



LED notched fibre distributing system

Calibration system for SiPM

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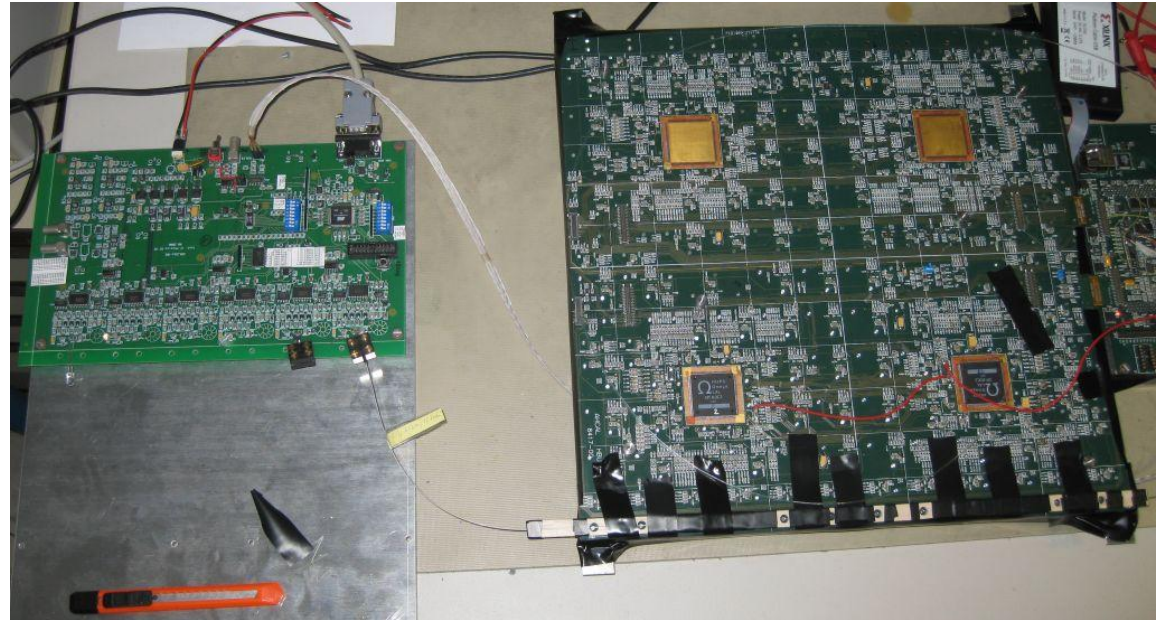
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1. QMB6 performance with HBU0, saturation of SiPM
2. Toroidal inductor at PCB
3. Notched fibre light distribution systems 3x24
4. Conclusions

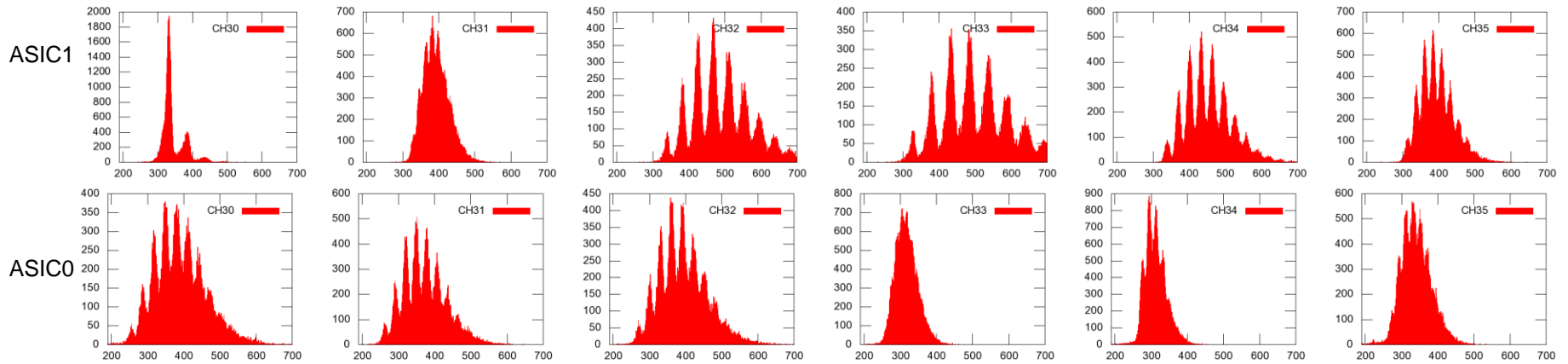
QMB6 performance on HBU0

Outline

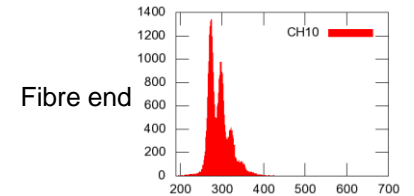
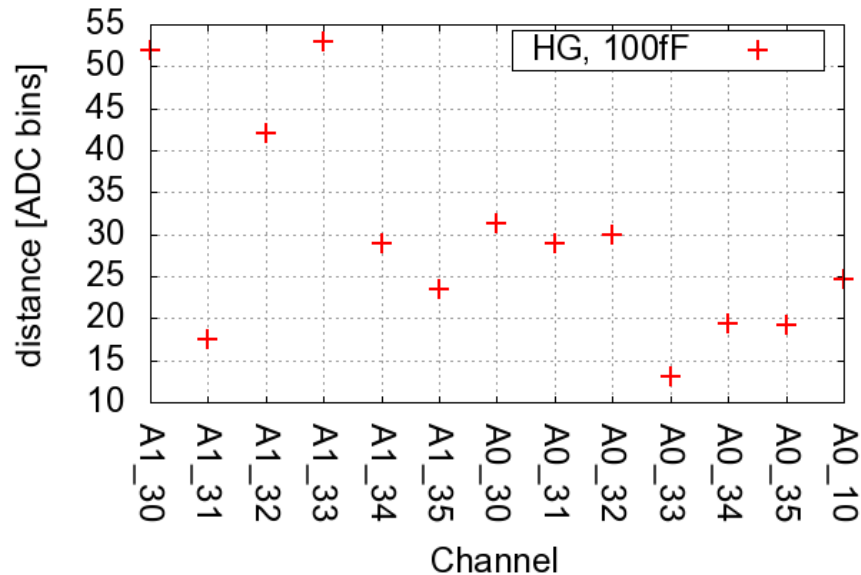
- SinglePE in HG
- Amplitude scans at LG
- HG vs LG ratio measurement
- 1st correction of ASIC gain
- Optical power measured in Prague
- 2nd correction of output optical power



Single PE spectrum



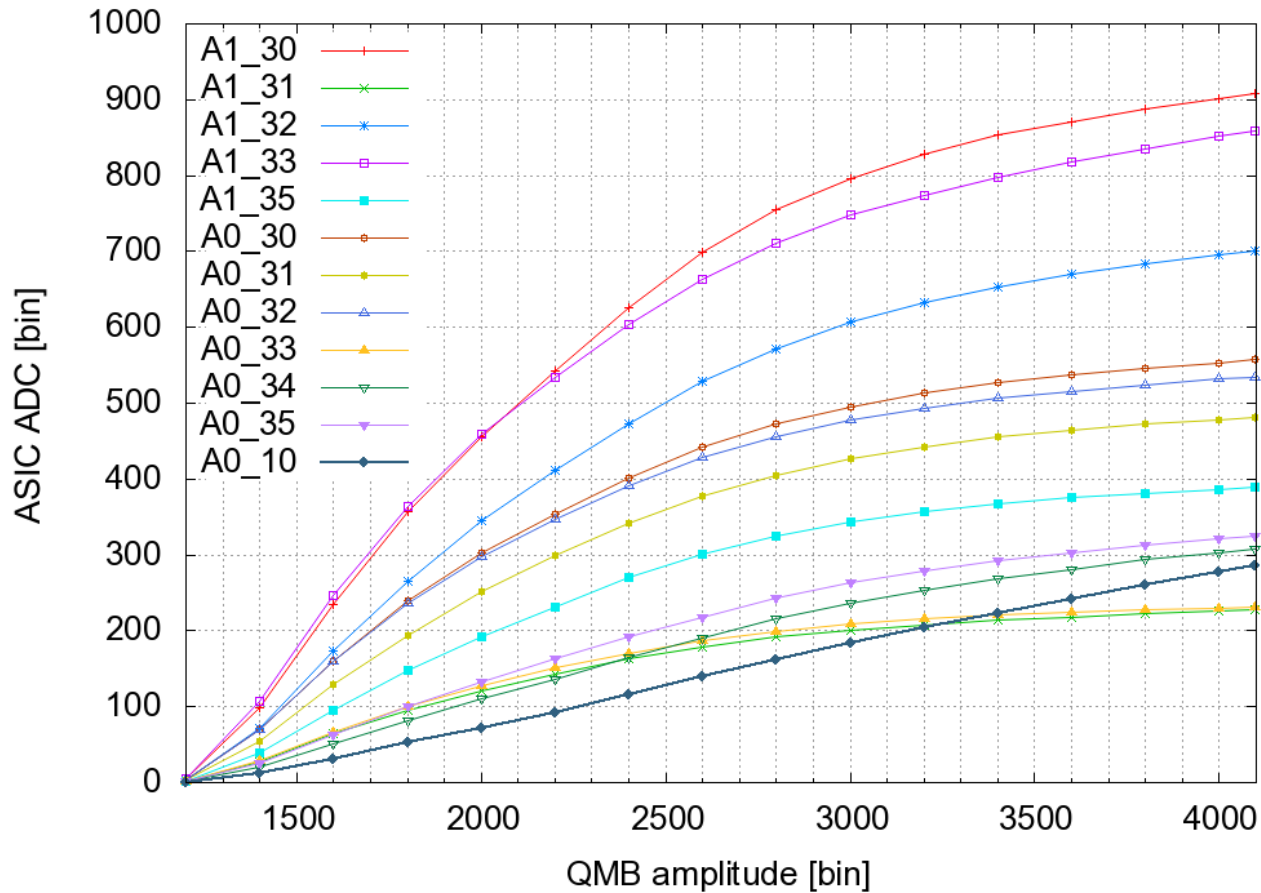
Distance among single photon peaks



- HG mode, 100fF feedback capacitance
- Statistics of 50K events
- **Big spread** of single_photon_peak distance [ADC count / pixel] among the channels
- SiPM voltage settings?

Amplitude scan

3mm LED, ASIC ADC with pedestal subtracted

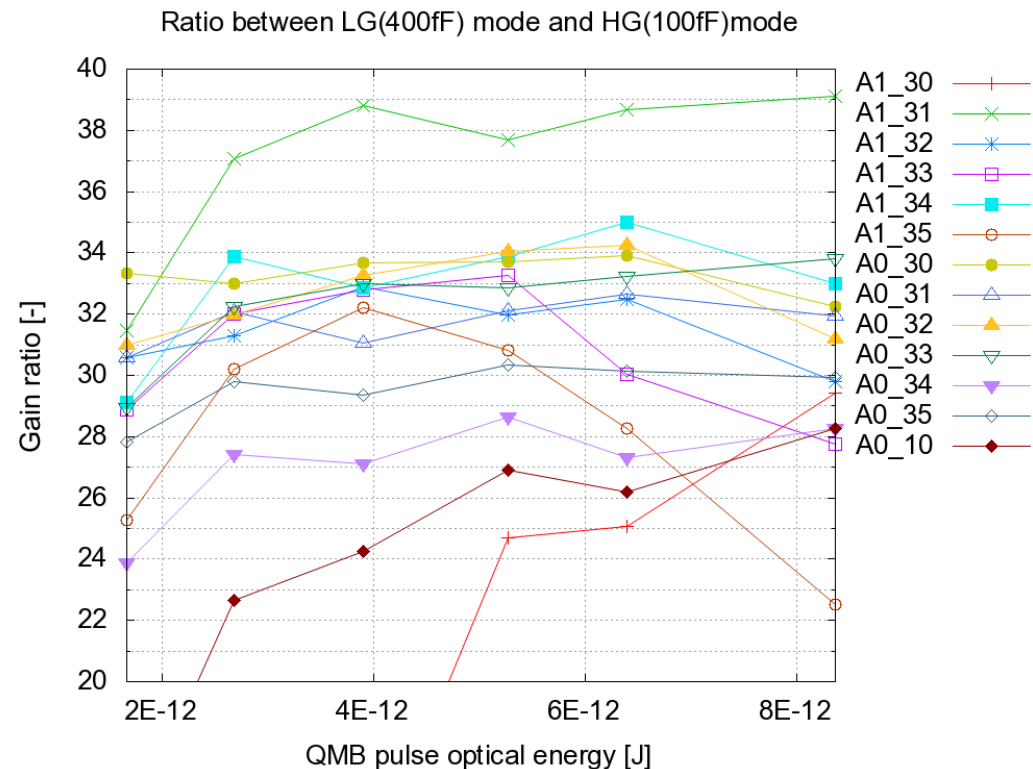
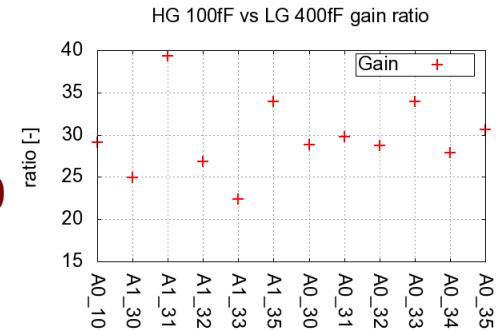


- Scan at LG, 400fF
- ASIC should not be saturated (range up to 4095 bins)

HG vs LG radio measurements

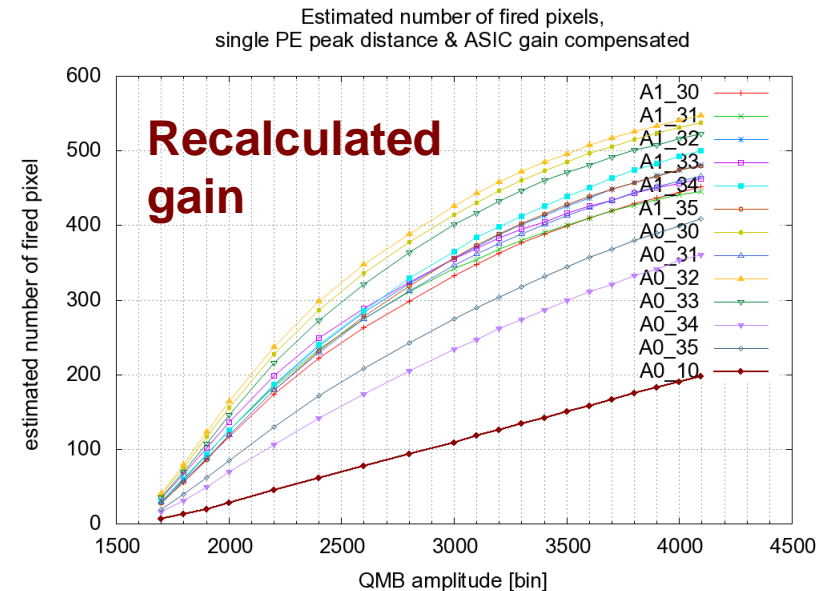
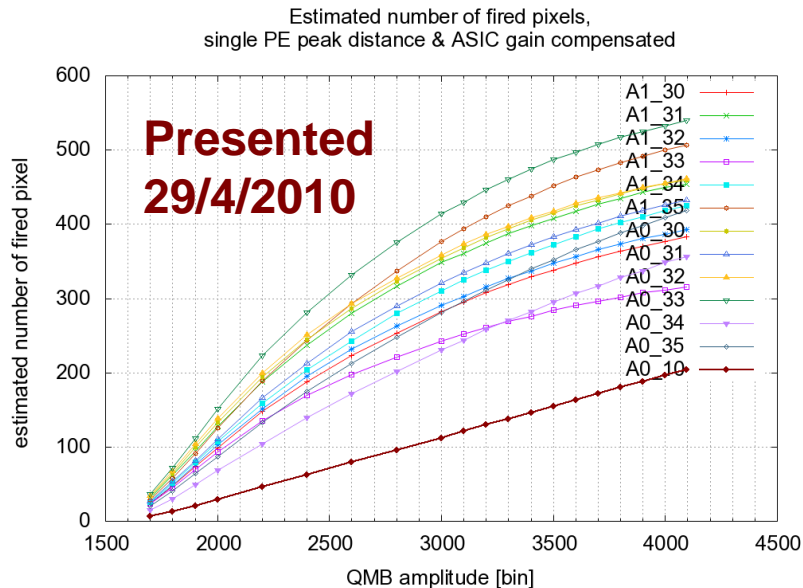
- 1st measurements were measured only in one fixed amplitude. These data were presented in April. Analysis showed, that **some channels were saturated** in HG mode.
- Therefore: we scanned the ratio in **several** (optical) amplitudes
- Data were taken at amplitudes, where
 - Signal is not saturated in HG mode
 - Signal is still reasonably high in LG mode
- Can the ratio be measured by charge injection? How does it correspond?
- Pedestal shifts during measurements?

Old data
29/4/2010



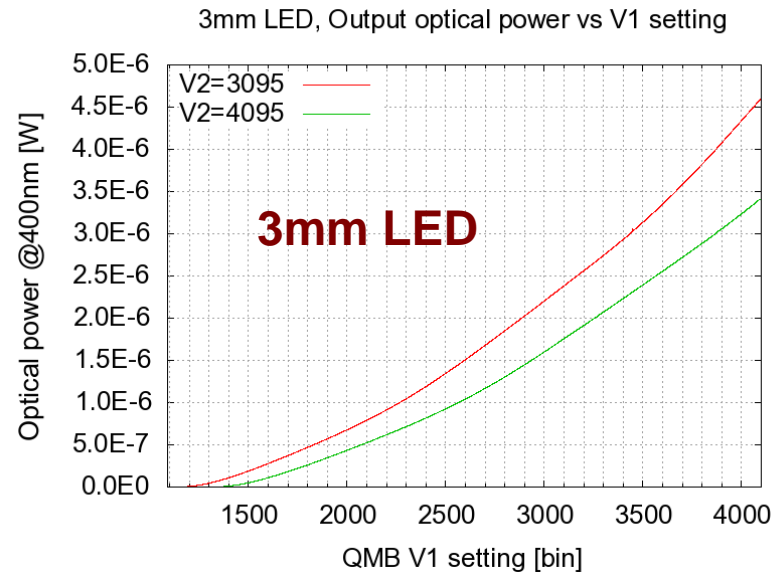
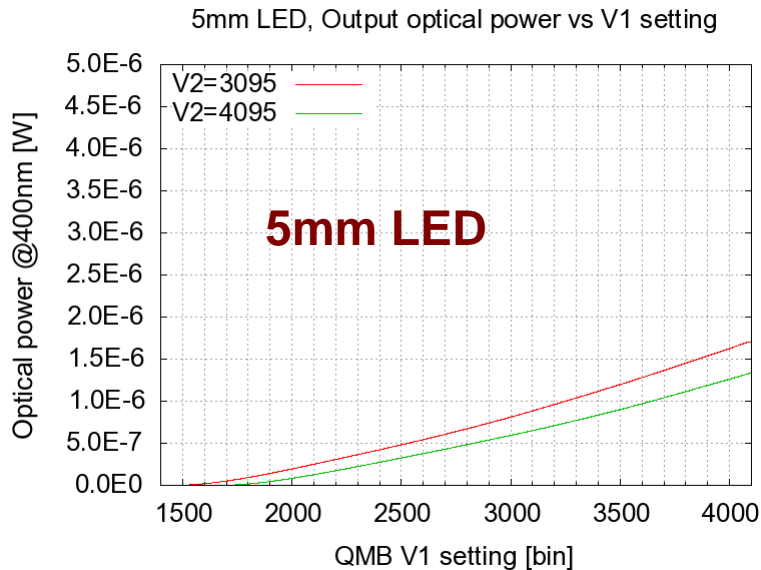
Amplitude scan corrected (1)

- From the distance between single photon peaks and from the HG vs. LG ratio, we are able to estimate the number of fired pixels



- New recalculation:
 - delivered optical power from the fibre is much more consistent
 - Curves are less crossing each other
- Next step: convert V1 value to optical power (energy)

Optical performance at Prague lab



- Equipment: Thorlabs PM100D & S130VC
- Slope is not linear, especially at very low amplitudes
- Reason: energy is stored in the inductor and the peak voltage has to rise above the V2 and the voltage drop of the UV LED

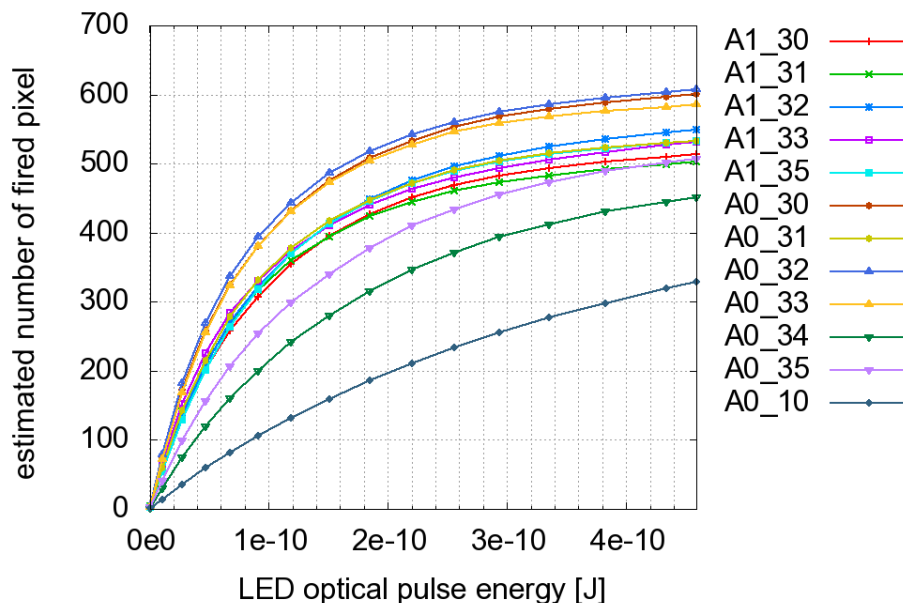
Amplitude scan corrected (2)

- Linear extrapolation of the initial slope indicate the dynamic range of ~200 MIPs

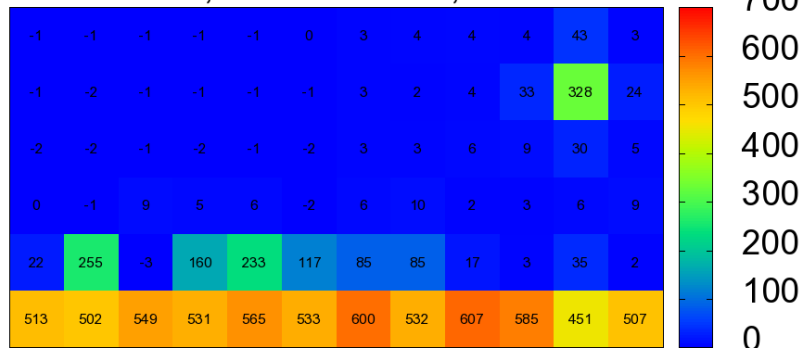
Final comments:

- The estimated number of fired pixels is larger than the real number of SiPM pixels
- Different shapes of saturation curve might indicate improper HG vs LG ratio
- Saturation curves does not match simple $f(x)=1-\exp(-x)$ function (unsuccessful fits)
- Not yet analyzed: shifts among ASIC memory cells (pedestal and data), crosstalk among memory cells, crosstalk among channels

3mm LED, Estimated number of fired pixels, single PE peak distance & ASIC gain compensated



Number of pixels estimation [pixels]
LG mode, 400fF V1=4095, V2=3095



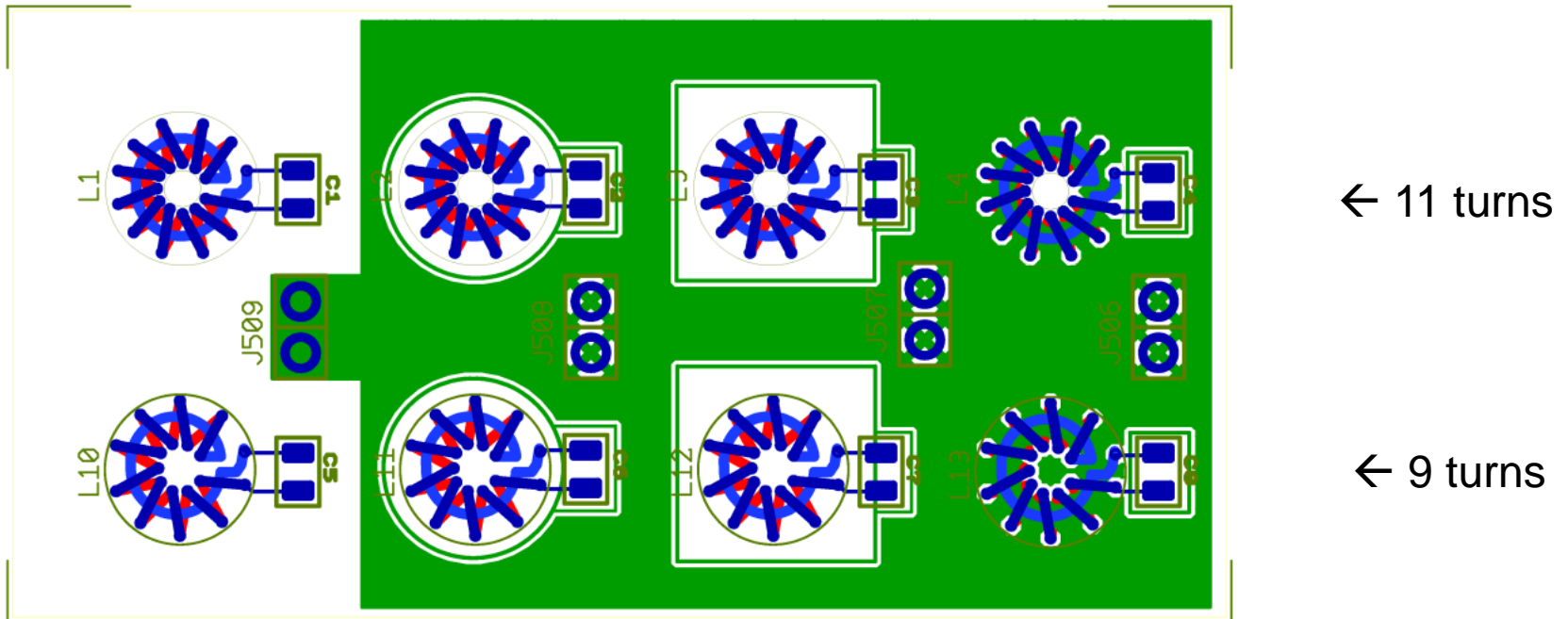
Test PCBs with toroidal inductor

1. Test mechanical dimension, thickness of PCB on inductance
2. test GND-plane influence

30 x 60 mm² 4 layers

CAM350 V 10.2.0 : Tue Mar 23 15:38:55 2010 - (Untitled)

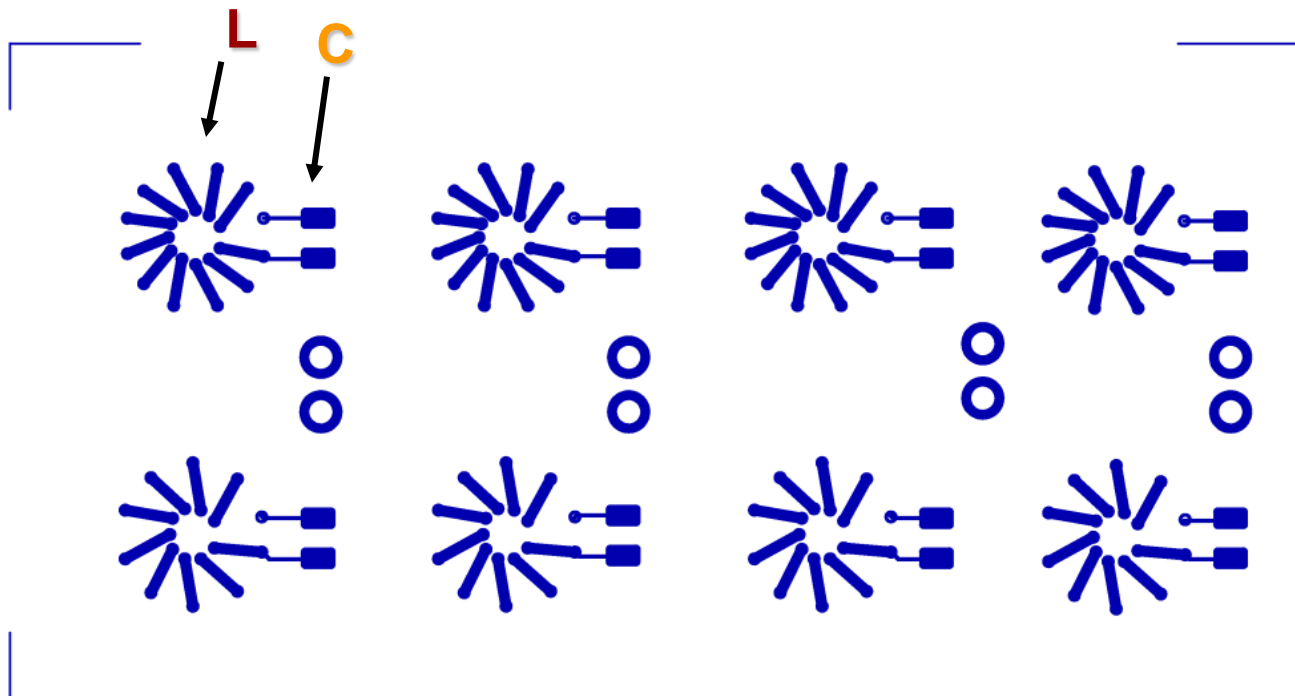
3 PCB thicknesses: 0.8, 1.2, 1.8, 3.2mm



Top layer, pads at right are for smd capacitors

1. First to measure resonant frequency of parasitic capacitors, only.
2. To get value of **L**, we add larger parallel **C**, all 200pF with tolerance 1%, And measure the resonance frequency by GDO meter.

CAM350 V 10.2.0 : Tue Mar 23 15:35:07 2010 - (Untitled) : CopperTop



$$f = \frac{1}{2\pi\sqrt{(L \cdot C)}}$$

After recalculating, we can see a spread of L and parasitic C (effect of GND layer)

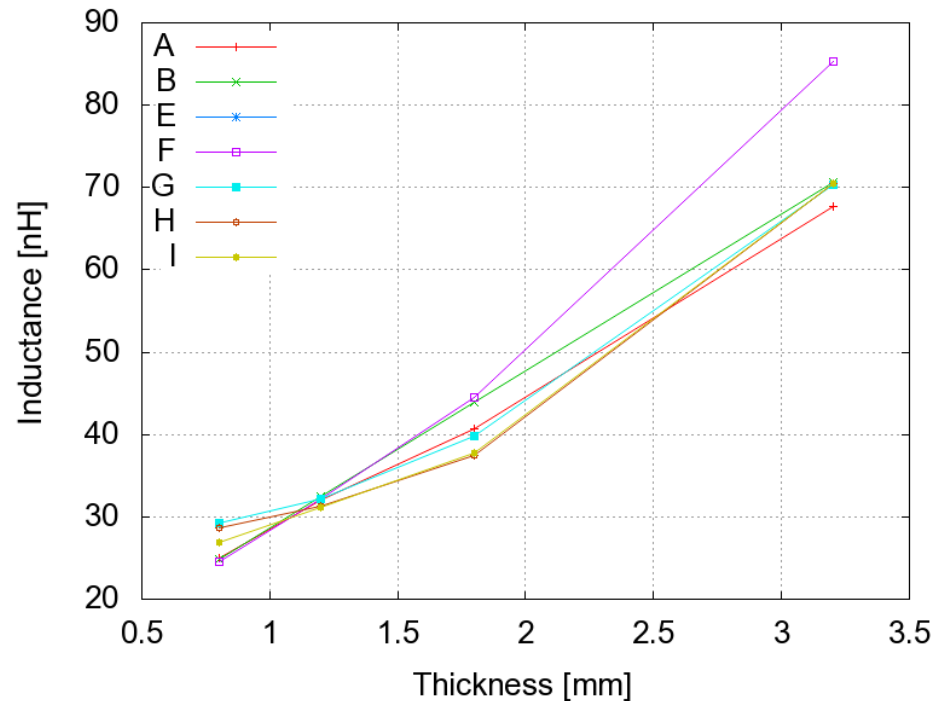
GDO = Grid Dip Meter, handy instrument to measure resonant frequency of LC circuit

Table of inductance values in MHz

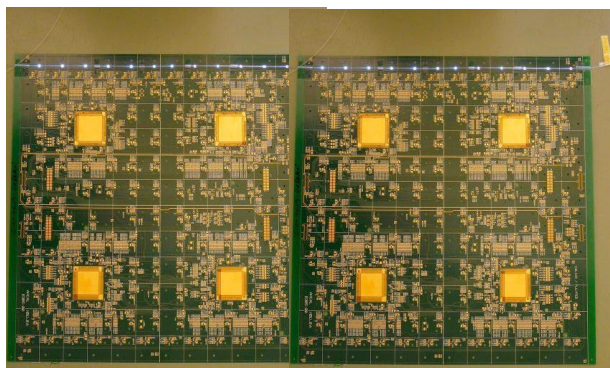
Thickness	0.8mm	1.2mm	1.8mm	3.2mm
Capacitor [pF]	198.6	199.6	201.4	200.4
PCB nr.	1	2	3	4
position				
A	71.483	62.891	55.563	43.225
B	71.706	62.464	53.493	42.289
C				
D				
E				
F	72.16	62.801	53.197	38.481
G	66.063	62.824	56.198	42.41
H	66.77	63.73	57.93	42.332
I	68.943	63.833	57.762	42.33
J	68.225	63.856	57.843	42.44

Test setup is proven, but precise frequency meter (counter) is needed. Internal counter of scope TDS 2024 is the weak point.

We will repeat the measurement to satisfy the precision.



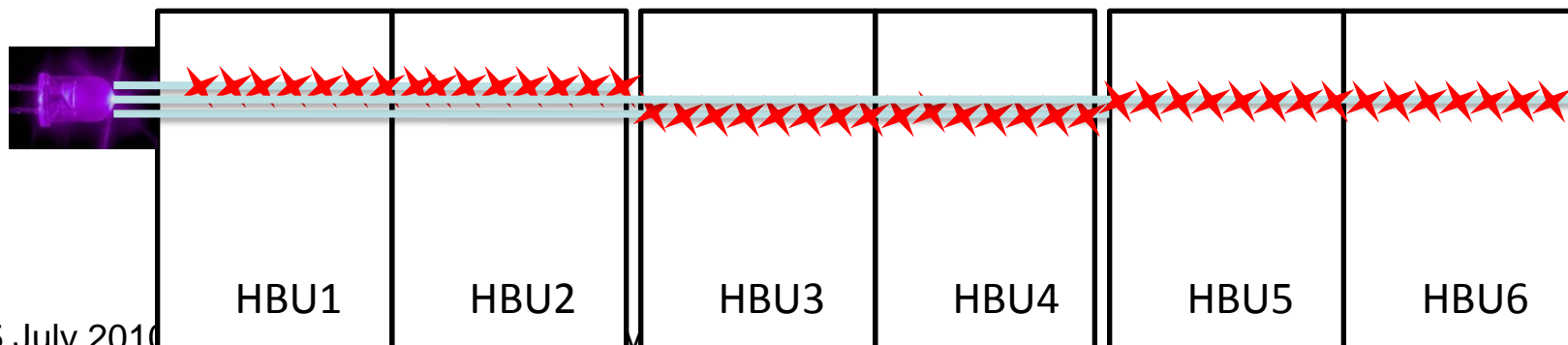
Intermediate solution for LED light distribution



2 HBUs = 1 fibre with 24 notches

3 fibres receive light from 1 LED

- Full length plane = 72 tiles in row
- Production of 1 fibre with 72 notches is tedious and expensive
- Agreement reached: 3 parallel fibres, each 24 notches (2 HBUs)
- For final calo we still plan to use full length fibre with 72 notches – automation needed

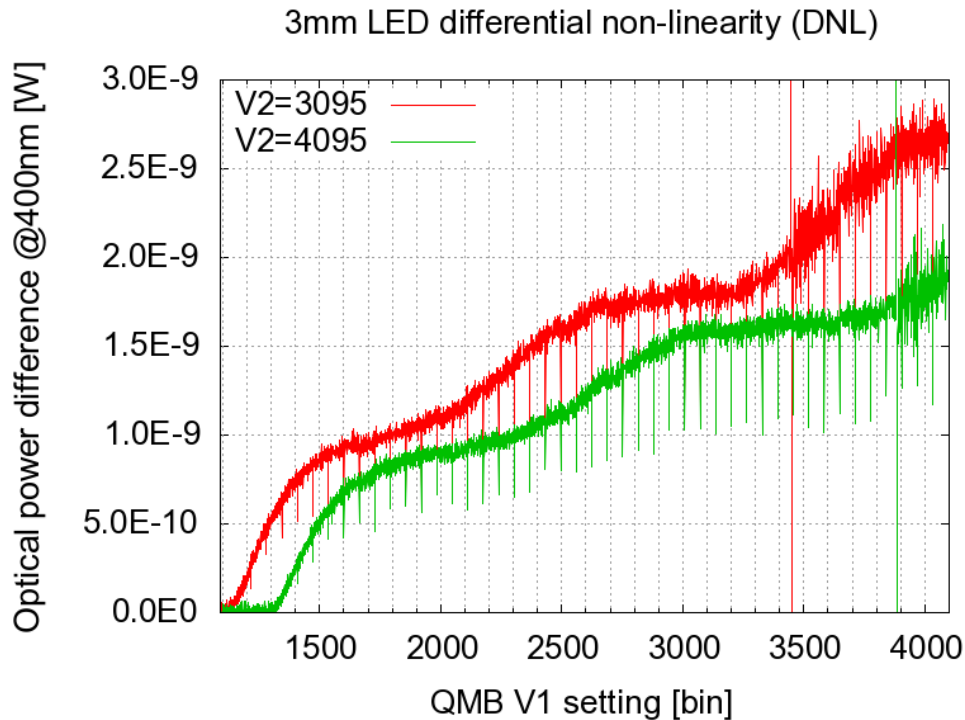


Conclusion

- We generate optical pulse 250mip equivalent, from single tap
- PCB toroidal inductors partly tested, redo with precise counter
 - An analyze is ongoing
- Preparing intermediate solution of layout: 3 fibres by 24 notches

BACK-UP

Backup: Multi-peaks of non-tuned LEDs



- “steps” in DNL graph correspond to secondary peaks. These peaks are unwanted, because they make optical pulse longer.
- Reason: incorrectly damped resonance of QRLED driver