

AHCAL Electronics.

Front-end electronics and DAQ

Mathias Reinecke

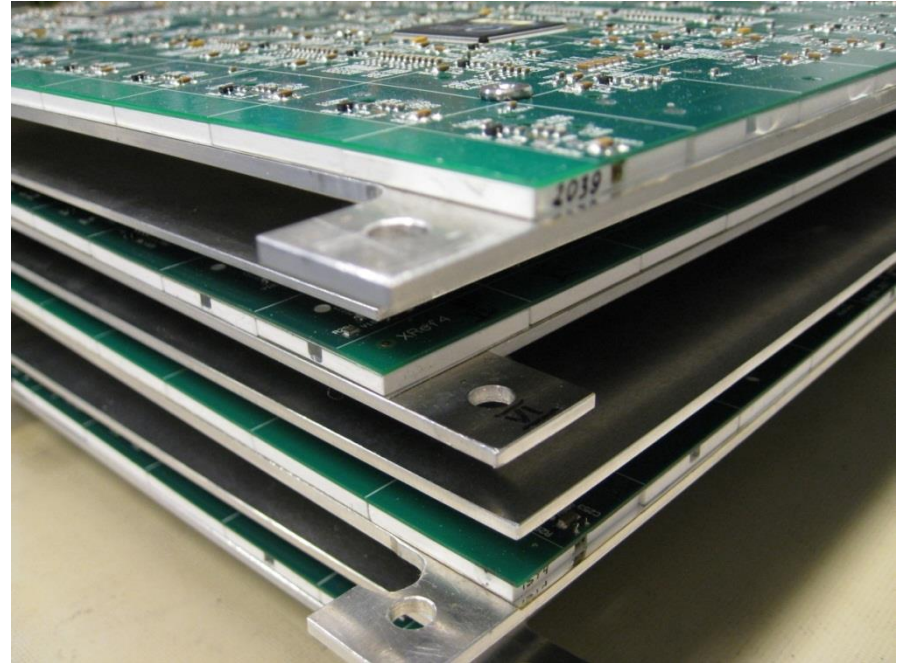
CALICE meeting Hamburg

March 21st, 2013



Outline

- Latest results from electronics tests
 - SPIROC2c
 - Integrated LED System
 - SiPM termination
- New AHCAL DAQ



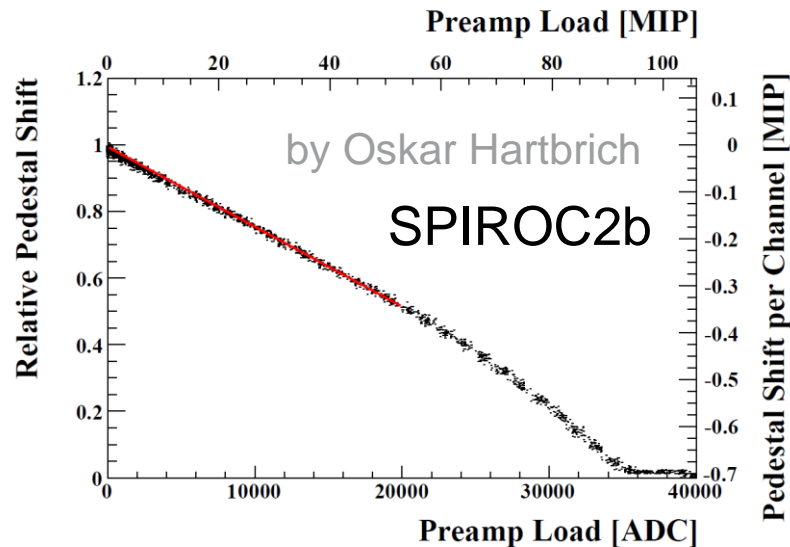
HBU2 stack

SPIROC2c at DESY

- Input stage referenced to GND (not VDDA)
- Set HG/LG PAs separately.
- SP2b pedestal shift gone? SP2b:



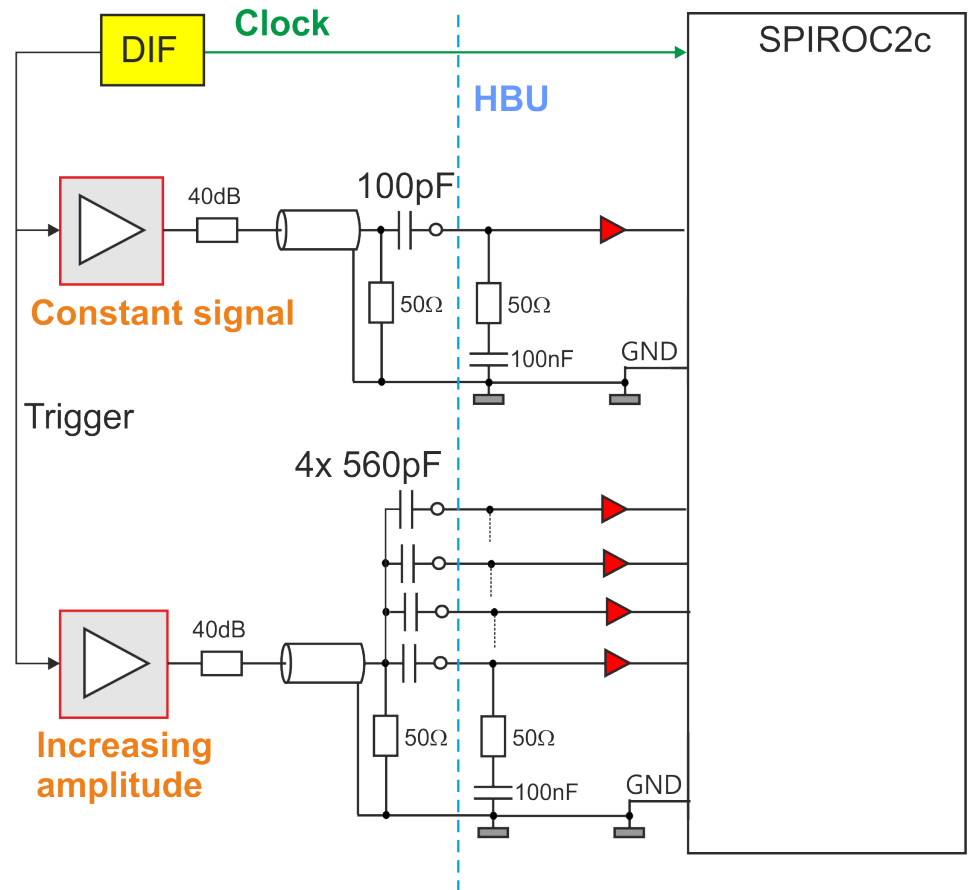
SPIROC2c on HBU2



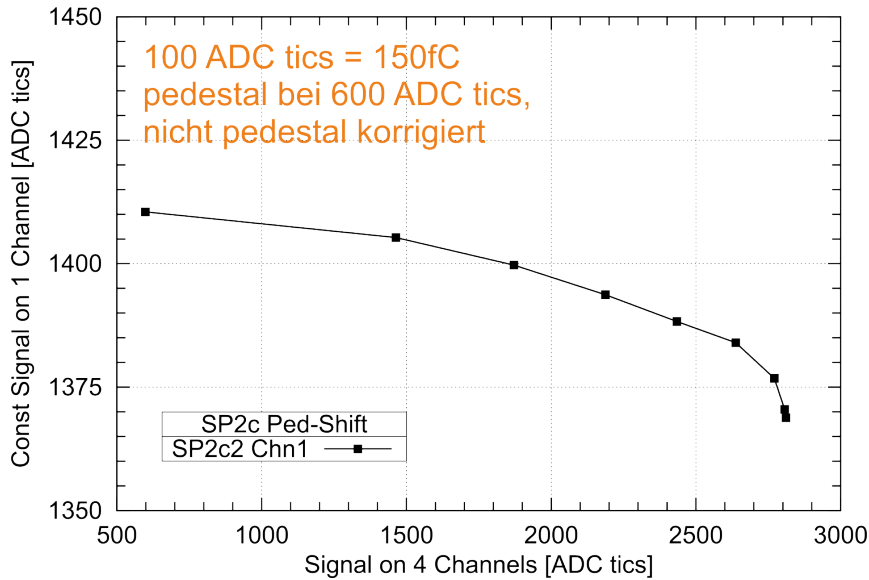
SPIROC2c ped.-shift: Setup

Experimental setups:

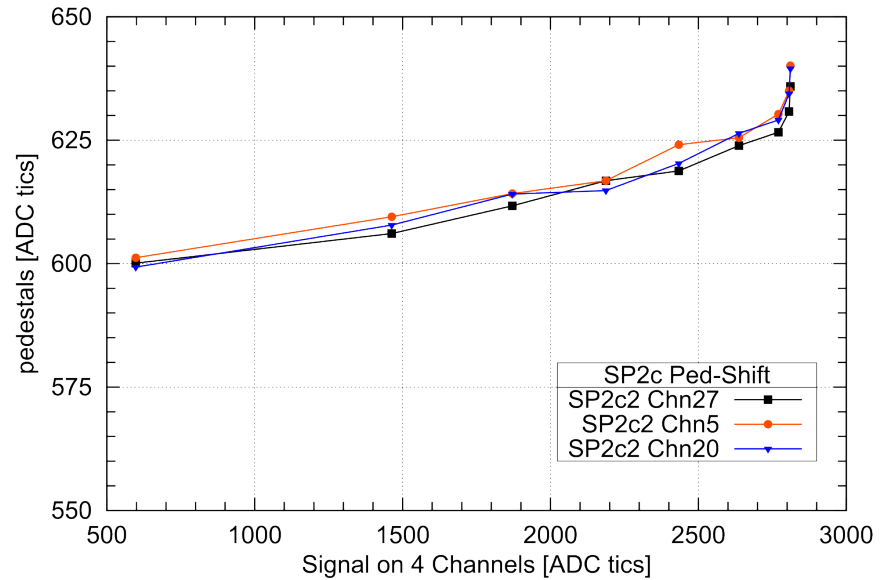
- > Charge injection with two pulse-generators (see right).
- > LED system and tiles.



SPIROC2c ped.-shift: Charge Injection, autotrigger



date 2013-01-11



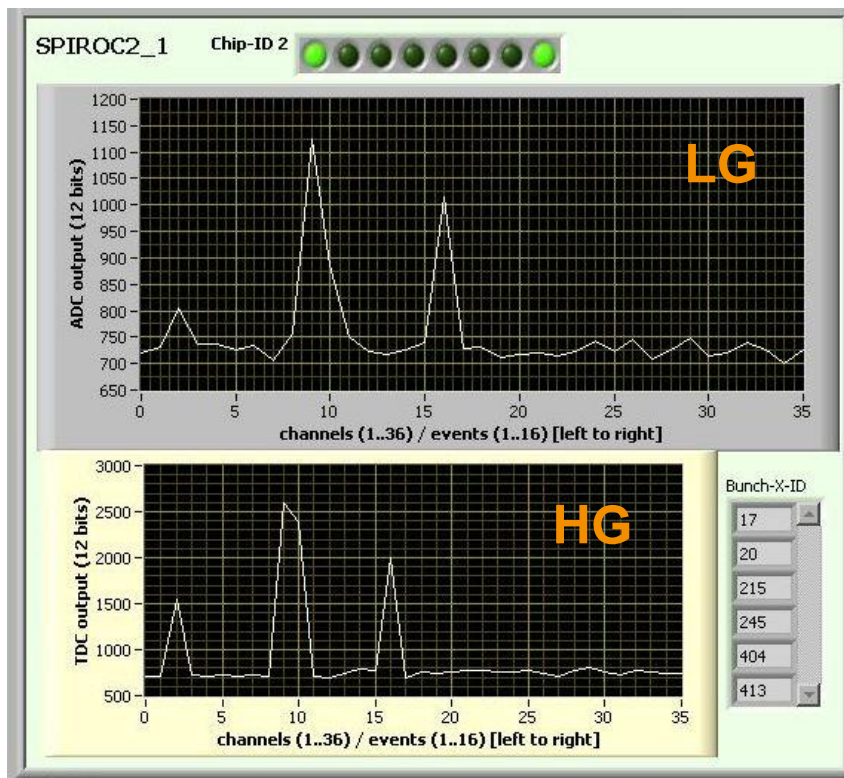
date 2013-01-11

- Channels with and without signal show different behaviour.
- Autotrigger mode: pedestals rise with signal amplitude in neighb. channels.

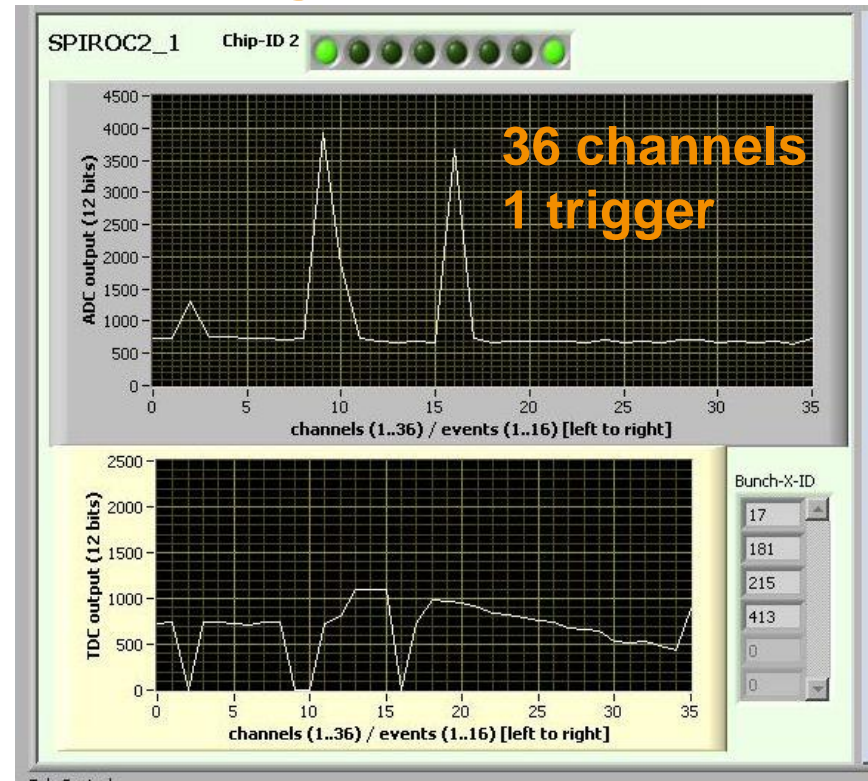
SPIROC2c ped.-shift: LED system

- LED light into 4 channels (50ns shaping, 300fF PA feedback).
- Pedestals show distortion at high signal amplitudes in neighb. channels.

medium amplitude



high amplitude

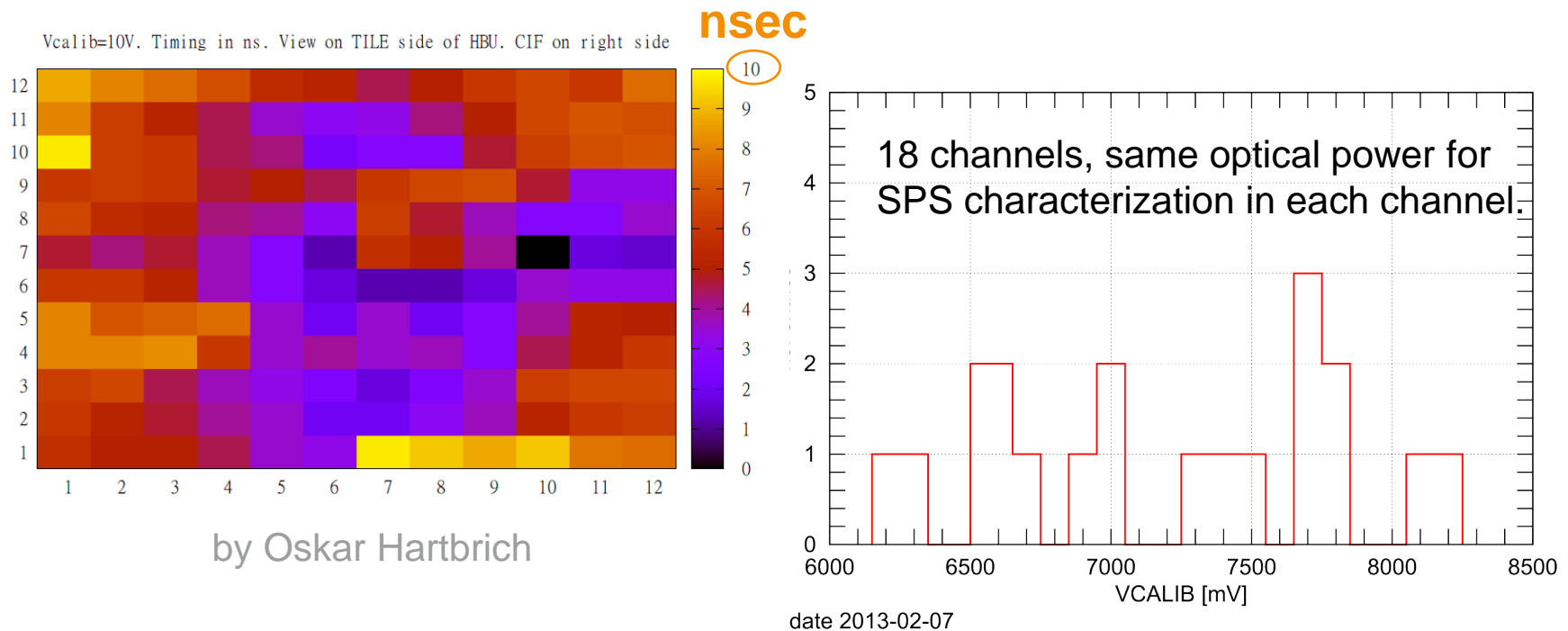


Conclusions SPIROC2c

- > Pure pedestal shift much smaller in SP2c. But additionally: pedestal distortion.
- > Possible reason for pedestal distortion: crosstalk via GND (input reference). One problem: changed pinout of SP2c: “high” impedance gnd path.
- > In SP2c and SP2b both, the pedestal shift/distortion depends on preamplifier and trigger discriminator setting (on/off).
- > The effects need deeper understanding => new tests ongoing.



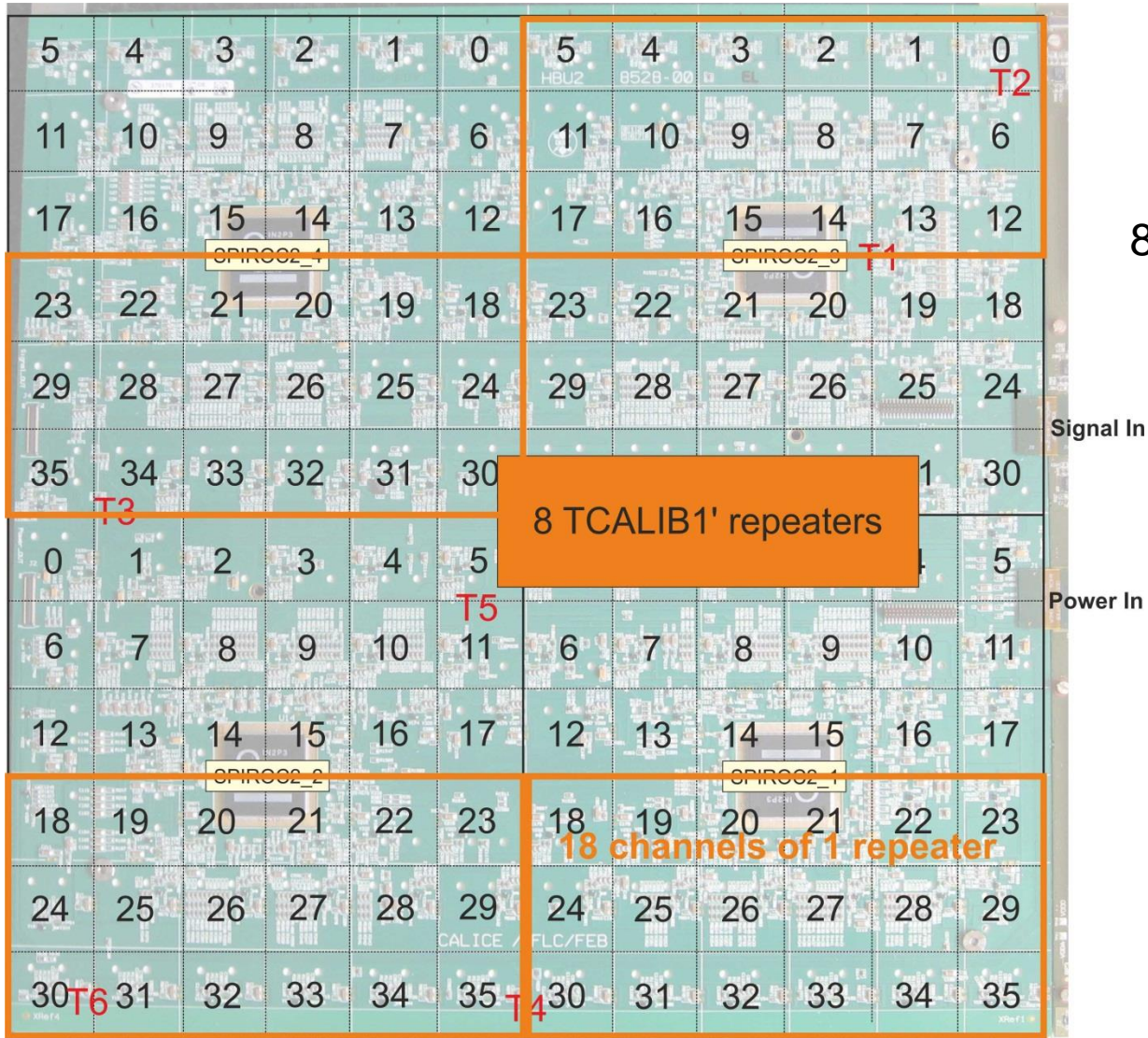
Current LED System



*LED light measured
with PMT H9858-01*

- > Switch-on time varies up to 10ns (left).
- > LED Bias (VCALIB) shows large spread (right) and depends on position.
- > Reasons for both cannot be the LEDs alone.

LED Driver on HBU2

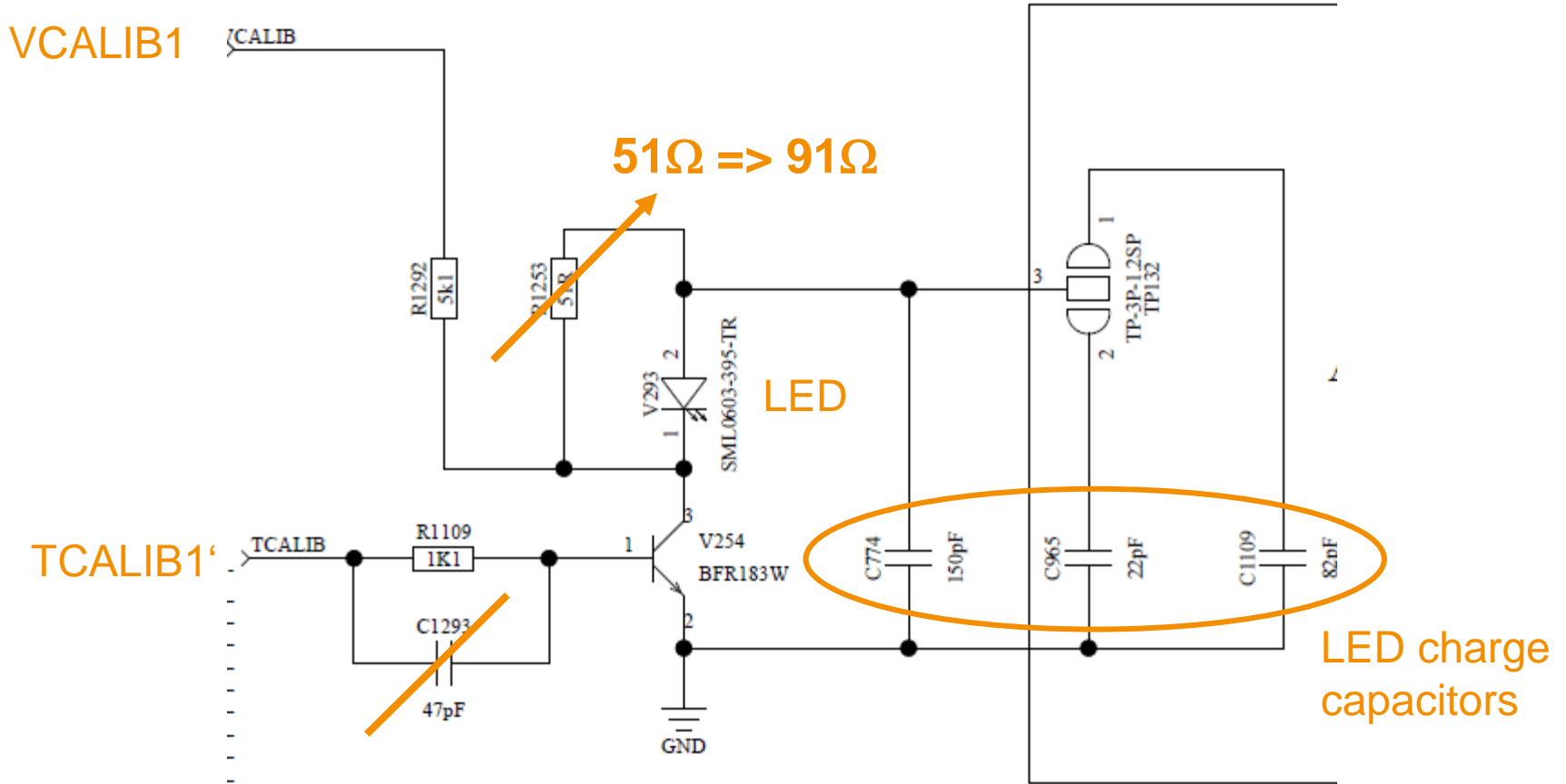


8 repeaters for 144 channels:

- > Different trace lengths.
- > Repeaters have to drive capacitive load and work at their limits.



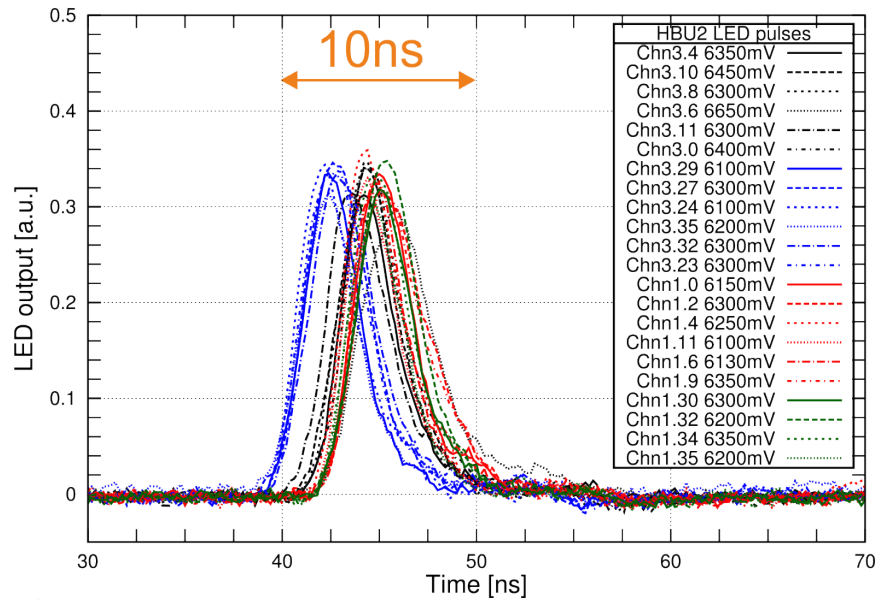
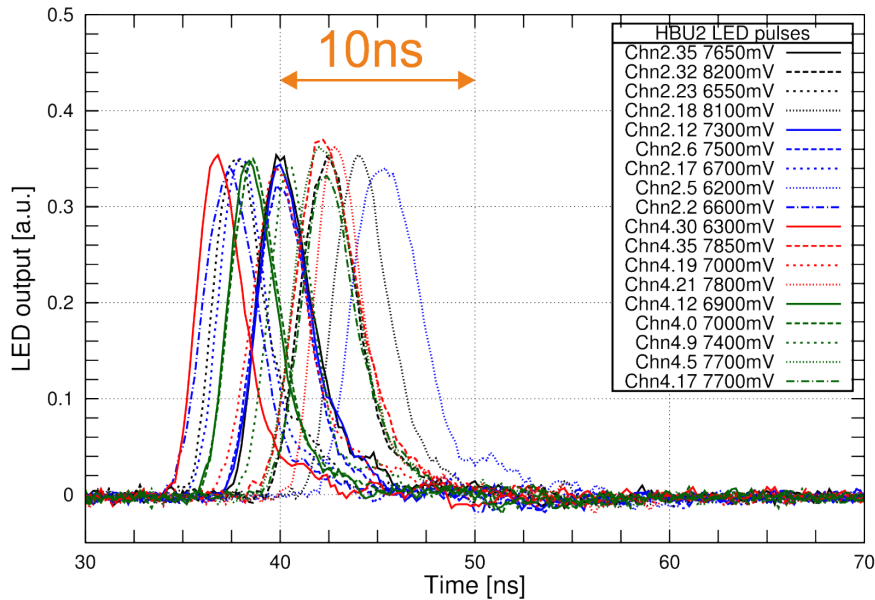
Modified LED system – Single Channel



144x on HBU2



LED performance – old and new circuit



date 2013-02-06

old LED circuit

date 2013-02-06

new LED circuit

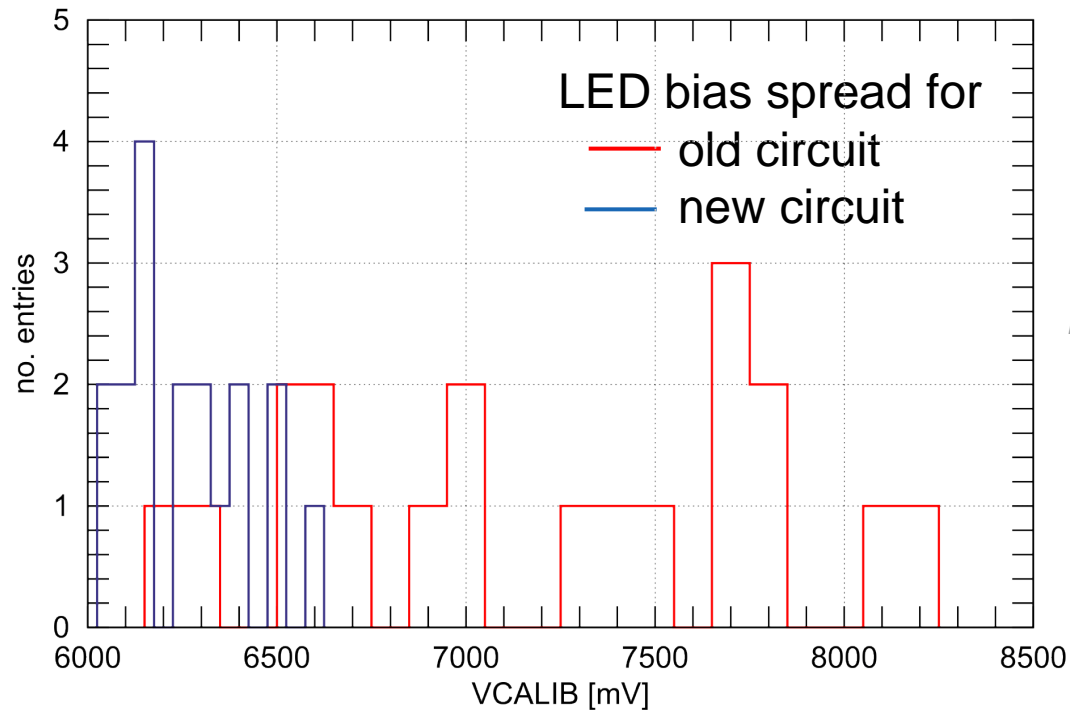
*LED light measured
with PMT H9858-01*

With new LED circuit:

- delay spread is much smaller (but still a few outliers),
- channels of one repeater (one colour) are close together (2-3ns, 18 chns).
- No pulse widening (FWHM <5ns)



LED performance - new circuit



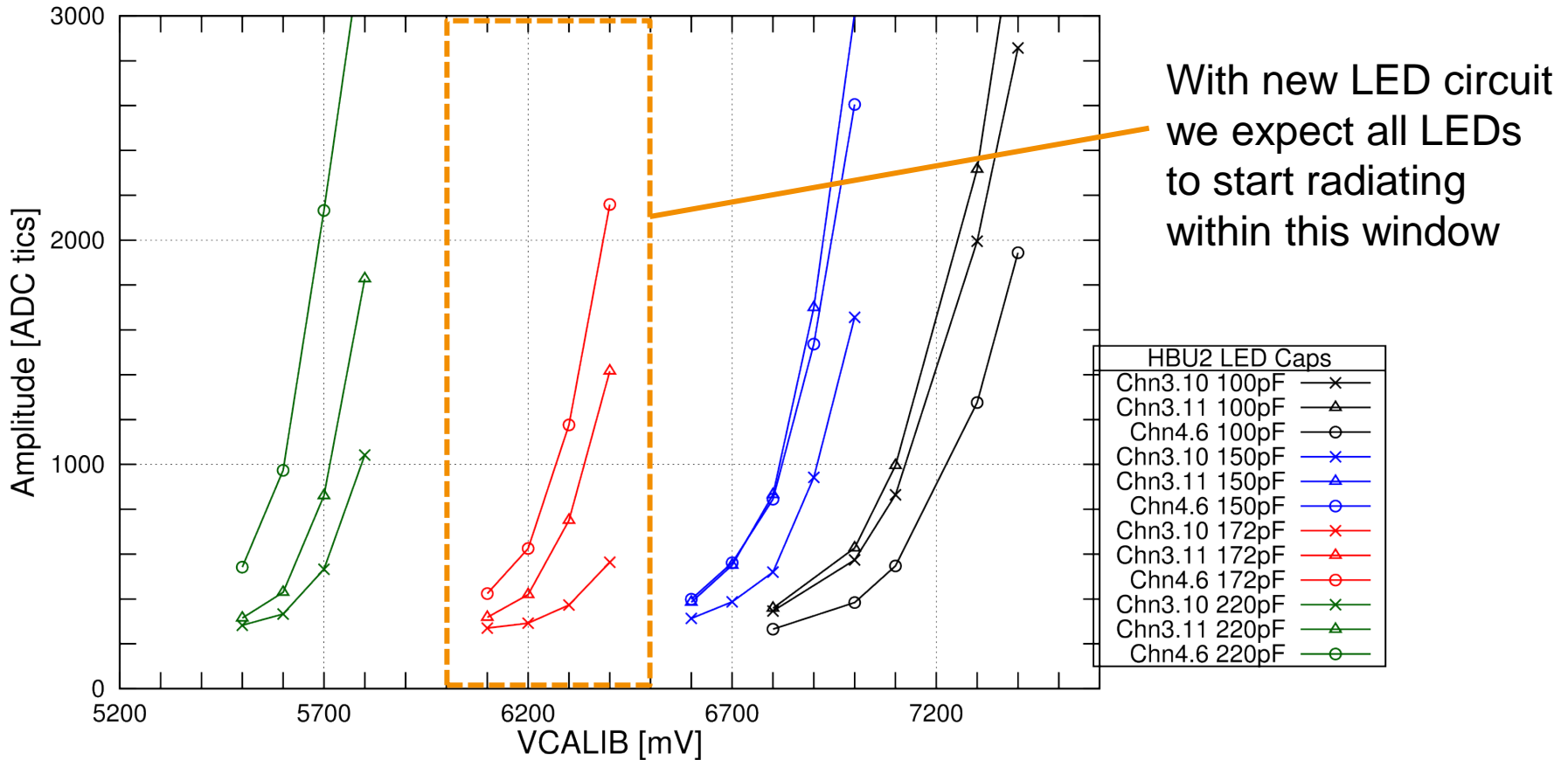
LED light measured with PMT H9858-01

date 2013-02-07

- > LED bias spread (VCALIB settings) is reduced by new circuit.
- > Much better dynamic range now (SiPM saturation)!



LED (tile) response for different LED charge-capacitors



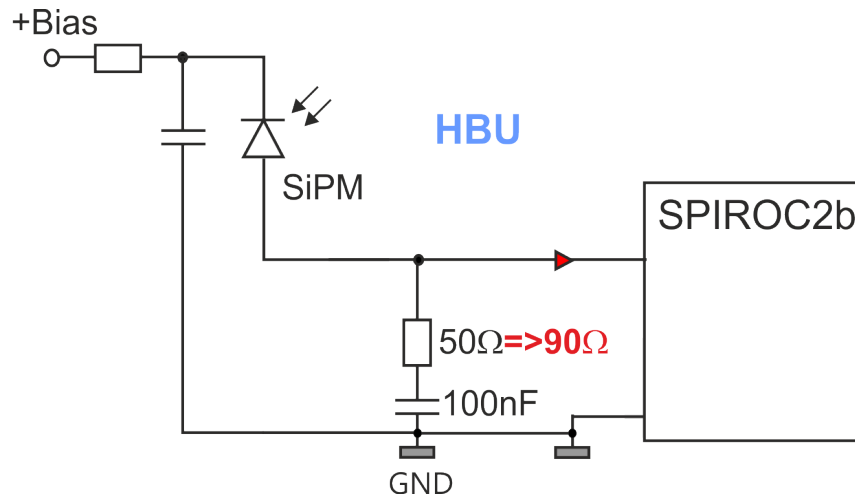
date 2013-02-06

➤ 150pF ± ~20pF should be ok for new LED circuit. (150pf def., 22pF, 100pF)



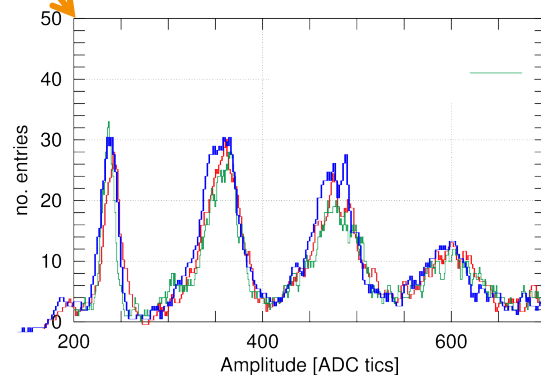
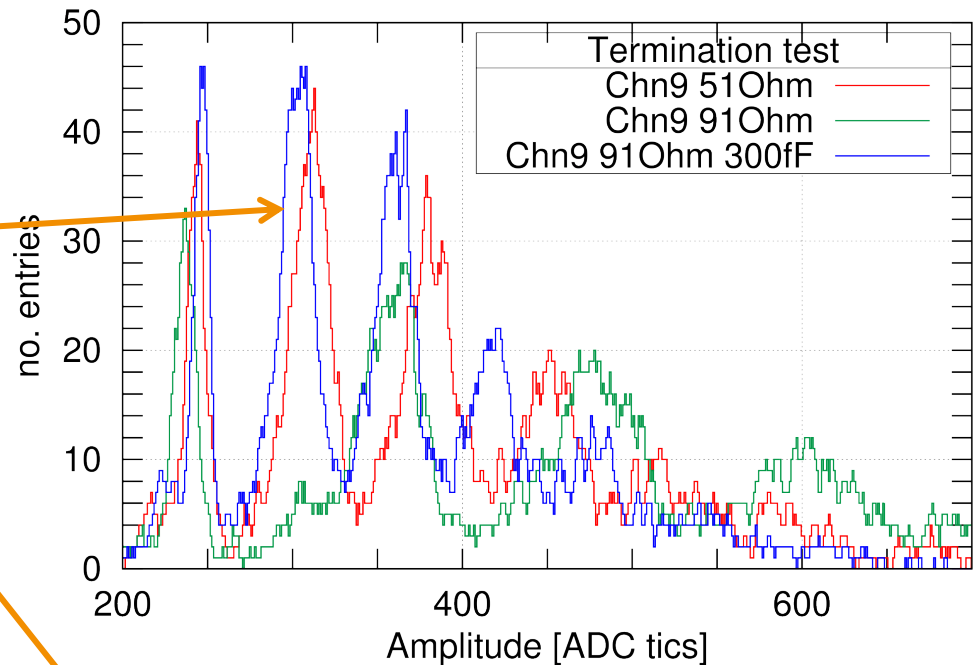
SiPM termination

- > Is a 50Ω termination necessary (longest trace $\sim 10\text{cm}$)?
- > Increase channel gain by a higher input termination.
- > Can the Signal/Noise ratio be improved by decreasing the
 - SiPM bias voltage?
 - SPIROC2b preamplifier gain?



SiPM termination

- 91Ω termination increases the channel gain as expected.
- SPIROC preamplifier gain can be decreased.
- No S/N improvement (after a first quick analysis).
- Can be used for low-gain SiPMs.

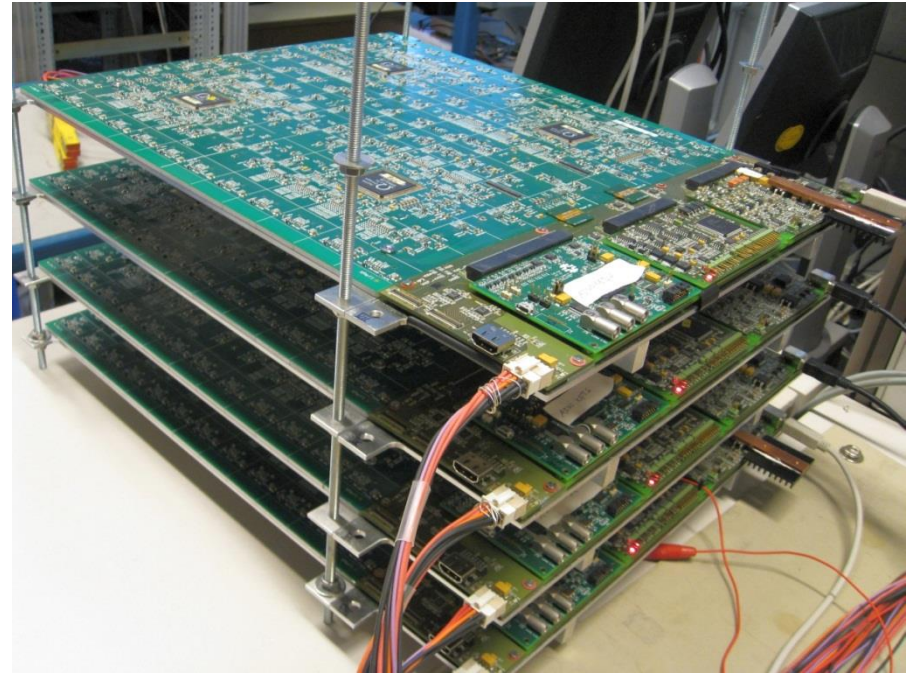


Curves of upper plot stretched and superimposed

AHCAL DAQ

- End of May: DESY testbeam with AHCAL tower.
- Current Labview/USB DAQ: only single layers possible.
- Synchronous operation of multi-layer setups, combined testbeam with other CALICE detectors: **new DAQ necessary.**
- CALICE DAQ not open for collaborators currently.

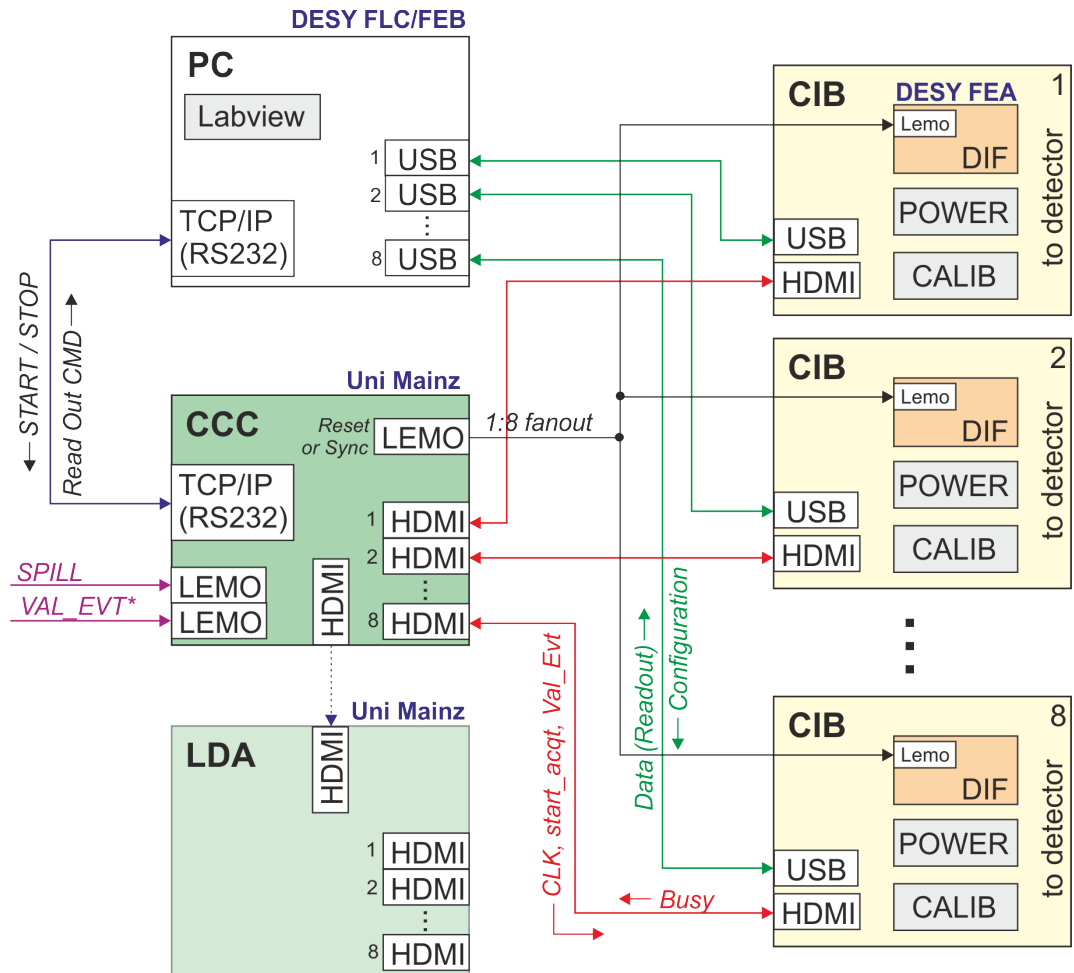
⇒ **AHCAL DAQ**



*AHCAL modules stacked up ...
... to a tower!!*

AHCAL DAQ

- Cooperation Uni Mainz, DESY...
- LDA integration in several steps. Very similar packet structure as CALICE DAQ.
- Direct integration of ScECAL and easy synchr. with SDHCAL possible.
- Status: Basic features tested, flow-control scheme has been set up.
- Middle/long term: switch to CALICE DAQ (better performance)!

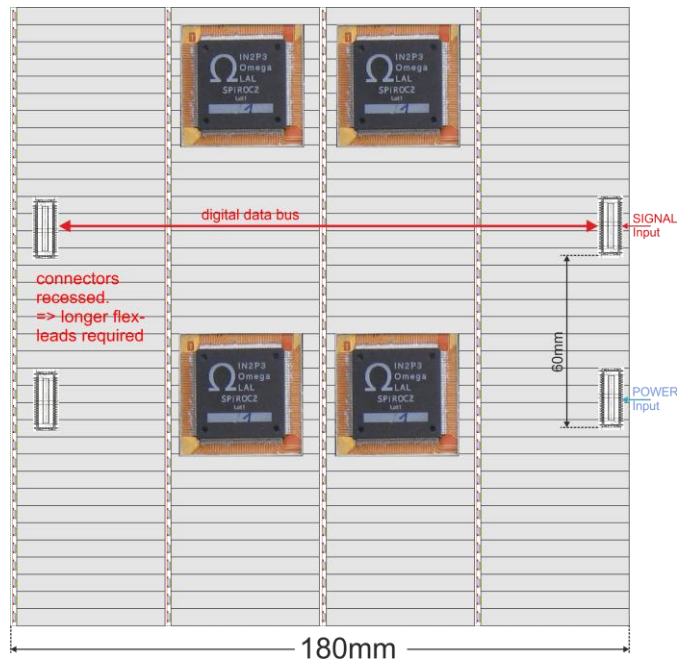


Multilayer USB adaptation:
Oskar Hartbricht



Module Production

- 8 new HBU2s, in production
- CIBs, CALIBs, POWERs, DIFs (NIU), in production / ordering phase
- EBU horizontal (in design):



EBU vertical, finished

- Setups (HBU2+DAQ+Labview) delivered: Mainz, Shinshu, NIU

Conclusions

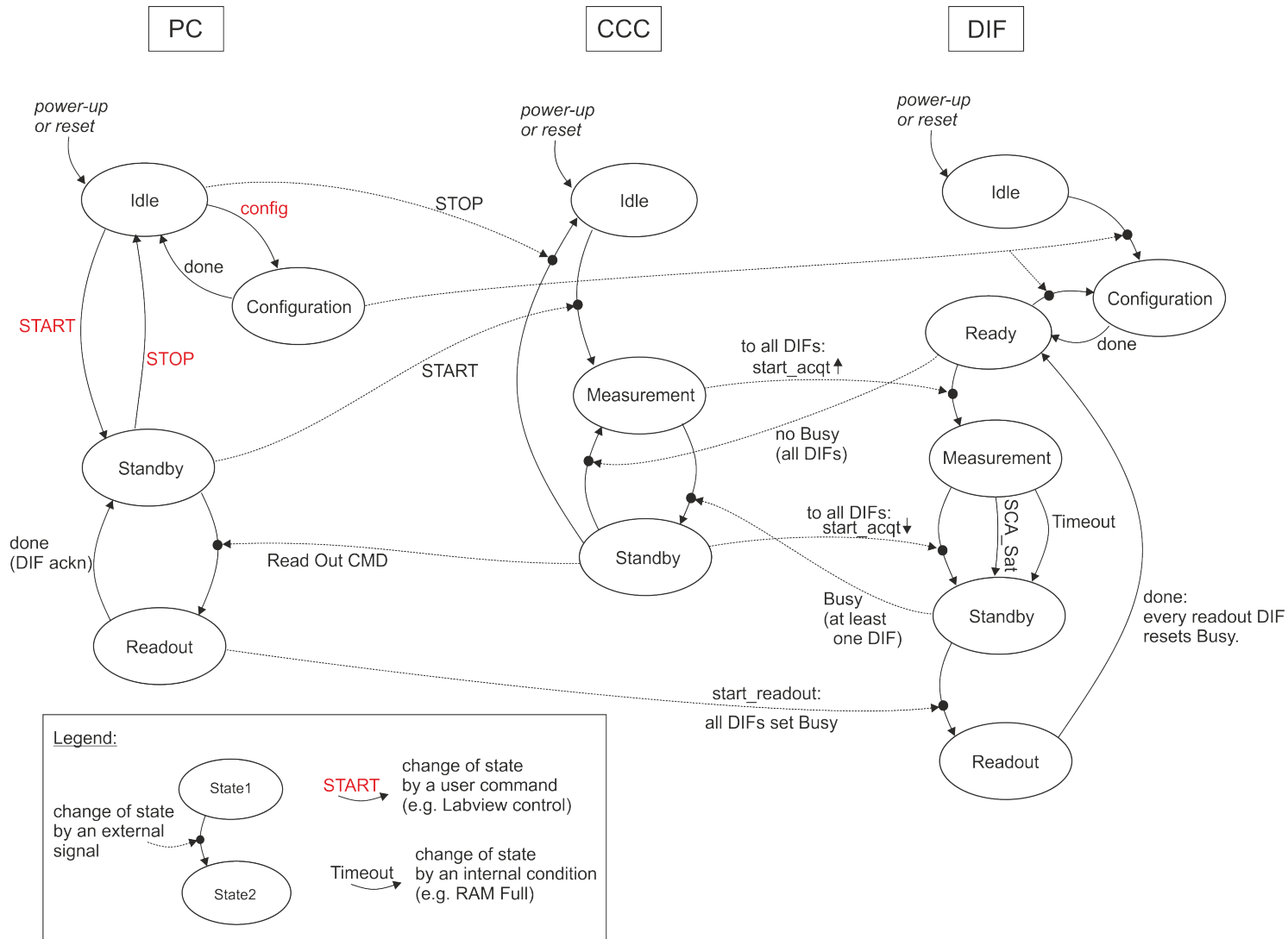
- > A new LED circuit is proposed with much improved switch on time (TDC calibration) and bias spread (number of calibration runs).
- > Dynamic range of LED system improved.
- > SiPM termination with 91Ω does not improve the S/N.
- > New AHCAL (and ScECAL) DAQ under development for May testbeam (Mainz and DESY). See:
http://adweb.desy.de/~reinecke/AHCAL_DAQ_proposal.pdf



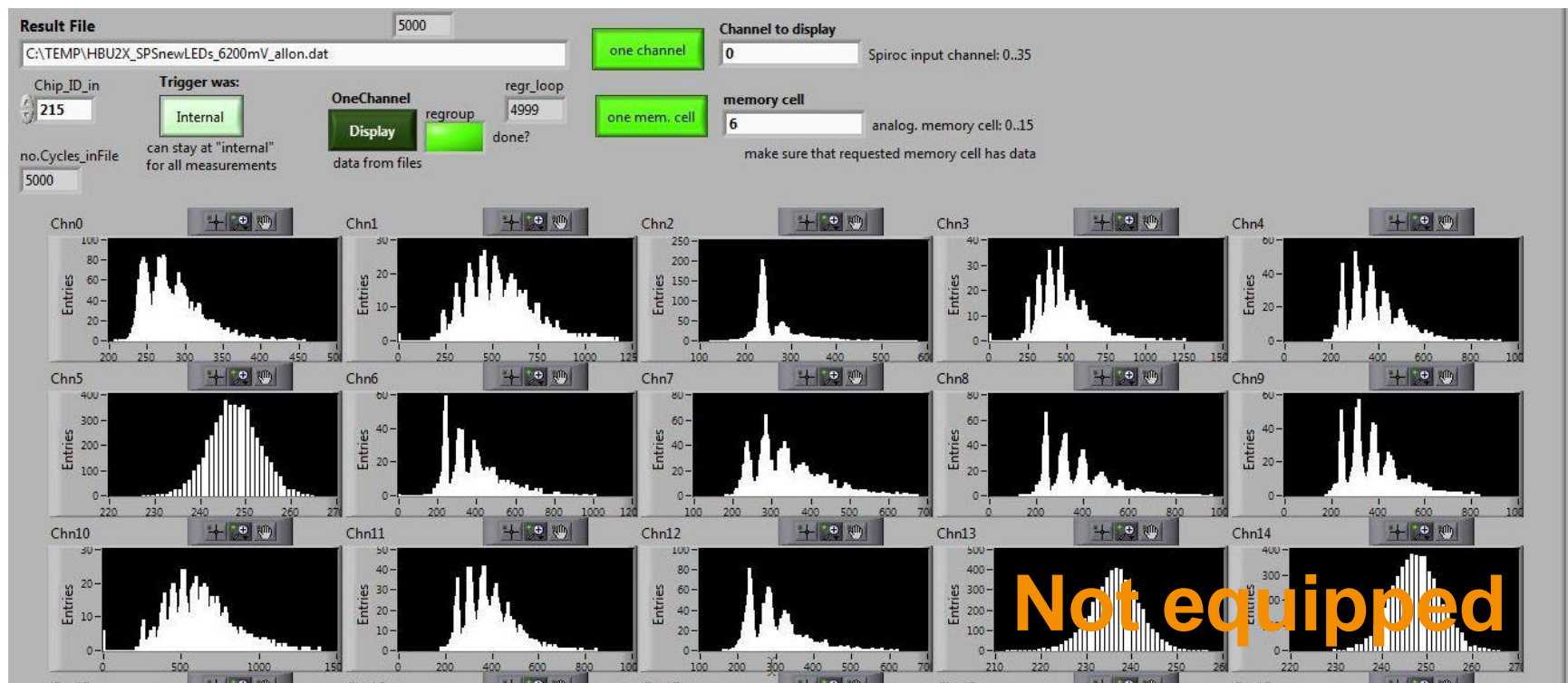
Backup Slides



AHCAL DAQ – Flow Control



New LED System: Single-pixel spectra and uniformity



- With only one LED Bias voltage V_{CALIB}, almost all equipped channels show SPS spectra. => Number of calibration runs reduced.