Progress Overview of EMC Barrel Activities in Gießen
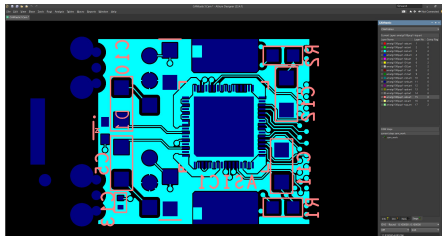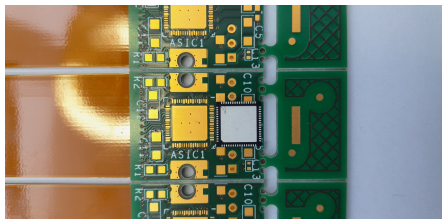
Aniko Tim Falk

07.02.2024

Status Triple PCB
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Series calibration
ooooo

Inventory meeting
ooo

APFEL Assembly

Upon closer inspection, the delivered APFEL PCBs showed a difference between the as-is-state and the expected design:

- Faulty pad sizes
- Faulty spaces in between
- Only a problem with the actual ASIC footprint

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Status Triple PCB
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Series calibration
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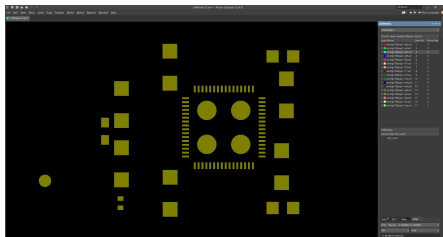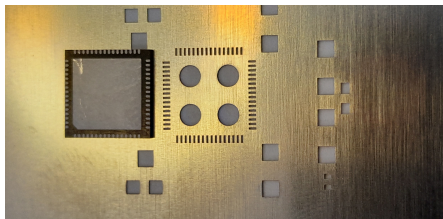Inventory meeting
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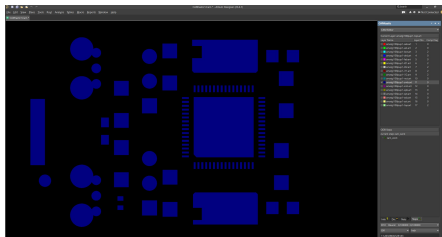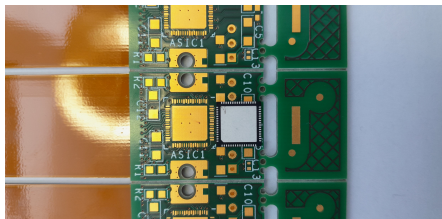
APFEL Assembly

The soldering masks delivered by Wuerth met expectations.

Two panels (6 APFEL each) were brought to MK-Kreuter for assembly.
The result looked good, the amount of soldering paste had to be adjusted.

Status Triple PCB
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Series calibration
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Inventory meeting
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APFEL Assembly

Functionality tests in our lab showed that one ASIC per panel was not working due to connected pads.

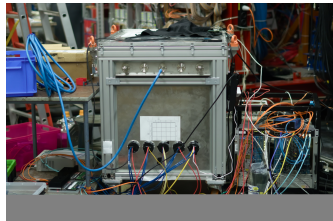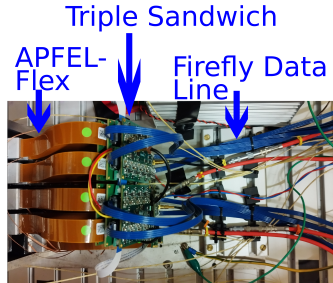After re-soldering them manually, one also worked.

Another panel was taken by colleagues from GSI for in-house assembly. The result was the same.

We are confident, that the automated assembly of the FEE can be done with acceptable yield.

Next PANDA Barrel EMC prototype

The prototype setup is under preparation again:

- Next beamtime should be scheduled for June-July
- Will contain assembled APFEL and SADC with up-to-date firmware
- Cosmic and source tests to be conducted

Triple Sandwich

APFEL-Flex

Firefly Data Line

APFEL assembly
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Series calibration
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Inventory meeting
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Status Triple PCB – Interface PCB

Currently proprietary Interface
PCBs with board-to-board
connector and adapter PCB

- FPC connection functional
- Tests with next to final
  version successful
- Next step: moving FPC
  connector onto Interface
  PCB
- One more prototype stage
  (5 PCBs) to be ordered Q1
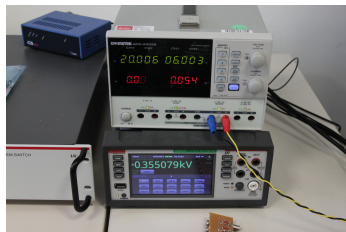- To be finalized in Q2
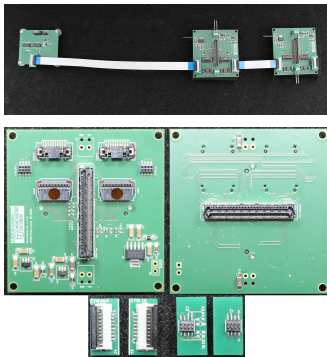
Status Triple PCB - Backplane PCB

Backplane PCB is finalized and ready to order

- Annealing LED tested and functional
- LED driver and some additional components for LED control missing
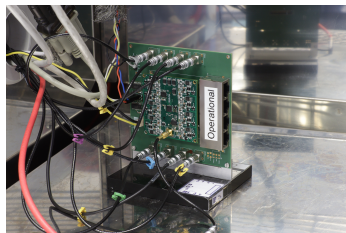- Gain configuration adjustable
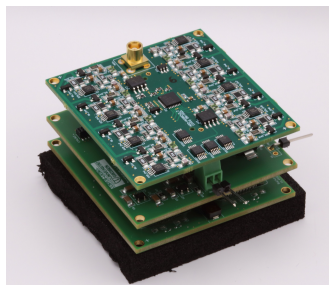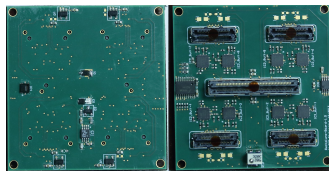
Status Triple PCB – High voltage PCB

Functionality tests

- Climate chamber for temperature measurement and stabilization
- Switch, HV source and DMM outside controlled volume
- System is scalable

APFEL assembly
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Series calibration
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Inventory meeting
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Status Triple PCB - High voltage PCB

198 PCBs from series production
tested

- Initially 187 HV PCBs
  passed all operational tests
- ~5.5 % failure rate (11
  PCBs failed tests)
- Re-soldering on SAA
  (QFN32)
- Reduce failure rate to ~2 %
- 8 PCBs for additional tests
  (irradiation etc.)
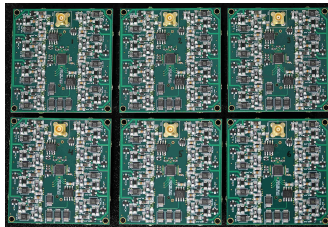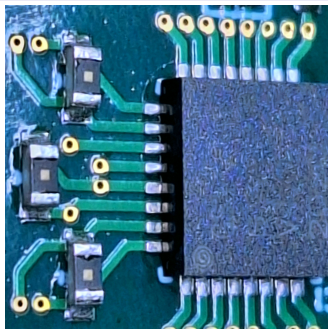
Calibration of ADS1115 Channel measurement

ADS1115 voltage calibration:

- ADS1115 voltage measurements differ per channel
- DMM6500 channel measurements are very similar
- Voltage dependence is linear in lower region
- Re-calibrating ADS1115 measurement to DMM6500 channel measurement
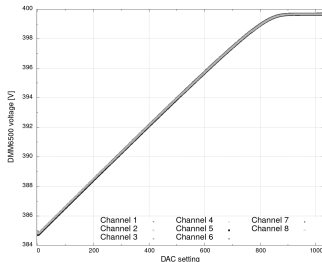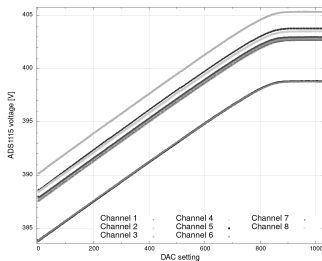
Calibration of ADS1115 Channel measurement

Calibration of ADS1115
measurement to DMM6500
channel measurement

- Using linear function
- Using full DAC sweep
- Preferably different HV
  sources for bigger statistics
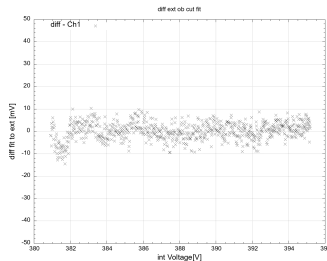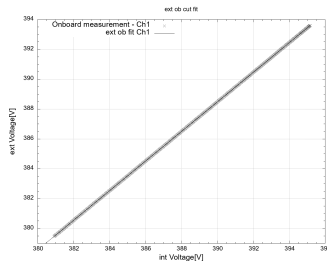
Temperature behavior

Temperature dependencies need to be known for pre-series slice

- Started taking calibration data (cw 5)
- Currently 24 - 48 h per PCB at 5 temperatures with full DAC sweep at 400 V
- Working on reducing calibration measurement time
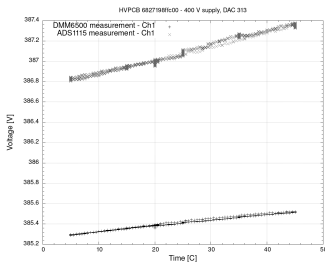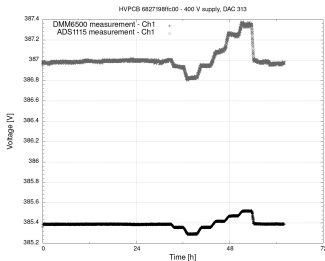
Power-on behavior

Small power-on drift observable
when applying HV

- Observed on different PCBs
- Onboard (ADS1115)
  measurement affected
- System stabilizes after
  several hours
- Important for calibration
  algorithm

APFEL assembly
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Status Triple PCB
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Inventory meeting
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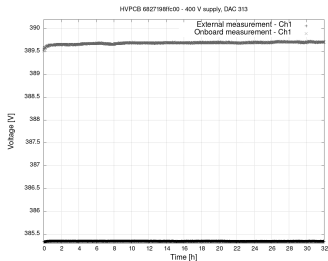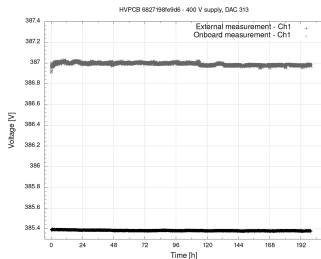
Status Triple PCB – High Voltage PCB

198 HV PCBs out of series production tested.

Calibration of HV PCBs started.

Calibration algorithm in progress to be shortened.

Backplane PCB ready to order.

Interface PCB last prototype to be ordered Q1.

Barrel EMC Inventory Meeting

Participants:

- JLU Barrel EMC group
- GSI EEL/HSP
- EMC coordinator
- PANDA TCs

Topics:

- Summary of current design, assembly, material and procurement status
- Review inventory of components and material
- Definition/review of work packages towards slice 0 completion
- Definition/review of work packages towards completion of slices 1…15

APFEL assembly
ooooo

Status Triple PCB
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Series calibration
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Work packages - Slice

I. Crystal QA[1]

II. APD matching & crystal glueing[1]

III. Module & supermodule mounting[1]

IV. Front-end electronics

1. APFEL-Flex PCB mounting & assembly
2. APFEL-Flex tests
3. HV-Board tests
4. FE-sandwich tests

V. Cables and cable routing

VI. DAQ (SADC)[2]

1. FireFly adapter production & tests
2. SADC crates

VII. Cooling system

VIII. Slice assembly

IX. Slice test & transportation

Further steps

- **Conclude assembly of slice 0**

- GSI EEL will take lead in FEE series production

- Equip existing slice 0 with most recent FEE units

- FEE mounting & testing at GSI EEL, all components already present

Addendum

target EMC

16 barrel slices

barrel slice

back planes
(buffer, HV regulation etc...)

support beam

single detector unit

flex
PCB

annealing
LED

ASIC

rear
inserts

capsule

LAAPDs

7 super modules & cooling system

super module

support beam
bottom

thermal insulation
feed

cooling pipes

module plate

modules

cooling pipes

vacuum thermal insulation panel

thermal
insulation
panel

module

Intermediate
plates

rear
insert

carbon fiber
alveoli pack

front inserts

crystal in
reflector
foil

light pulser coupling

- **Envisaged milestones:**

Assembly of 1st full Barrel EMC slice
- Infrastructure ✔
- Mechanics (not approved yet) ✔
- 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 FOS slice (✔)
  - Cooling & thermal insulation ✔ in progress
  - Backplanes ✔ to be tested
  - Cables ✔
  - Light pulser fiber coupling in progress
  - Design Support Beam (✔) done, to be tested