- In the past bought from Gerry Luppino (CARMENES, PANIC, ...)
- New mount needed anyway (also for a one to one exchange with HAWAII-2)
- Complex design to match the detector interface
- Interface well described by Teledyne
- US units like inch-pounds for torque – we can manage
- Materials like Cooper-Beryllium and INVAR used for operation in cryo and matching the CTE of detector housing

The Detector Mount

... so, we designed it by ourself



HAWAII-4RG detector package

Heaters, temp. sensors and thermal switch for the first stage temperature control

Aluminum base plate

Heaters, temp. sensors and thermal switch for the second stage temperature control

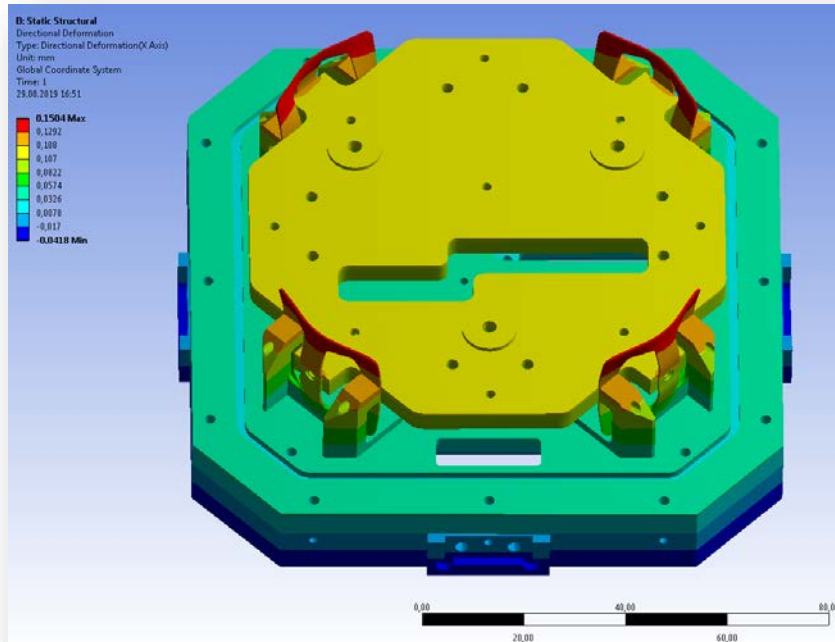
Flex board for a one to one connection of the detector output to the back side of the module

Invar plate, mounted with CuBe2 springs to the aluminum base plate

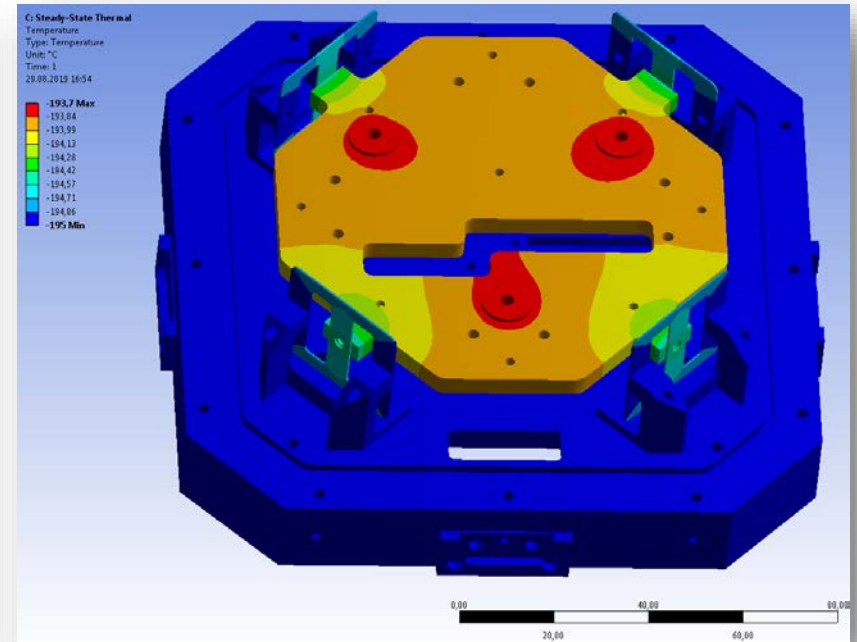
Cover with field mask

The Detector Mount

FEA for ...



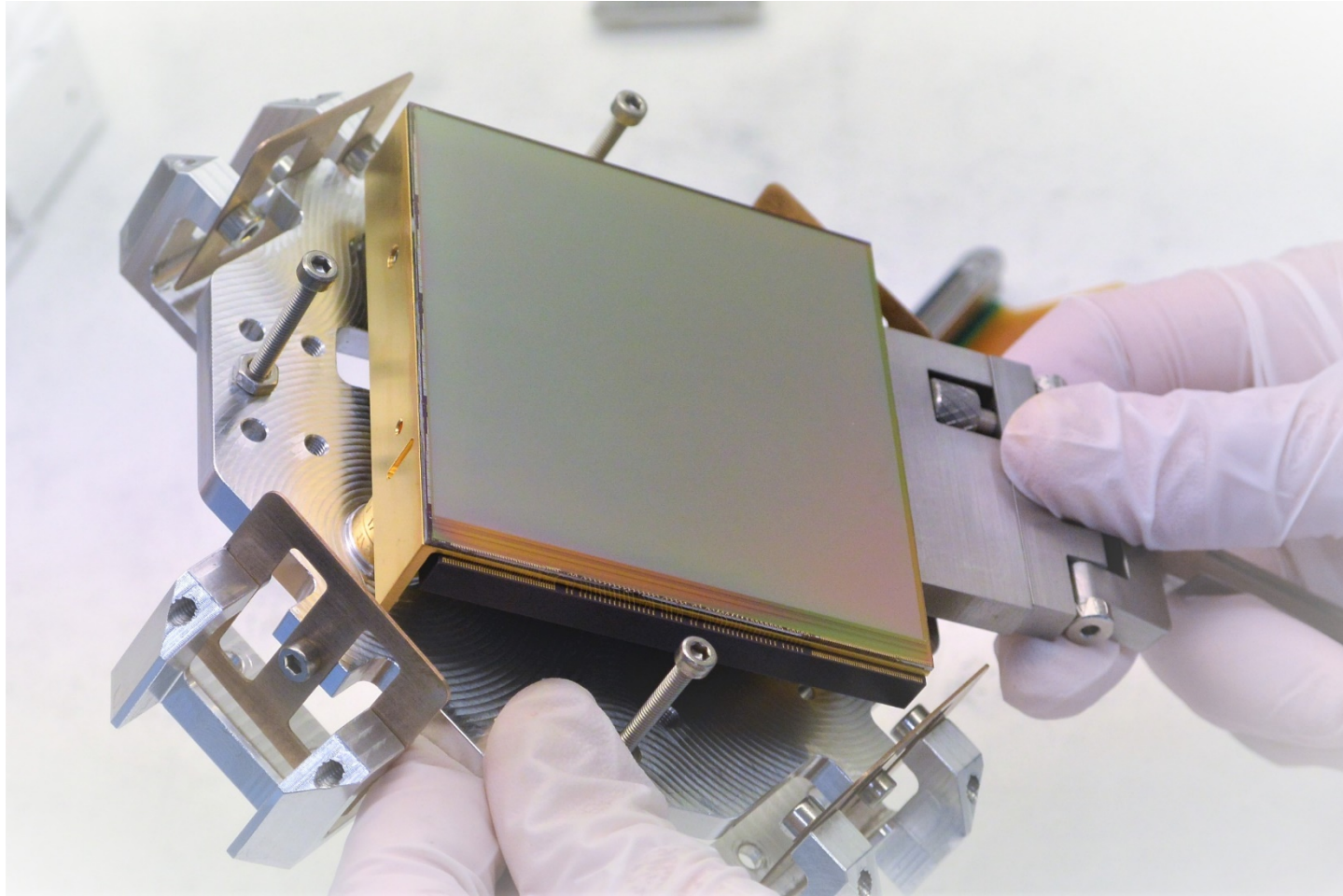
Deformation due to cool down
→ introduced stress into the detector
($< 1 \mu\text{m}$ maximum)



Temperature distribution
(uniform at the interface points)

Review by Teledyne engineers

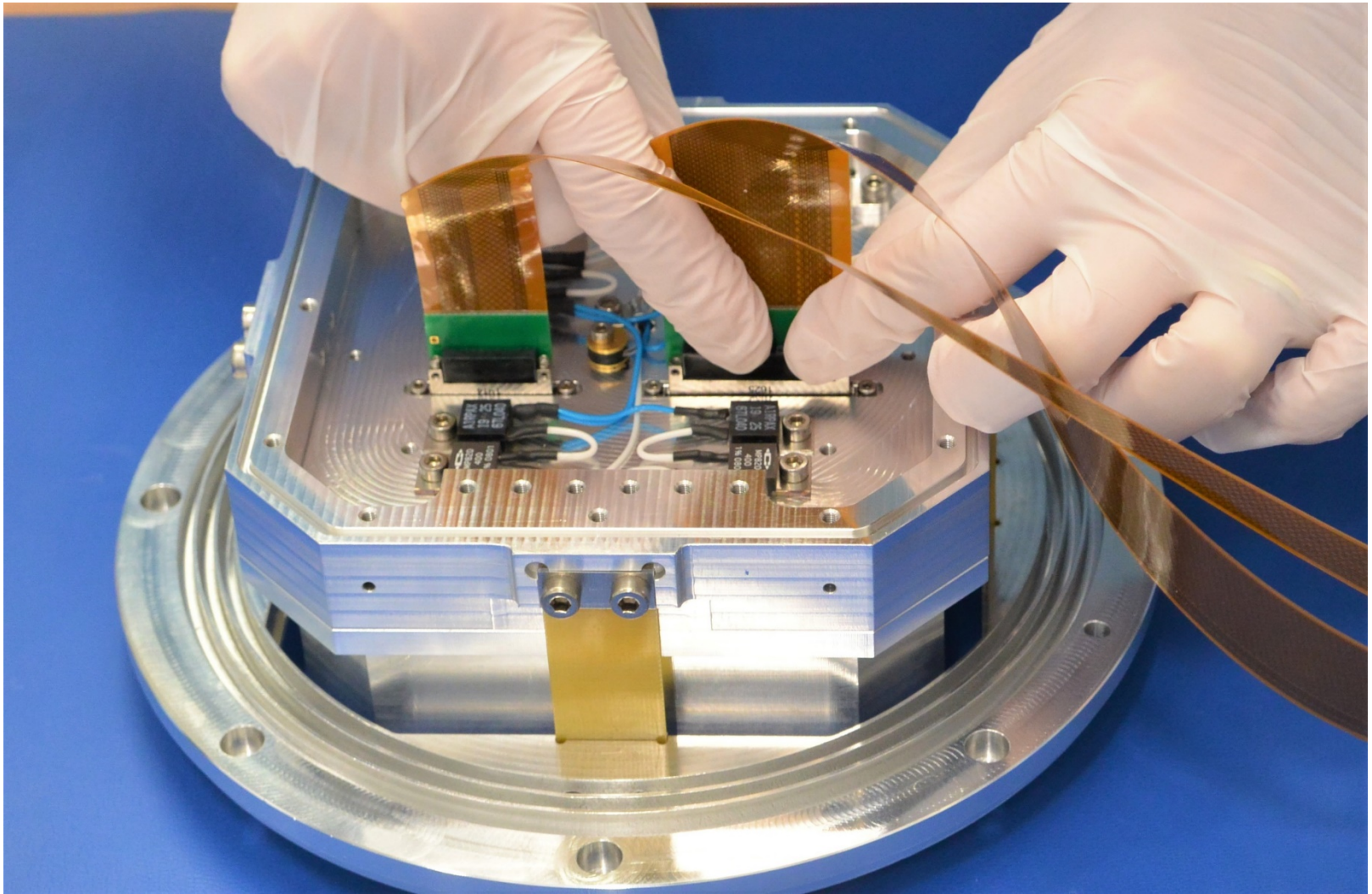
The Detector Mount



Tested with MUX at cold



The Detector Mount

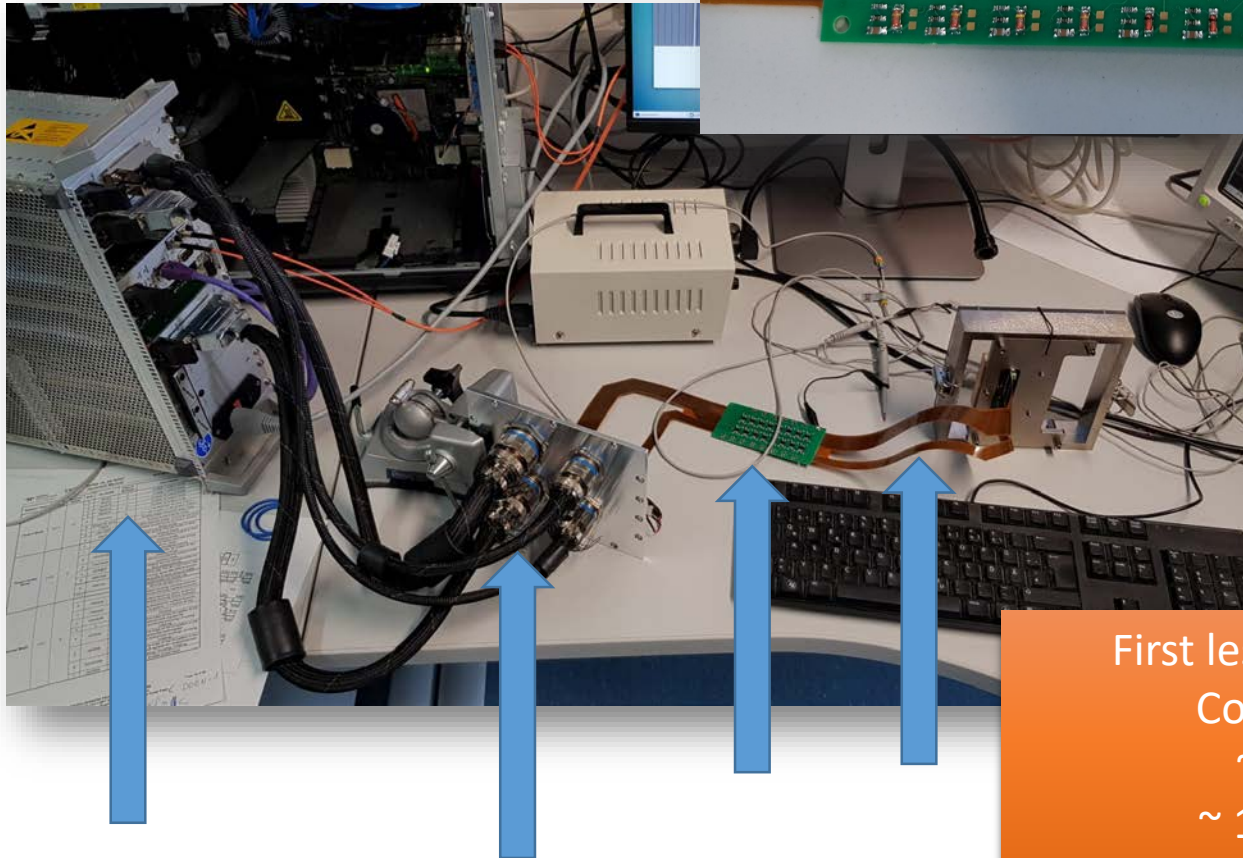


Tested with MUX at cold



The Readout Electronics

- New readout electronic
- New connectors
- New cabling
- New pre-amps (operated at cold)



First lesson learned:
Connectors
~ 19 k€
~ 19 weeks

The Readout Electronics

New features need to be implemented

- Column Deselect Feature
- Number of output modes

Table 5-1: Frame times for the different output modes

Output Mode	Pixel Rate	Frame Time (4096 x 4096 pixels)
1 output	100 kHz	168 s
	5 MHz	3.36s
4 outputs	100 kHz	42 s
	5 MHz	840 ms
16 outputs	100 kHz	10.5 s
	5 MHz	210 ms
32 outputs	100k Hz	5.3 s
	5 MHz	105 ms
64 outputs	100 kHz	2.7 s
	5 MHz	53 ms

This applies to ROE and software

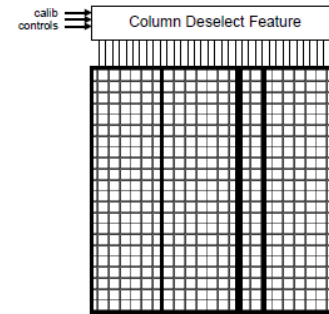


Figure 4-1: Disconnected columns using the deselect feature

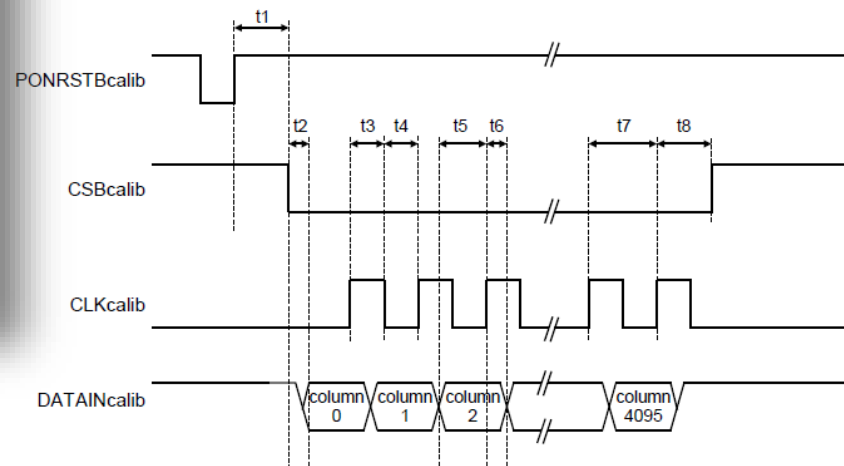
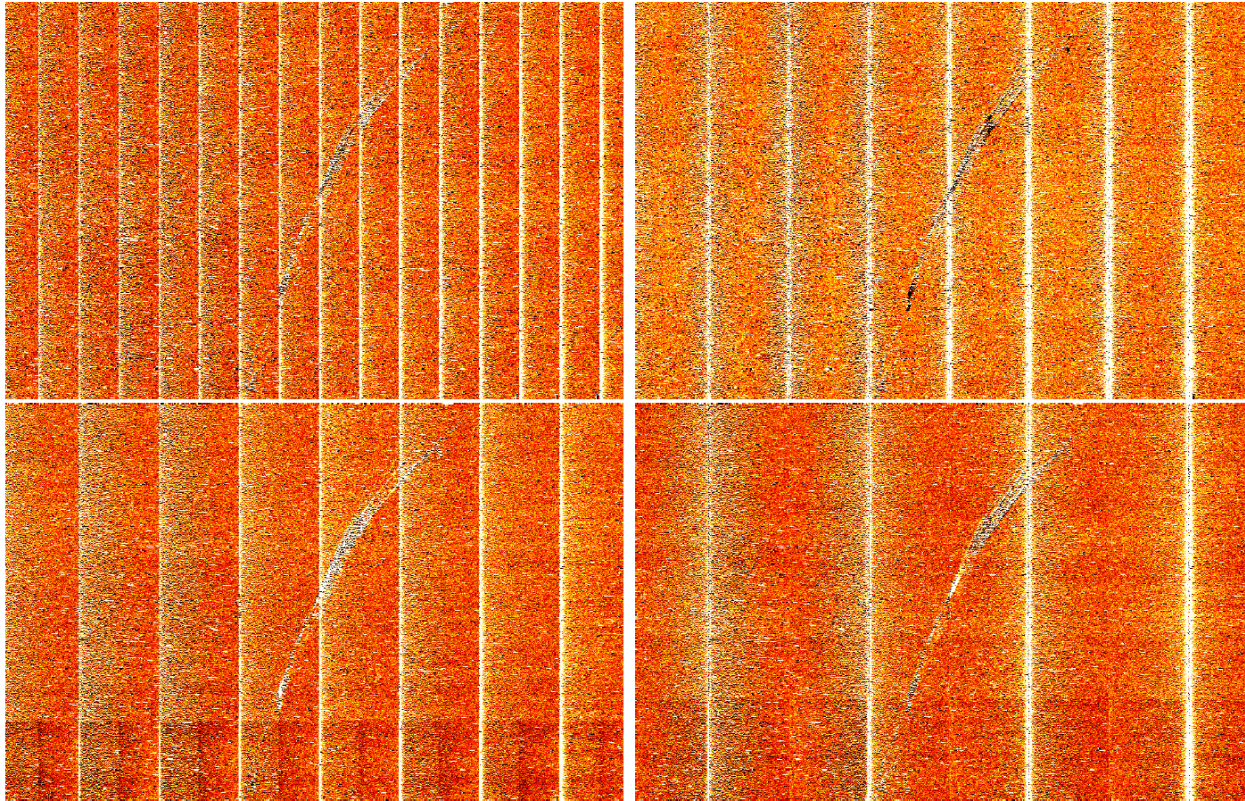


Figure 4-2: Timing diagram for the column deselect serial programming interface

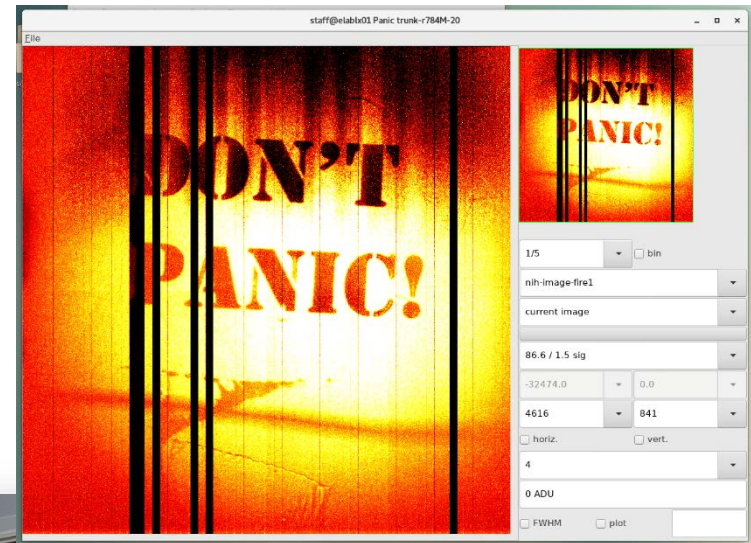
The Software

- Identical read out modes
- Adapted to 64 channels and all sub-sets



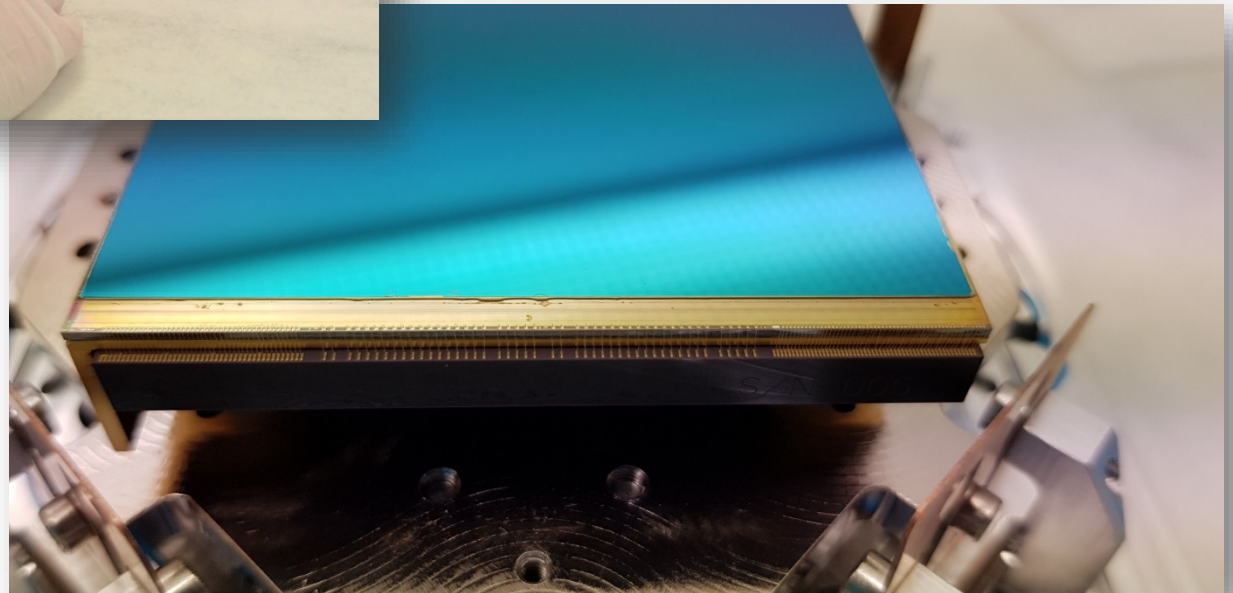
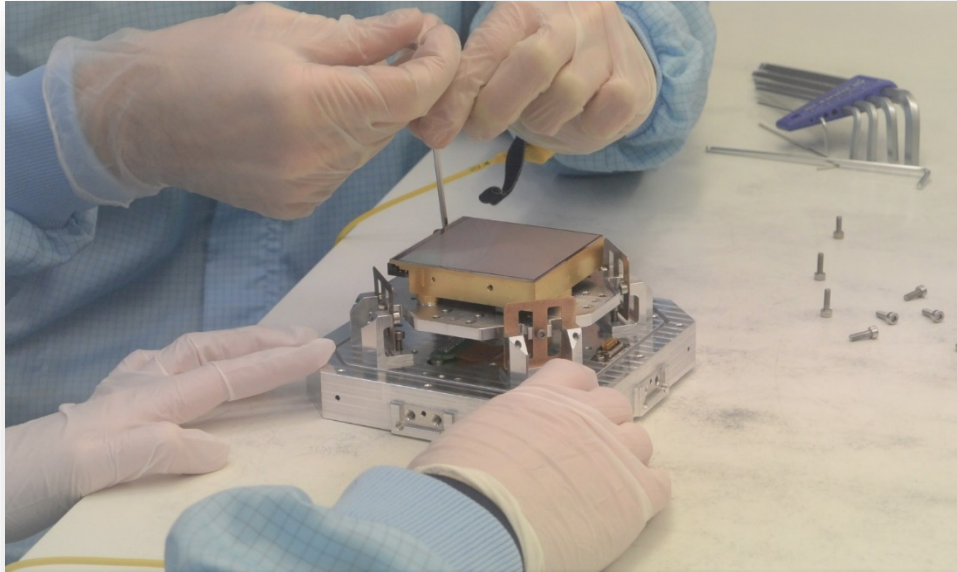
AIV & First results

First data with the MUX ...
... for the Fachbeirat



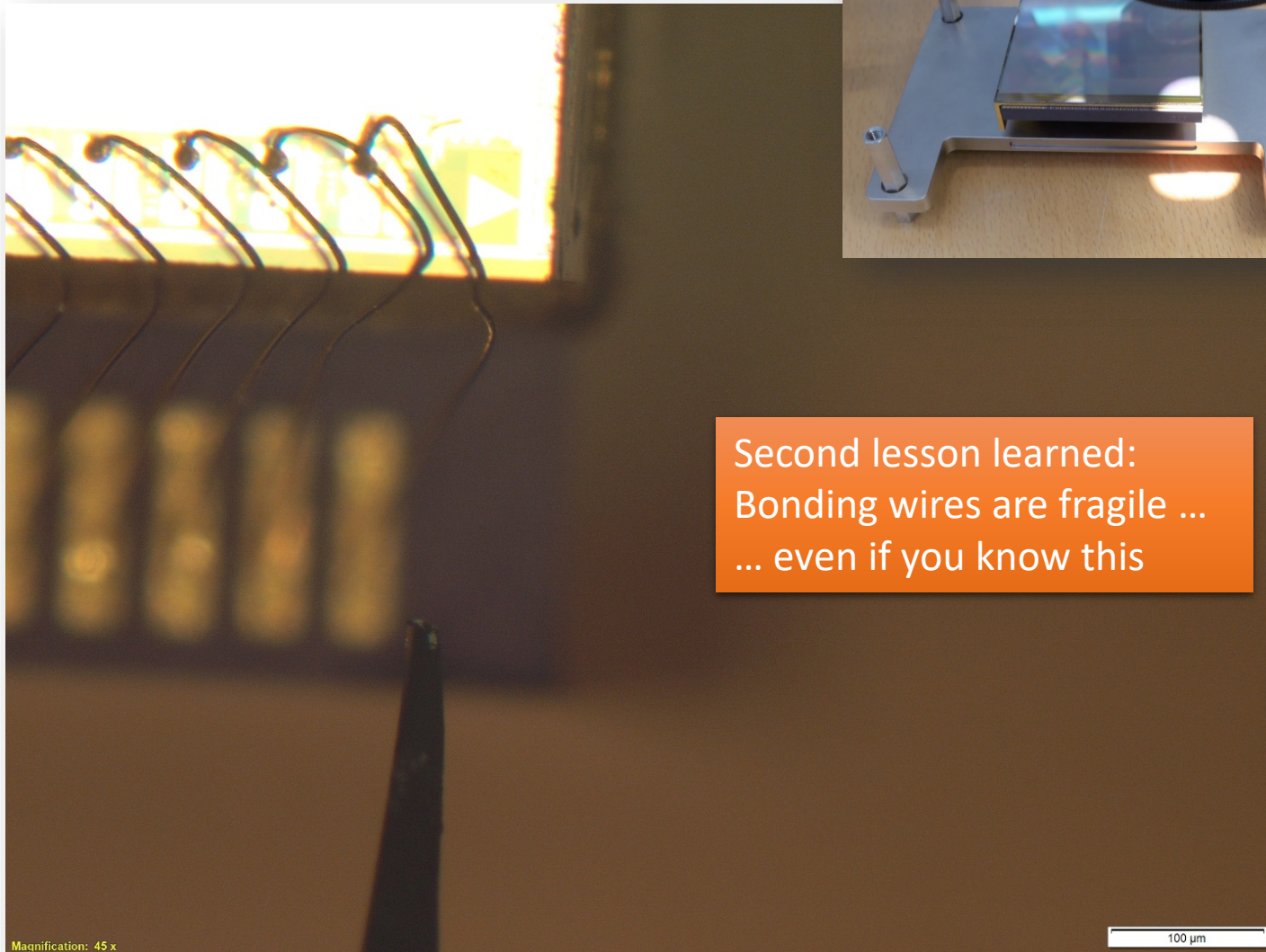
AIV & First results

First ~~data~~ experience with the MUX ...



AIV & First results

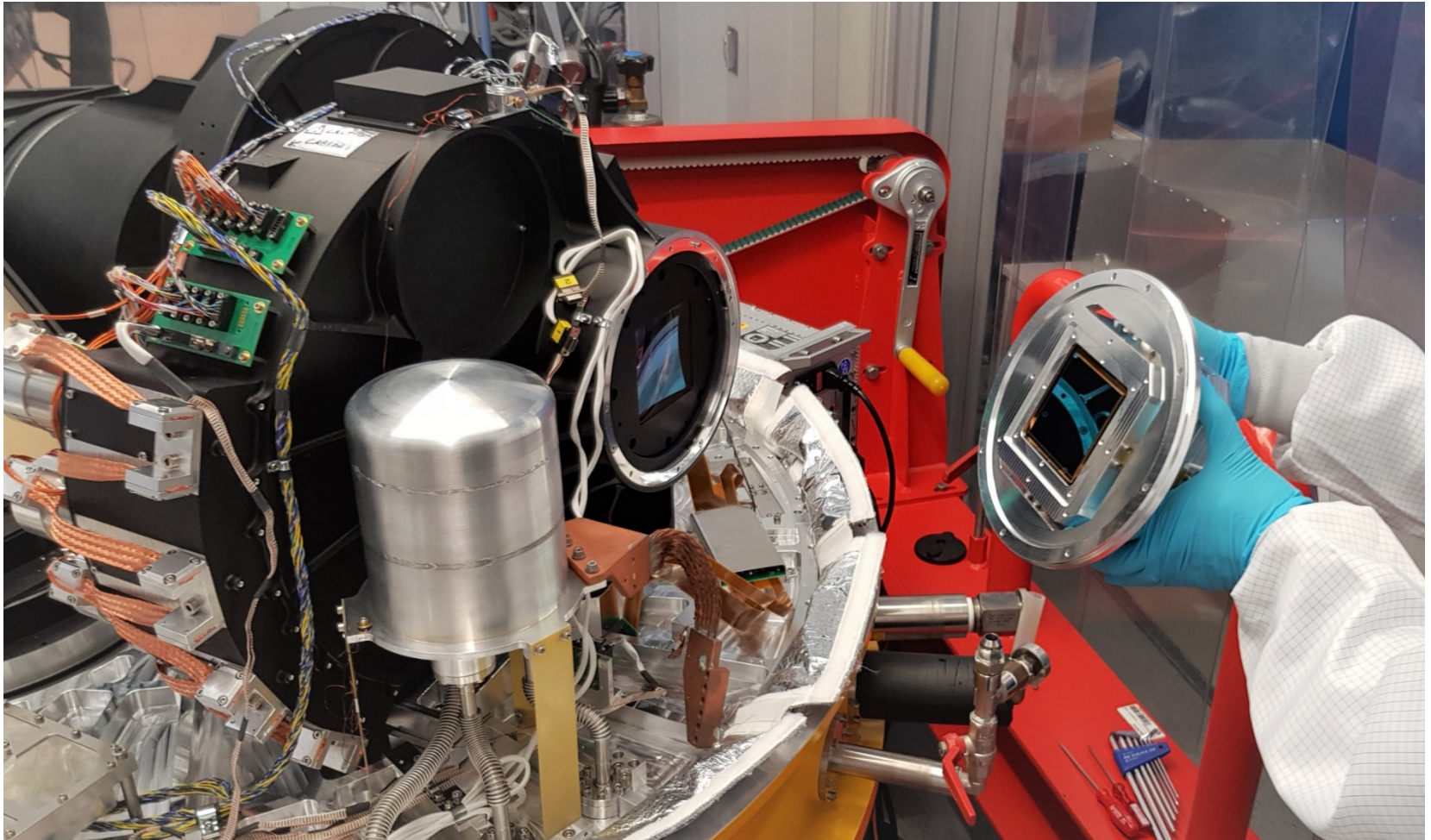
First ~~data~~ experience with the MUX ...



Second lesson learned:
Bonding wires are fragile ...
... even if you know this

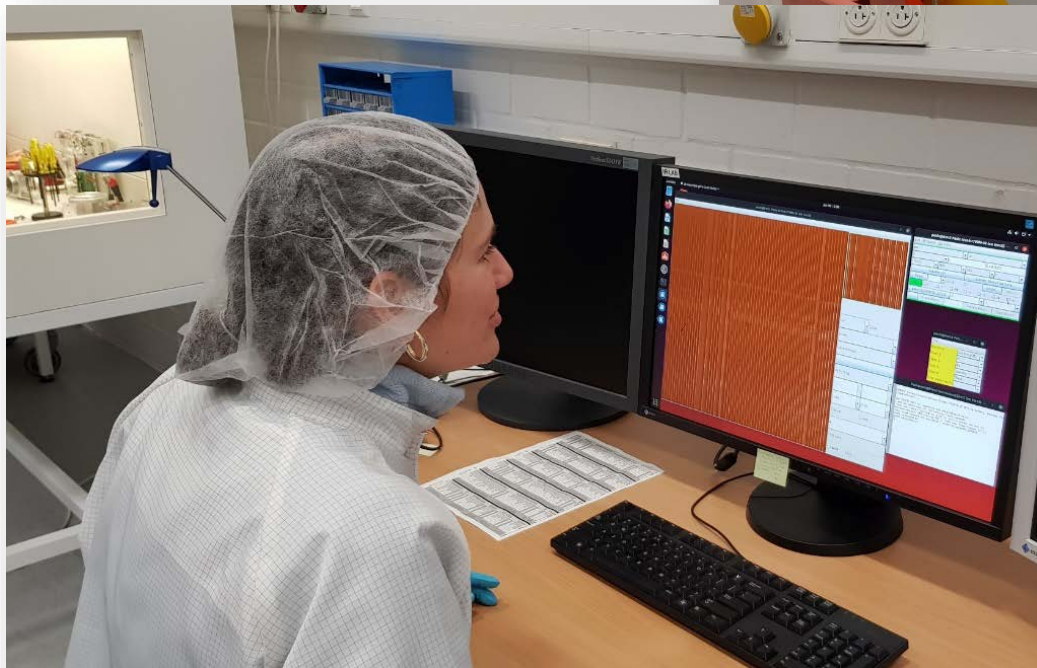
AIV & First results

Integration with science grade detector



AIV & First results

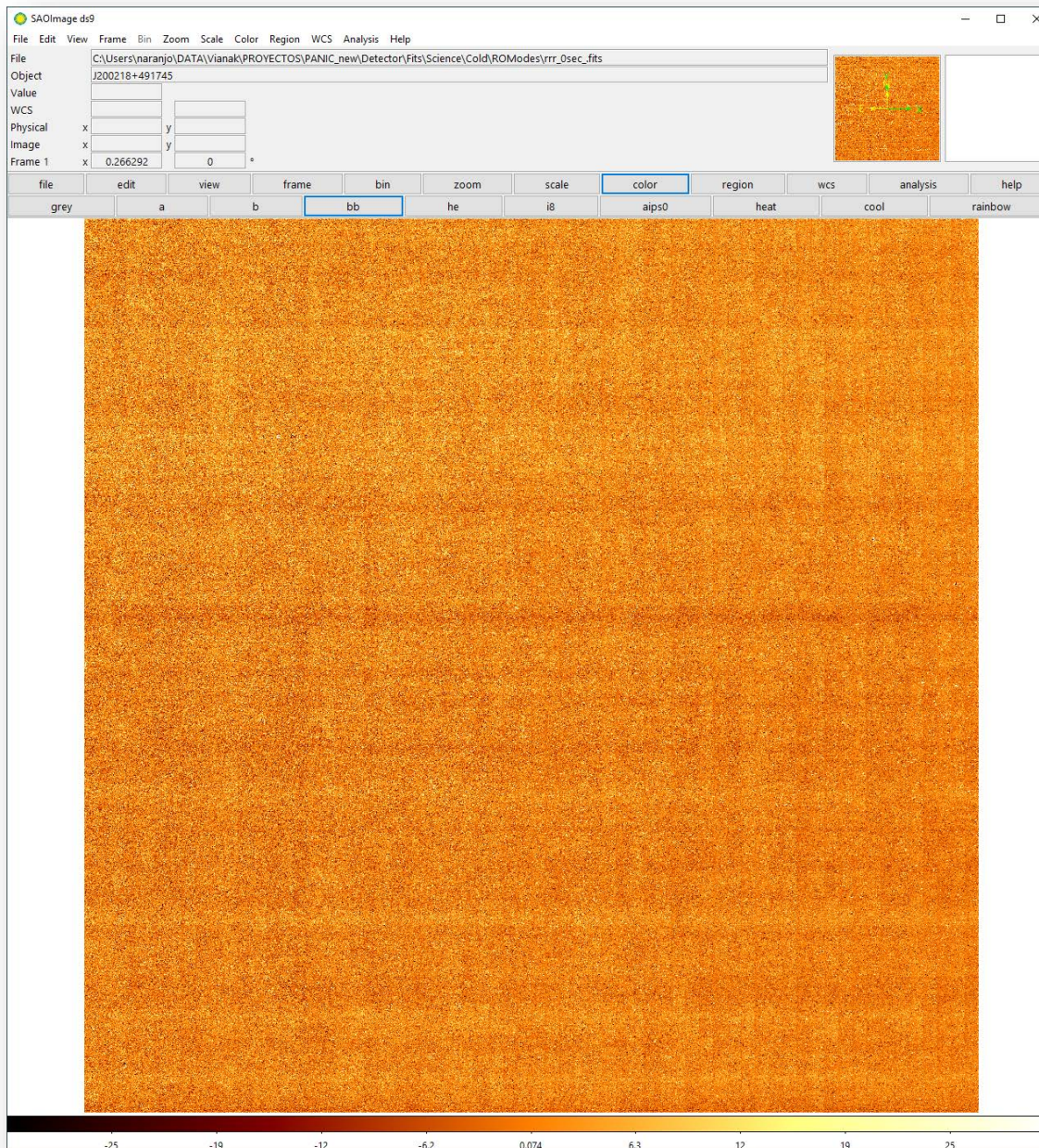
Integration with science grade detector



Cool down of science detector

First data cold

AIV & First results



Where are we?

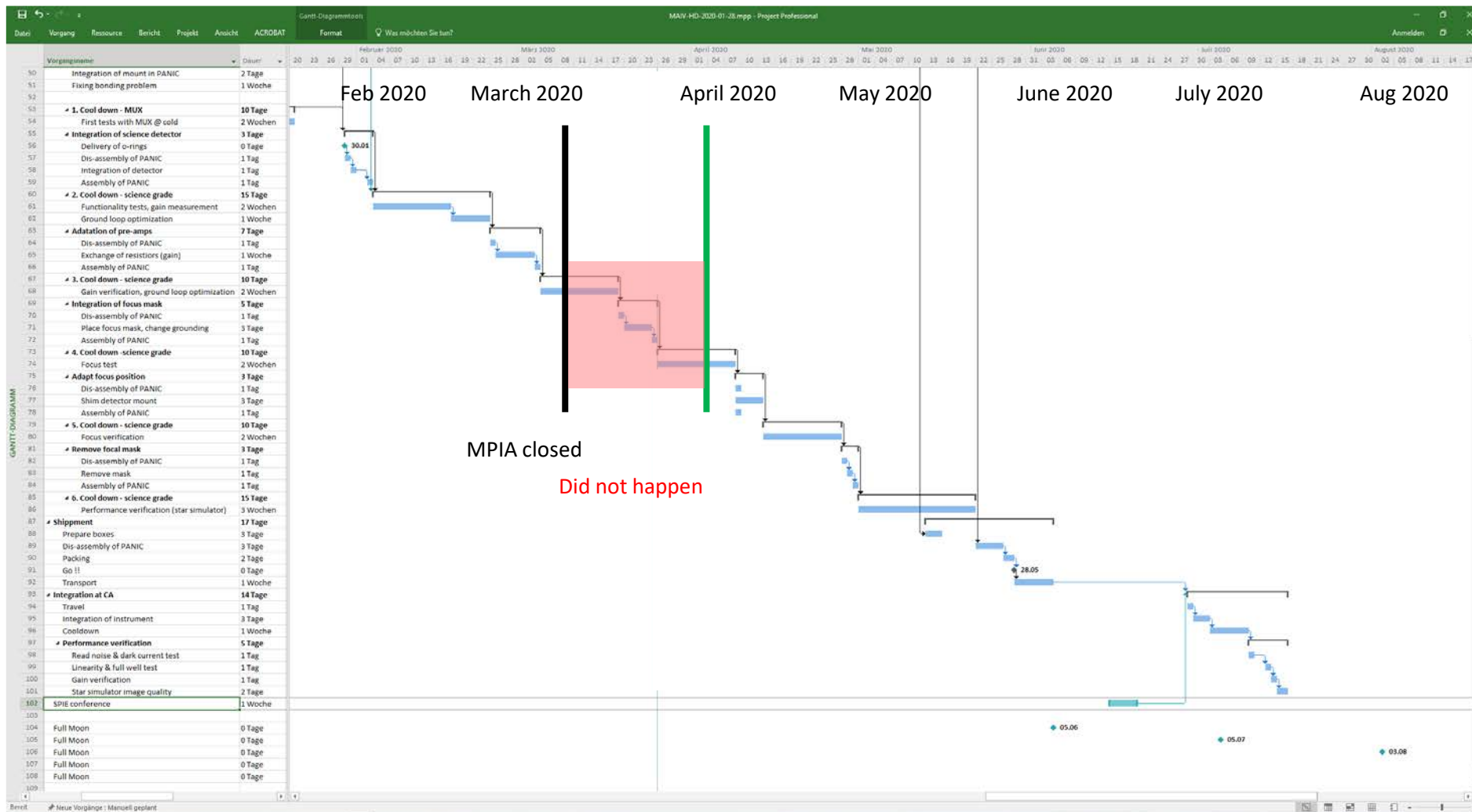
We fixed already

- Mismatch in the connector pin layout
- Supply circuit for reset voltage
-

4k x 4k dark in CDS

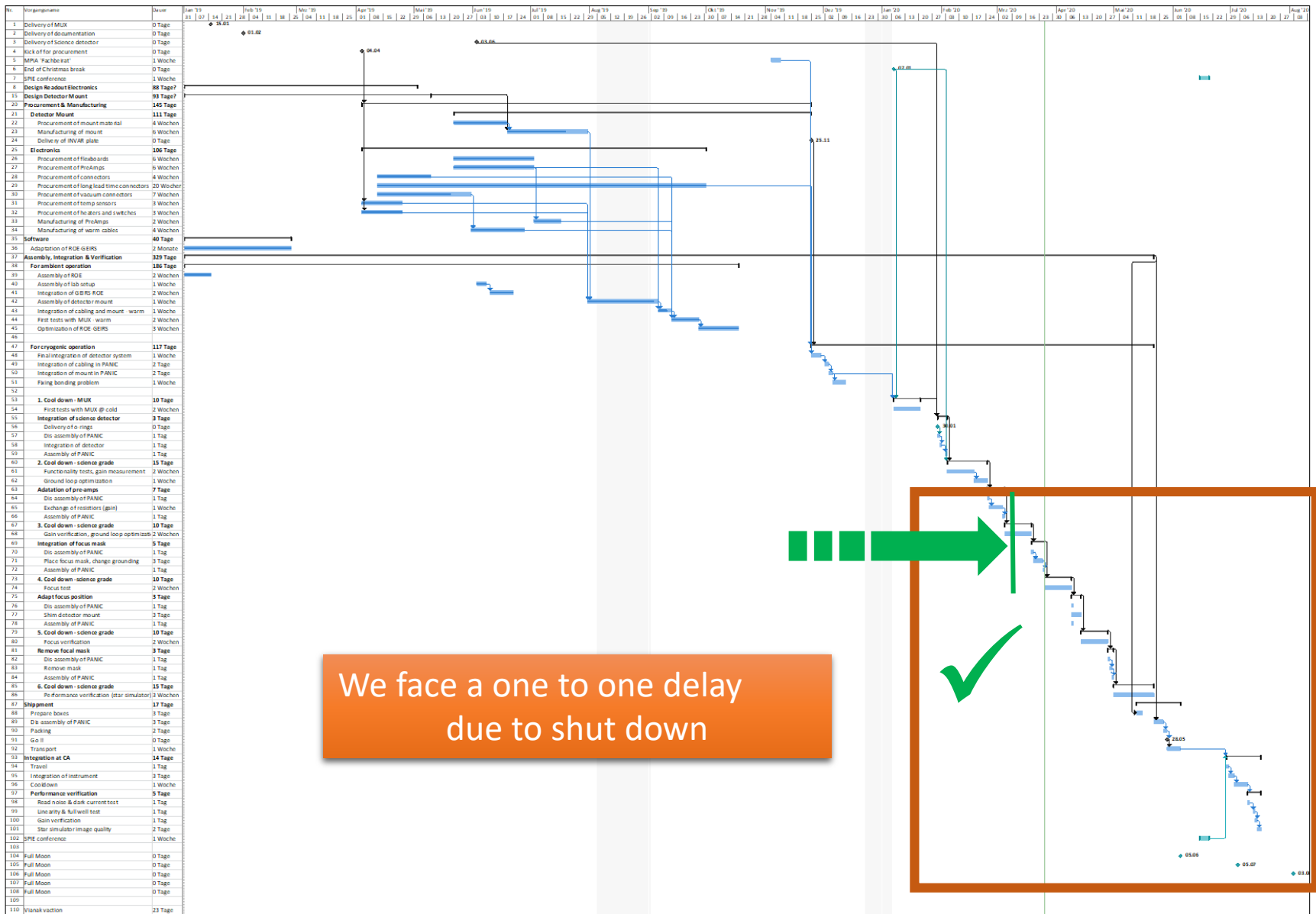
Looks very promising
but
we are not there yet

Status & Outlook



Commissioning in August will not happen

Status & Outlook



The End

However,
we will finish ... may be just a little bit later

Thank you