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AHCAL – Electromechanical Integration

M. Reinecke

Calorimeter for ILC

Outline

-AHCAL - Mechanical and Electrical Integration

-Light Calibration System – First Results

-Integration Studies

AHCAL Half Sector - Integration

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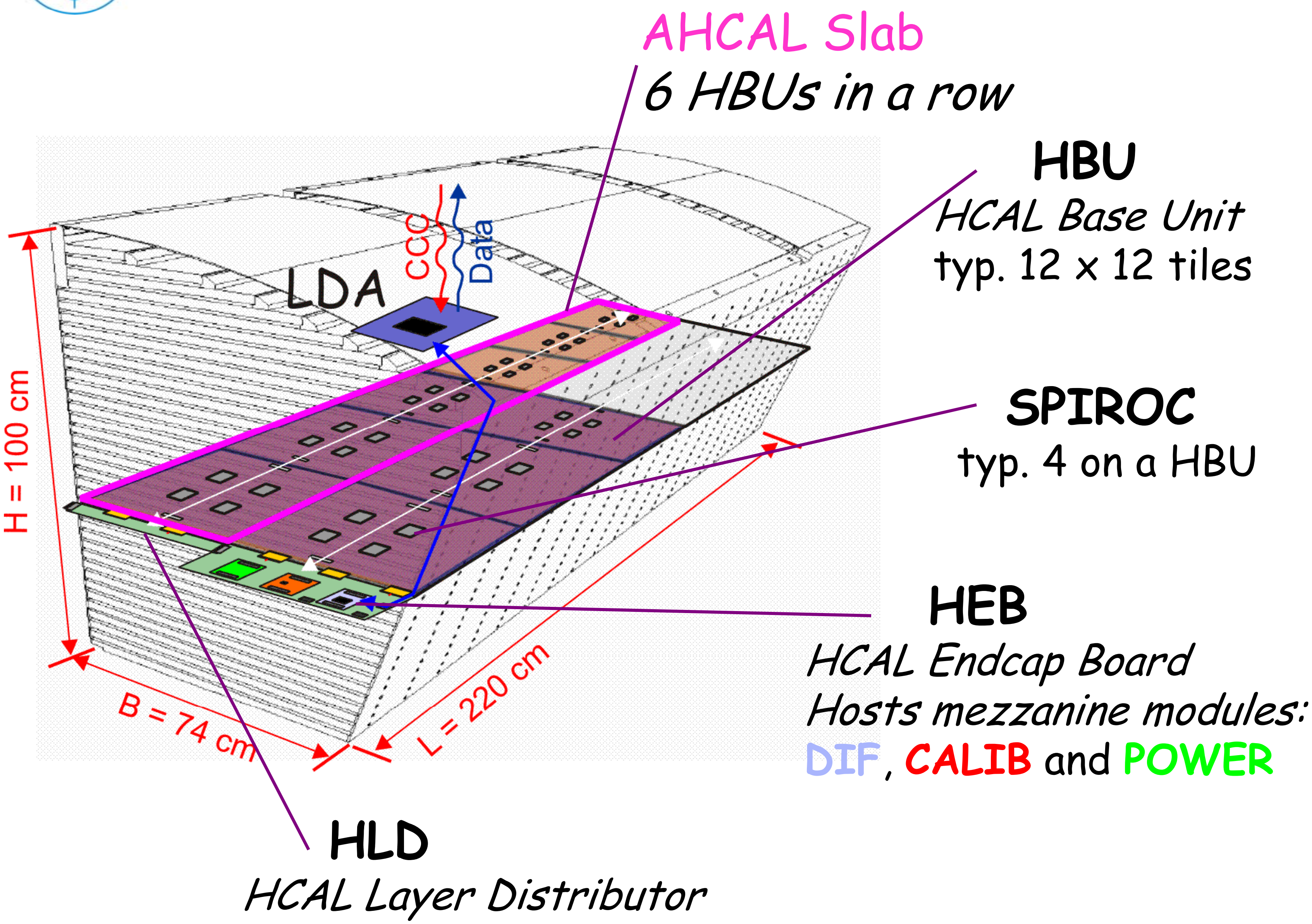
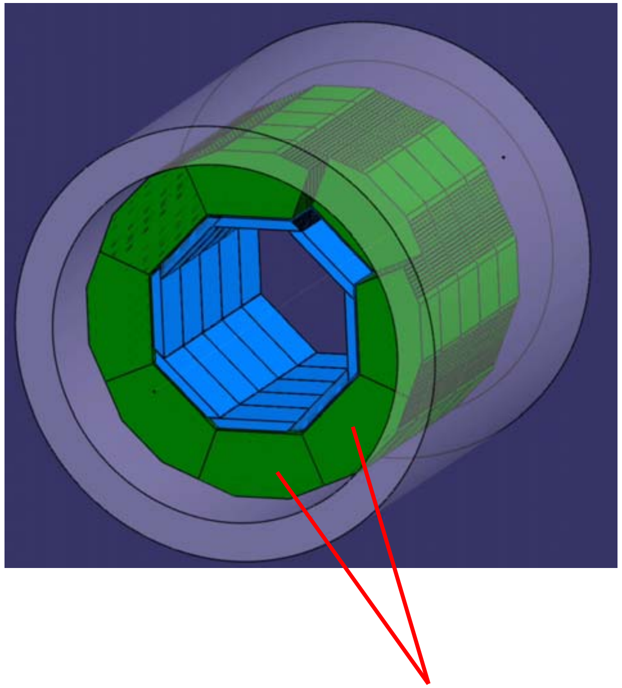


Mechanical Constraints

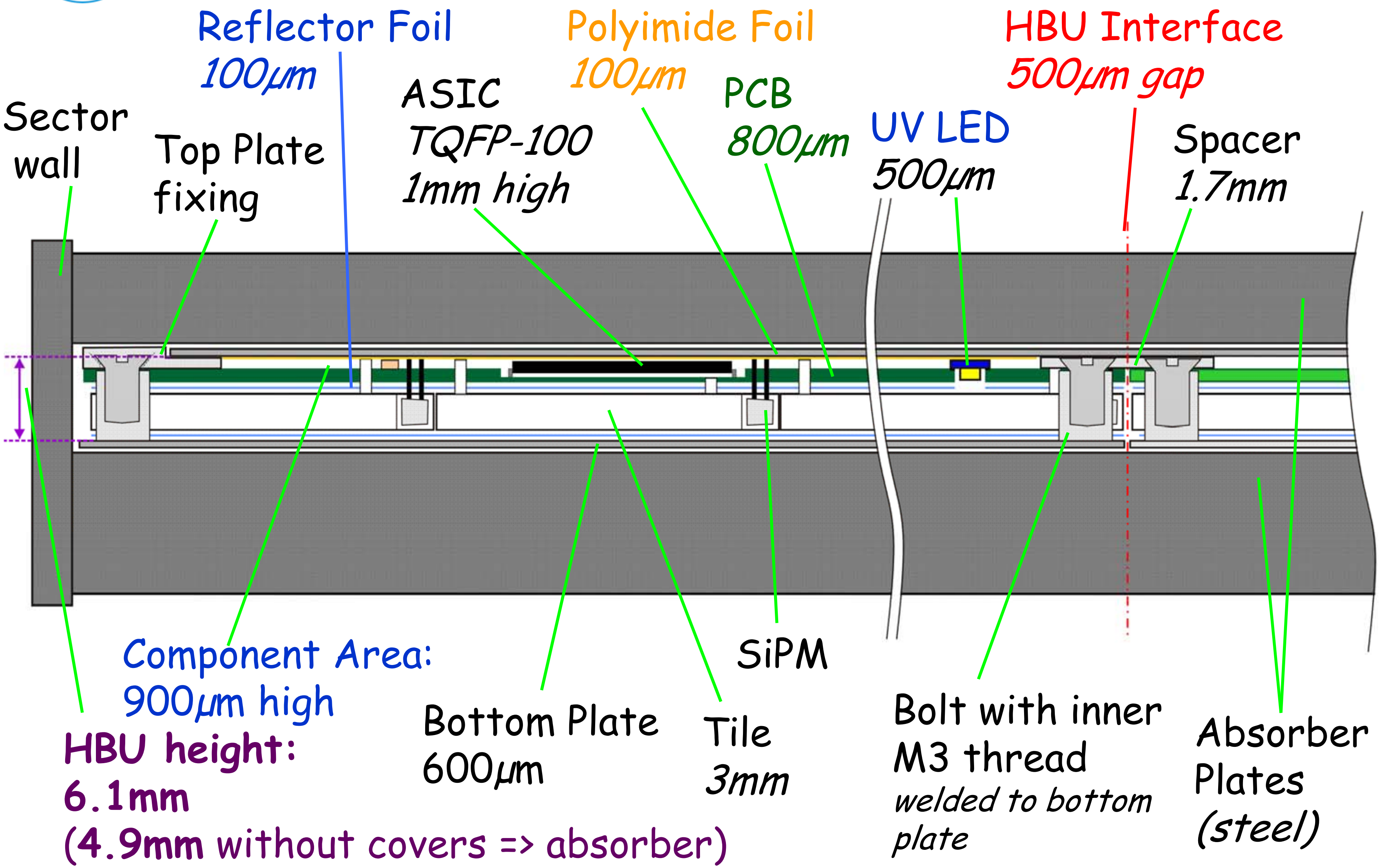


HCAL: 2 x 8 Sectors
2,432,000 Tiles

Requirements for a HCAL Base-Unit (HBU) from the Barrel's mechanics:

- -As large as possible (assembly time)
- -As thin as possible (barrel diameter)
- -Easy de-/installation of single units (repair)
- -Rail System needed (Sector walls ?)
- -Minimize dead area

HBU - Cross Section



HBU – PCB Layer Structure

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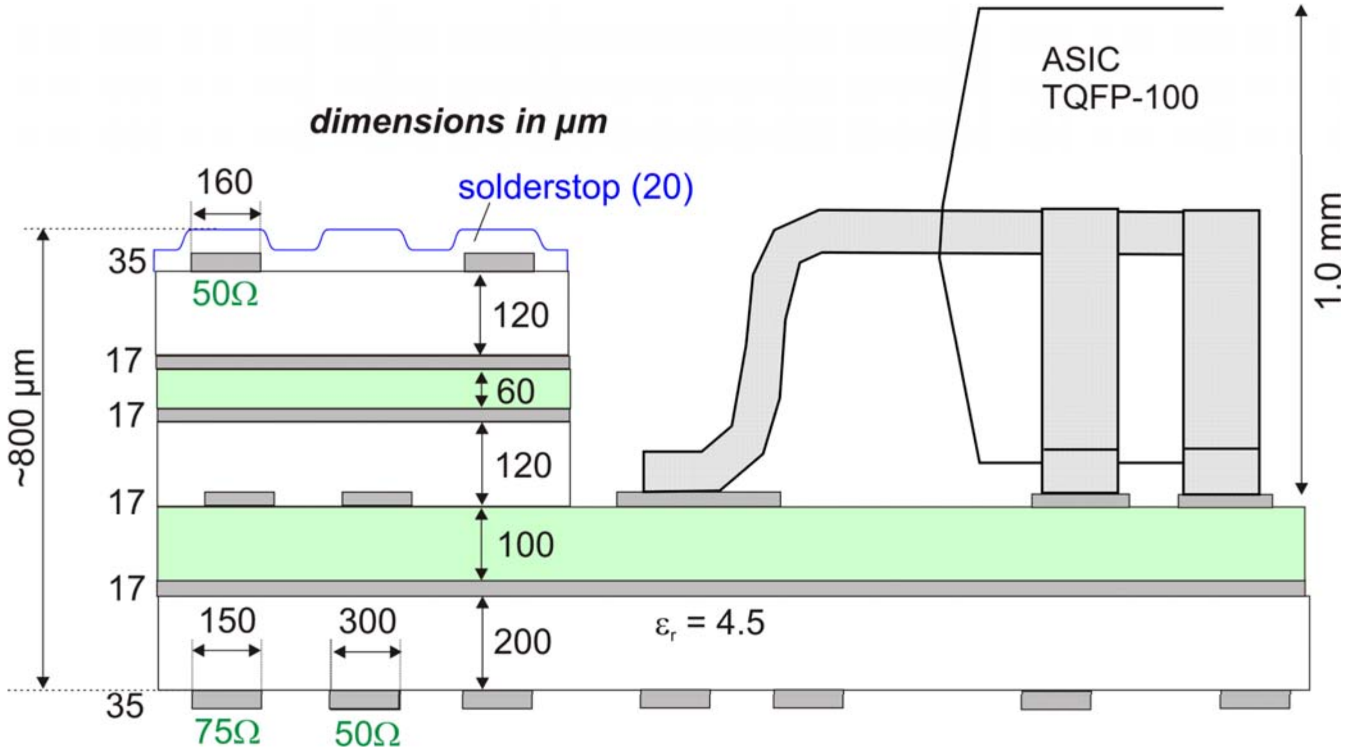
- 6 layer design with cut-outs for ASICS and connectors
- 75Ω Lines for high-gain SiPM setup
- Two signal layers for impedance-controlled routing
- **Total height (PCB + components): 1.5mm**
- Two companies agreed on structure at reasonable costs!!



Ligth Calibration System (LCS)

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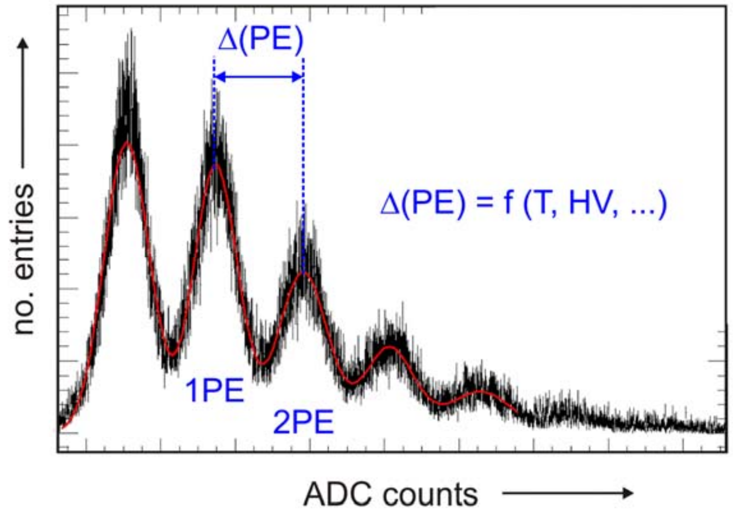
SiPM response strongly depends on temperature and bias voltage.

LCS (based on UV LEDs) needed for

-Calibration (ADC counts per PE)

-Gain Monitoring



Two different concepts under investigation:

- Quasi-Resonant LED driver setup on DIF, fibers into AHCAL gaps (see: our Prague colleagues, I. Polak et al.)
- One LED per tile, direct coupling without fibers (currently tested at DESY)

LED Testboard (LCS Test)

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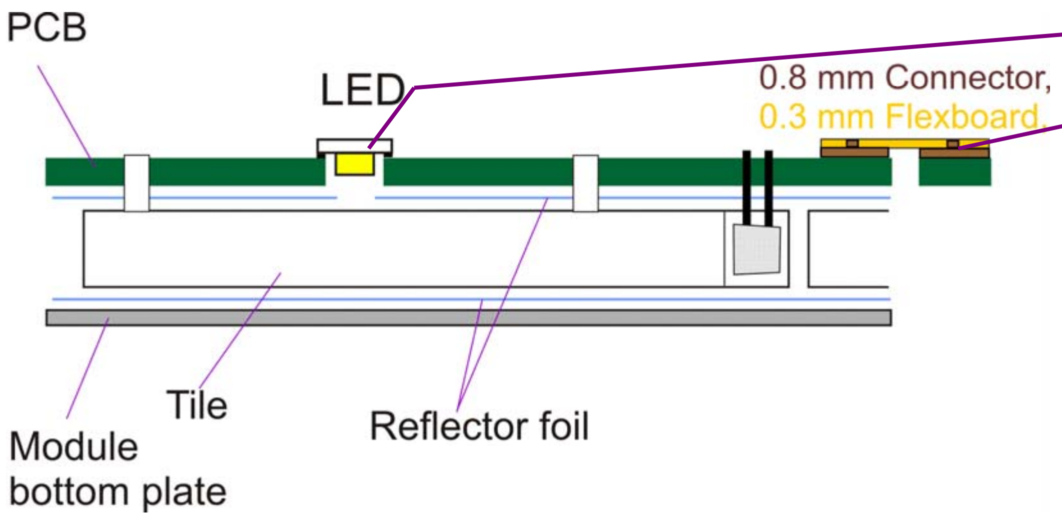
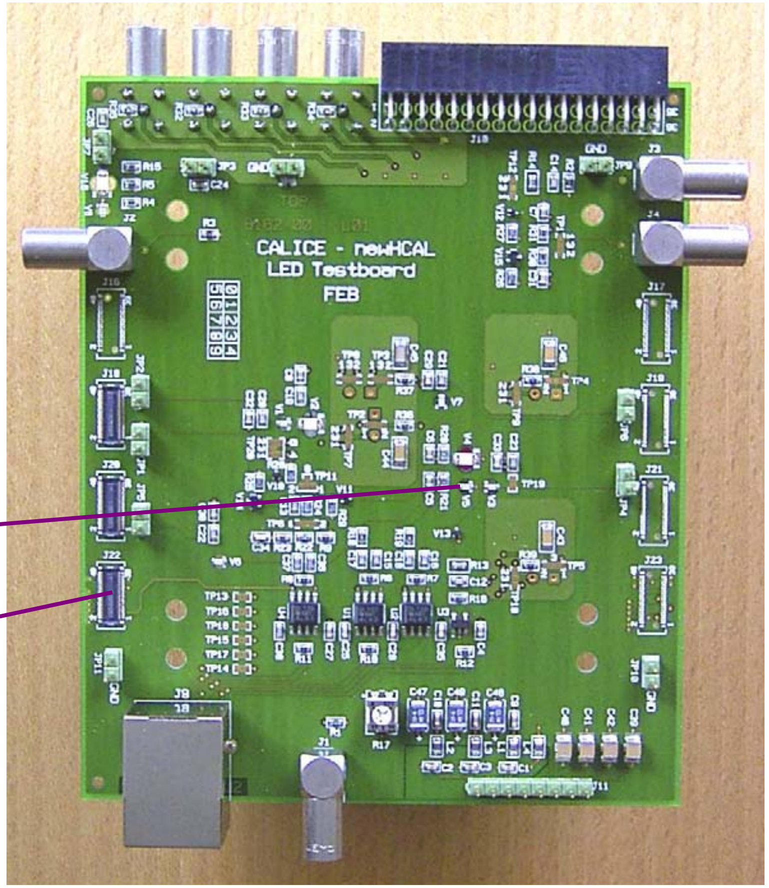
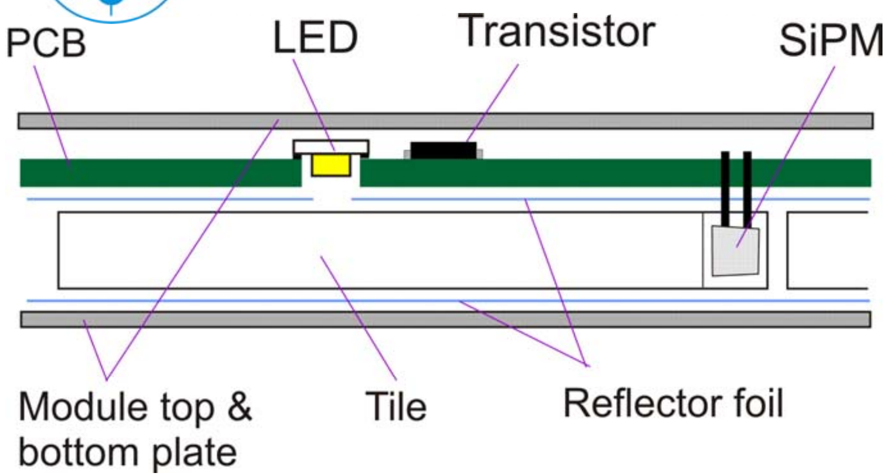
Test LED integration into HBU (LCS):

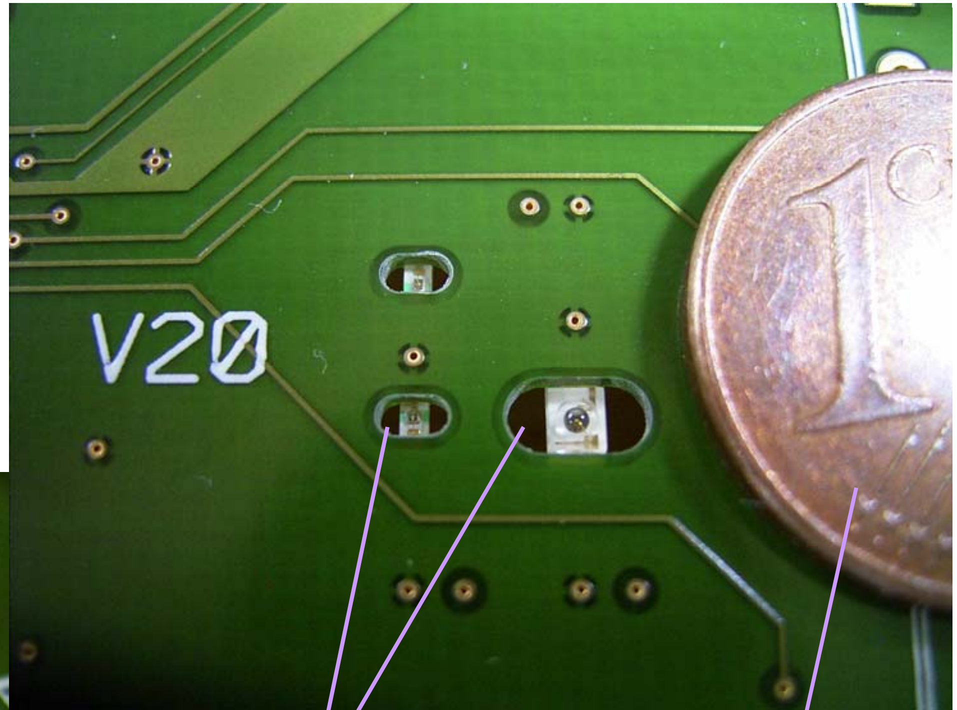
- Crosstalk of driving circuit to SiPM?
- Integration to PCB / coupling to tile?
- Connector test: stability, number of connection-cycles?

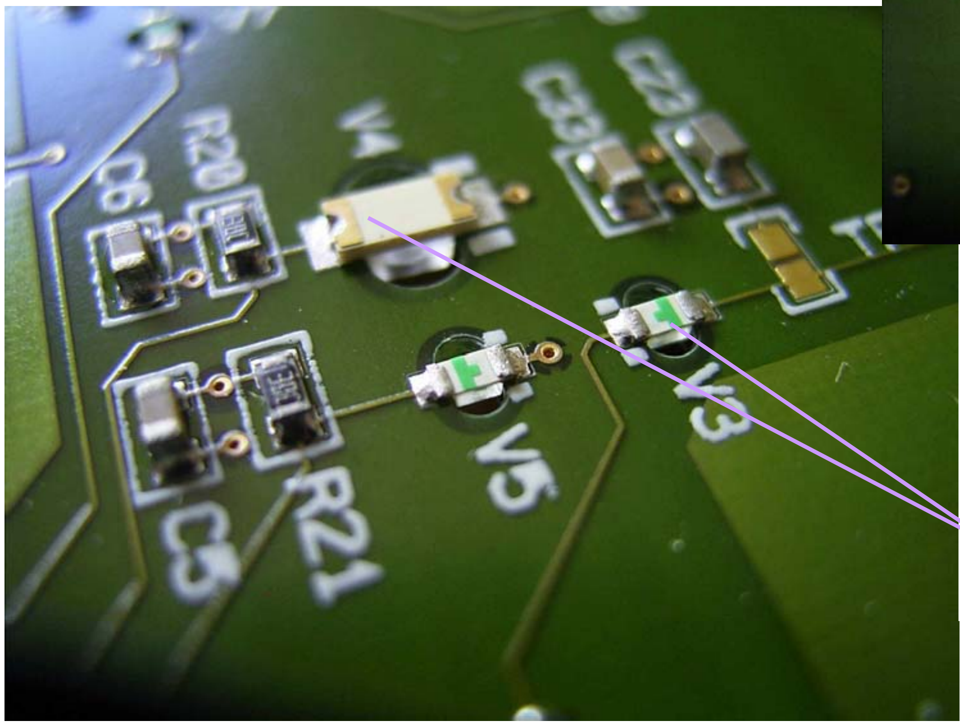




LED Integration







LEDs radiate through holes in PCB

1 Cent

Two different types of LEDs assembled on PCB (top)

LED optical output

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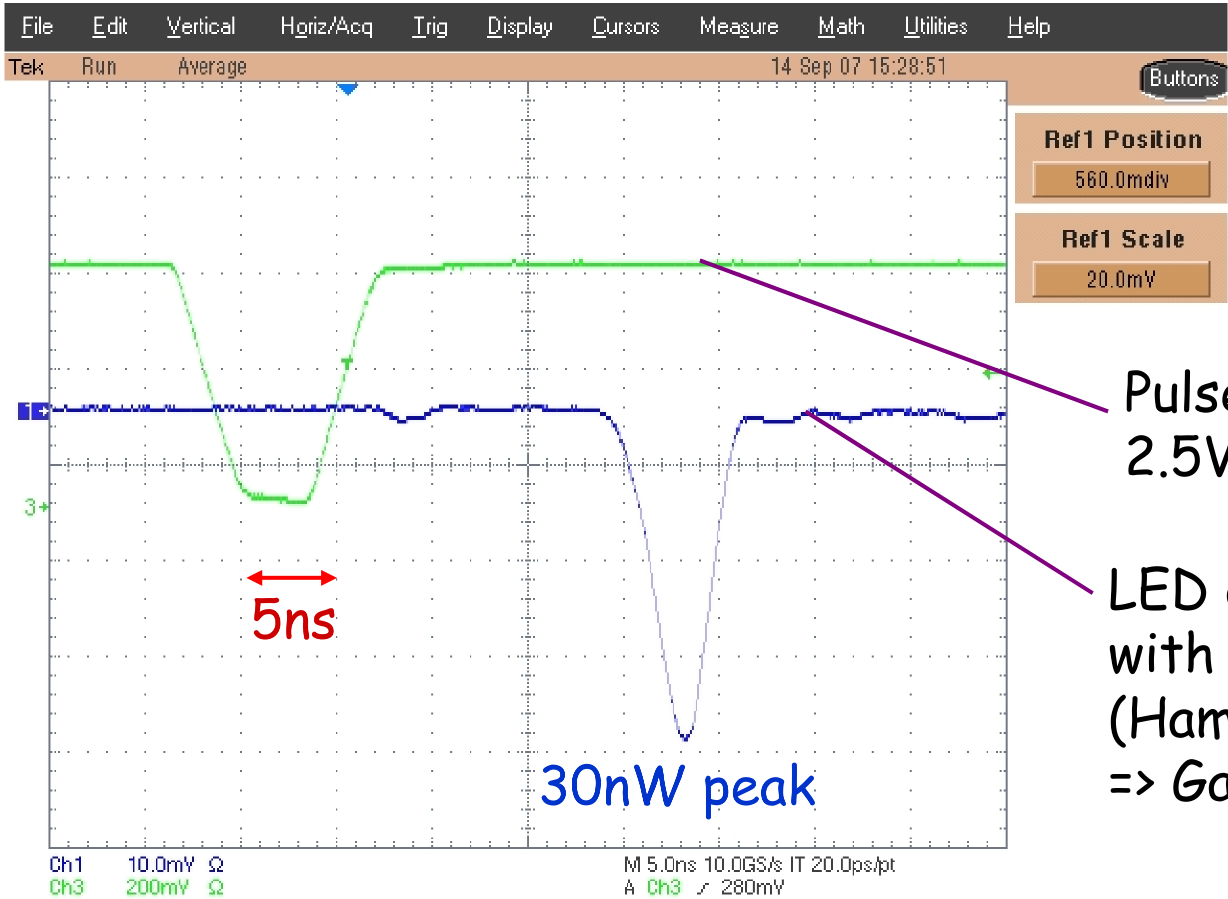

Pulse Generator Output (inv), 2.5V pre-bias of LED

LED optical output, measured with PMT H9858-01 (Hamamatsu) in 50Ω, Vc=0.8V => Gain ≈ 3*10^(4) A/W

Our LEDs are very fast !!!

LED driving circuit on HBU

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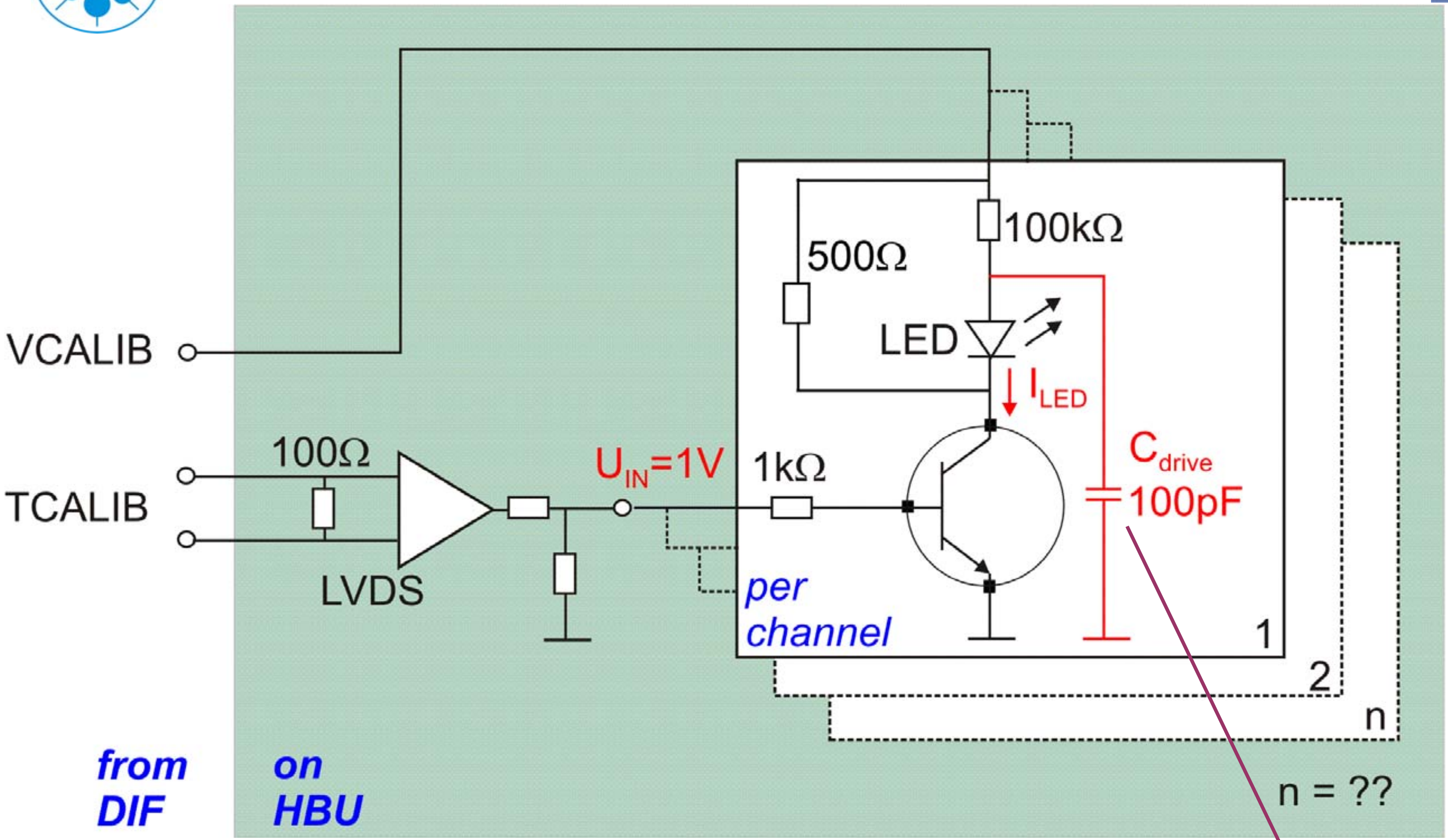
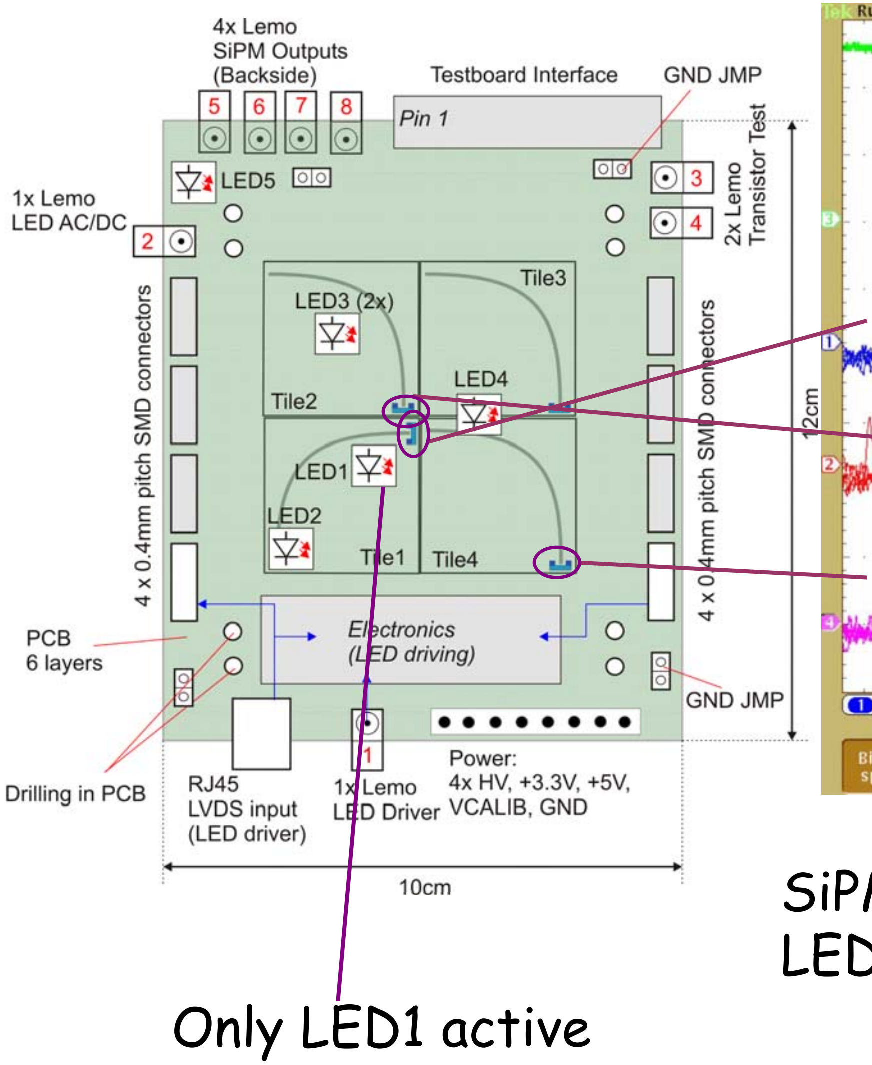
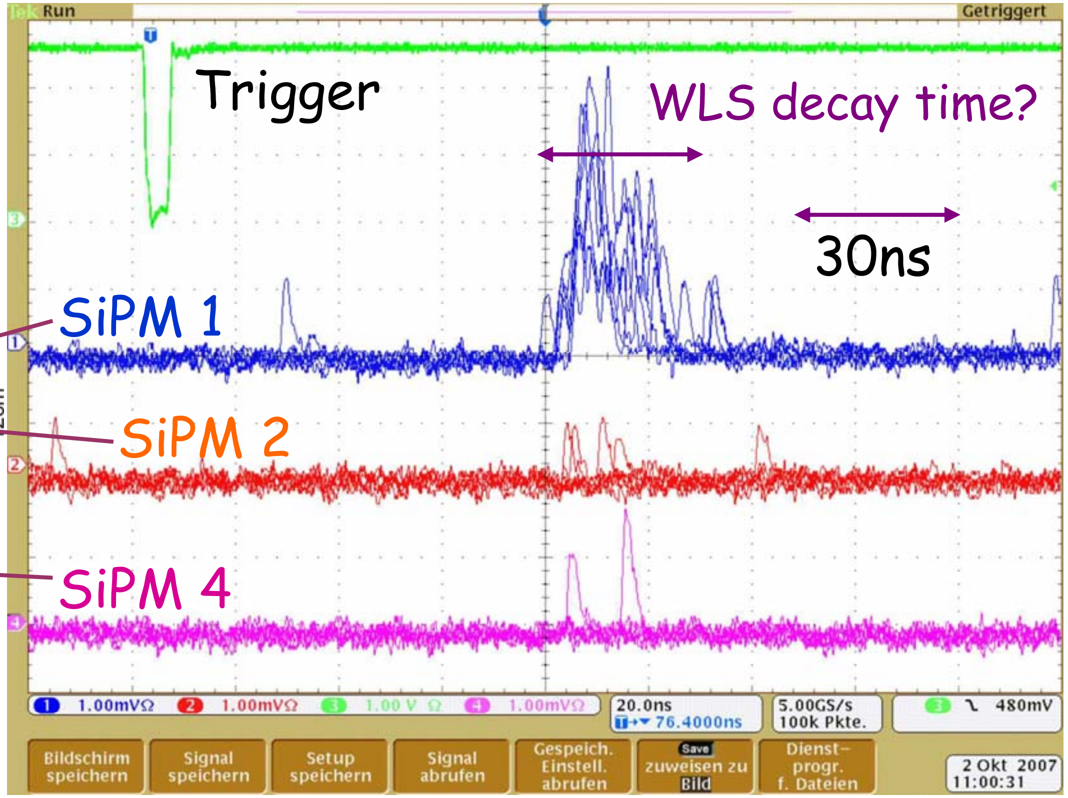


LED: Ledtronics SML0603-395-TR
Transistor: Infineon BFR340F (npn)

Charge on C_{drive} defines current through LED

Response from Tiles





SiPMs coupled to oscilloscope (50Ω),
LED1 amplitude controlled by VCALIB(DC).

Estimate Crosstalk

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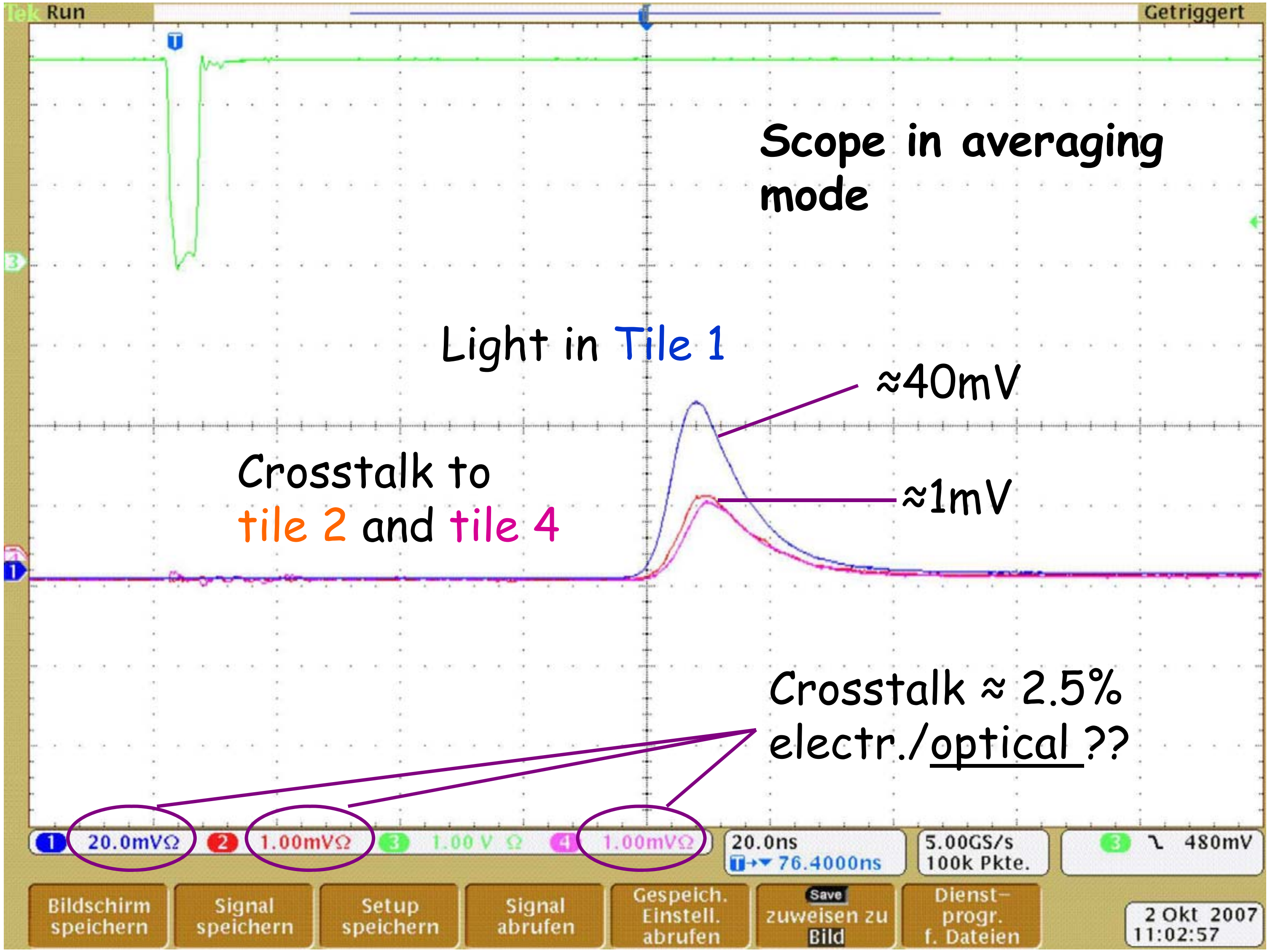

LCS Status

GOOD

- The LEDs can be assembled automatically without problems. All of the 5 tested LEDs survived the assembling.
- The LEDs are very fast.
- The driving circuit works concerning speed and amplitude. The amplitude can be controlled in wide range by VCALIB (6-9V)

Critical

- The driving voltage (base of transistor) has to be large (1V step).
- The sensitivity to changes of the driving amplitude is high.

Next steps

- Connect the LED testboard to the ASIC's testboard (VFE ASIC) in order to measure dynamic range, crosstalk and linearity w.r. to VCALIB and LED uniformity.

Testboard II : ASIC + Integration

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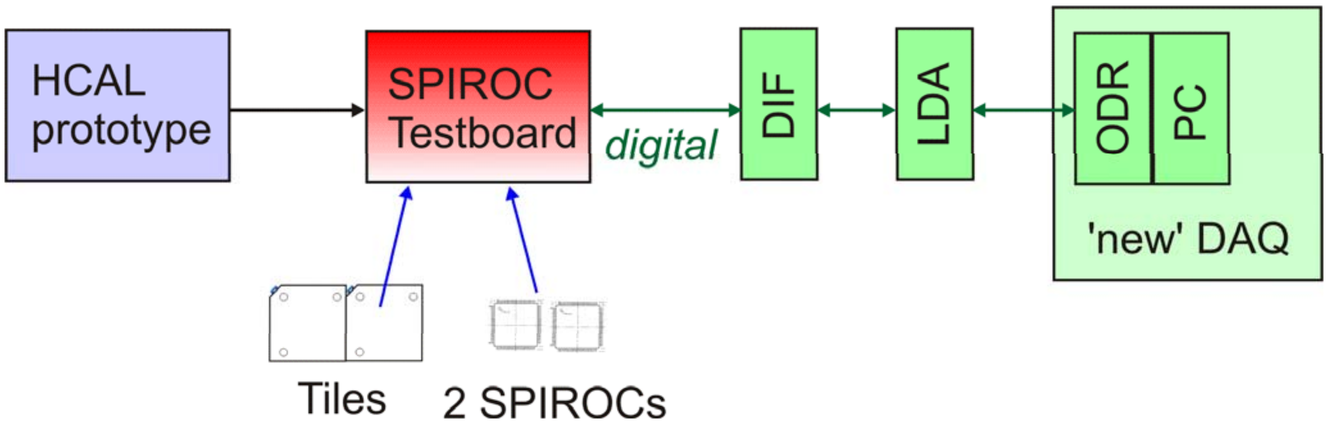
SPIROC Testboard (HBU prototype):

-Assembly (Tiles, PCB, ASICs, LEDs), Cassette Construction
-Performance in the dense HBU setup:
 Noise, gain, crosstalk, power and signal integrity
-DAQ Interface
-LCS with LEDs on board.

Tile integration to HBU : see M. Danilov's talk (alignment pins)



Testboard III : Power-System

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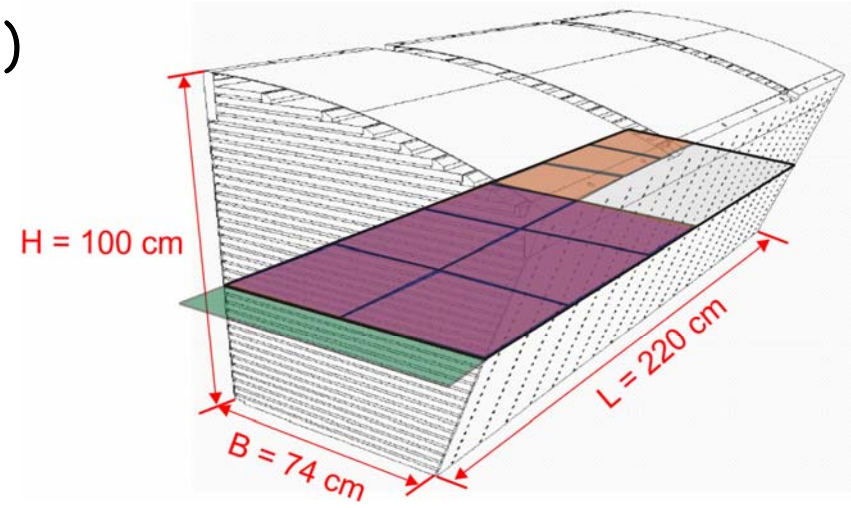
Test Power-Ground System (2.20m)

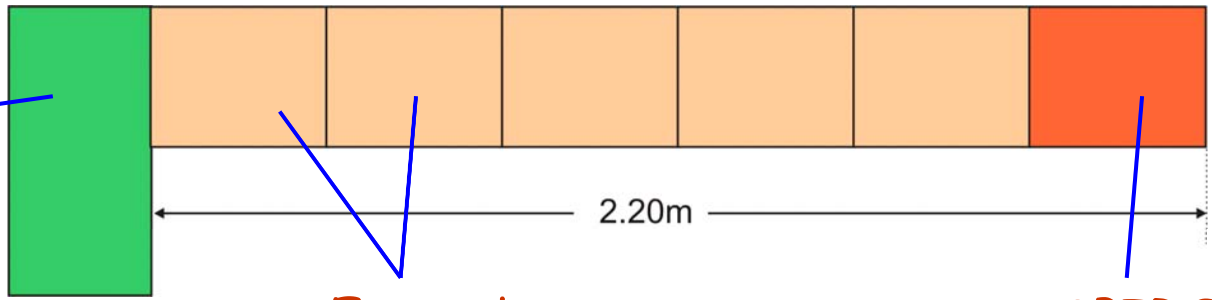
-Oscillations when switching?

-Voltage drop, signal integrity
(traces, connectors)?

-SPIROC performance @ far end
(blocking caps sufficient)?



‚Layer Concentrator' (DIF*)



Extenders (Power-Gnd, Traces)

SPIROC Testboard

Conclusions

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-First ideas about the next generation AHCAL develop to a promising concept.

-Feasibility of many design aspects (e.g. PCB structure) have to be proved.

-Testboard Design I (LCS) is alive now!
-Testboard II (HBU prototype) design starts in spring 2008.
-Testboard III (power plane test) runs in parallel (beginning of 2008).

-Mechanical engineering of absorber stack and HBU cassette is starting!