



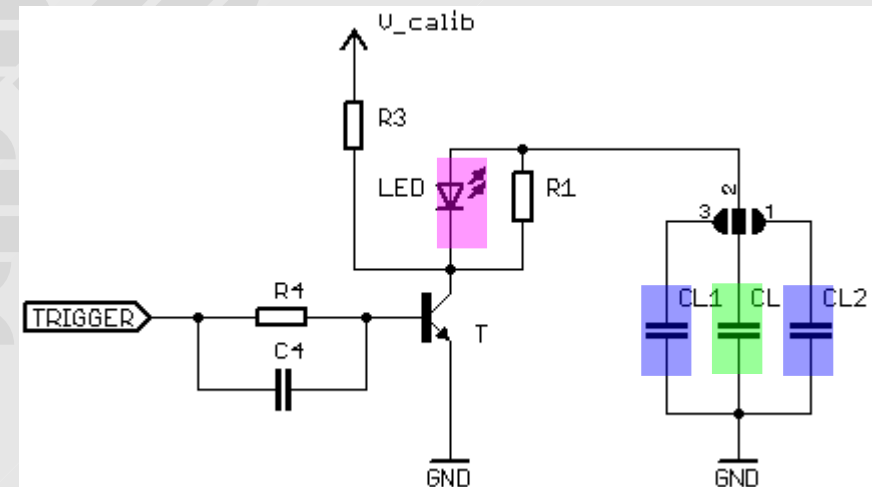
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Status update of the Integrated LED Calibration System

- The LED calibration system in short
- Implementation on HBU
- Performance
- Current issues

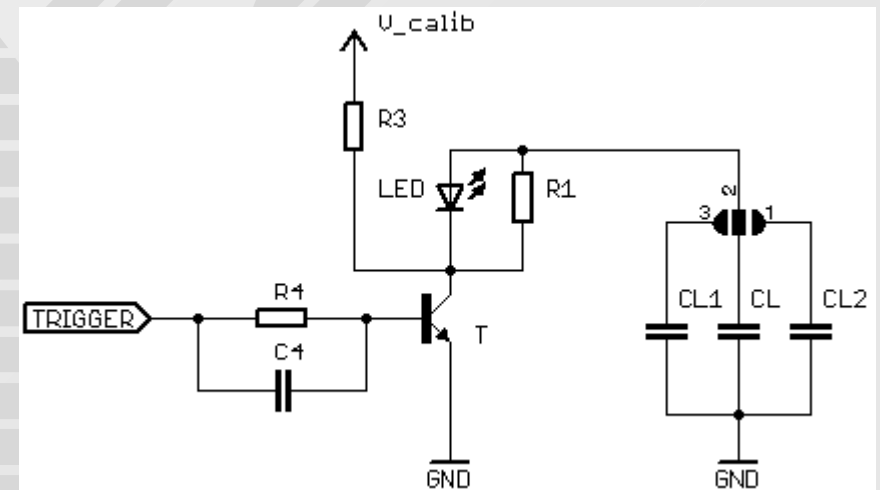
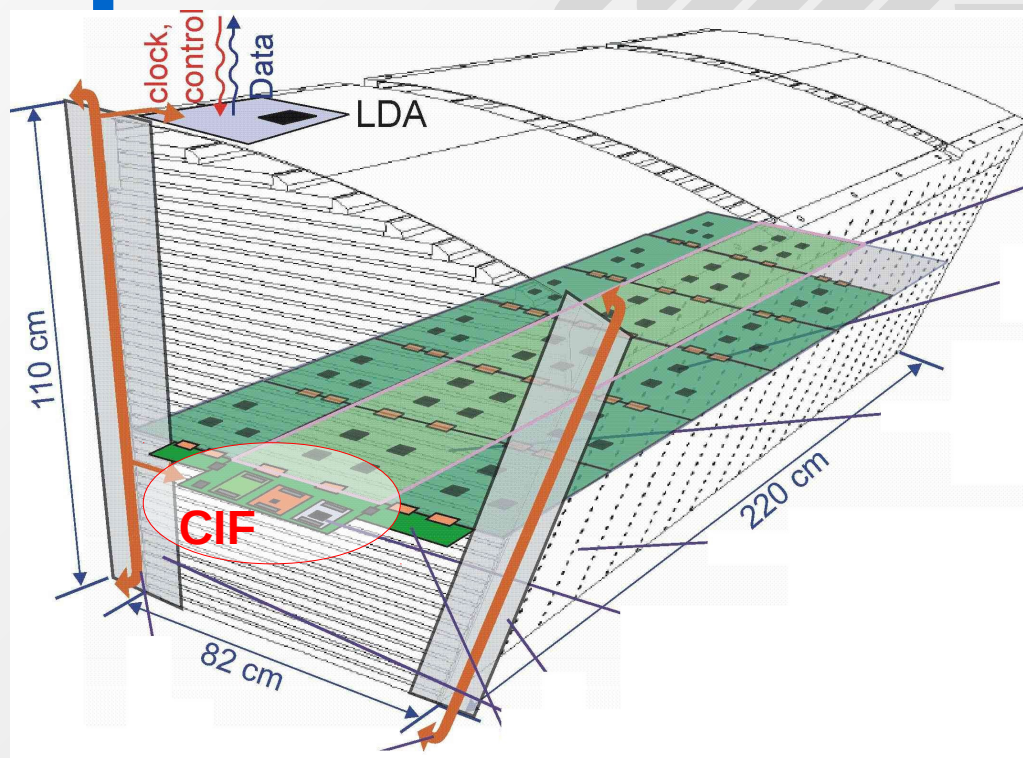
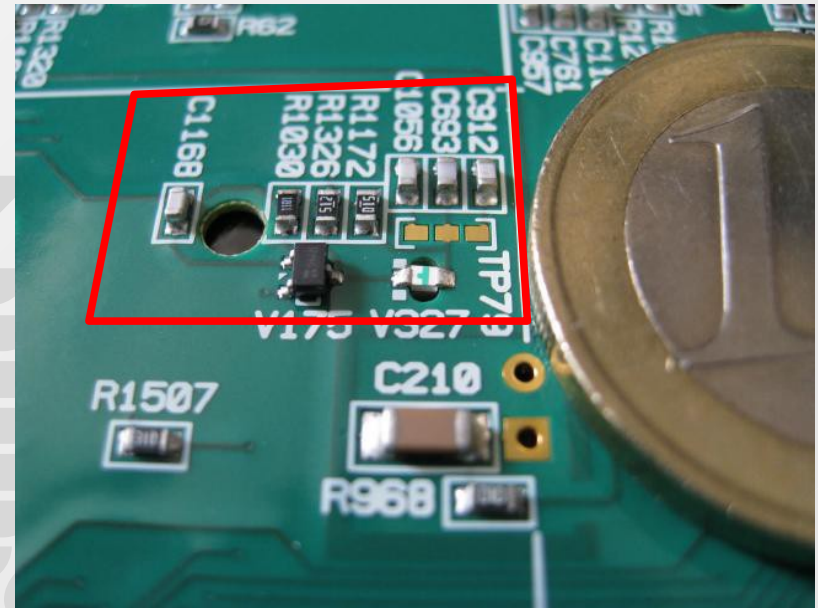
Reminder: The integrated LED calibration system

- One LED with pulse generator circuit („pulser“) above each tile
 - → Simple, small & cheap solution needed
- Principle of work
 - Capacitor charged to V_{calib} (common for 1 layer)
 - On LED-trigger: Discharge via UV-LED
 - light pulse
 - Charge (V_{calib}) steers light yield from LED
 - Light yield should be the same for all pulsers and single V_{calib}
 - *SiPM calibration with only 1 voltage setting!*
 - *2 tuning capacitors via solder jumper*



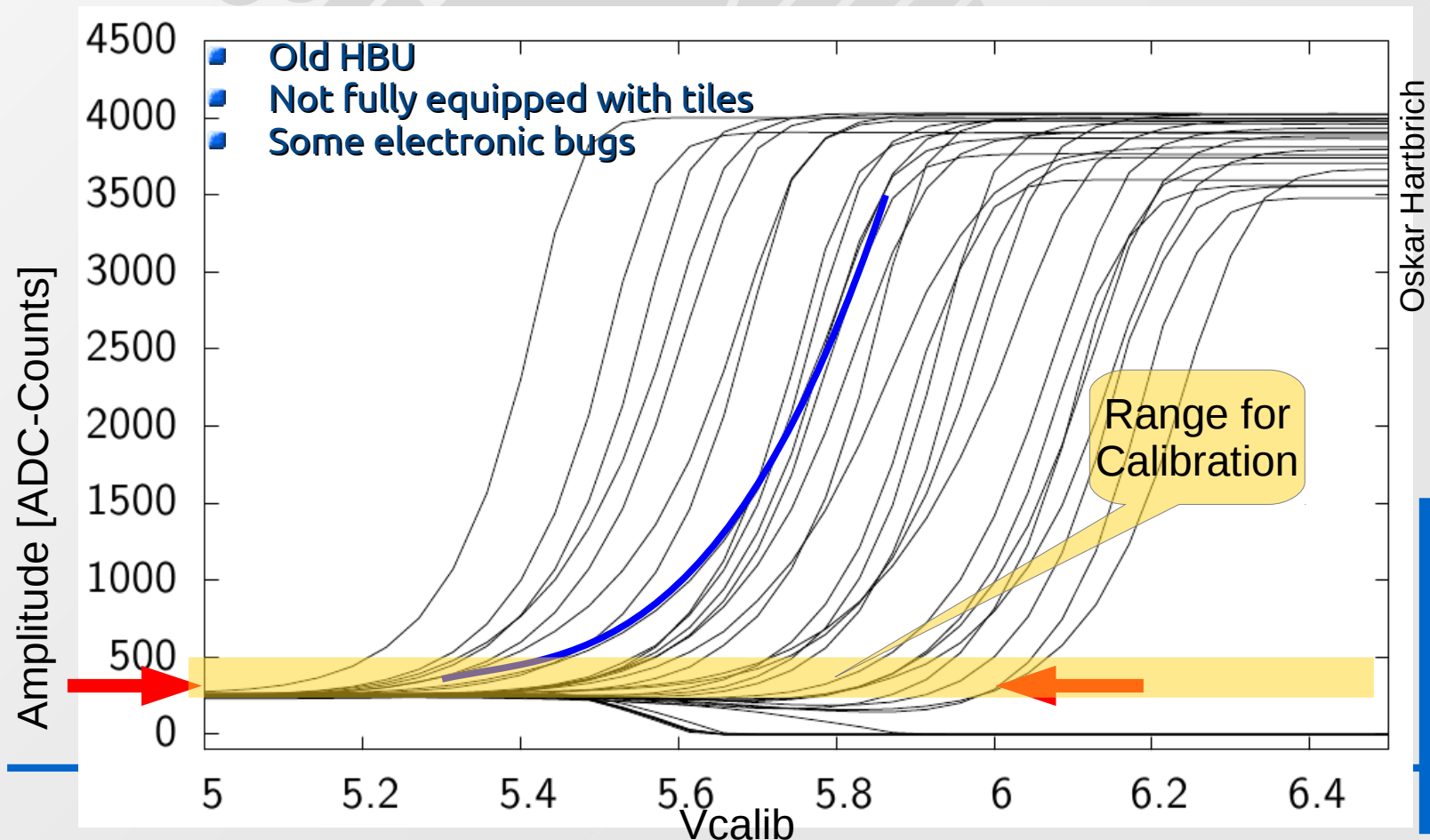
Implementation on HBU

- CALIB-Board on CIF
 - Vcalib (Range: 0 – 10V)
 - LVDS LED-trigger signal
 - Both common for whole layer
- On each HBU:
 - 1 LVDS receiver
 - 8 drivers
 - 18 pulsers each

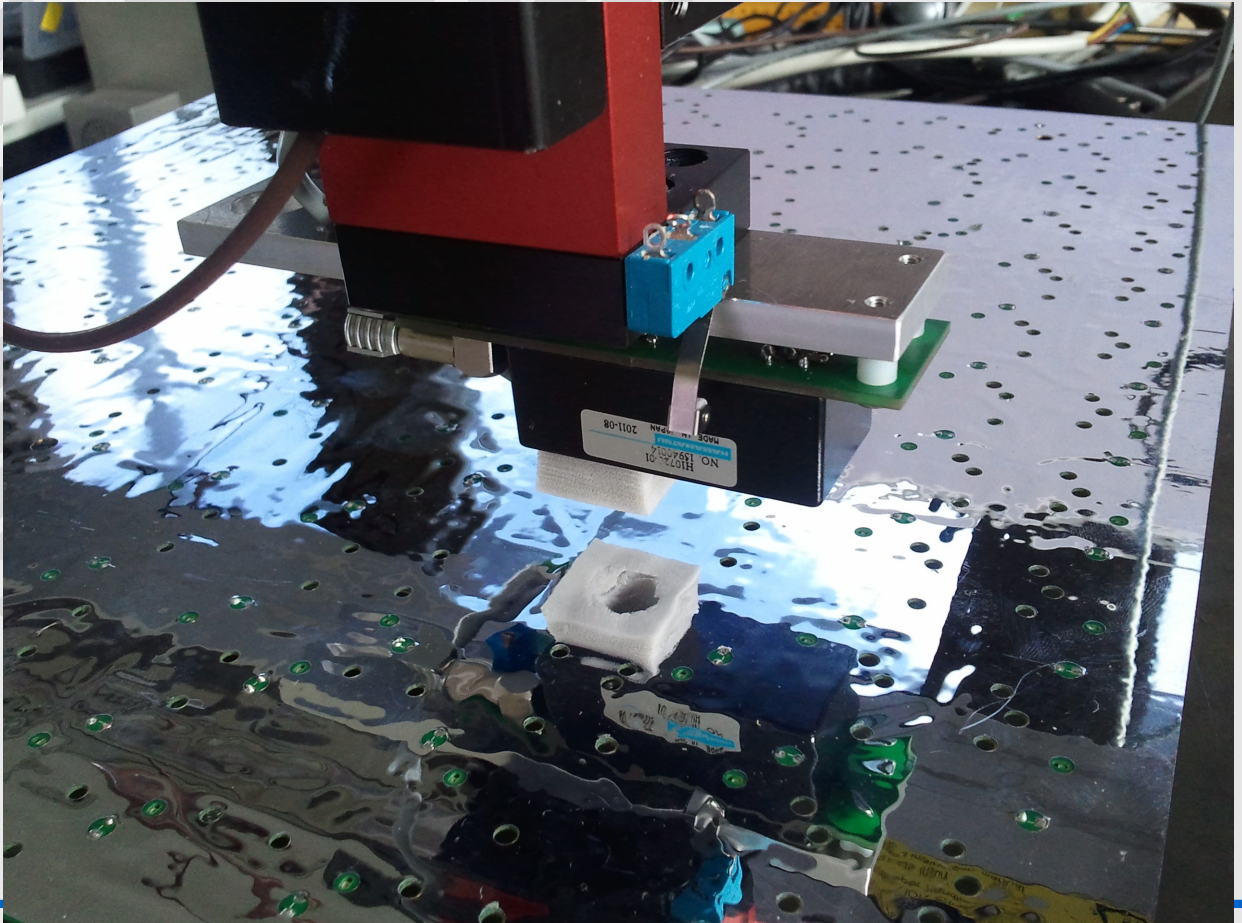


Vcalib-Scan on HBU

- Sweep Vcalib & measure SiPM-signal
- **Large spread in light yield** (light starts at 5 – 6V)
 - Too much to be compensated by tuning capacitors
- Sometimes lower **slope**

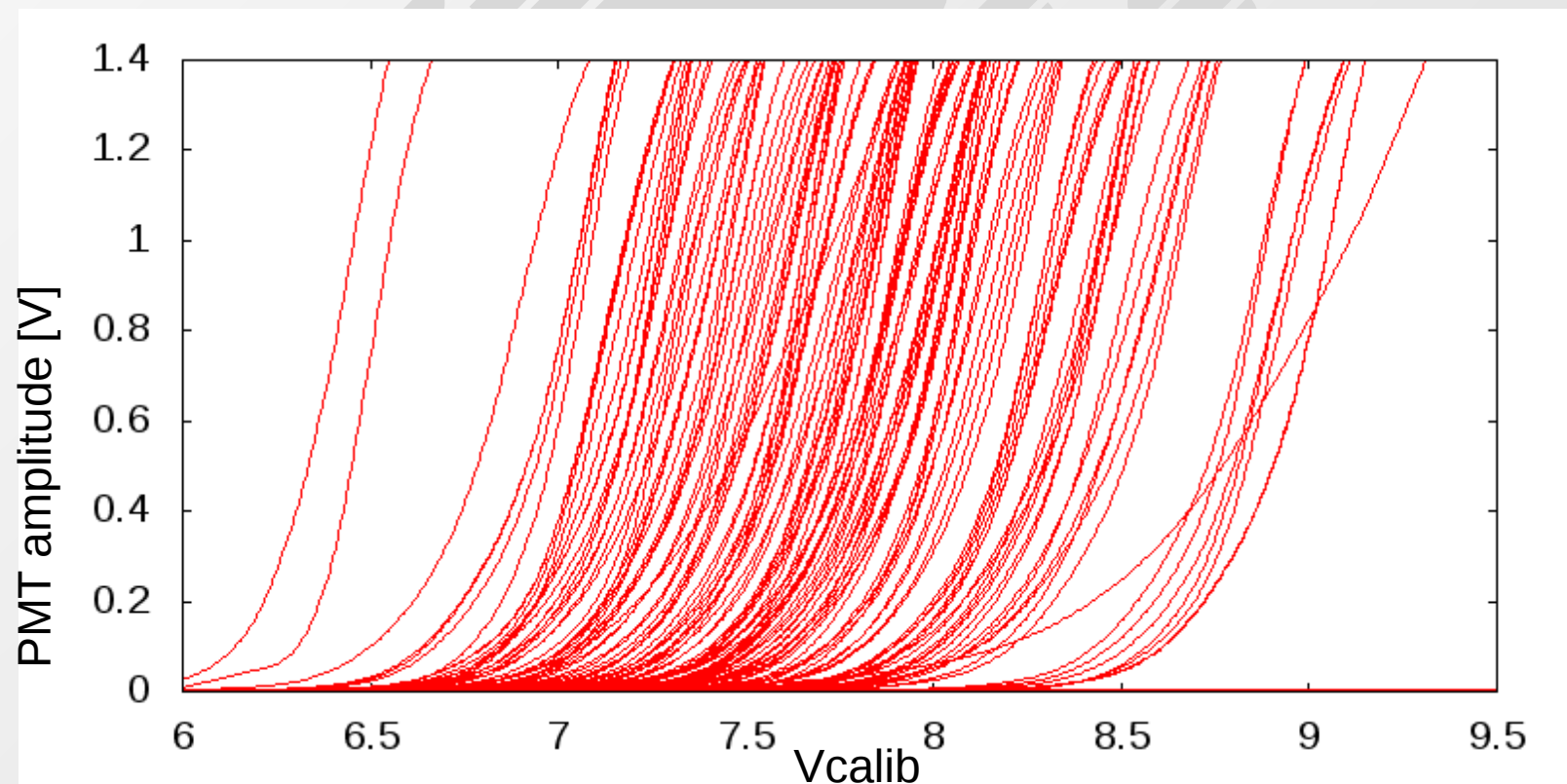


- HBU without scintillator tiles
- XY stage with fast Hamamatsu Photomultiplier *tube*
- Oscilloscope readout
- Same sensor / cable length for all LEDs



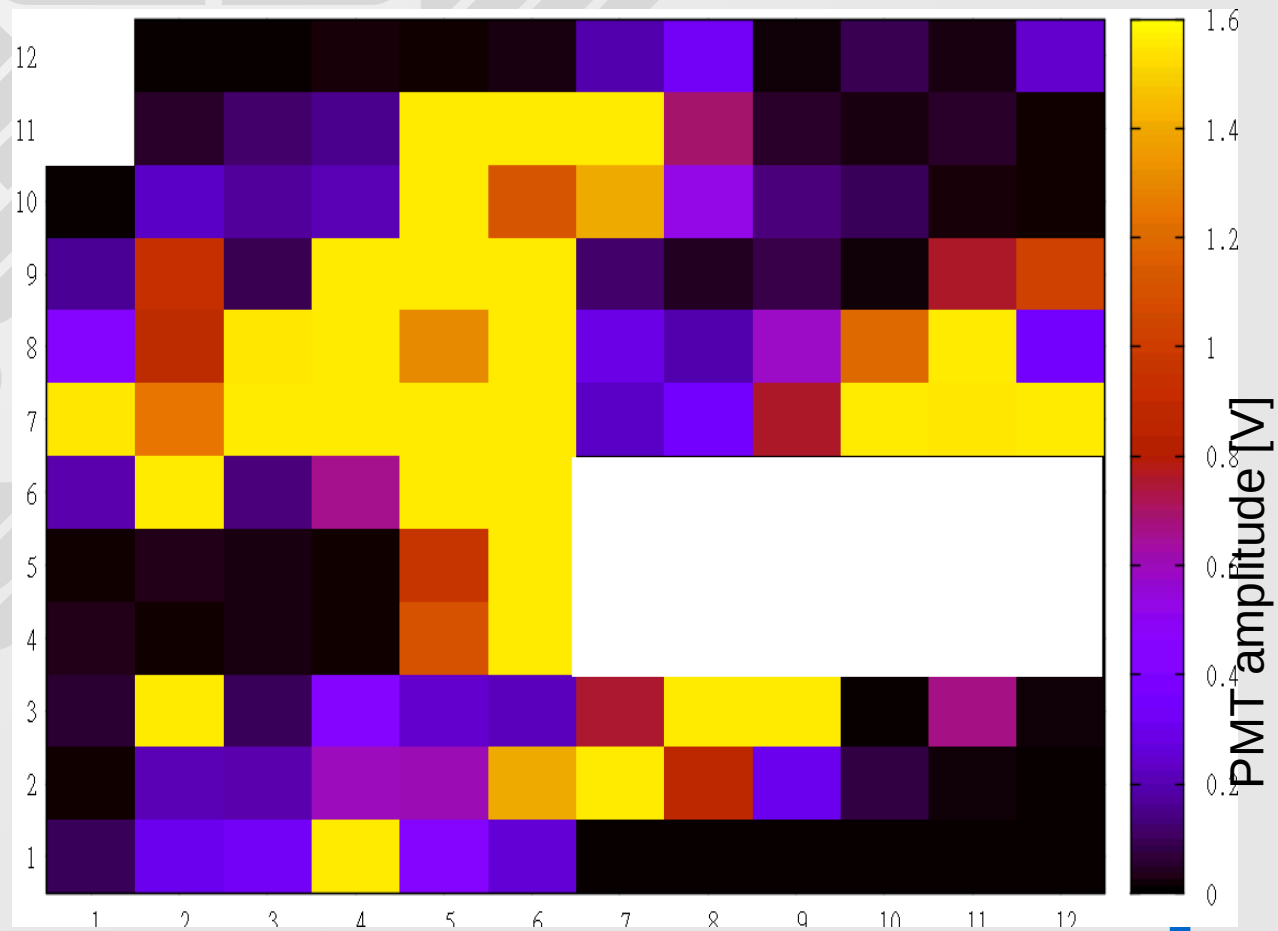
Vcalib scan with PMT

- 124 channels (20 not working due to technical reasons)
- Same effect, even worse observed
- → For SiPM calibration, several Vcalib settings needed!
- Is this part variance?



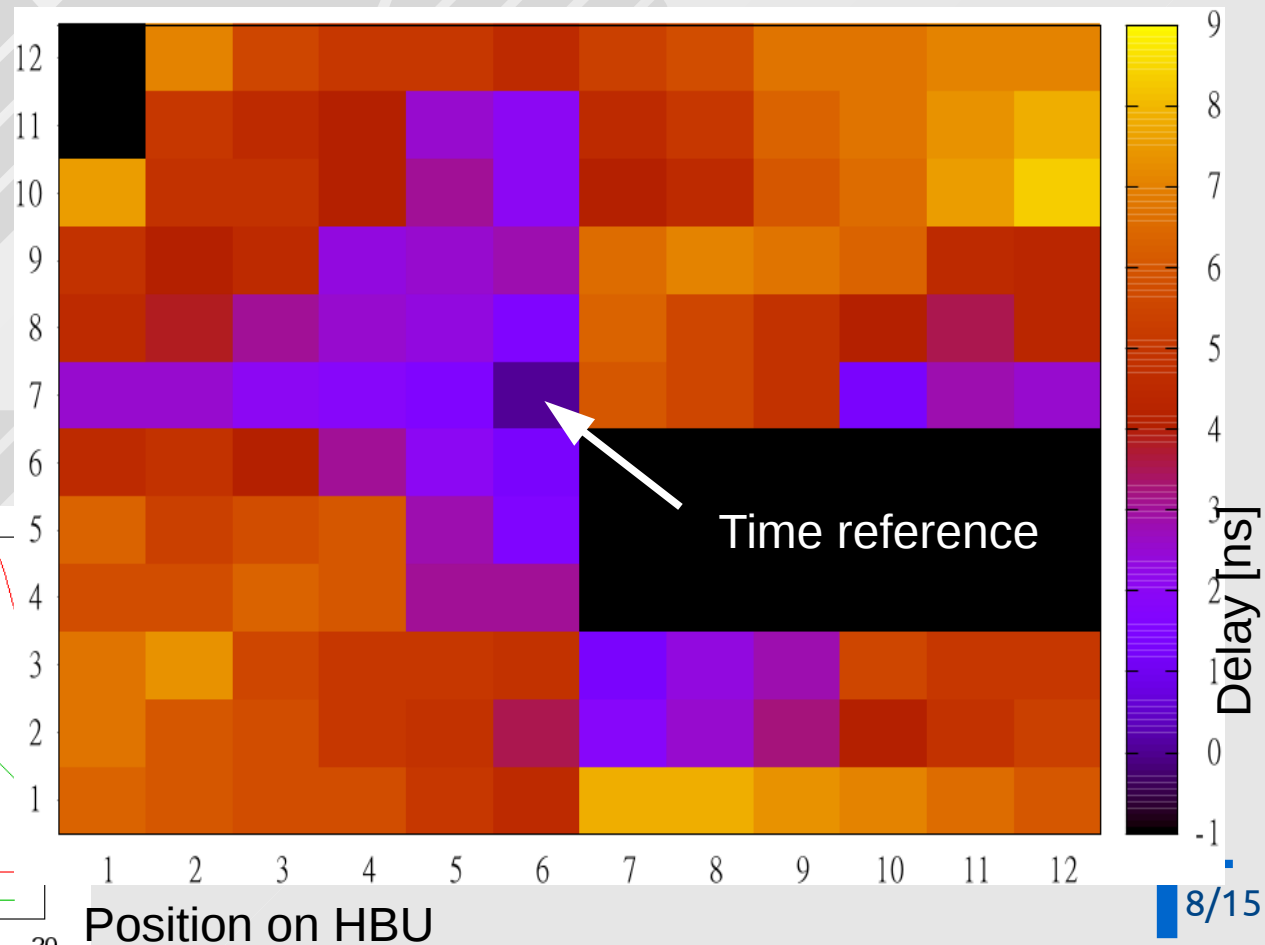
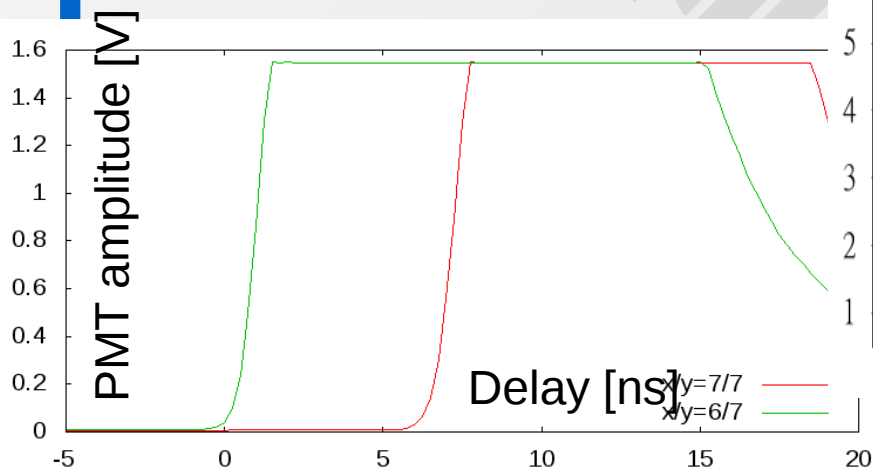
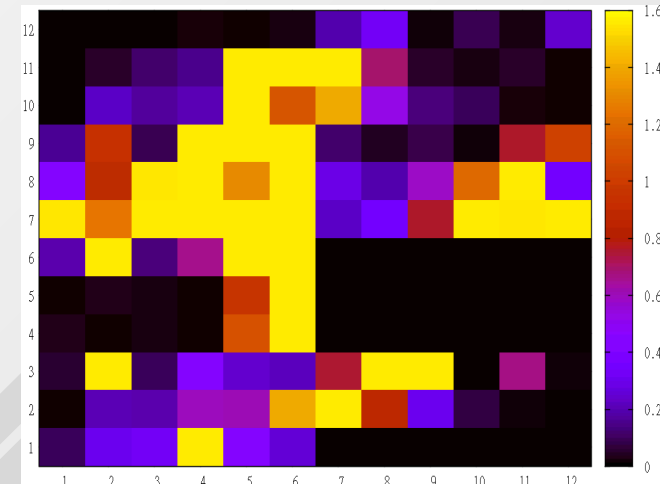
Vcalib scan with PMT

- Signal amplitude vs. LED position on HBU for one Vcalib
- Systematic, not random effect!
 - Not caused by part variance etc.
- Effect of trigger distribution



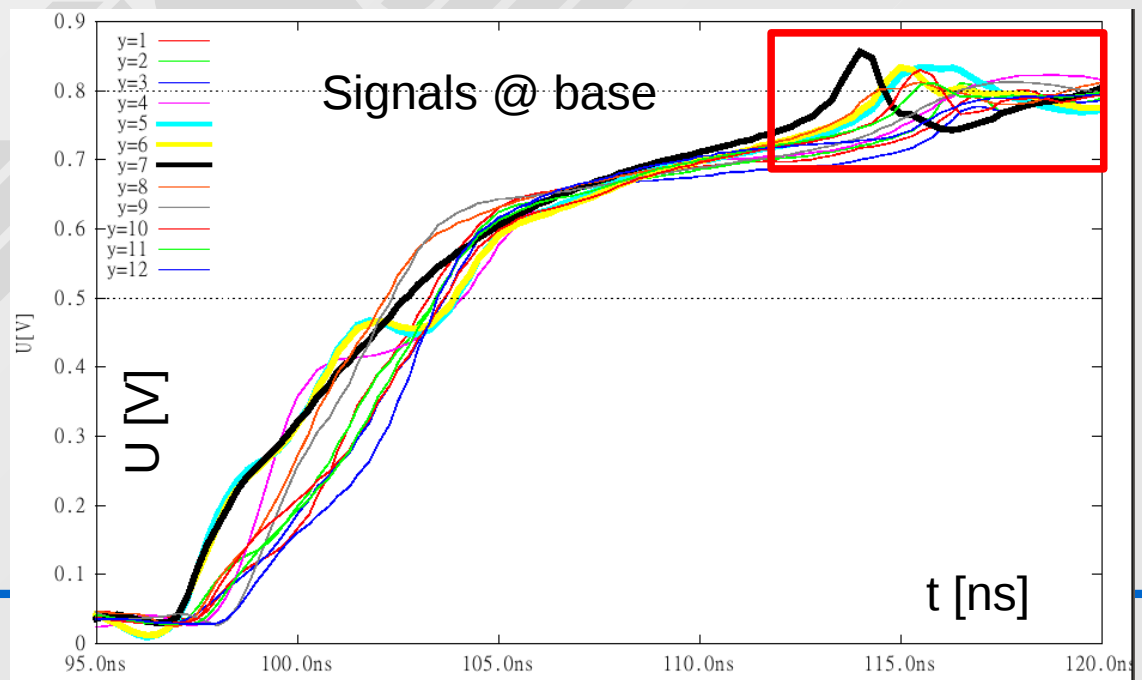
Timing

- LED system used for TDC measurements @DESY in past weeks
- Large delays between channels observed
 - Can not be PCB track length
- Confirmed by PMT measurement: delay up to 9ns
- Correlation with amplitude!



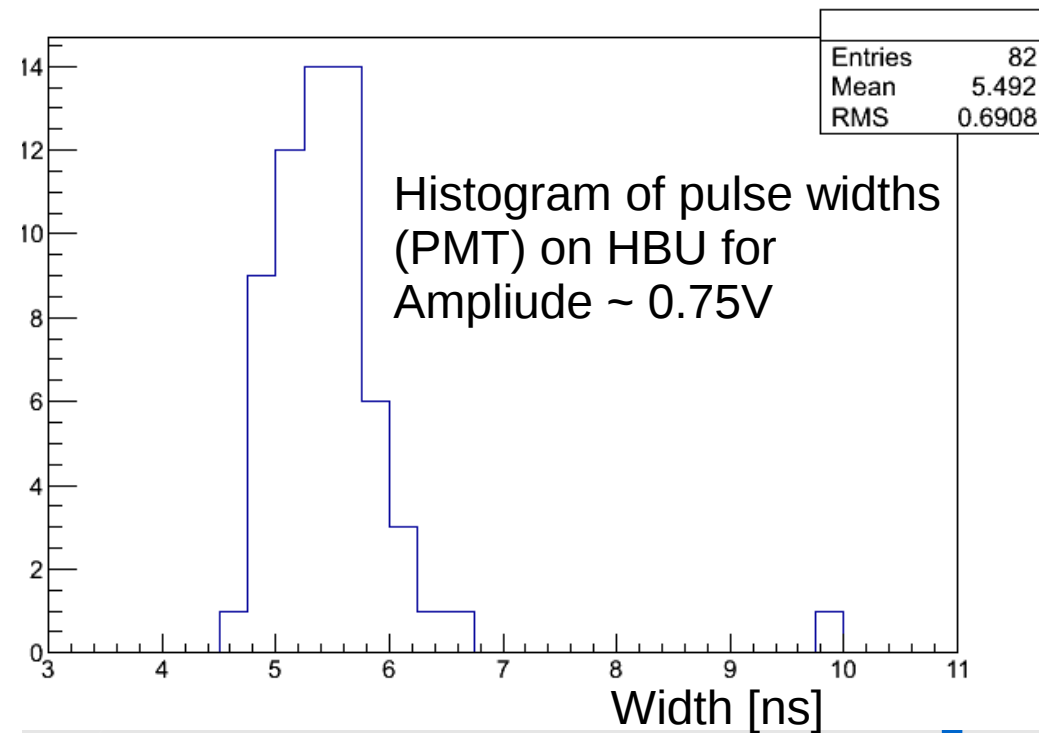
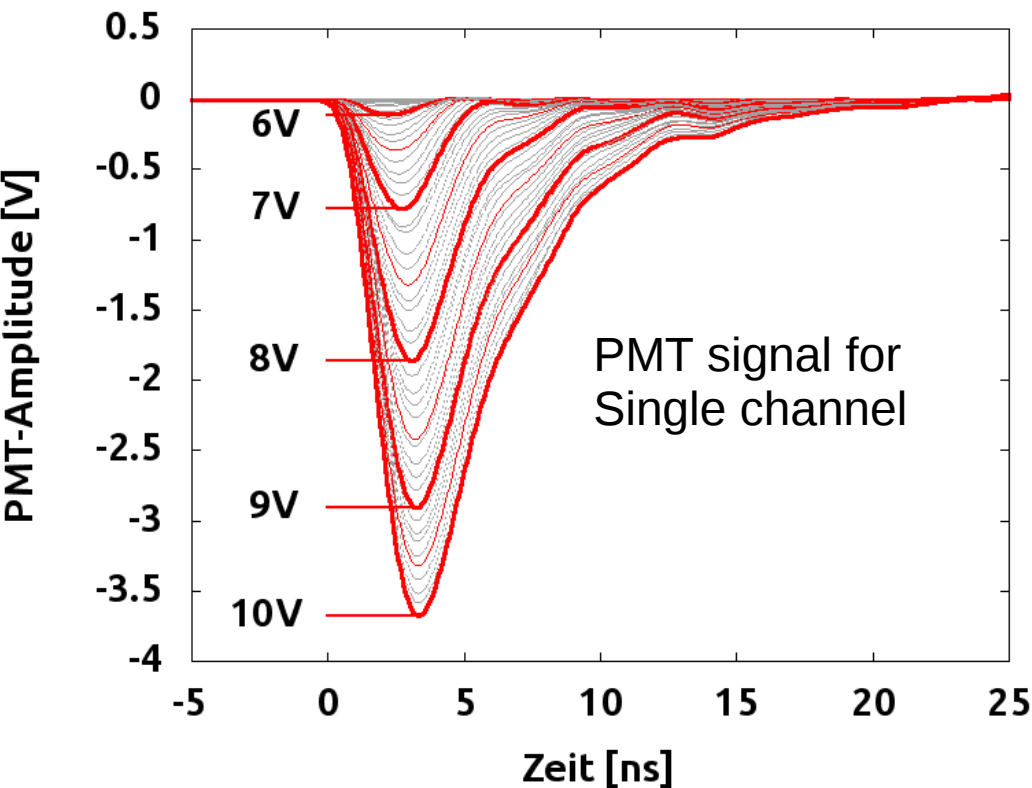
Timing & homogeneity

- LED-system was never intended for TDC measurements!
- Delay not important for SiPM calibration: $O(50\text{ns})$ integration time!
- However, correlation with homogeneity problem
- Problem tracked down to LED trigger distribution:
 - Track inductance & signal reflection
 - Weak drivers
- May/should be solved in future versions



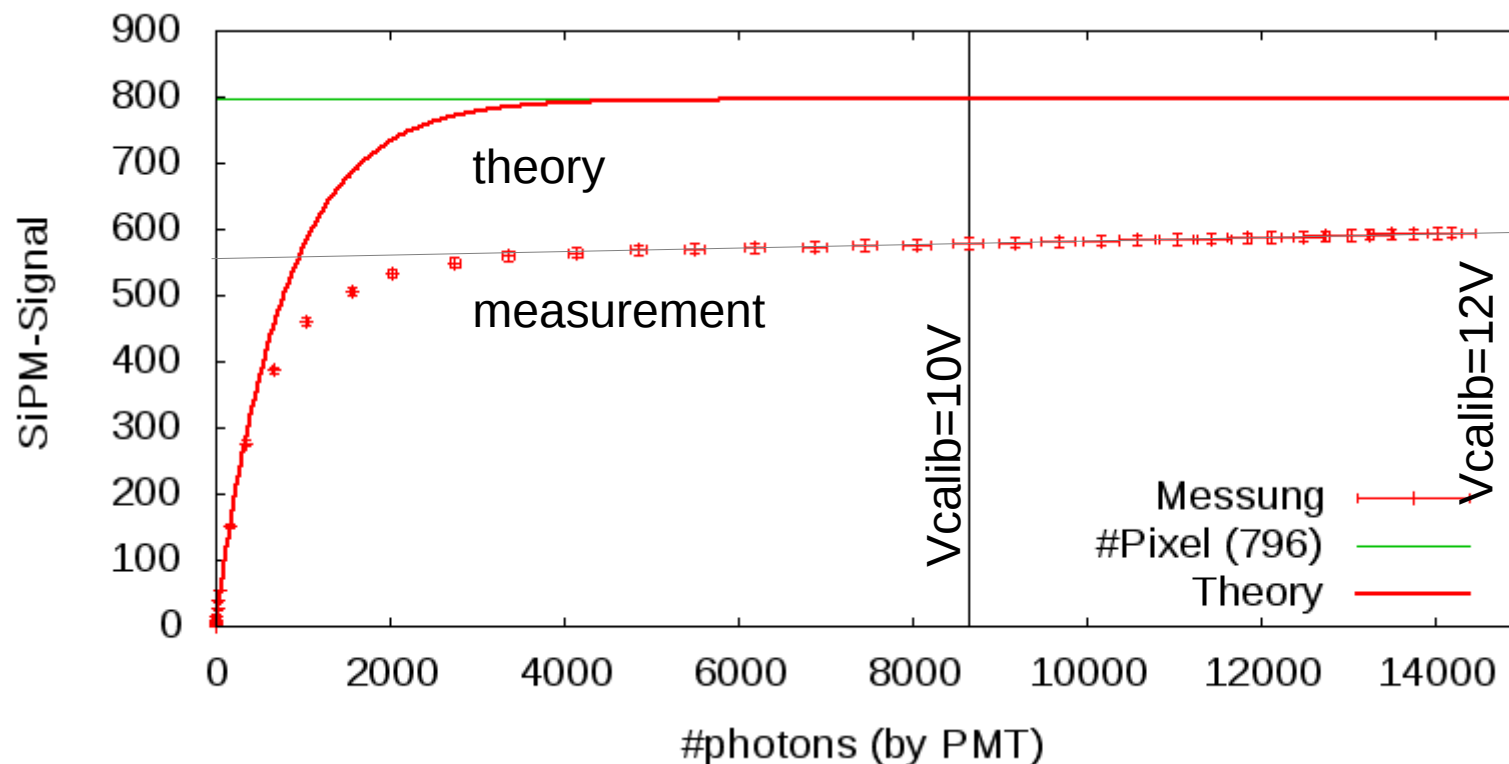
Pulse width (PMT signal)

- Short pulses $O(5\text{ns})$ for $V_{\text{calib}} < 7\text{V}$ (calibration range)
- Tail for higher V_{calib} (saturation range)
- → Pulse width definition: signal width at 10% amplitude
- HBU: $5.5 \pm 0.7\text{ns}$ pulse width
- Calibration possible with correct V_{calib} settings!



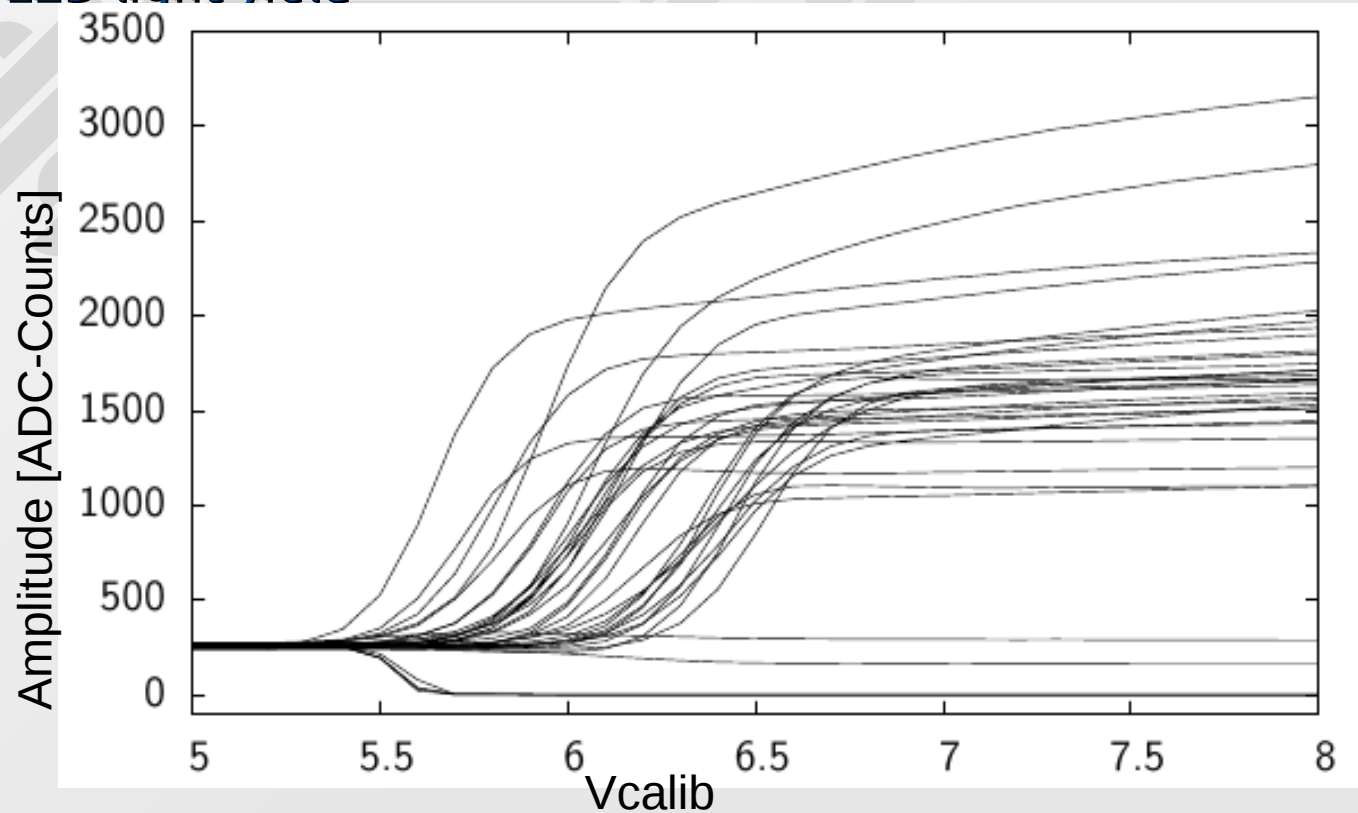
Saturation

- SiPM show saturation due to number of pixels
- Setup 2011:
 - single tile (no HBU)
 - 796pix-SiPM
 - PMT monitoring
 - Calibration to pixel equivalent
- Saturation with LEDs possible!
 - ~8500 photons @ $V_{calib}=10V$
 - ~15000 photons @ $V_{calib}=12V$
 - Saturation at 2000 photons
- Low saturation level & non-constant plateau:
inhomogeneous light distribution on SiPM



Saturation on HBU

- Saturation effect can also be observed with HBU
 - But no monitoring of LED light yield
- Various slopes at plateau
- different saturation levels
 - Signals not calibrated → electronic bugs
- Also spread in LED light yield



Conclusion

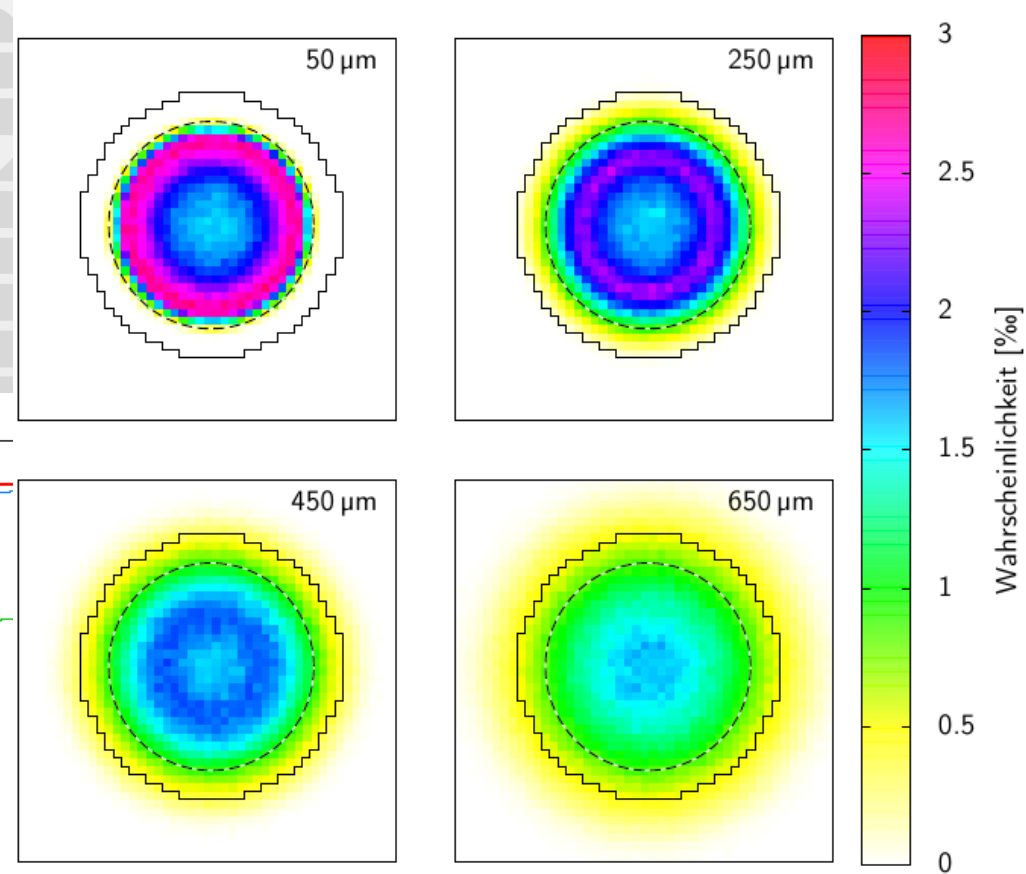
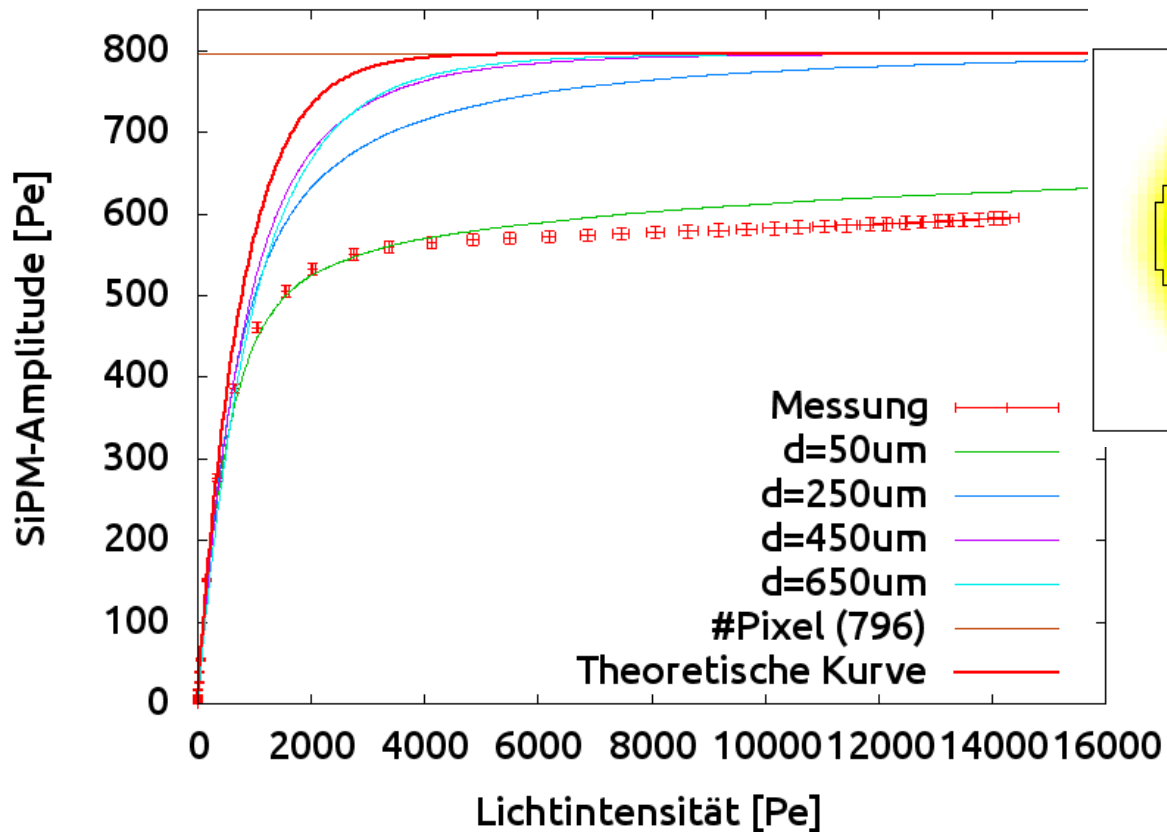
- LED system is able to produce short light pulses $O(5\text{ns})$ for SiPM calibration on HBU
- Large spread in light yield observed
 - Several values of V_{calib} needed to calibrate all SiPM
 - Investigation needed to equalize yield for future version
 - *Reason for problem known*
 - Correlation to channel-to-channel delay
- Also high light yields possible for SiPM saturation measurements



backup

Simulation fiber on SiPM

Saturation simulation



Pixel hit Probability map (Itep)