Update on mechanics and cooling of the luminosity detector

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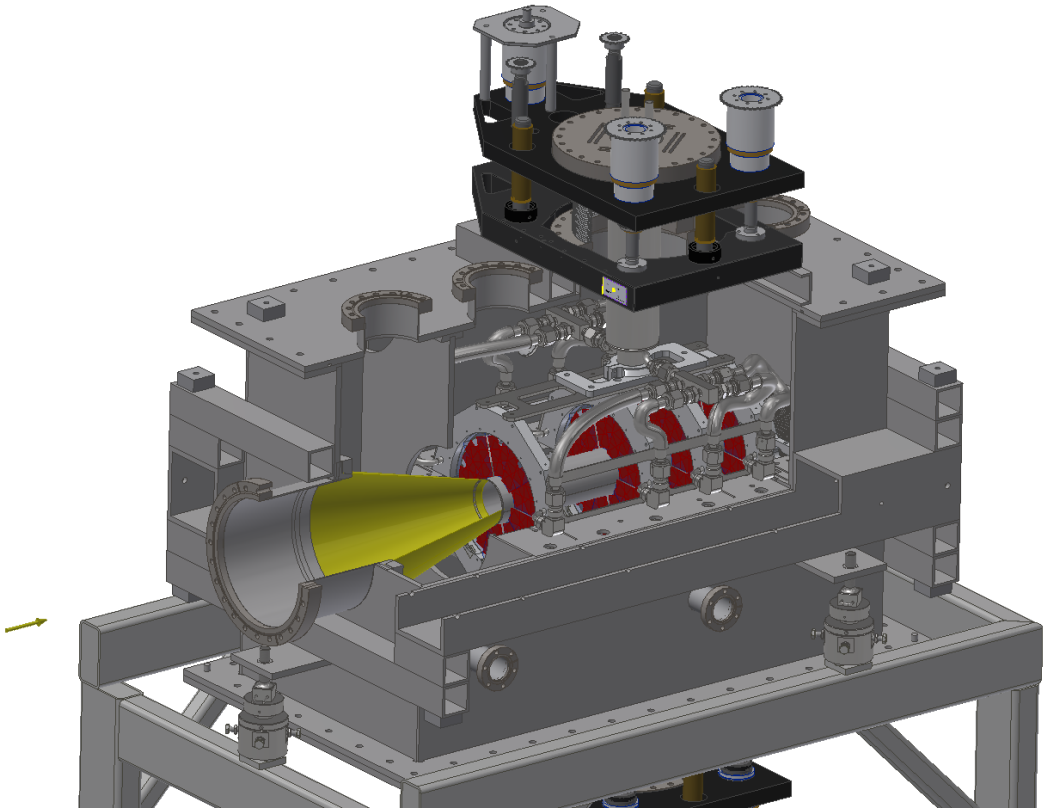
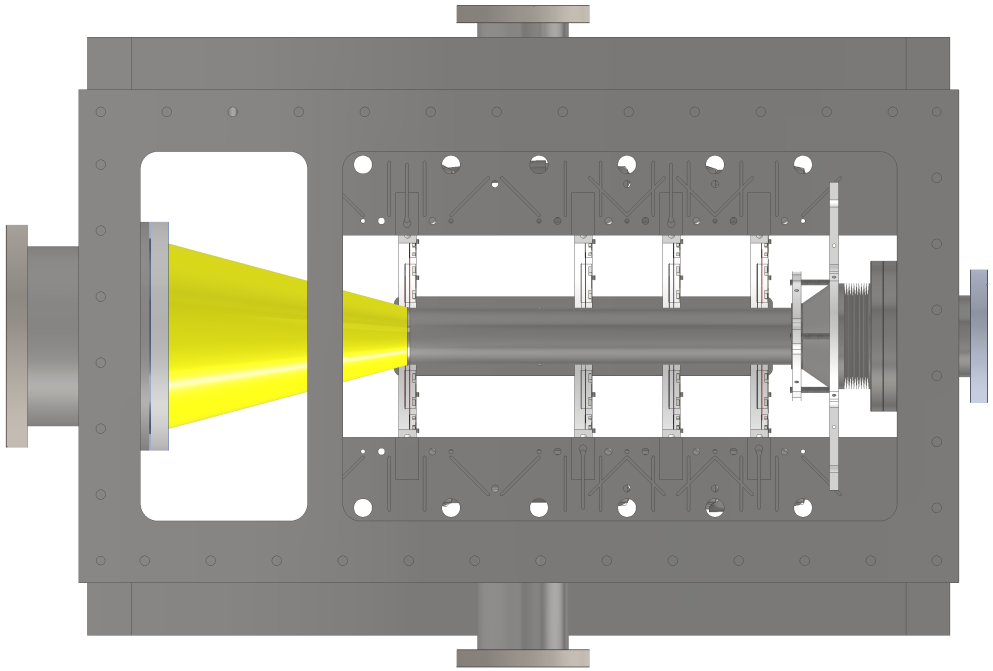
Overview of the luminosity detector



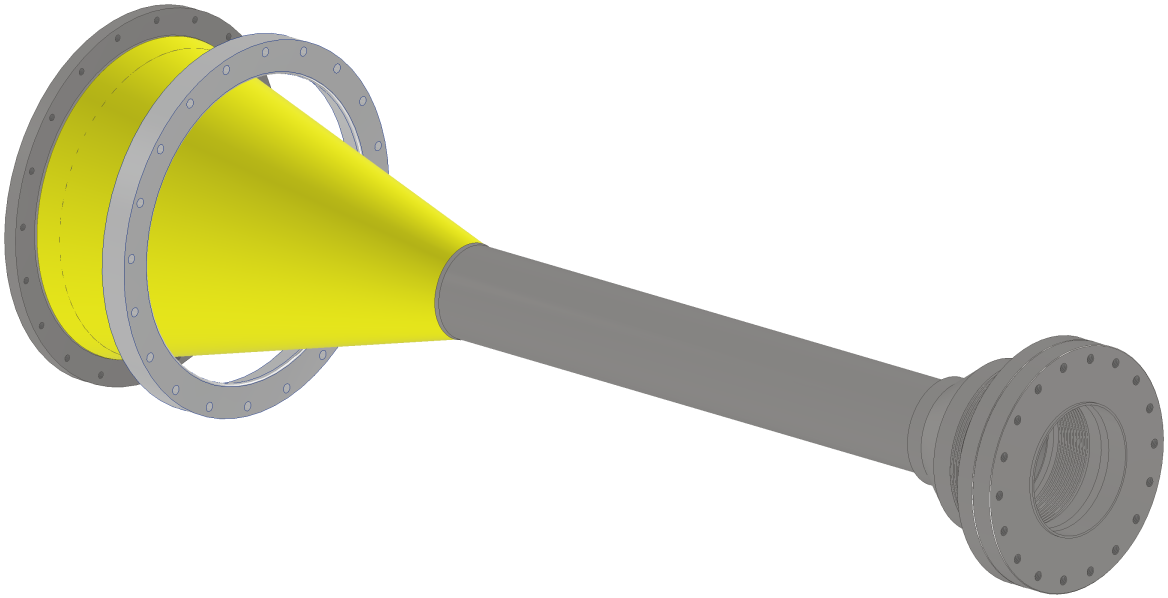
- 4 retractable layers of active sensors in secondary vacuum
- rigid vacuum box for good position information of the sensors
- active cooling necessary

Vacuum box middle part



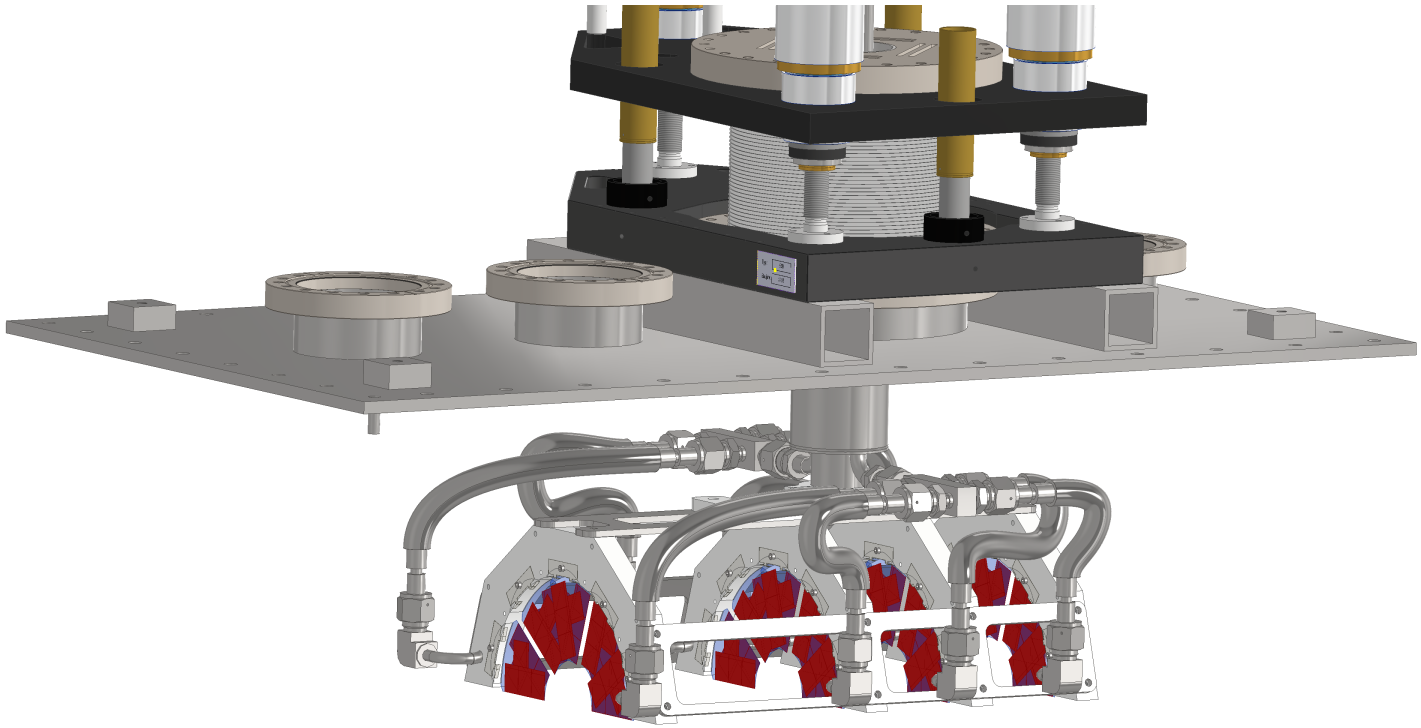
- houses inner beampipe and position sensors
- glueing of foil cone in the box after positioning the inner beampipe
- minor changes on the outside expected
- rework of the inner beampipe compared to the prototype

Inner beampipe changes



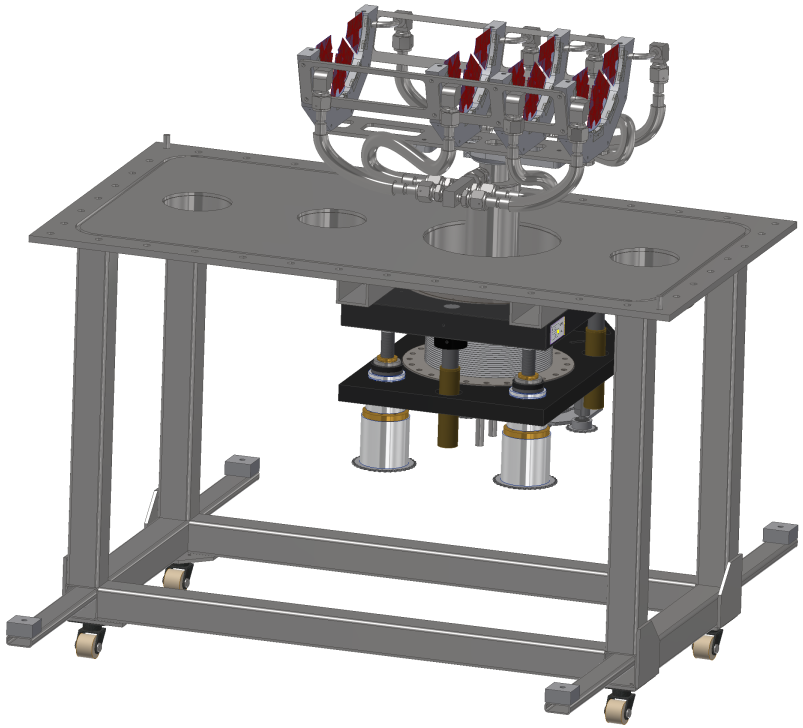
- connection to vacuum box changed to CF type flange
- seamless pipe from titanium grade 2
- outer pipe diameter 68 mm, wall thickness $\leq$ 750 µm

Vacuum box lid 1



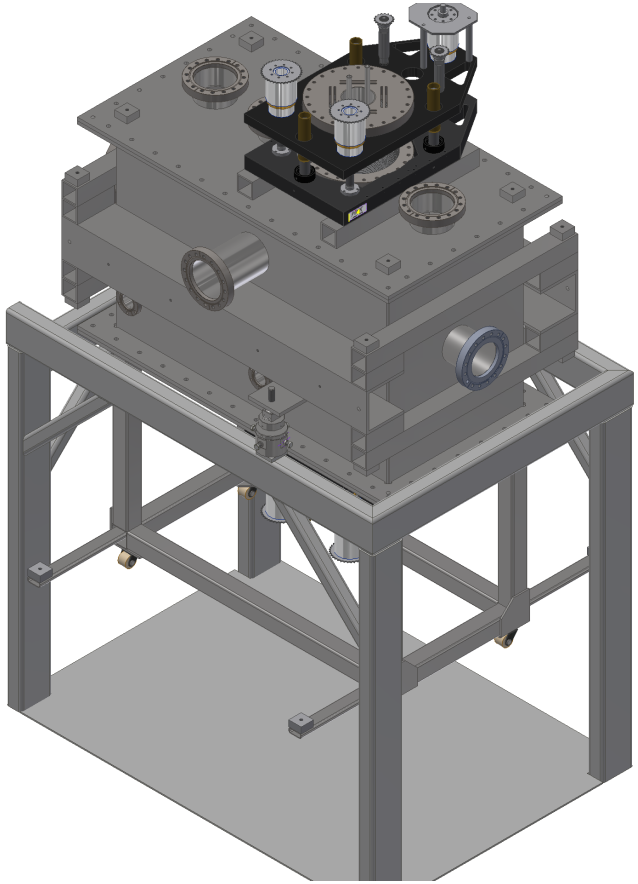
- houses half detector and LSM with all feedthroughs
- allows easier installation and testing
- next steps: LSM and prototype installation

Vacuum box lid 2



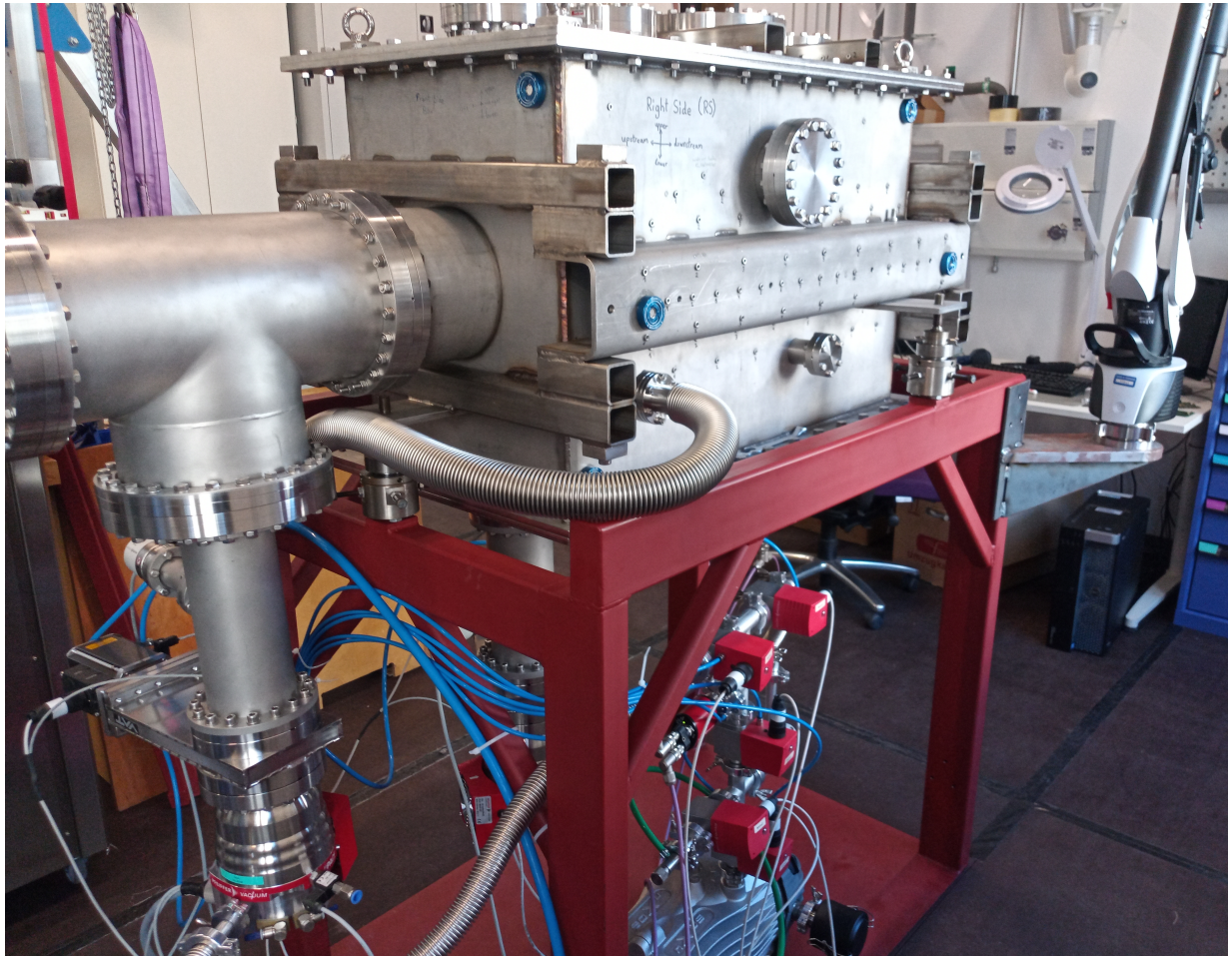
- lower lid installation procedure successfully tested
- repeatability of lid position good (∼50 µm), see talk by Jannik

Vacuum box lid 2



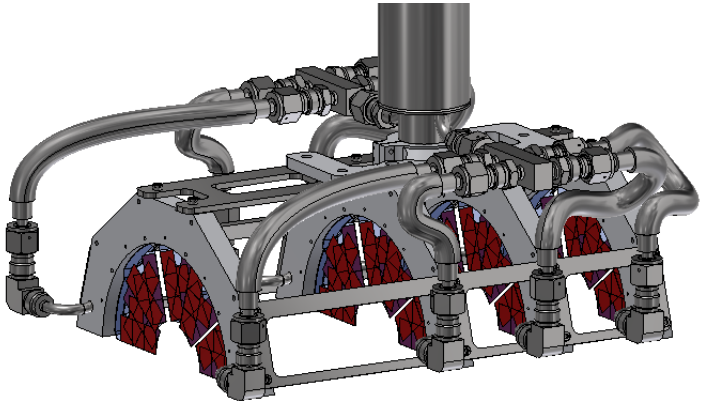
- lower lid installation procedure successfully tested
- repeatability of lid position good (∼50 µm), see talk by Jannik

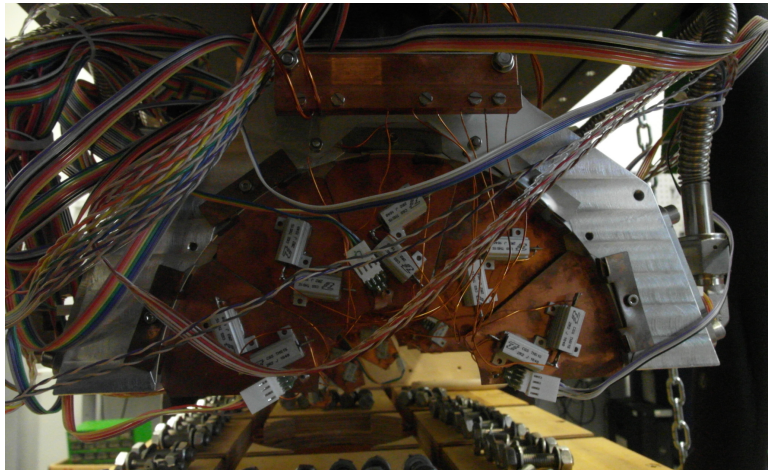
Mechanics: Vacuum box



- mechanical rigidity within expected parameters, see talk by Jannik
- vacuum tests under preparation

Cooling system: General setup





	sensors	LDO Voltage regulator	resistance in flexcables	Multiplexer etc.
worst case	1040 W	320 W	160 W	∼100 W
likely case	380 W	120 W	20 W	∼100 W

- Total estimated heat load per half detector: 310 W to 810 W
- Worst case: 7 mW mm^{-2}, likely case: 2.5 mW mm^{-2}
- For cooling test: copper dummys and high power resistors

Cooling cycle test

Cooling cycle:

- Set bath temperature to $-20\,^{\circ}\mathrm{C}$
- When $-20\,^{\circ}\mathrm{C}$ is reached wait 10 min
- Switch on power supply and wait 15 min
- Switch off power supply and set bath temperature to $20\,^{\circ}\mathrm{C}$
- When $20\,^{\circ}\mathrm{C}$ is reached wait 10 min

>500 cycles run with 340 W (14 W/module)

>500 cycles with 465 W (19 W/module)

expected case: 10 W/module

- no changes in cooling behaviour

Summary and outlook

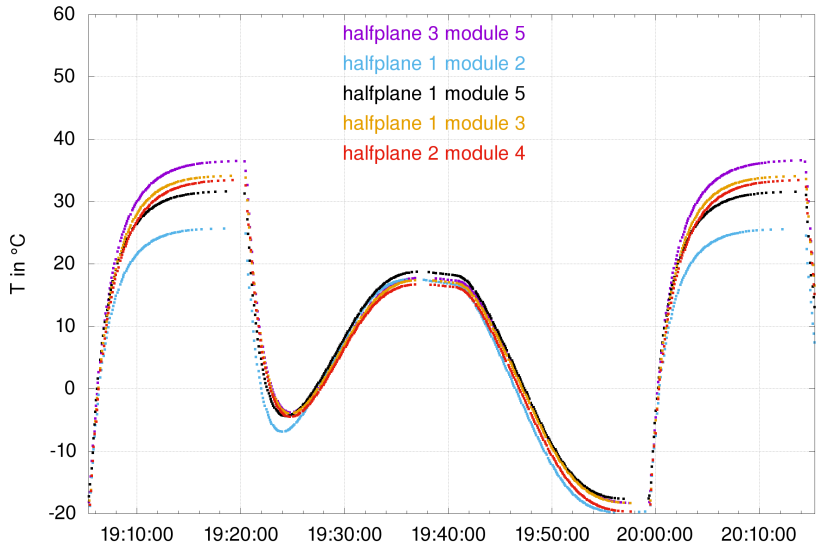
- vacuum box prototype successfully tested for mechanical stability
- vacuum box handling tested
- half detector cooling working

What is next:

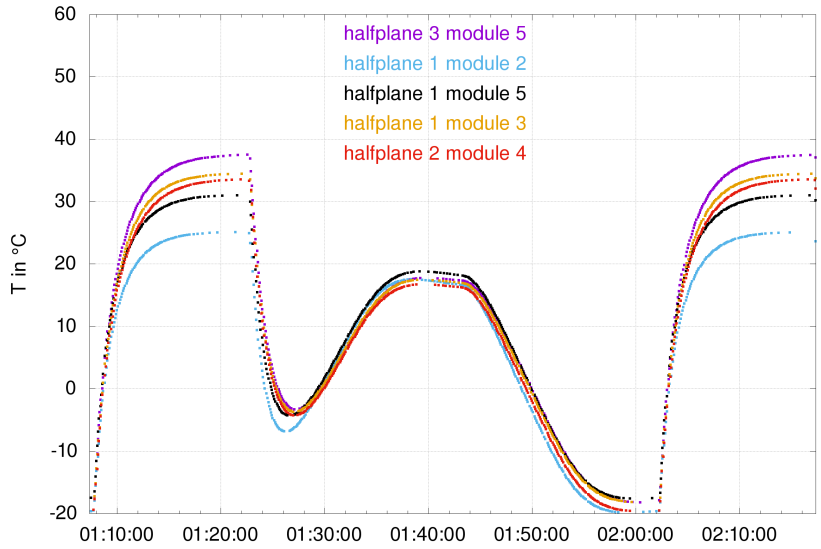
- extended vacuum testing of the box
- production of half detector prototype with sensors
- production of final detector

Cooling cycle result I

First cycle:



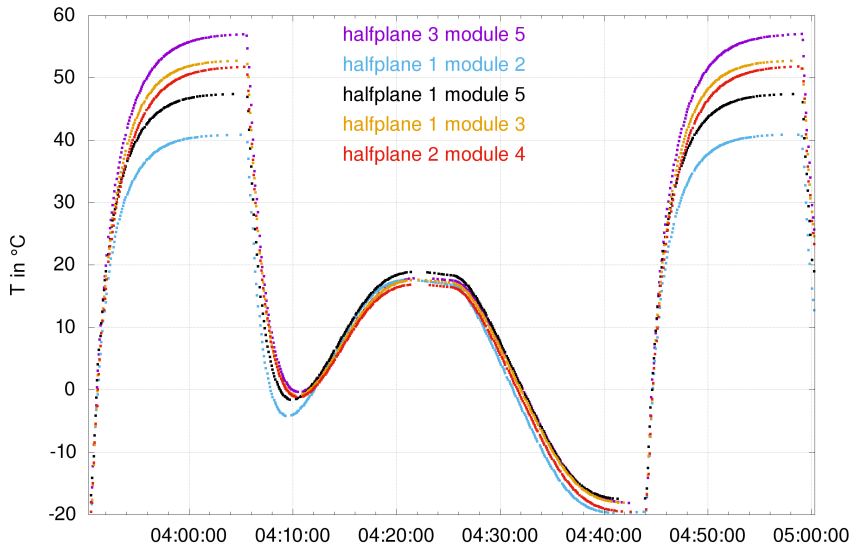
Last cycle:



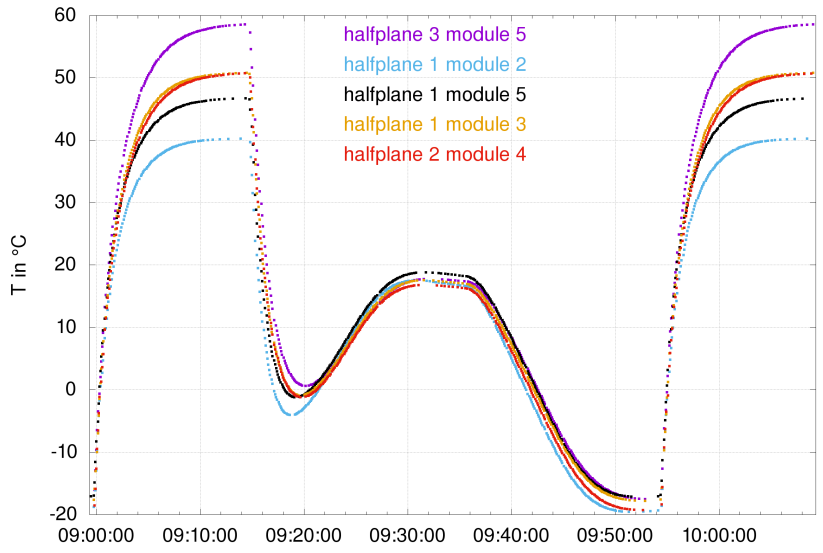
- No change in 500 cycles for 340 W
- Placement of modules difficult du to stiff copper cabling and heavy weight
- Well-placed modules show acceptable temperature under realistic conditions

Cooling cycle result II

First cycle:

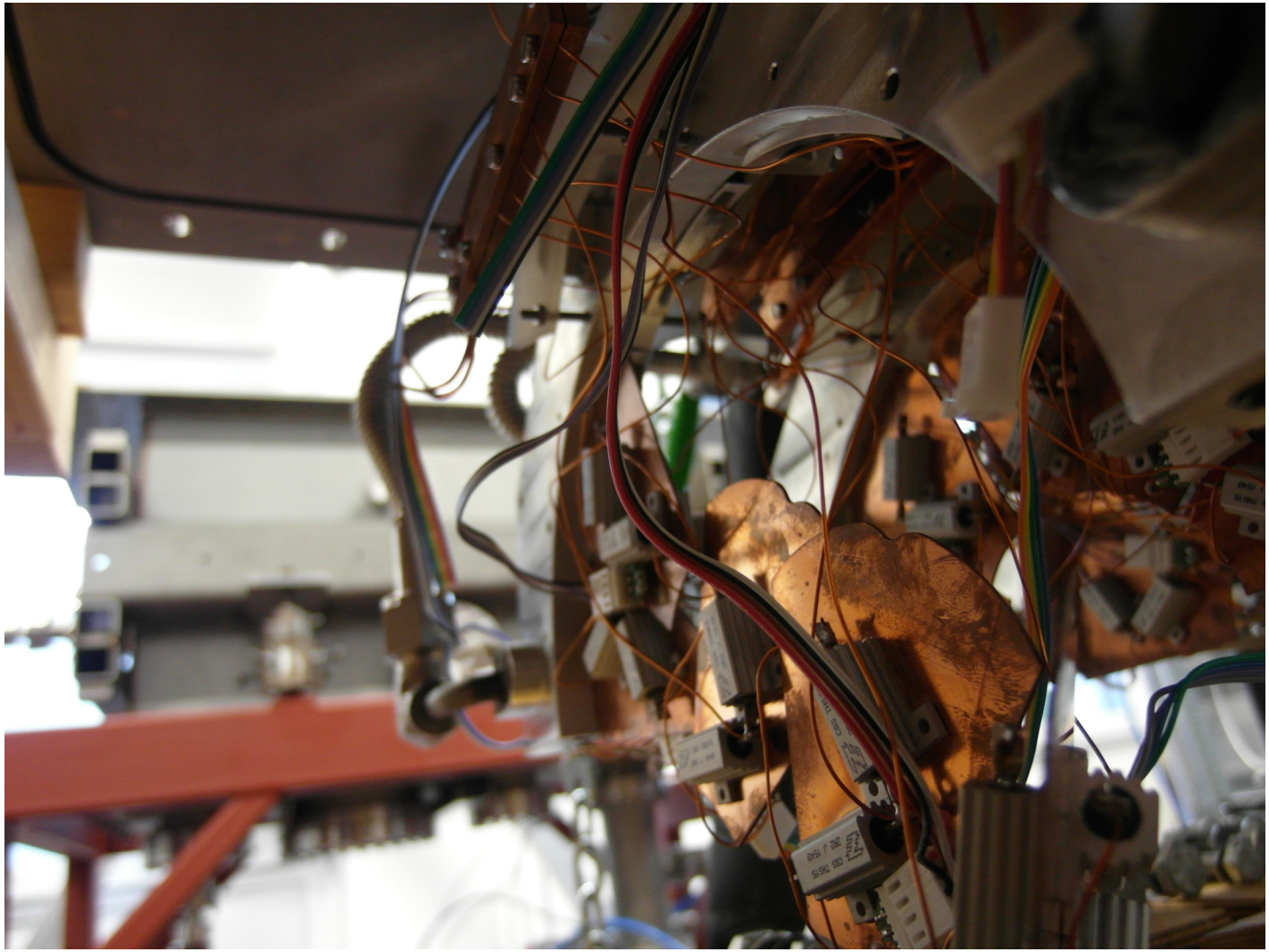


Last cycle:



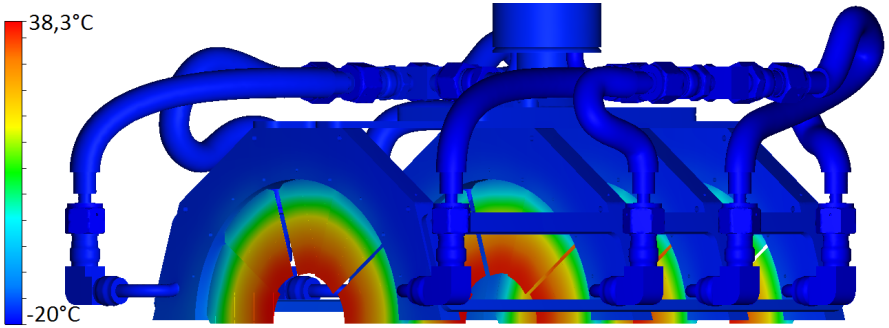
- Small changes after 500 cycles for 465 W
- Three copper dummies lost contact
- Well-placed modules still ok
- Contact loss due to mechanical collision of resistors and inner beampipe aligner (not a problem with sensors)

Contact loss during cycle test

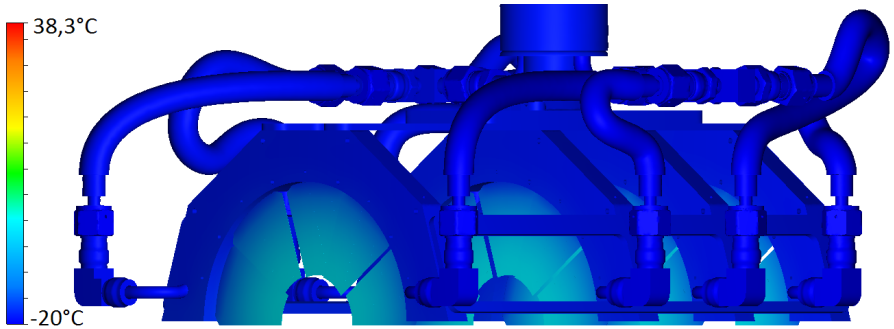


Simulation

worst case:



expected case:



- No transition or radiative effects
- Inlet temperature $-20\,^{\circ}\mathrm{C}$, pressure difference 1 bar
- diamond in nominal thickness
- maximum temperature:

  worst case: $\sim 39\,^{\circ}\mathrm{C}$

  ecpected case: $\sim 0\,^{\circ}\mathrm{C}$