AHCAL Electronics.

SPIROC2 and HBU measurement results

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CALICE main meeting

Univ. HASSAN II, Casablanca, Morocco

Sept. 23rd, 2010

HELMHOLTZ GEMEINSCHAFT

CALICE Calorimeter for ILC

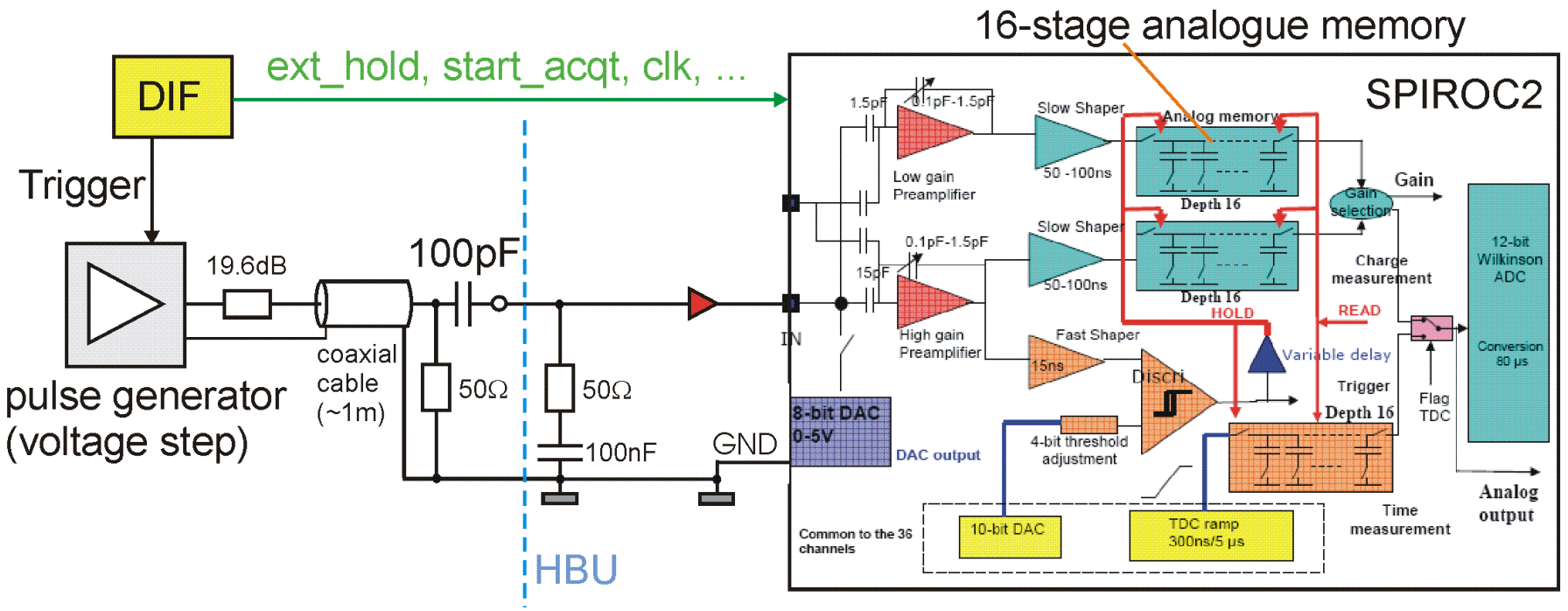
EUDET

DESY

Outline

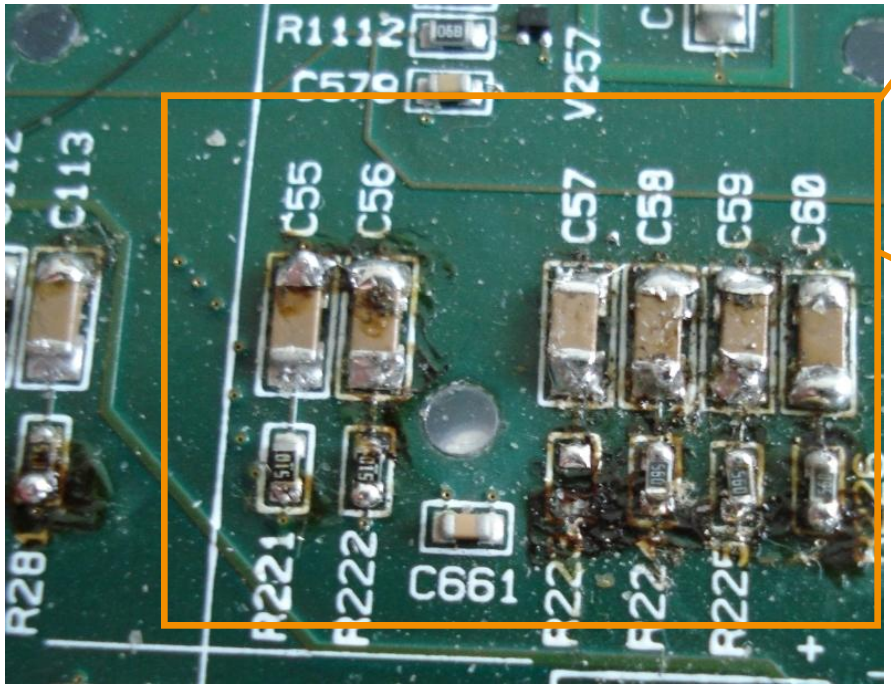
- Setup Electronics for Charge Injection
- SPIROC2 measurement results
  - Compensation capacitors
  - HOLD Scans, Dynamic Range
  - Autotrigger / Testbeam / MIP Efficiency
  - Rate Dependency
- Results from LED system
- Outlook
- Conclusions

Charge Injection Setup I – HBU_I in laboratory

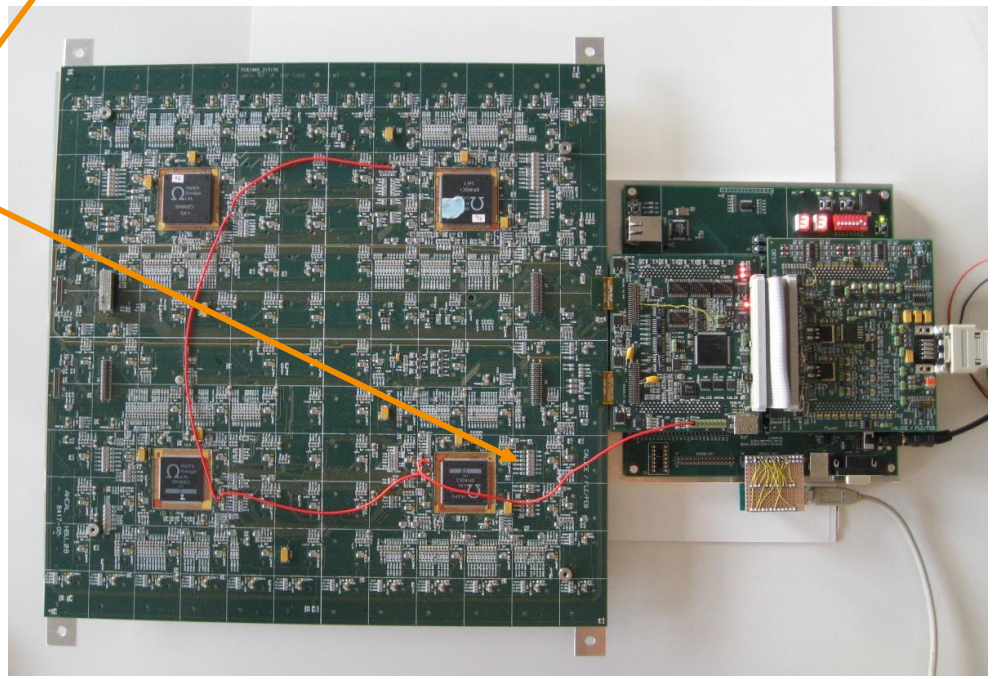


Looks like an easy setup, but ….

Charge Injection Setup II



SiPM termination @ SPIROC2 input



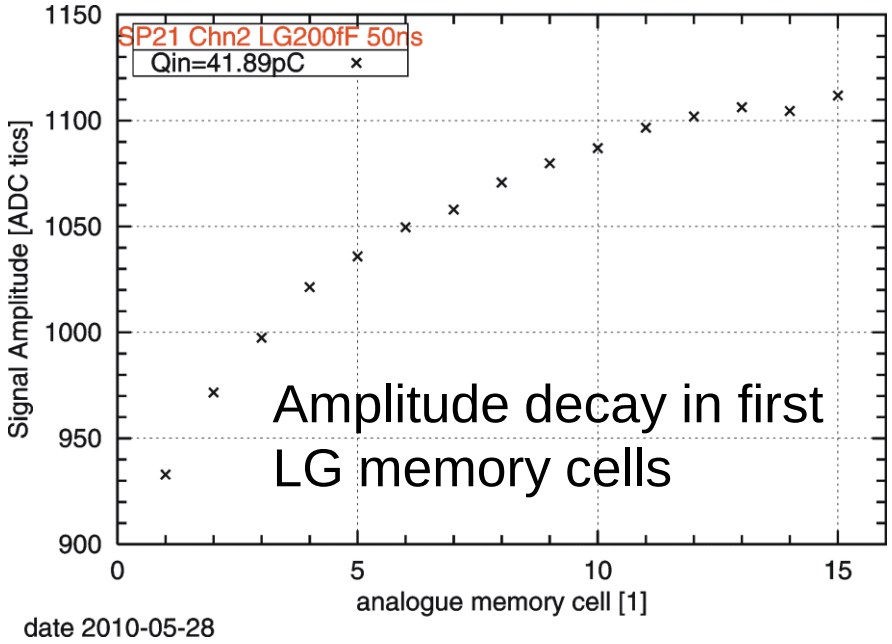
HBU has not been designed for charge-injection tests!

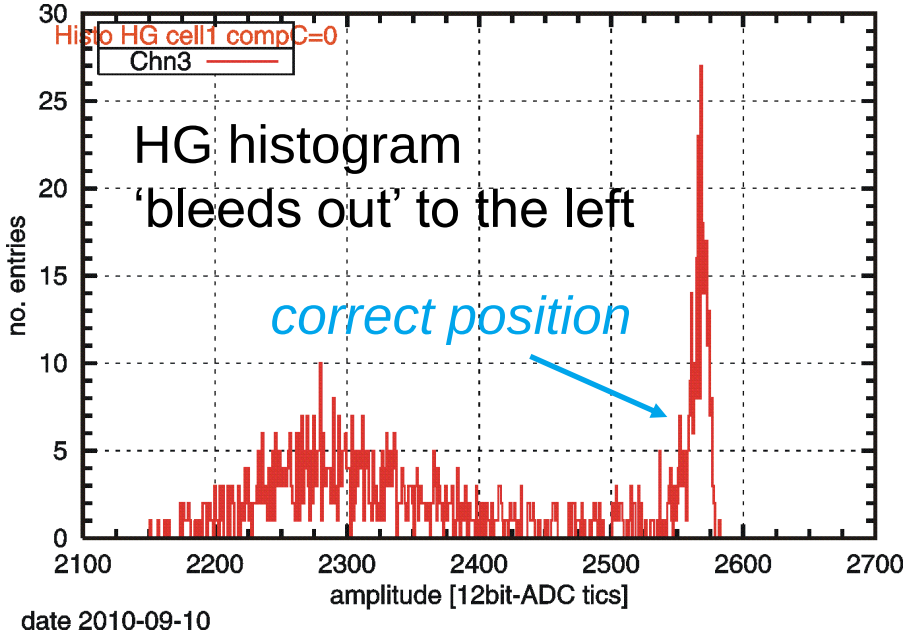
Initial idea: Analogue SPIROC tests => LAL testboards,
HBU => tests of digital part / readout chain / DAQ / system (SiPMs)

Due to new effects: HBU is used for analogue tests as well…

SP2 PA compensation capacitors

Problem: Cell dependent amplitude





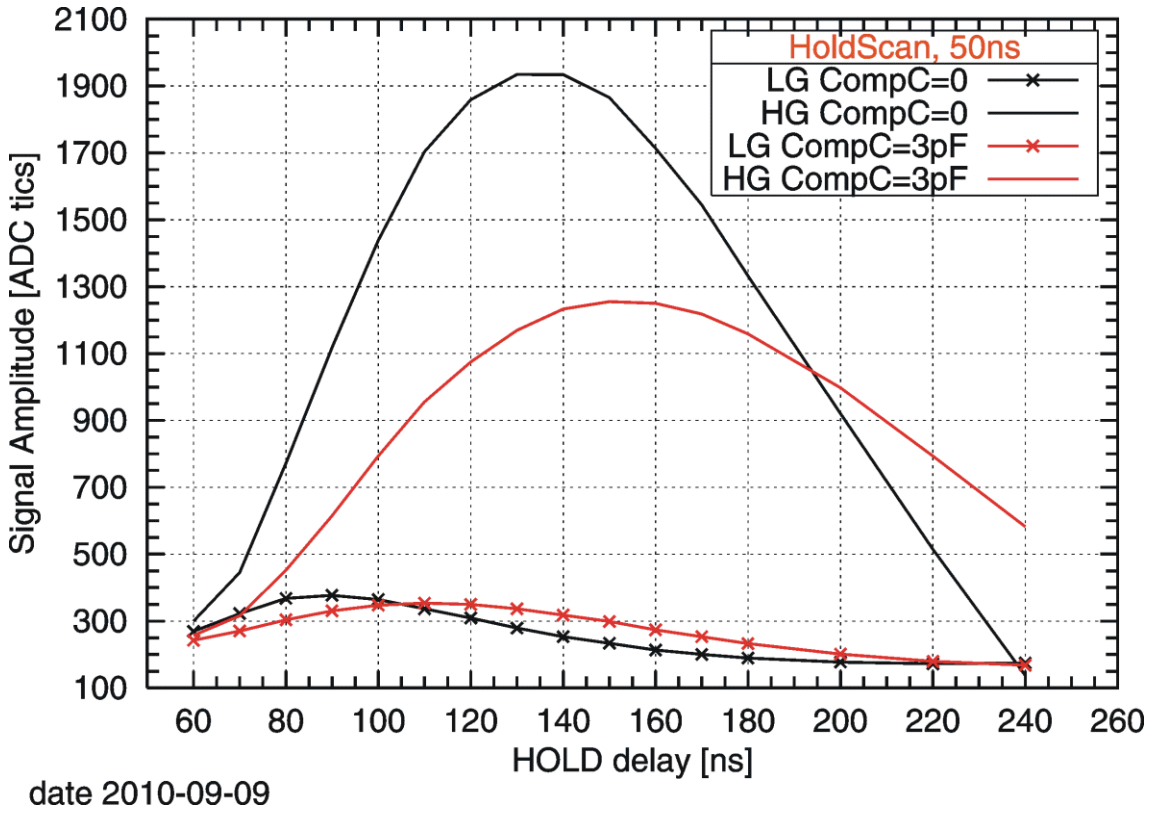
Effect cannot be eliminated as at LAL
by a high blocking-cap on VDDD2 (R. Honda)

Effect = f(amplitude, input signal shape, PA comp. caps)
Effect != f(trigger rate, block-caps@100µF)

HG PA=100fF, LG PA=200fF
50 ns shaping, ext. Hold/Trig.
hold-time=95ns (LG), 130ns (HG)
Charge Injection with 5ns risetime.
No PA compCs

SP2 PA compensation capacitors

Holdscan w/o compensation capacitors (CompC)

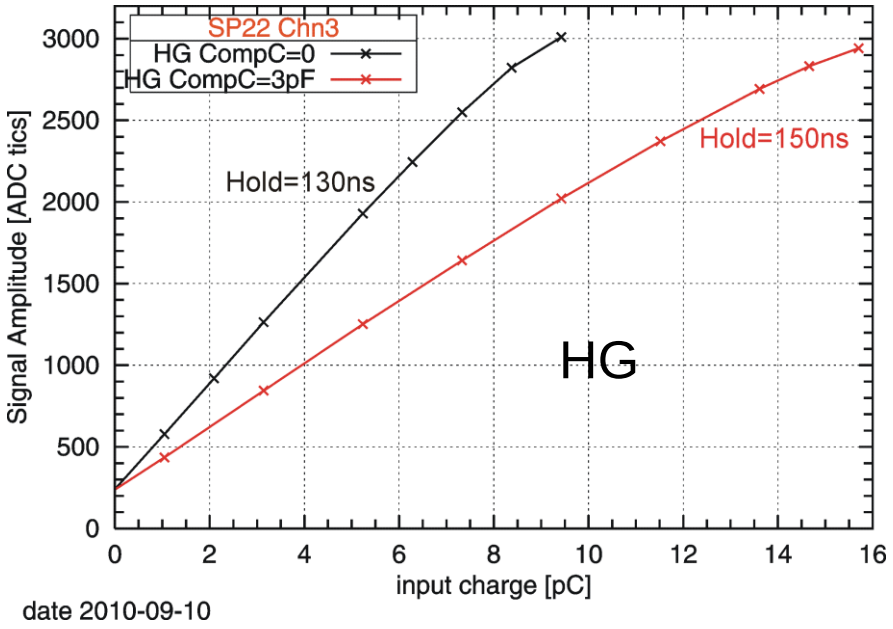


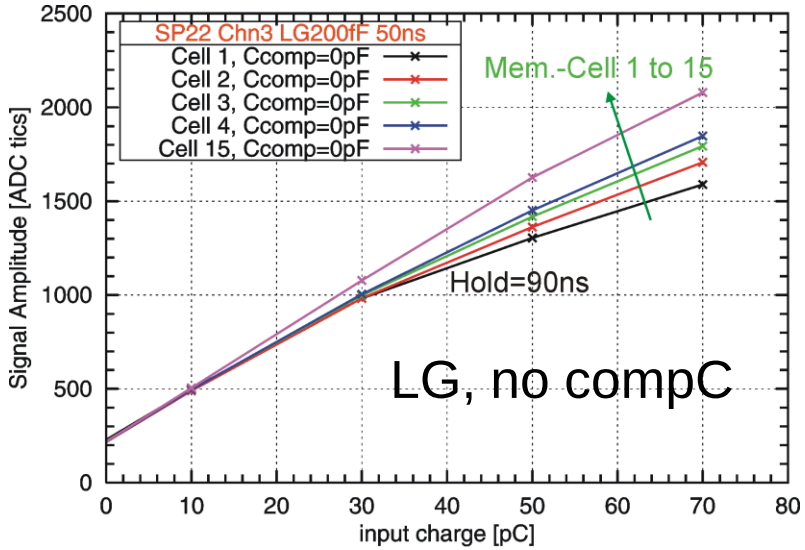
compensation caps change input signal shape….

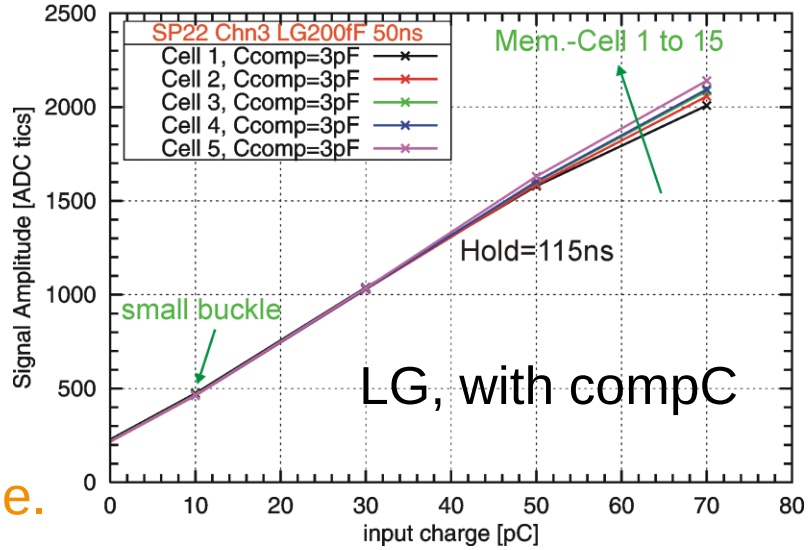
HG PA=100fF, LG PA=200fF
50 ns shaping, ext. Hold/Trig.
Charge Injection with 2ns risetime.

SP2 PA compensation capacitors

Dynamic Range HG and LG







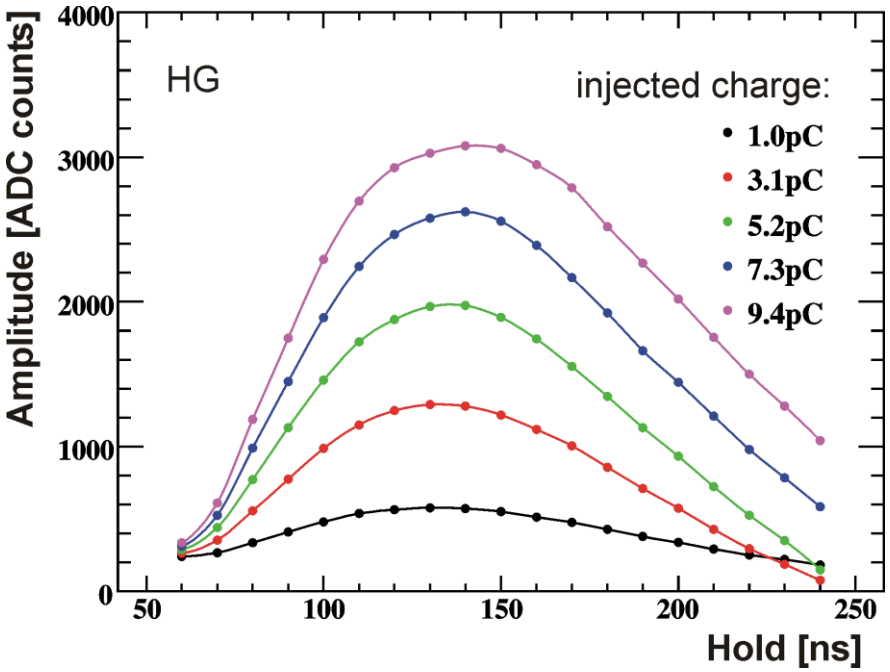
CompCs improve severely cell uniformity,
CompCs increase HG dynamic range,
CompC=3pF still not large enough
for very fast signals

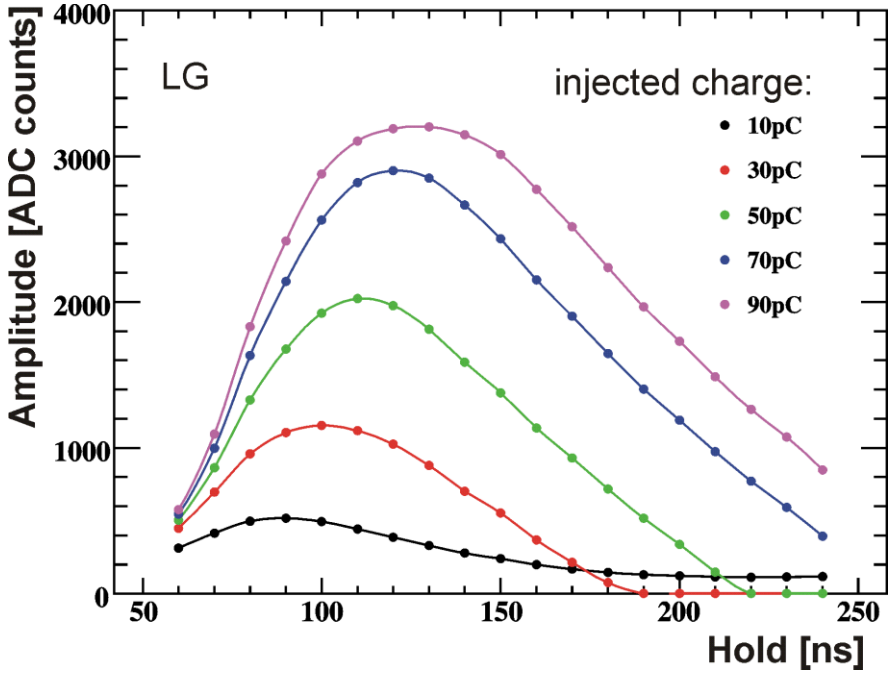
=> Input signal shape changes amplitude.

HG PA=100fF, LG PA=200fF
50 ns shaping, ext. Hold/Trig.
Charge Injection with 2ns risetime.

SP2 Holdscans

Problem: Position of Hold-Maximum depends on signal amplitude.
Position is different for HG and LG





Compensation capacitors do not improve this behaviour.

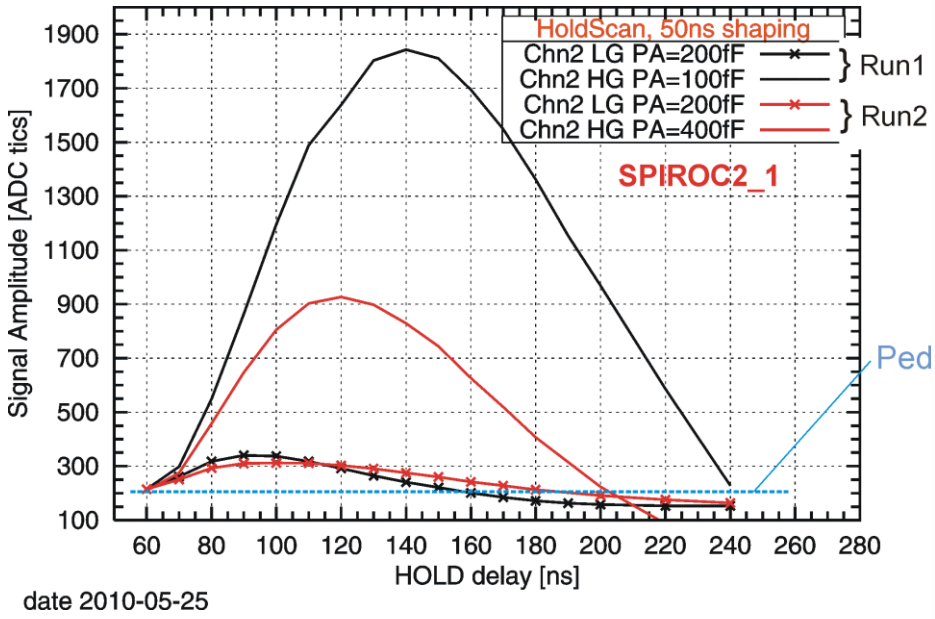
HG PA=100fF, LG PA=200fF
50 ns shaping, ext. Hold/Trig.
Charge Injection with 2ns risetime.
No PA compCs

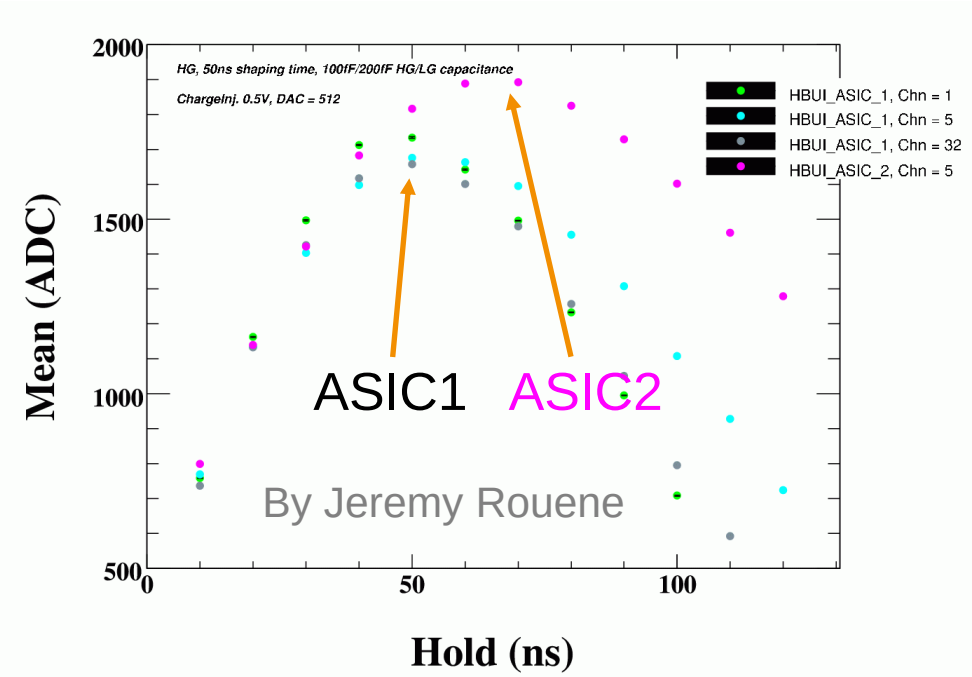
By Mark Terwort,
Mathias Reinecke

DESY

SP2 Holdscans

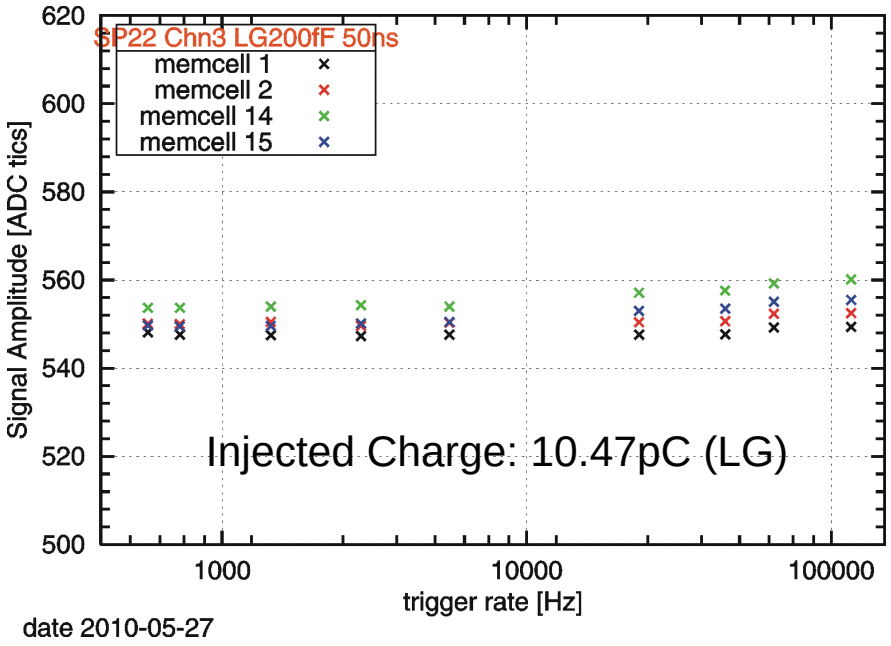
Problem: Position of Hold-Maximum depends on preamp. setting (left) and varies from ASIC to ASIC (right)

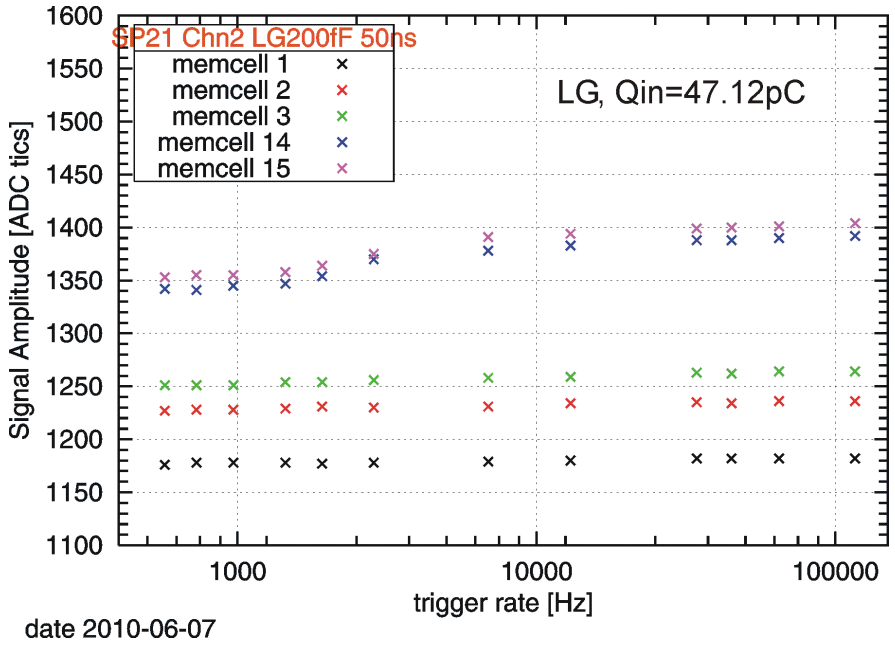




Charge Injection with 5ns risetime.
50ns shaping, ext. Hold/Trig
No PA compCs

SP2 Rate dependency



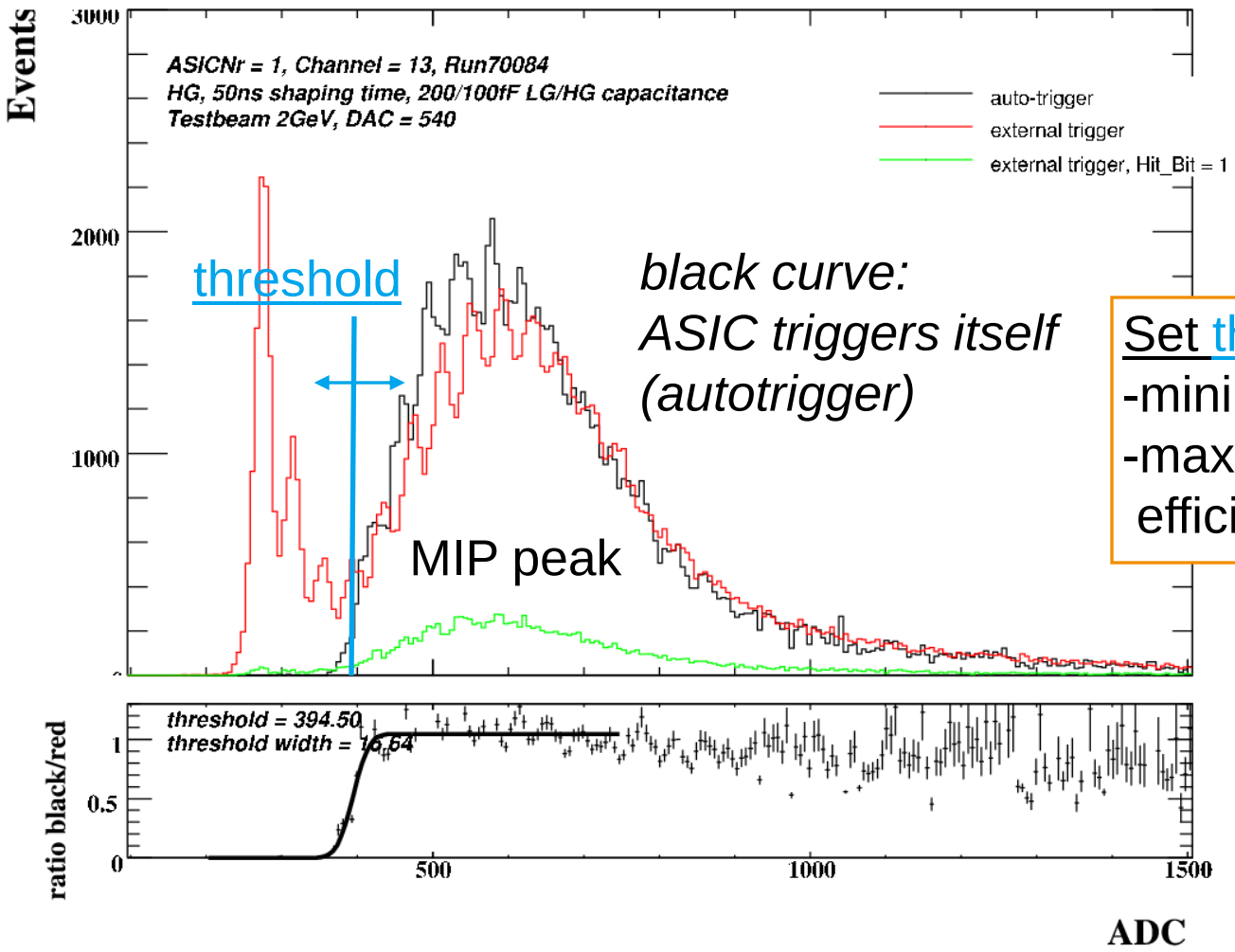


Good behaviour at small signals:
-no discharge of analogue memory
-no rate dependency

Fairly good behaviour at large signals:
-no discharge of analogue memory
-low rate dependency in last mem.-cells
-amplitude decay in first mem.-cells

HG PA=100fF, LG PA=200fF
50 ns shaping, ext. Hold/Trig.
hold-time=95ns (LG),
Charge Injection with 5ns risetime.
No PA compCs

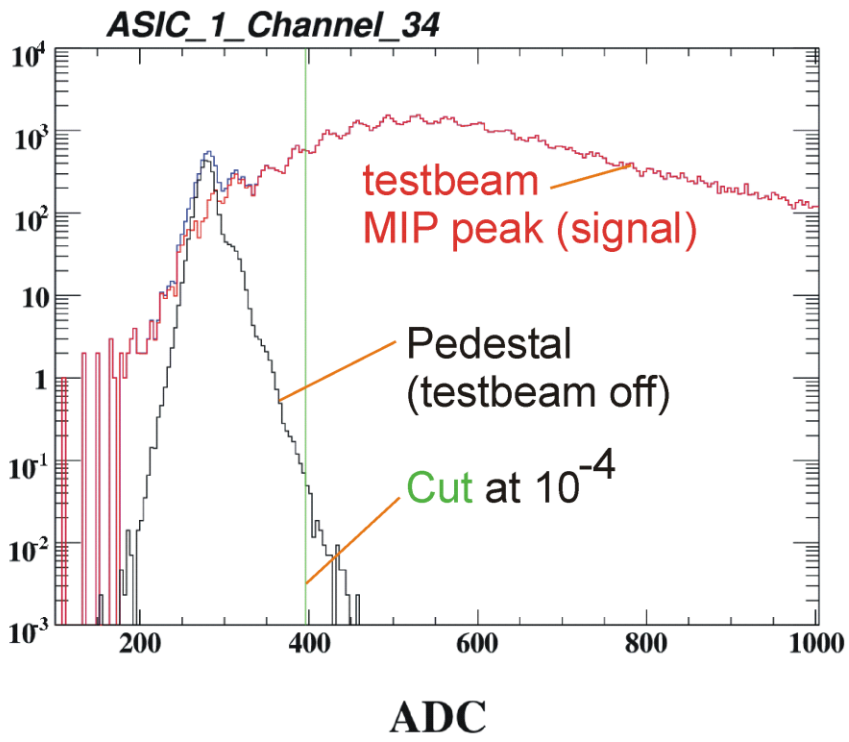
DESY Testbeam – ext. Trig vs. Autotrigger

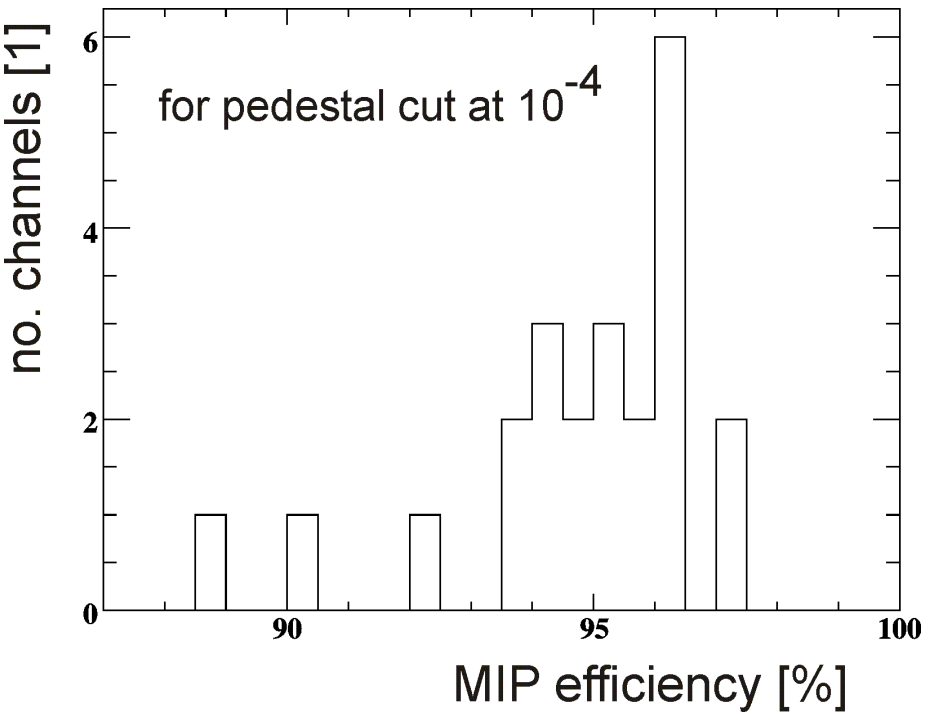


Set threshold to:
-minimize noise hits
-maximize MIP detection efficiency

Results by
Jeremy Rouene

Autotrigger MIP efficiency



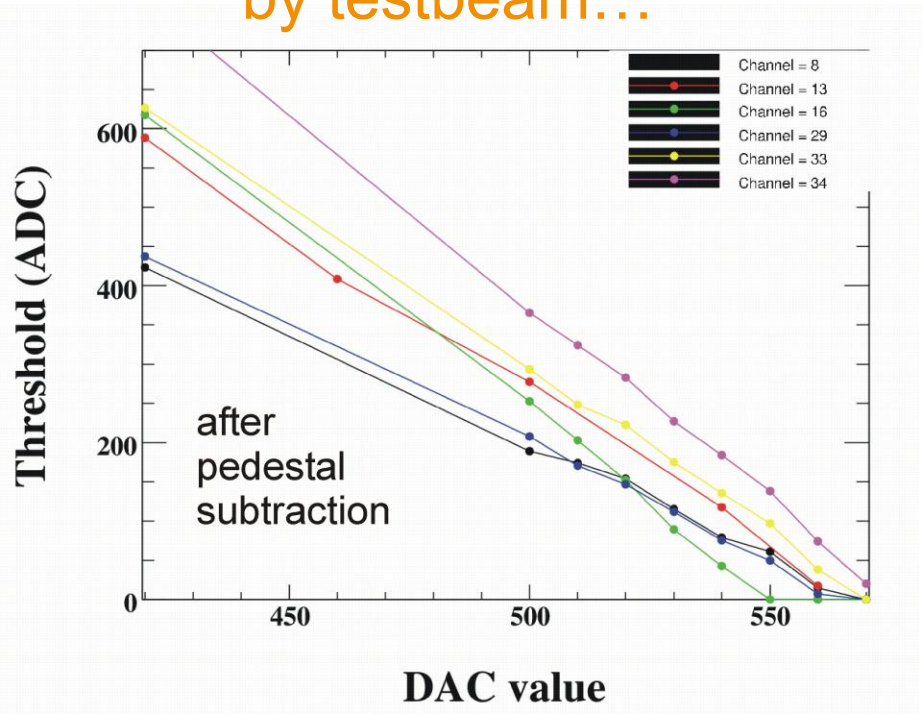


A MIP efficiency of ~95% can be achieved for a threshold-pedestal- cut at 10^(-4) for most channels (autotrigger mode).

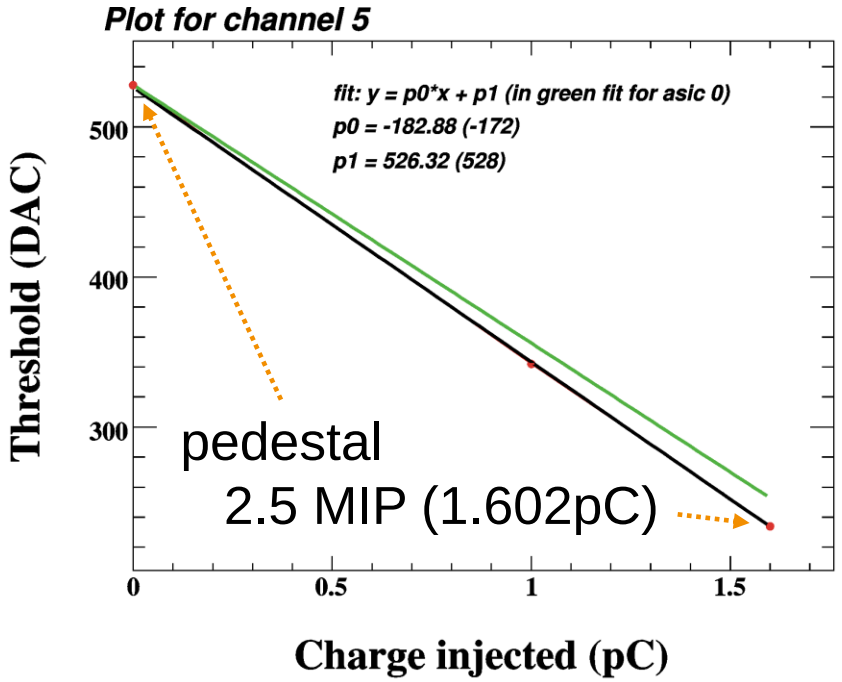
See more results in the report:
'Analysis of the autotrigger of the read out chip of the front-end electronics for the HCAL of the ILC.'
(Hamburg, Aug. 2010)
by Jeremy ROUENE

SP2 autotrigger threshold definition

by testbeam…



by charge injection…



~191 DACtics / pC (chn 8)
~120 DACtics / pC (chn 33)

(8pixels and 350ADCcounts per MIP,
SiPM gain of 5*10^5)

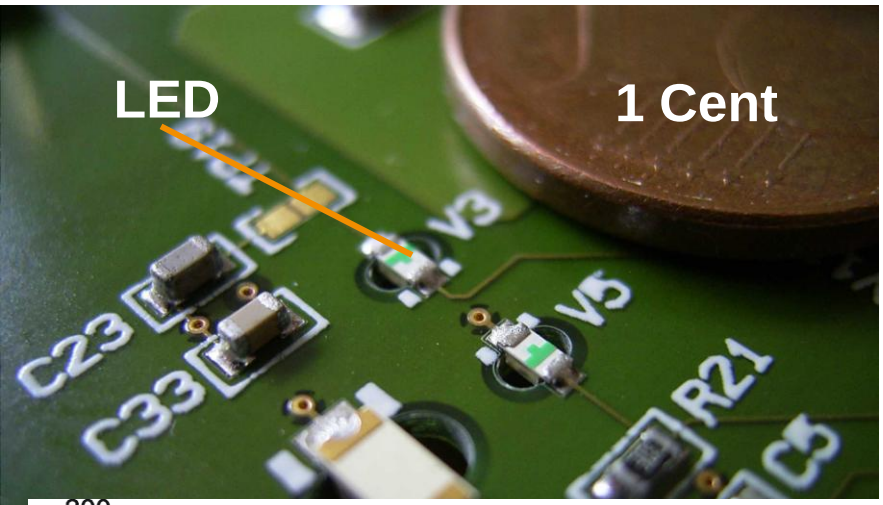
~ok!

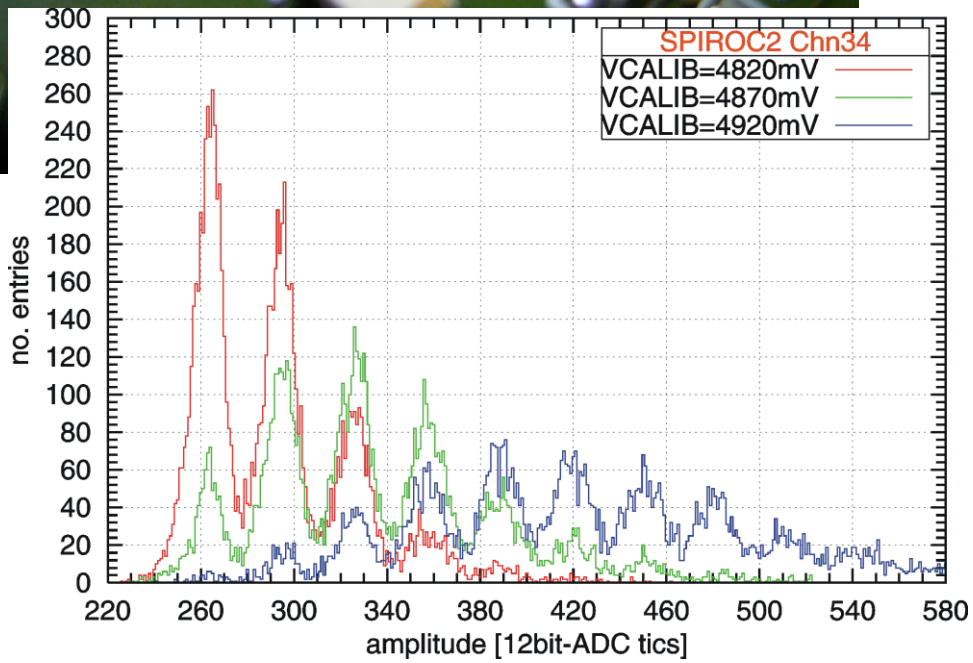
~172 DACtics / pC (ASIC1)
~182 DACtics / pC (ASIC2)

Spread: Channel-wise threshold adjustment necessary!

Results by
Jeremy Rouene

LED Calibration Systems II – DESY + Uni Wuppertal

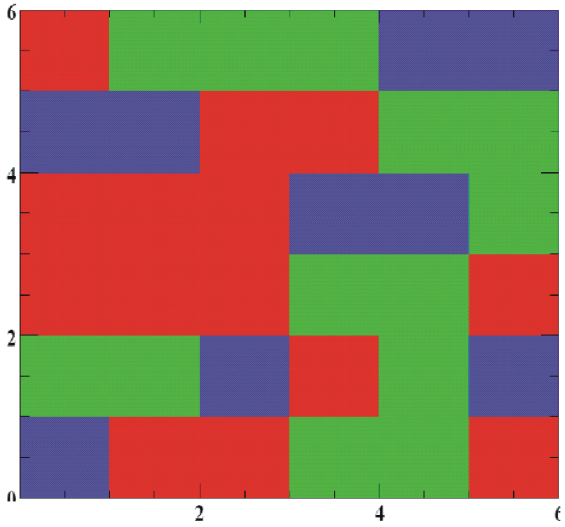




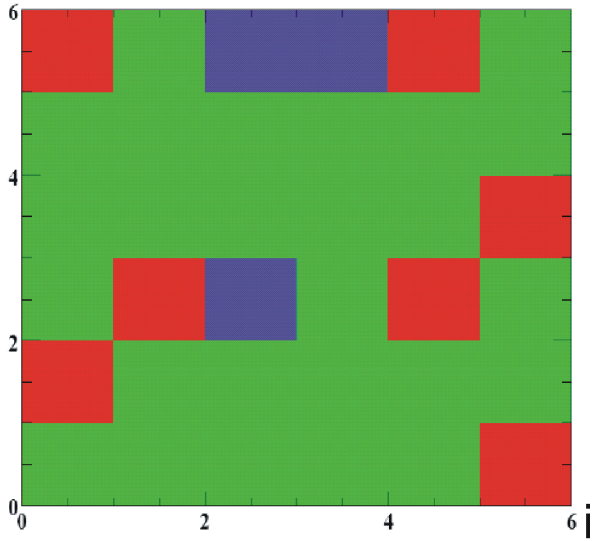
- LED uniformity under investigation
- Wuppertal recommended new LED driving circuit and new LED type with lower spread in output.
- HBU2 will contain solder parameter field in order to adjust LED power per channel.
- Problems: LED light output spread, dynamic range (saturation)

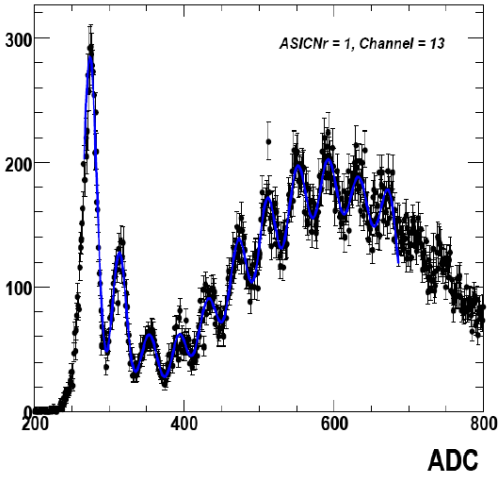
LED Calibration System – Current Activities

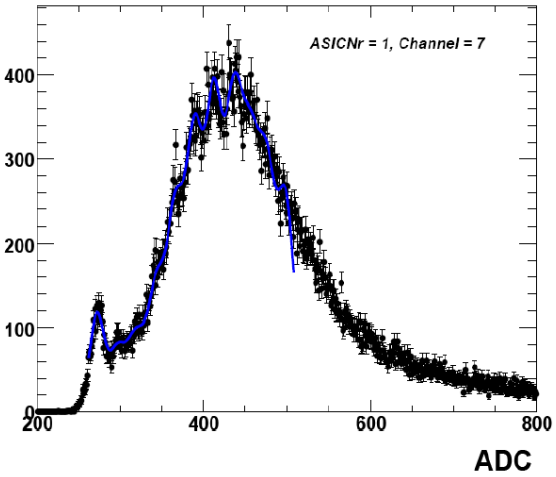
SPIROC2_2



SPIROC2_1







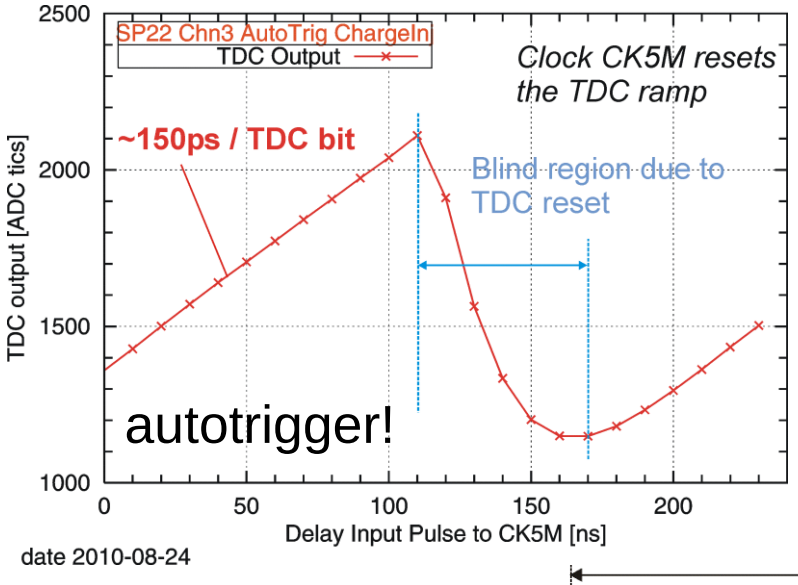
HBU-wide charact. of SiPM single-pixel spectra

green: good single-pixel spectrum
red: SiPM does not show single-pixels
blue: LED or SIPM dead
(to be analyzed …)

Development of:
Automatic FIT and gain extraction routines (here: for testbeam MIP signals)

Results by Julian Sauer

Next important steps (the last two big points):



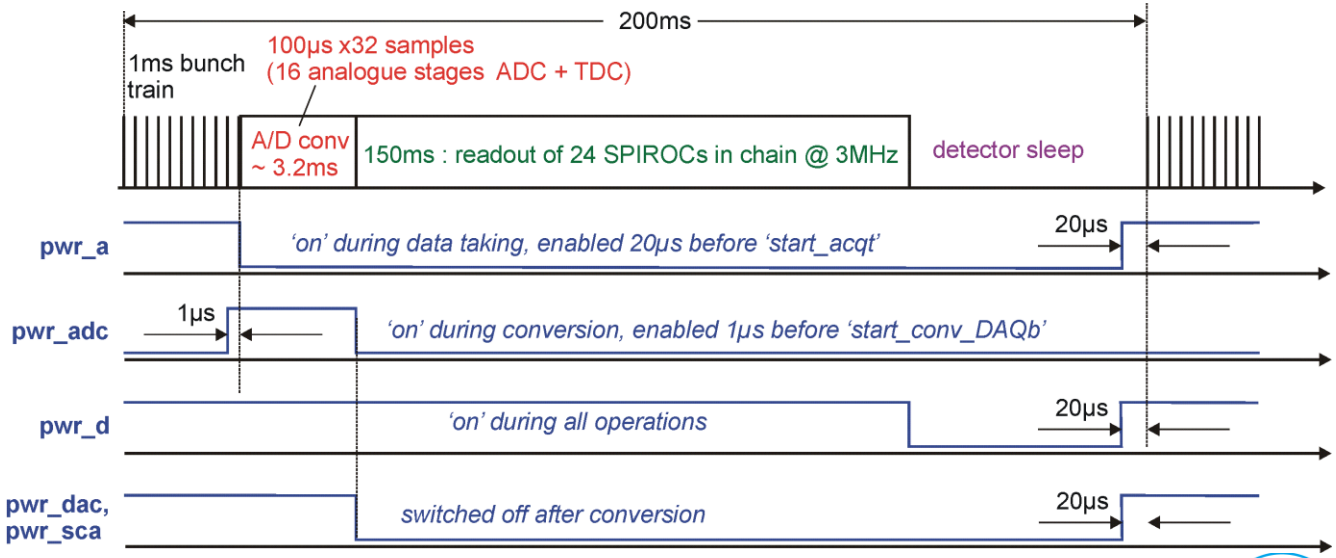
HG PA=100fF, LG PA=200fF
50 ns shaping, ext. Hold/Trig.
hold-time=130ns (HG/TDC),
Charge Injection with 5ns risetime.
No PA compCs

SPIROC2 TDC characterization

first results already there….

SPIROC2 power pulsing

DIF firmware needs update…



Conclusions and Outlook

- Ongoing system tests are important, but delay redesigns as well.
- Current effects should be visualized by SPIROC2 **simulations** (LAL).
- Studies from R. Honda at LAL show very similar effects => origin SPIROC2 ?
- Not much activity on DIF/DAQ development at DESY currently.