Forward Endcap

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RUHR UNIVERSITÄT BOCHUM RUB

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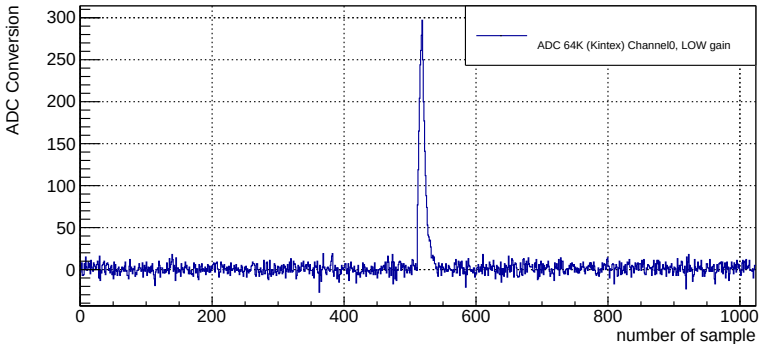
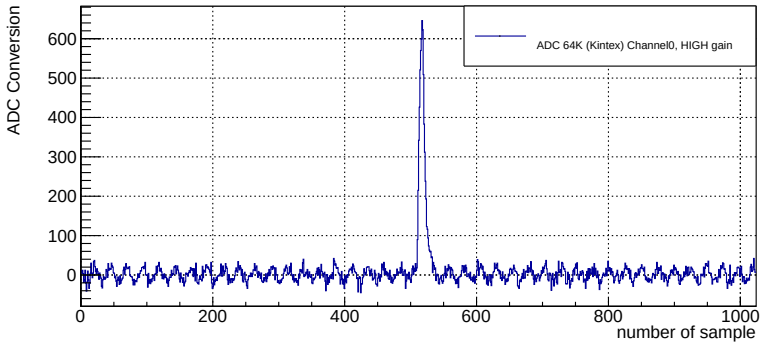
Topics

- Readout electronics: ADC board w/ shaper
- Subunit manufacturing
  - VPTT subunits
  - APD subunits
    - APD preamps (gain determination)
    - "The 1:2 problem"
  - Integration of LEDs for stimulated recovery
- Buildup of forward endcap
  - Front and back covers
  - Cooling: Liquid flow tests
- Channel-wise HV adjustment (Bonn)

Readout electronics

- ADC/shaper board tested in Bochum
  - Different high pass shapers tested (100 ns, 200 ns, 300 ns, 400 ns)
  - (Digital low pass filtering)
  - Even the 'low' shaping versions show good noise performance
  - Linearity checked to be okay
  - However, oscillation shows up in high gain branch (may modulate signal: double peaks in Malte's FE)
  - High/low gain ration and absolute gain needs to be adjusted



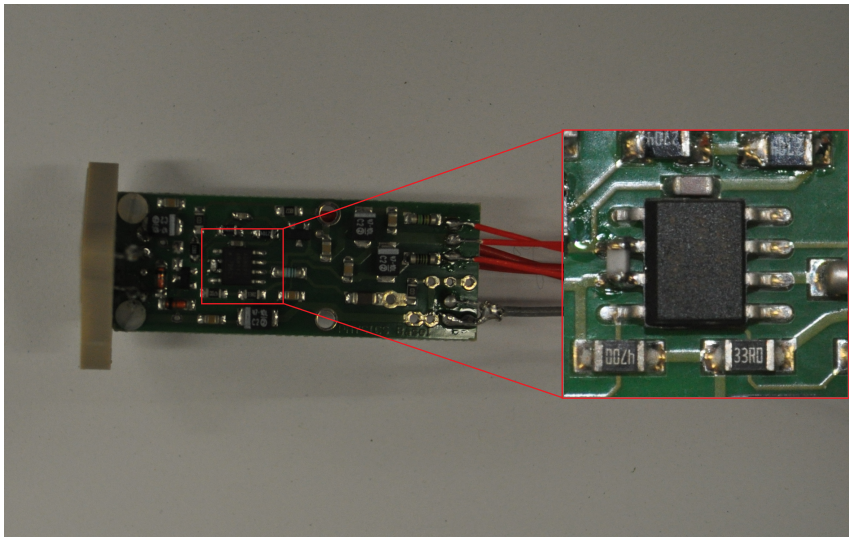


APD preamps

- Determination of necessary APD preamp gain:
  - Comparison with VPTTs
    (active detector surface, QE, detector gain)
  - Derived from beam data
  - Derived from cosmics measurements (Bonn setup)
- VPTT comparison/beam data:
  needed preamp gain about 0.1 V/pC
- Quite consistent with original design
  (0.5 V/pC for APD-gain of 50 instead of 200)
- Awaiting cosmics measurement results
  for independent confirmation
- This low preamp gain gets the well known problem of ringing/oscillation even worse!

APD preamps

- Current test versions with 0.1 V/pC gain and additional stability measures now in Bochum (ringing)
- (Current Bonn setup for cosmics measurements suffers from oscillating preamps (0.3 V/pC)!)
- Will an additional ground layer introduced to the preamp PCB help? (Discussed in one of the latest forward endcap SeeVogh meetings)

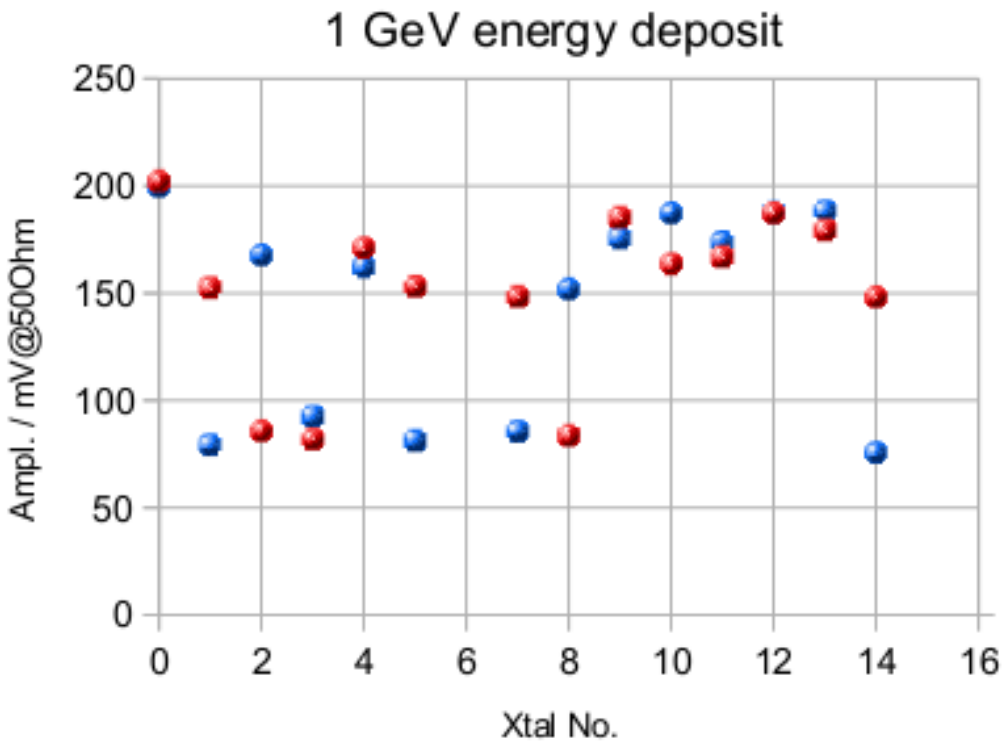


VPTT subunit manufacturing

- Parts available for production:
  - Mechanics: Inserts, mount plates, interface pieces
  - Cables: HV, LV, Signal
  - Fibres (light pulser coupling)
  - Carbon alveoles
  - Photo tubes (screened and sorted)
- Arriving end of June: VPTT preamps from Basel
- The missing B-Field gain loss screening of half the VPTT amount will be done now by M. Kuhlmann (Bochum, Bonn)
- Once all data is available we can assign tubes to crystals and group and build subunits

"The 1:2 problem"

- The problem:
  - There are crystals whose two APD readout channels show different output signals
  - The preamp output signal ratio is often found to be about 2
  - We see this on half of the number of crystals of the latest manufactured APD subunit (in Proto192)



"The 1:2 problem"

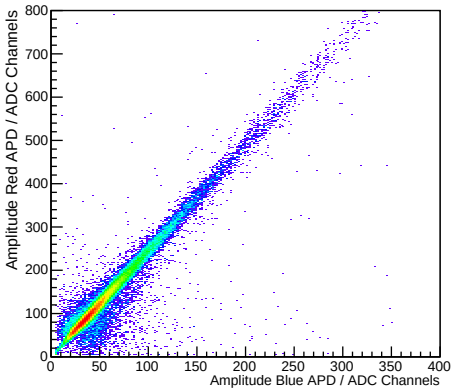
- The problem:
  - 'Red' and 'blue' indicate the two APD positions on each crystal
    - Sometimes the red channel output is twice as high as the blue one, sometimes it is the other way around
    - Most crystals w/ equally responding readouts belong to the high output group, one to the low one
  - The barrel group observed similar output signal ratios on barrel shaped crystals
  - There is a barrel crystal GEANT simulation resulting in different amounts of light seen by the two APDs (S. Diehl, GI)
  - Yield ratios derived from beam/cosmics data differ from light pulser derived ratios
    ($\rightarrow$ reason tracked down to be unlucky combination of inaccurate $PbWO_4$ light modeling and highly pulse form susceptible shaper module)
  - We do not see any sigificant differing output signals on VPTT-equipped crystals (from crystal to crystal)

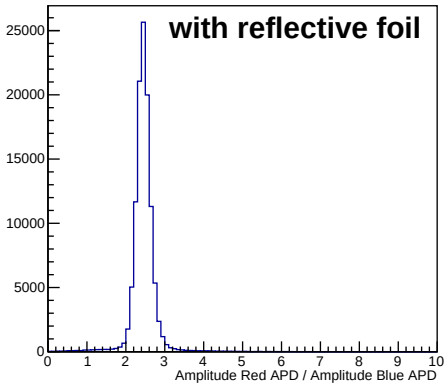
"The 1:2 problem"

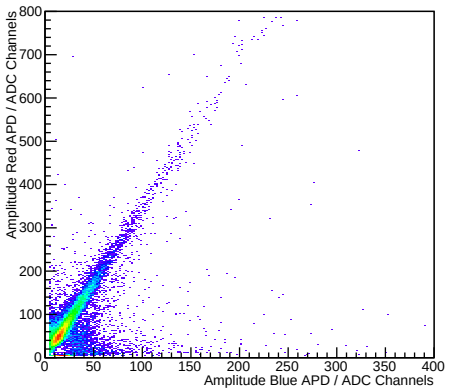
- The problem:
  - There is one crystal showing a 1:2 ratio in the test stand now that gave equal responses (1:1) when mounted in the subunit (all other crystals did not change their readout ratio!)
- Guesses on the cause:
  - Mismatched APDs (screening errors) - ruled out! (GSI, BO screenings, checked on removed APDs)
  - Bad APD-crystal couplings - some hints from lab tests, re-glueing tests ongoing, most (all?) crystals show coupling problems (probably insufficient curing time)
  - Just last week: Loss of test couplings done with refined glueing procedure (special cleaning fluid)
    - $\rightarrow$ Does the inclusion of mirror foil in the glueing process harm the curing (acting as a sealing)?
    - Is the resulting thickness of glue (=thickness of foil) preventing a safe coupling?
    - However, no damaged VPTT couplings and early test couplings (yet) with this glueing technique

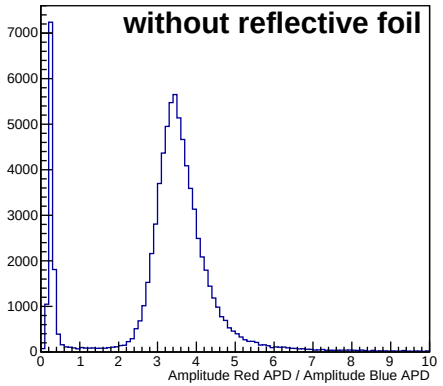
“The 1:2 problem”

- Guesses on the cause:
  - The mirror foil surrounding the crystals: 10 percent effect (change of subunit orientation), removing foil changes ratio from about 1:2.5 to 1:3.6 on one crystal







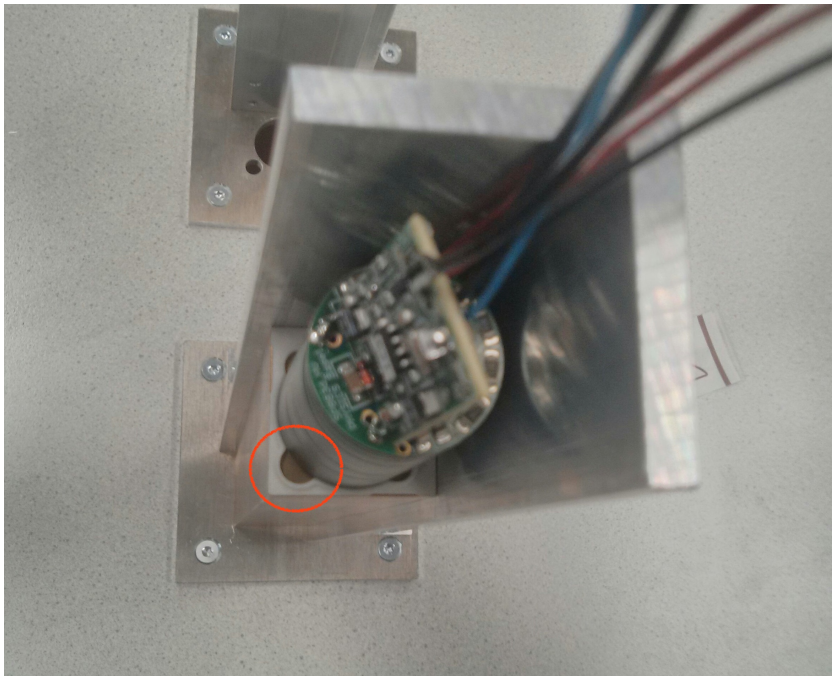


"The 1:2 problem"

- Guesses on the cause:
  - Geometrical/optical effects - strong hint from GEANT simulation, endcap crystal simulation ongoing (incl. Cherenkov light)
  - Run of the crystal symmetry axes (different refraction indices)
  - Tricky combination of several interfering causes
- Activities:
  - Determining readout ratio after reglueing of fallen off units
  - Glue: New coupling tests w/o mirror foil
  - Closer look to the VPTT couplings (currently in Bonn)
  - Monte Carlo simulations of endcap shaped crystals
  - Measurements on influence of reflective foil covering

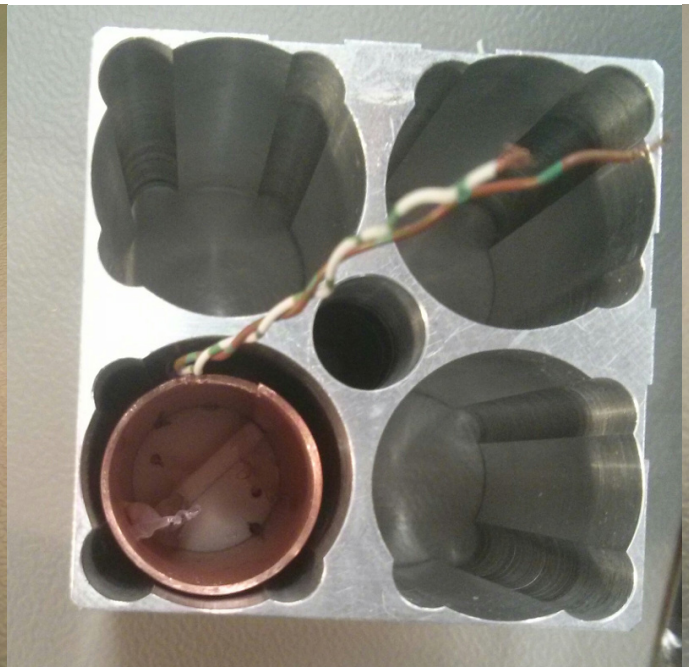
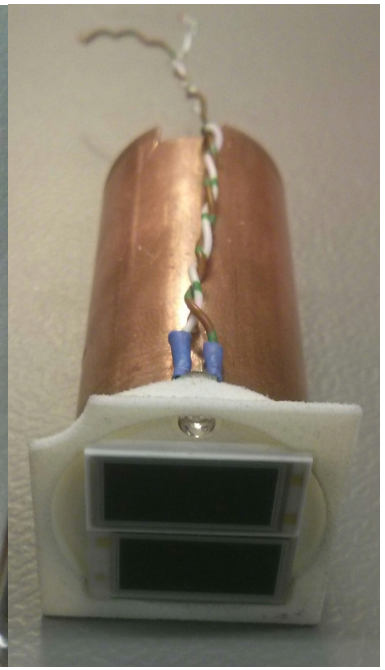
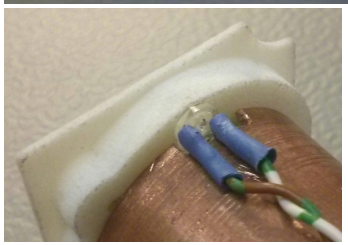
Integration of LEDs for stimulated recovery

- Impossible to supply necessary amount of light for recovery by light pulser fibres
- VPTT subunits: 'free' holes in inserts/capsules

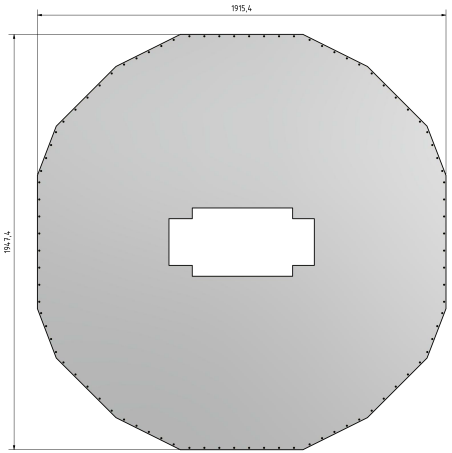


Integration of LEDs for stimulated recovery

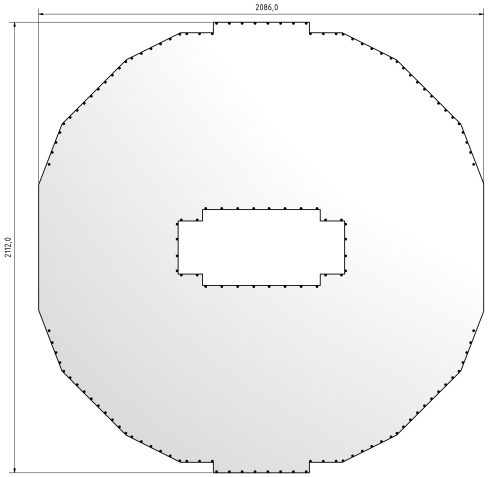
- APD subunits: hole to be drilled in capsule
- Feasibility to be checked: noise pickup

Buildup of Forward Endcap: Front and Back Covers



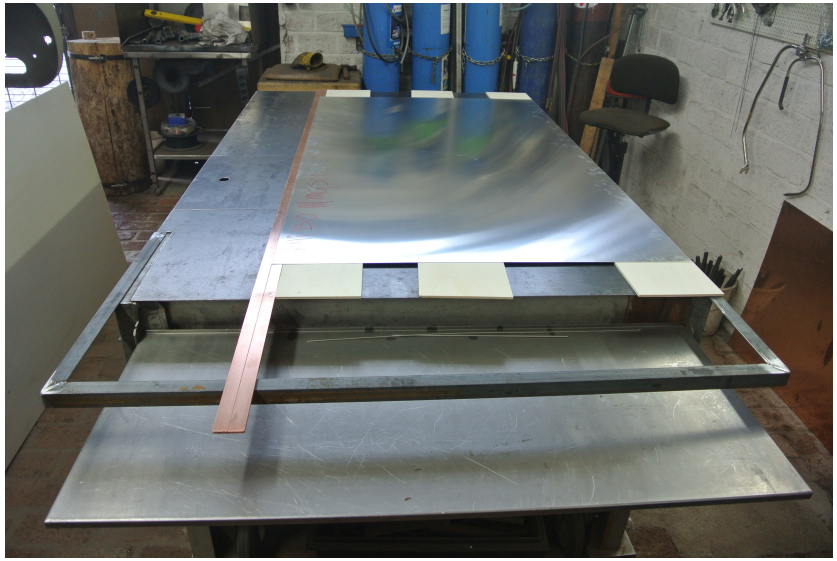
Front Plate (thickness= 0,8 mm)

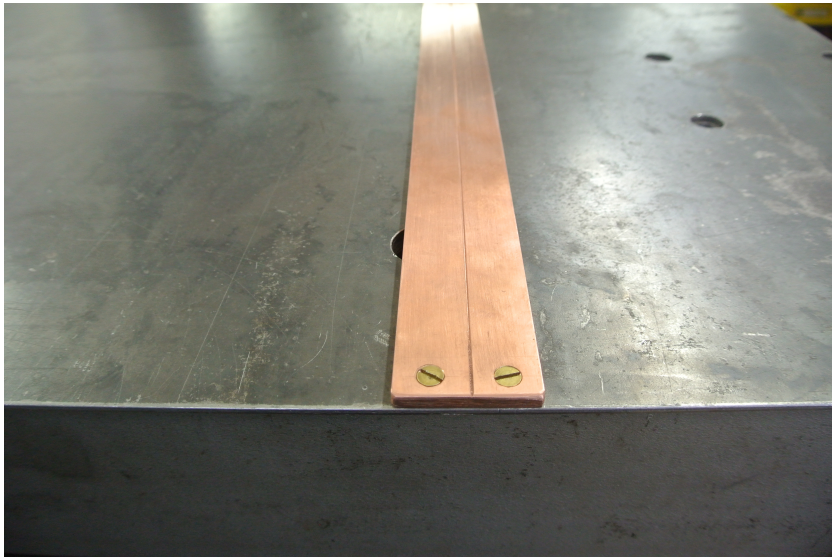


Back Plate (thickness= 3 mm)

- Front and back cover plates of forward endcap:
  0.8 mm / 3.0 mm aluminum
- Covers span about 1.9 x 1.9 m^2 / 2.1 x 2.1 m^2
- Impossible to find aluminum sheets of this size for the end user
- Covers weld from two sheets each
- Finished and ready to be machined to final shape

Buildup of Forward Endcap: Front and Back Covers

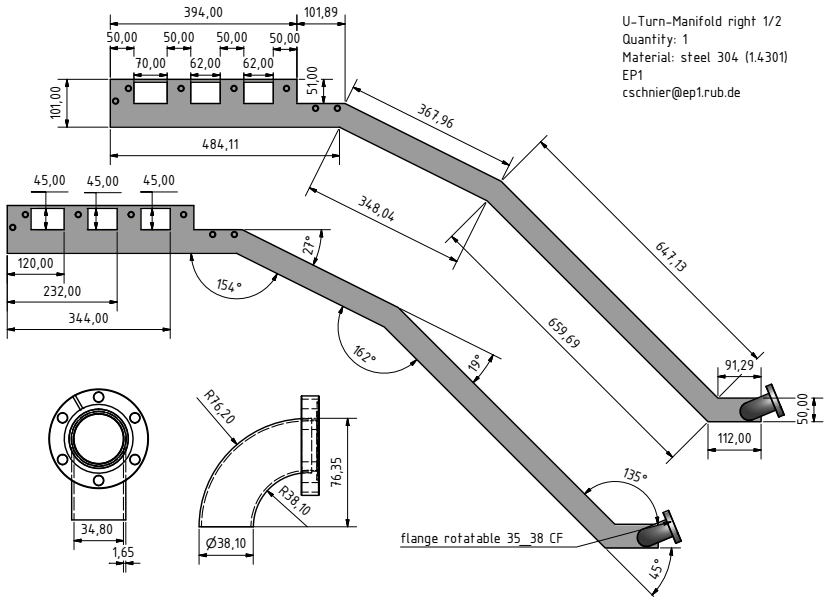




- Standard task in case of 3 mm back cover
- Tricky in case of 0.8 mm front cover
- Special suspension and copper cooling bars below and on top of weld

Buildup of Forward Endcap: Front and Back Covers

Buildup of Forward Endcap: Cooling



- Chiller system installed in the lab (Orsay people)
- All parts for cooling liquid flow tests available
  - Swagelok-connections to backplate
  - Distributor manifolds ('bones') made at KVI and delivered
- Weldings of hoses to manifolds to be done at BO workshop (minor design change by reason of cost optimization)

Channel-wise HV Adjustment

- Bonn group (C. Schmidt) is working on a channel-wise HV adjustment
- Mitigates the APD grouping problem: HV supply for 8 APDs in common
- Idea: I^2C controlled electronics placed on piggy back PCB on top of patch pannel on endcap backplate
- Based upon barrel EMC approach, development in close contact (radiation hardness tests in GI)
- Mechanical mock-up in progress in order to test feasibility of mounting sequence

Summary

- Finishing of forward endcap is progressing
  - Closing covers of endcap to be machined
  - First coolant flow tests on endcap soon (some welding to be done)
- What really prevents us from 'just' finishing subunit manufacturing is the "1:2 problem"
  - We urgently need closer insight into the cause of this phenomenon
  - Several measurements and simulations in progress to get closer insight in the cause(s)
- The APD preamp's susceptibility to oscillation due to its low gain is still an issue!