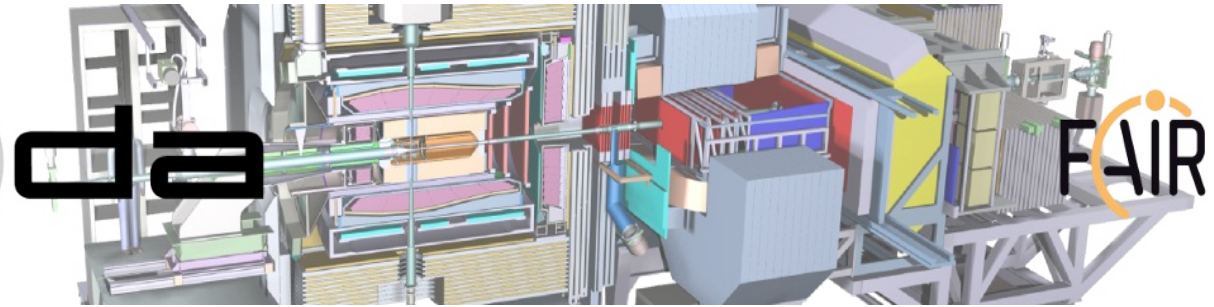


Barrel EMC Slice Assembly Status



Markus Moritz, 2nd Physics Institute, JLU Giessen

PANDA CM, June 2019

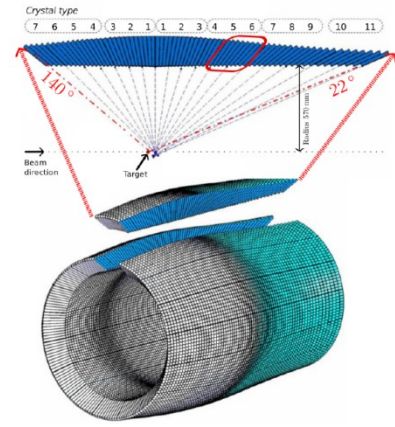


Next IHEP delivery arrived in Gießen

Envisaged milestone (M8): Assembly of 1st full Barrel EMC slice

- Infrastructure ✓
- Mechanics (except Supportbeam) (✓)
- 710 detectors ✓
 - 710 crystals in 11 different geometries ✓
 - 1420 APDS
 - Screening including irradiation ✓
 - Matching ✓
 - Glueing ✓
 - Capsules ✓
 - Wrapping ✓
- Assembly of 18 modules ✓
- Assembly of Supermodules ✓
 - 360 left and 360 right handed APFEL-ASIC with flex PCBs ✓
 - ASIC housing or fixtures ✓
- Assembly of full slice X
 - Cooling & thermal insulation
 - Backplanes
 - Light pulser fiber coupling
 - Design Supportbeam

in progress
 in progress
 in progress
 in progress

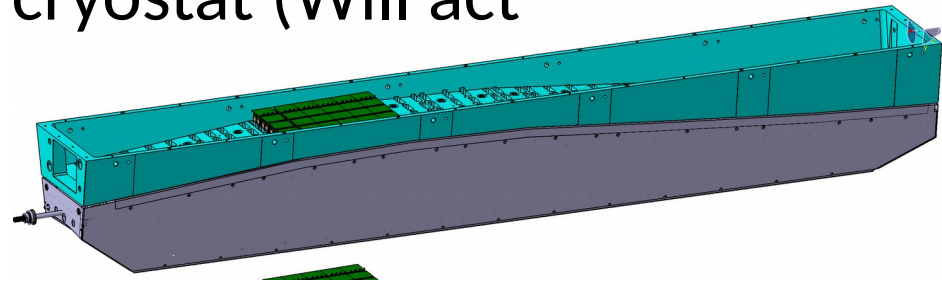
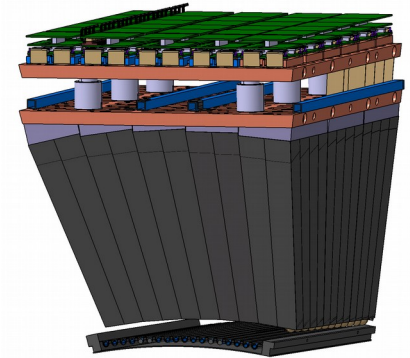


Tasks:

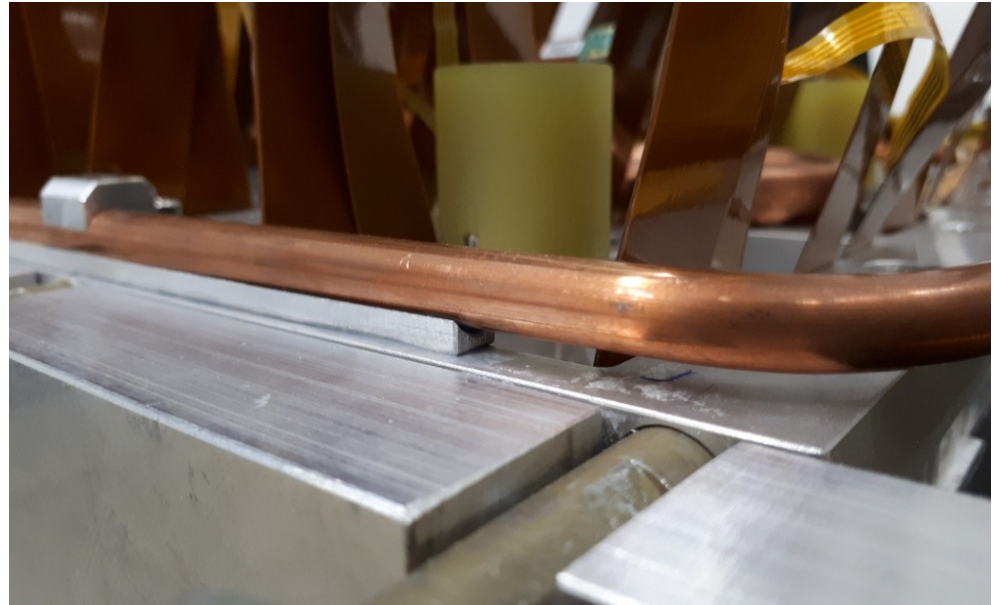
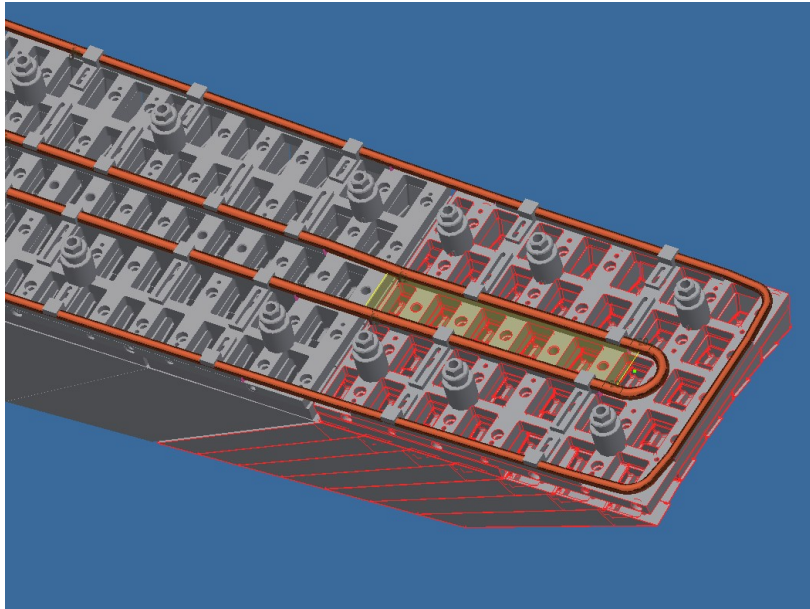
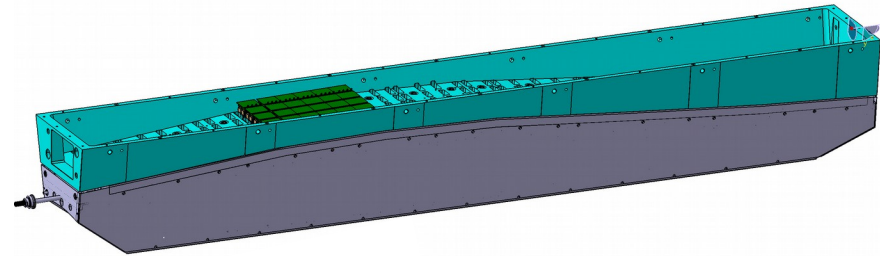
- Create comparable conditions to final PANDA Installation
- Reach target temperature and homogeneity for all crystals with and without dummy heat-load
- Finalize mechanical designs on cooling (so mass production can start)
- Gain findings for cooling system behavior and control (ramping, emergency shutdown in case of leak etc.)

Heat transfer & load:

- Each slice's cold volume neighbours cold volumes of other slices (very small temp gradient)
- Cold Supermodule plates face hot support beam
- Supportbeam faces magnet cryostat (Will act as heat insulation)
- Crystal fronts are insulated



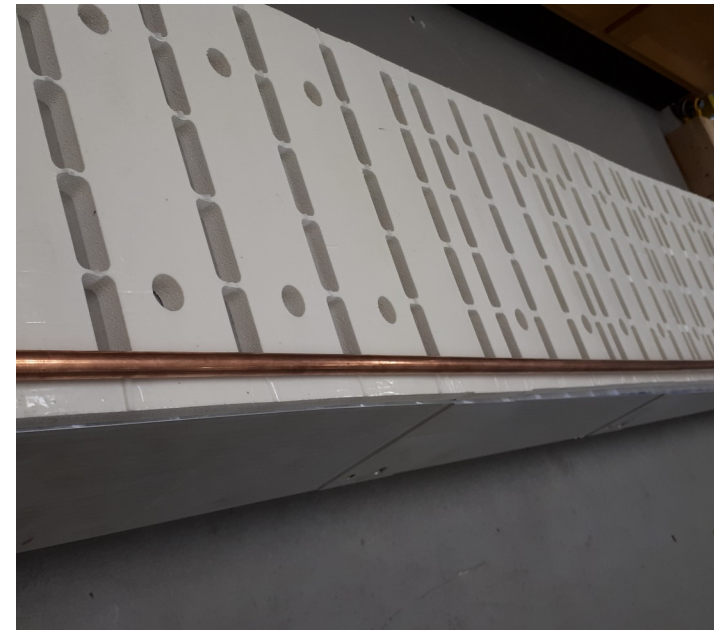
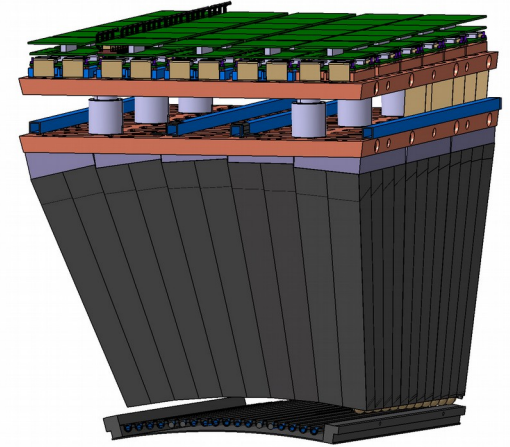
Main cooling lines consisting of two copper pipe loops (10 mm and 8 mm)



No modification of other components needed

Thermal insulation support-beam side

- 30 mm foamed silicone
- Waterjet cut
- Supplied by Rehm Dichtungen

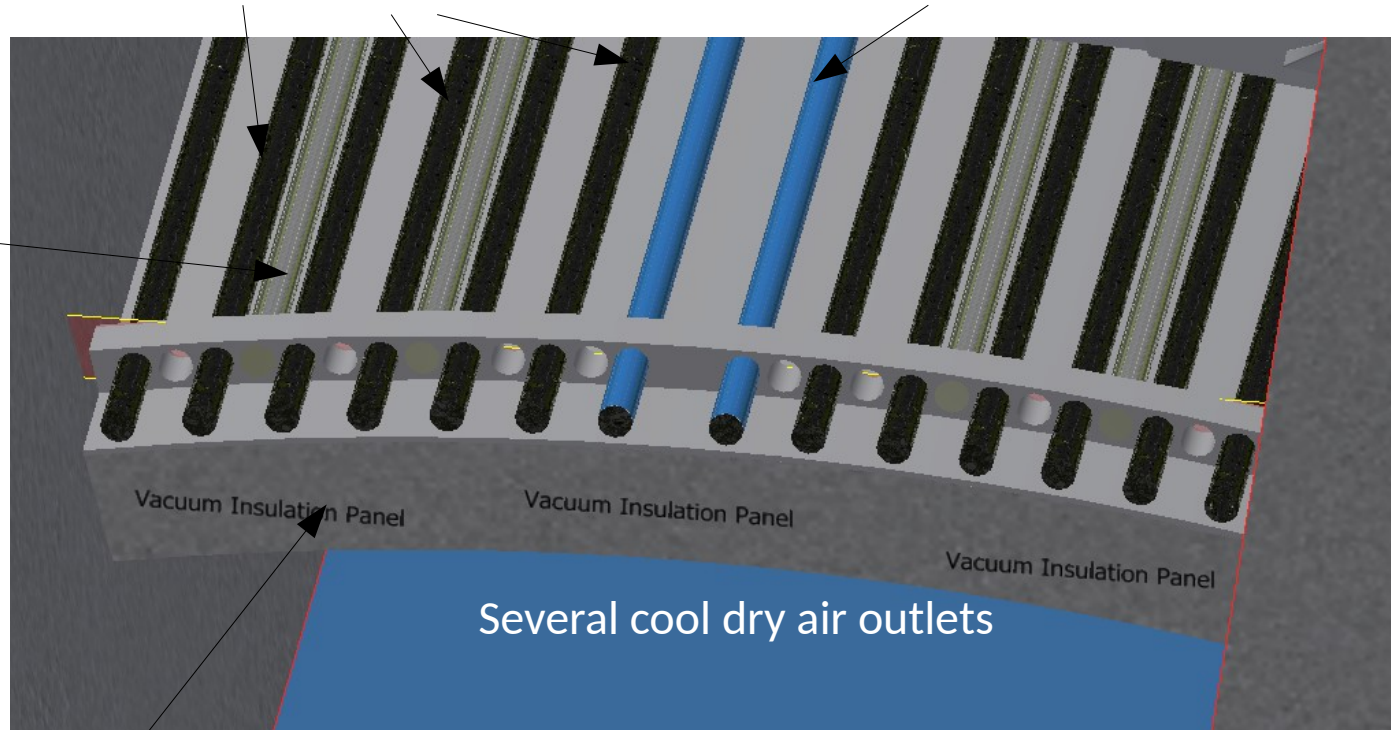


Crystal fronts face

6x4mm PU-Tube for liquid cooling

Cooled air distribution

Rods for stabilization



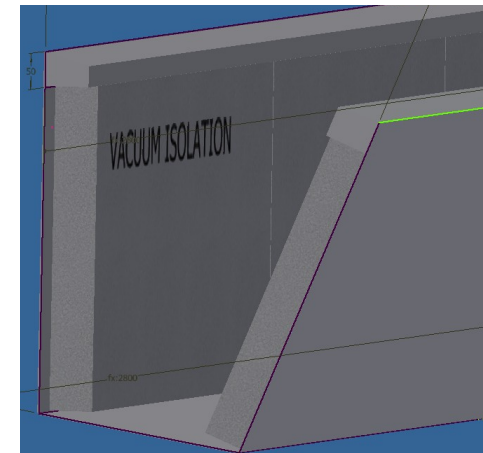
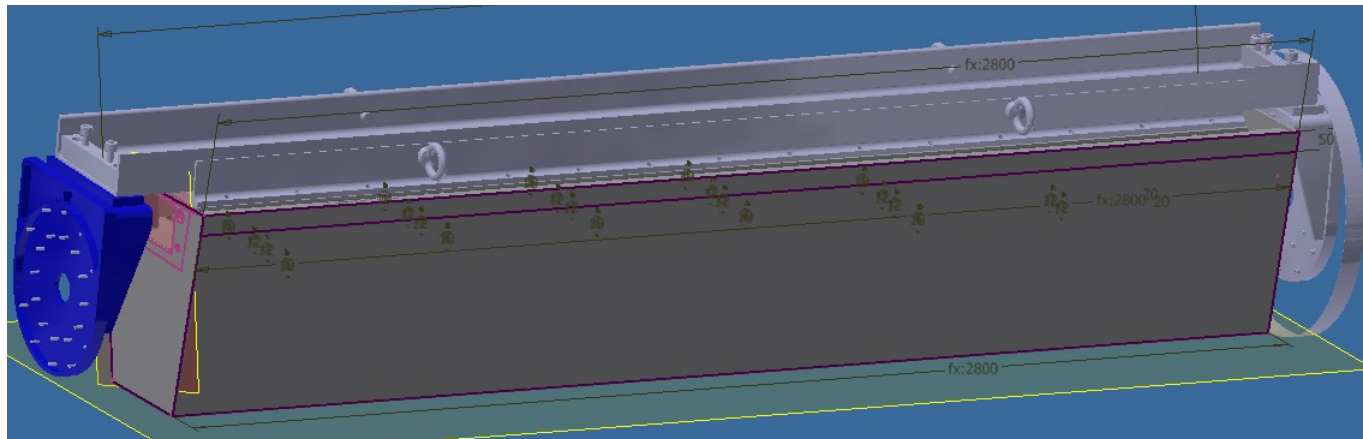
Vacuum insulation panel (20mm)

Setup for Prototype Test

- Test box suitable for existing xy-turning device
 - Goal: airtight sealing
 - 60 mm VIPs on each side
 - Panels to emulate low temp gradient between slices



Heat exchanger for pressurized air

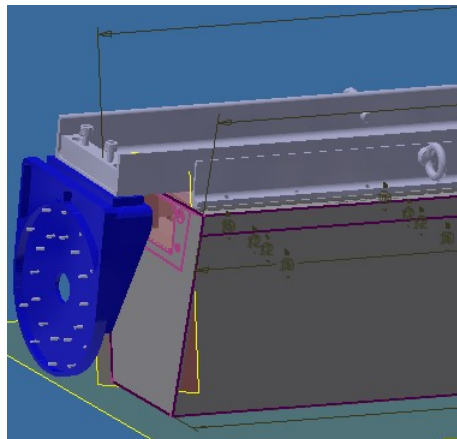


Setup for Prototype Test

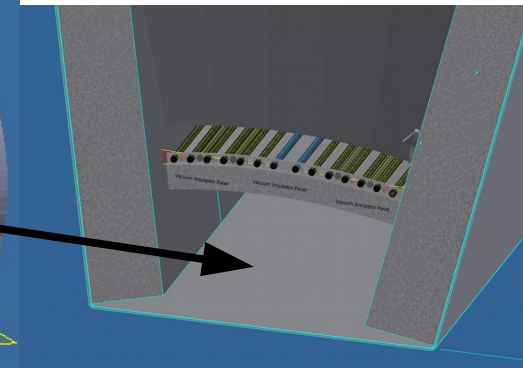
- Test box suitable for existing xy-turning device
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 - Panels to emulate low temp gradient between slices



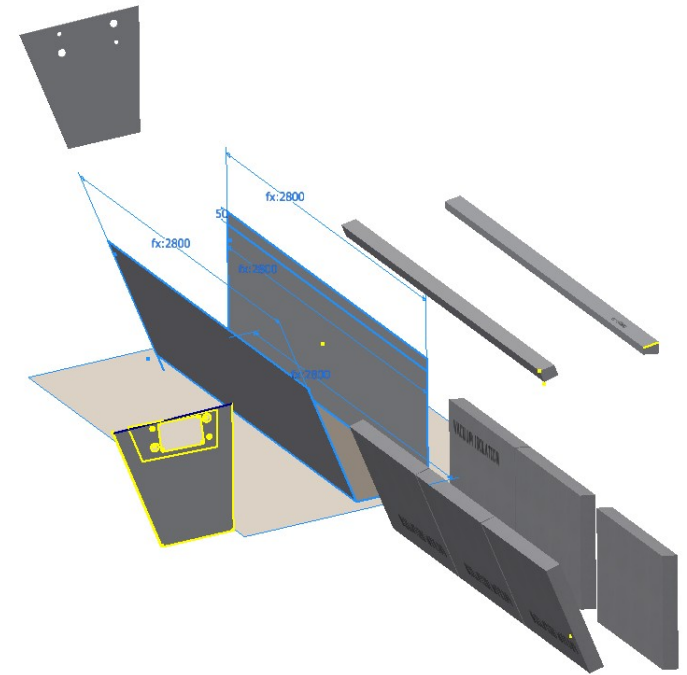
Heat exchanger for pressurized air

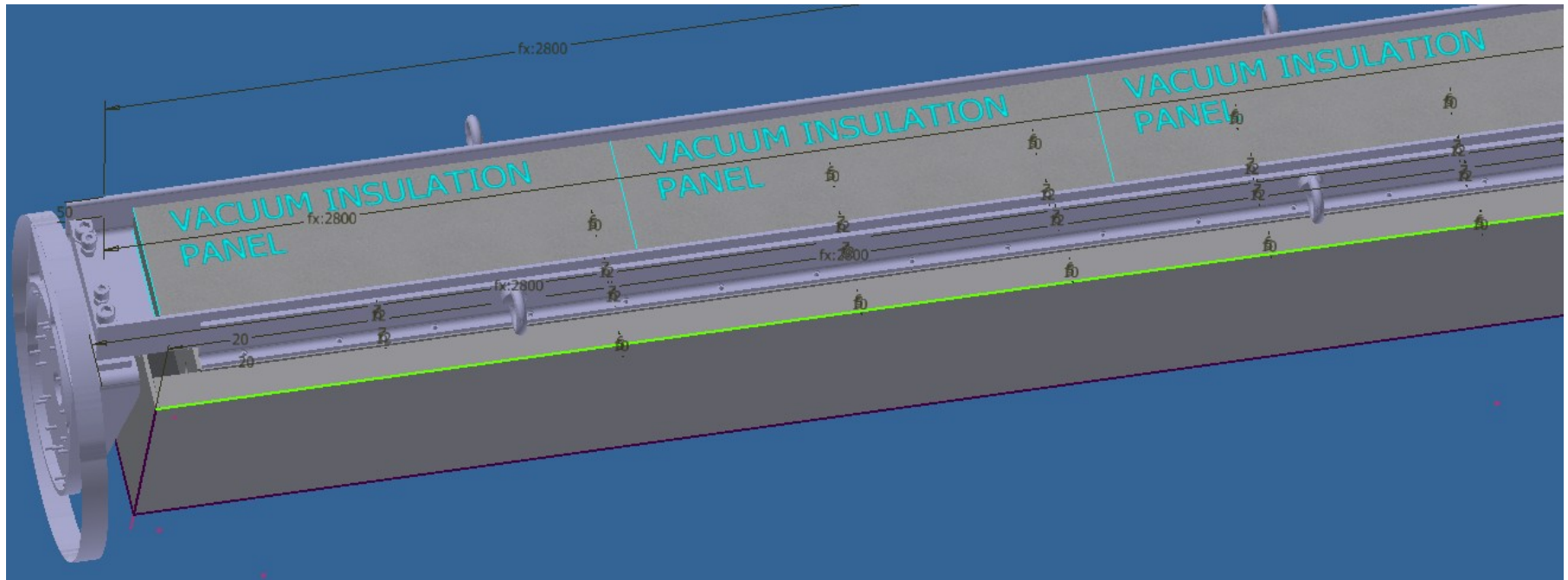


Space for additional
Sensors/Piping/
mechanical support or
dummy heat load under
front VIP



- Body: bended aluminium to support VIP-weight
- 8mm machined Aluminum „endcaps“ for stability
- Plastic rails/frame to hold on support beam
- Box will be sealed using PU based automotive chassis sealant/glue





Additional VIPs on top of the technological beam will emulate the heat insulating properties of magnet cryostat

Test box and front cooling:

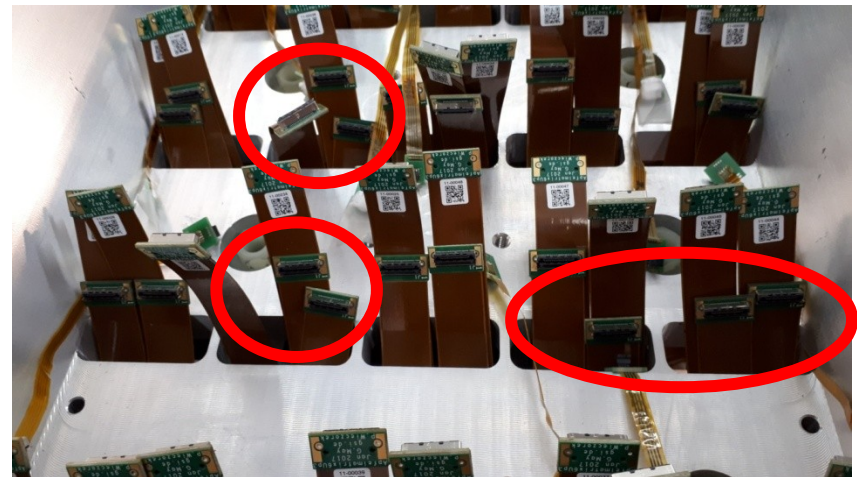
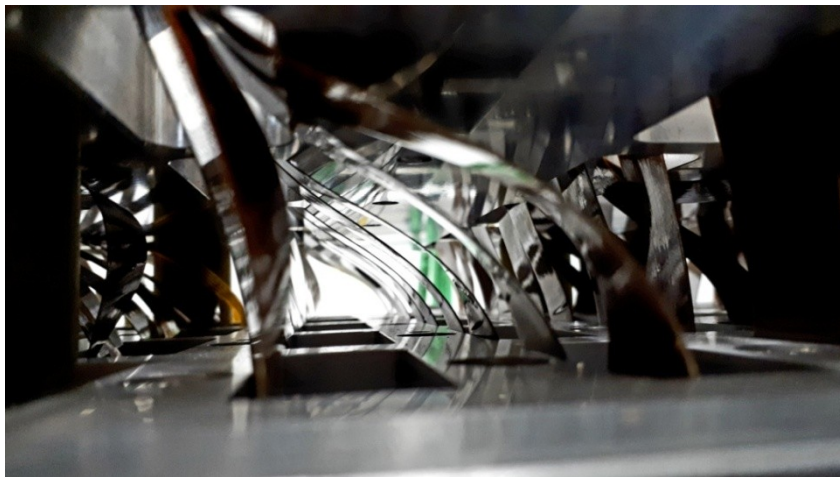
- In Production @ Bochum (waiting on mechanical components)

Main cooling:

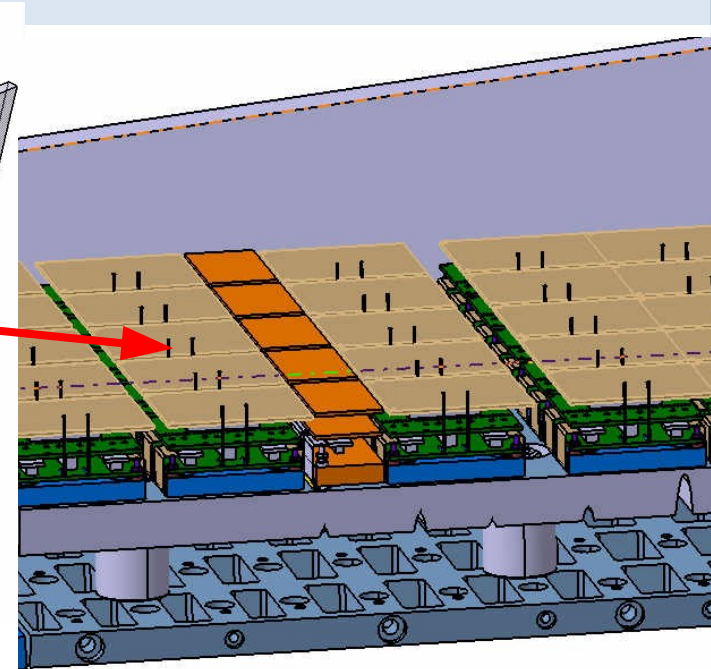
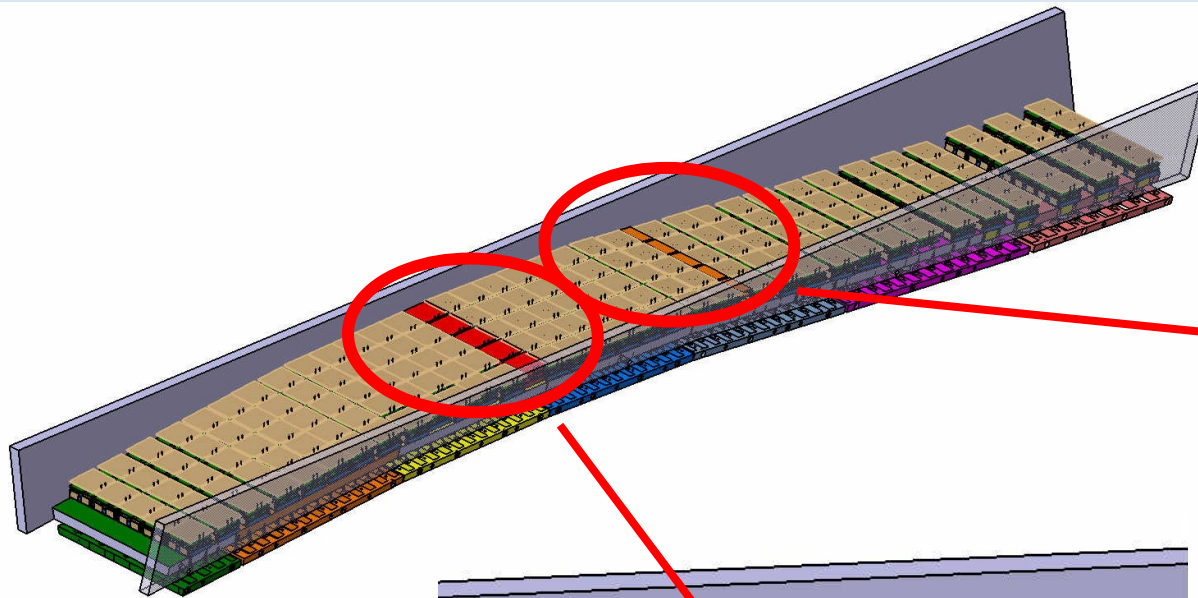
- Parts produced, have to be installed

- Thermal insulation difficult
- Routing FlexPCBs difficult, some can not be connected to backplanes

➔ Supportbeam for first slice needed



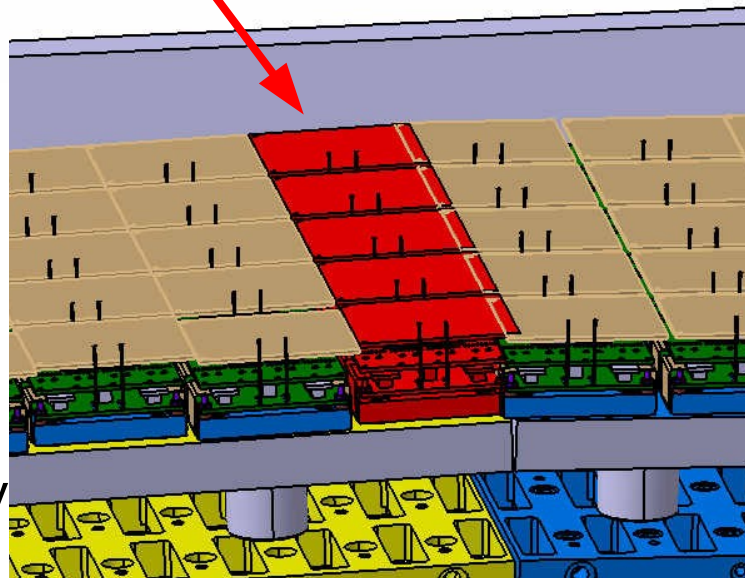




Odd number of rows

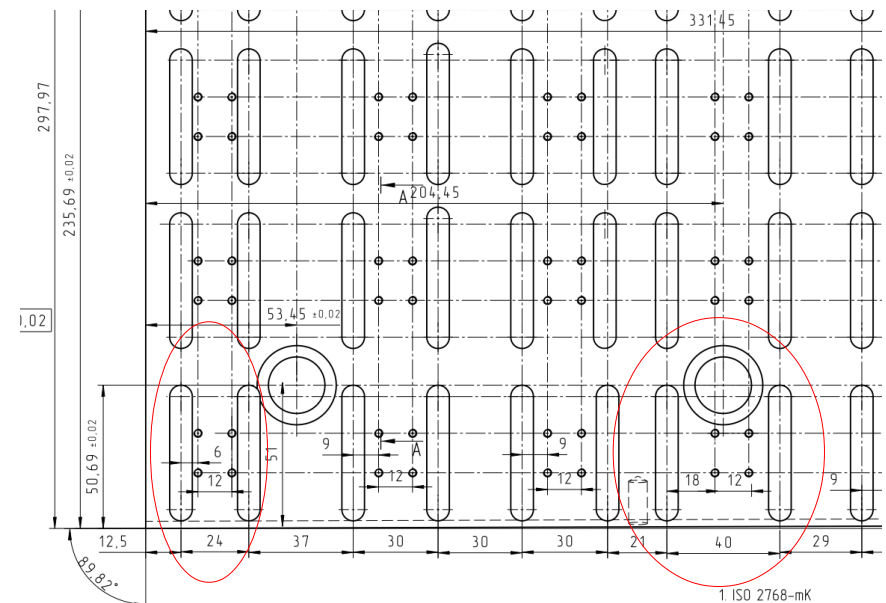
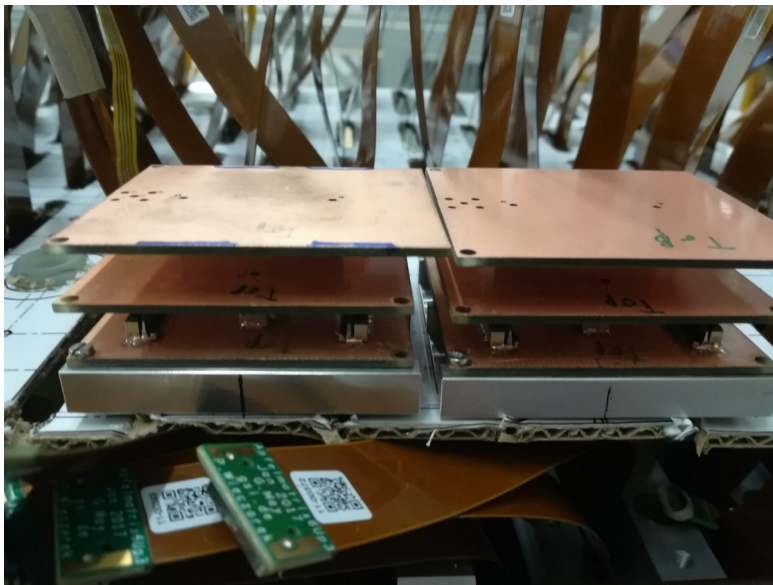
Half size backplanes
not possible

Highest
density of
backplane
layout already
reached



No space problems anymore
between two backplane
adapters at all support beam
dummy plates

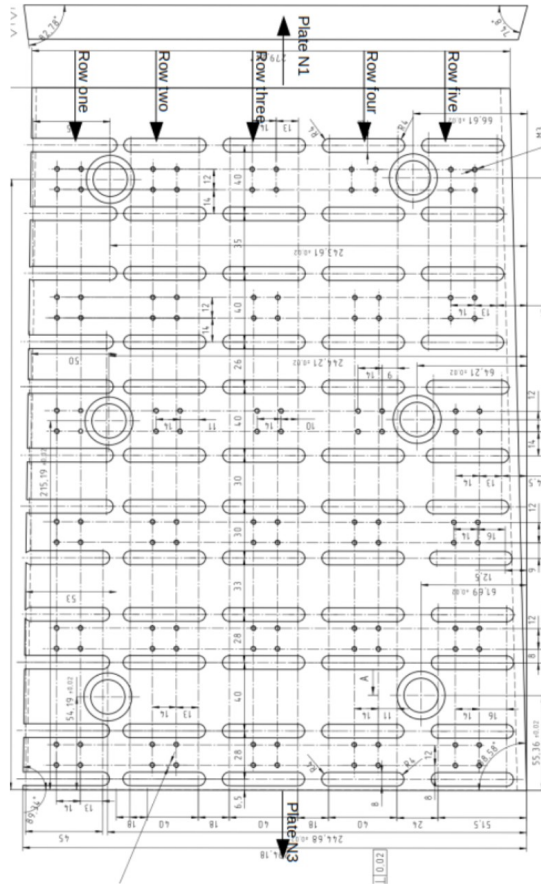
Different types of backplane
adapters needed for
example at plate N4



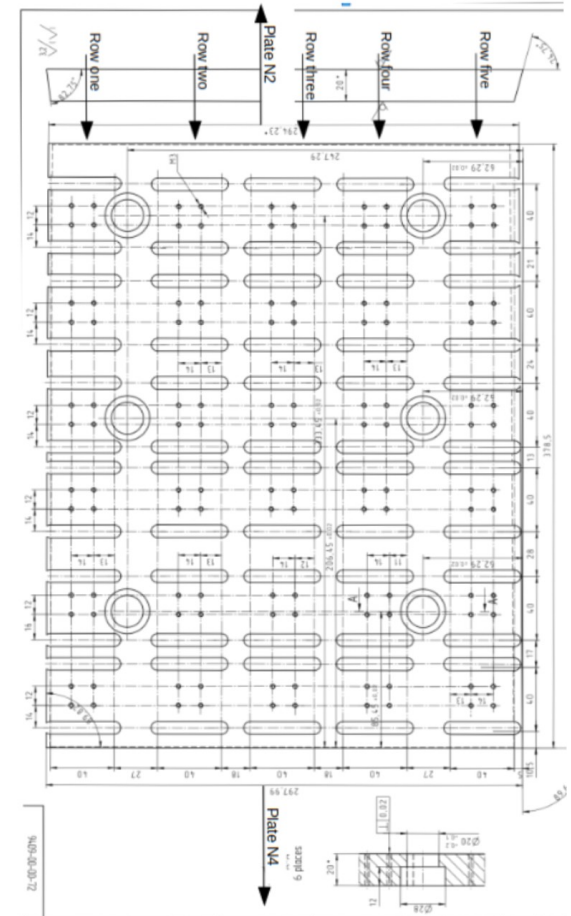
Some minor issues:



Overlap Plate N1 with N2 by 1-2mm



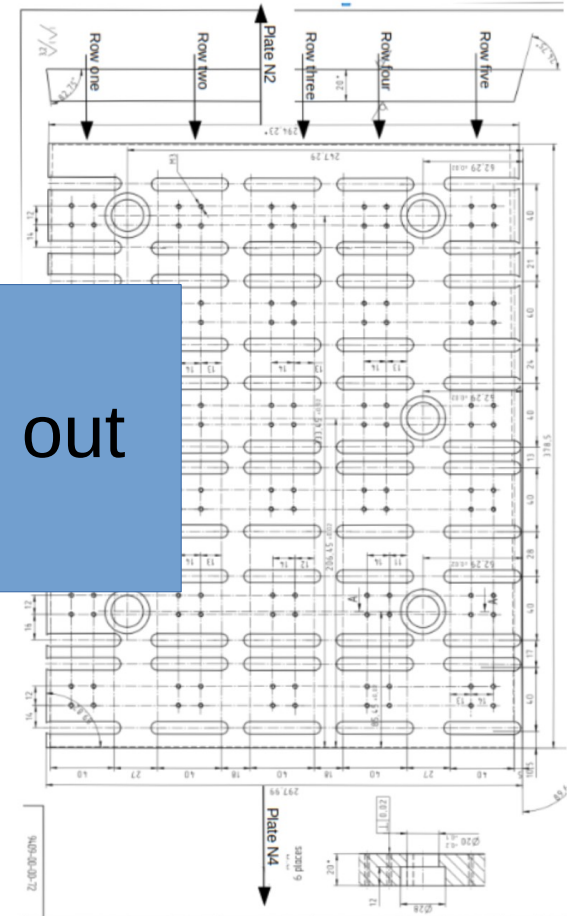
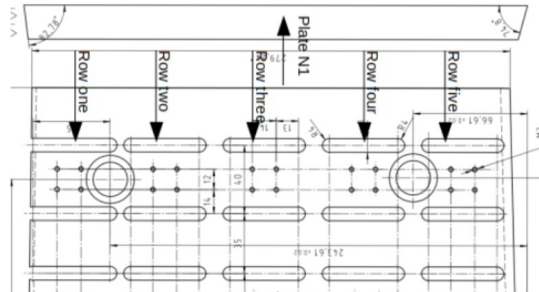
Drawings for plate N2 & N3 turned by 180°



Some minor issues:

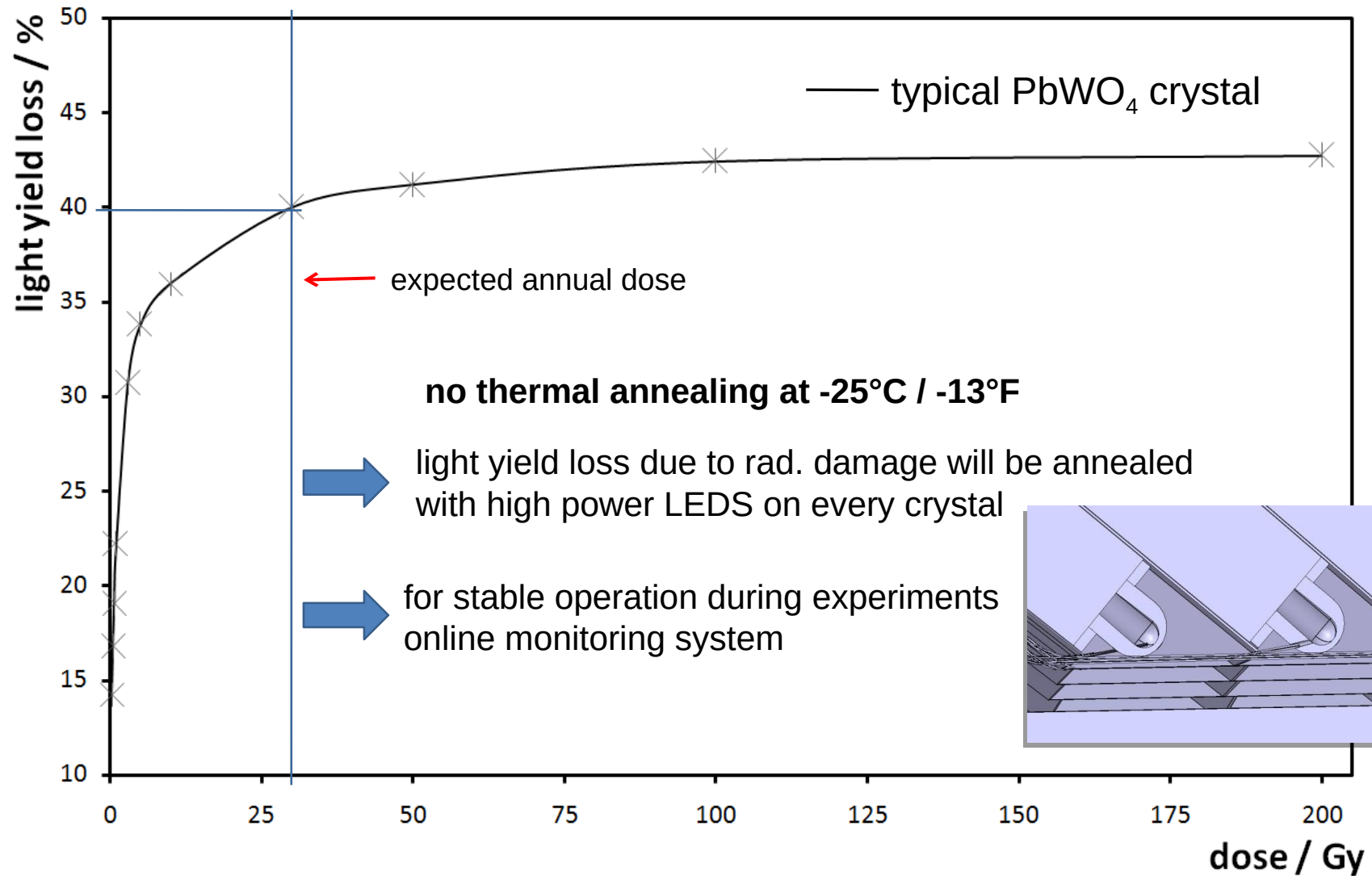


Next step:
segmented support beam out
of solid material



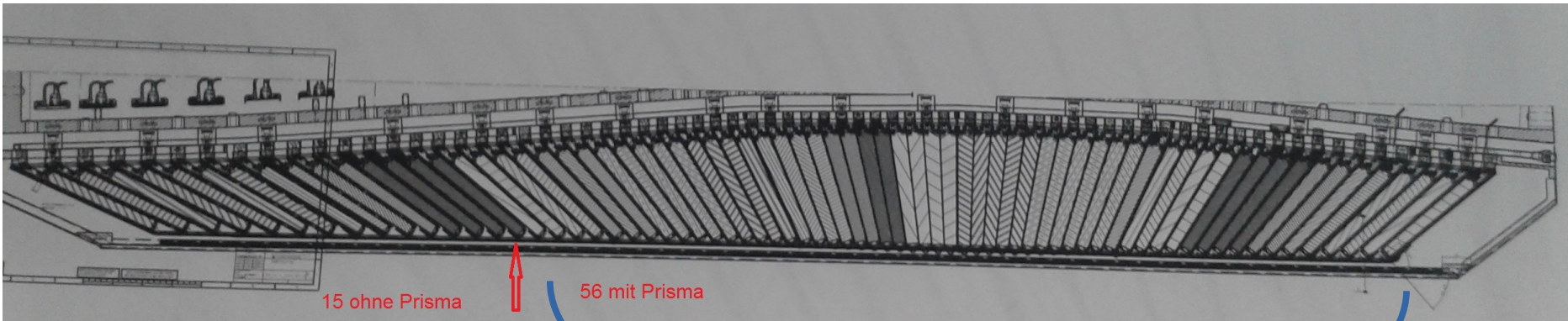
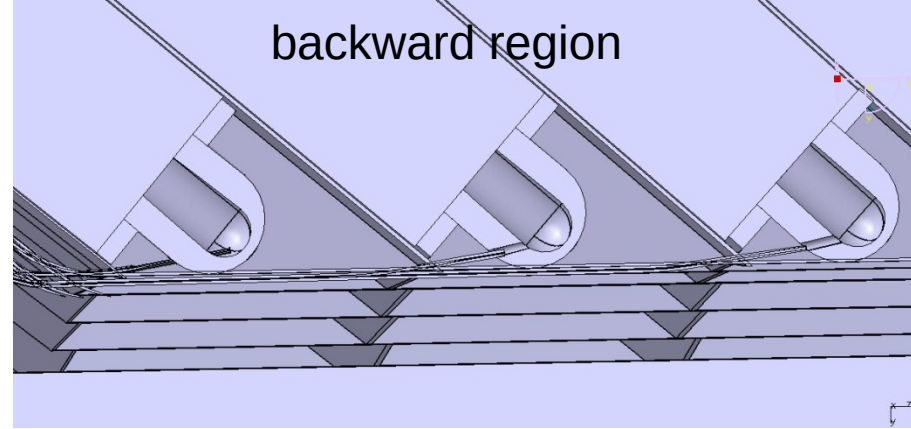
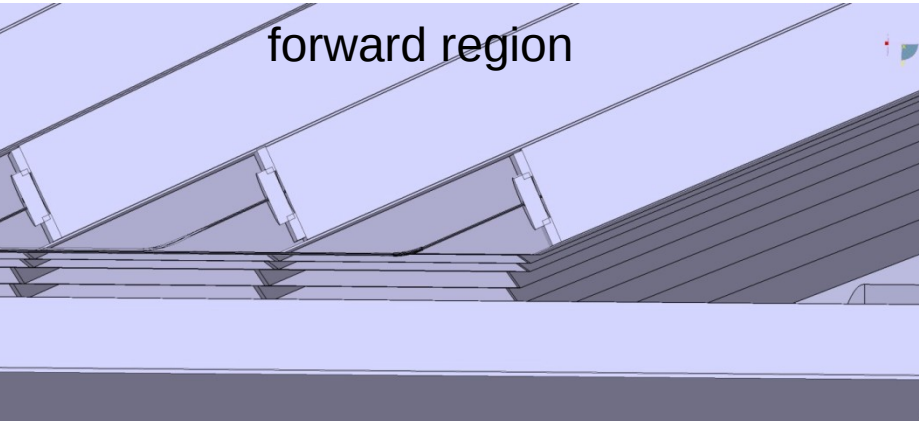
Overlap Plate N1
with N2 by 1-2mm

Drawings for plate N2 & N3 turned by 180°



forward region

backward region



15 ohne Prisma

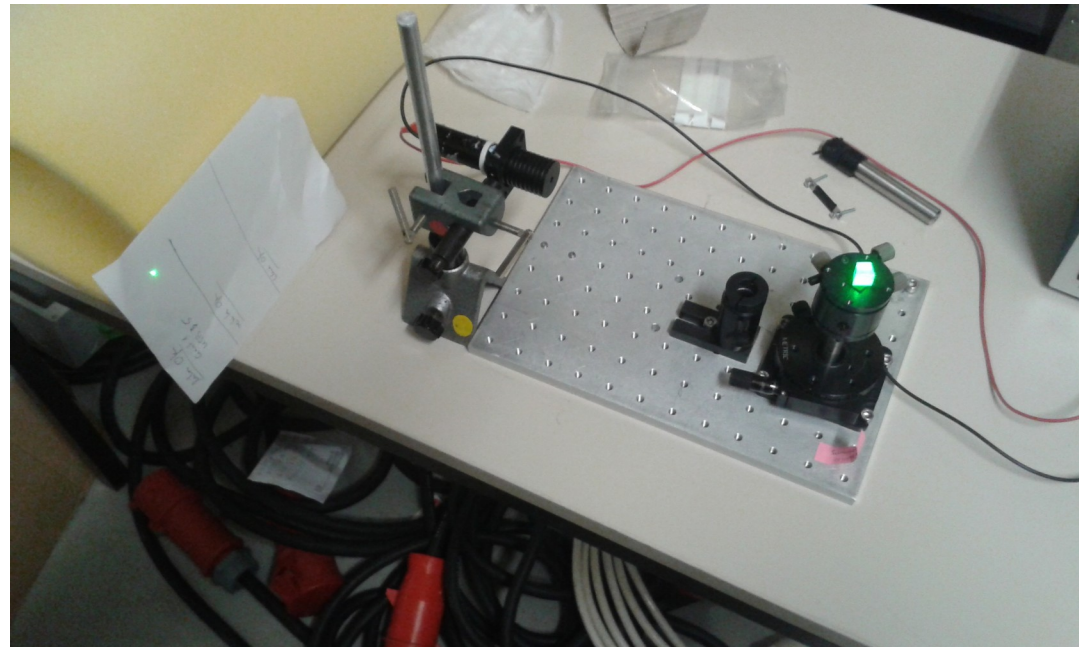
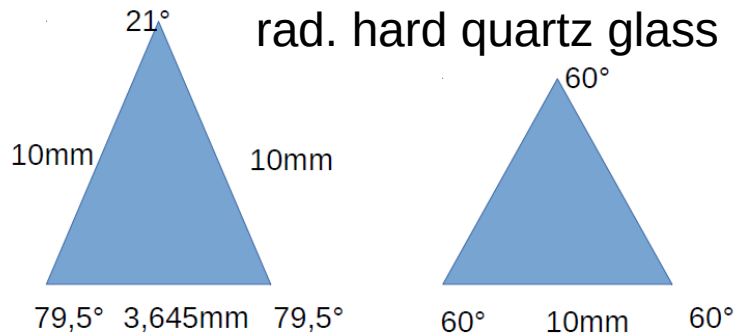
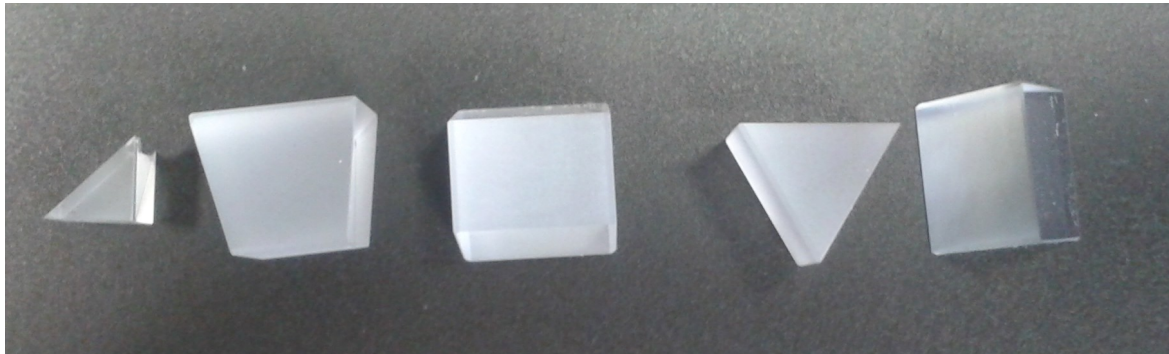
56 mit Prisma

Prism needed

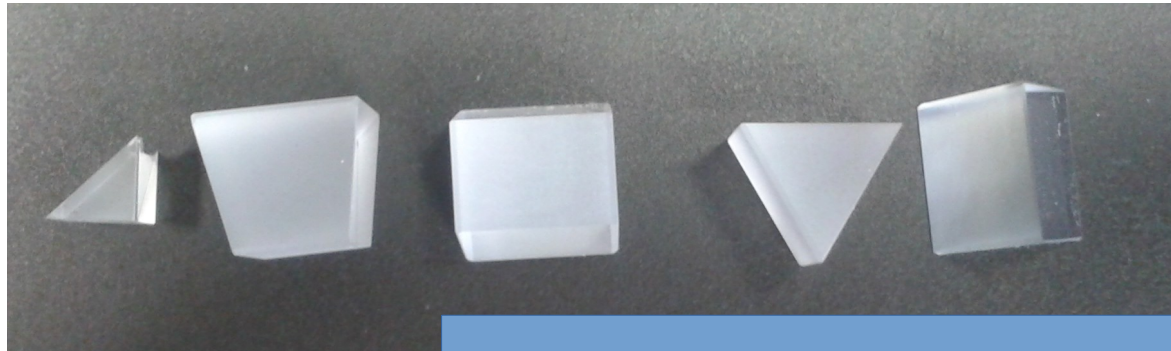
40°-140°
deflection



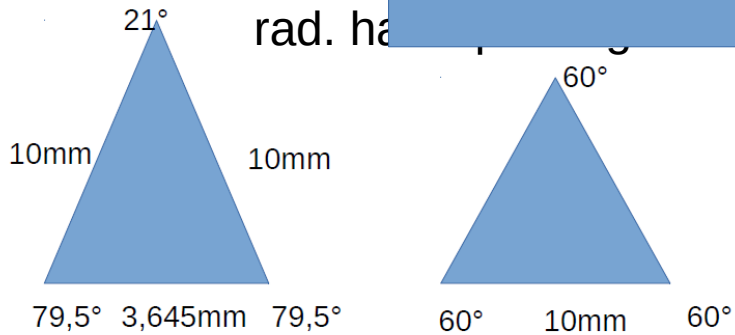
40°-140° deflection needed



40°-140° deflection needed

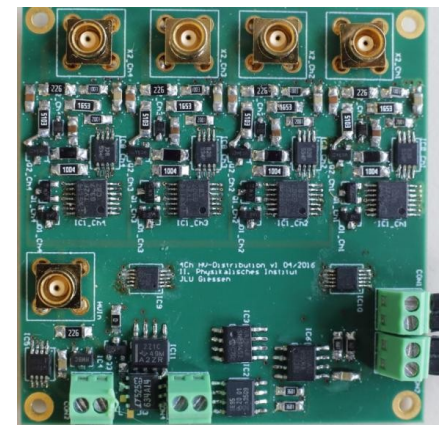
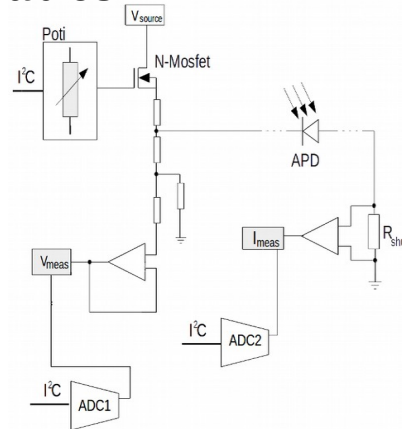
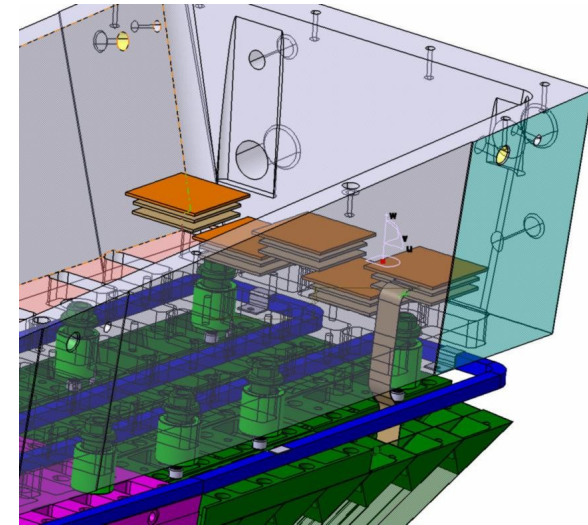


Next step: efficiency measurements



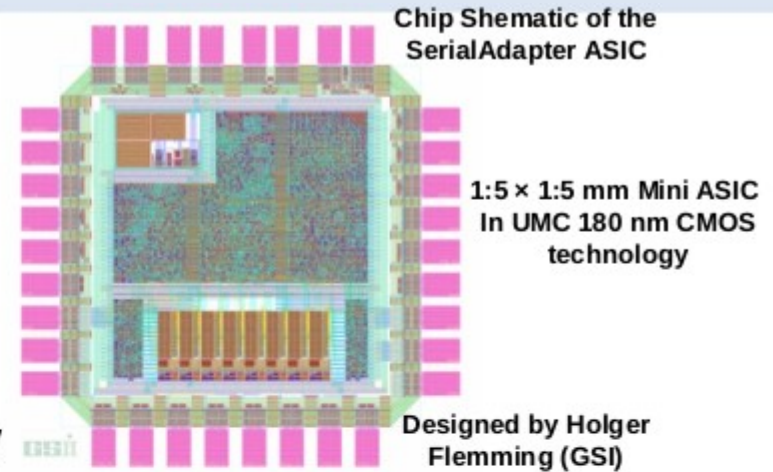
3 Layers

- **Top: HV distribution & regulation**
 - Adjust bias voltage of 8 APDs
 - 50V from HV input downwards in $< 0,1V$ steps
 - All channels fed from the same HV source
 - safes space inside support beam
 - Online measurement of APD voltage and current
- **Middle: Connector board for signal cables**
- **Bottom: Board for FlexPCBs / ASICs**
 - Connectors to FEs
 - 8x2 Diff. Line drivers
 - APFEL I/F buffers
 - Temp/Humidity sensors

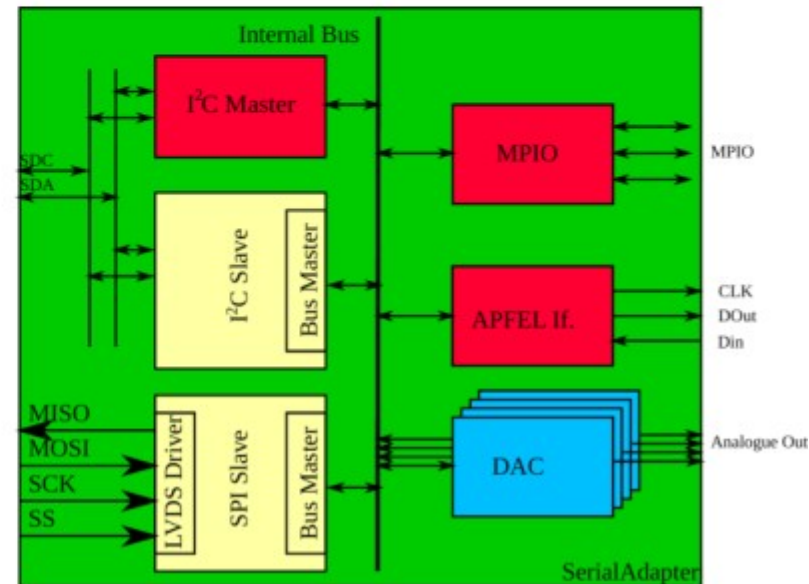
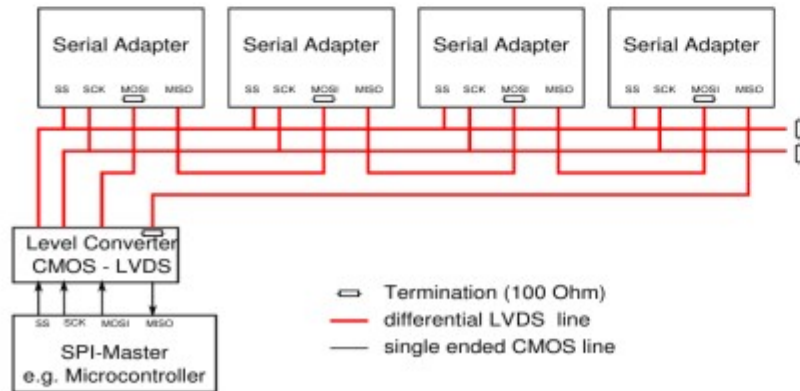


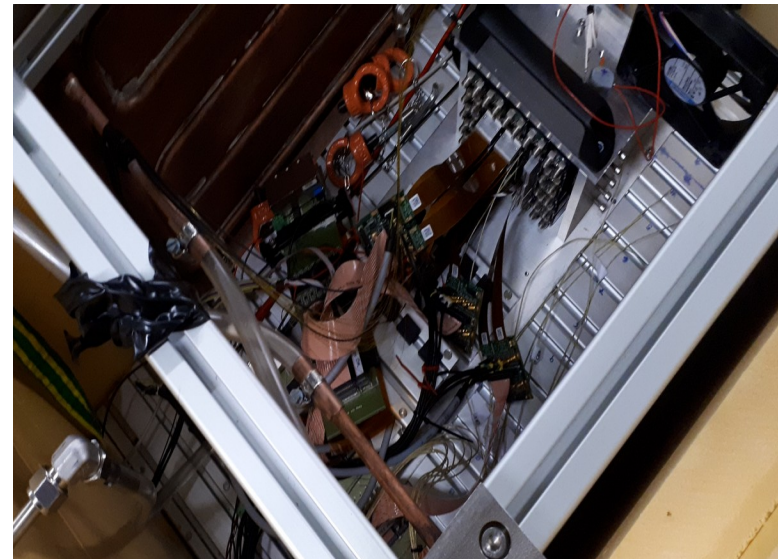
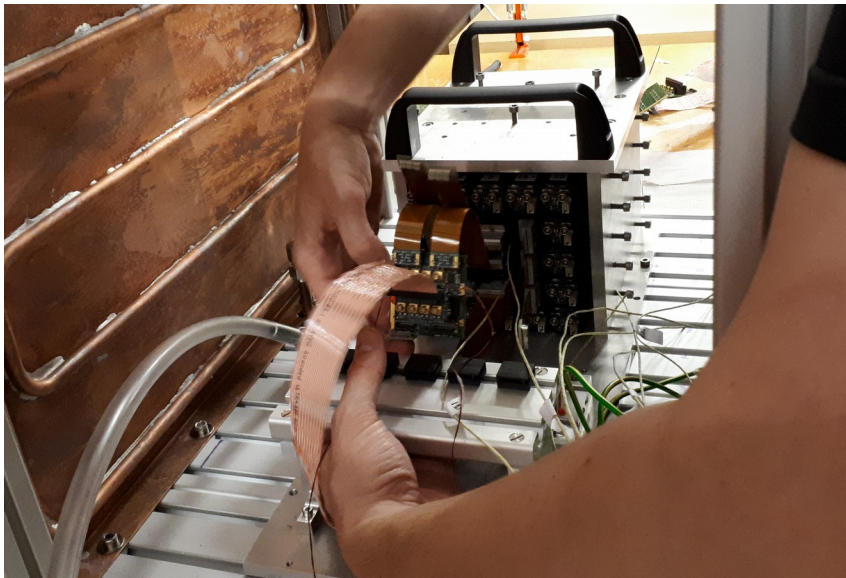
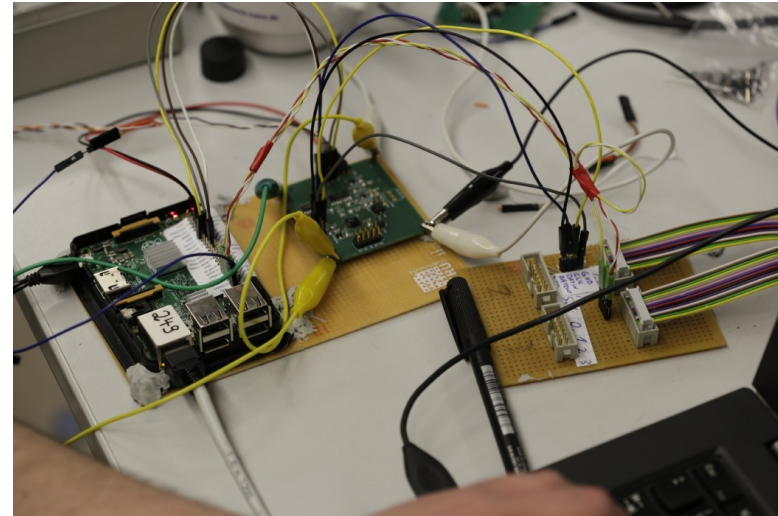
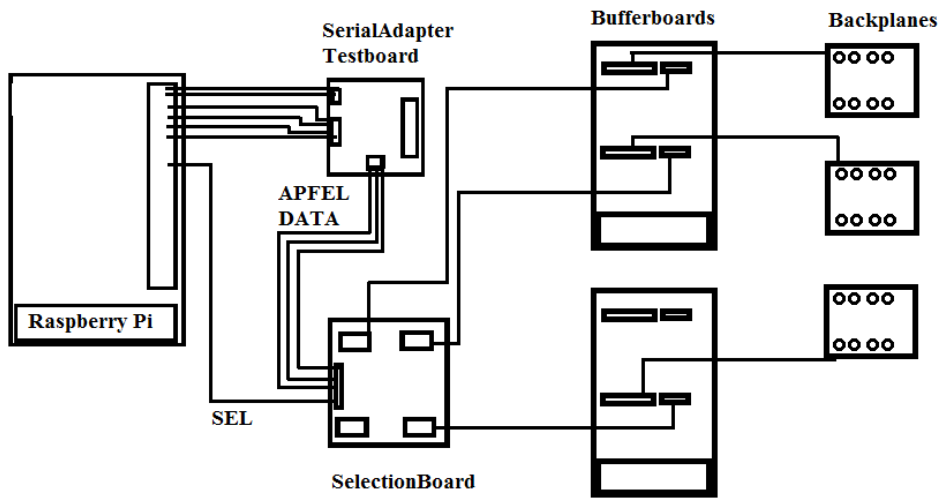
4-ch prototype

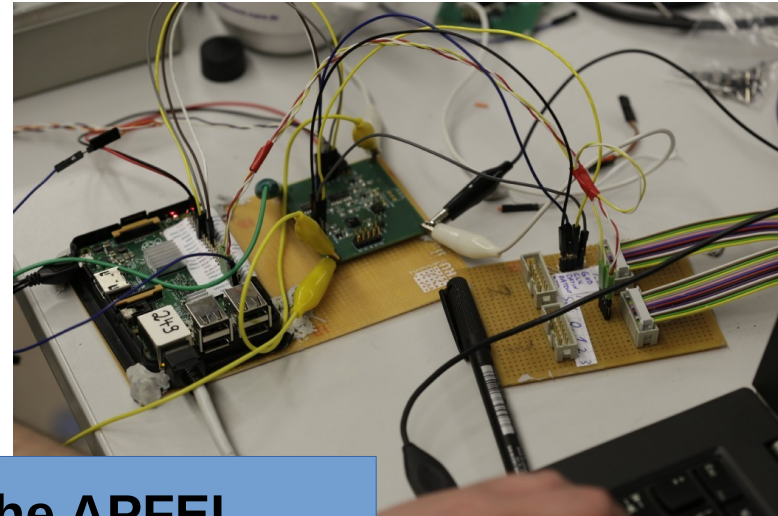
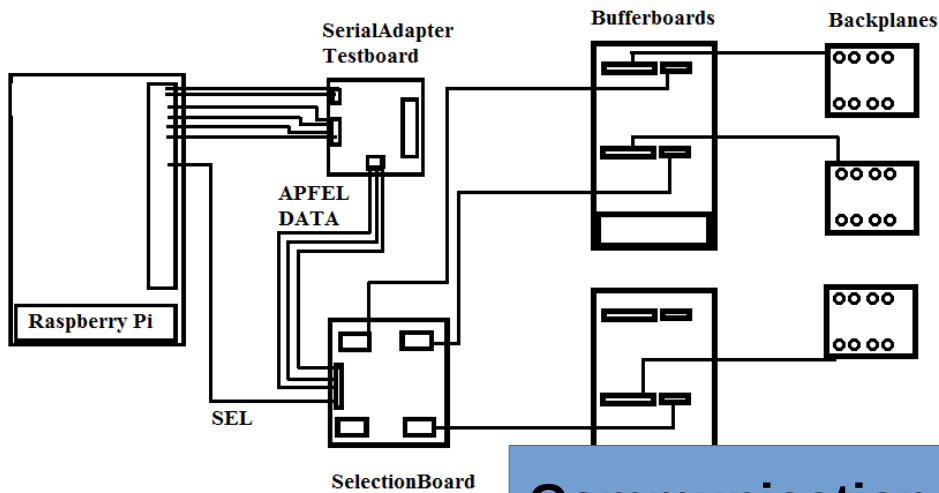
- **Present design:** two different busses for FE and HV regulators
- **Idea:** integrated slow control ASIC with common interfaces (I2C, SPI and APFEL interface)
- Daisy chaining of Backend-Interface for 5 (10) backplane PCBs → Saves 4/5 of slow control cables (36 vs. 180)
- Use DACs for HV adjustment



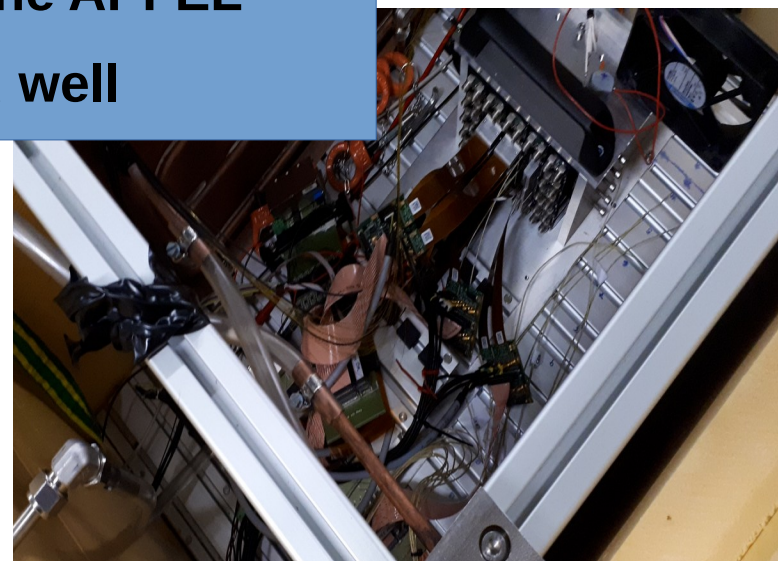
Using a daisy chained SPI interface

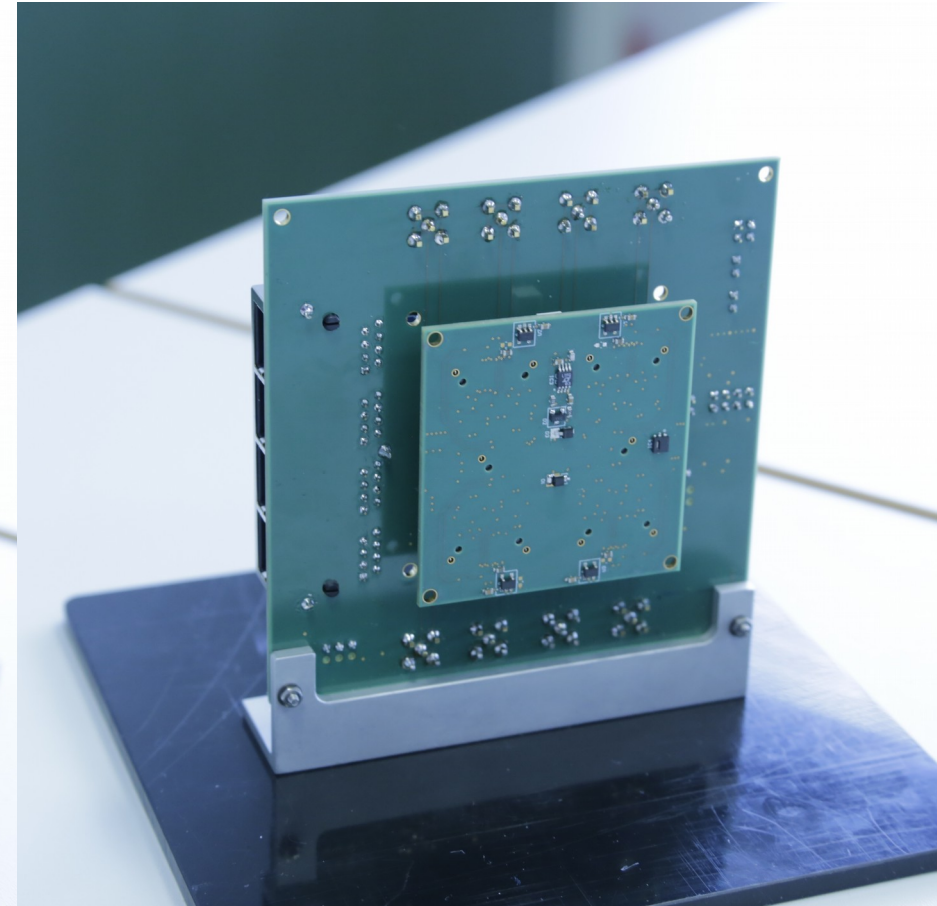
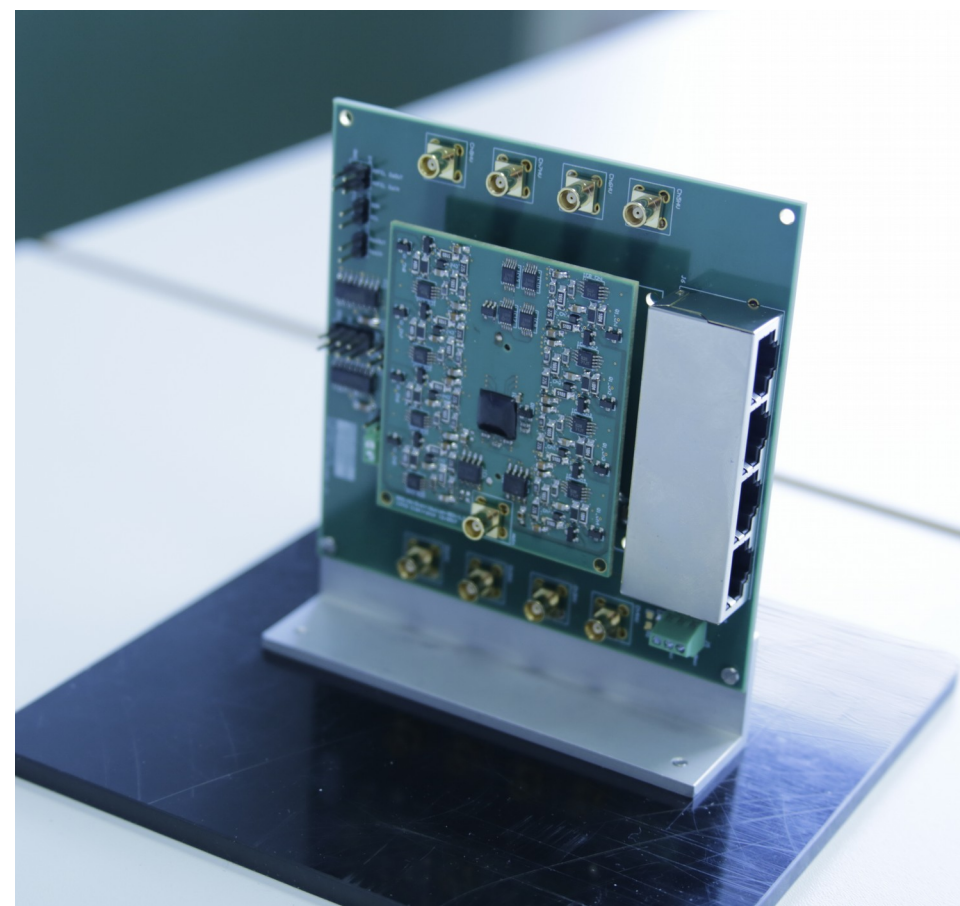




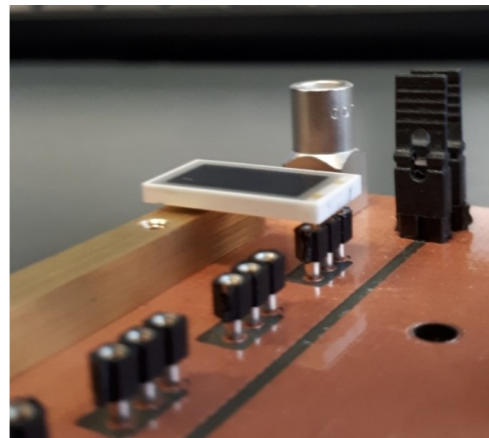
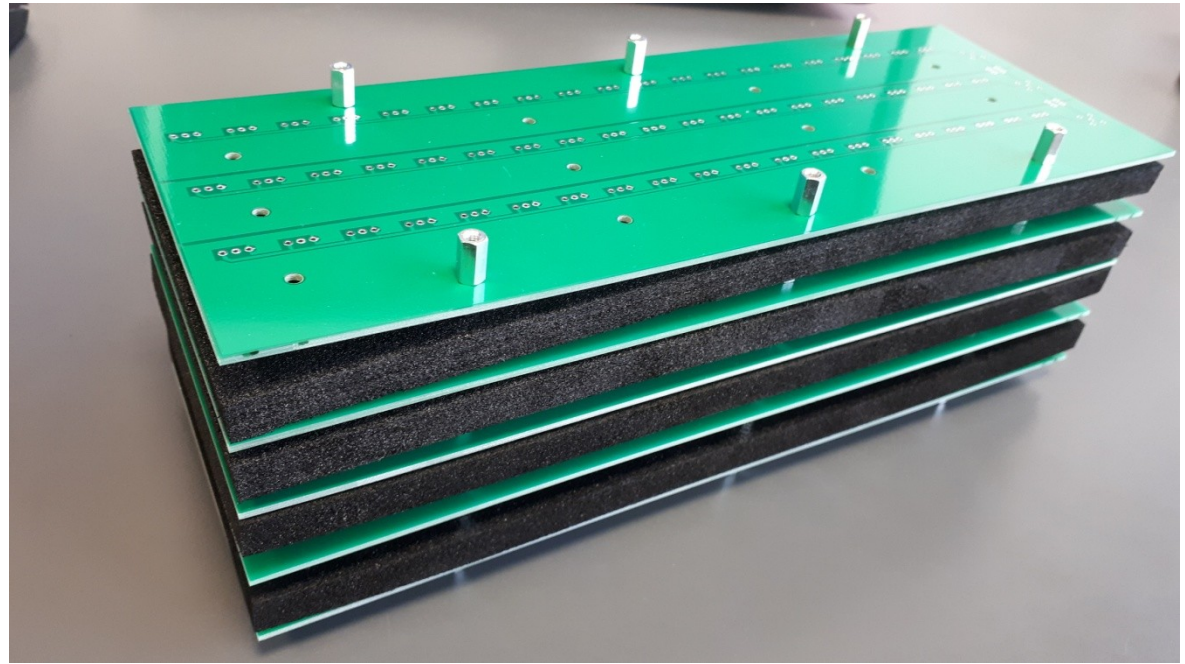
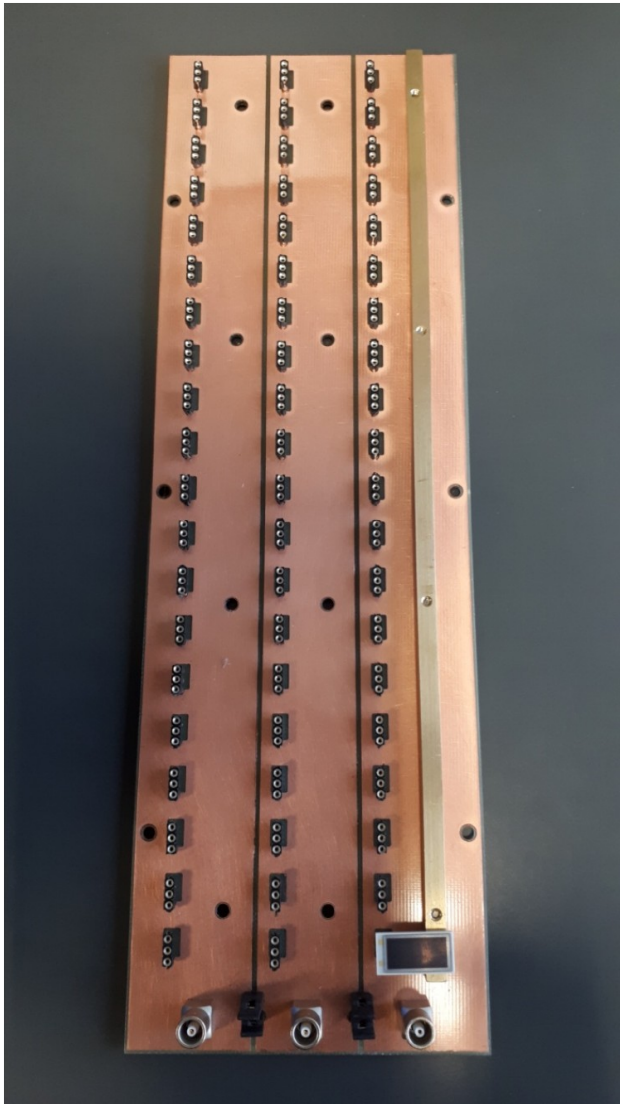


**Communication with the APFEL
ASIC worked well**





- **Cooling**
 - Concept for first slice almost ready for tests
 - Slice housing currently produced
- **Support-beam**
 - Revision CAD model done
 - New paper dummies of support beam bottom seems fine
 - Stiff plastic segments incl. sidewalls, mounting test backplanes
- **Light pulser fiber coupling**
 - Direct coupling for 1/4 of the crystals possible
 - Prisms for 40°-140° deflection needed
 - Efficiency tests pending
- **Backplanes**
 - APFEL ASIC control via Serial Adapter ASIC tested
 - Sandwich (HVD) test board ready
 - Tested prototype sandwich ready end of this year
- **Crystal annealing tests with LED @ APFEL ASIC pending**



- PCBs can be used for
 - Irradiation
 - Annealing
 - Shipping
- 60 APDs each