

FEE for the backward EMC

Status report

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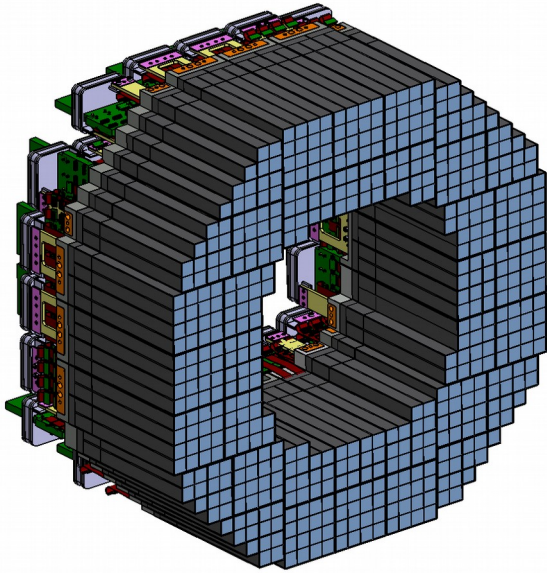


PANDA Meeting, June 2019, GSI

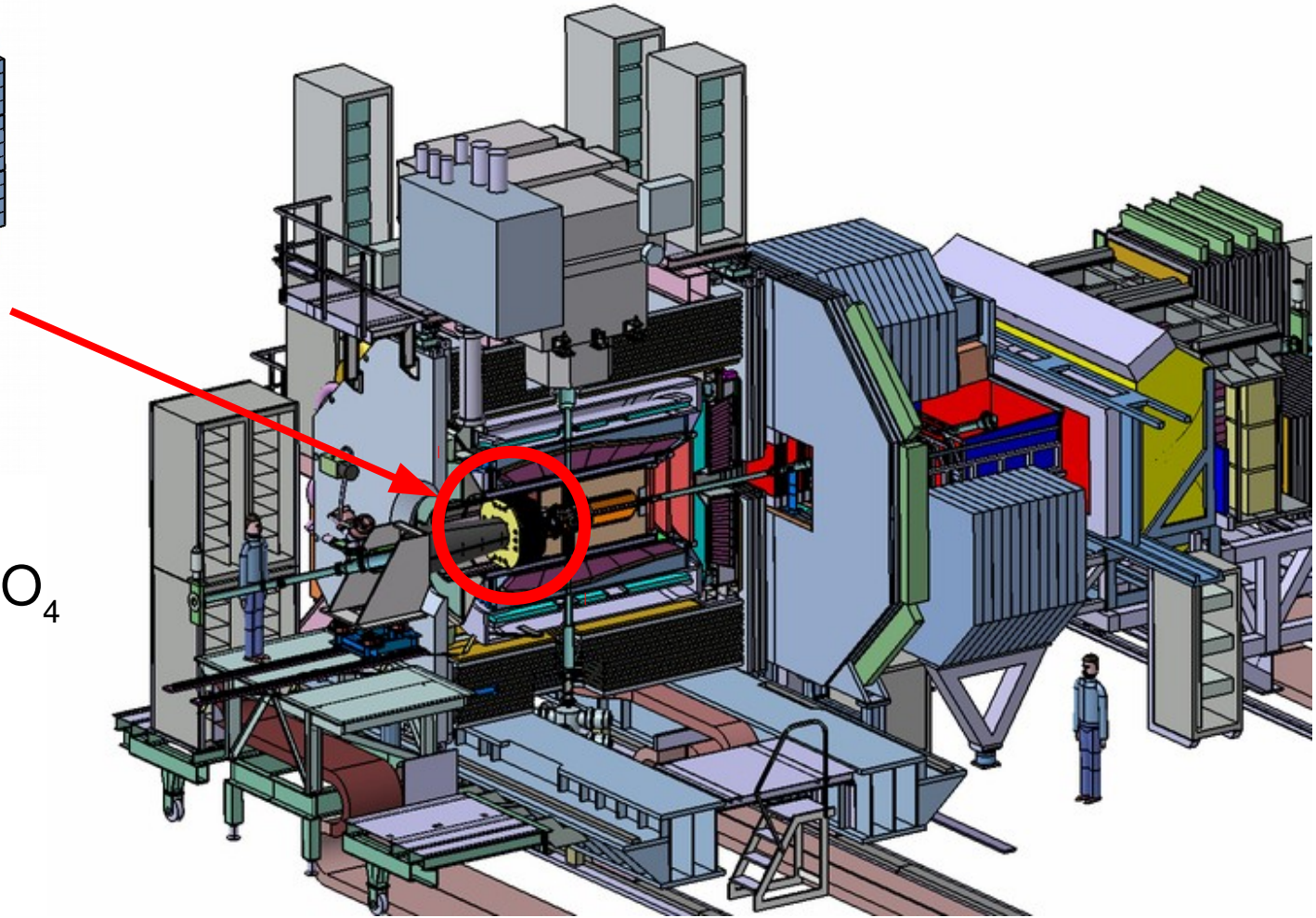
Topics

- Backward EMC readout: overview
- Details of submodule design and readout
- Prototype tests
- Latest developments
- Summary of status and perspectives

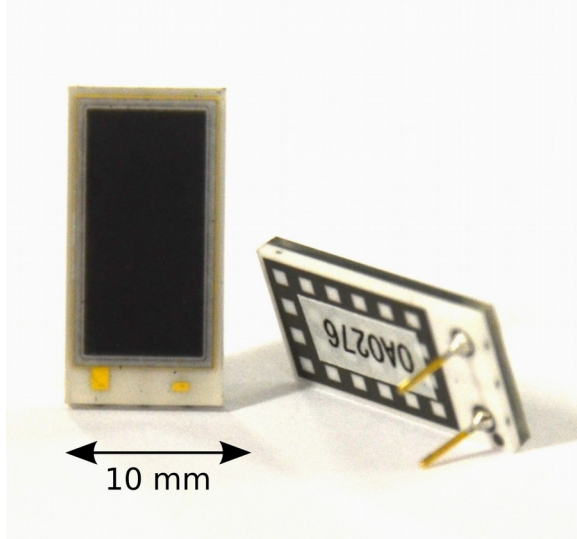
The backward EMC



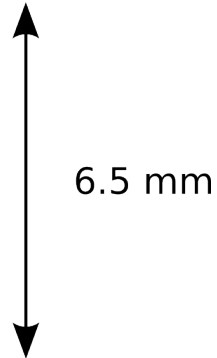
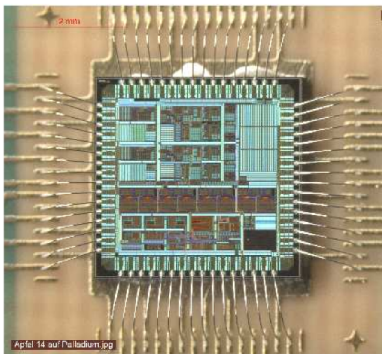
- Homogeneous PbWO_4 calorimeter
- ~500 crystals
- Operated at -25°C



Light readout

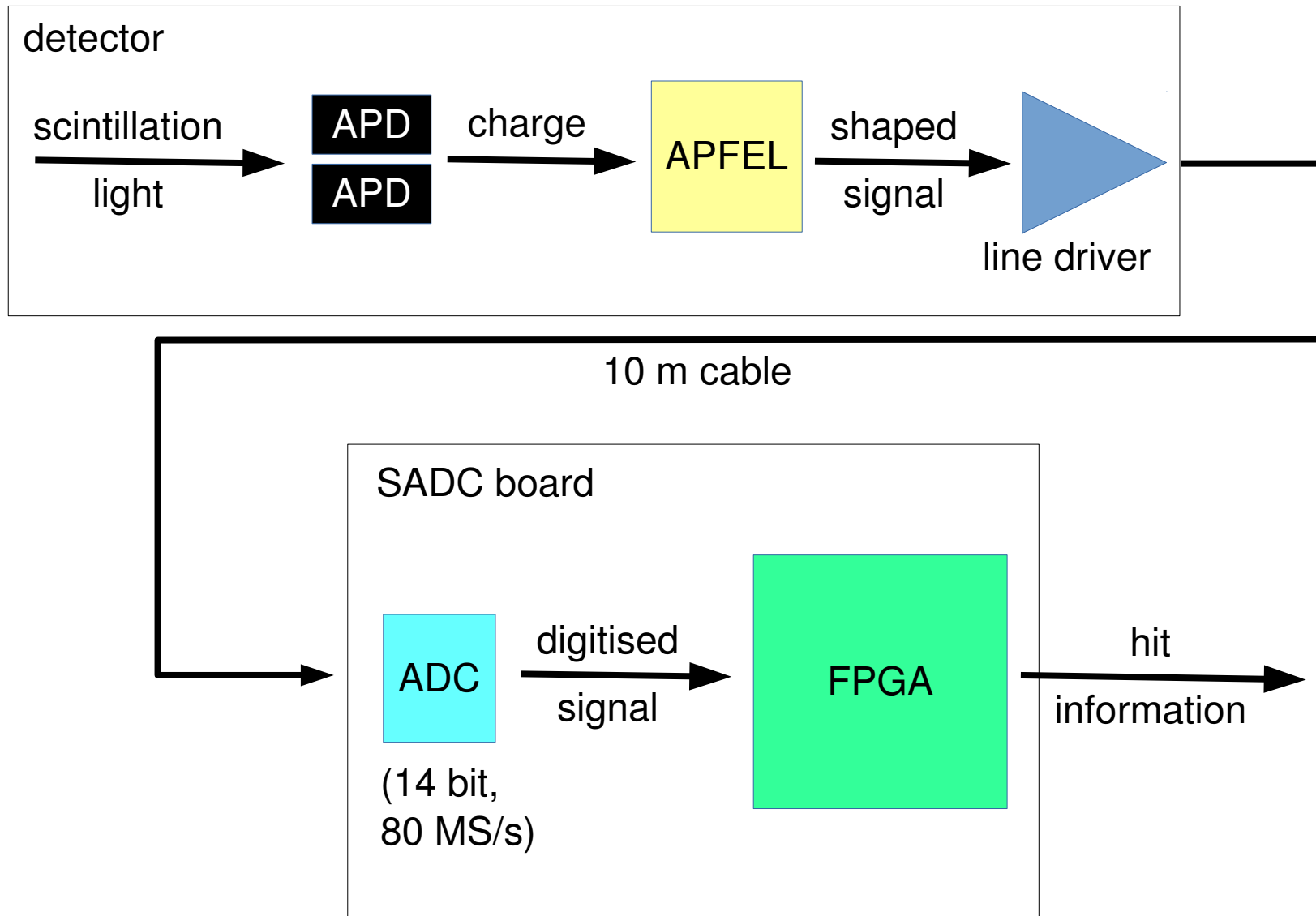


- Large area APD ($7 \times 14 \text{ mm}^2$)
- Capacitance: 270 pF (full depletion)
- Operated at gain ~ 200
- Two APD per crystal

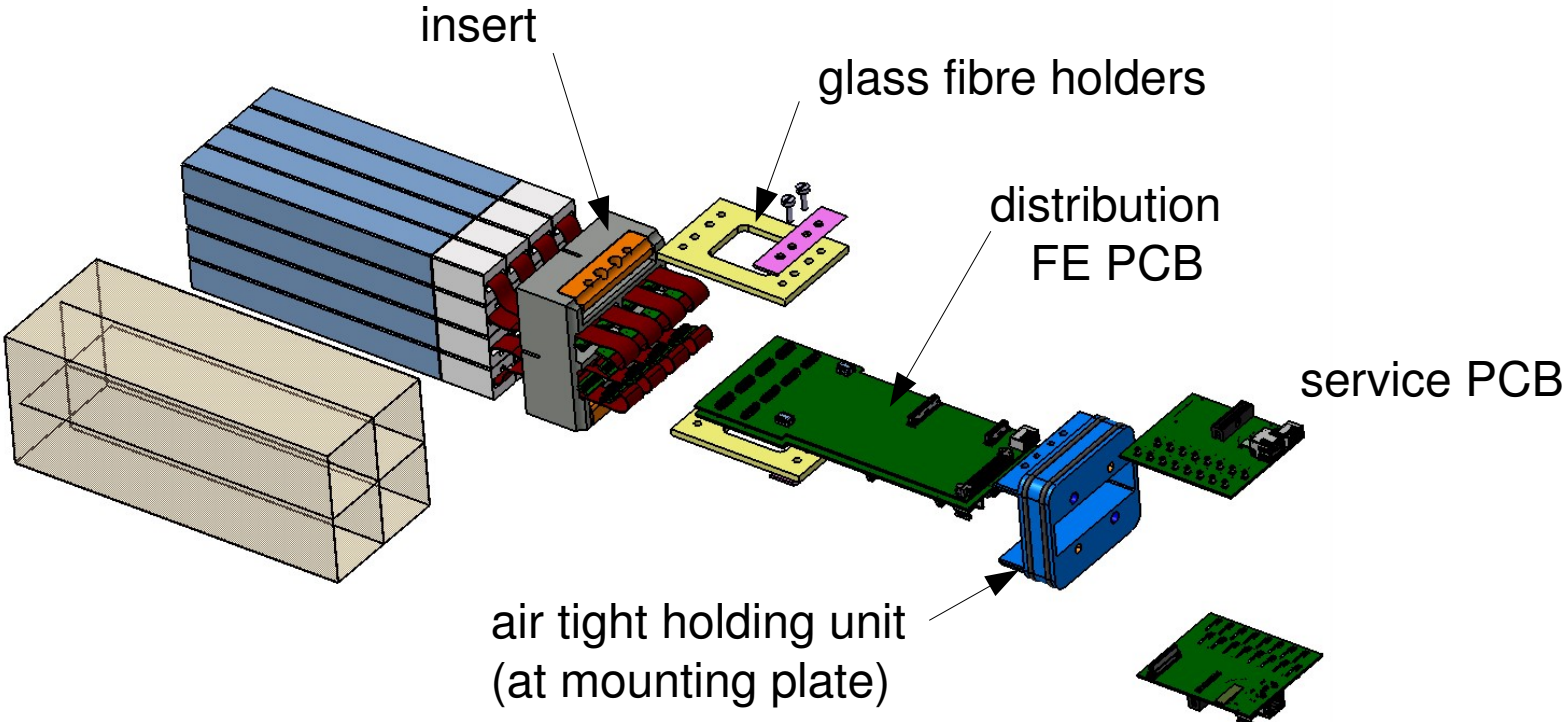


- Charge sensitive preamplifier: APFEL (ASIC for the PANDA Frontend Electronics)
- Reads out two APD (one crystal)
- Low noise input stage
- Shaper ($\sim 1 \mu\text{s}$ shaping time)
- Two main amplifier (gain 1 and 10)
- 4 output signals (2 APD \times 2 gains)
- Low power consumption ($\sim 100 \text{ mW}$)

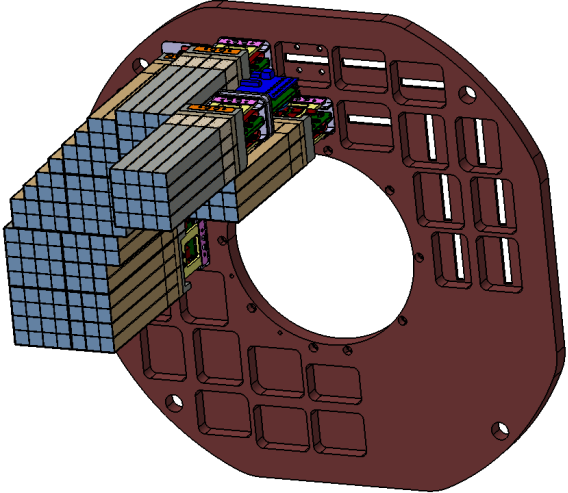
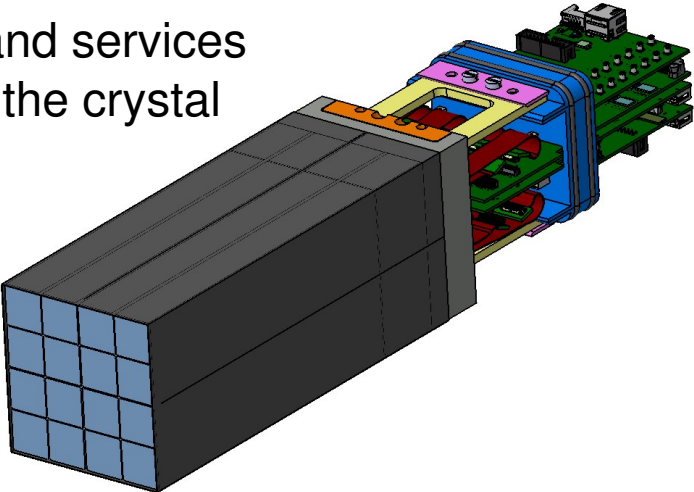
Readout scheme



Submodule design



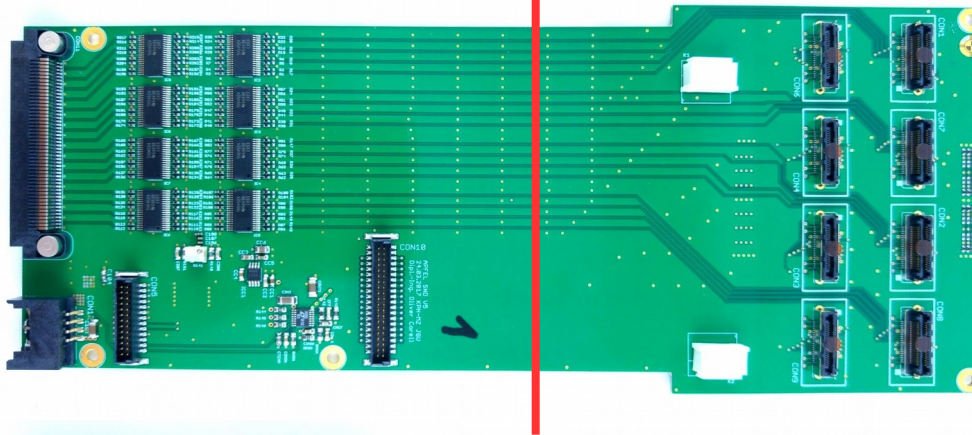
all cables and services stay within the crystal projection



modular design

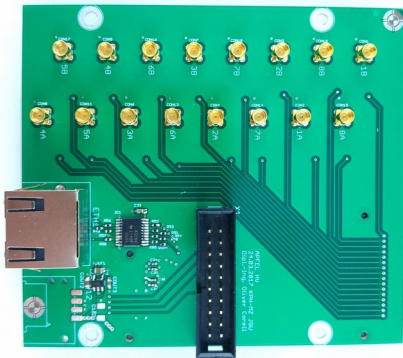
Submodule frontend boards

warm | cold



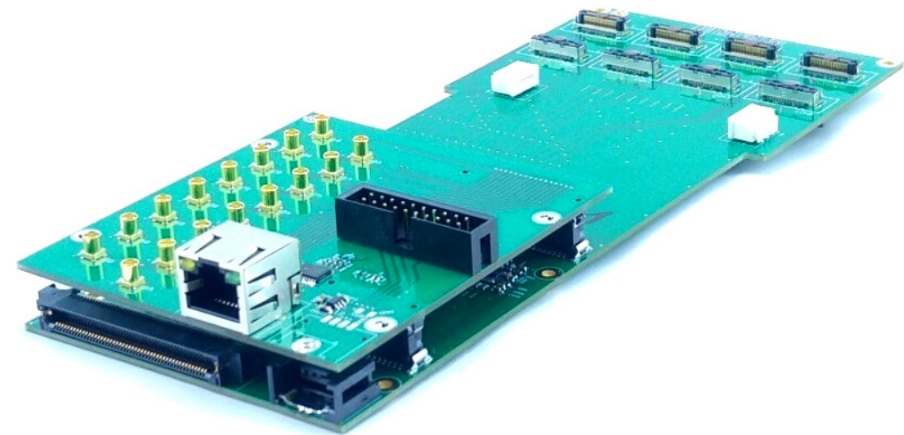
Line driver board

- feed-through board
- 8 APFEL
- Pt100 connection (x2)
- multichannel amplifiers
- connector for signal readout



Service board

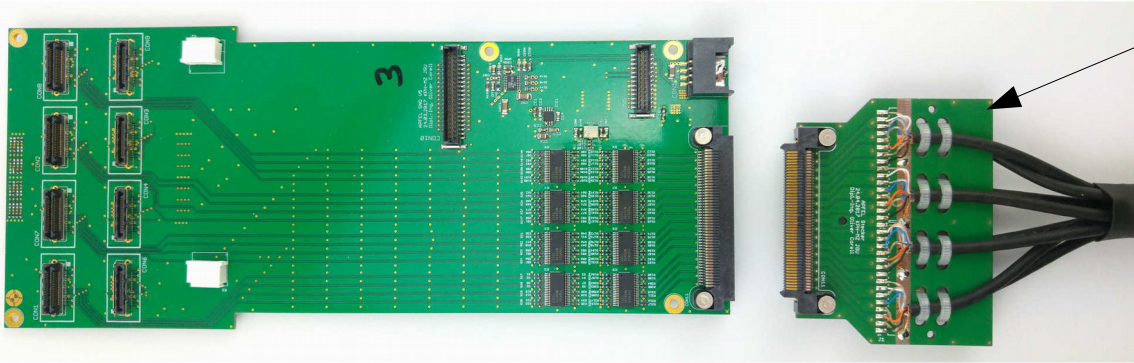
- HV distribution
- APFEL control
- temperature readout



To be completed

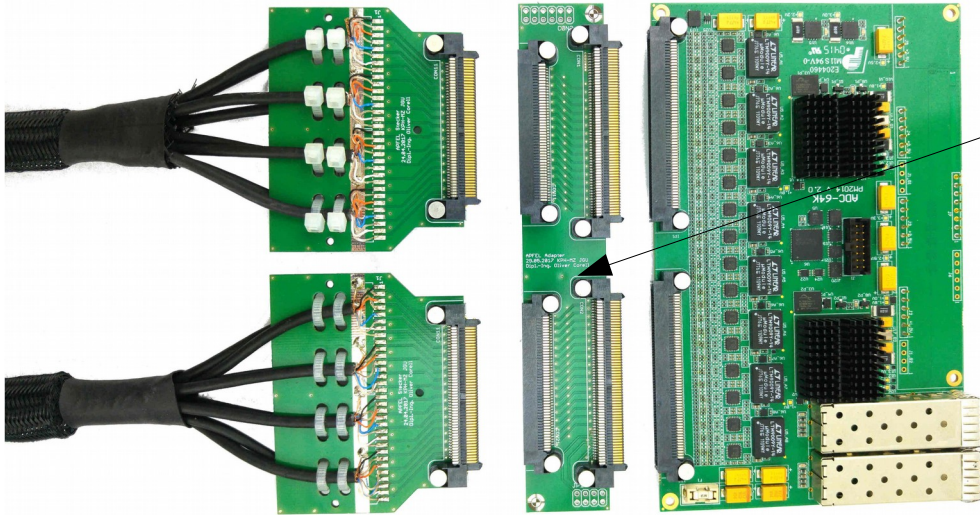
- LED connection on the line driver PCB
- Service board:
 - HV control
 - APFEL+HV communication

Signal cables and connectors



Connector boards

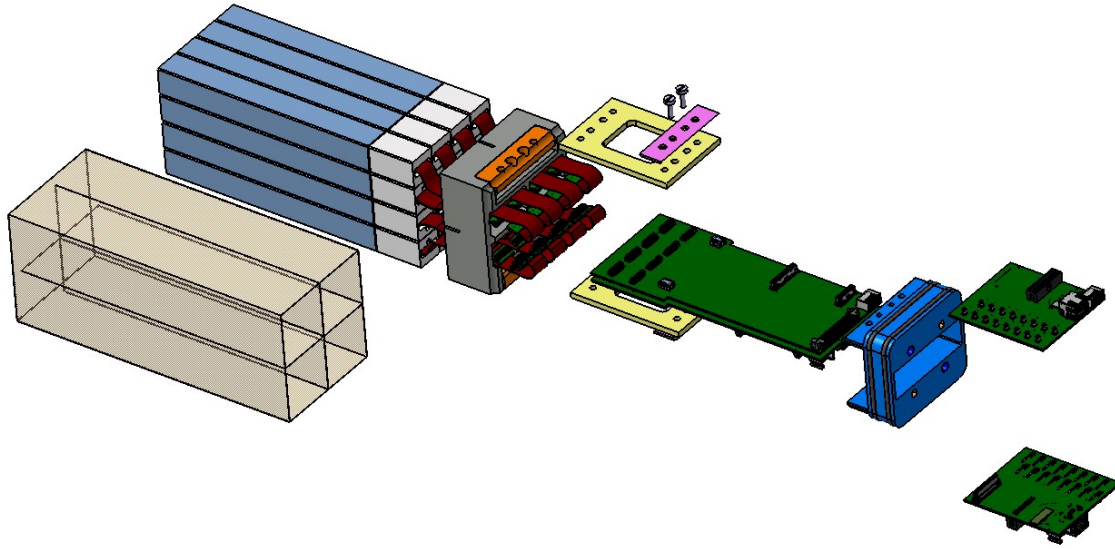
- thin cables from Gießen used (4 shielded twisted pairs, $\varnothing 5$ mm)
- 1 board = 8 cables/32 channels
- soldering requires some effort (or money)



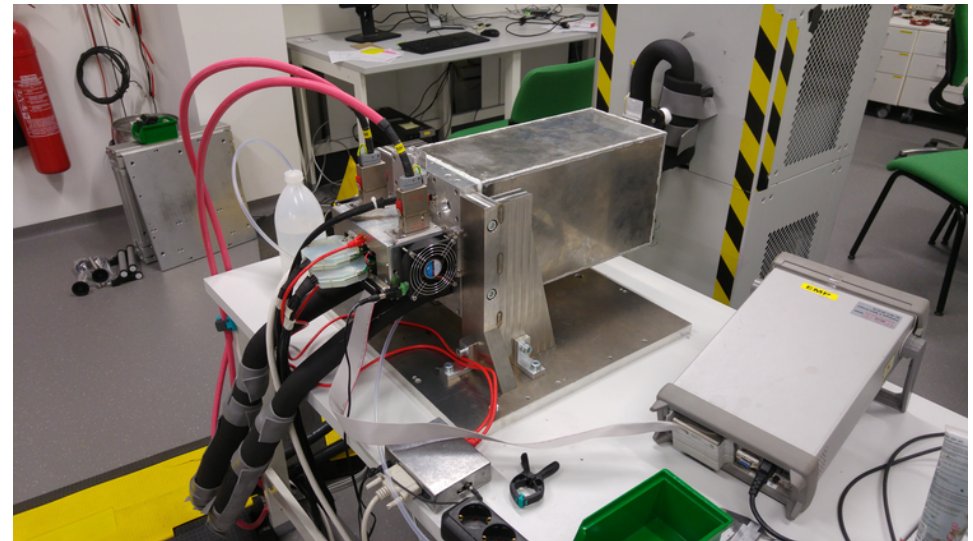
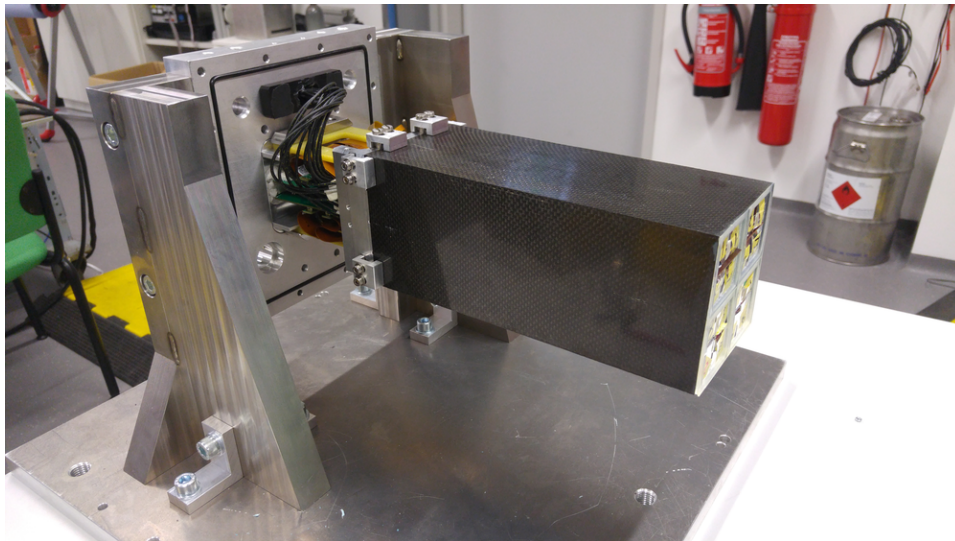
Adapter to SADC to be modified

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

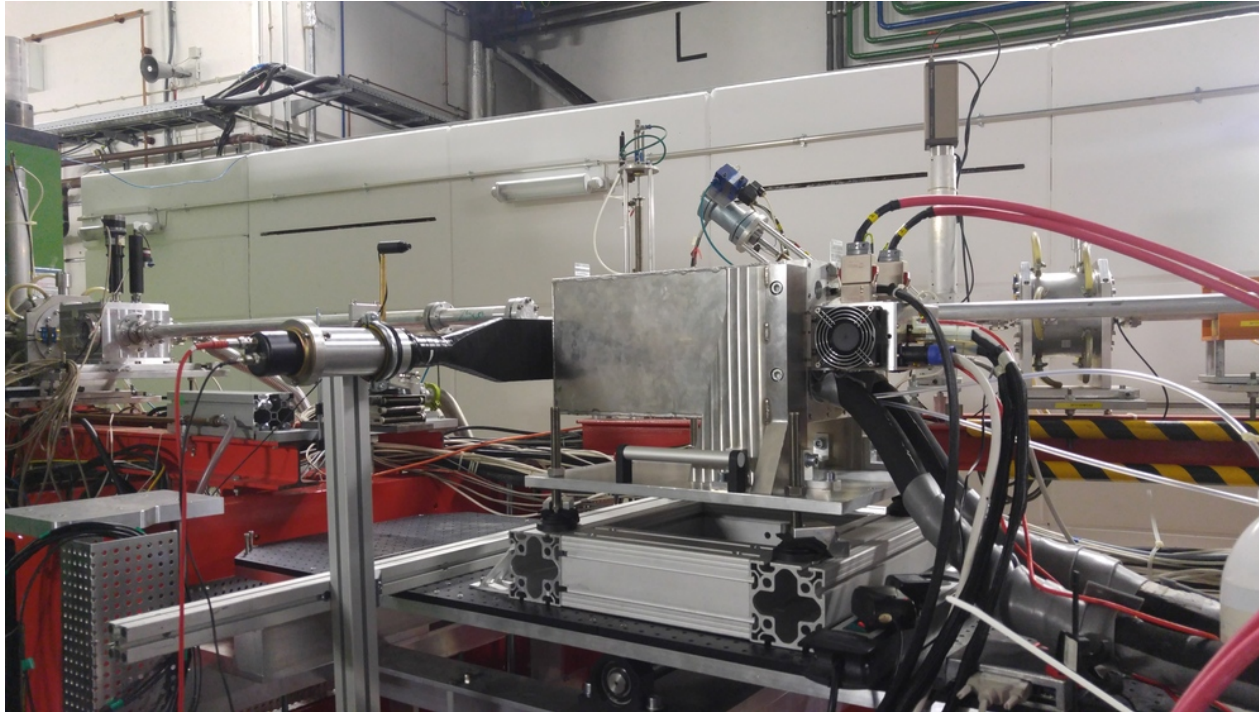
Prototype Proto16v2



- 2nd version of the 16 crystals prototype
- Same components as a BVEC submodules
- construction completed in 2018



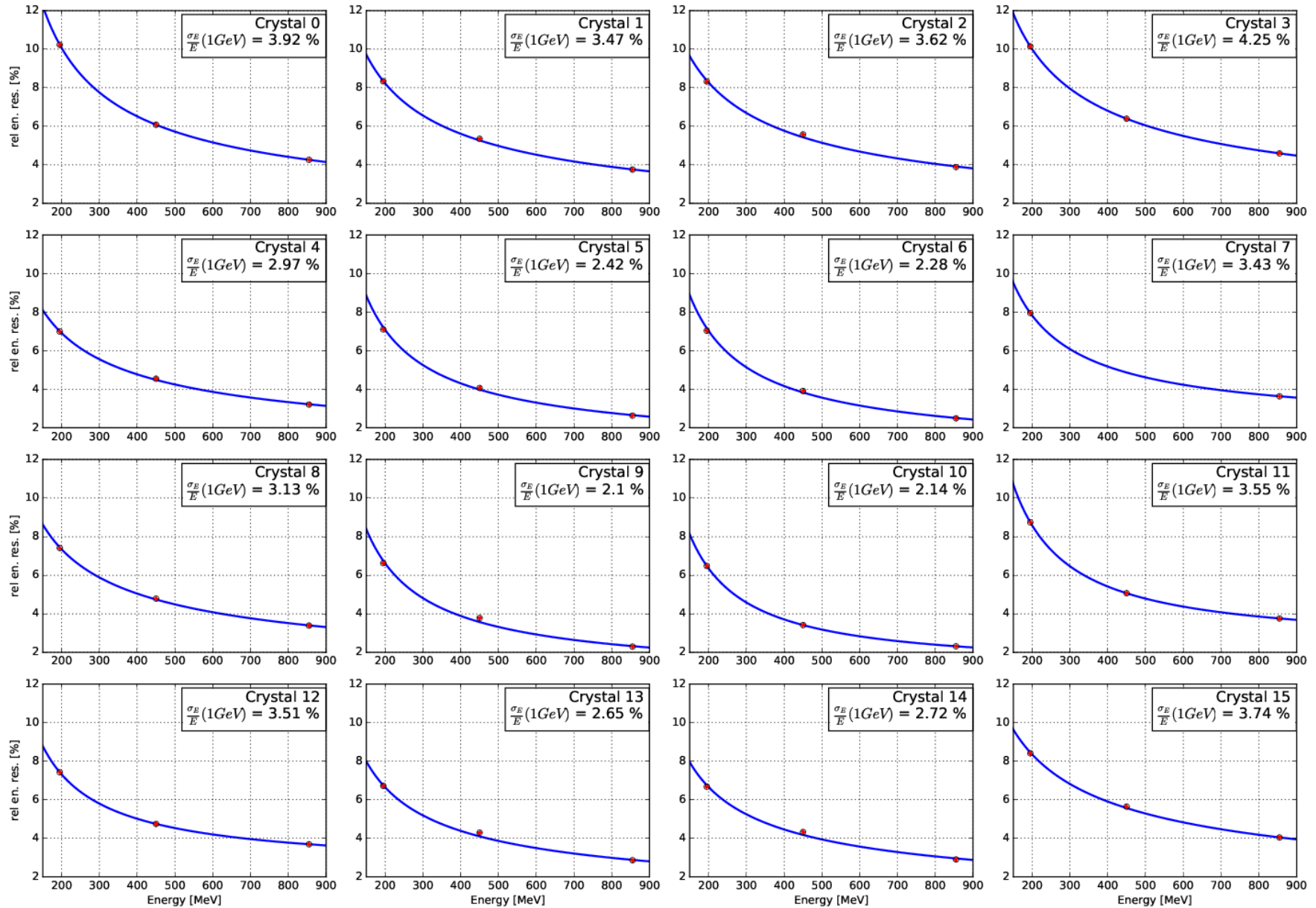
Beam test at MAMI



- from 8 to 11 August 2018
- at the X1 exit beam line
- electron beam directly on detector
- 6 beam energies: 195, 315, 450, 600, 720, 855 MeV
- rates from ~ 1 kHz up to ~ 400 kHz
- smooth operation for 4 days
- measurements with the PANDA (Uppsala) SADC
- tests of new signal processing firmware (optimised for the APFEL)

Beam test results

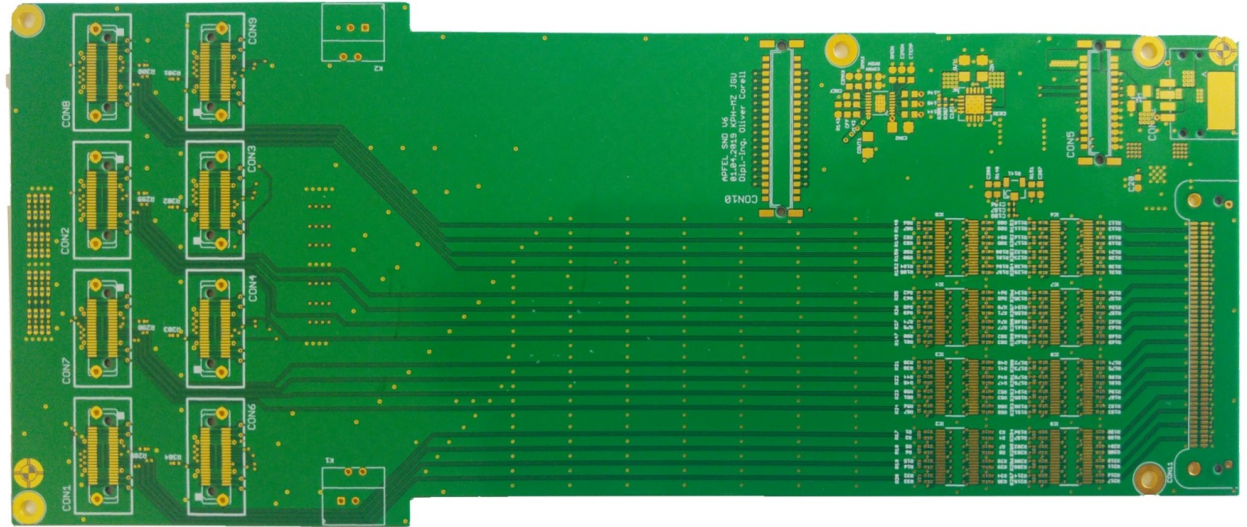
- Results presented in the EMC session (Nov. 2018)
- PANDA specifications fulfilled



New frontend boards

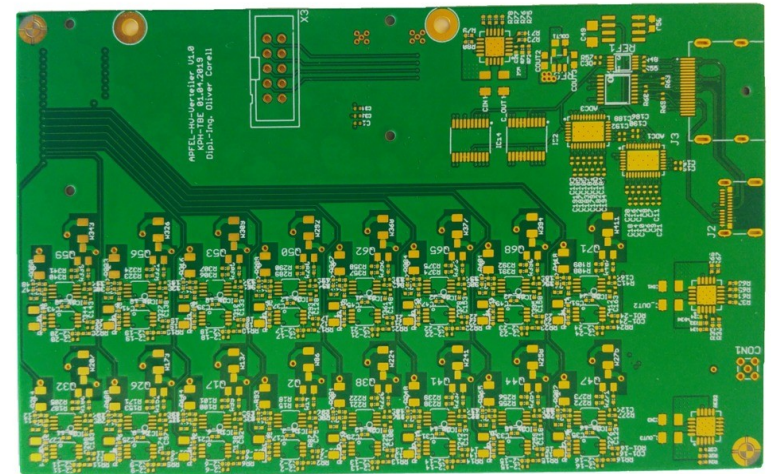
Line driver board

- supply for LED on APFEL board

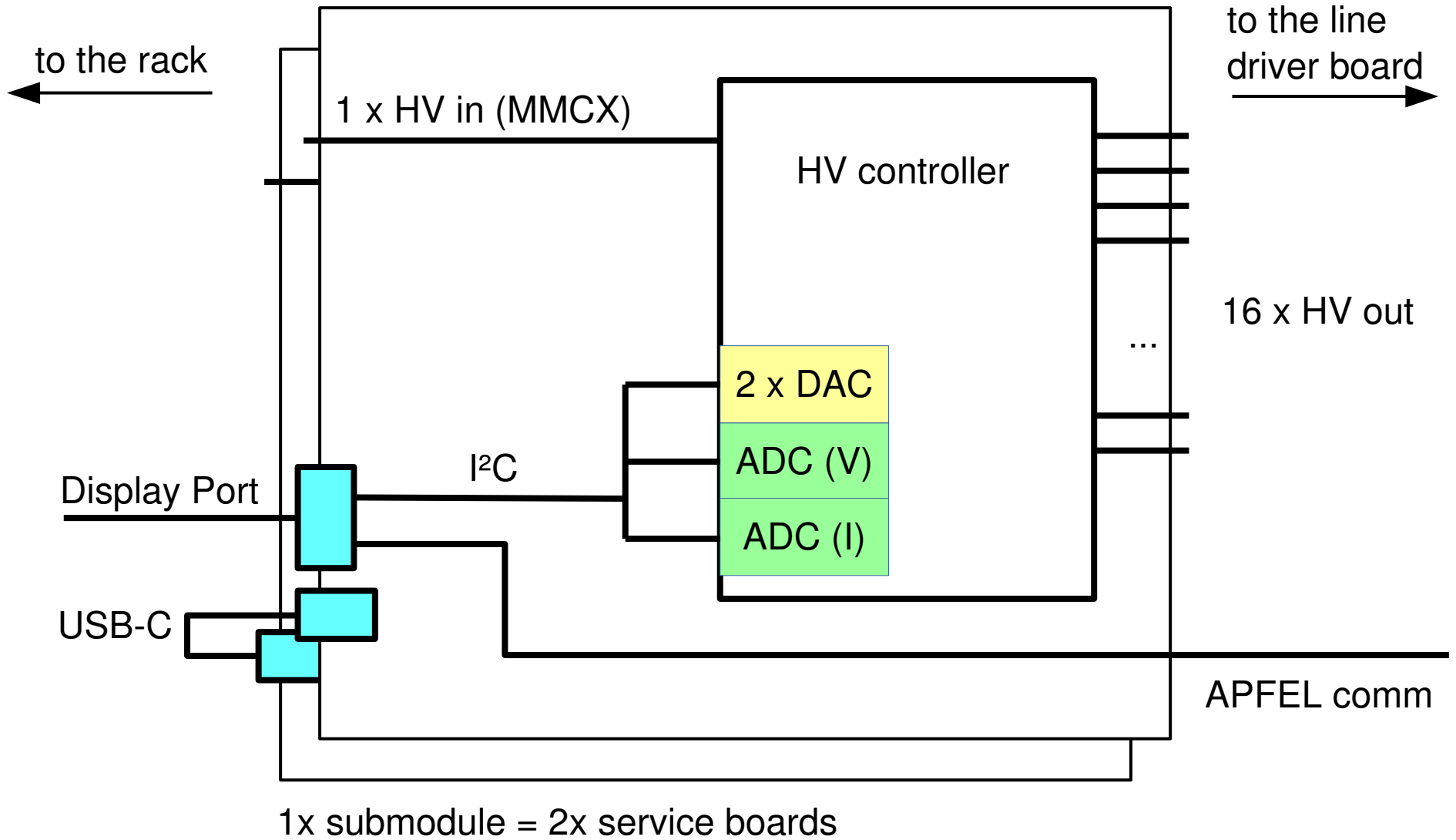


Service board

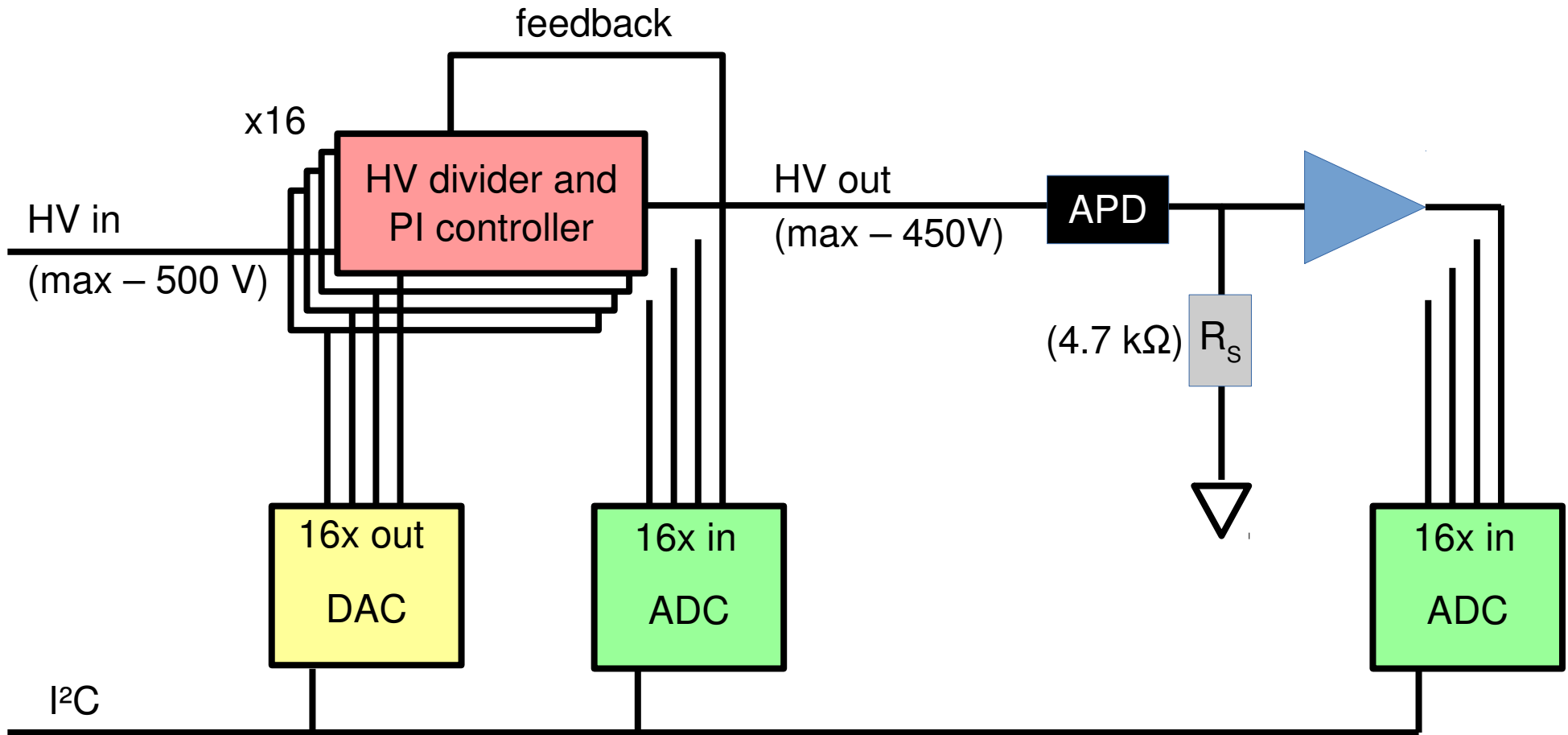
- HV splitter and controller
- Communication interface for APFEL and HV (I²C) on same cable



New service board

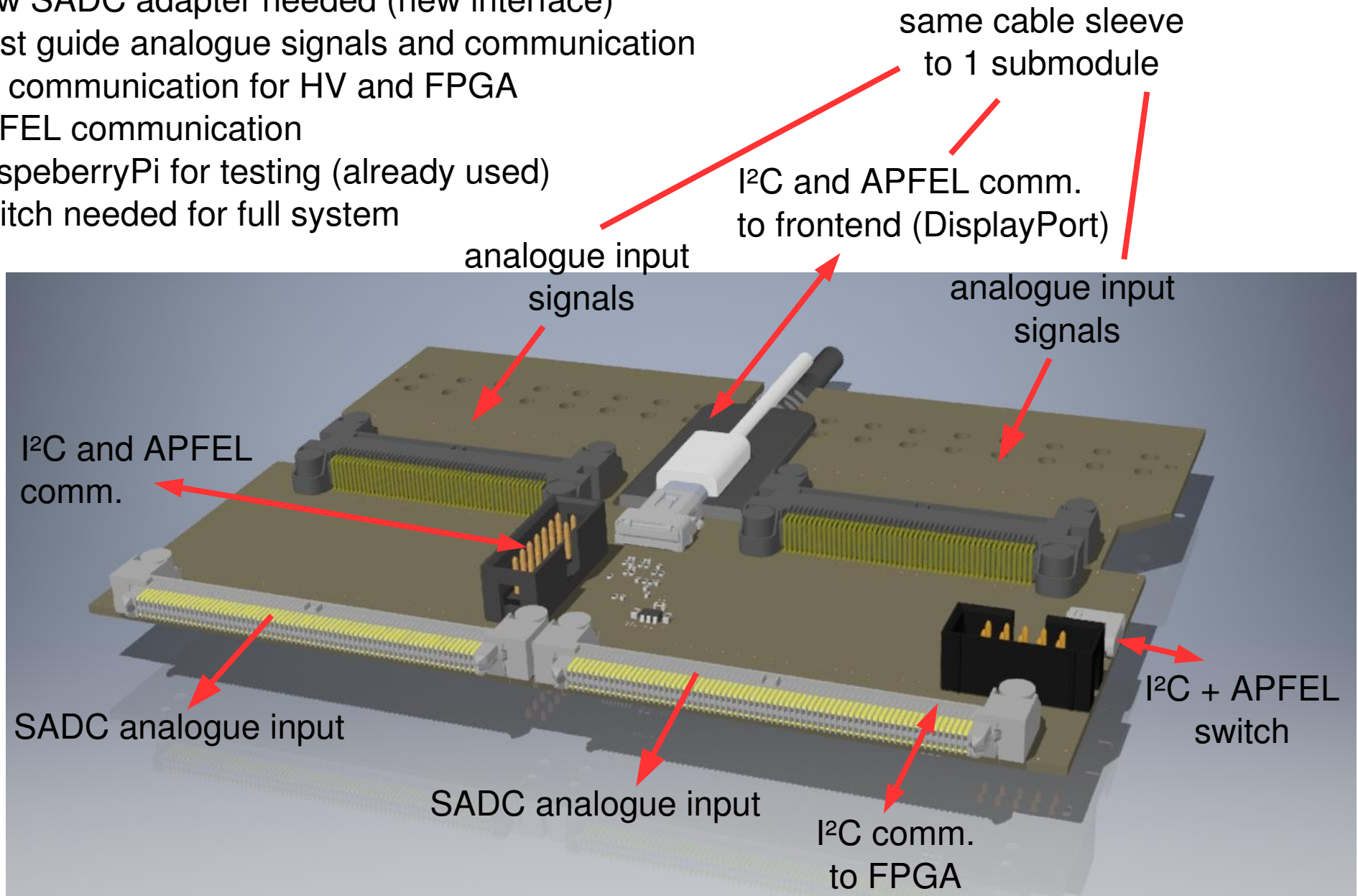


HV controller



SADC adapter board

- New SADC adapter needed (new interface)
- Must guide analogue signals and communication
- I²C communication for HV and FPGA
- APFEL communication
- RaspberryPi for testing (already used)
- Switch needed for full system



Status and perspectives

APD

- 1200 pcs purchased
- at GSI?
- will they be characterised in Bochum?
(when?)

APFEL boards

- Layout final (except for the LED polarity?)
- Lengths are defined
- 800 pcs will be ordered
- delivery just after the summer?

Frontend boards

- 8 prototypes printed (line driver+service),
to be assembled
- tests during the summer
- series production hopefully in autumn

SADC adapter boards

- design ready
- prototype cards in about 1 month
- tests during the summer
- modifications possibly needed

SADC boards

- 40 pcs ordered
- to be assembled (missing components?)
- to be tested in Uppsala, possibly with
help from Mainz (in autumn?)

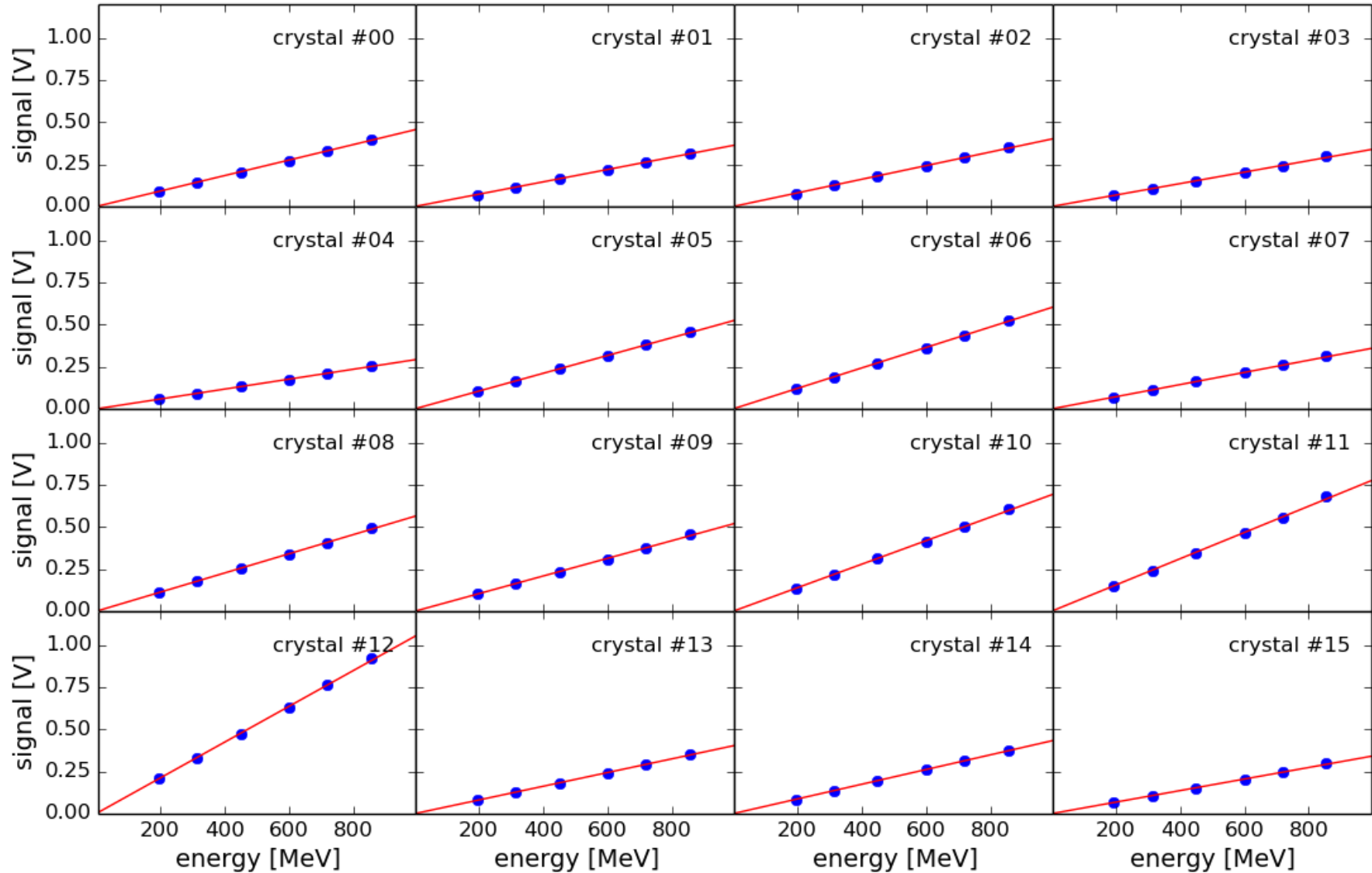
SADC Backplane

- forward EMC design not usable
- to be designed
- probably end of the year/beginning
next year

Thanks for the attention!

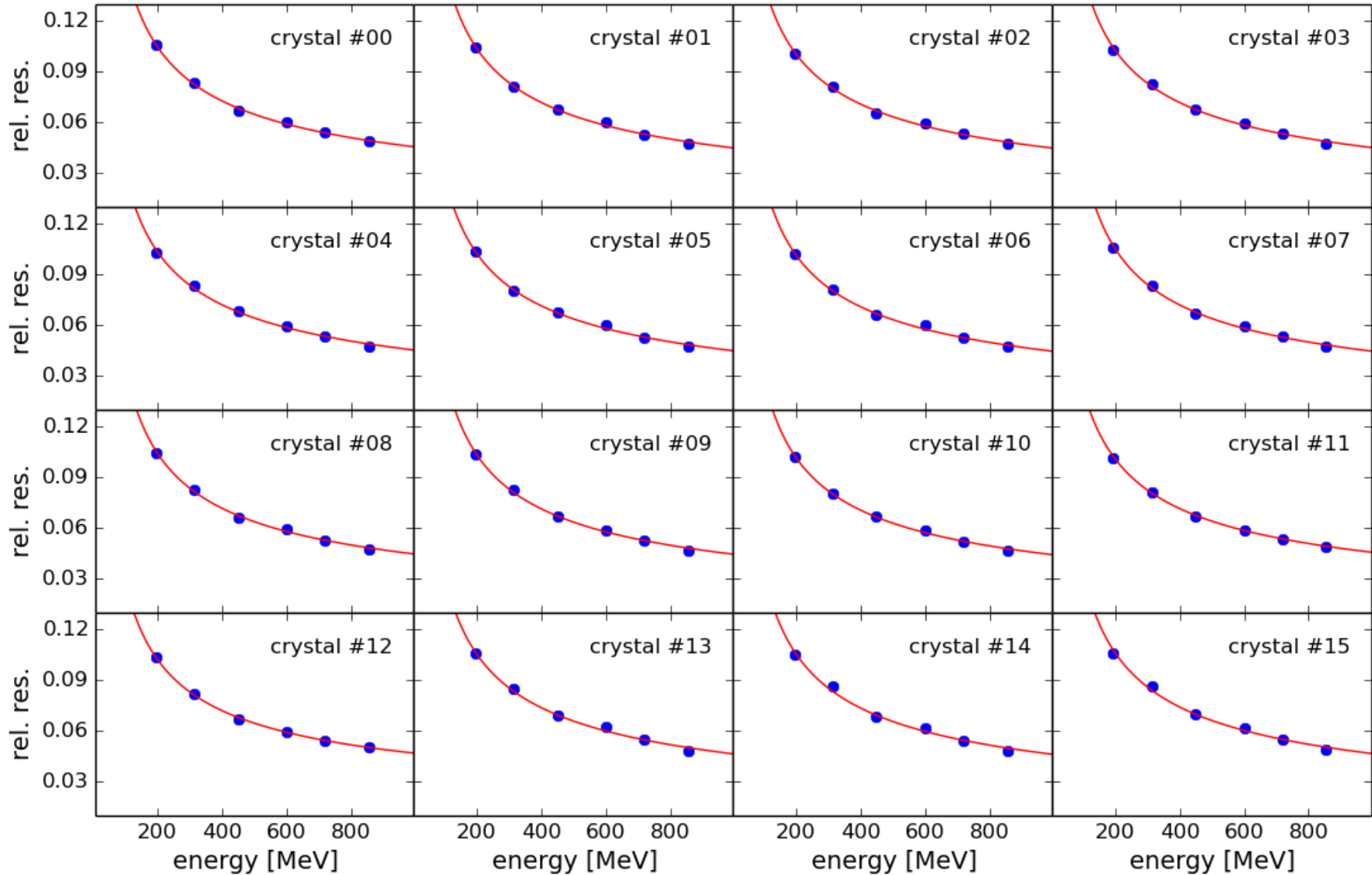
Main beam test results

Mean pulse height



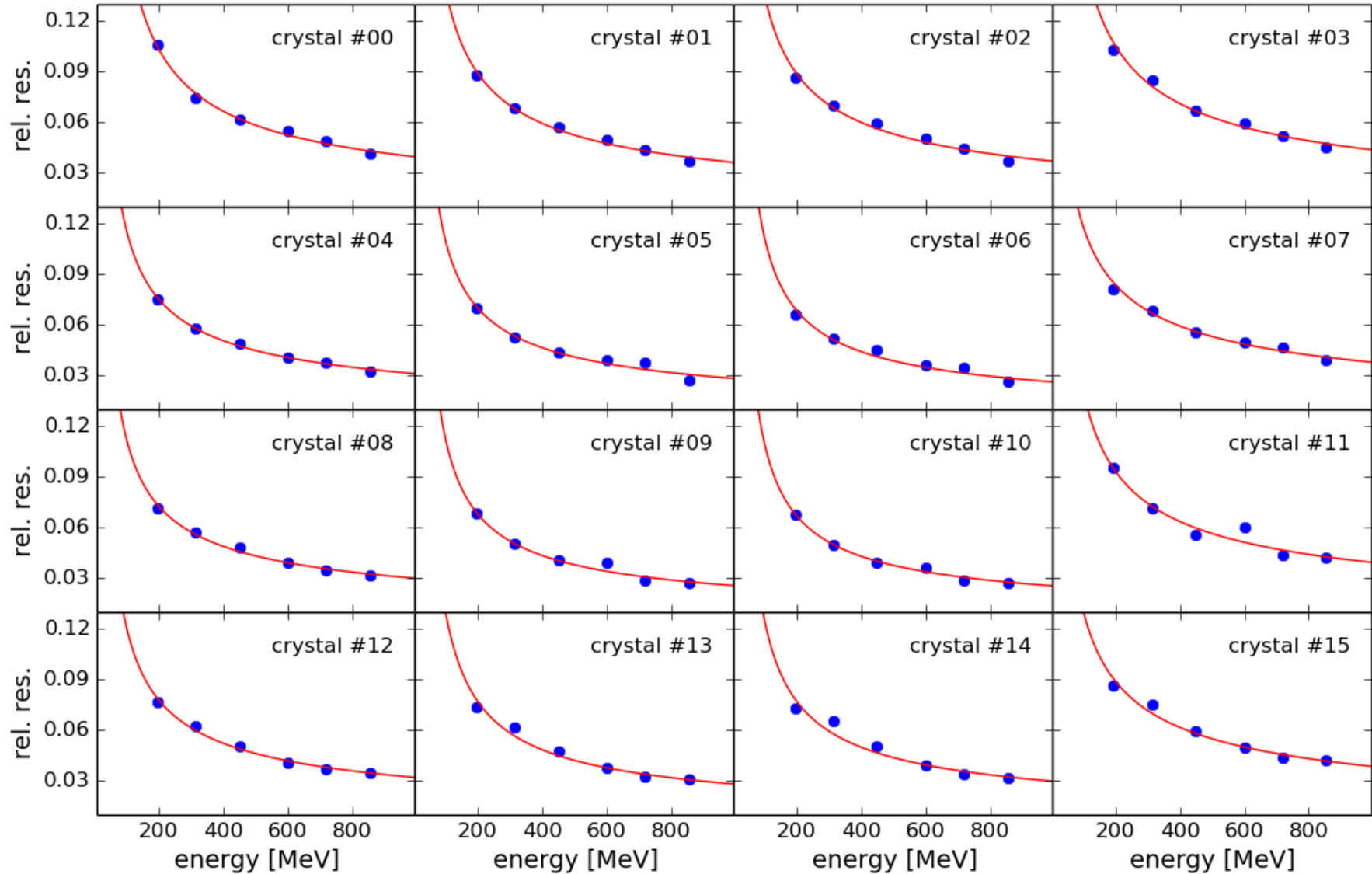
Main beam test results

Relative energy resolution: single crystals

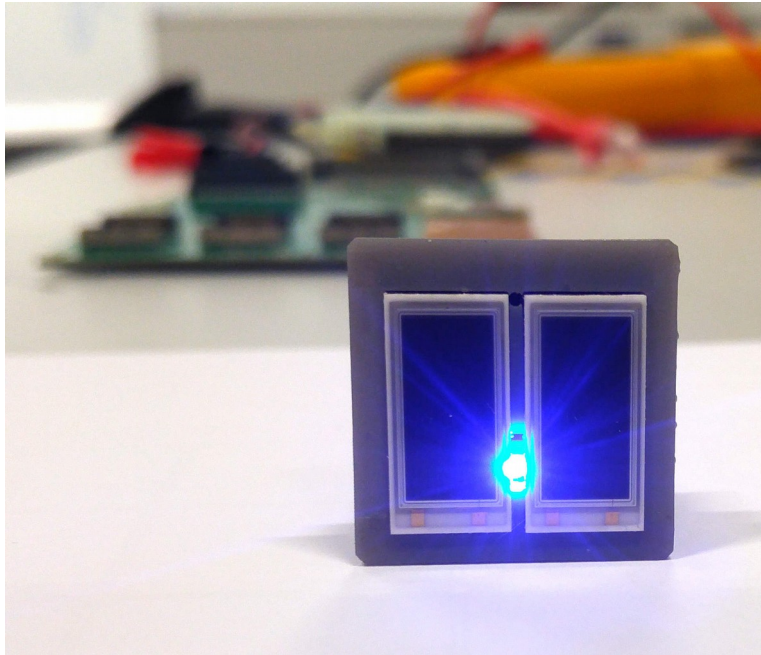


Main beam test results

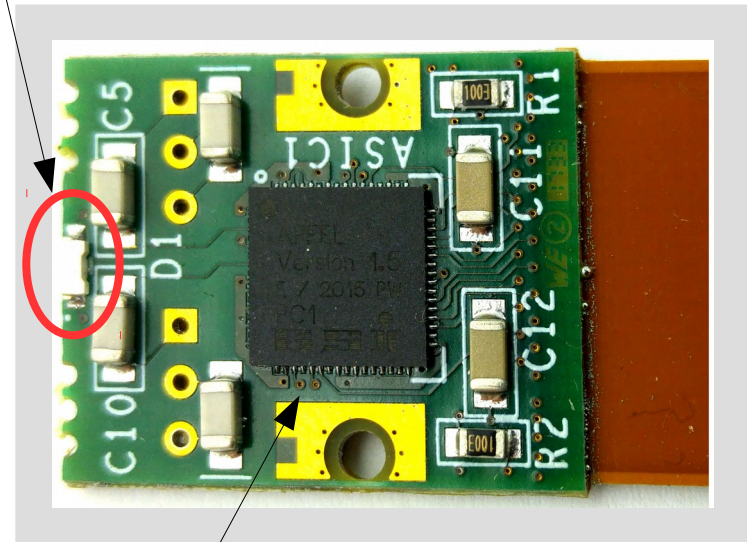
Relative energy resolution: 3x3 crystal array



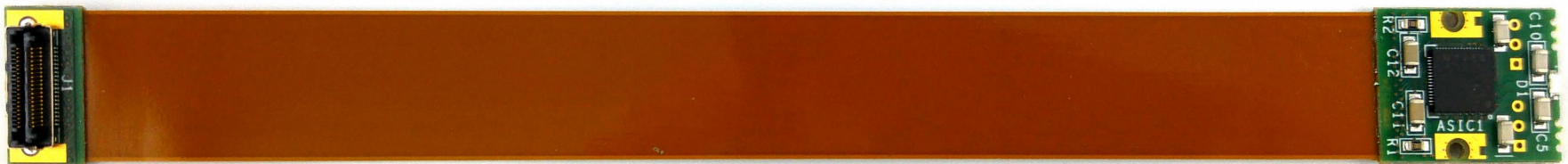
APFEL flex board with LED



LED for crystal annealing



Packaged APFEL chip



200 mm