# AHCAL Electronics.

## Status and Outlook

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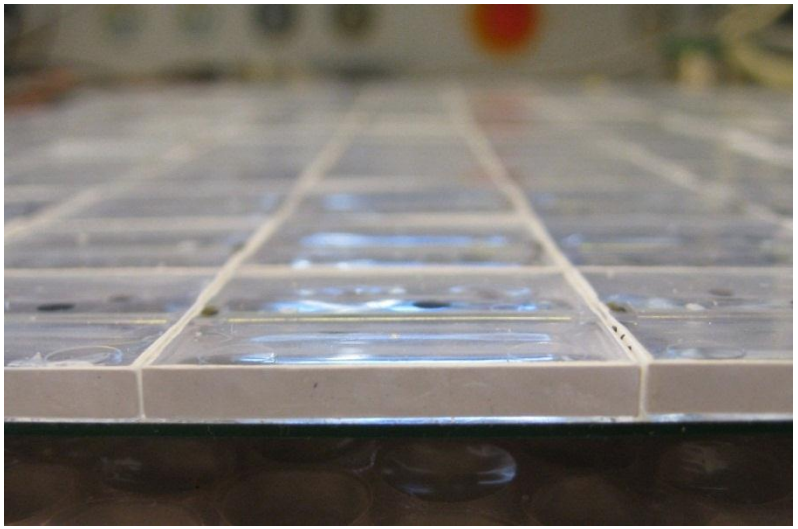
CALICE collaboration meeting
Cambridge, UK
March 16th-19th, 2012

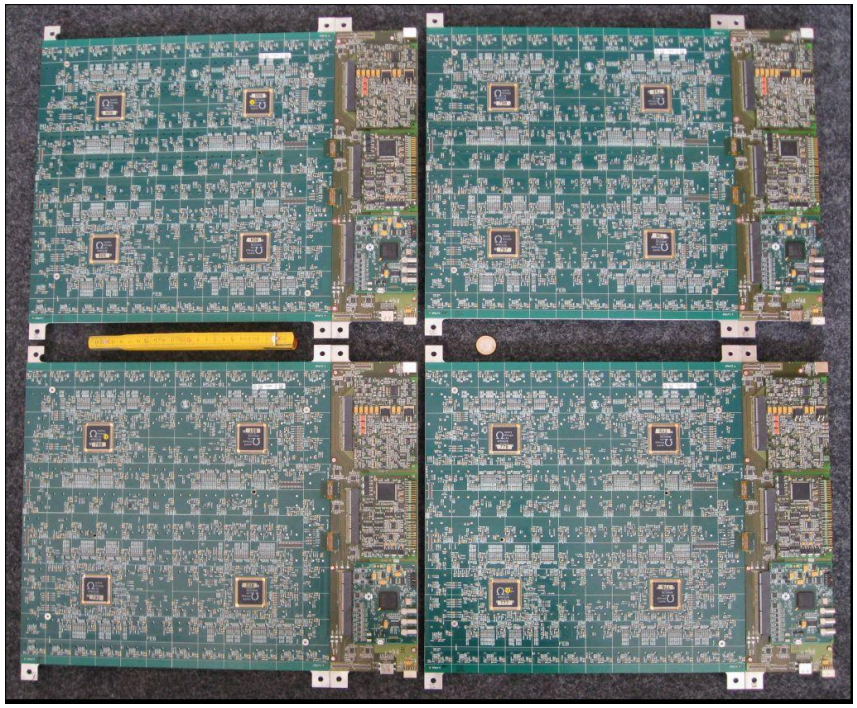
# Outline

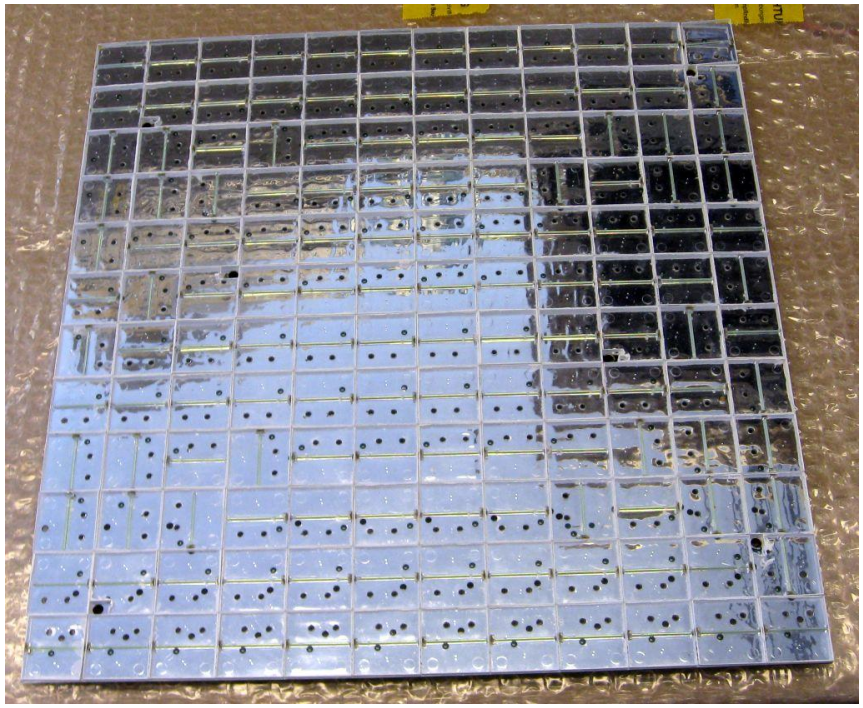
- Hardware Status
  - New AHCAL Modules
  - Surface Mount HBU (SM_HBU)
  - Scintillator ECAL-BU (EBU)
- Testbeam Preparations
  - Multichannel Gain Equalization
  - Autotrigger Threshold
  - Time (TDC) measurements in SP2b
  - Power Pulsing (optional)



*Assembled tiles below HBU2*

# New AHCAL Modules

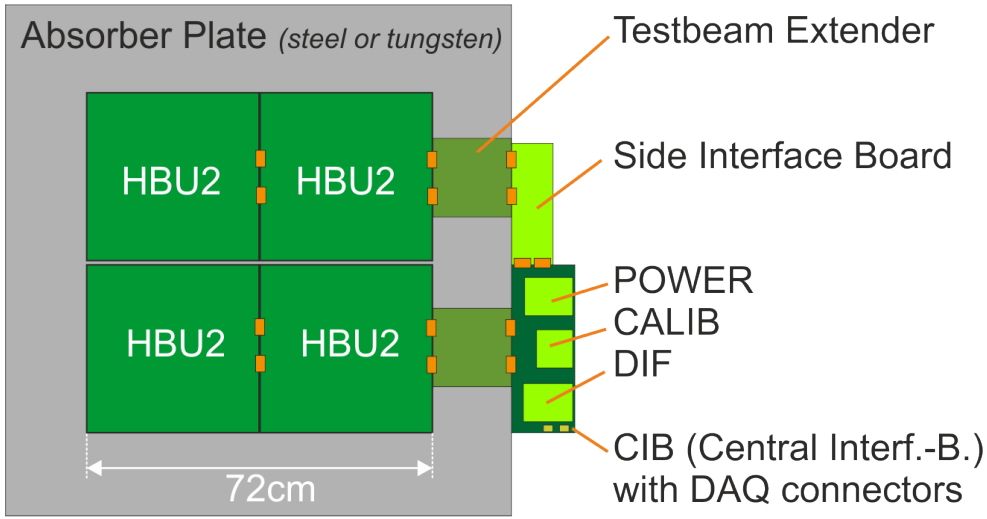


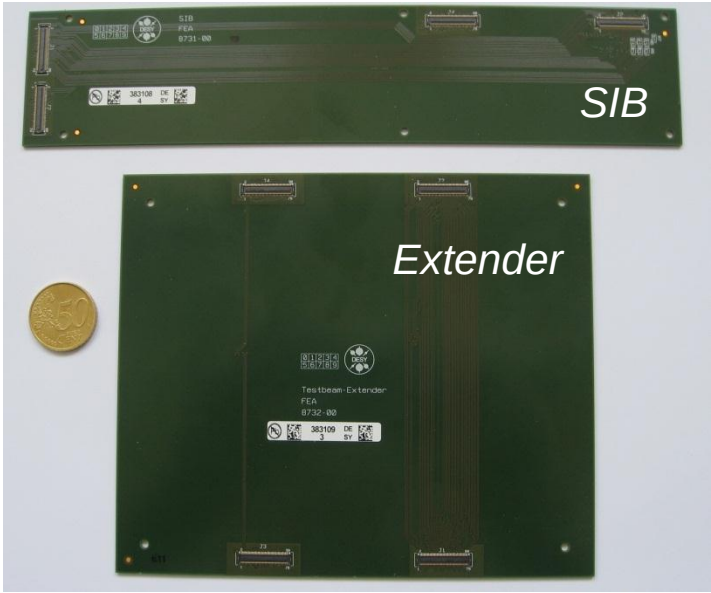


- 6 new HBUs realized: 4 testbeam, 1 SPIROC2c, 1 spare module
- 10 new DAQ setups (CIB, POWER2, DIF2, CALIB2) realized.
- 4 HBUs equipped with tiles and in steady operation. Modules work fine!

# New AHCAL modules (CERN testbeam specific)

## Side Interface Board and Testbeam Extender Module

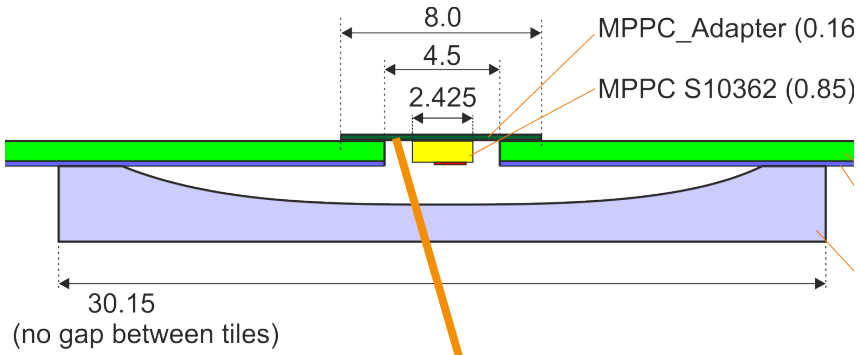


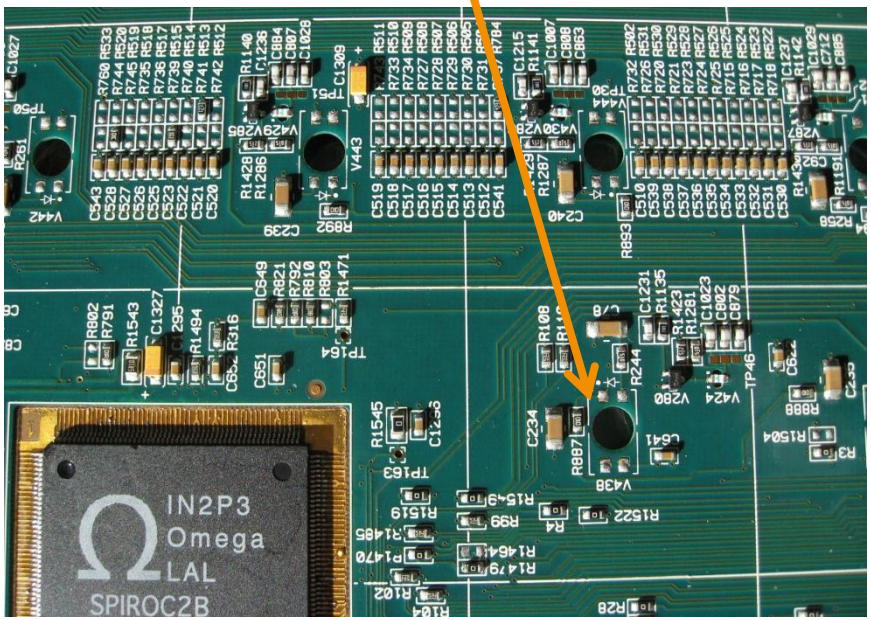

- 4 SIBs and 4 Extenders realized.
- Extender tested: OK!
- Full setup including SIB can only be tested in final testbeam cassette: Foreseen end Sept.

# Surface Mount HBU (SM_HBU)

- Idea: MPPC is part of the HBU: Easy assembly in one step.
- Scintillator has curvature: Improvement of light uniformity.
- NIU – DESY collaboration.







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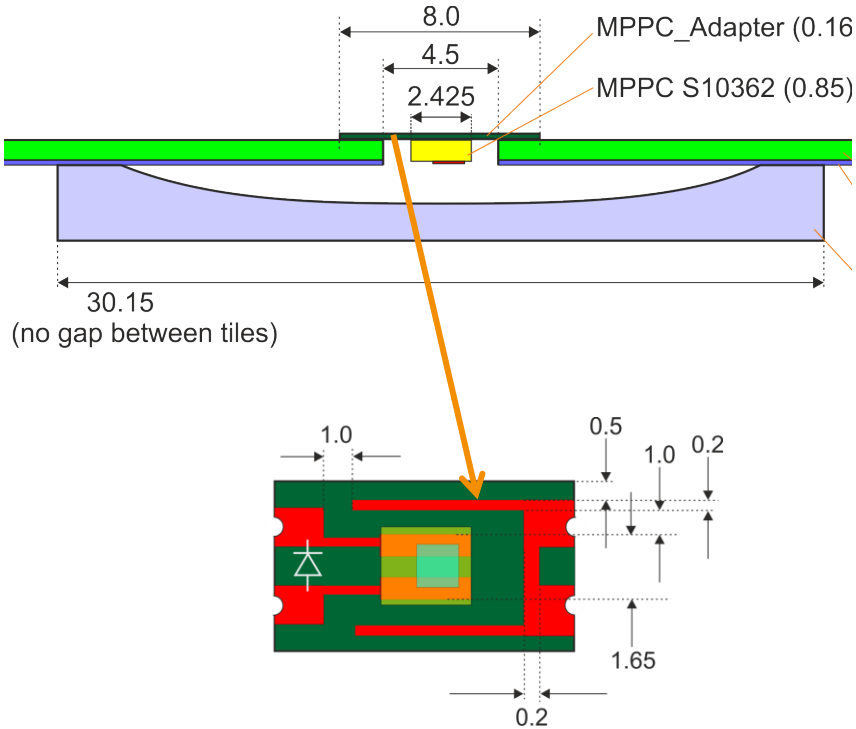
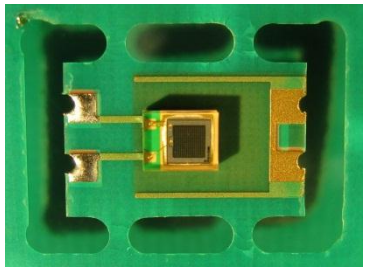
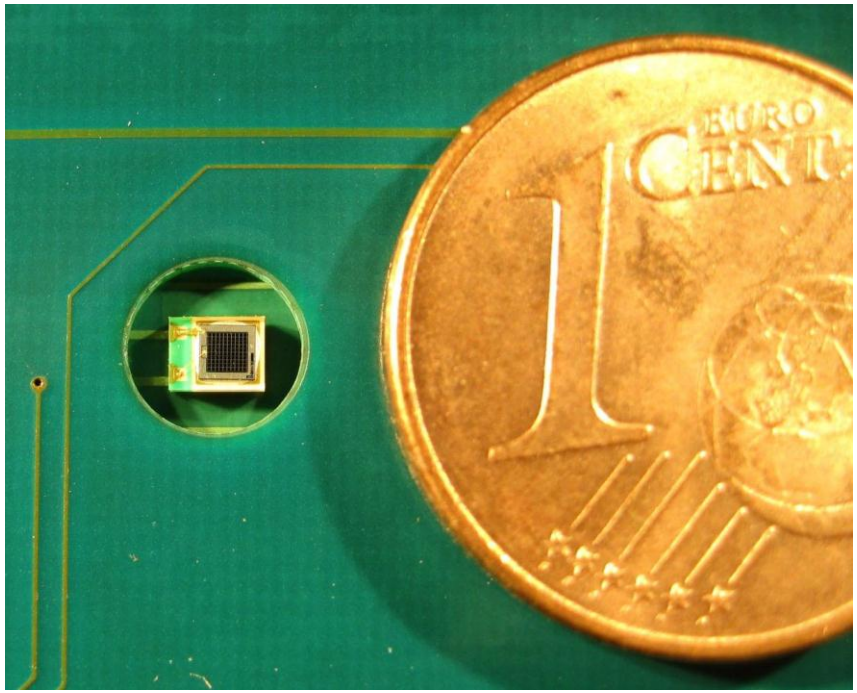


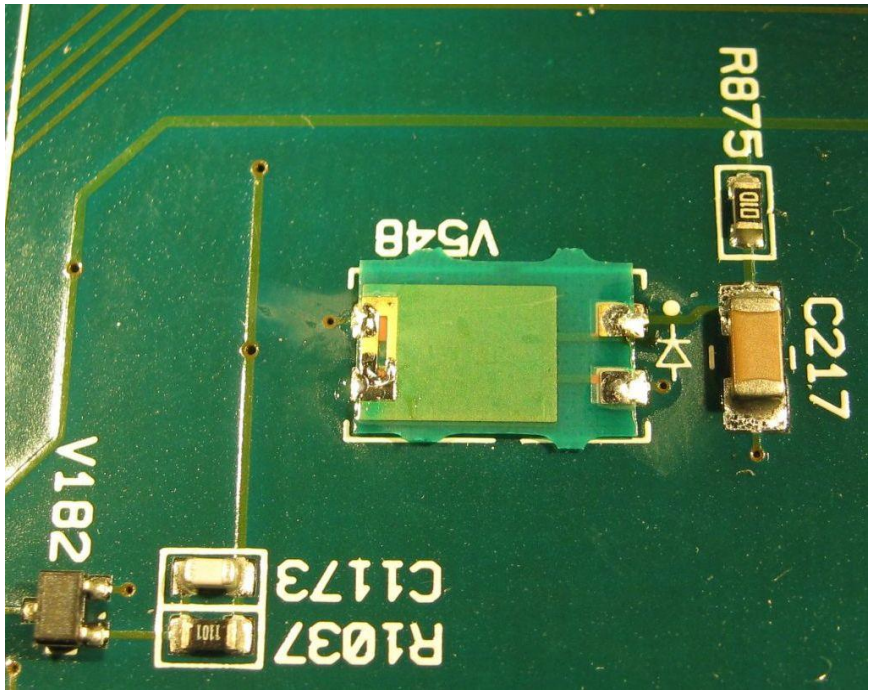



Idea → Reality

# Surface Mount HBU (SM_HBU)



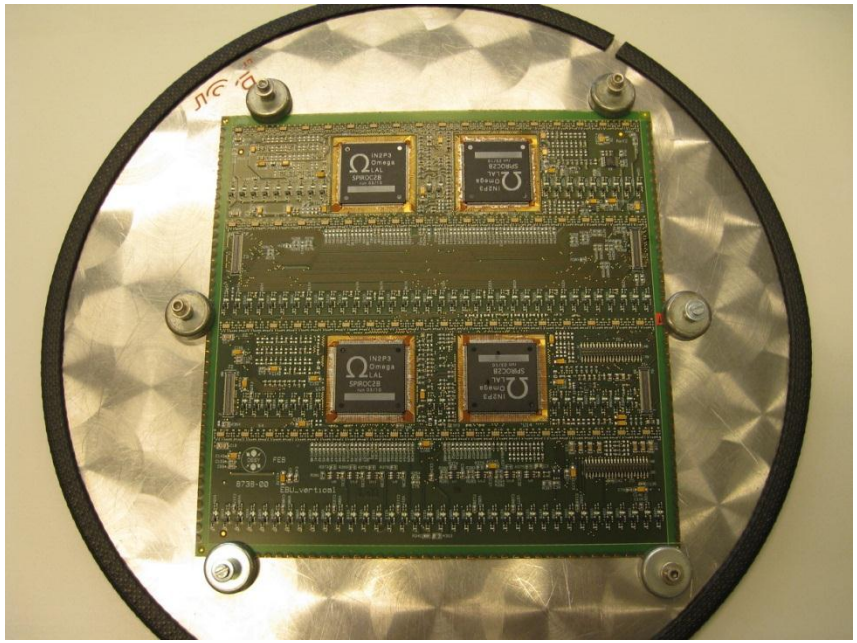
SM_HBU backside




SM_HBU front-side

- 2 SM_HBUs realized: 1 works fine, 1 has a broken SPIROC (to be replaced)
- 12 MPPCs on MPPC Adapter available (from NIU), 1 assembled
- Setup for SM_HBU with DAQ allocated, Scintillator not equipped.

# Scintillator ECAL-BU (EBU)



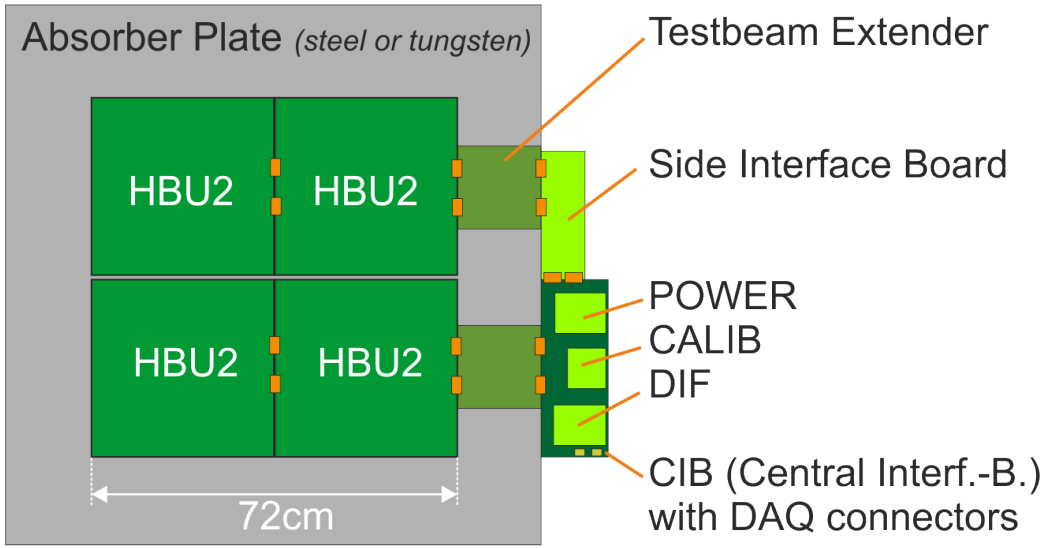
MPPC flexlead strips
(Shinshu Univ.)

- 4 EBUs in production (boards ready, in assembly at DESY).
- Commissioning at DESY with AHCAL HBU DAQ and Labview software.
- Assembly of MPPC strips and scintillators afterwards.
- Foreseen for electron testbeam at DESY in October (Shinshu Univ.).

# Testbeam Preparations

## Testbeam at CERN beginning of Nov. 2012

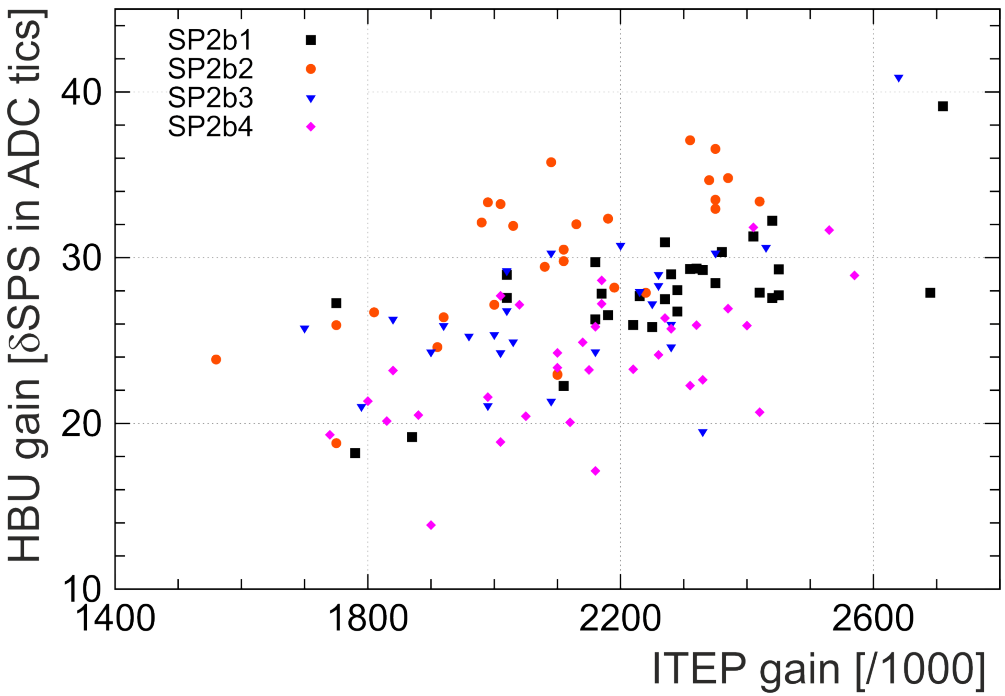
- 4 HBU2s in 1 layer.
- Labview DAQ.
- Details: See AHCAL session (Benjamin).




- 4 HBUs equipped with 2 batches of tiles: gain of 3 HBUs: 1750000-2450000
  gain of 1 HBU : 500000-1300000
- Due to the large gain spread: Channel **gain equalization** necessary.

# HBU2 Channel Gain Equalization

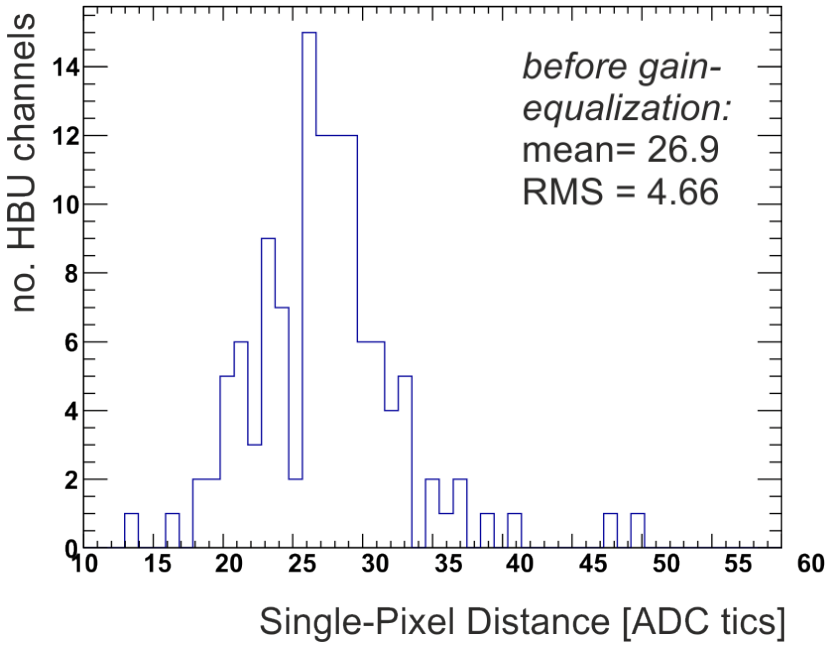
- Step 1: Measure the Single Pixel Spectra (SPS) of each channel with the integr. LED system. Extract from the SPS the channel (SiPM*Preamp) gains.
- Compare with the ITEP gain measurements (results correlated?).

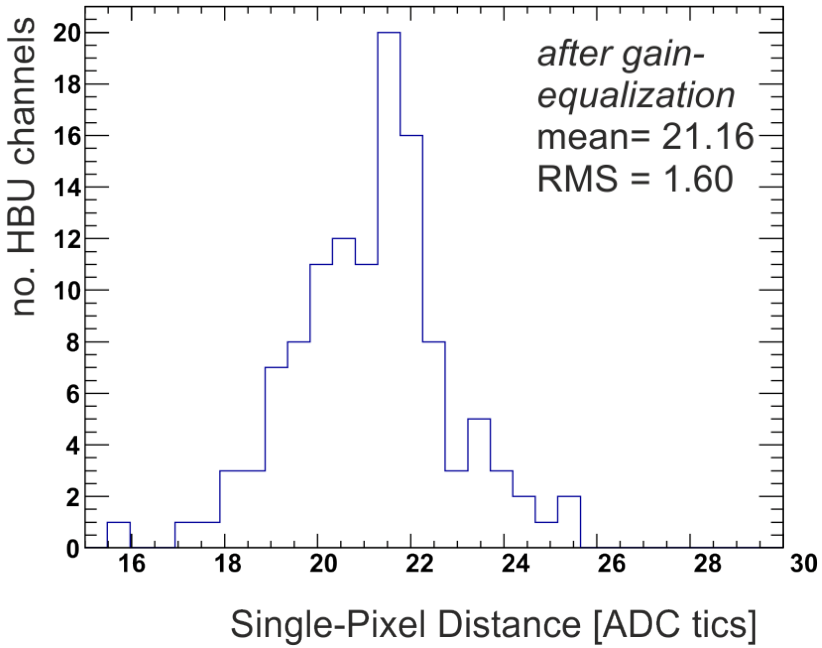



Gain equalization:
Oskar Hartbrich

# HBU2 Channel Gain Equalization

- Step 2: Adjust the SPIROC2b preamplifier gain per channel (trade-off between SPS resolution and dynamic range in high-gain mode).
- Step 3: Check results by additional LED calibration run.

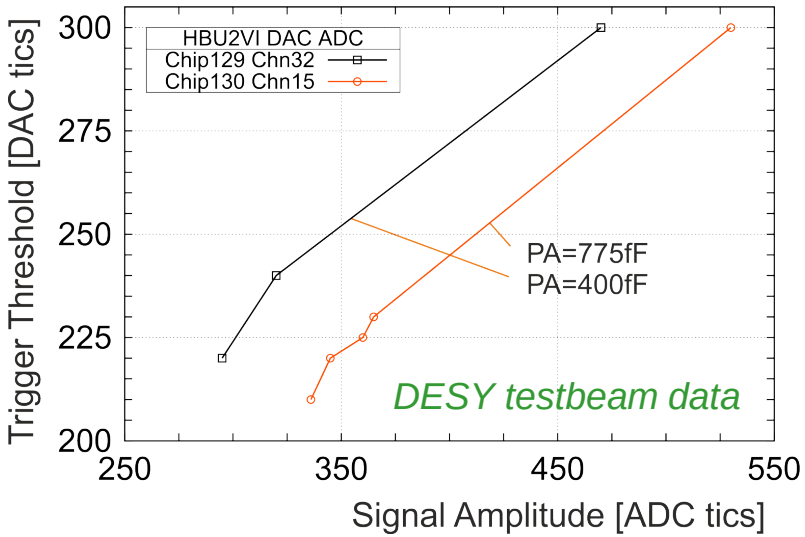



- Gain equalization works fine for all 4 modules.

# Autotrigger Threshold and Noise

- In autotrigger mode, a trigger threshold (DAC) must be defined for SPIROC2b, which is aimed to be set to a signal amplitude (ADC) of ½ MIP.
- Relation: trigger threshold DAC setting to ADC signal amplitude:

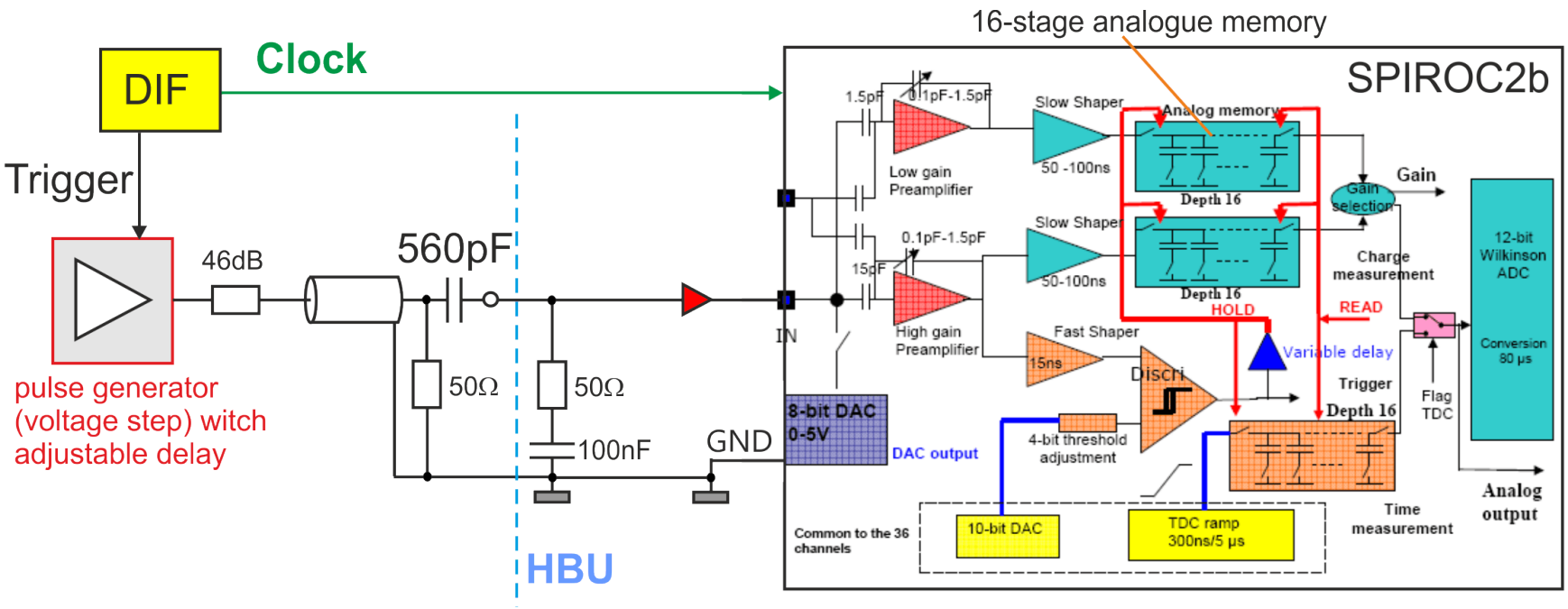



*<u>Preliminary</u>: MIP~500 ADC tics, Pedestal ~240 ADC tics*
*⇒ ½ MIP ~ 370 ADC tics*
*⇒ Trig. threshold ~ 250 DAC tics*

- The ADC-DAC relation depends on the SPIROC2b preamplifier (PA) setting and the input pulse shape. Difficult to define a single trigger threshold setting for all channels of one SPIROC2b.

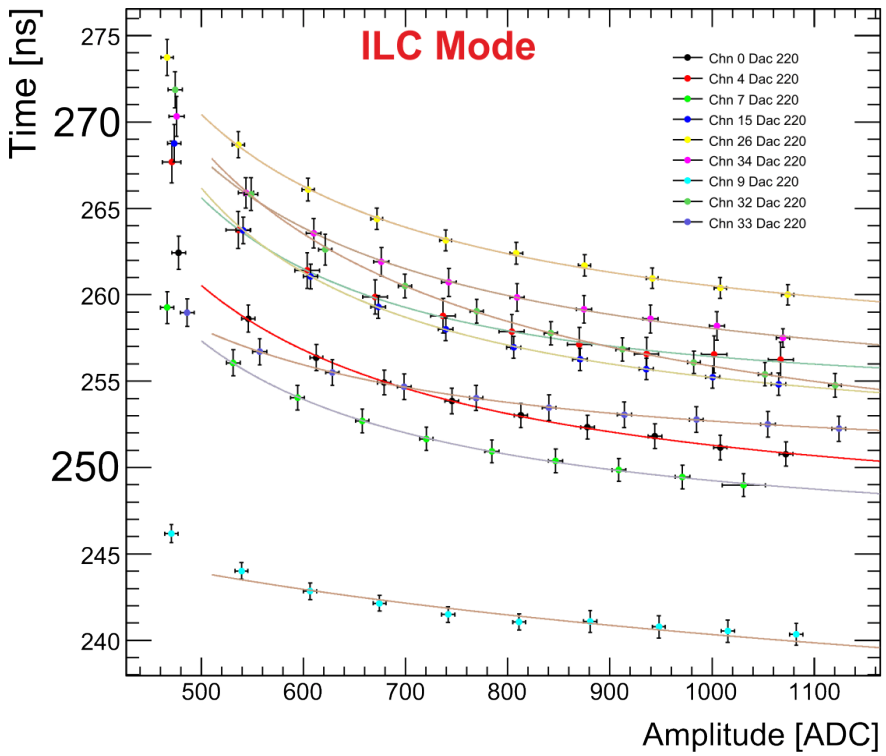
# Time measurement (TDC) in SPIROC2b

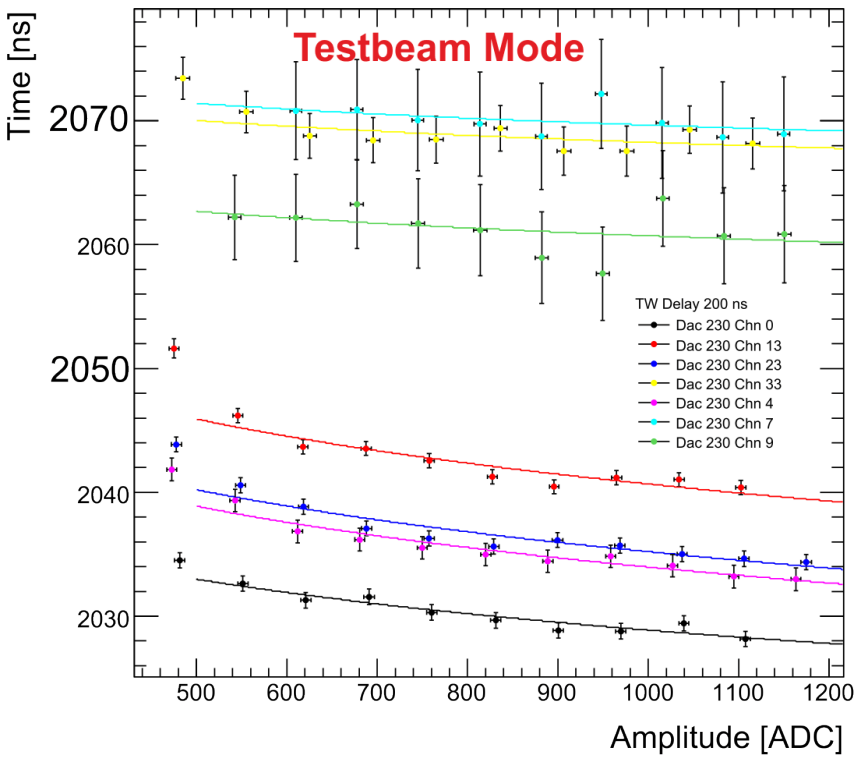
## Charge Injection Setup and prepared Operation Modes:




- **ILC Mode**: **Clock** = 5MHz, achieved resolution (single channel): ~ 350ps
- **Testbeam Mode**: **Clock** = 250kHz, resolution (single channel): ~ 1..1.5ns
- For details: See report from Eldwan Brianne *"Studies of the front-end electronics of the Analog HCAL"*

# TDC: Time Walk and Channel-to-Channel Spread

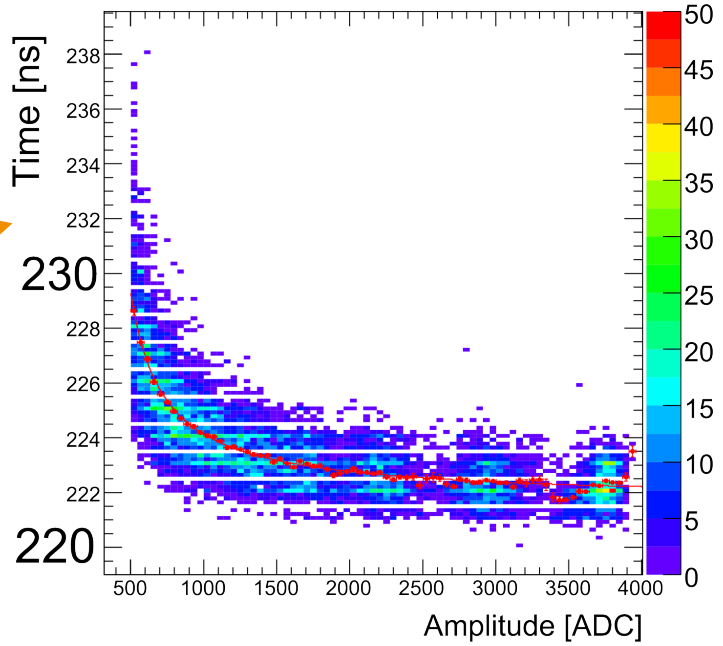



- SPIROC2b channels show significant amplitude-dependent time-shifts and channel-to-channel differences.
- Difficult to parameterize because of different behaviours. Channel-wise TDC calibration necessary as for ADC (MIP calibration)?

# TDC: Considerations

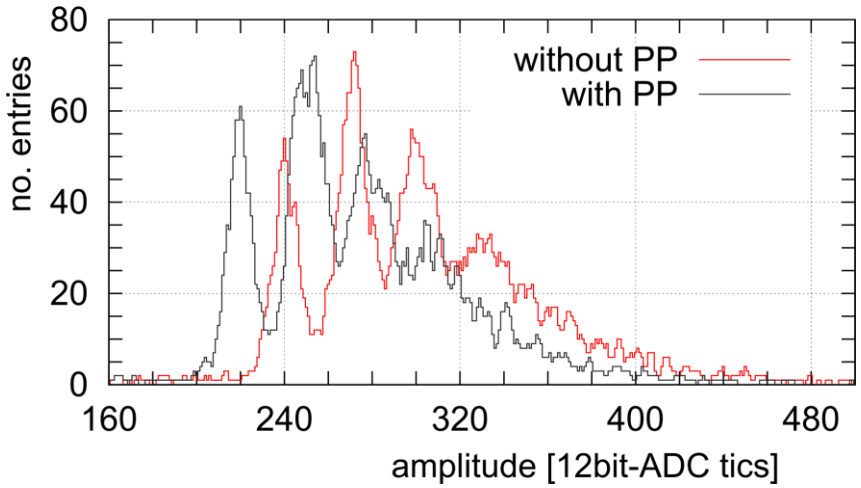
- Use integrated LED system for channel-wise TDC calibration. High statistics needed! To be analyzed.
- Use em-shower.




- For CERN testbeam use Testbeam Mode:
  - Smaller TDC dead-time (<2% instead of 30% in ILC mode),
  - event validation (rejection of noise trigger) is only possible in Testbeam Mode,
  - TDC ramp-to-ramp spread is negligible.

# Power Pulsing (PP)

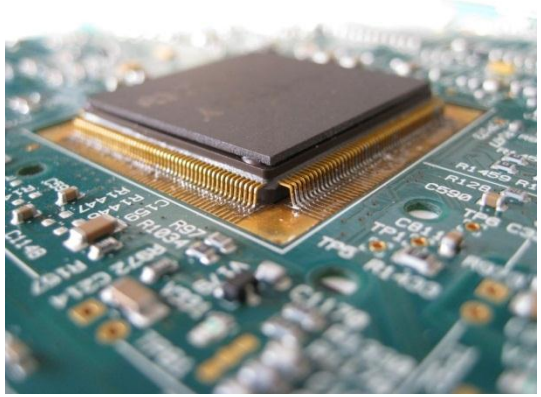
- Aim: Switch on as short as possible before data taking starts (initial idea: 20µs).
- Single-Pixel Spectra measurements show a reduced amplitude with PP.




*For this PP measurement, the filter capacitors on the SPIROC2b bias points were still in. Results without capacitors will follow.*

# Conclusions

- 6 new HBUs have arrived, 4 are assembled with tiles and are in operation. Preparation for testbeam at CERN ongoing.
- 2 SM_HBUs are ready for operation. 12 MPPC modules available.
- EBU vertical is in the last steps of production.
- SPIROC2c is assembled to one HBU, but still not working. Bad slow-control programming assumed.
- CALICE DAQ development is interrupted, we await eagerly the publication of the new software framework.



*SPIROC2c on HBU2*