Backward Endcap Status Report

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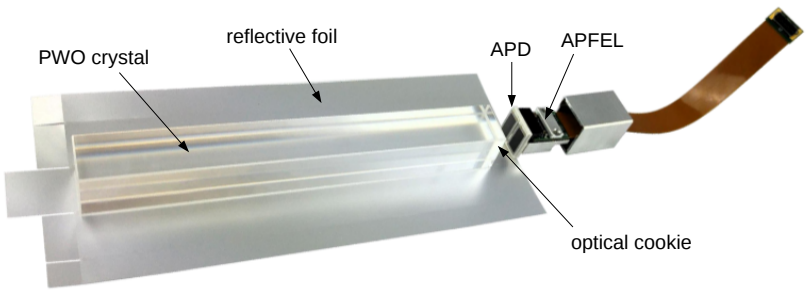
PANDA Meeting – EMC session, October 2021, online

Outline

- Detector components update
- Issues with APFEL flex boards
- Tests of line driver boards

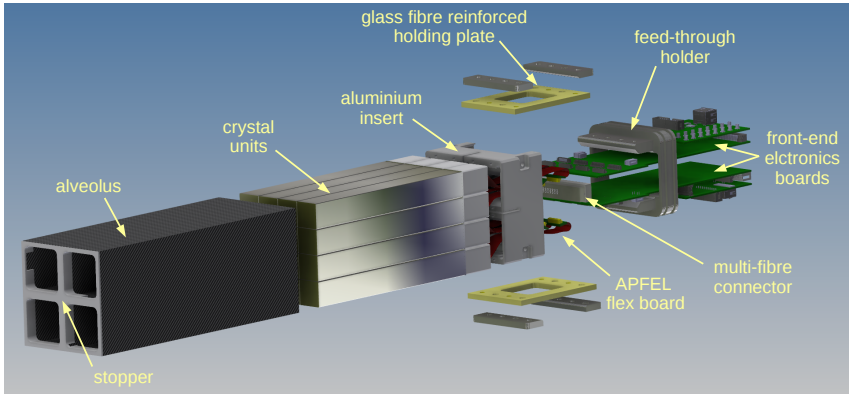
Status Detector Construction

Crystal Unit Components

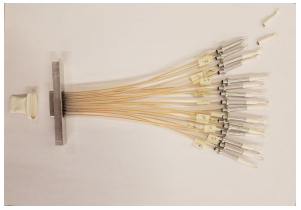


- Crystals ✓
- reflective foils ✓
- APD plastic case ✓
- optical cookies ✓
- APFEL Al capsules ✓
- APD ✓ ➜ ∼✓
  (277 APD need to be re-characterised)
- APFEL boards ✓ ➜ ✗

Submodule Components



- Holding components ✓
  (alveoli, inserts, holders)
- Pt100 sensors ✓
- Light fibre bundles ✓ !

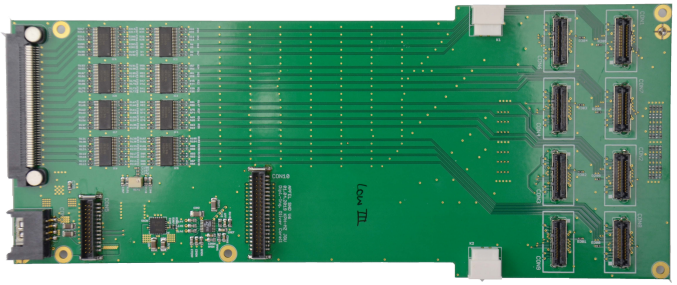


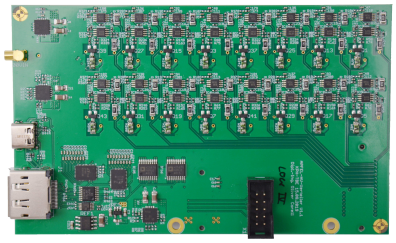
- very long and difficult process
- still 4 pieces in the pipeline → spares

Status Detector Construction

Electronics

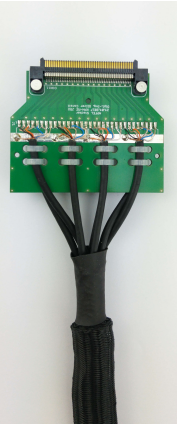
- Line driver ✓
  - delivered →
  - series tests done
  - few errors to be fixed
- HV distribution ✗
  - prototypes available → tests finished
  - some problems with communication: series prod. postponed
  - not needed for submodule mounting





Cables

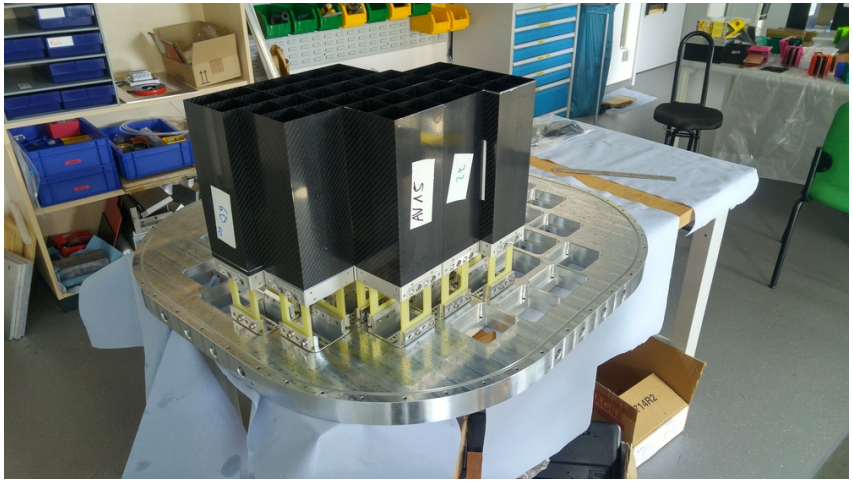
- cable assemblies commissioned
- DisplayPort cables ordered
- plastic cases (3d printed) to be ordered

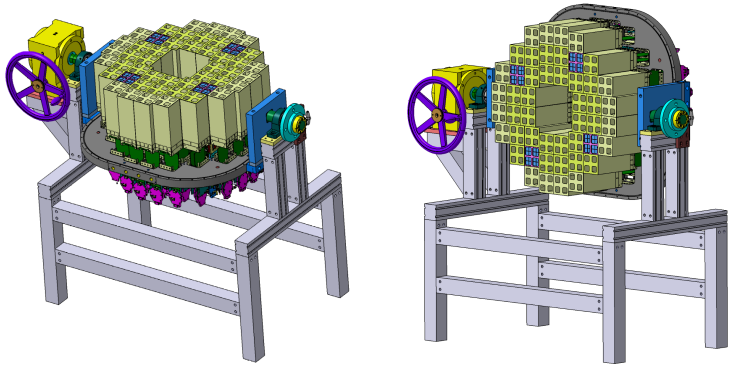


Status Detector Construction

Alveoli, mounting plate and mounting support

- alveoli:
  - 55 of 4×4 type fine cut for phase 0
  - 22 of 4×4 type } to be cut for PANDA
  - 32 of 2×4 type } to be cut for PANDA
  - enough for phase 0, PANDA and spares
- mounting plate (phase 0) manufactured
- mounting tests with empty submodules
- mounting support structure manufactured
  - mount submodules in horizontal position
  - turn smoothly around centre of mass
  - perform tests in vertical position

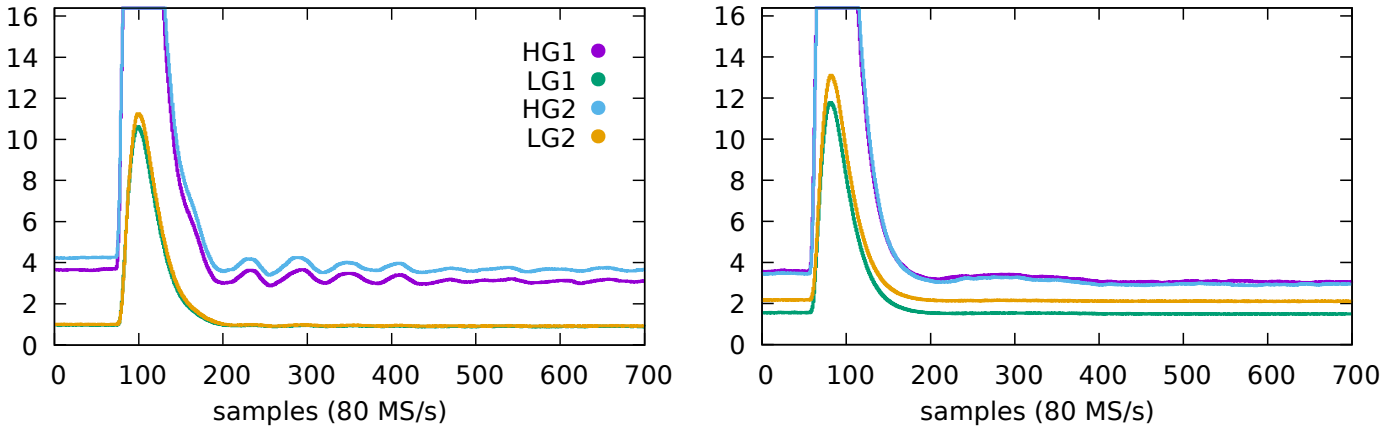




APFEL Signal Issue

Issue

- ringing after APFEL pulses not observed in the pre-series production



- reason: different HV input capacitor (470 pF)
- changed in the series production because no more available
- some original capacitor (Multicomp) could be found, enough for BWEC
- several alternatives were tested

APFEL Signal Issue

	C [pF]	max V [kV]	ringing	
Multicomp	470	1.0	no	original capacitor, new purchase
VISHAY	1000	1.0	no	larger baseline fluctuations (noise) with no bias voltage; similar noise at 350 V
VISHAY	1000	1.5	no	
VISHAY	470	1.0	yes	
TDK	3300	0.5	yes	
YAGEO	820	2.0	yes	

Barrel

- VISHAY 1 nF: good candidates

Backward End-Cap

- 1380 Multicomp capacitor found – 1280 needed for phase 0
- 810 sent to GSI – 400 new boards to be assembled this month
- 570 used to modify by hand 285 old boards
- 234 extra boards modified with VISHAY, 1 nF, 1.0 kV (spares)

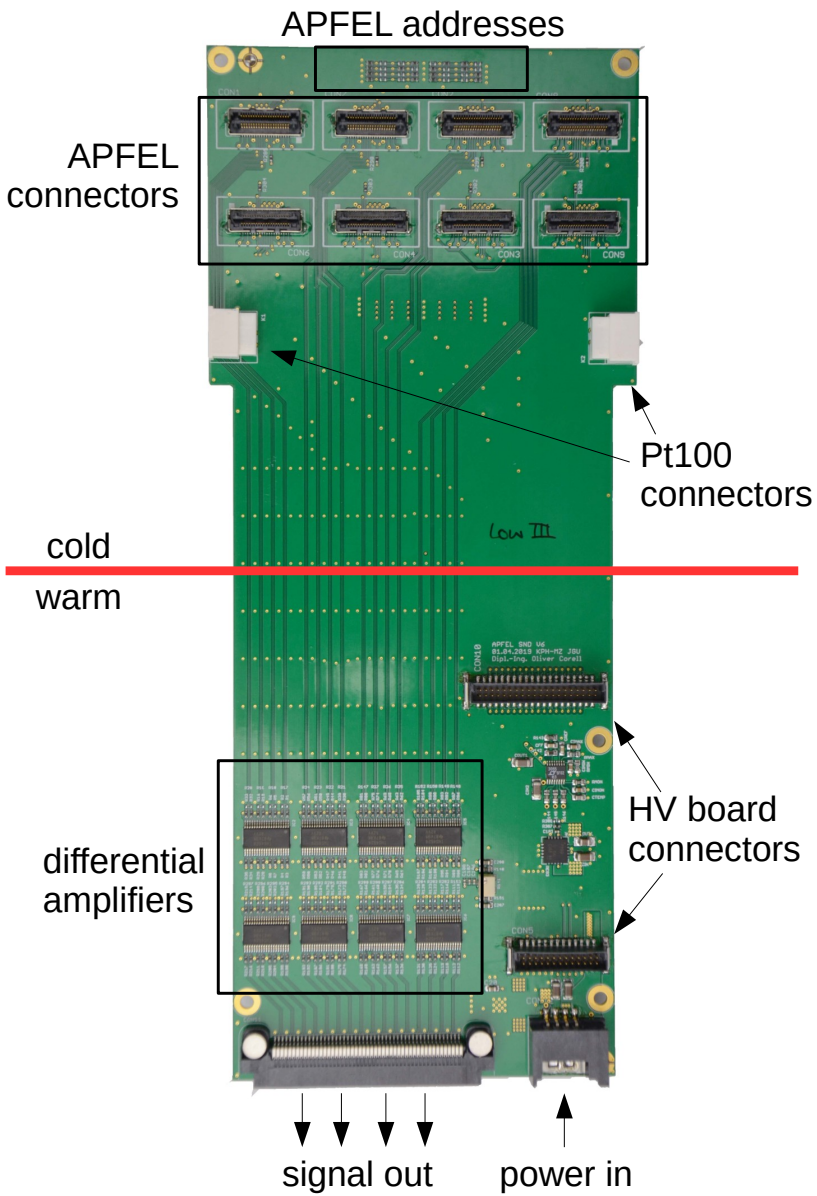
Test of Line Driver Boards

Batch

- 2 board types:
  - low APFEL address (0...7)
  - high APFEL address (8...f)
- 50 pairs, 100 boards in total
- 40 pairs needed for phase 0

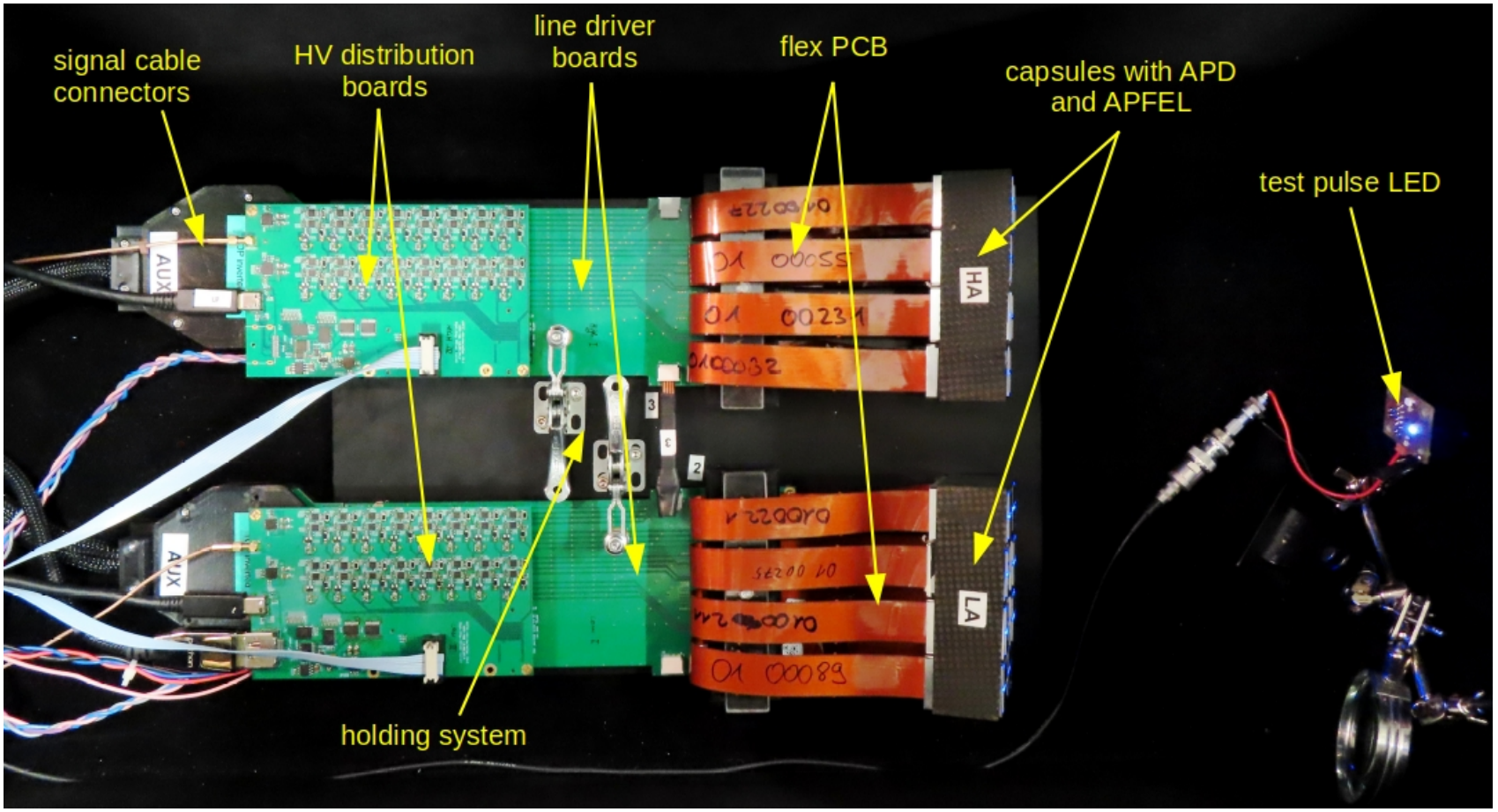
Features to be tested

- annealing LED
- temperature sensor readout
- power consumption
- APFEL addressing/communication
- APFEL output signal transmission
- HV supply



Test of Line Driver Boards

Setup



Test of Line Driver Boards

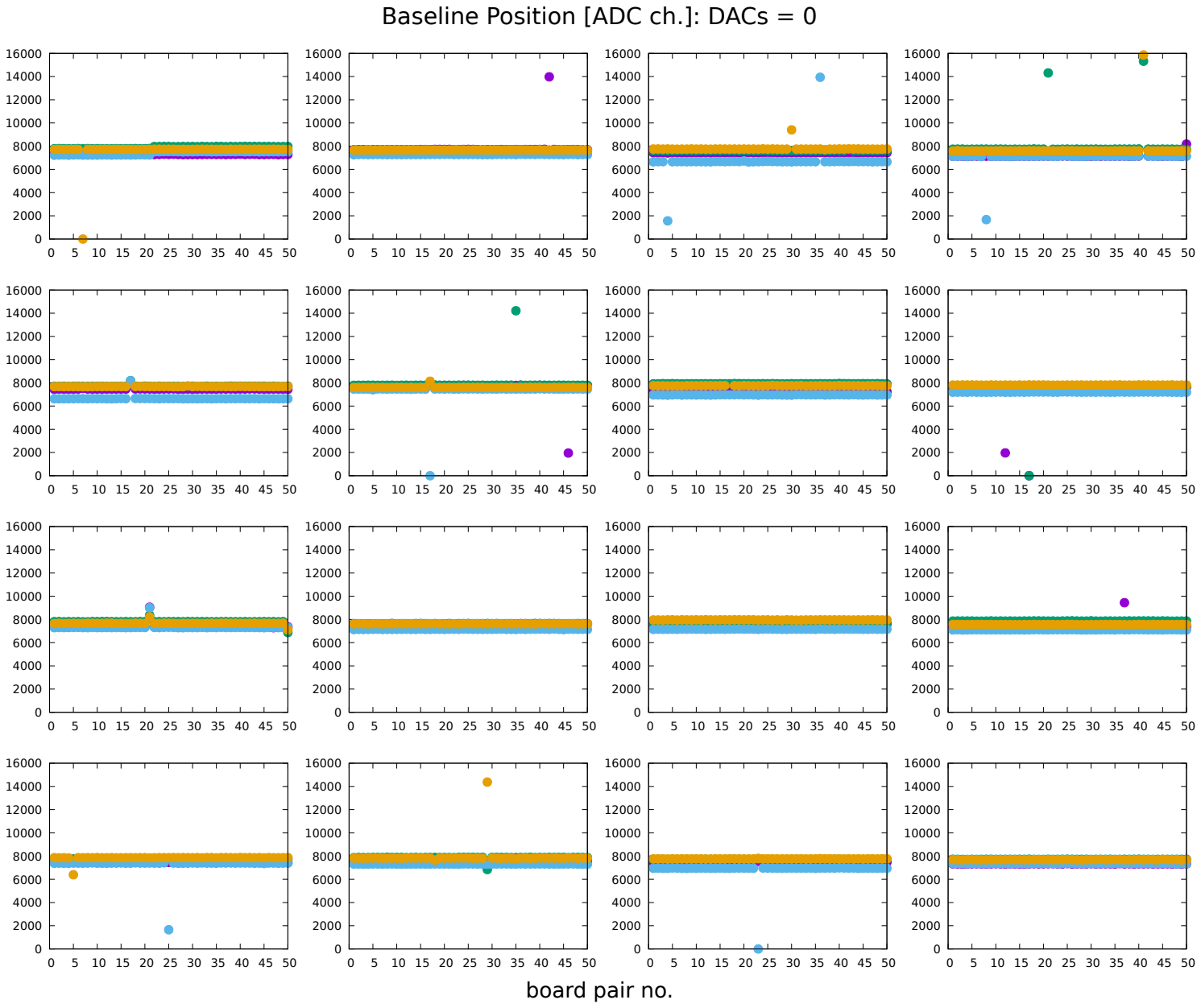
Procedure (largely usable for submodule tests as well)

- connect all components
- run interactive script managing one pair's tests
  - prompts for successive test steps
  - runs scripts controlling settings and data taking
  - keeps track of performed steps
- perform standardised tests following script instructions
- check saved data and plots
- document possible failures

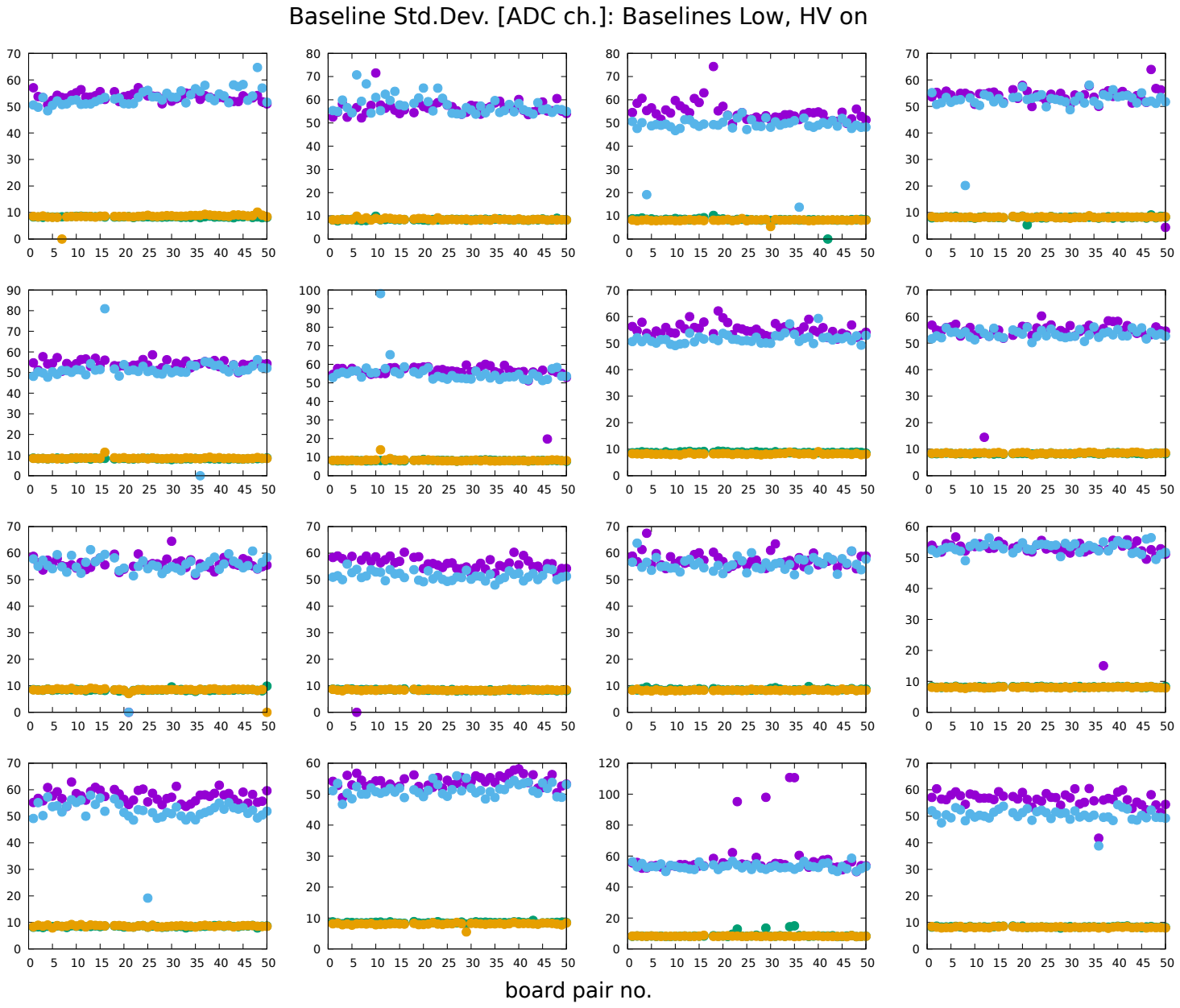
Database

- 50 data directories (1 per board pair) named with serial numbers (QR code)
- 50 pictures documenting LED functionality
- 200 resistance values (Pt100)
- 750 power supply records (low voltage and current)
- 19200 baseline records (mean, std. dev., max−min)
- 1600 HV records (voltage and current)
- 200 HV ADC temperature values
- 6400 pulse height spectra ($\sim$1500 entries each)

Test of Line Driver Boards

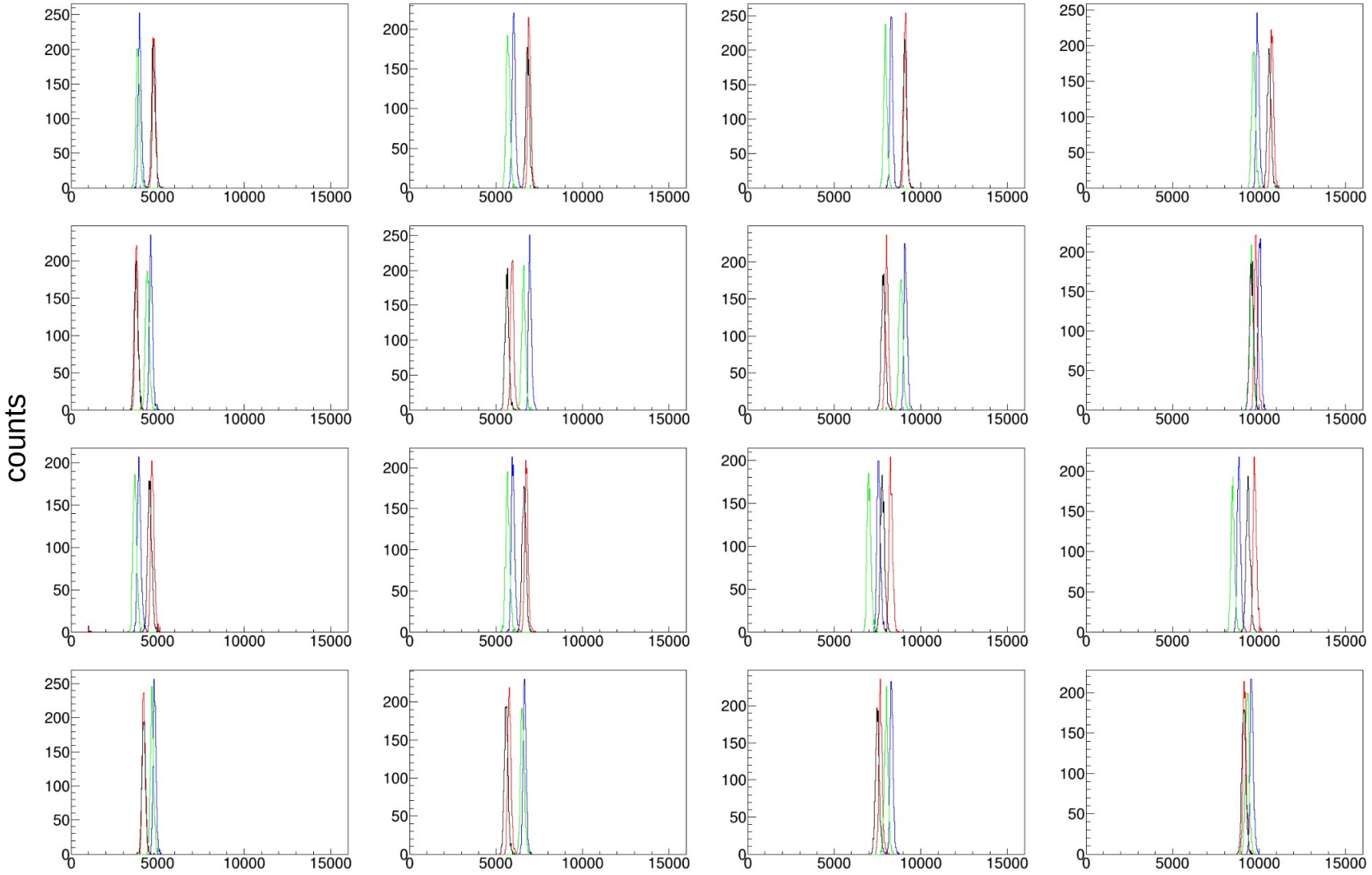


Test of Line Driver Boards



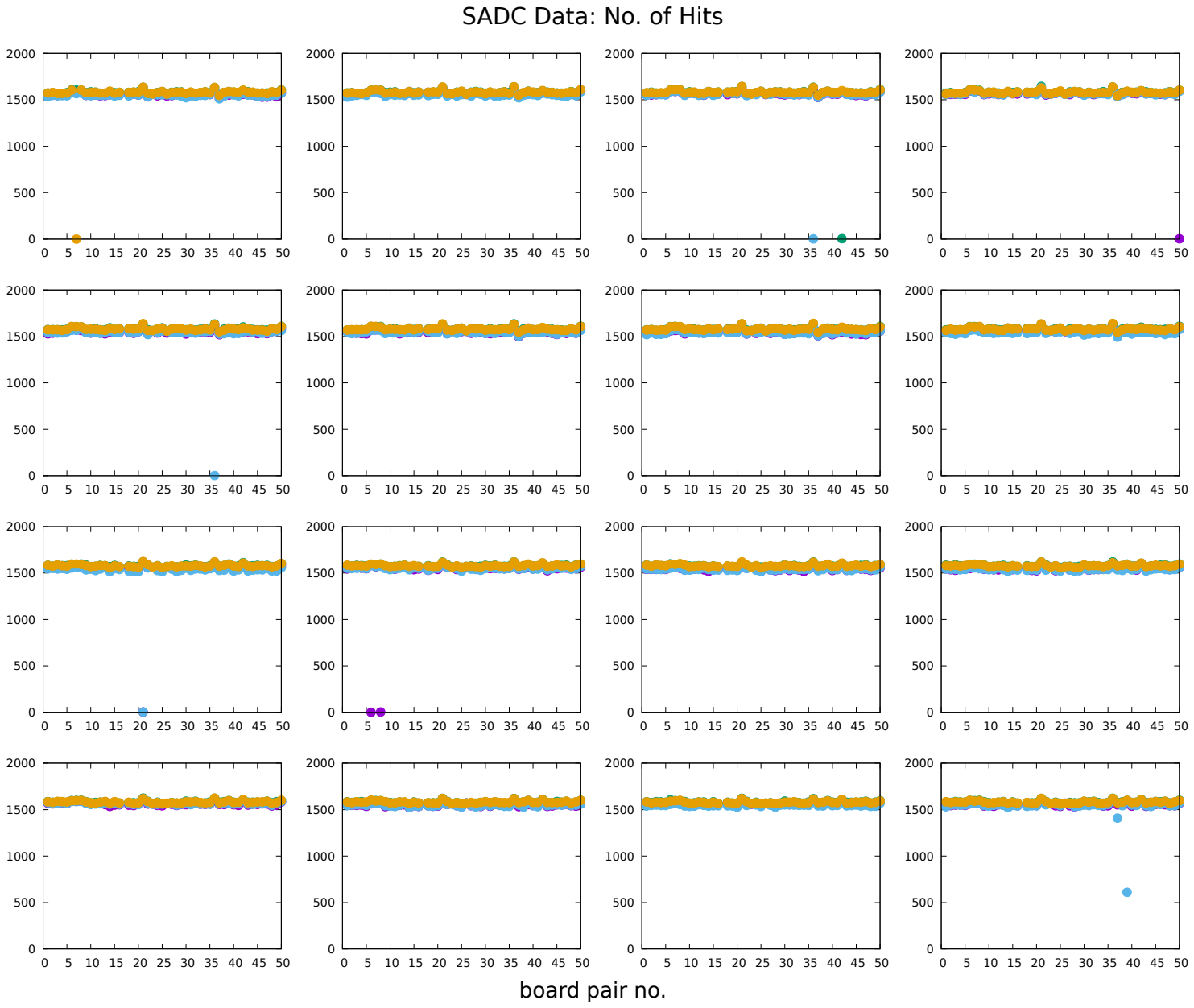
Test of Line Driver Boards

Example of Pulse Height Spectra



(low gain signals scaled $\times 10$)

Test of Line Driver Boards



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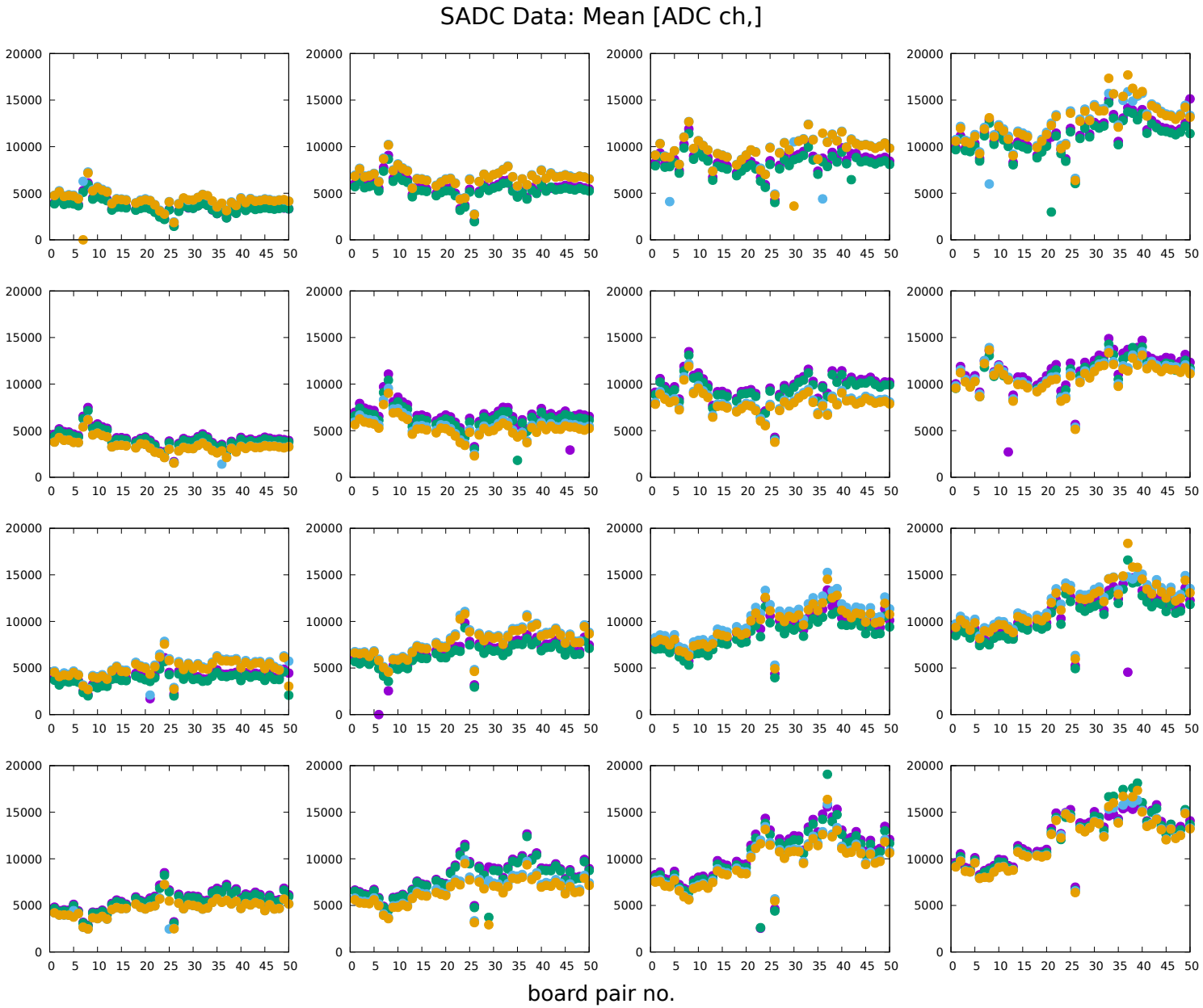

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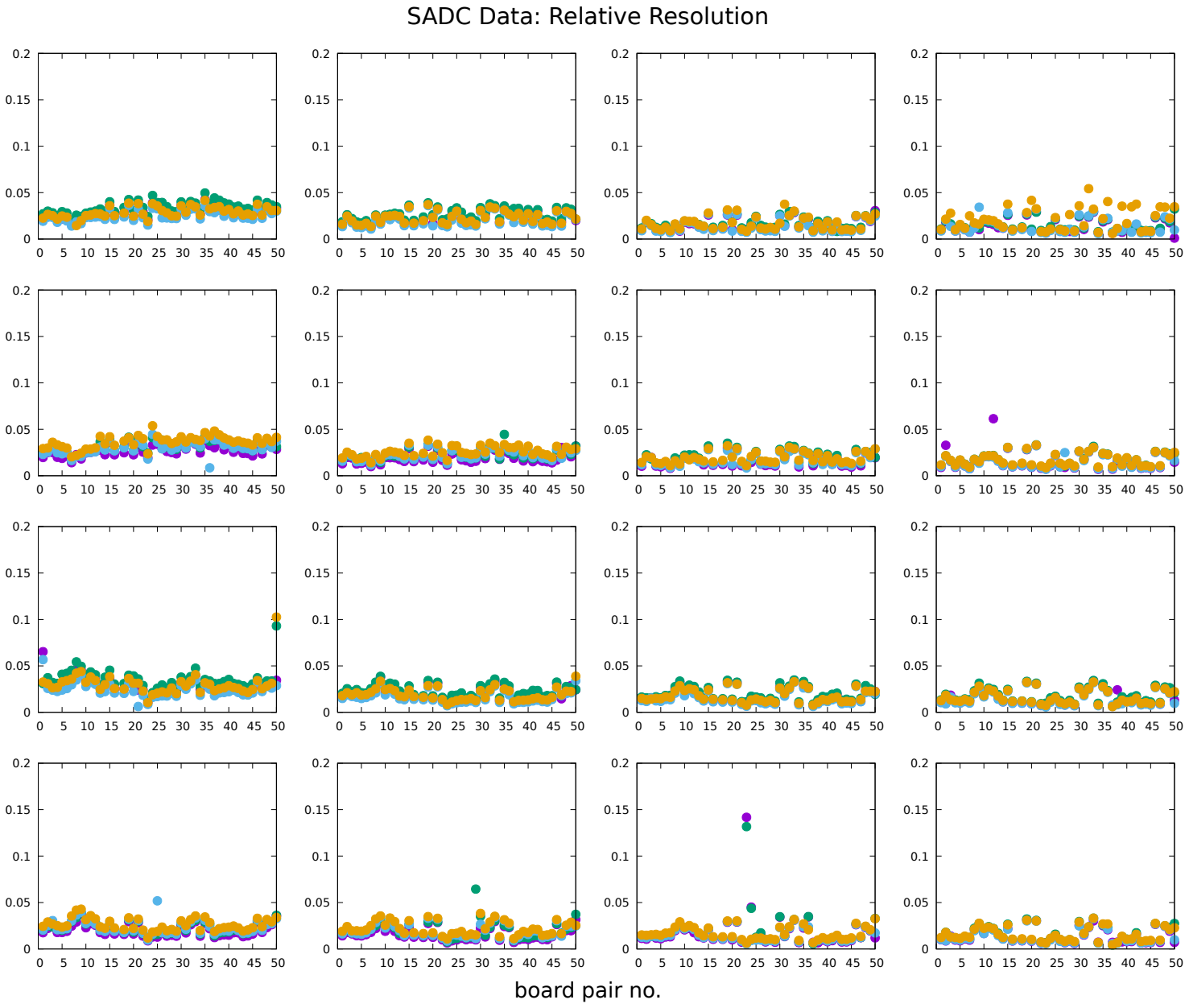


Test of Line Driver Boards

Errors found

- wrong APFEL address (wrong resistor): 3 of 800
- annealing LED not working: 2 of 800
- LV connector missing: 9 of 200
- wrong amplification, probably a wrong resistor: 16 of 3200 channels
- wrong signal shape (wrong or badly soldered component?): 1 of 3200
- OA broken: 1 of 800
- 24 of 100 boards affected

Next steps

- faulty boards being checked in the workshop
- board pair glued to Al feed-through holder: working fine
- few more boards will be glued to start with submodule assembly

Summary

- Submodule components fully acquired for several units
- Production of submodules can start
- Mounting support for the phase 0 detector built
- Communication problems with HV distribution boards
  $\Rightarrow$ series production postponed

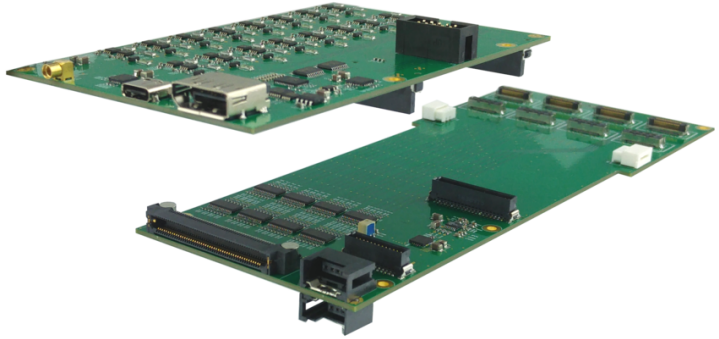
- Issue with APFEL signals solved (input HV capacitor)
- Various capacitors tested, alternatives for barrel found
- Enough old capacitors for BWEC

- Series tests of line driver boards finished
- Few errors found and being fixed
- Gluing test successful

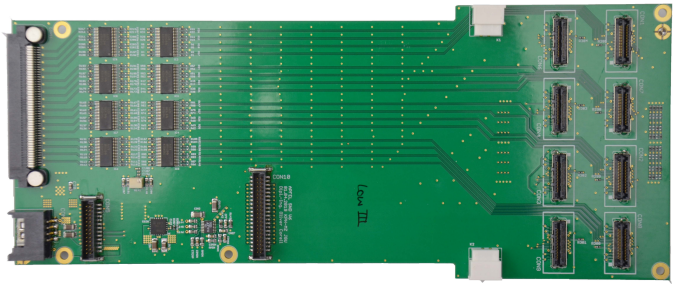
Backup

Front-End Boards

- 2 pairs per submodule
- number of crystals: 2×8
- number of APDs: 2×16

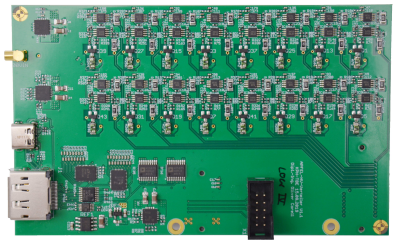


Line driver board



- 8 × APFEL preamplifiers
- 8 × differential amplifiers
- 32 × analogue output signals
- 2 × temperature sensor readout
- LV power supply

HV board



- 1 × HV input
- 16 × HV output
- 1 × rack comm. (DisplayPort)
- 1 × inter-board comm. (USB-C)
- 2 × temp sensor readout (pin-header)