Status Forward Endcap EMC

PANDA Collaboration Meeting 18/3, GSI, November 7, 2018

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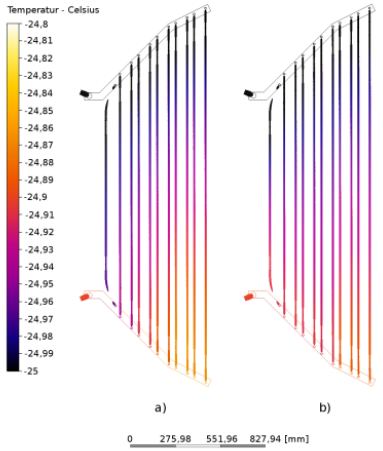
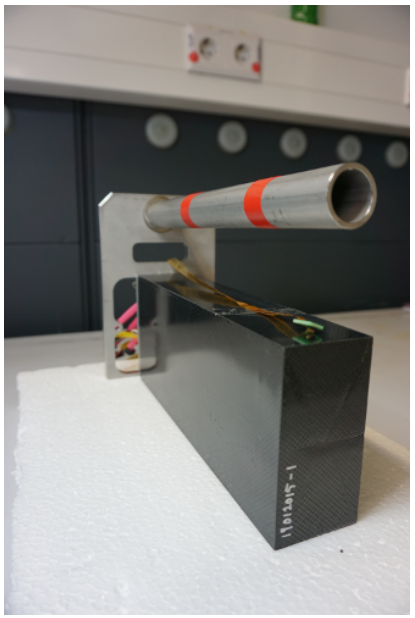
Outline

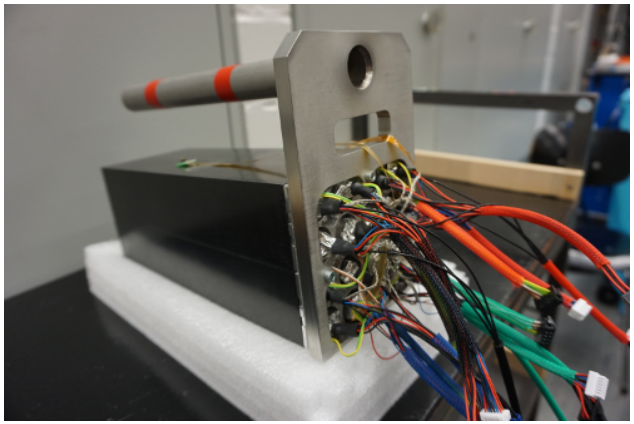
- VPTT Submodule Production
- APD Submodule Production
- Jülich Installation
- Coolant Flow Adjustment Simulation
- Inner Stiffener Ring

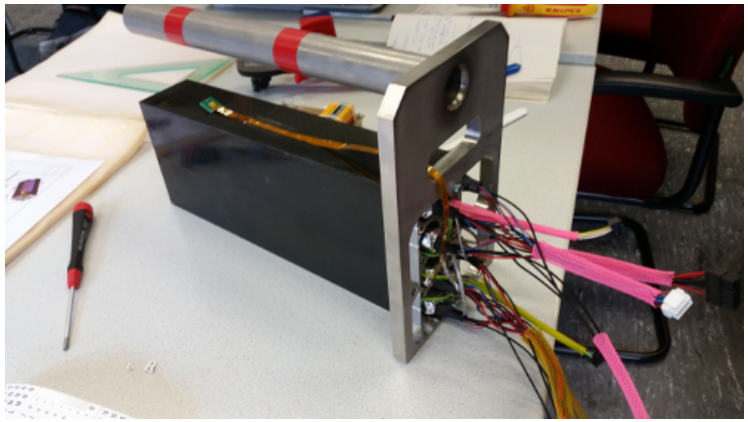




VPTT Submodule Production

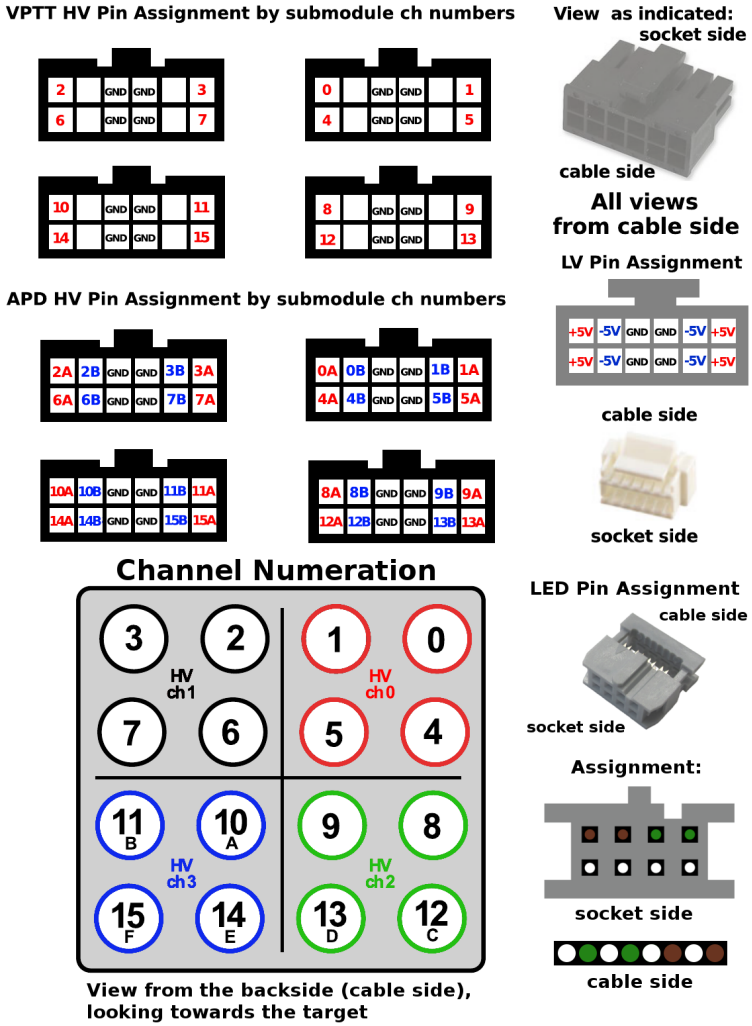
- Production of VPTT equipped submodules ran August to October
- All 54 submodules are produced (768 crystals) (42 16-crystal modules, 12 8-crystal modules)
- All submodules light pulser tested in Bochum
- Cosmics tests at Bonn University ongoing
- Constant production and delivery rate of 5 submodules per week
- 20 % (768 crystals) of forward endcap finished





VPTT Submodule Production

- Very valuable cabling guide (6-page document, Bonn)



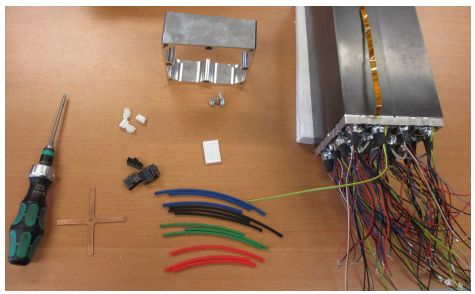


Figure 1: Materials and alveole

Start with screwing on the slanted metal interface. Be careful to use the correct one in the correct orientation.
The four crystal in each corner form a unit in regards of the connectors: top left (black), lower left (blue), top right (red) and lower right (green) (see Appendix 6). Each unit needs one black connector the high voltage, one white connector for low voltage and a cable comb for the signal wires. Additionally there are the yellow/green and brown/white LED wires, plus the big silver grounding wires, which should already be connected to the middle screw.

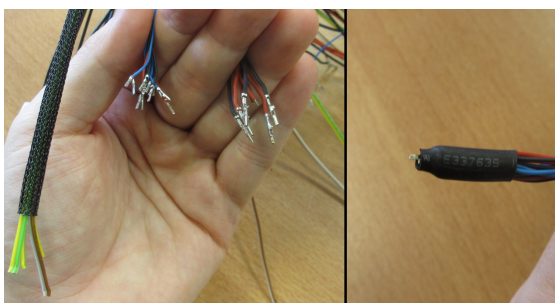
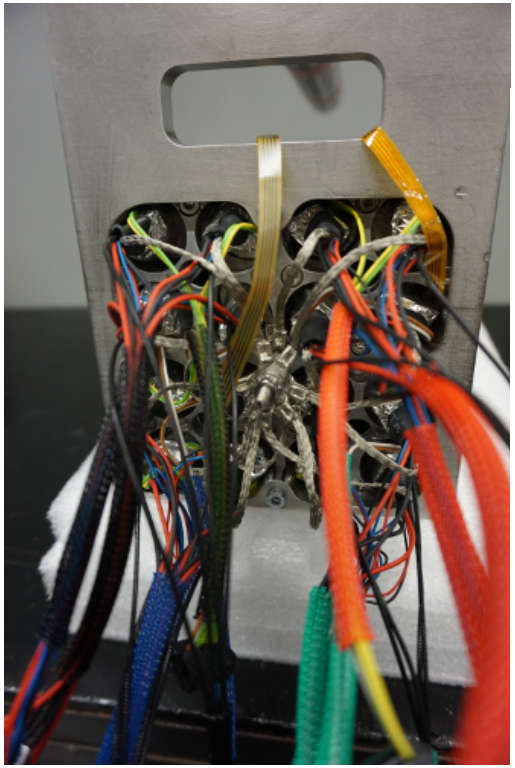


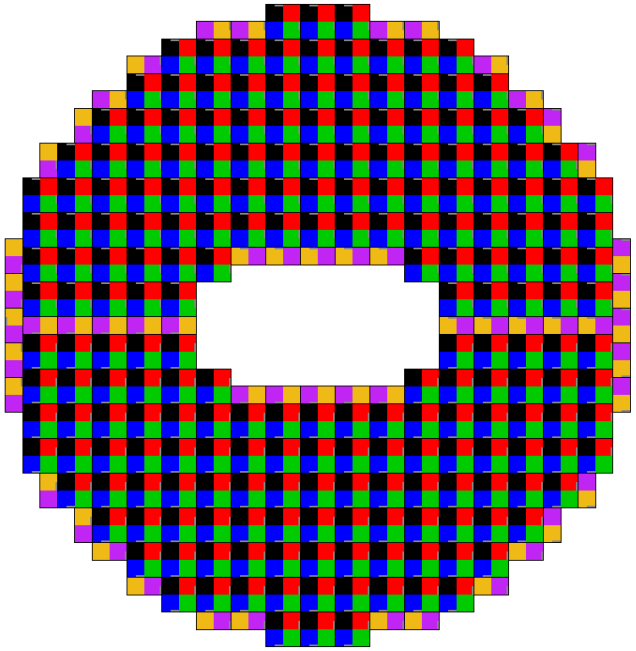
Figure 2: LED, LV, HV cables (from the left) and sleeving preparation; note the missing blue HV wires: this is a VPTT alveole

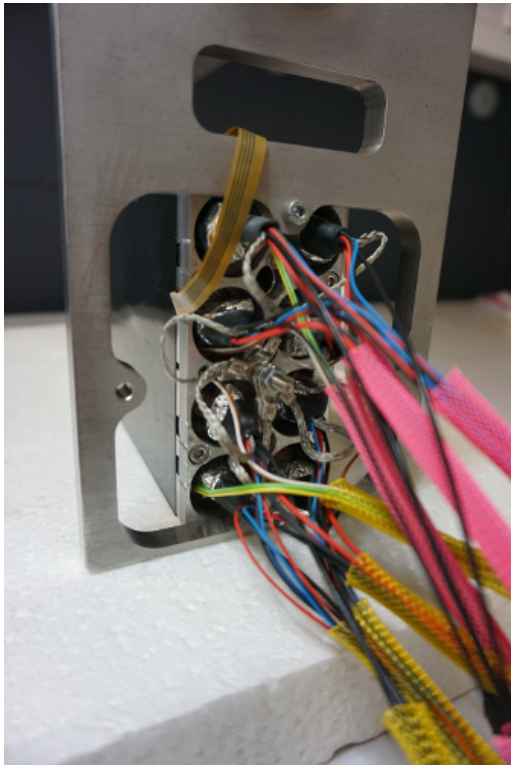
Now sort the wires of the four crystals in one corner. Then put the LED wires in a cable sleeve. Their plug is located in the middle of the top or bottom respectively. You can extend the sleeve by

VPTT Submodule Production

- Color coded grouping of submodule cables



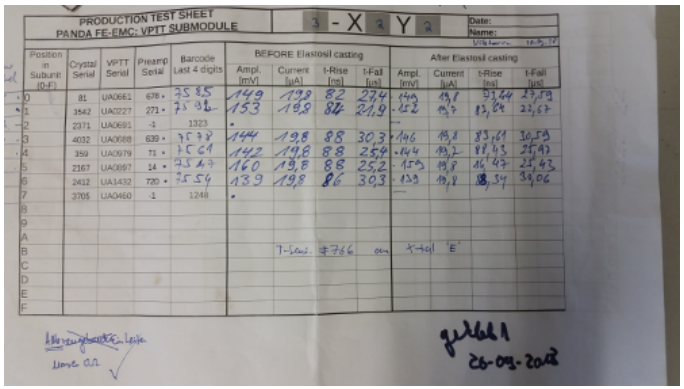




- 96 temperature sensors fitted
- 2 (1) per 16 (8)-crystal unit

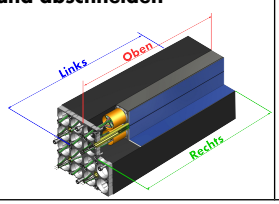
VPTT Submodule Production

- In addition to QA "Production Test Sheets": Checklist to be filled out during assembly


PRODUCTION TEST SHEET
PANDA FE-EMC: VPTT SUBMODULE

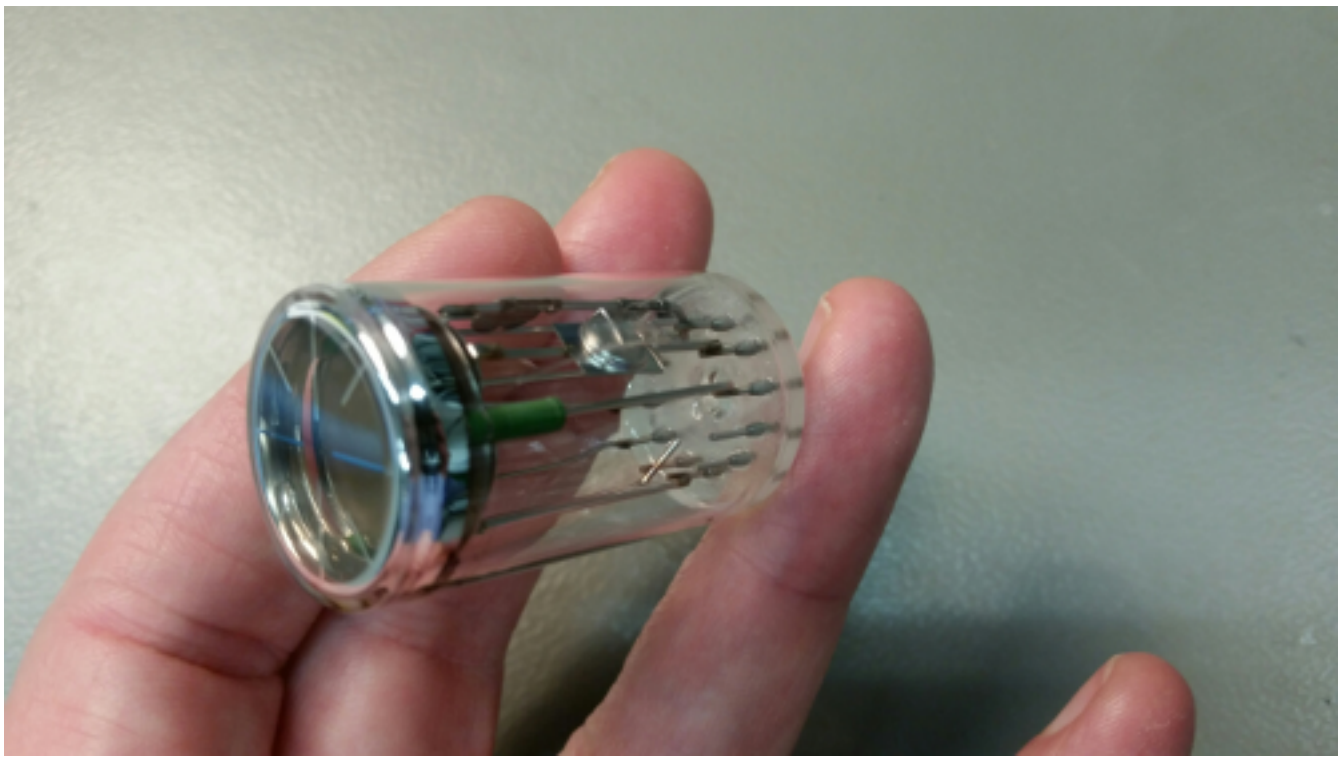
Checkliste Submodulfertigung

[ ] - X [ ] Y [ ] LfdNr: #[ ]

	OK?
• Kristall-Seriennummern überprüfen	
• Kohlefaseralveole auf Beschädigungen überprüfen	
• Aluminium-Schirmungen aller VPTT-Einheiten überprüfen	
• Ausheilungs-LEDs testen (Multimeter-Adapter, Einstellung: ⊣◗⊢)	
• Zugentlastungen für LEDs (Tesa-Streifen) überprüfen	
• Masseverbindungen zwischen Masseband und Aluminium-Klebeband, HV-Masse, LV-Masse, Signalkabel Schirmung prüfen (Multimeter Einstellung/Zielwert: <1Ω)	
• Temperatursensoren testen (Multimeter: Ω, Bereich 200Ω)	
• Orientierung aller Kohlefaserkreuze prüfen	
• Kabel bündeln vor Montage der Mounplate Auf eingeklemmte Kabel achten!	
• Gewinde in der Mountplate testen	
• Korrekte Länge der Schrauben prüfen 1. Mountplate an Inserts: 16 x M4; Länge 12mm (!!) 2. Haltegriff an Mountplate: 4 x M4; Länge 16mm (etwas länger als Schrauben aus 1.)	
• Nach Zusammensetzen: Beweglichkeit der Kristalleinheiten in z-Richtung testen. ◦ Bei zu großem Spiel (>0.5mm) oder vielen wackelnden Einheiten → Zerlegen, Capsules prüfen, evtl. Rand abschneiden ◦ Gesamtlönge des Submoduls messen (Messschieber, Angabe in mm) ▪ Oben ▪ Links ▪ Rechts 	_____ _____ _____

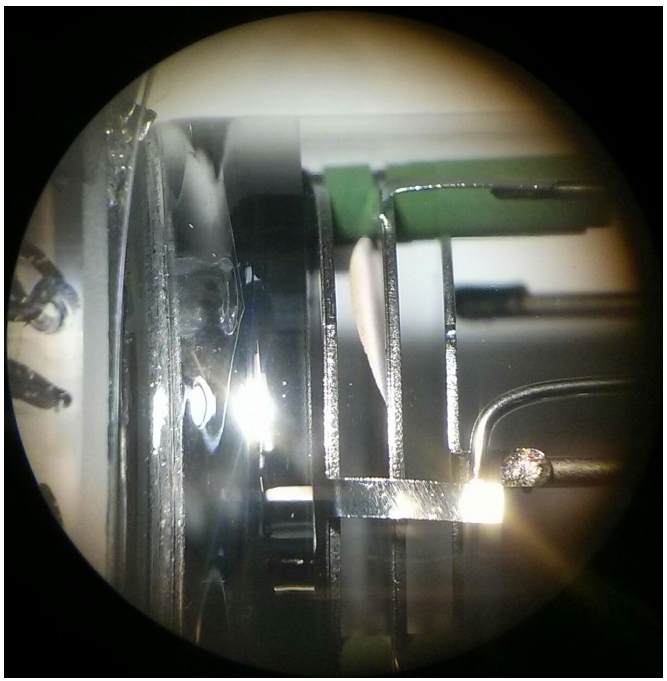
VPTT Submodule Production

- Losses: 1 broken crystal unit, 3 broken/vented VPTTs,
  2 VPTTs w/ loose mesh dynode, 1 bad temperature sensor
- About 100 VPTTs and preamps spare left
- No spare submodules production,
  individual single channel exchange if necessary



VPTT Submodule Production

- Hamamatsu failure analysis report: Detached dynode ”very rare case”



HAMAMATSU
HAMAMATSU PHOTONICS K.K.
ELECTORON TUBE DIVISION
314-5 SHIMOKANZO, IWATA CITY 438-0193, JAPAN
TELEPHONE : (81)539/62-5248
FAX : (81)539/62-2205

FAILURE ANALYSIS REPORT

Doc.No.72-0059
November 2, 2018

Customer	UNI BONN
Part Number	Head-on PMT R11375-01
Quantity	1
Serial Number (Shipping Month)	UA0162 (Feb. 2014)
Customer Reference Number	HO-148335

1. Description of concern / Reason of rejection
The detached 2nd grid and no signal

2. Team
HPK: Hiroki Moriya (Dept.22), Ryutaro Obata (QC)

3. Containment Actions/Inspection Result
We confirmed that the mesh dynode was detached as the following picture shows. Then, we checked 100 pcs of stock R11375-01 by X-ray transmission image, and no tubes had this defect.

4. Root Causes
There is a possibility that strength of this mesh dynode was already weak when manufacturing this tube. However, we concluded that this weak mesh dynode is a very rare case which only happened on UA0162, because no other stock tubes have this defect.

5. Corrective Actions
This tube will be replaced with a new one.

6. Verification of Corrective Actions
N/A

7. Prevention of Recurrence
N/A

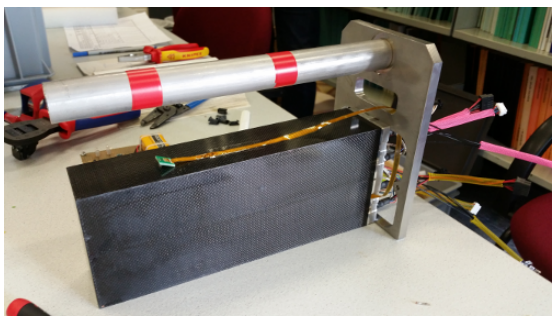
8. Remarks (Disposition)
We will specially replace UA0162 though its warranty period already expired.

Reported by
Ryutaro Obata
QC department

Approved by
H. Tahara
Harutoshi Tahara
Manager, QC department

VPTT Submodule Production

- Constant delivery rate of 5 submodules per week by Fahrdienst RUB (to Bonn for cosmics tests)
- Submodules w/ handle bar individually enclosed in cushioned boxes (empty boxes returned)

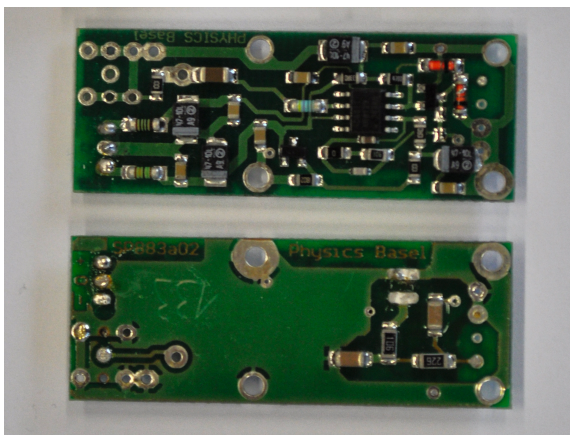


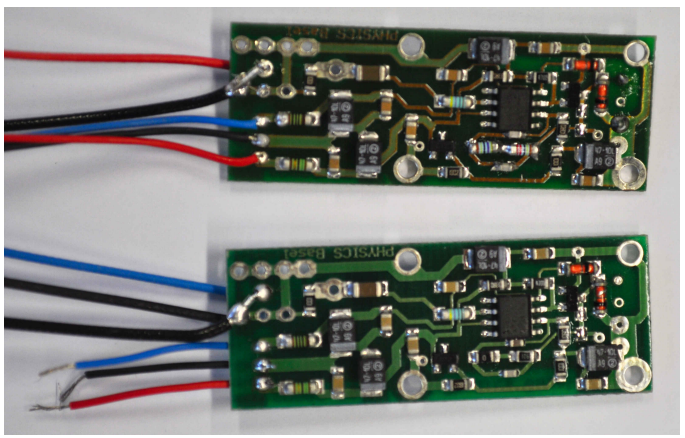
VPTT Submodule Production

- All VPTT submodules currently stored in Bonn,
  will go to Jülich in one batch when tests are finished

APD Submodule Production

- 4 times as much APD submodules as VPTT submodules
- 4 times 3 months = 12 months
  $\Rightarrow$ need to speed up production!
- VPTT submodule mounting in Jülich in parallel!
- Preparation of electronics: Preamp cabling etc.
- APD screening ongoing: Increasing pool of screened APDs for grouping



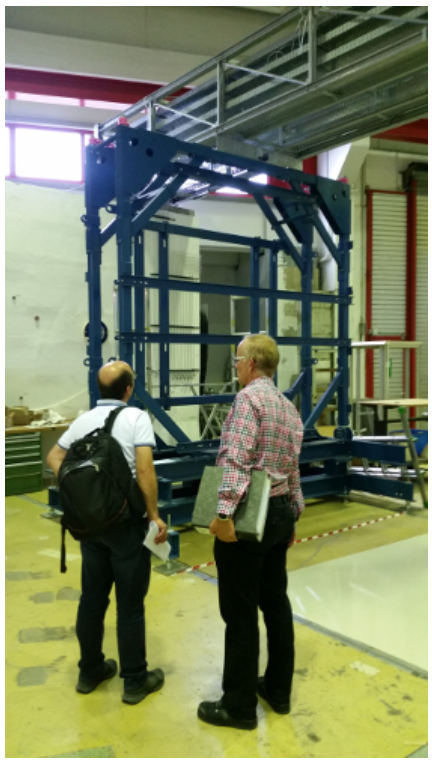


APD Screening Setup

- Bochum APD screening setup:
  Full capacity extension almost finished
- Will give twice the throughput:
  250/500 APDs a week (prior to/after irradiation) (shift work)
- Irradiation at Strahlenzentrum Giessen running smoothly
- More details in Jan Reher's talk
- One rejection criterion: APD dark current at M=800(!)
  and -25 °C after irradiation/annealing less than 10 nA
  (Headroom for future gain increase according to
  crystal light yield loss needed!)
- Additional selection criterion (forward endcap/barrel):
  Slope of gain curves (dM/dT, dM/dU) (statistics)

Jülich Installation

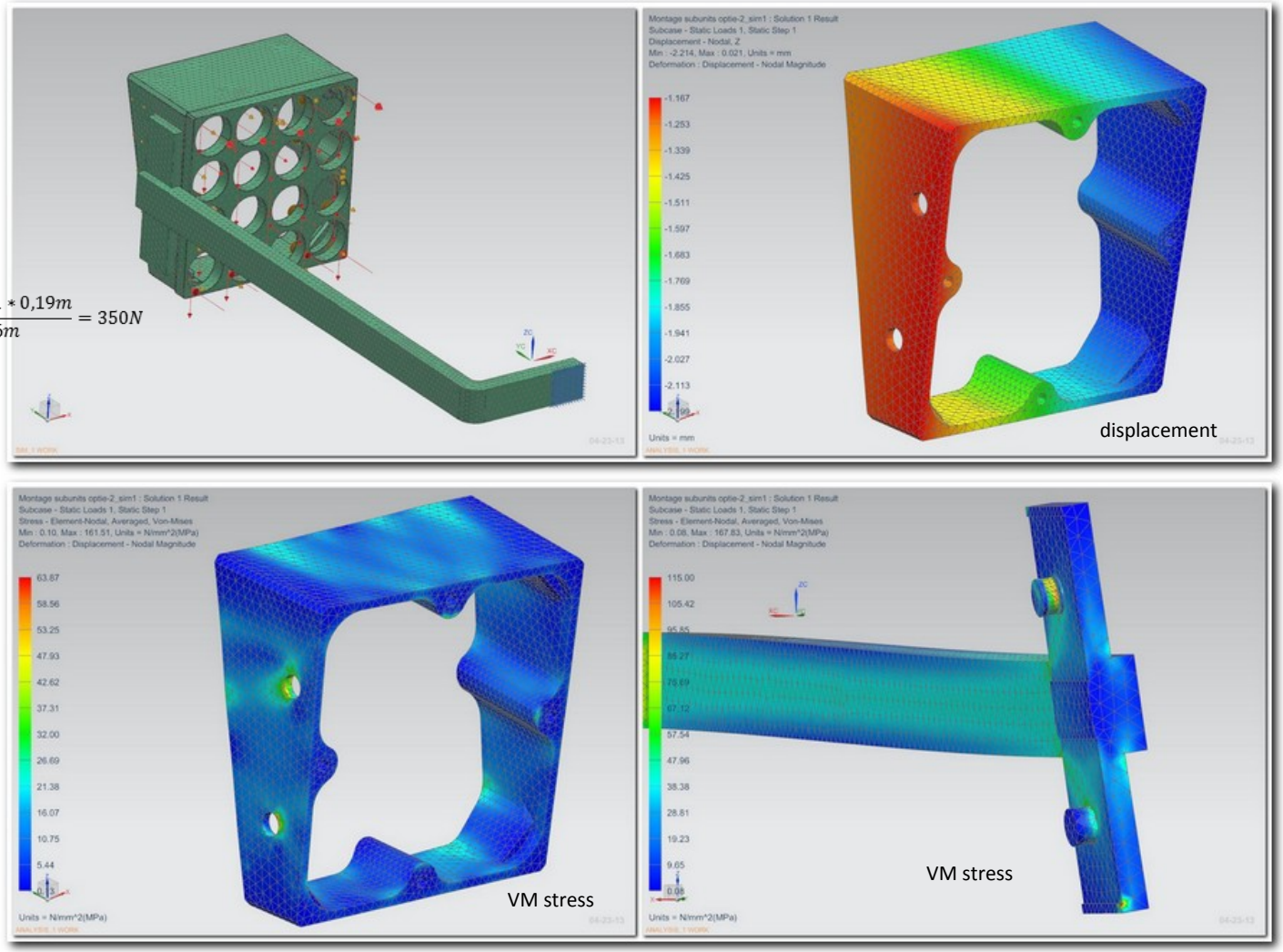
- Forward endcap support frame and pedestal fixed in place in Cosy TOF hall
- Manipulator arm (CMS): Repair ongoing, submodule adapter design (J. Colienne, FZJ)


Mounting subunits

Stress & displacement in interface when subunit (18kg) is carried by manipulator

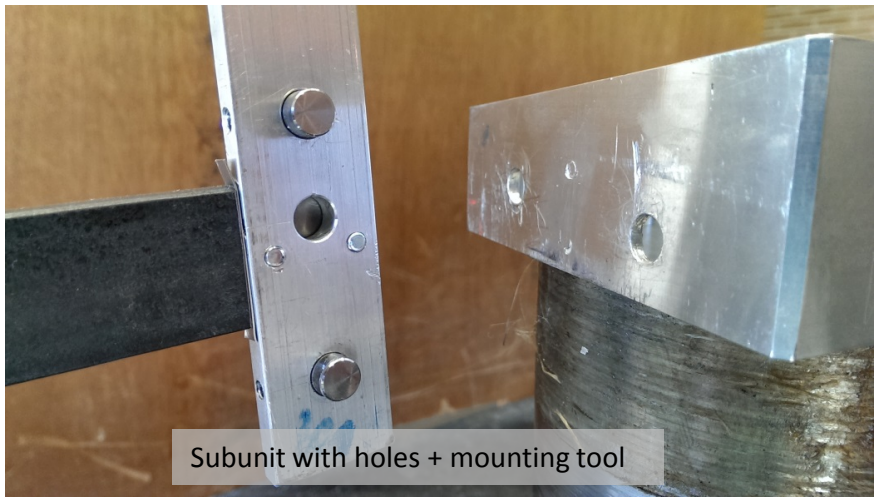
$$\frac{18kg * 9{,}81 * 0{,}19m}{0{,}096m} = 350N$$



Mounting subunits

Mounting tool to hold the subunits when mounting

Subunit hanging on mounting tool

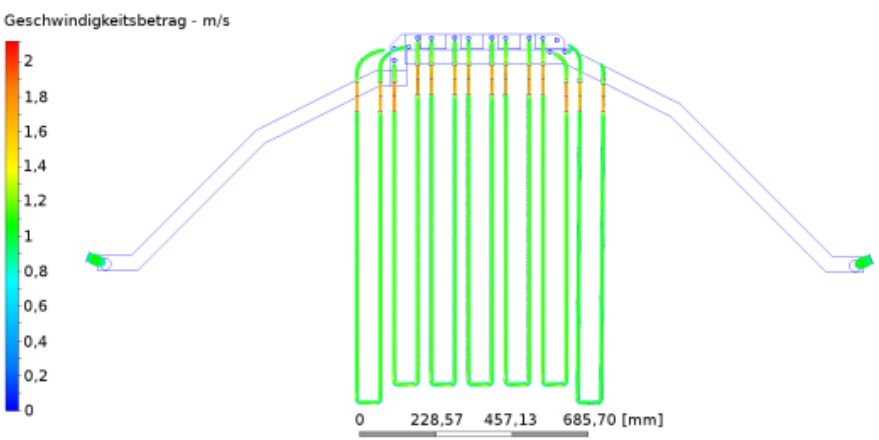


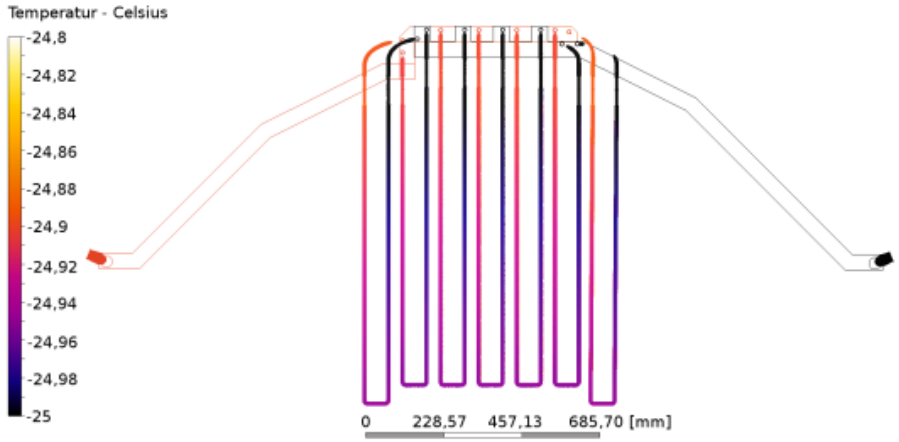
Subunit with holes + mounting tool

Subunit with counter weight

Cooling

- Simulation of coolant flow through backplate and resulting temperature profile at maximum electronics power dissipation (Claudius Schnier)

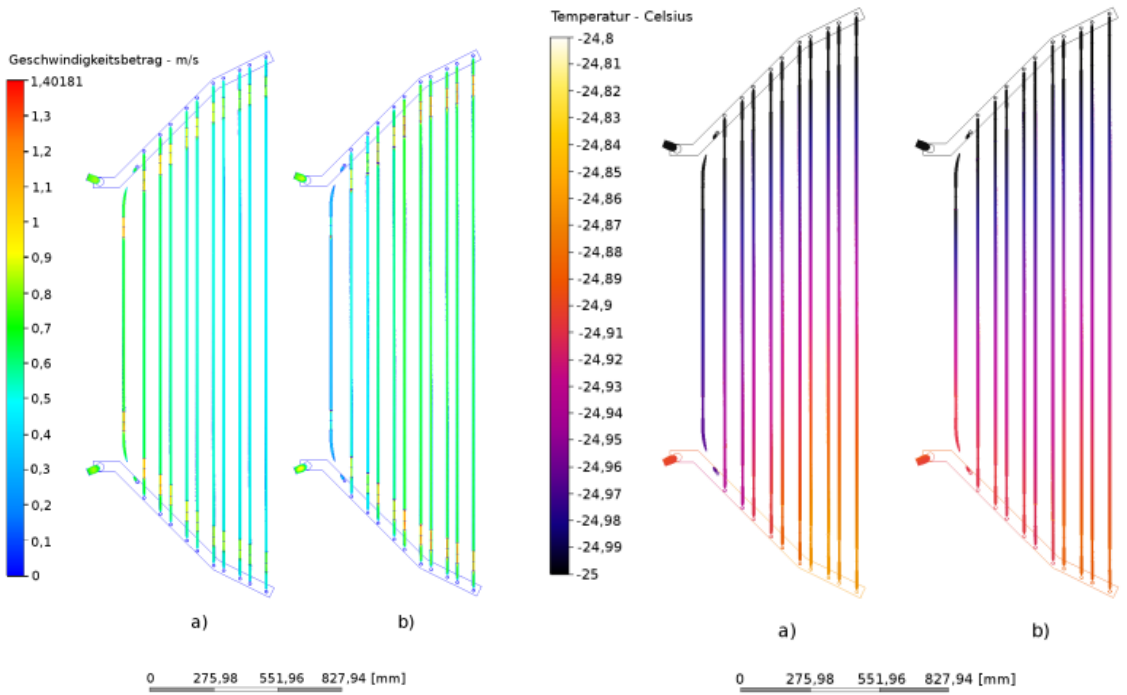




- Circuit on top/below beam pipe hole: Equal piping drill lengths, no individual flow adjustment necessary
- In-/outlet temperature difference less than 0.1 K, flow of 52 l/min, pressure drop 366 mbar

Cooling

- Circuit backplate side regions: Calibrated holes in copper disks sealing coolant hose joints to backplane piping drills
- a) no flow adjustment b) adjustment by hole diameter
- In-/outlet temperature difference 0.1 K,
  flow of 40 l/min, pressure drop 120 mbar



Cooling

- Experimental verification of simulated coolant flow and temperature distribution (within T range accessible) in Bochum
- Chemical passivation of welded coolant piping needed: Establishing long term water/methanol mixture resistance

Inner Stiffener Ring

- “Inner Stiffener Ring” completed:
  Inner closing of cold volume (beam surrounding)
- 0.8 mm aluminum sheets folded (2 identical parts)