

AHCAL Status.

Electronics and DAQ

Mathias Reinecke
CALICE meeting Argonne
ANL, Mar. 19th, 2014



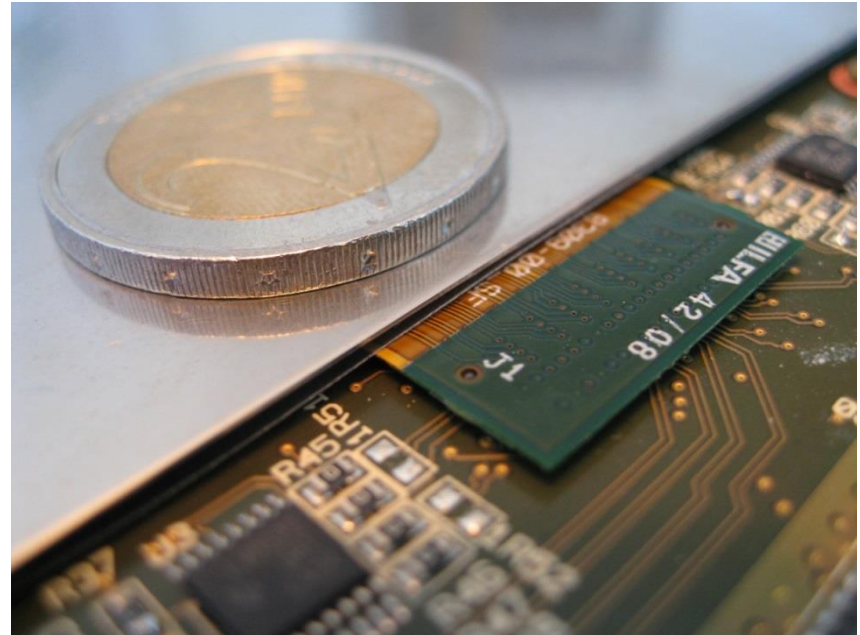
Outline

> Status Hardware

- HBU3 redesign.
- EBU

> New DAQ

- Replace USB => x-LDA
- Towards a combined CALICE testbeam



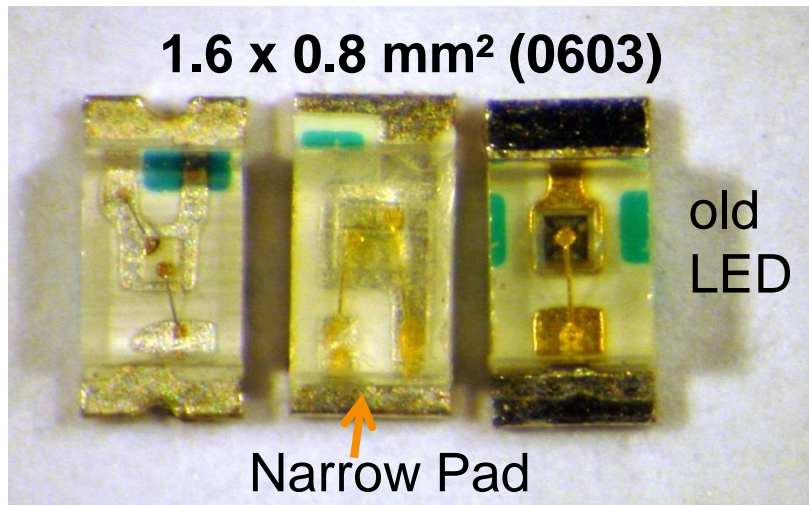
*A flexlead disappears in an
AHCAL steel cassette.*

HBU3 redesign

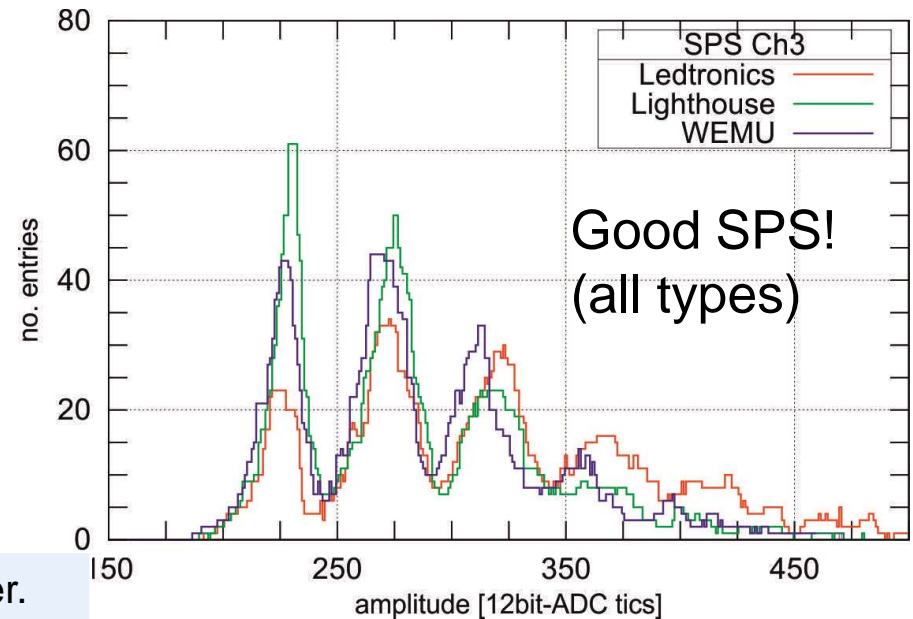
> UV LEDs of calibration system obsolete => redesign.

> Two new LED types have been investigated:

Uni Wuppertal, DESY

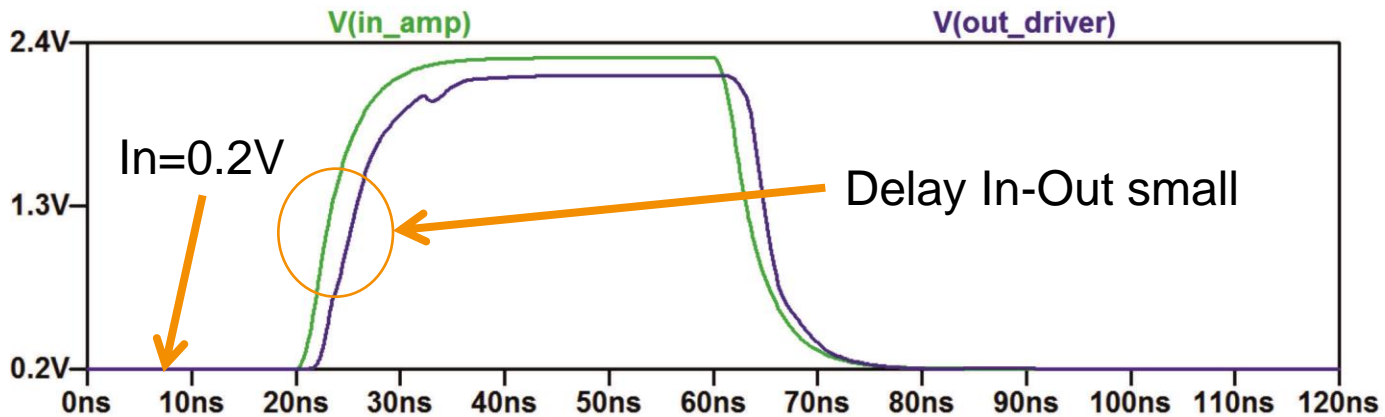
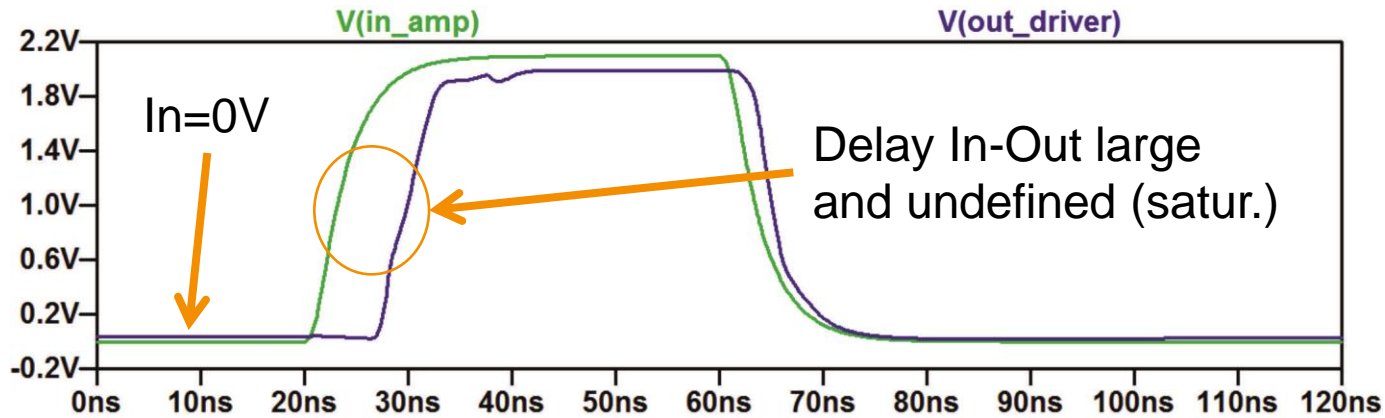


	Wavelength [nm]	Pulse width FWHM [ns]	oper. Voltage [V]
Ledtronics (old)	395	~7	6.3
WEMU	420	~7	6.1
Lighthouse	400	~9	5.1



Lighthouse LED will be used!

LED driver – input bias

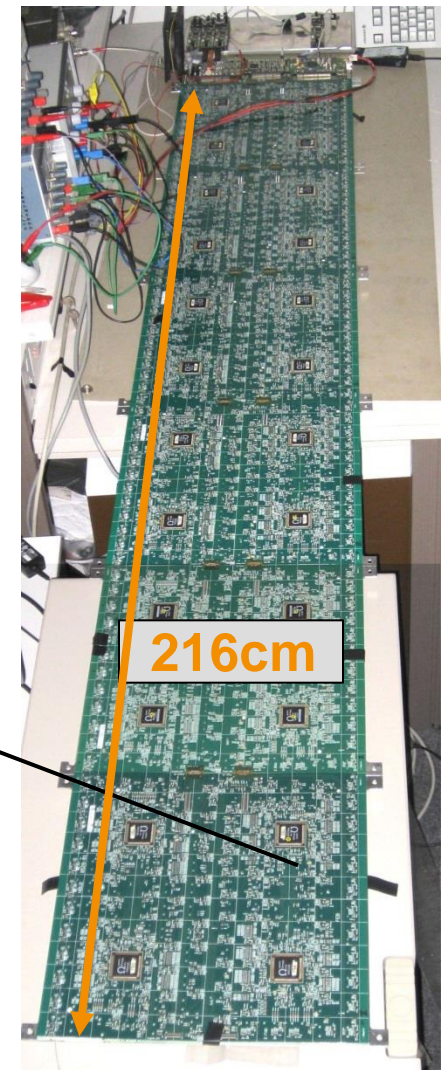
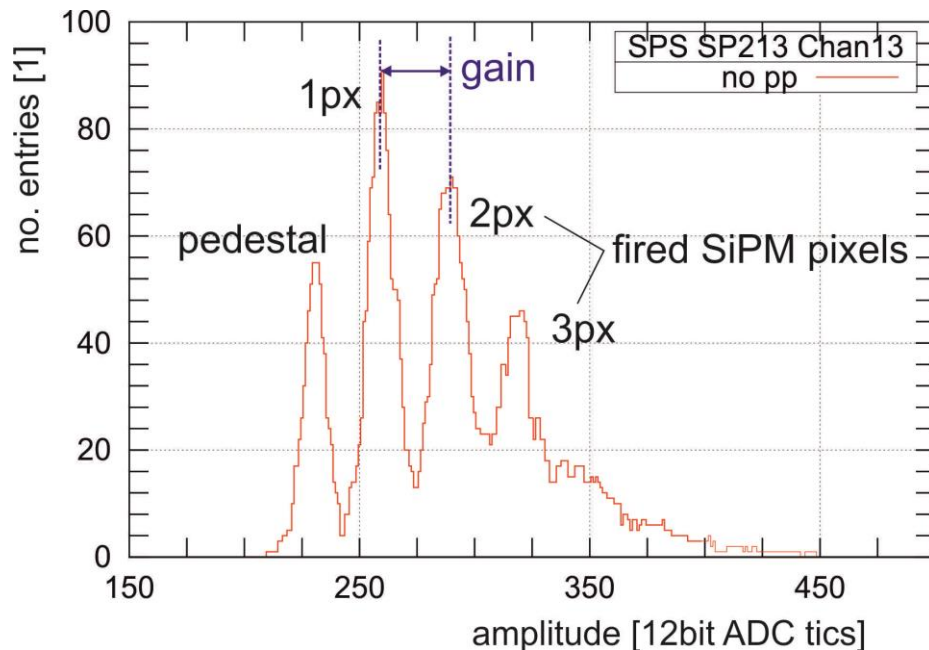


- LED driver modified in HBU3 accordingly. Can we use LED system for TDC calibration now?



Full extension: Test of 6 HBU2s in a Row

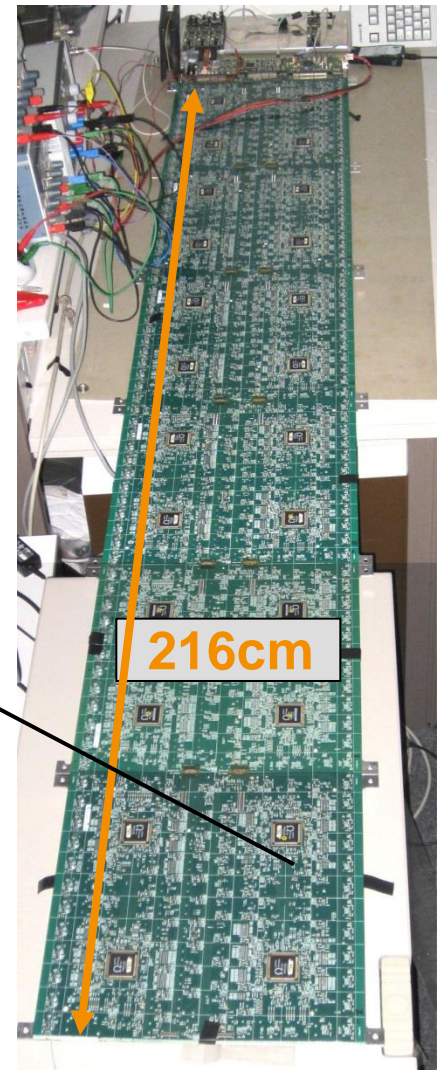
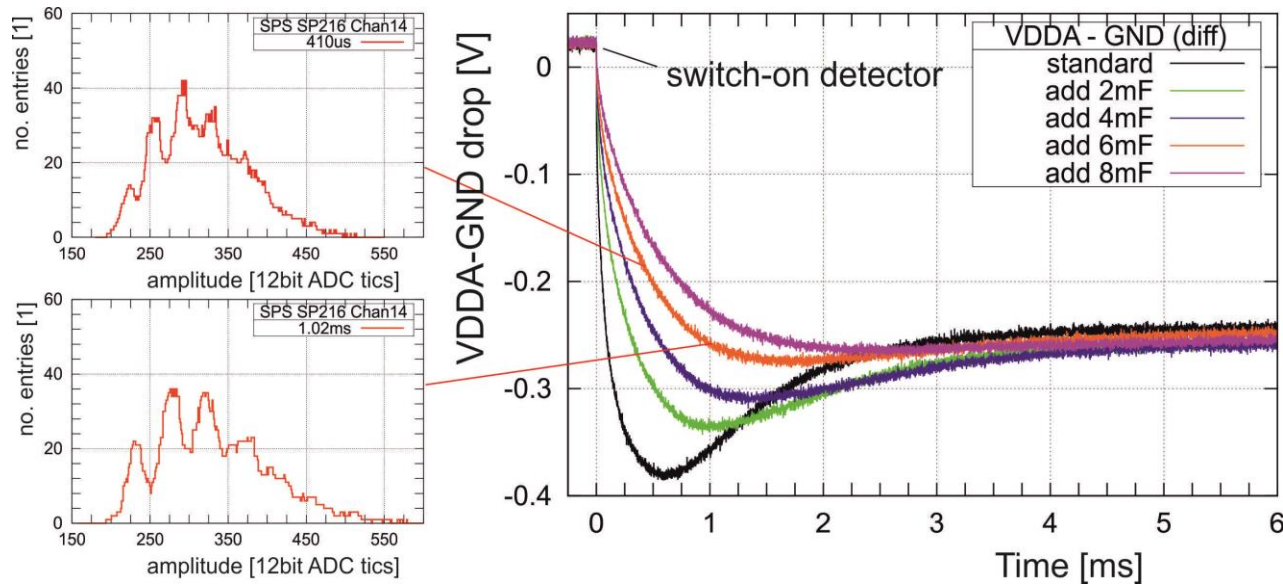
- 6 HBU2s with 864 detector channels in lab (Sept. 2013).
- Questions: Transport of 40MHz LVDS clocks, power, LED trigger over 216cm possible without limitations of detector performance?
- First results for smallest signals (single-pixel spectra of SiPMs) prove the suitability of the setup:



Full extension: Power Pulsing

- Switched Current: 2.75A (analog supply voltage VDDA).
- Voltage drop across 216cm (dominated by flexleads):
 - 0.18V on VDDA (19mΩ per HBU2+flexlead)
 - 0.04V on GND (4mΩ per HBU2+flexlead)
- Tradeoff needed: switch-on time – blocking caps:

Quite good, however...

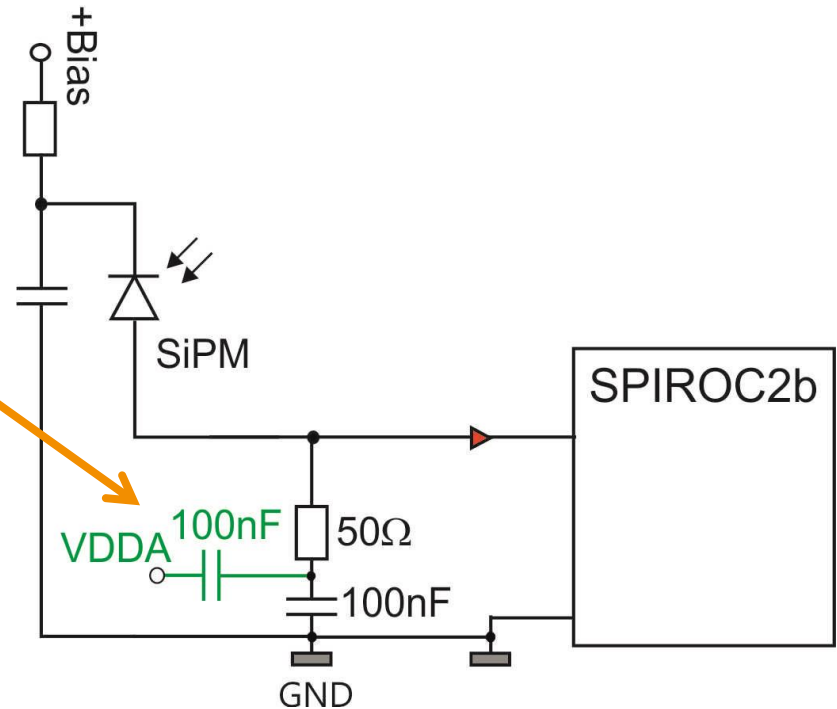


- Switch-on time T_{on} too small: Low gain and high noise!



HBU3 redesign – changes to HBU2

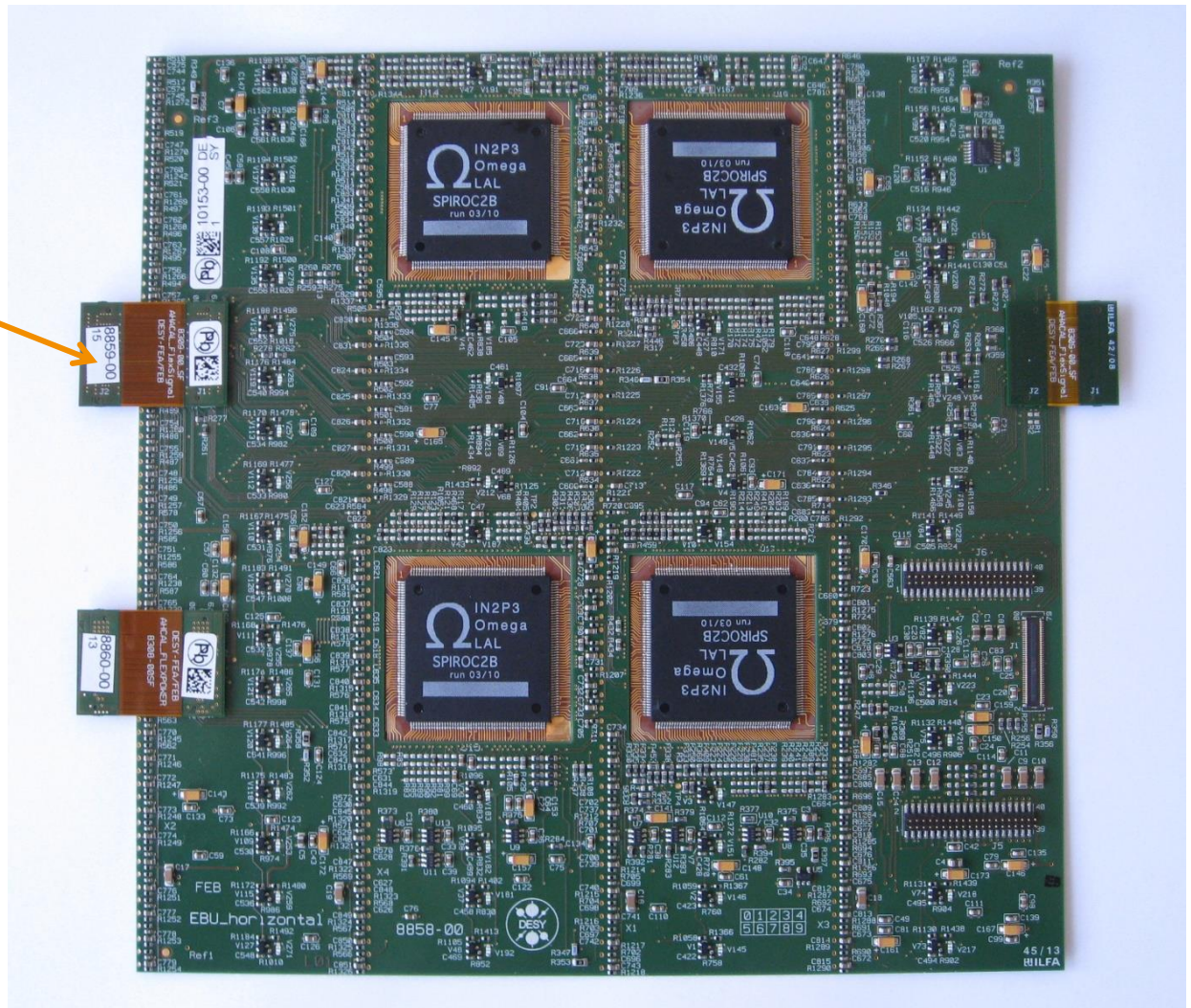
- New LEDs
- 2mF additional block capacitors VDDA-GND (40 capacitors per HBU).
- Termination of SiPMs to VDDA. Same for SPIROC bias references.
- VDDA/GND pads next to flex-connectors.
- LED trigger: line lengths equilization.
- LED driver circuit optimization.
- Remaining 960 SPIROC2b have been sent for packaging.



HBU3 redesign completed. Board can be ordered now.

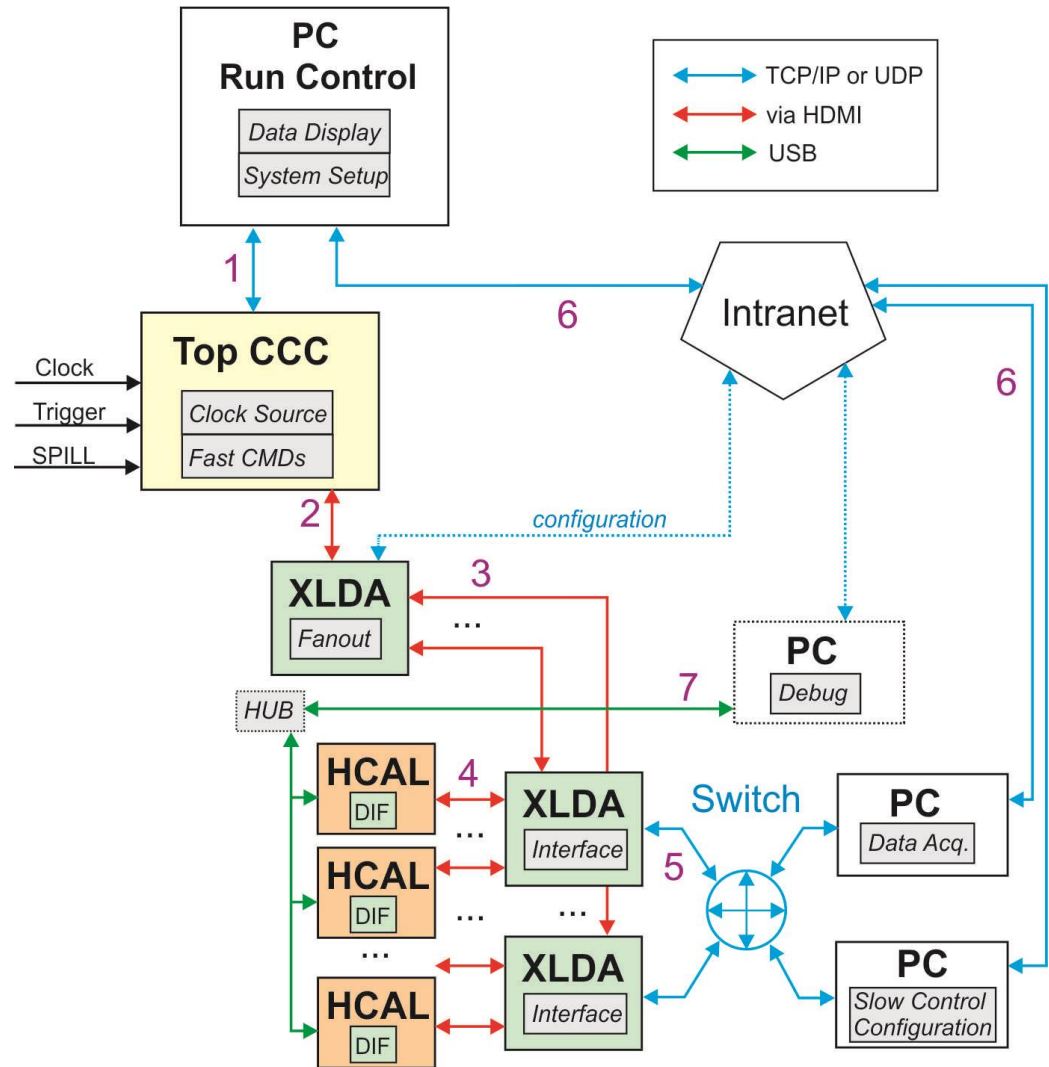
EBU_horizontal / Long Flexleads

- 4 EBUs realized.
- Horizontal strip orientation.
- Long flexleads realized for EBU interconnection.
- Survived smoke test (pedestal readout).

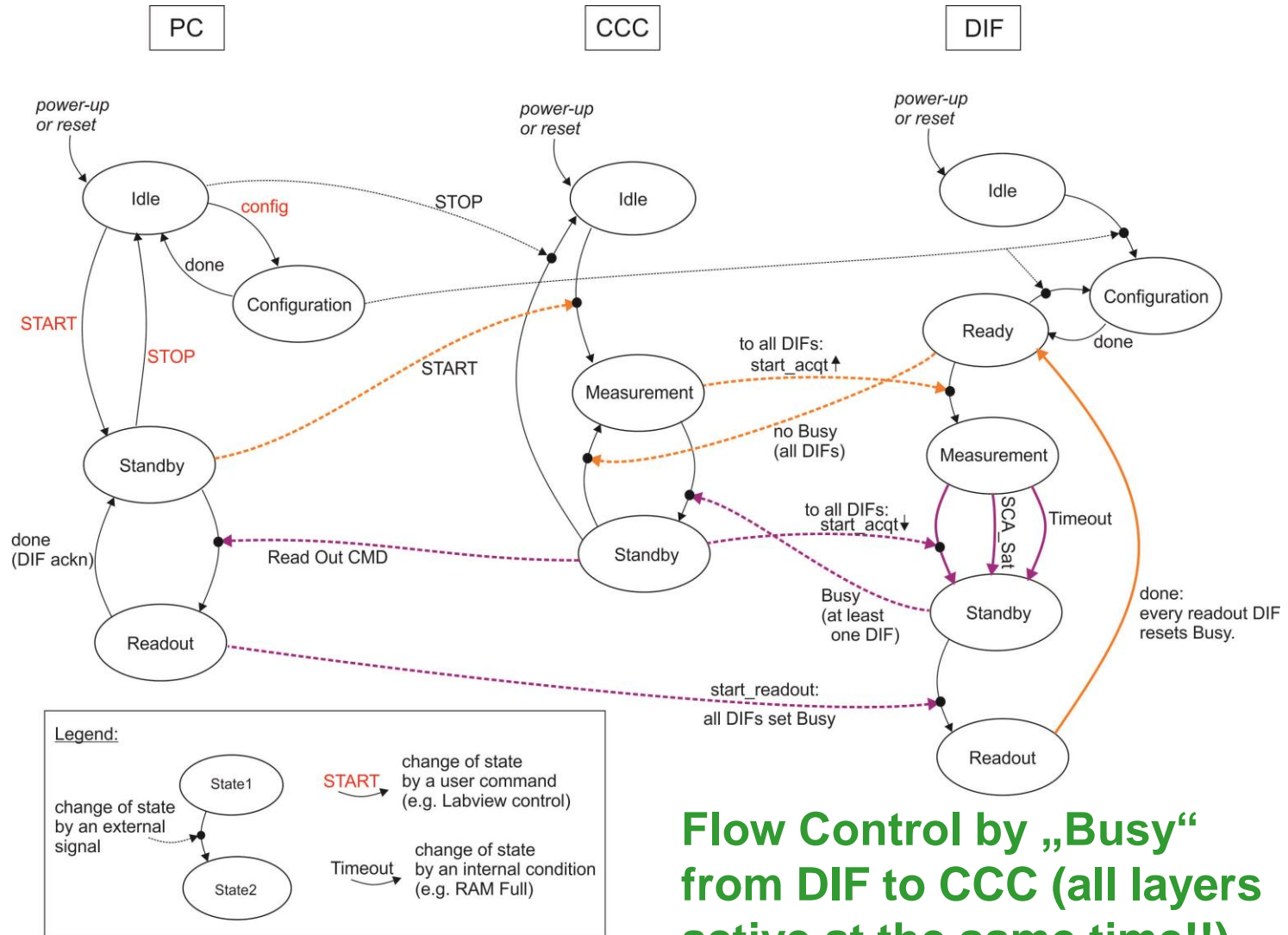


AHCAL DAQ proposal

- Cooperation Uni Mainz and DESY.
- Can operate ScECAL directly.
- CCC and x-LDA based on Zedboards (Xilinx Zynq).
- includes Wing-LDA from Mainz (96 layers)
- Still in conceptional design phase. Currently implementing block-transfer commands via HDMI into DIF.
- First „operation“: October CERN testbeam.

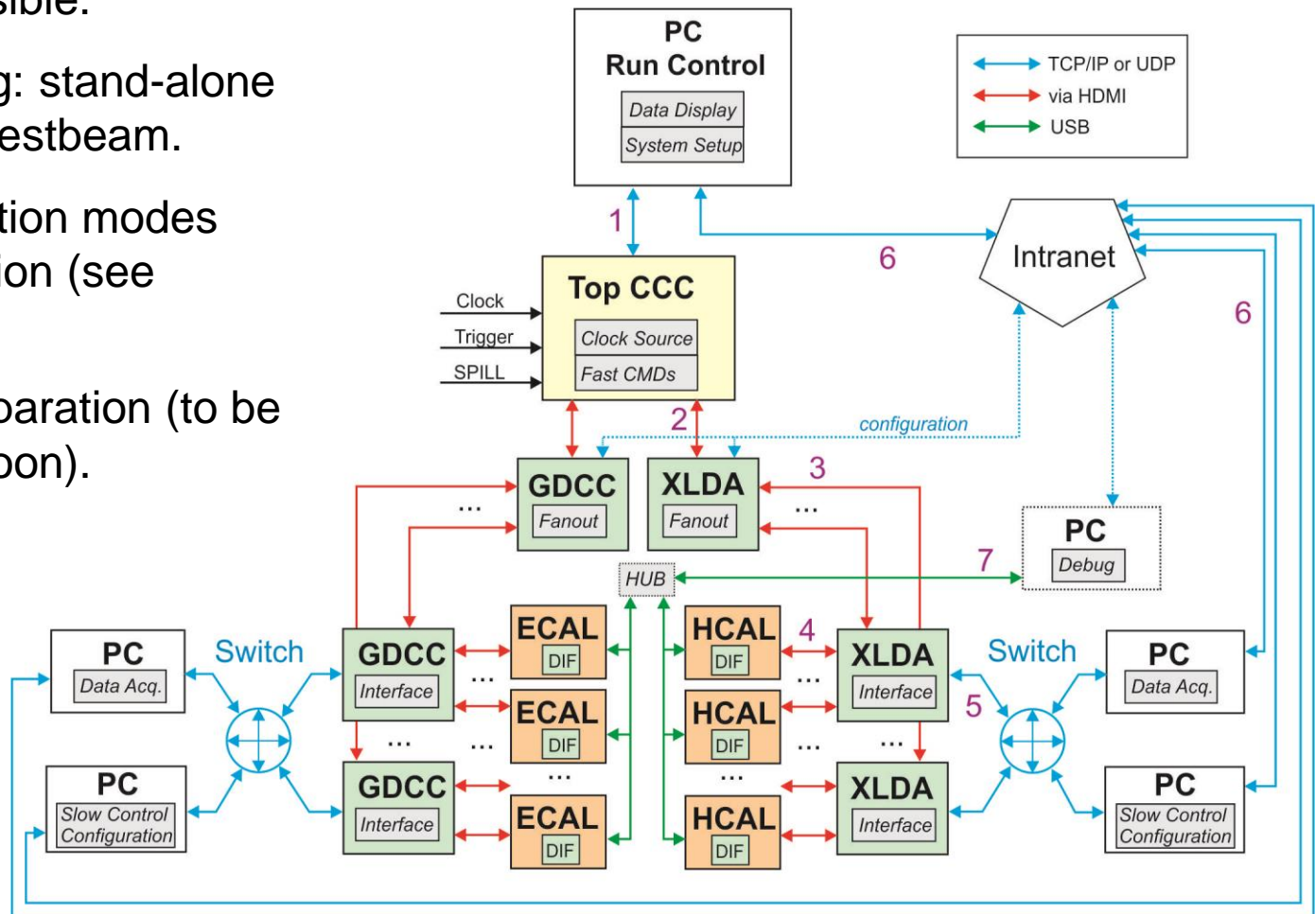


Flow Control proposal



Combined testbeam with other CALICE detectors

- Independent operation of all detectors possible.
- Easy switching: stand-alone ⇔ combined testbeam.
- Various operation modes under discussion (see Taikan's talk).
- Manual in preparation (to be sent around soon).



Outlook

- > HBU3 and testbeam extenders ready for ordering.
- > DAQ under development in order to replace USB completely.
- > New LEDs have been ordered and need to be turned over in reel.
- > Temperature readout problem has been fixed (CALIB2 board).



Backup Slides



Towards the next SPIROC

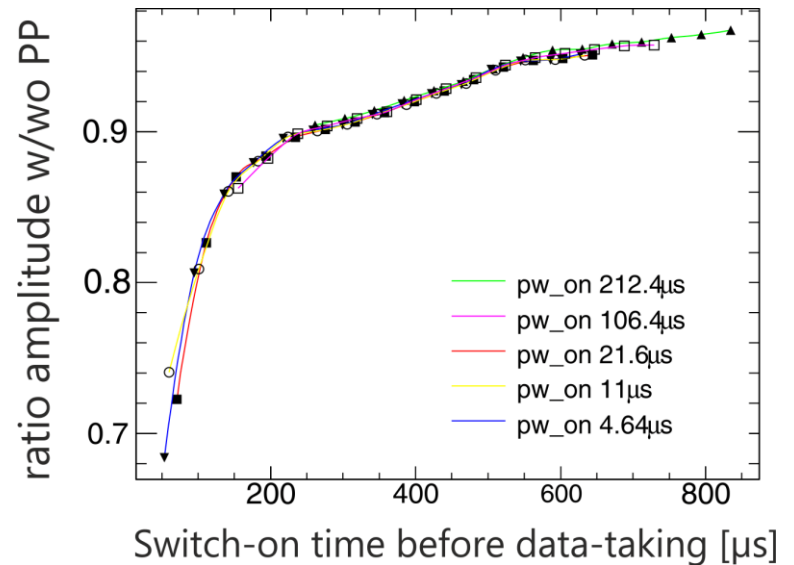
Topics to keep in mind ...

- > Pedestal shift when too many channels have a high signal.
- > Memory cell dependent amplitude decay. Solved by compensation caps.
- > Slow-Control configuration is problematic for long slabs.
- > Feedback of channel-wise trigger thresholds on the global threshold.
- > Random zero events and zero-results for the first trigger.
- > Poor uniformity of the input DACs.
- > Holdscan is different for HG/LG.
- > Trigger threshold width increases with threshold height.
- > Amplitude-to-threshold relation depends on preamp. setting and pulse shape.
- > TDC: Amplitude dependent time-shifts and channel-to-channel spread.
- > TDC: Result depends on which ramp is used and the memory cell.
- > TDC: big chip-to-chip spread of ramp slopes.



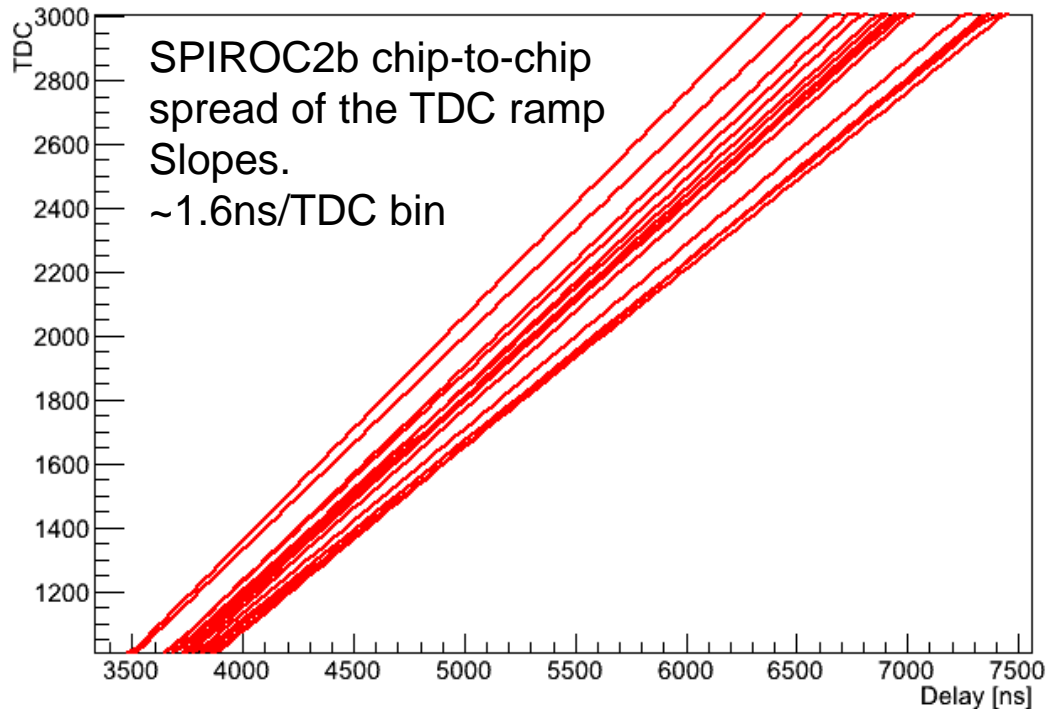
Power and Power Pulsing (PP)

- Aim: Switch on as short as possible before data taking starts (initial idea: $20\mu\text{s}$).
- Results with charge injection show a decreased amplitude response with PP.
- Single-Pixel Spectra measurements show a reduced amplitude with PP.
- Aimed power dissipation of $20\mu\text{W}$ per channel not reached yet.

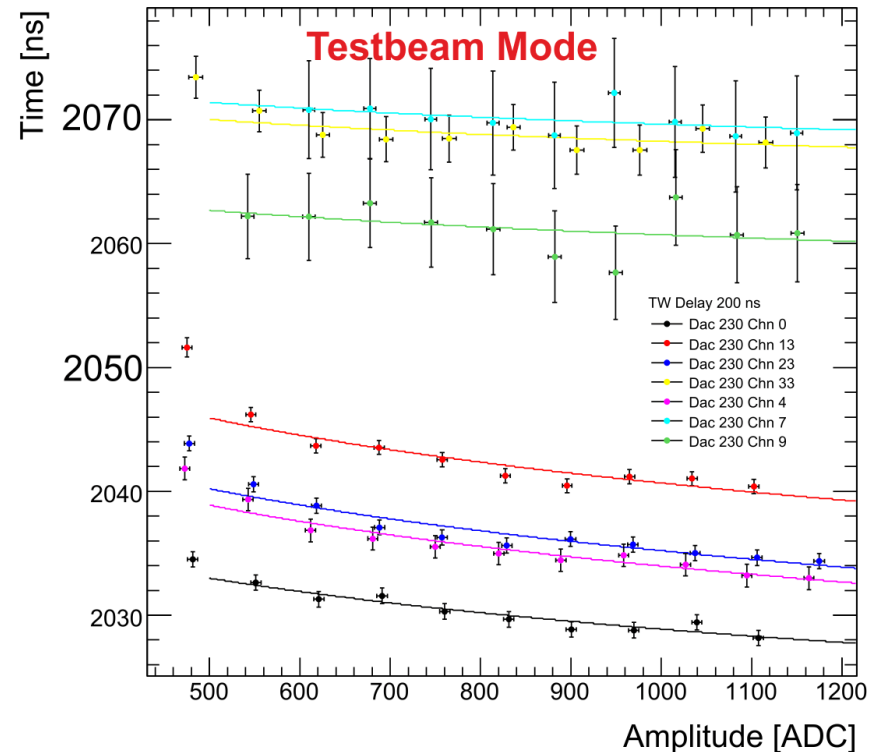
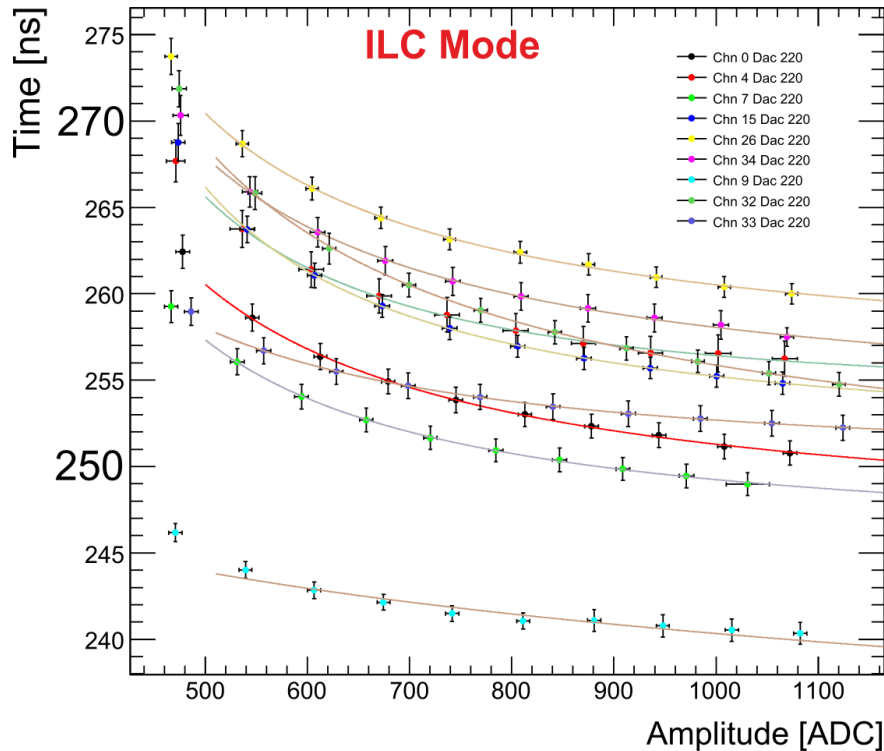


TDC Calibration – CERN Module

- Calibration of all 16 SPIROC2b ASICs of the CERN Testbeam-module with charge injection.
- Chip-to_chip spread of the TDC ramp slopes: Calibration necessary: TDC (time measurement!).



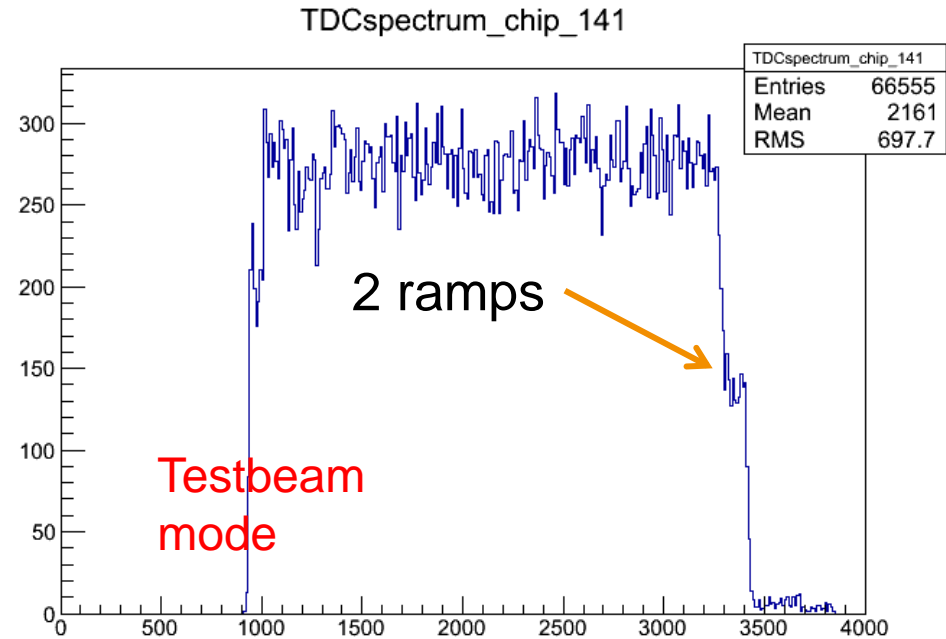
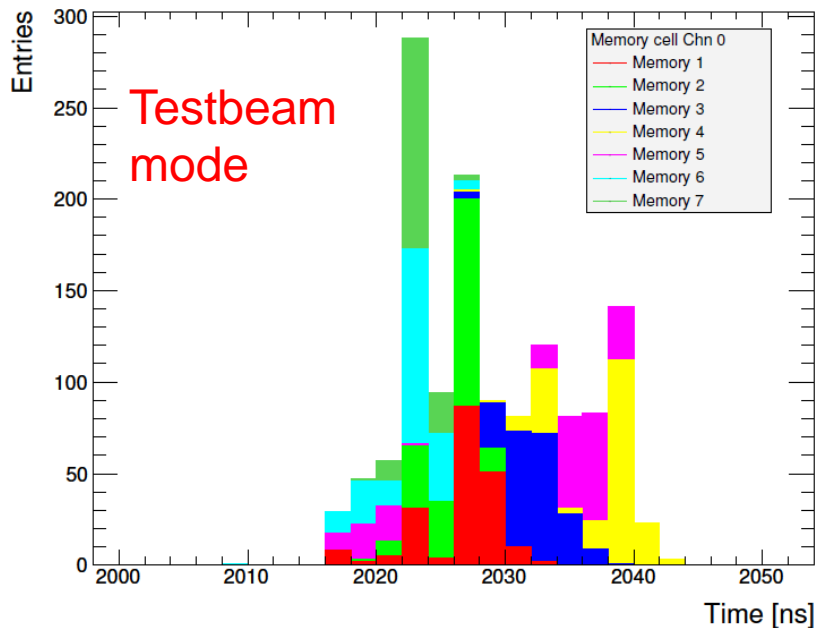
TDC: Time Walk and Channel-to-Channel Spread



- Amplitude-dependent time-shifts and channel-to-channel differences.
- Difficult to parameterize because of different behaviours. Channel-wise TDC calibration necessary as for ADC (MIP calibration)?



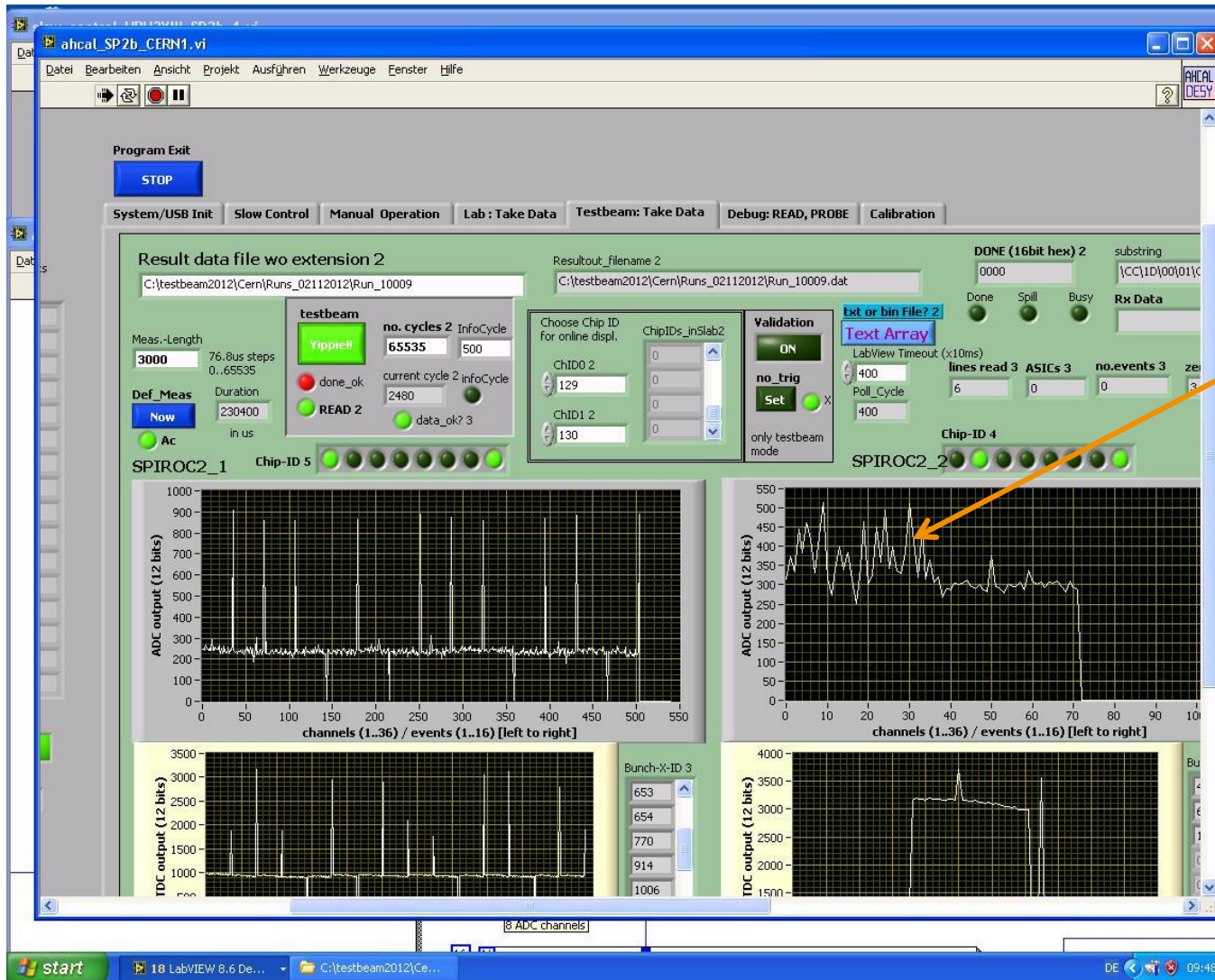
TDC: Memory Cell Dependence and „2-Ramp“ Problem



- TDC result depends on memory cell
- The SPIROC2b internal TDC ramps have different amplitudes and for a specific event it cannot be identified with which ramp the TDC result has been achieved (known problems).



Start-Run Problem



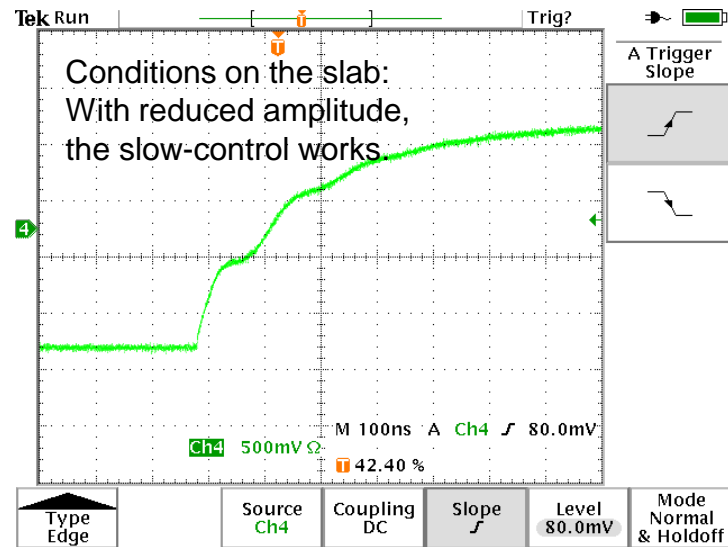
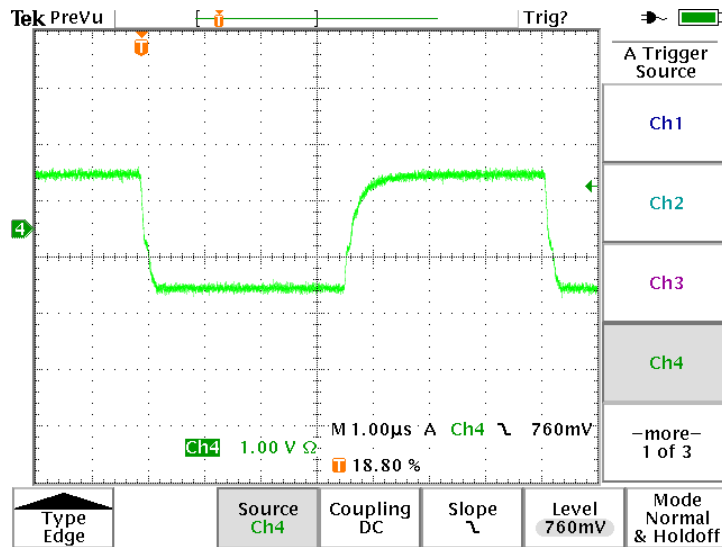
CERN testbeam

High noise on pedestal for first 1-2 readout cycles



Slow-Control Problem

- For longer AHCAL slabs, the slow-control programming is instable. Reason: Slow-control clock, special pulse-shape needed (series R, termination R, block-C)



- Although the slow-clock looks fine, the configuration does not work.
- Analysis ongoing, I2C in SPIROC3.