

# BWEC status report

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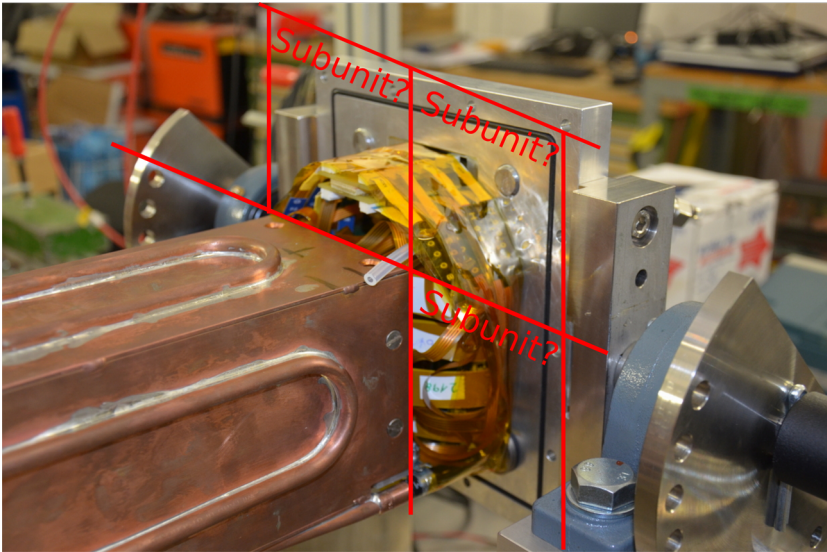


PANDA Meeting, November 2018, GSI

# Topics

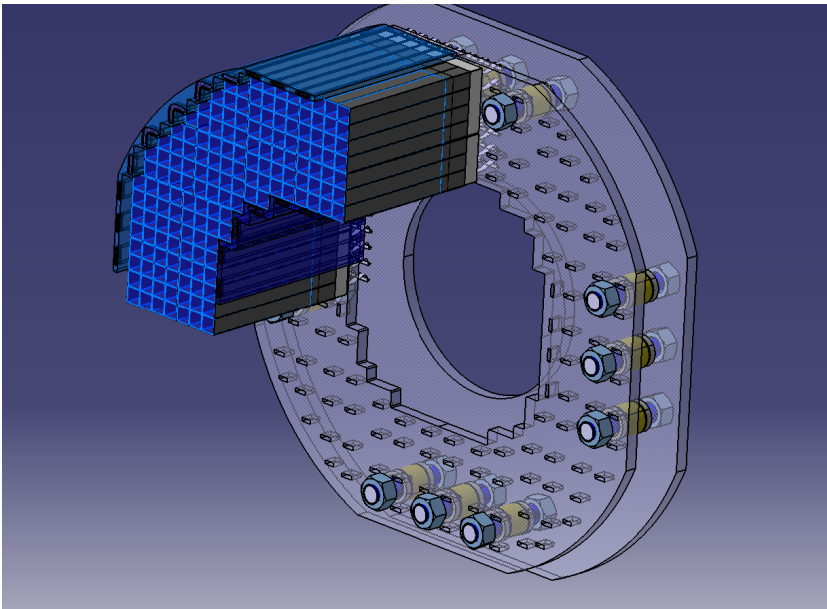
- Proto16 version 2.0
- Tests of the APFEL board with LED

# Second prototype: motivation



## Issues:

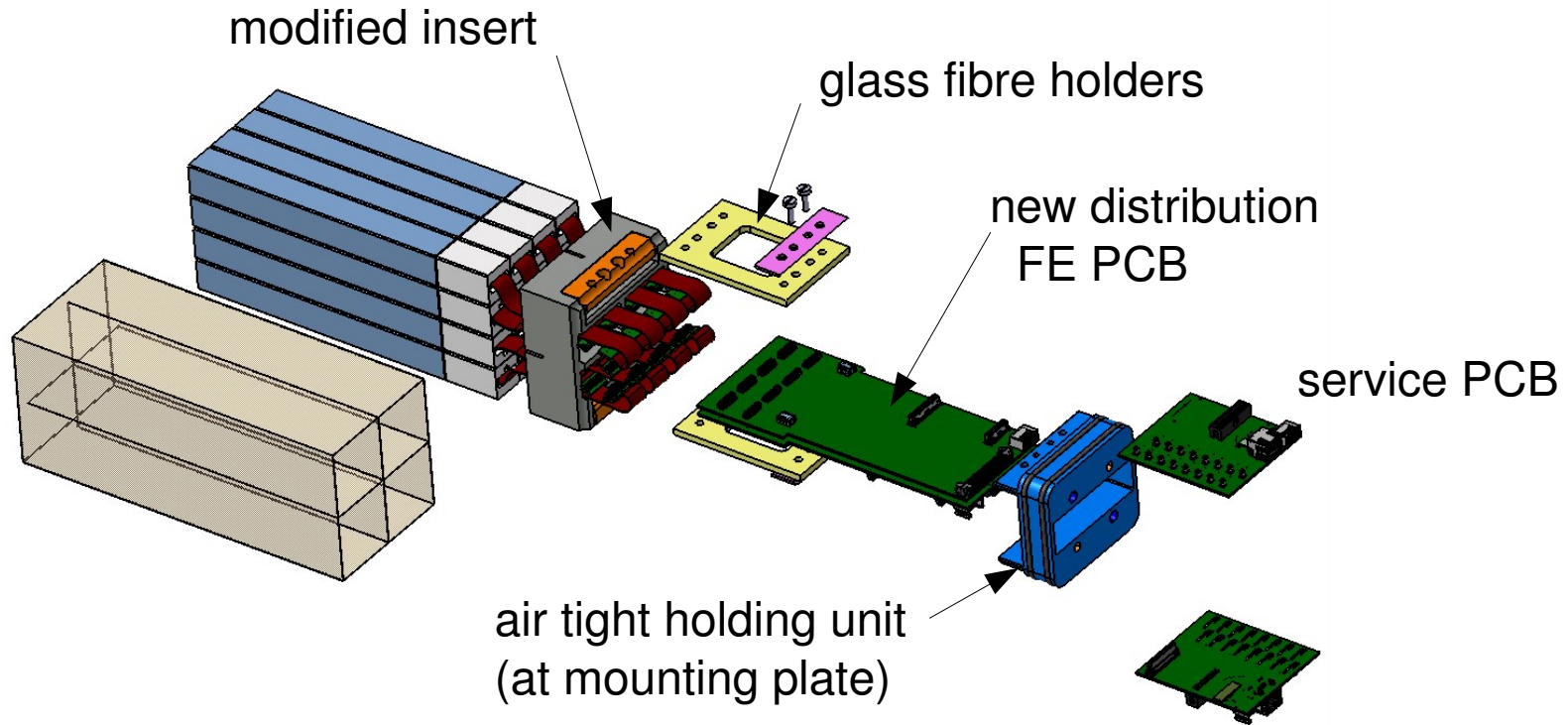
- all cables should remain in the submodule projection
- space for holders interferes with cable routing
- changing the layout  $\Leftrightarrow$  rethinking 2 mounting plates



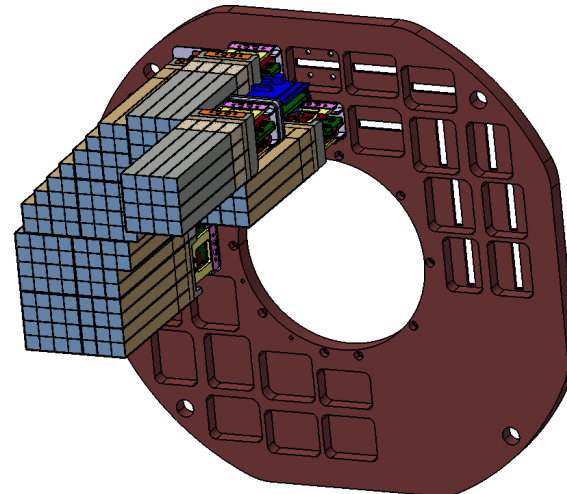
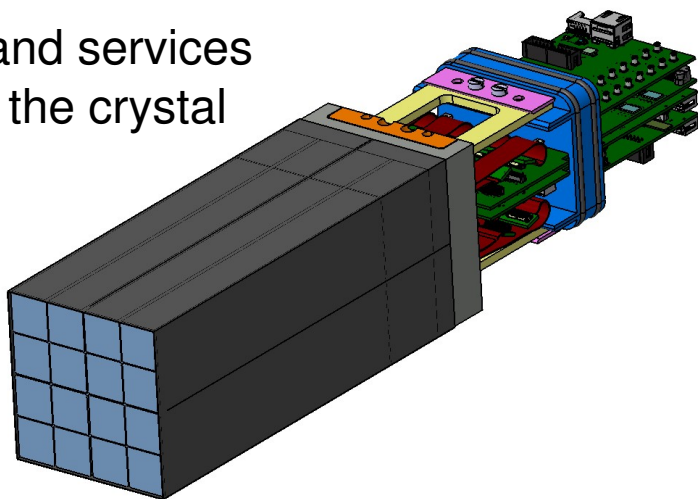
## Solution:

- eliminate mounting plate 1 (cold)
- distribute the weight support through single submodules

# New submodule design



all cables and services stay within the crystal projection

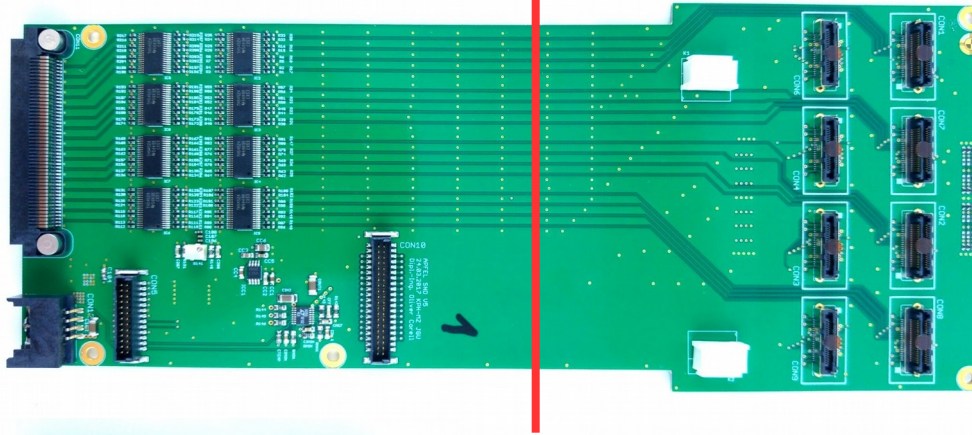


more modular design



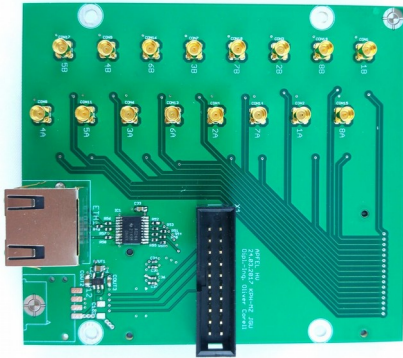
# New submodule electronics

warm | cold



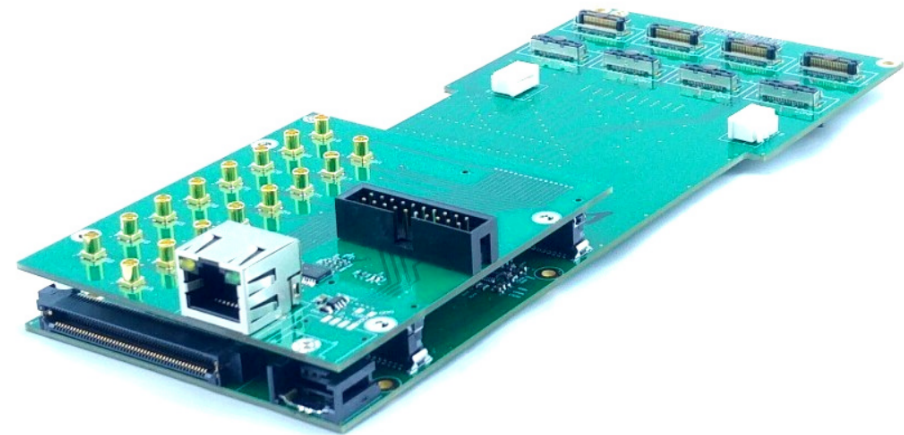
## Line driver board

- 8 APFEL (instead of 4)
- Pt100 connection (x2)
- multichannel amplifiers
- signal readout



## Service board

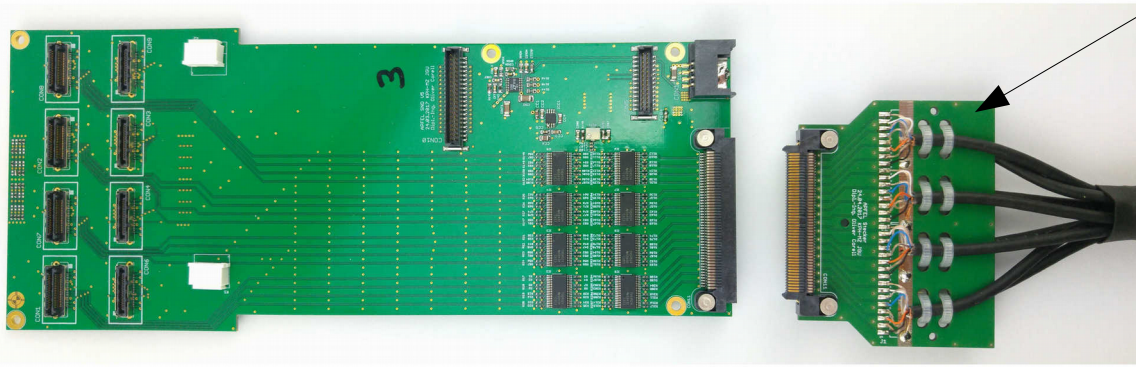
- HV distribution
- APFEL control
- temperature readout



## To be completed

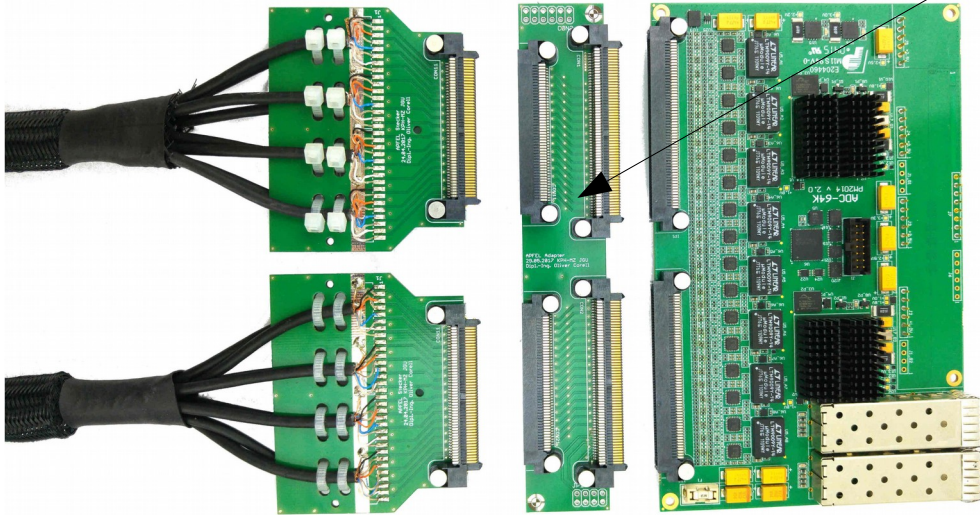
- LED connection on the line driver PCB
- Service board:
  - HV splitter
  - Serial adapter ASIC

# Signal cables and connectors



## Connector boards

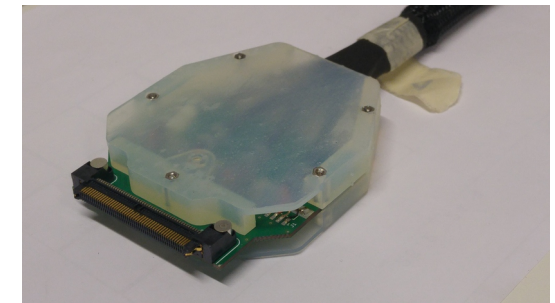
- thin cables from Gießen used (4 shielded twisted pairs,  $\varnothing 5$  mm)
- 1 board = 8 cables/32 channels
- soldering requires some effort (or money)



## Adapter to SADC to be modified

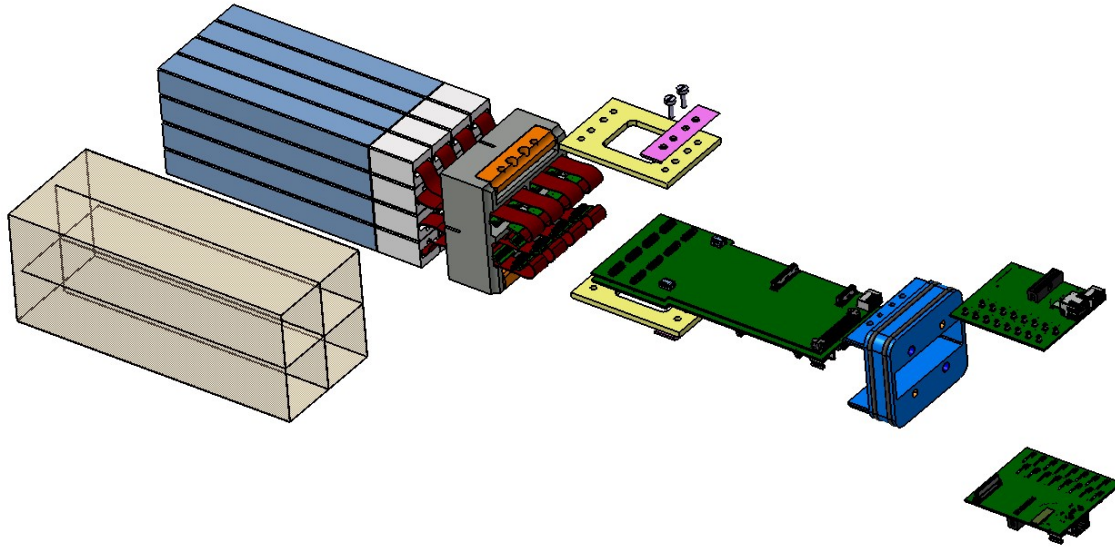
- SADC board has new connectors
- APFEL/HV control can be implemented there (I2C connection)

## Plastic case

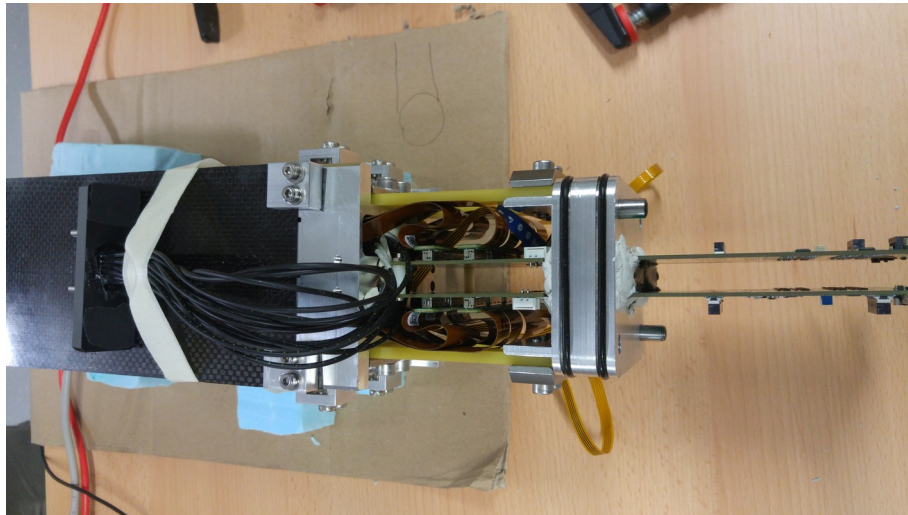




# New prototype Proto16v2

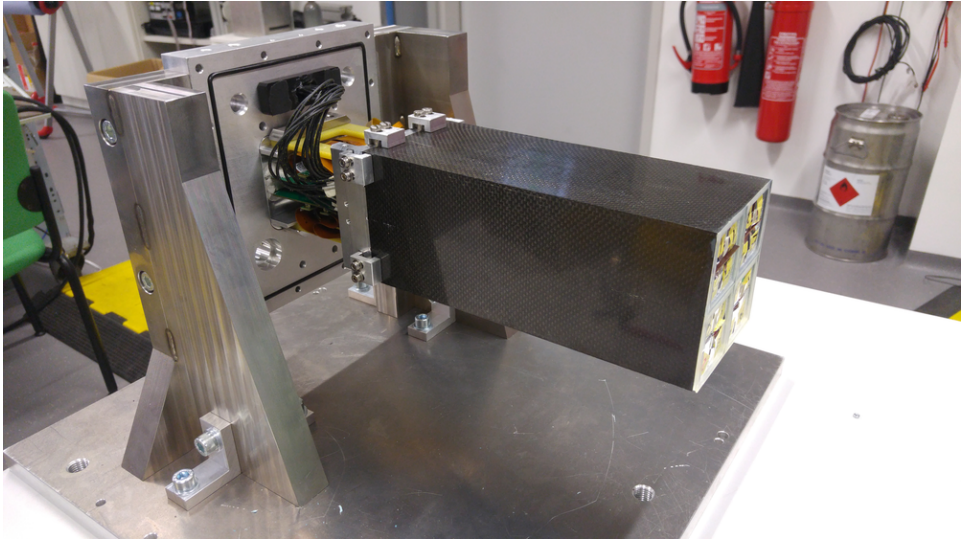
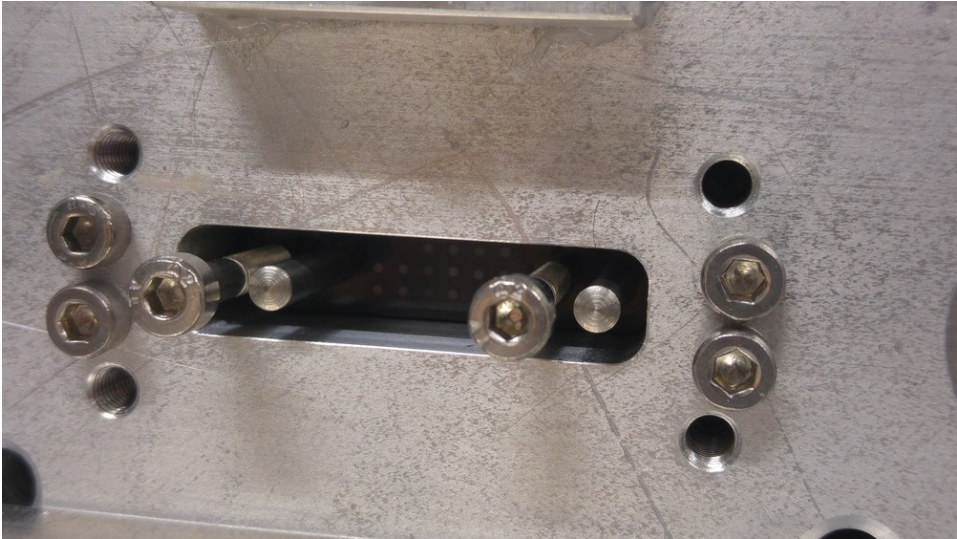
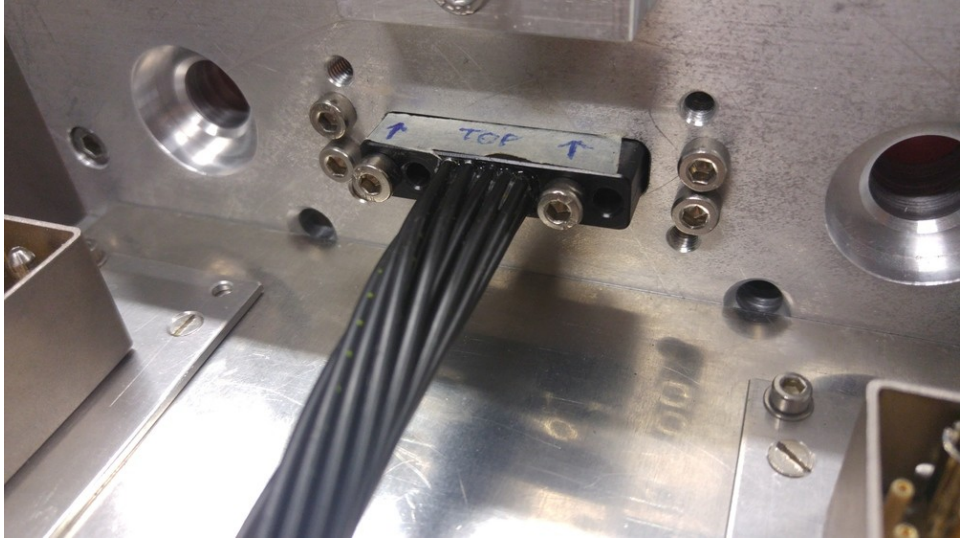


- All components manufactured
- New prototype mounted



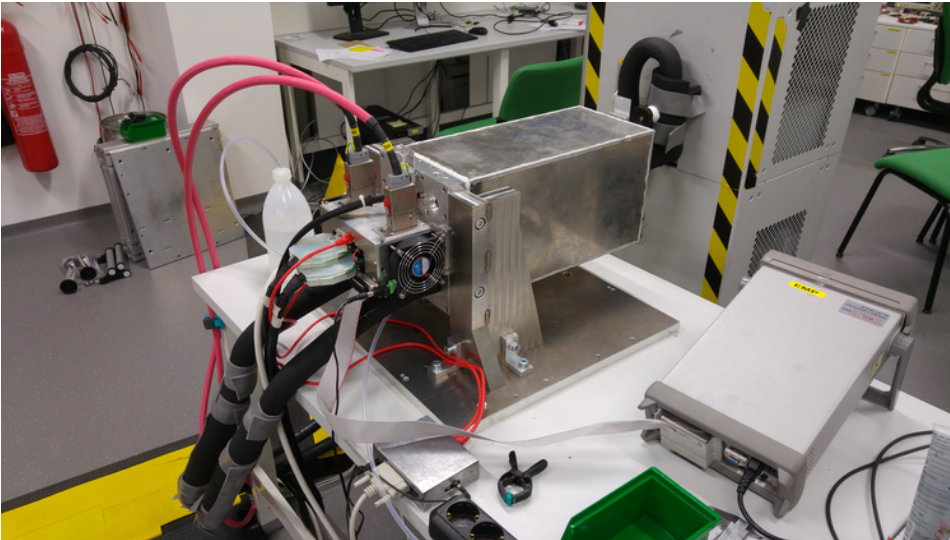
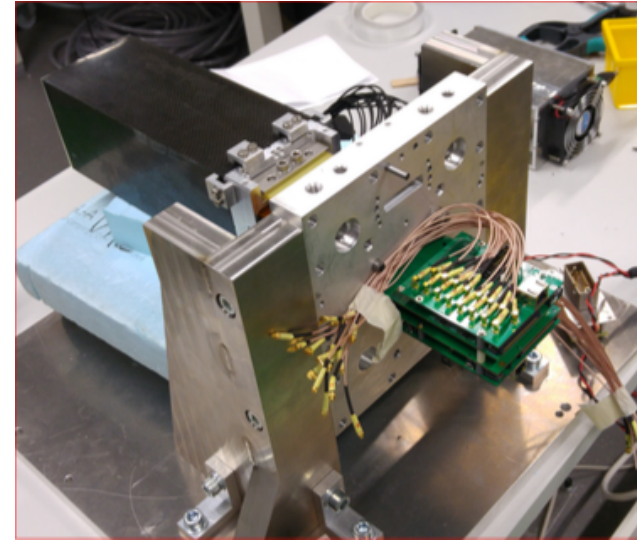
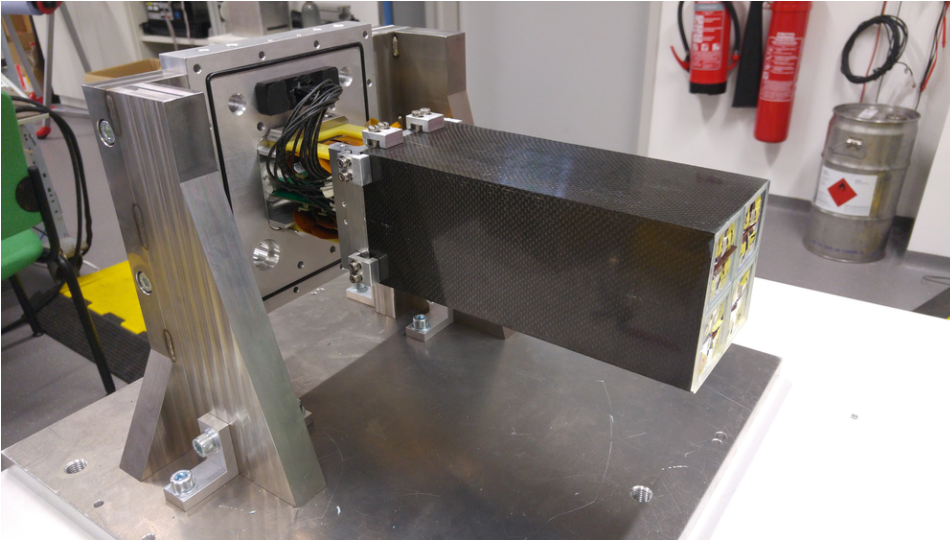
- To be completed
- APFEL flex-PCB length
  - routing of optical fibres

# Light fibre connectors



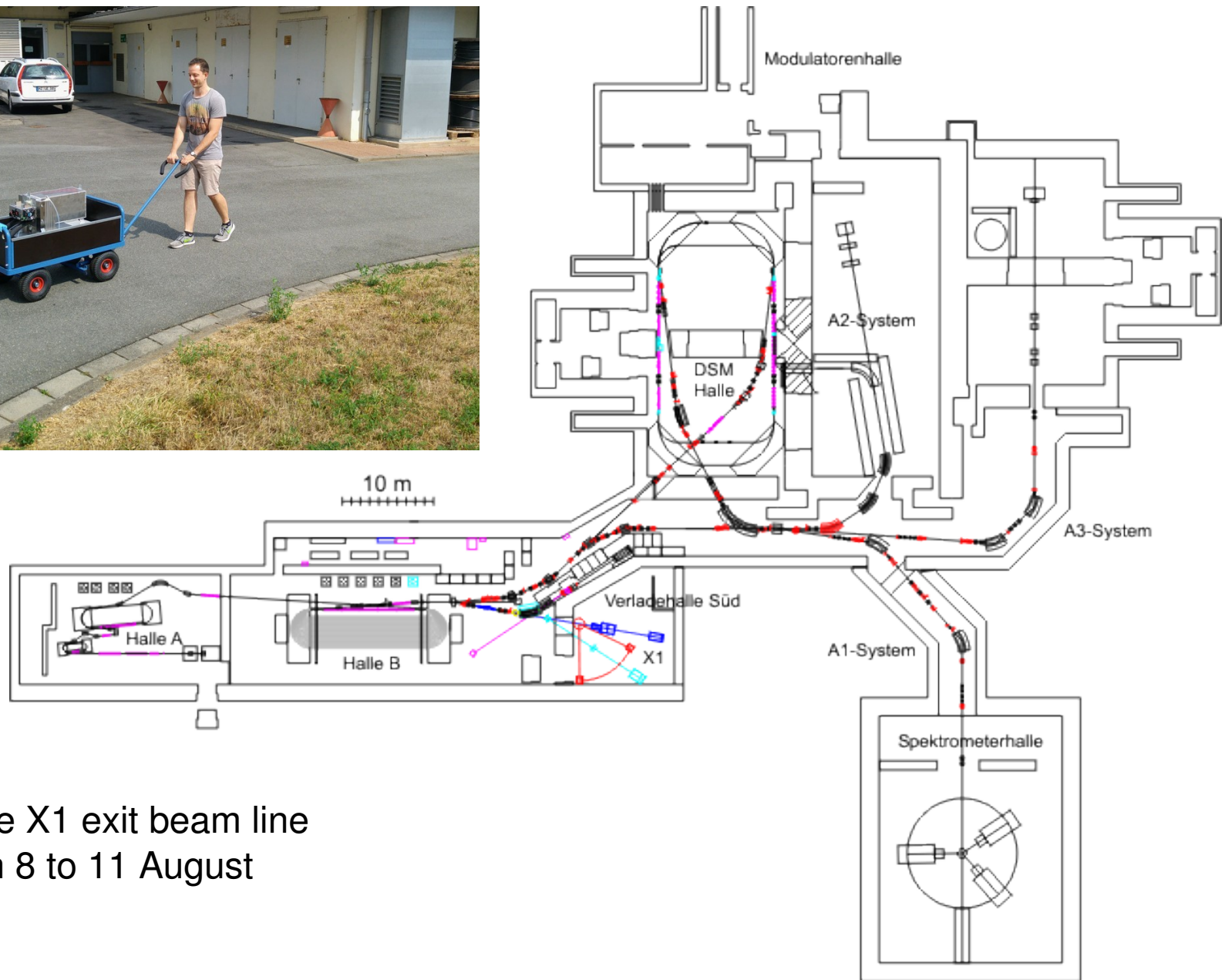


# Mounting the new prototype



- mounting and cabling successful
- shielding/mounting box for the FE boards and connectors
- to be developed in full scale for the BWEC
- ⇒ ready for testing!

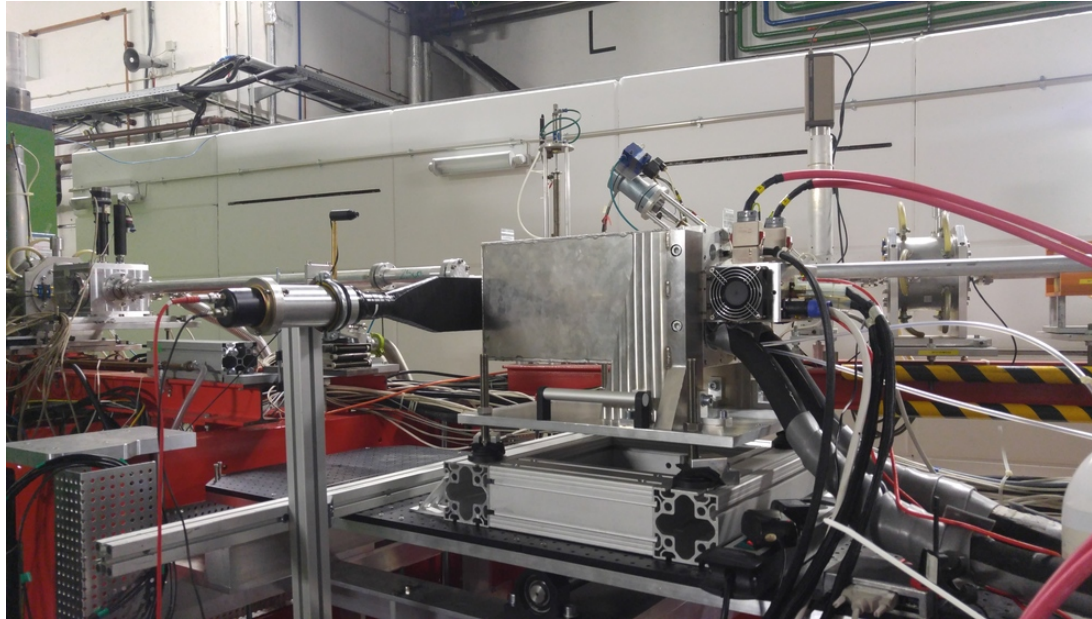
# Beam test at MAMI



- At the X1 exit beam line
- From 8 to 11 August



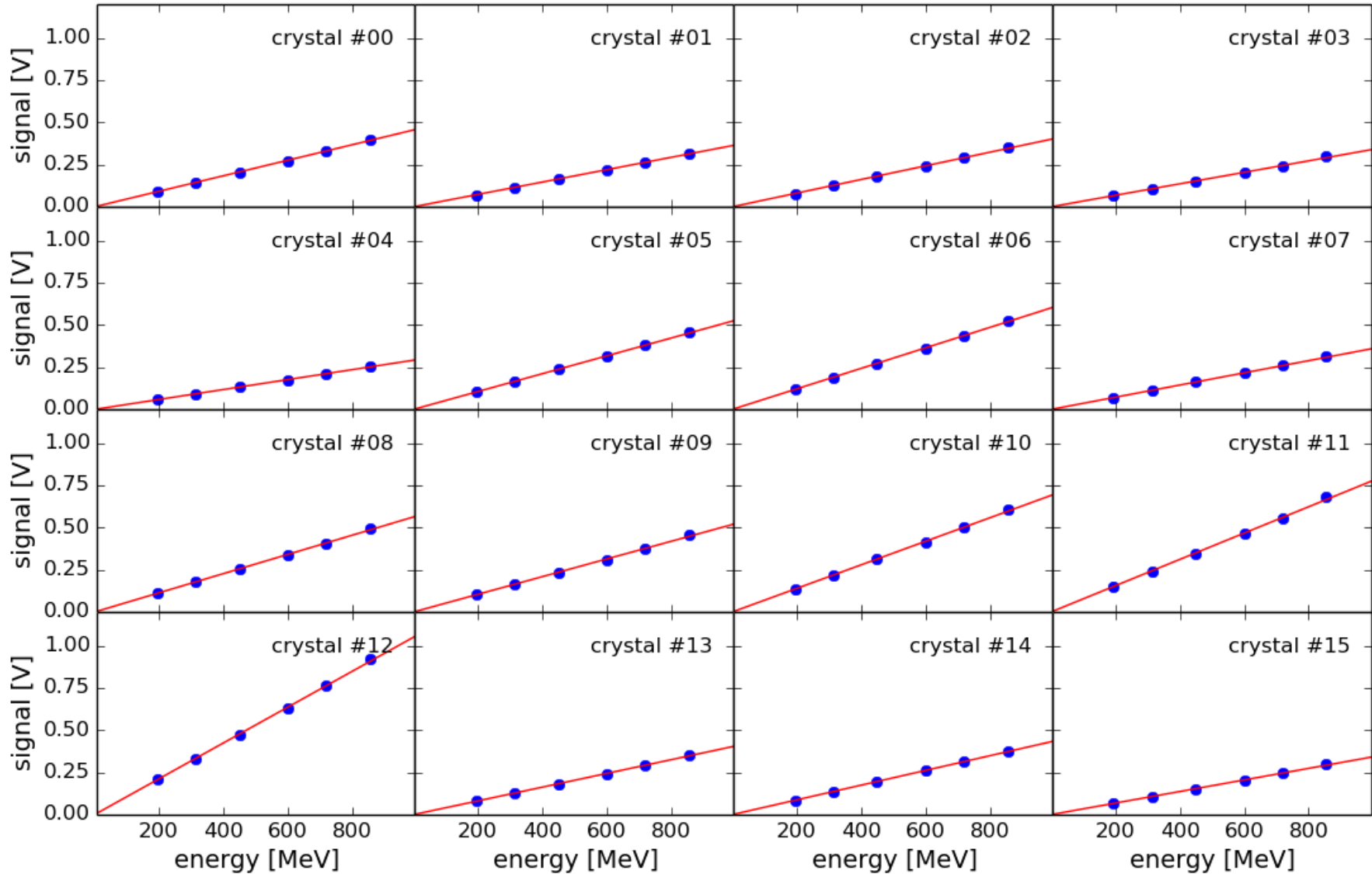
# Beam test at MAMI



- electron beam directly on detector
- 6 beam energies: 195, 315, 450, 600, 720, 855 MeV
- rates from  $\sim 1$  kHz up to  $\sim 400$  kHz
- readout trigger: coincidence of prototype and a plastic scintillator
  
- smooth operation for 4 days
- no ice/condense water formation issues
- no noise issues
- measurements with the PANDA (Uppsala) SADC
- tests of Oliver's signal processing firmware

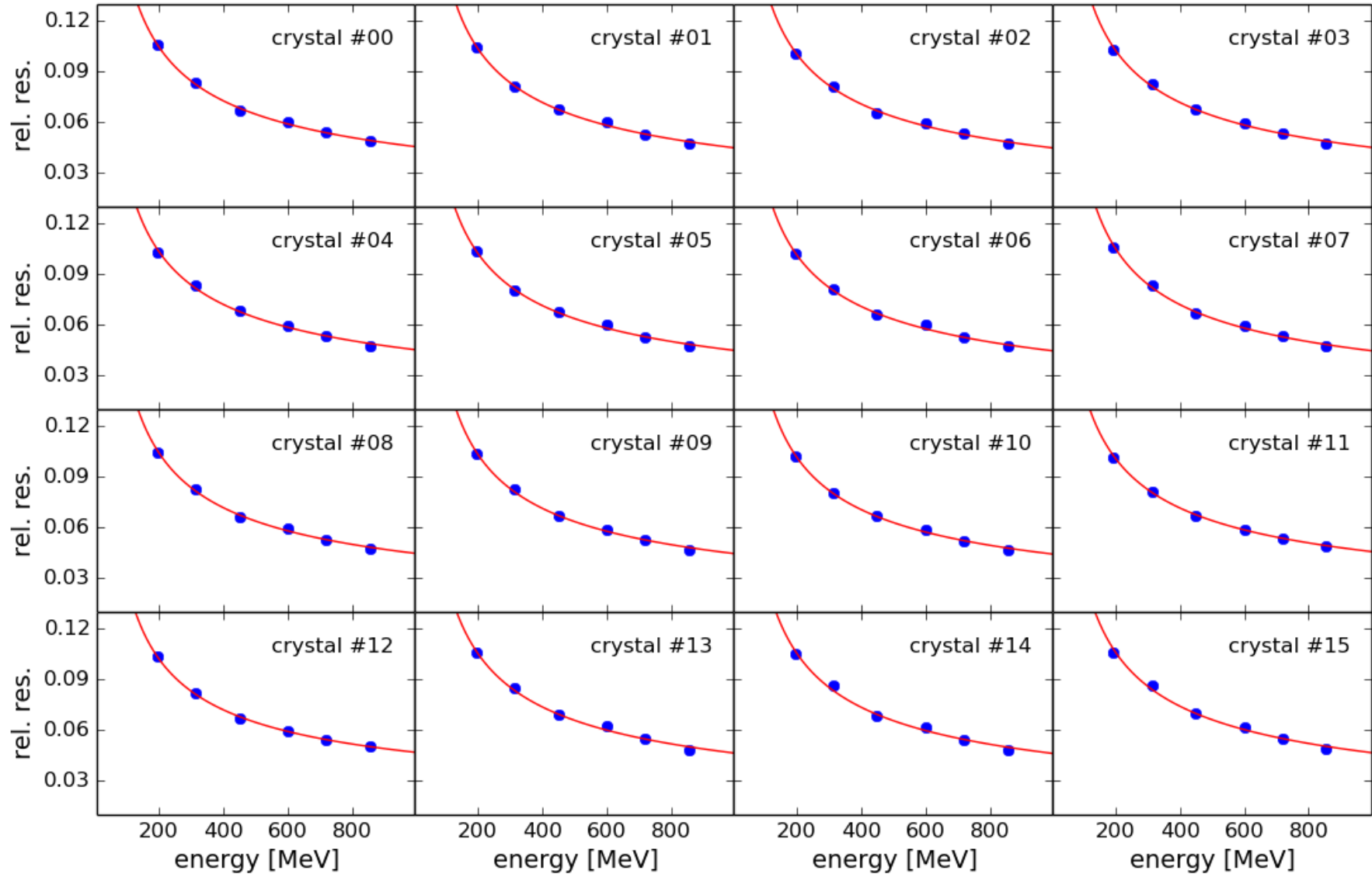
# Main beam test results

Mean pulse height



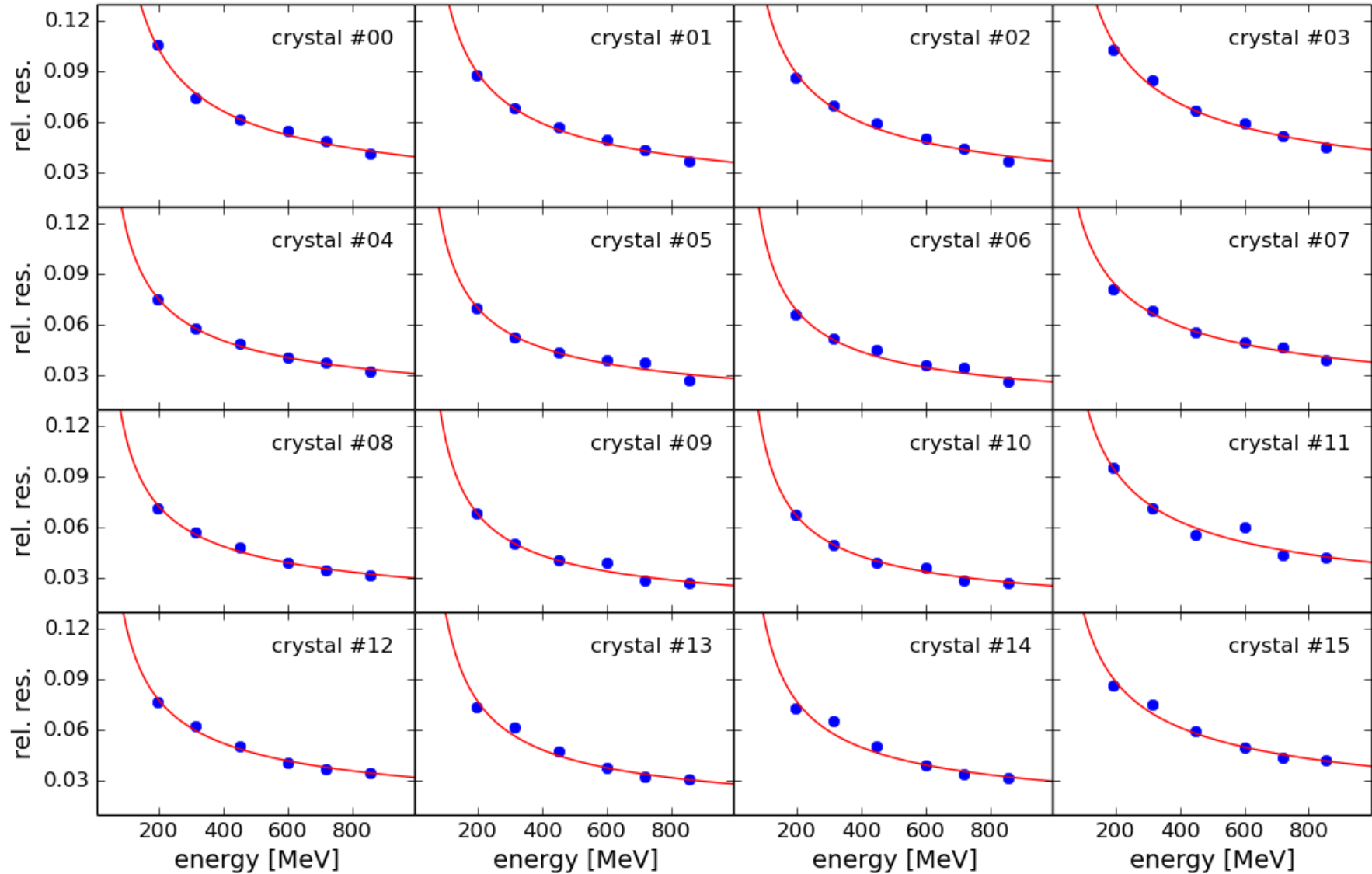
# Main beam test results

## Relative energy resolution: single crystals

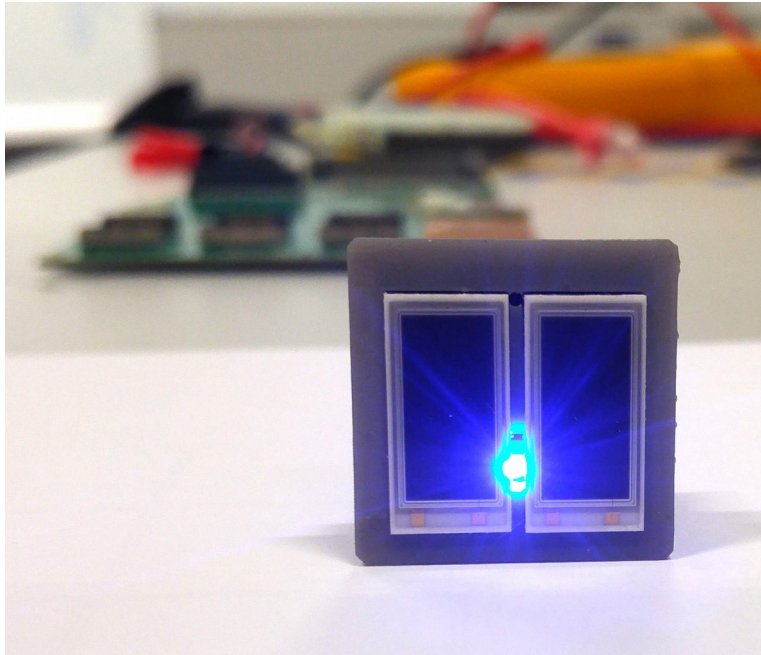


# Main beam test results

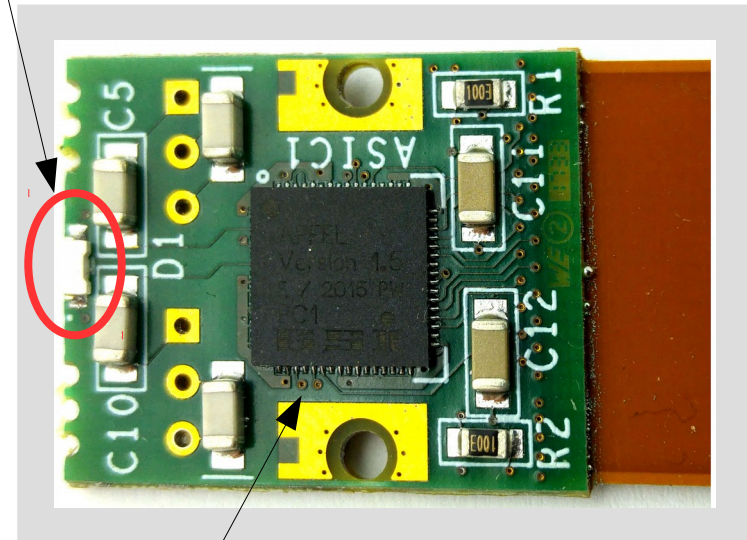
Relative energy resolution: 3x3 crystal array



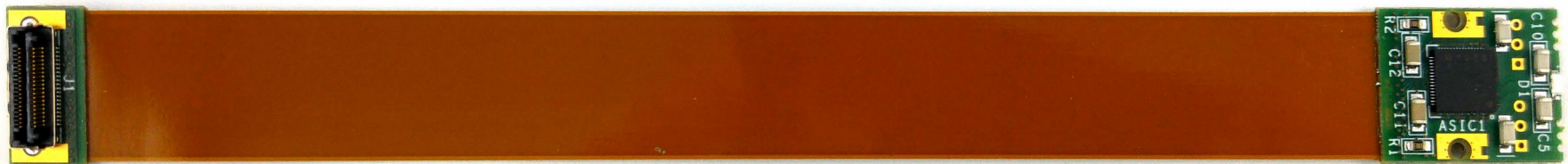
# APFEL flex board with LED



LED for crystal annealing



Packaged APFEL chip



200 mm



# Tests of the new APFEL board

## Need for tests:

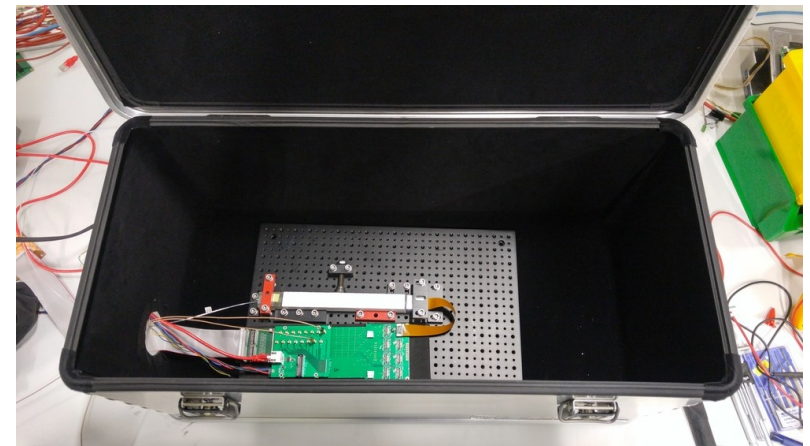
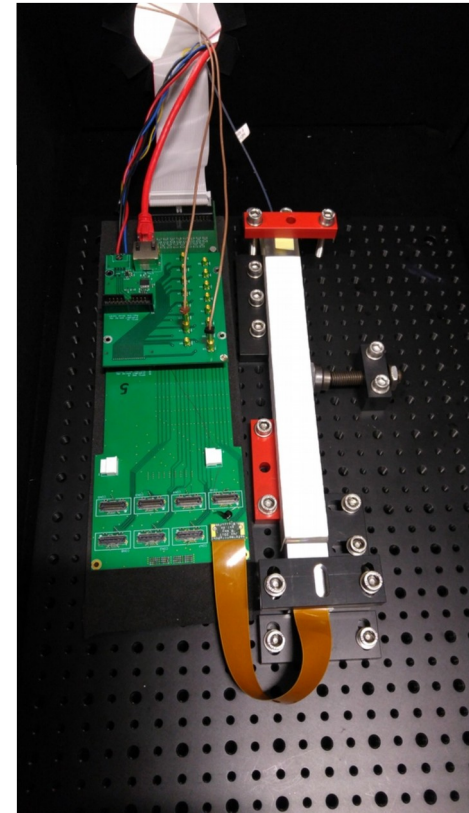
- until now APFEL always bonded on PCB
- the LED could cause some pick up noise

## Extra useful information:

- needed annealing time with the LED
- best if annealing at low  $-25^{\circ}\text{C}$

## Test setup

- measure the light transmission through a crystal
- possibility to remove/reinstall the crystal
- reproducibility?





# First measurements

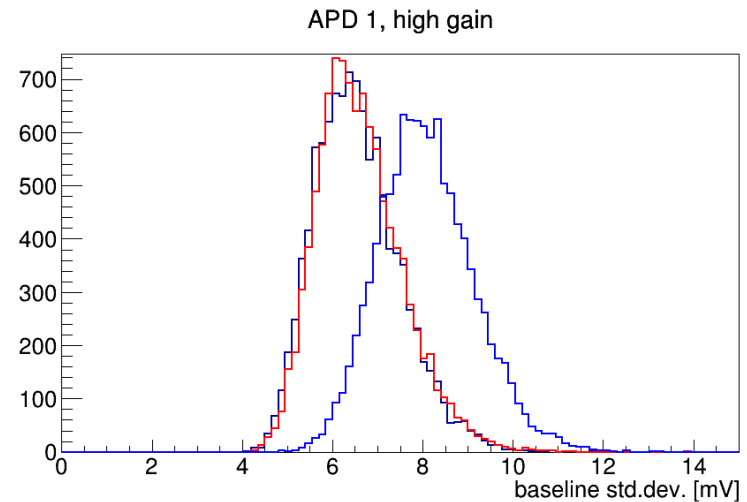
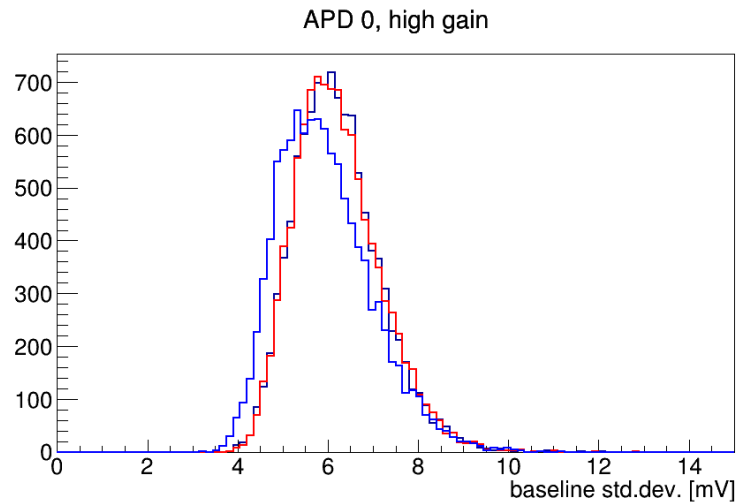
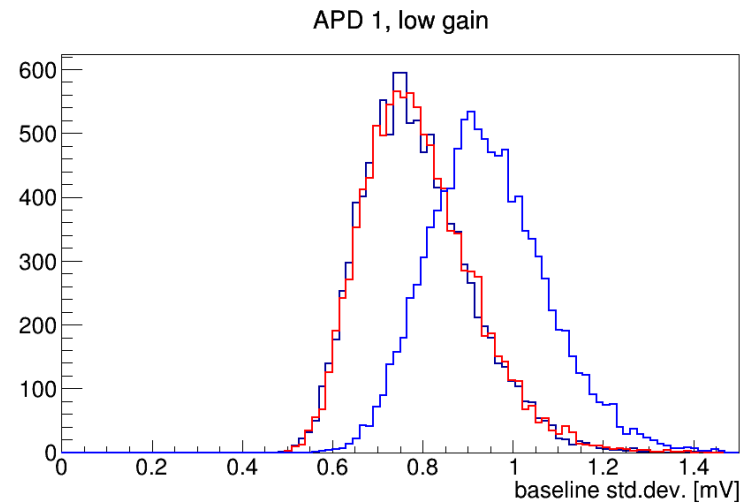
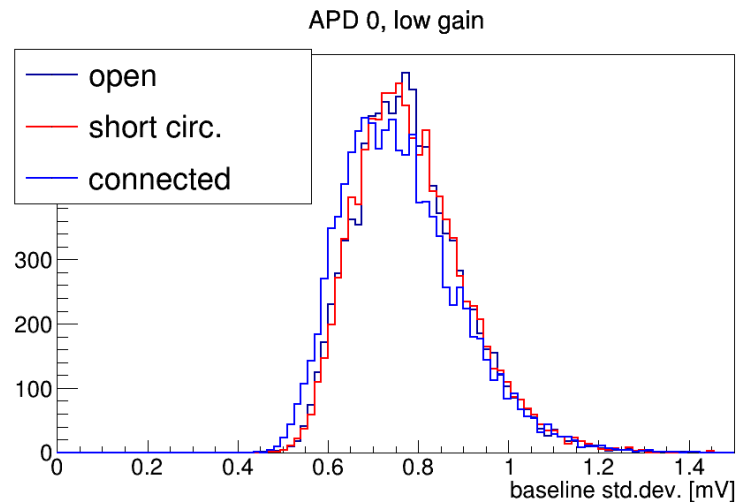
## Arrangement

- input light pulses: 10 ns
- HV on: 350 V
- room temperature
- readout with SADC (Febex, 14 bit, 50 MSP/s)
- LED connections:
  - 1) open
  - 2) short-circuited
  - 3) connected to voltage supply

## Measurements

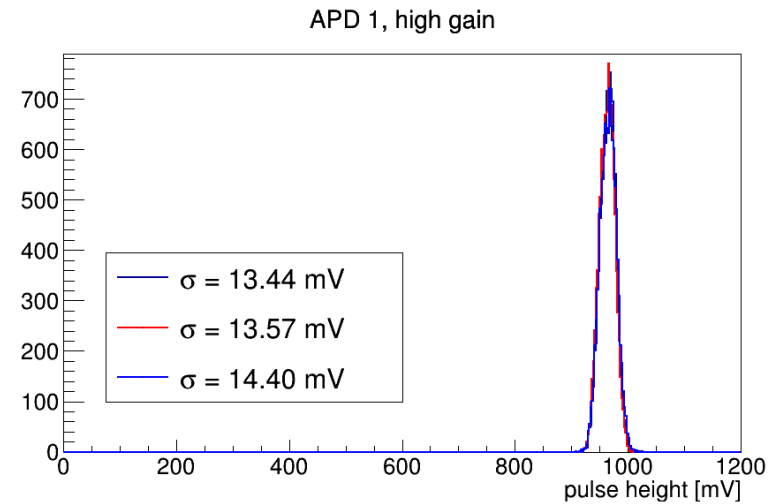
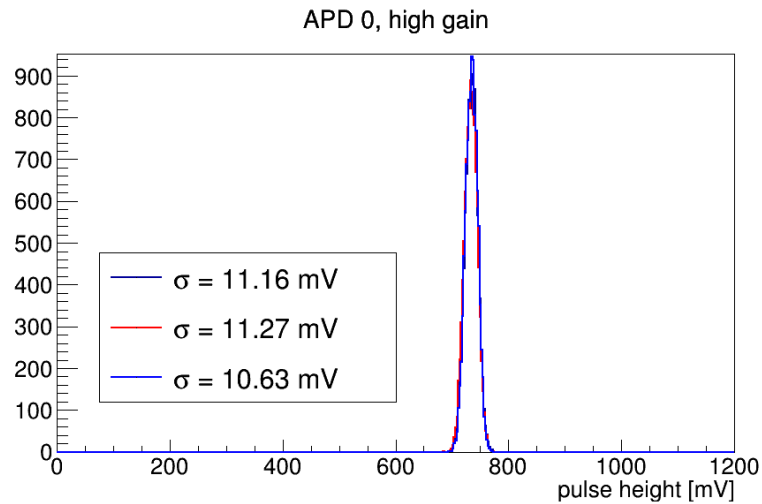
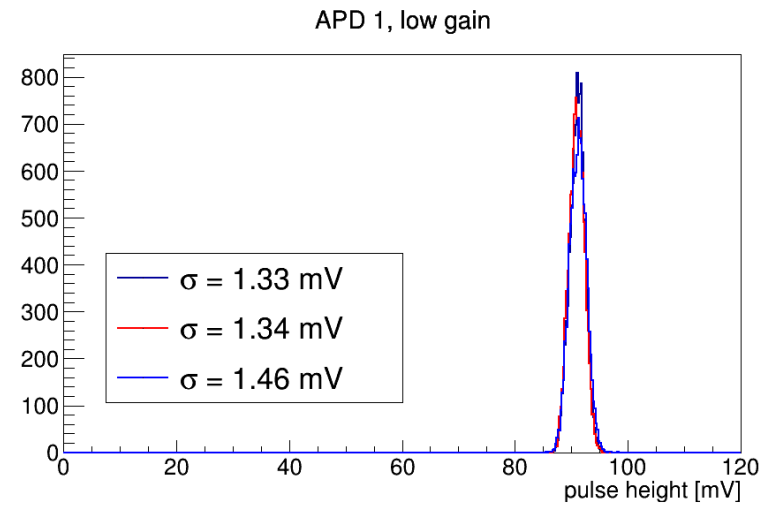
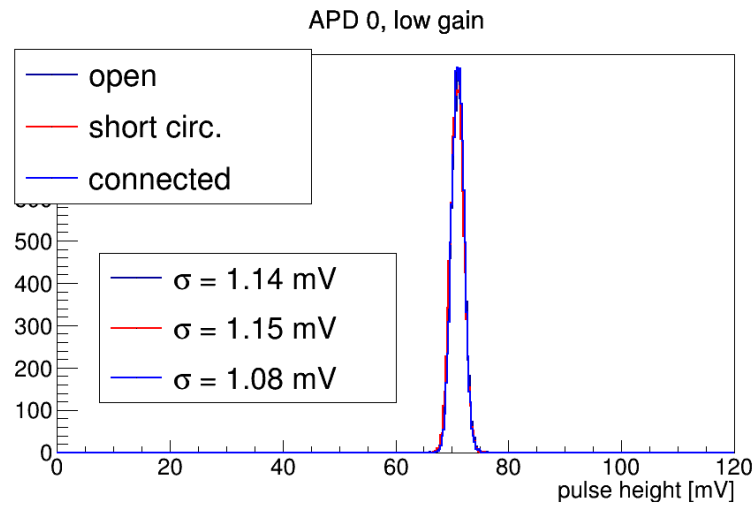
- Baseline fluctuation: standard deviation over 12.5  $\mu$ s traces
- Pulse height spectra

# Baseline fluctuation



- fluctuations as with the old APFEL board:  $\sim 1 \dots 2$  MeV
- effect with the connected supply to be investigated

# Pulse height spectra



- relative resolution  $\sim 1.5\%$  (typical)
- no relevant difference between configurations

# Summary

## Tests with APFEL+LED board

- Test setup available
- First data show
  - the packaged APFEL works fine
  - the LED has no relevant impact on the signals

## Next Steps

- more measurements varying input intensity and HV
- reproducibility tests
- more pick-up tests at Gießen?
- measurements at  $-25^{\circ}\text{C}$
- irradiation tests (to be organised with Gießen)

## New submodule design

- new prototype built
- successful tests with beam

## To do

- finalise front-end boards
- fix some details (light fibre routing, APFEL flex cable length)