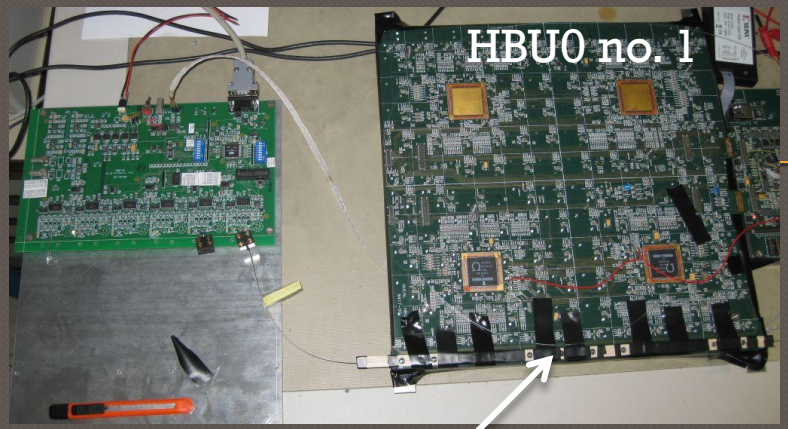
Optical calibration system – recent activities in Prague

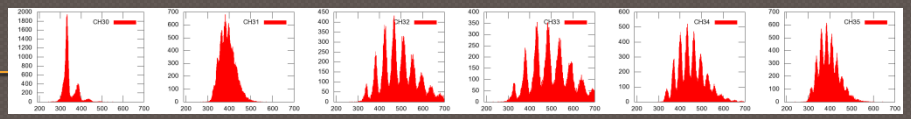
1. DESY tests
2. Electronics developments
3. Optical developments
4. Outlook

DESY test 1



Notched fibre fixed in balsa frame

ASIC1

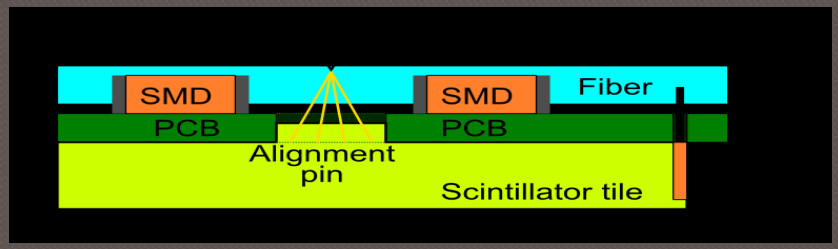


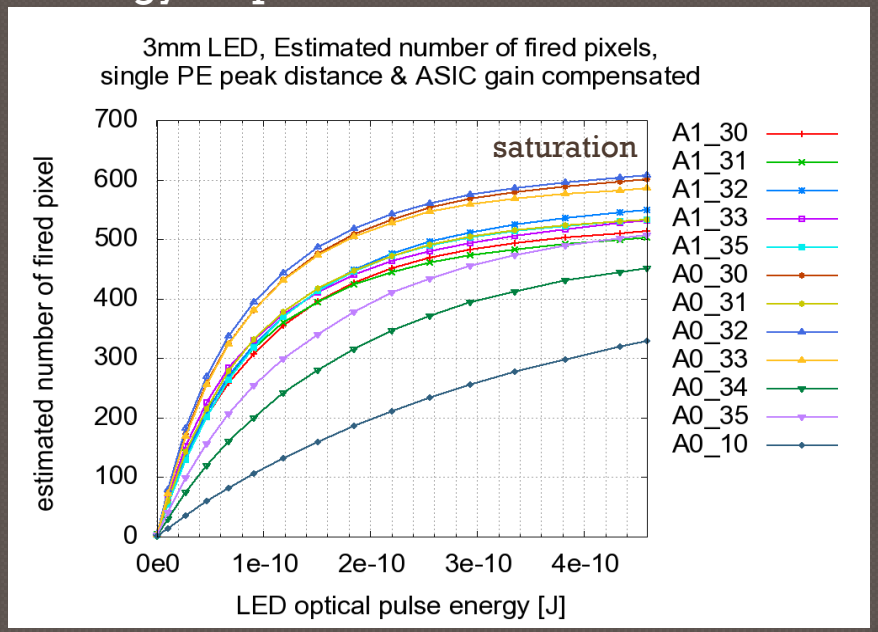
- Large spread of single_photon_peak distances - SiPM voltage settings?
- Amplitude scan in LG, 400fF
  - Fired pixels in LG estimated using single photon peaks in HG + HG/LG ratio
  - QMB amplitude V1 converted to optical energy output

QMB6 performance on HBU0

- Single p.e. peaks in HG
- Amplitude scans at LG
- HG vs. LG ratio measurement

Calibration by notched fibre

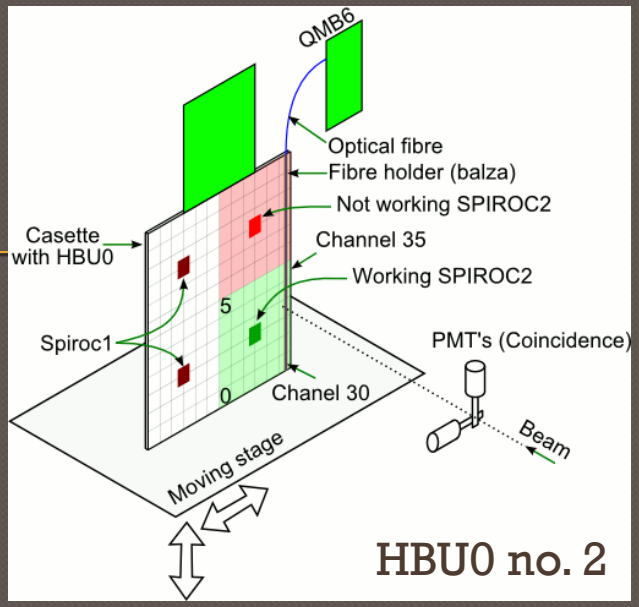


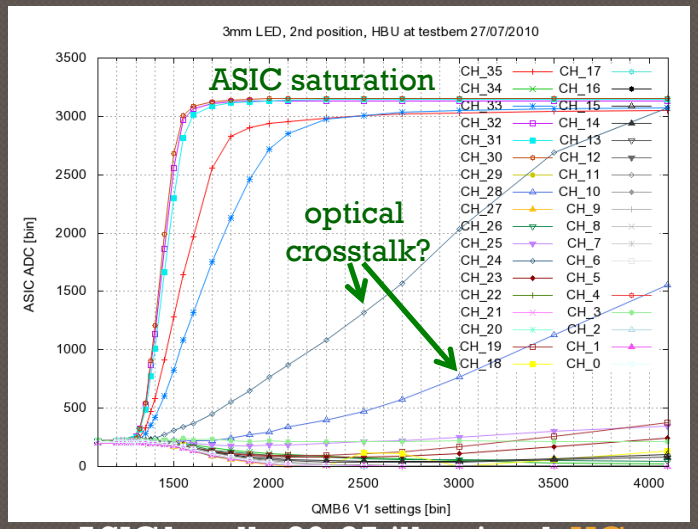


DESY test 2 – in beam

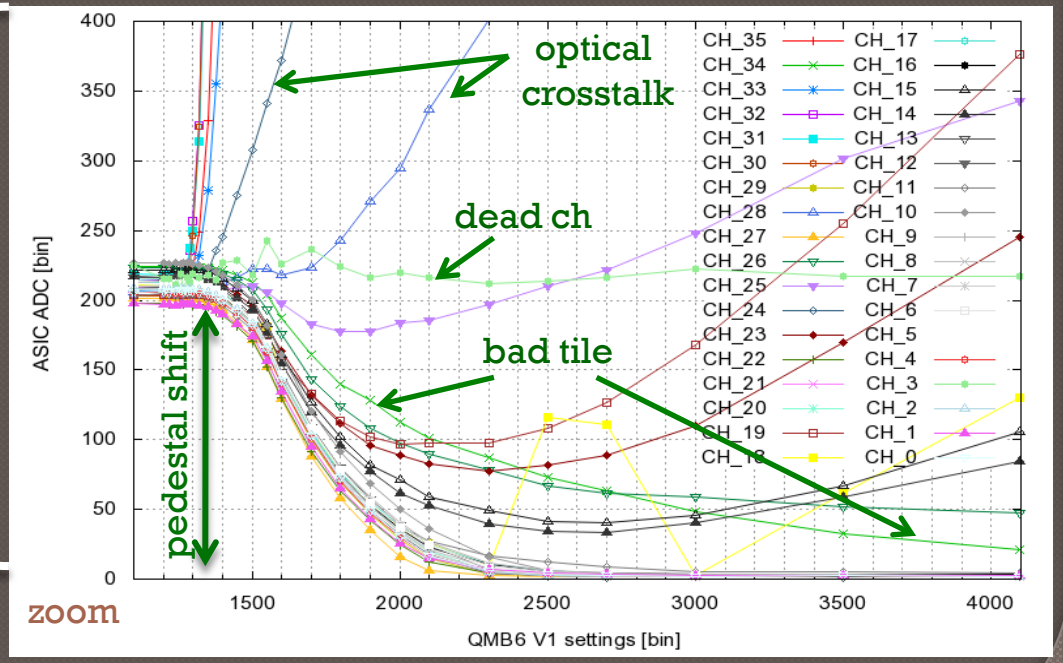
ASIC0 (green) fully working
ASIC1 (red) problems with programming
trigger: beam or internal DIF trigger
Channels 30..35 were illumined
Measurements:

- MIP signal in High Gain and Low Gain
- Gain in HG and LG using MIP signal
- Scan over various V1 setting of the QMB6
- Pedestal shift for non-illumined cells

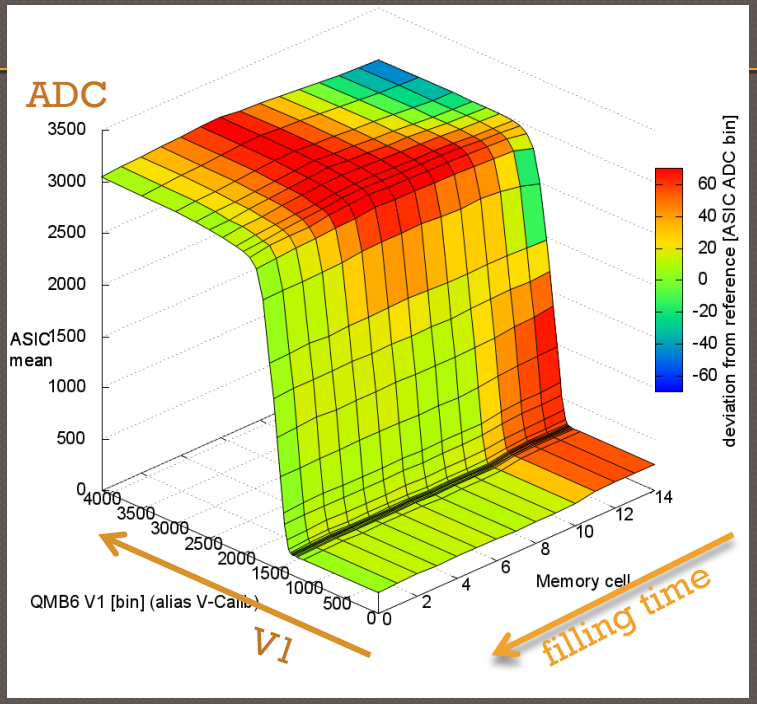


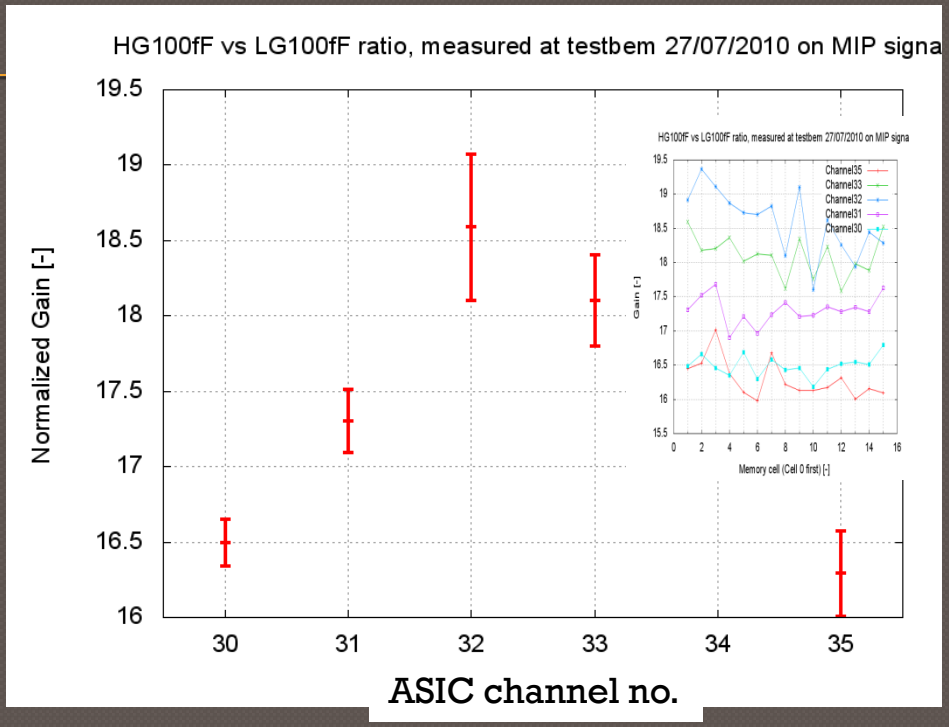


ASIC1, cells 30-35 illumined, HG



DESY test 2 – preliminary results





Analogue memory cells filling 1 ASIC channel – high gain:

- scan over various V1 setting of the QMB6, (0 – 4000)
- ASIC ADC values averaged over a run
- reference value (green) - last filled memory cell
- decrease of pedestal during filling!

Ratio HG/LG – important for calibration

- MIP signal in High Gain and Low Gain
- spread over memory cells
- spread over ASIC channels
- ratio channel dependent and > 10(?)
- Important parameter for energy scale setting

Electronics developments

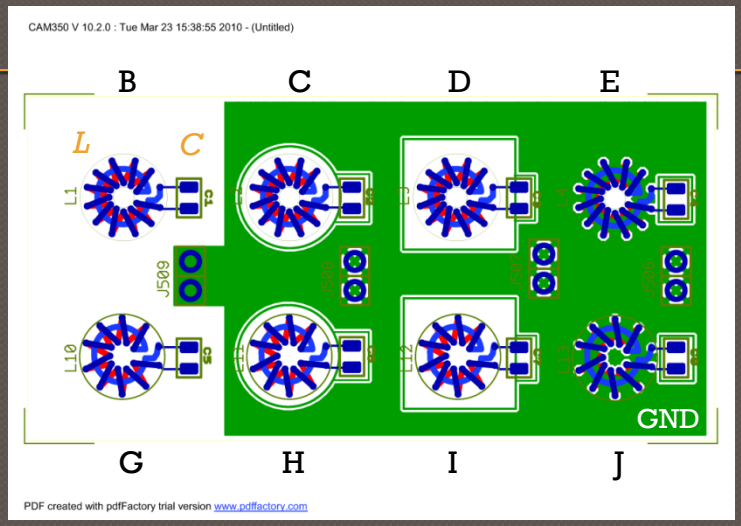
Higher inductance improves linearity behaviour of the of the QRLED driver
How to increase L?

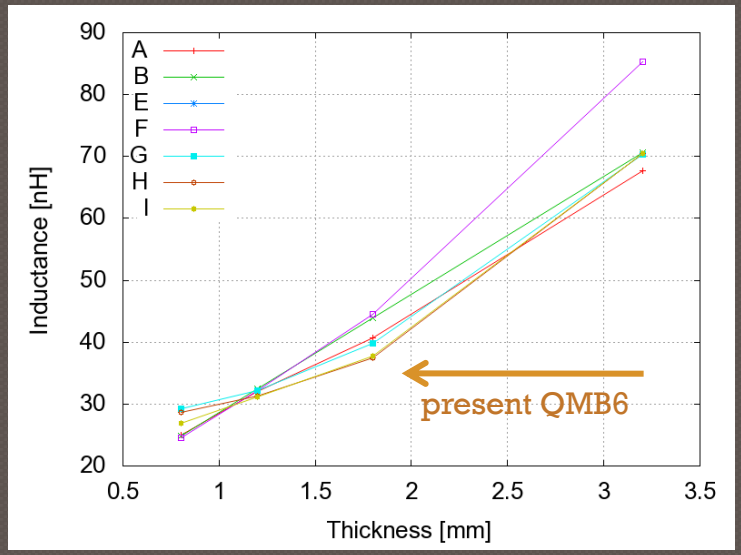
- toroid size: 11 and 9 coil turns, and diameter
- thickness of PCB: 0.8, 1.2, 1.8, 3.2 mm
- GND-plane geometry

Inductance *L* measured via resonance frequency with parallel capacitance *C* (200 pF)

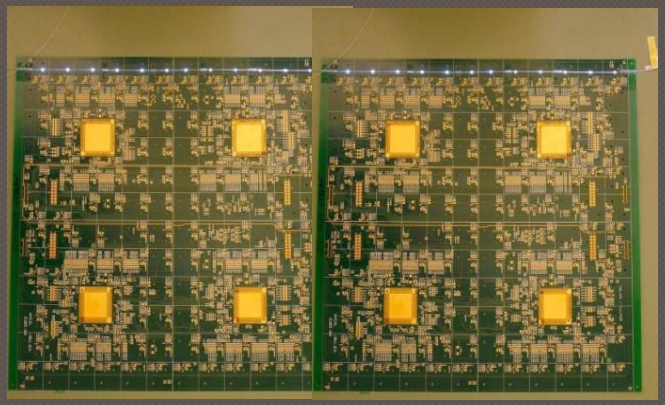
- accuracy needs improvement
- dominant effect of PCB thickness
- impact of the coil diameter? - still to be tested

Next version of the LED driver – modular based on single channel modules





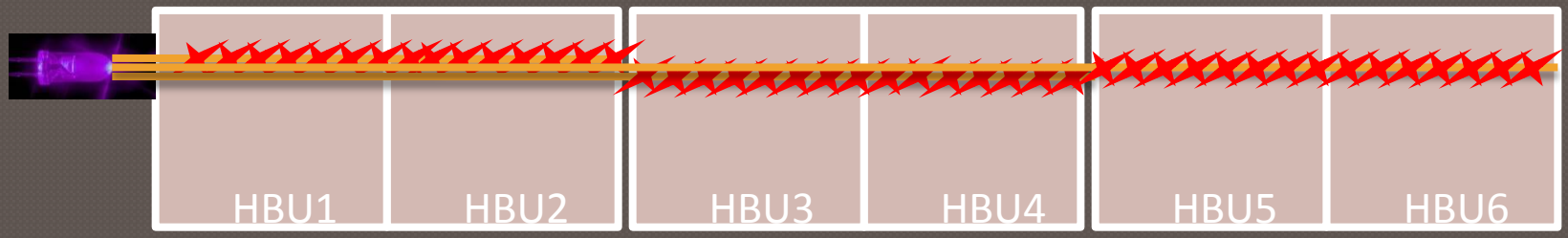
Optical developments



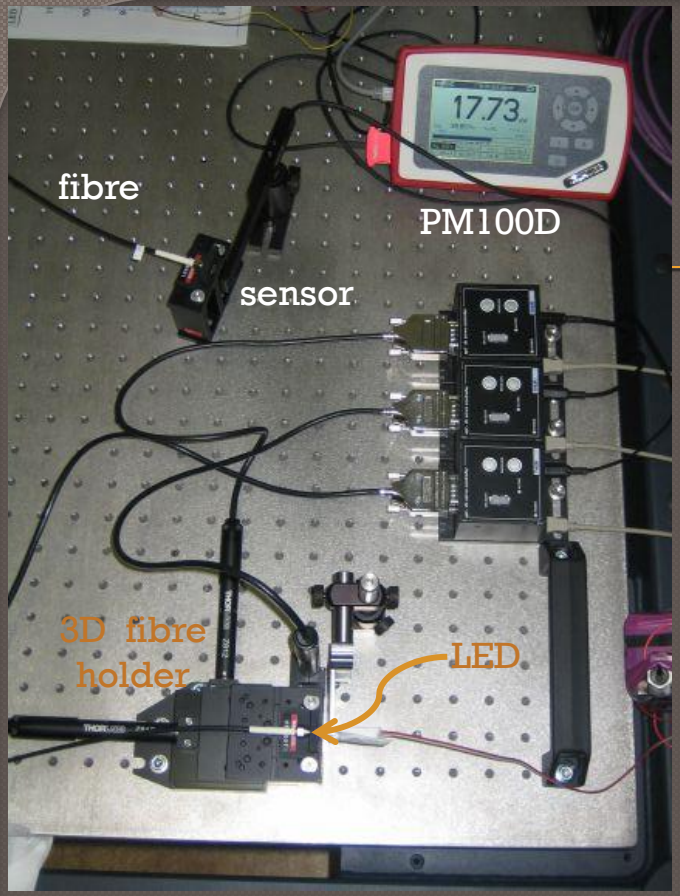
2 HBUs = 1 fibre with 24 notches

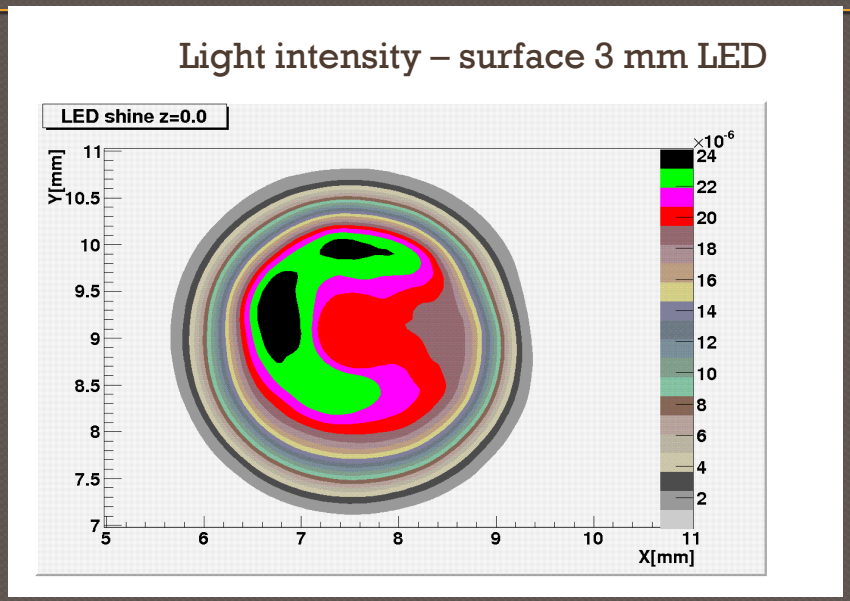
- Full length plane = 72 tiles in row
- Production of 1 fibre with 72 notches is tedious and expensive
- Agreement reached: 3 parallel fibres, each with 24 notches (1 fibre for 2 HBUs)
- For final calorimeter we plan to use full length fibre with 72 notches – automation needed
- Order placed to SAFIBRA comp.: by the end of 2010 we shall get and test the first set of 3 fibres, beginning of 2011 – 3 more sets will be delivered

3 fibres receive light from 1 LED



Optical developments 2

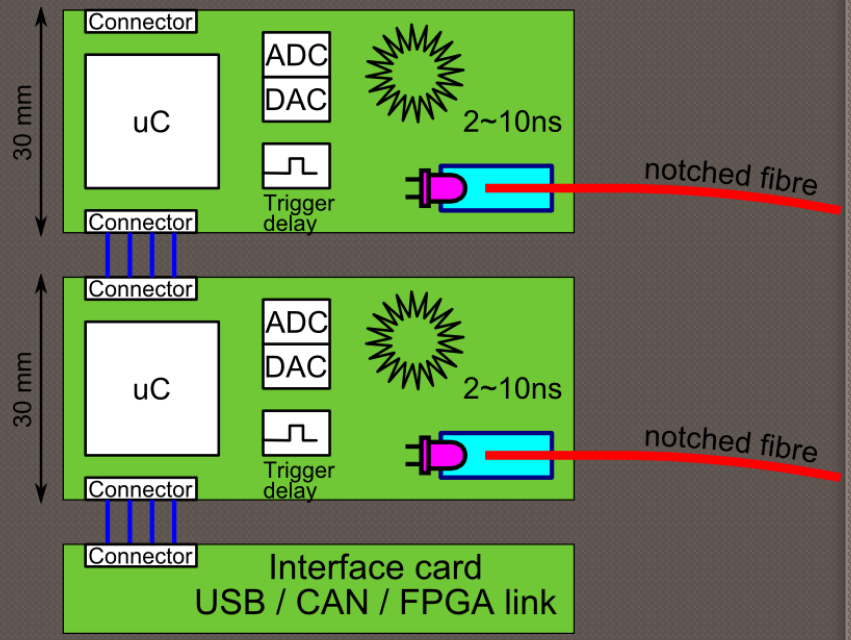




- 1 LED for more fibres – distribution of light intensity on the LED surface?
- We scanned a 3 mm LED S130VC by the THORLAB set up + PM100D
- Light intensity shows asymmetry (chip position) – inhomogeneity ±10%
- ±15% observed for 5 mm LEDs used in 1m^3 HCAL calibration system
- Not a problem - inhomegeneity from notched fibres on ±20% level

Outlook

- Focus: increase of the optical performance:
  - increase of the pulse width from the current 3.5 ns
  - Improvement of the optical coupling from LED into the fibre
  - Improvement of the transmission to the scintillation tile
- New QR LED driver prototype envisaged
  - only 1 electronic channel per board
  - different onboard inductors for different pulse width in range of 4 ~ 10 ns
  - 3cm PCB width to match the tile size
- Notched fibre production (Q4/10-Q1/11)
  - 4 sets by 3 notched fibres each with 24 notches



Thanks to my Prague colleagues M. Janata, J. Kvasnička, I. Polák, J. Smolík and M. Reinecke, M. Terwort and J. Zálešák for DESY tests support!