LED notched fiber system

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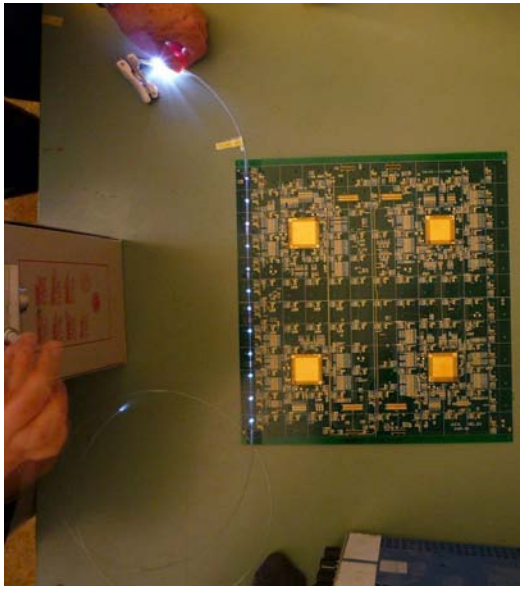
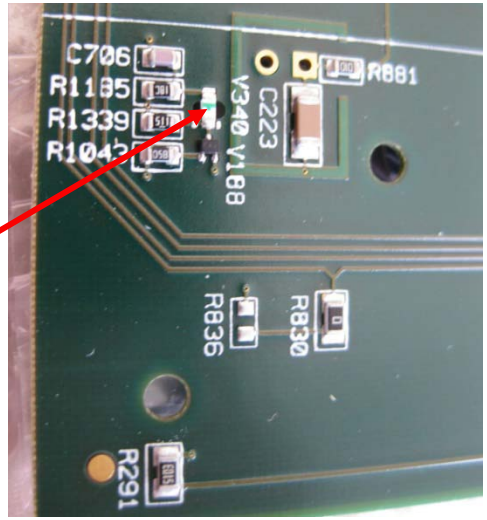
1. **Introduction**
2. **Test setup and fiber layout on HBU0**
3. **Performance**
4. **Single p.e. Spectra at HBU0**
5. **Conclusions**
6. **Plans for 2010**

Flashing UVLED - 2 methods

- Light distributed by notched fibers



- Light distributed directly by microLED to the scintillator - distributed LEDs



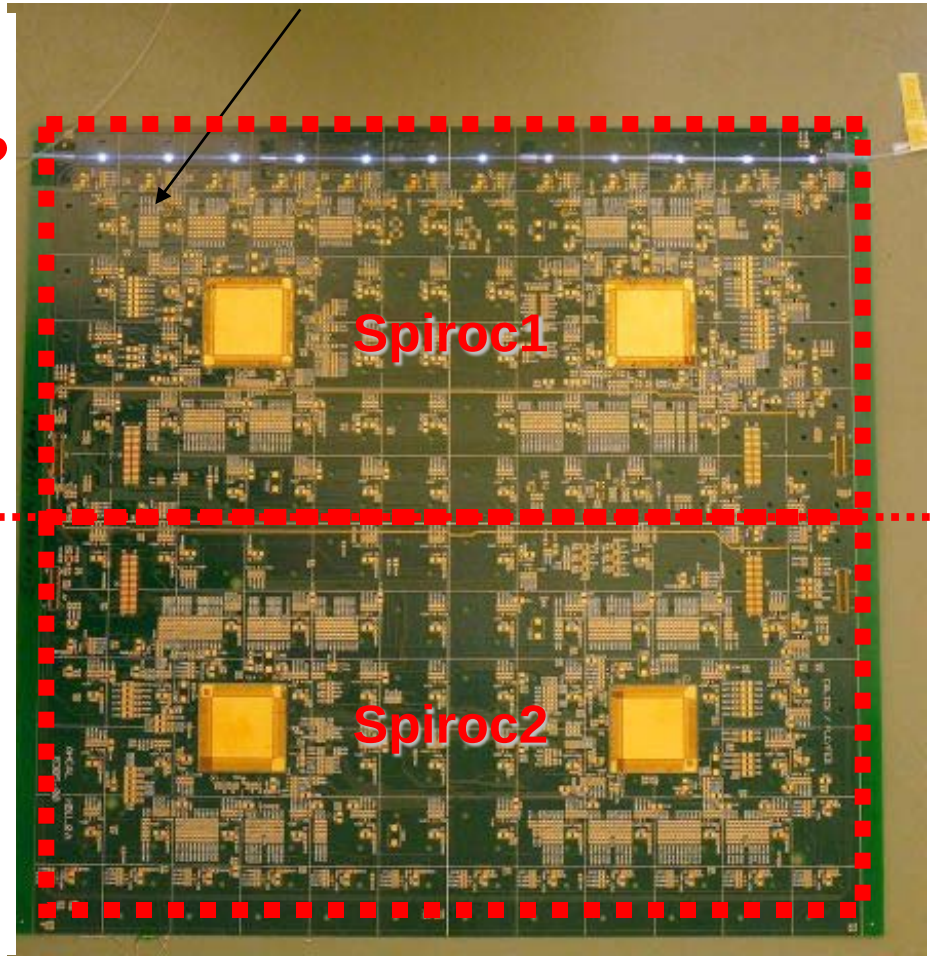
Institute of Physics ASCR, Prague (= FZU),
Shinshu University [http://azusa.shinshu-u.ac.jp/~coterra/VCI2010kotera00.pdf]

DESY Hamburg
UNI Wuppertal

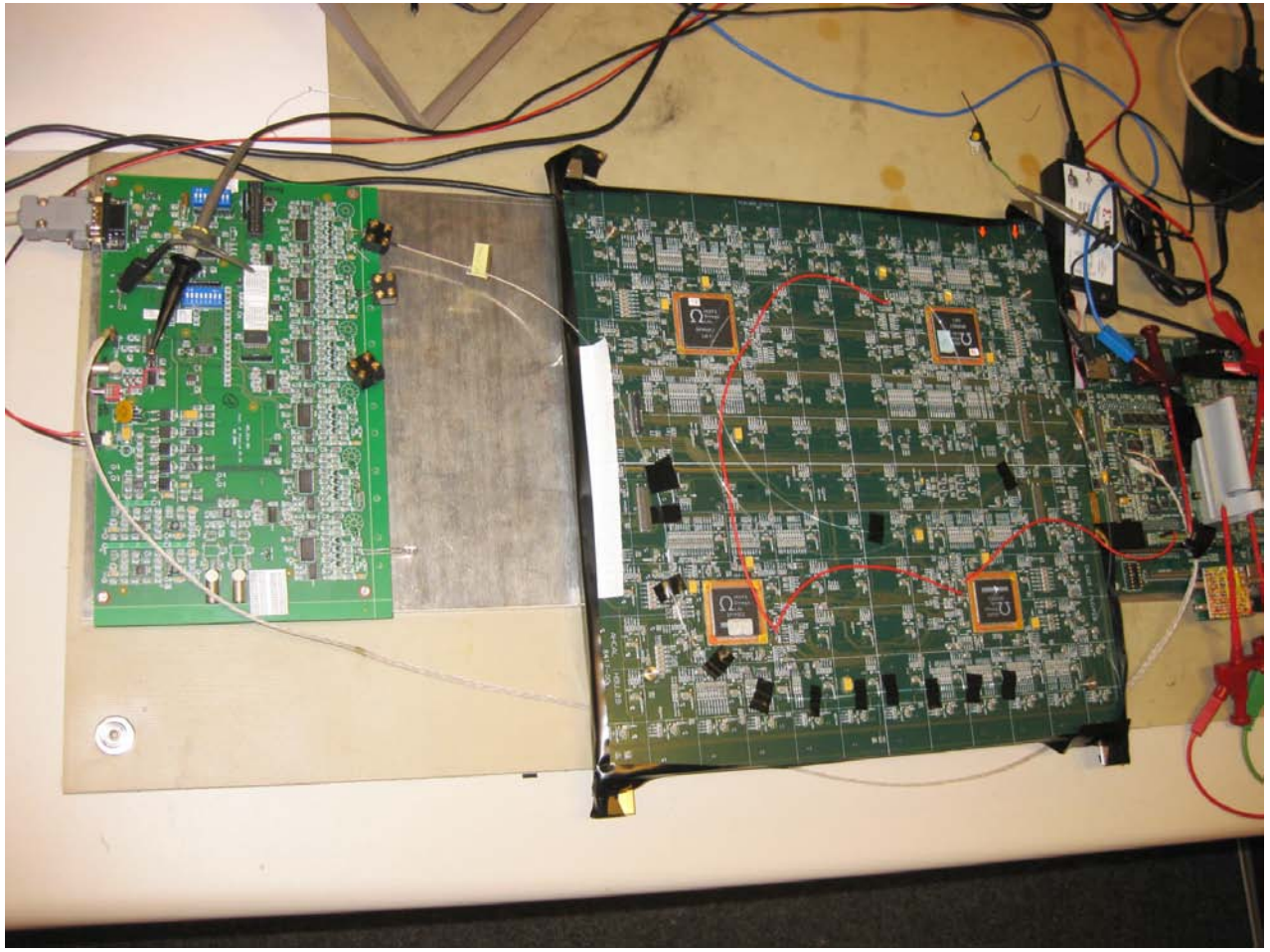
Notched fiber system

- **advantage** – tuneable amplitude of LED light from 0 to 50 mips
- Variation of LED amplitude does not affect the SiPM response readout
- LED circuit and LED's enable optical pulses with around 5ns width
- Spread of light intensity from notches can be kept under 20%
- **disadvantage** LED with control unit outside the detector volume
- Notched fibre production is not trivial

Notched fibre routed at HBU0, taps illuminates the scintillators through the special holes



Setup QMB6 + HBU0



December 2009

Configuration

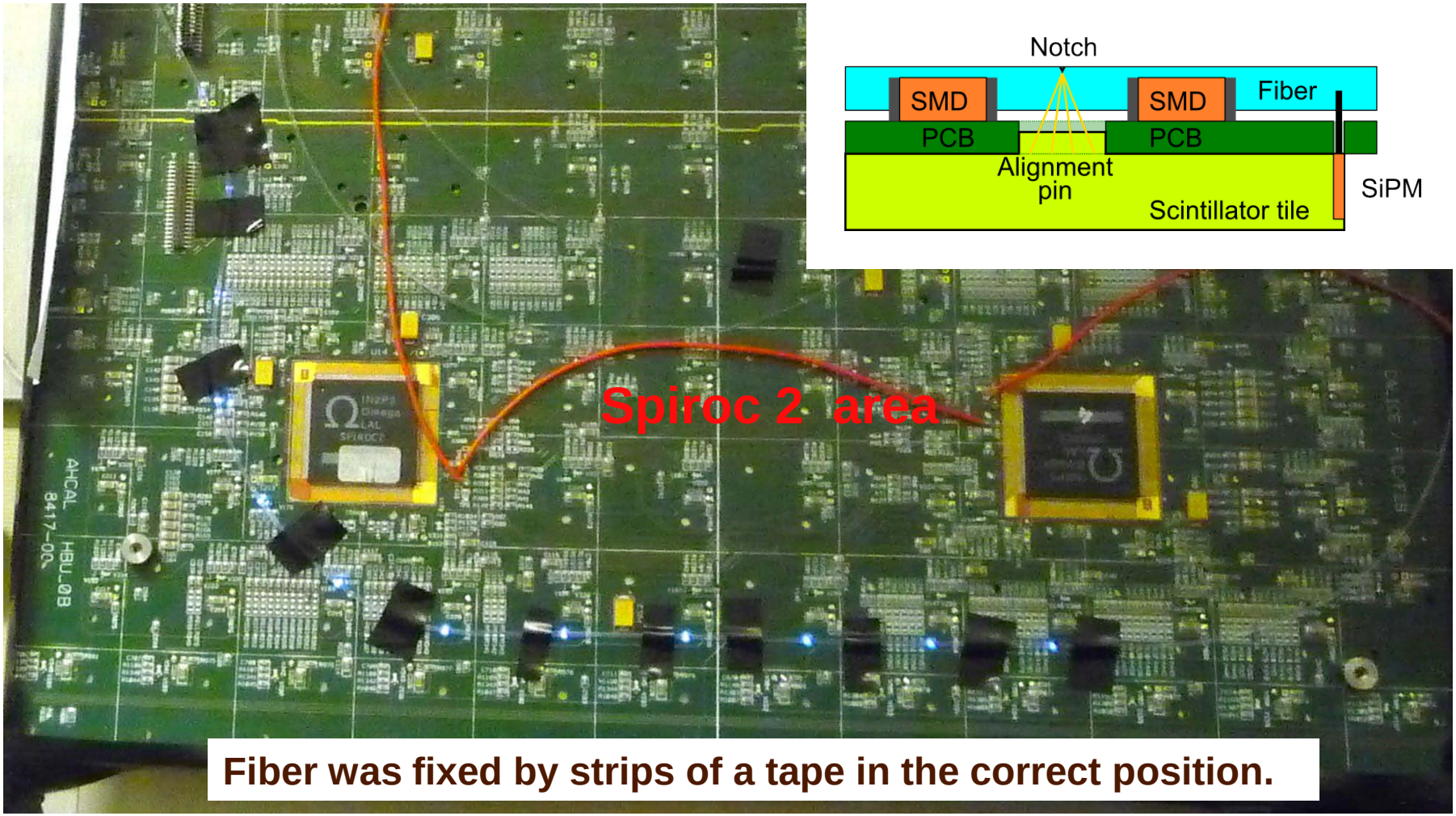
- QMB6 (6-ch Quasi-resonant LED driver Mainboard) with 1 channel
- One UVLED 5mm
- One Notched fiber (12 notches)
- From HBU0 (calib board):
  - signal T-calib LVDS
  - trigger delayed 60ns
- power +15V/0.16A
- CANbus slow-control

Almost plug and play

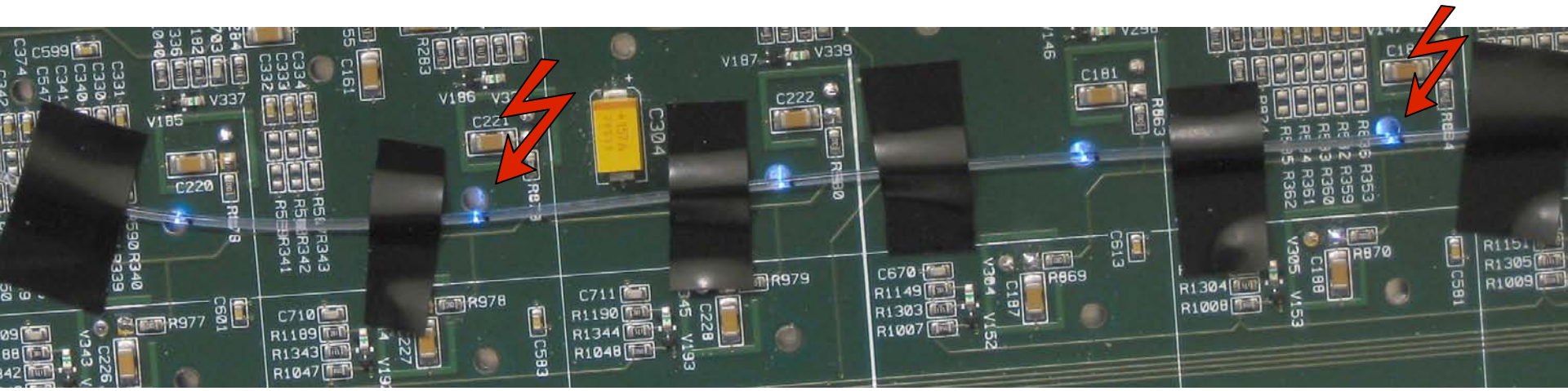
Control: LabView 8.2 exe-file, One PC with DAQ, USB --> CAN

Notched fiber layout

- Picture: Notched fiber was illuminated by small pocket spotlight.
- Most of 12 notches are above alignment pins



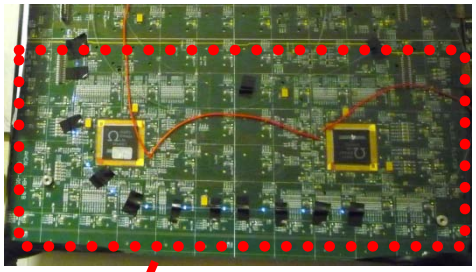
After the test we discovered a misalignment of the fiber



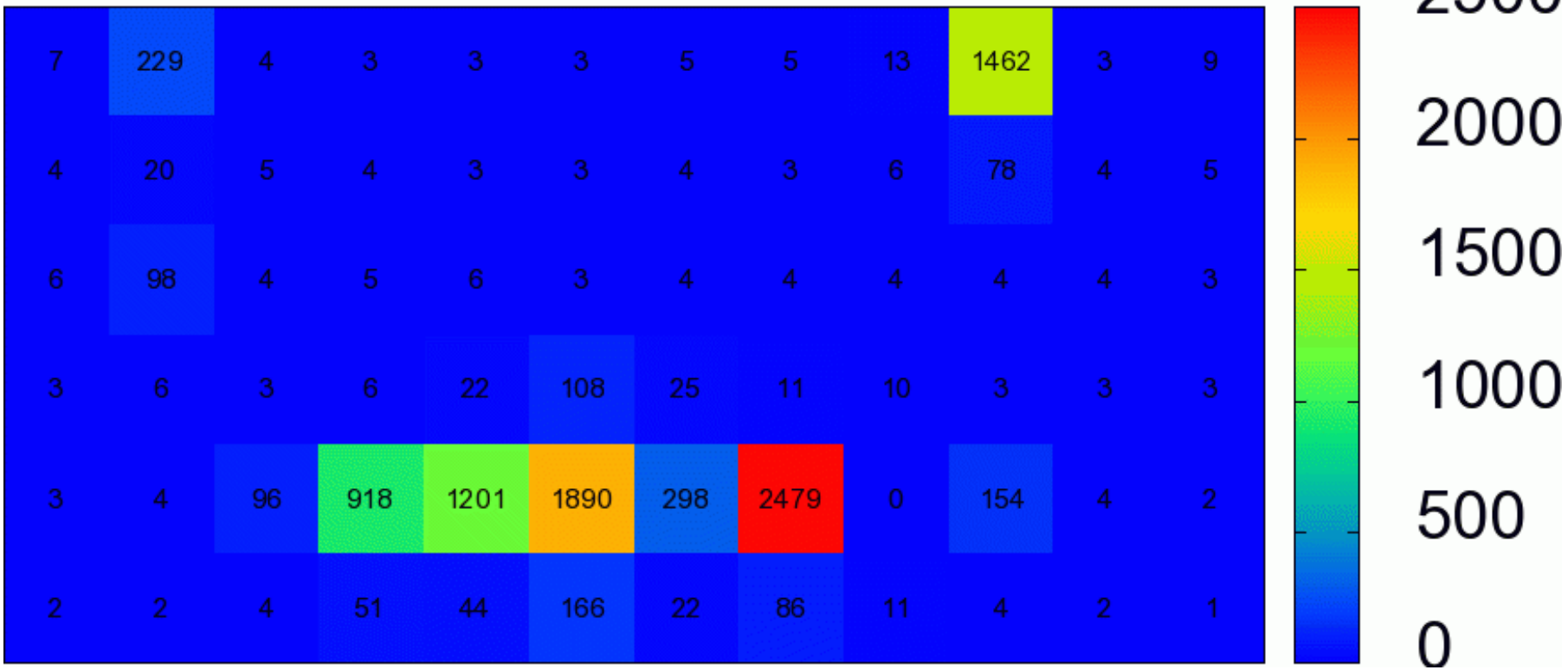
Electrical tape did not fix the bent fiber properly

Effect of the fiber on the HBU0 channels

- The optical signal is not strong enough to see the SiPM saturation. We reached 61% of the SPIROC2 ADC range
- Position and path of the fiber is clearly visible



Topological map of 12×6 scint. tiles. Each square represents mean of a fit to SPIROC2 ADC spectrum (low gain mode, Cf=400fF)

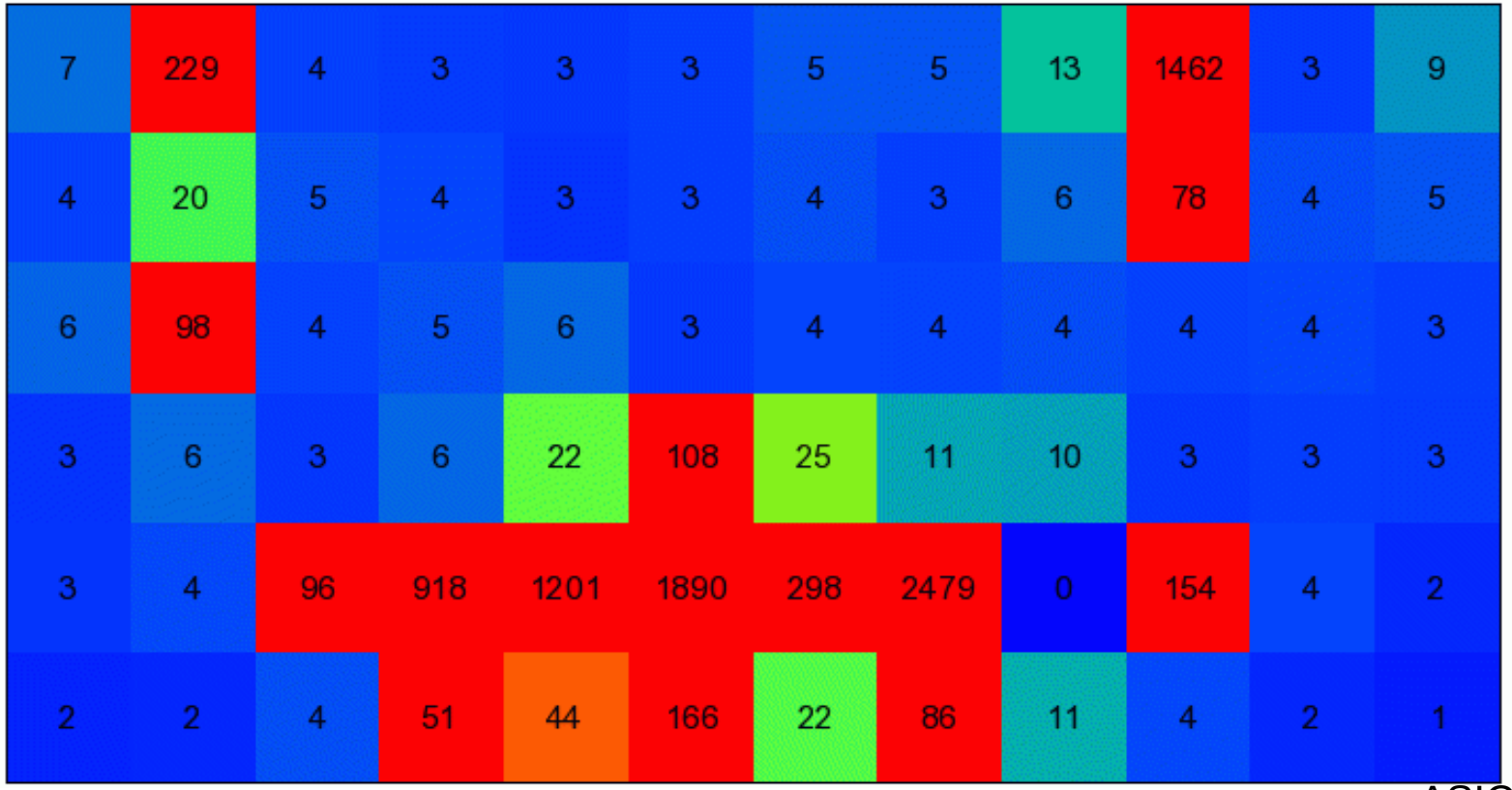


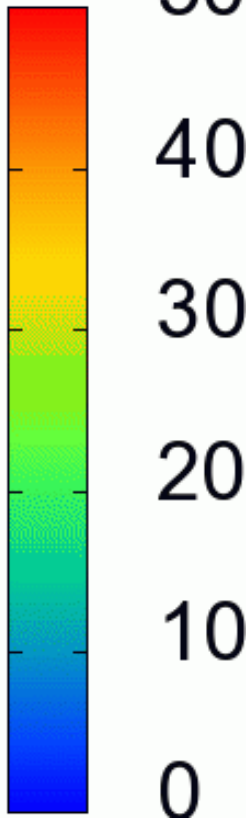
ASIC response [ADC count]

Optical Crosstalk

- Signal contribution from the neighboring tiles (noise)
- Reason: notches of the fiber were uncovered and shined under the cover

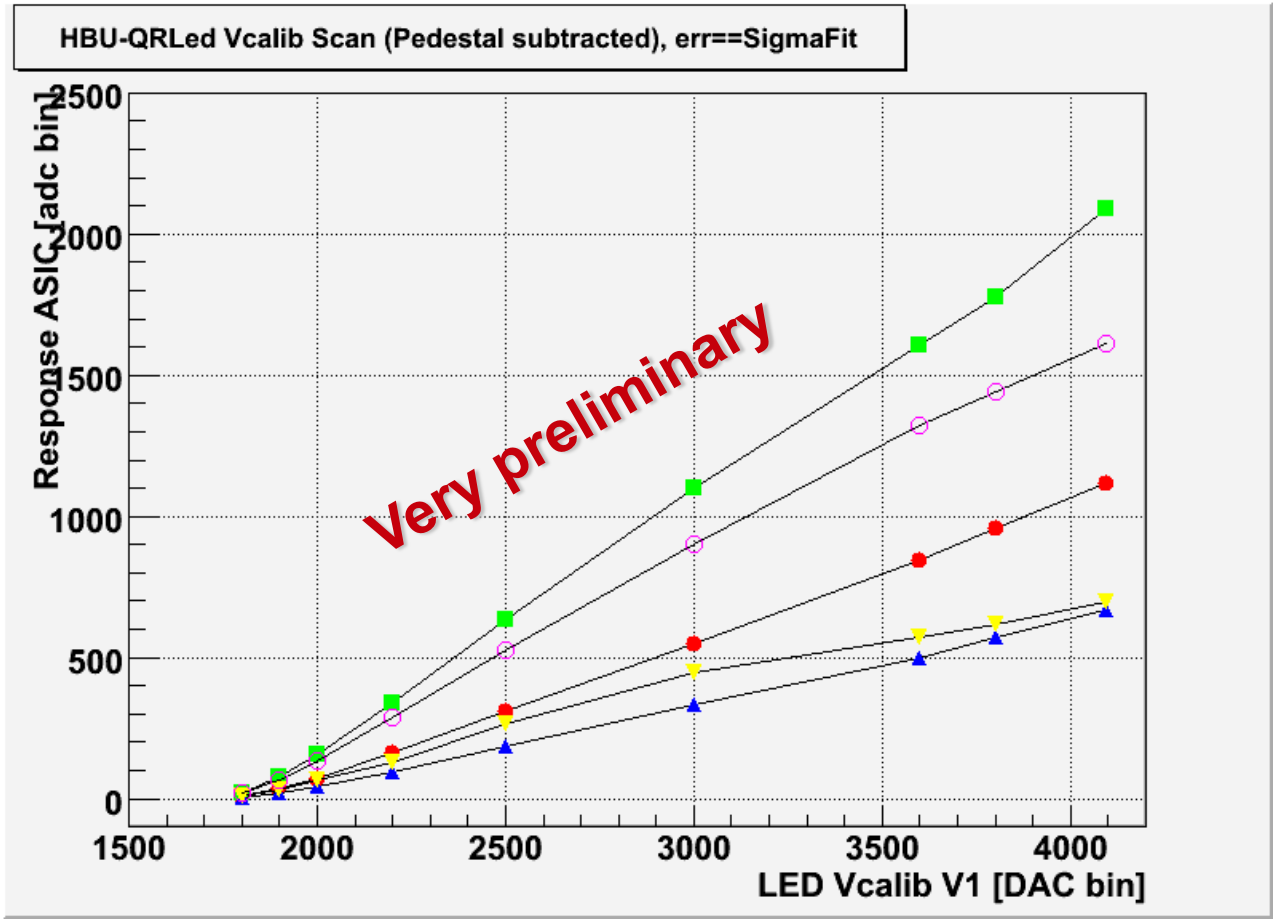
Fine scale of the topological map of 12×6 scint. tiles. Each square represents mean of a fit to SPIROC2 ADC spectrum (low gain mode, Cf=400fF)





ASIC response
[ADC count]

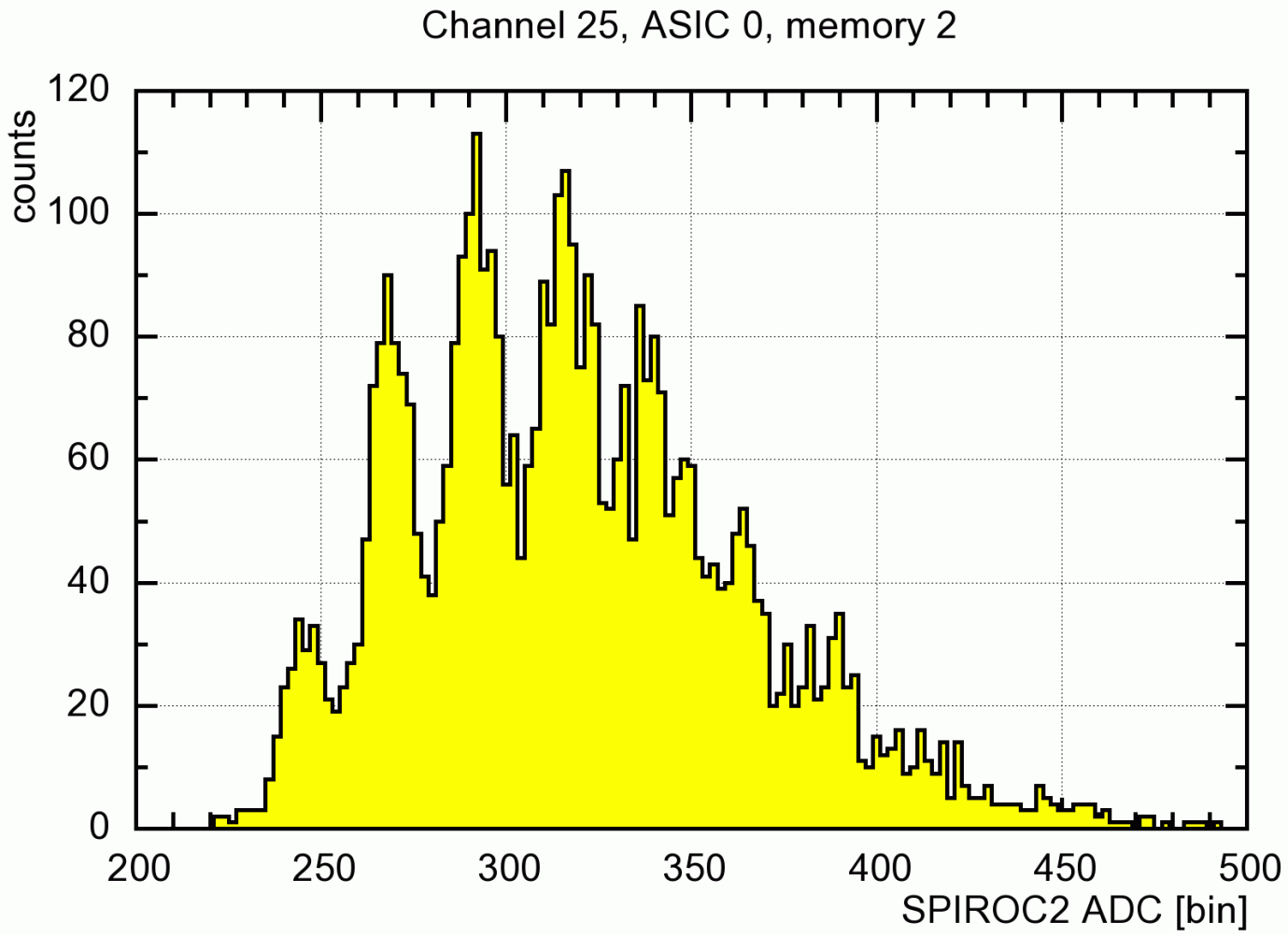
Linearity test (it means a saturation curve)



Settings:
Cf = 400fF
Low gain mode

- We do not yet see the saturation effect.
- Better optical coupling is required.
- Higher LED pulse energy can be made with larger pulse-width (3.5 → 7ns)

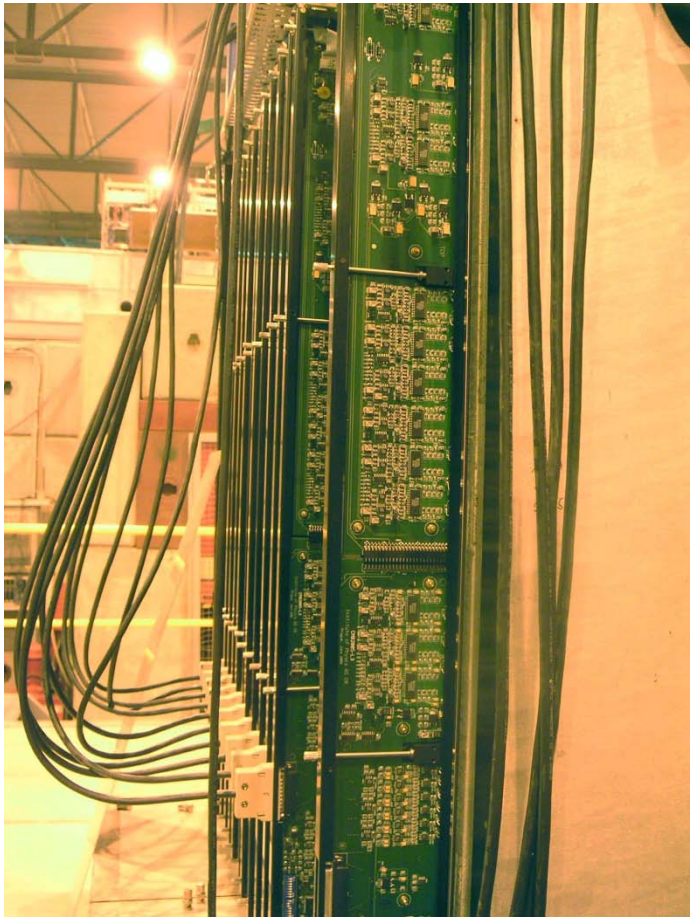
Single p.e. spectrum



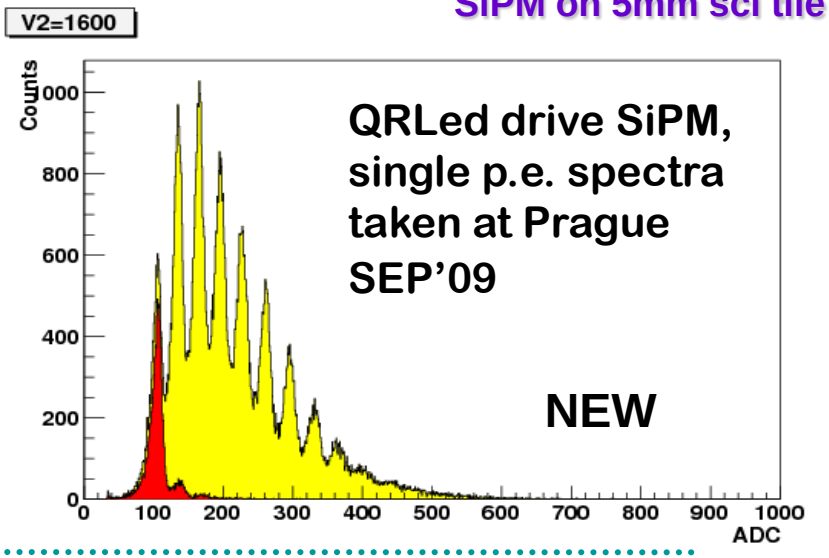
Calibration mode,
High Gain
HBU0
Labview DAQ

- Very low statistics (slow DAQ)

Single photoelectron spectra with CMB and QRLED

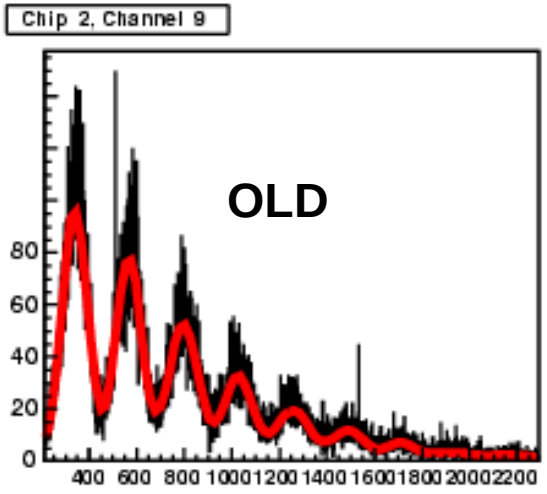


LED light 400nm to SiPM on 5mm sci tile



←CMB in tuning position at AHCAL TB 2007 CERN

one of the single p.e. spectra →



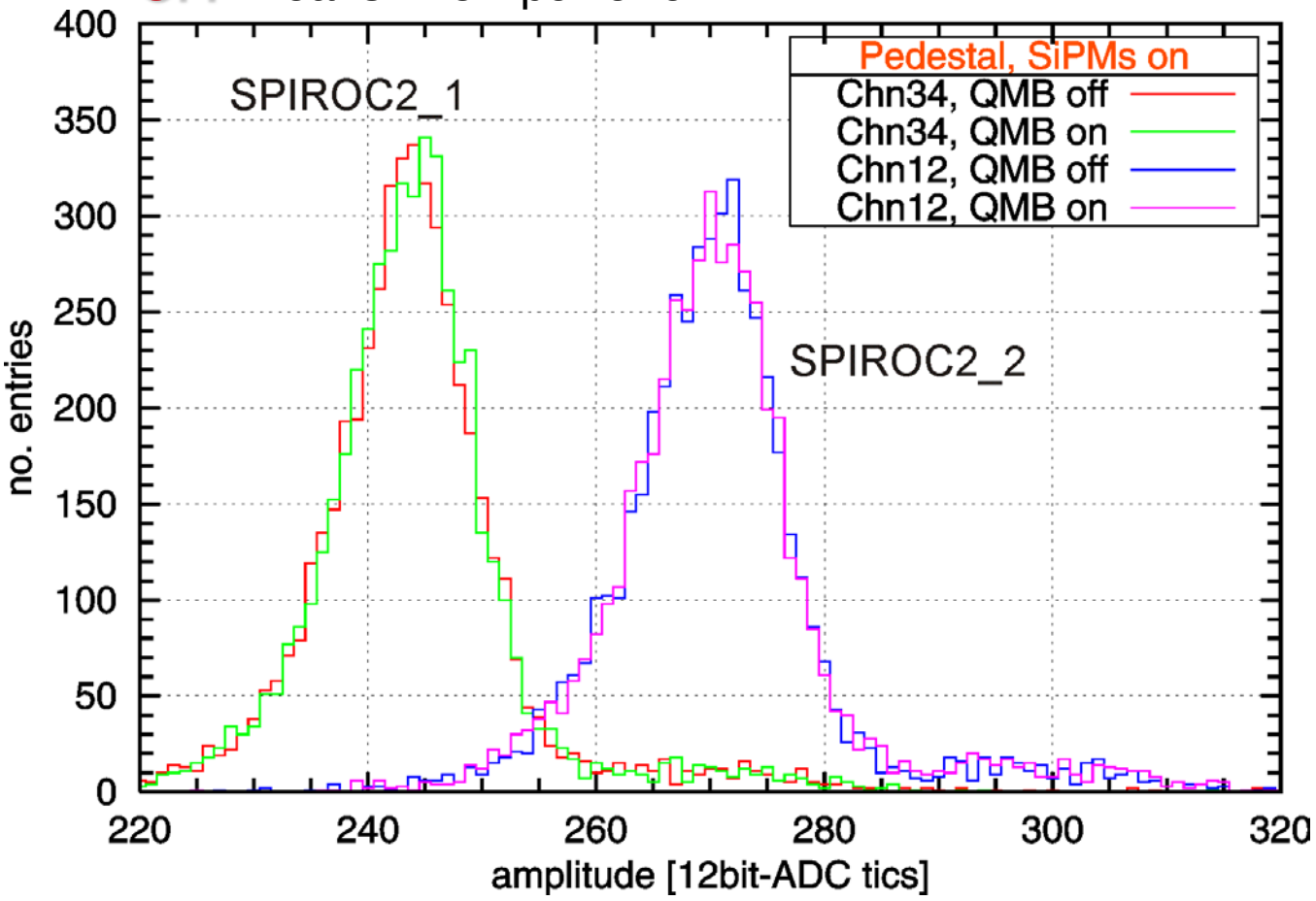
More info about CMB can be found at:

http://www-hep2.fzu.cz/calice/files/ECFA_Valencia.Ivo_CMB_Devel_nov06.pdf

QMB6 **ON**/**OFF** test (EM noise)

ON means T-calib on, LED off

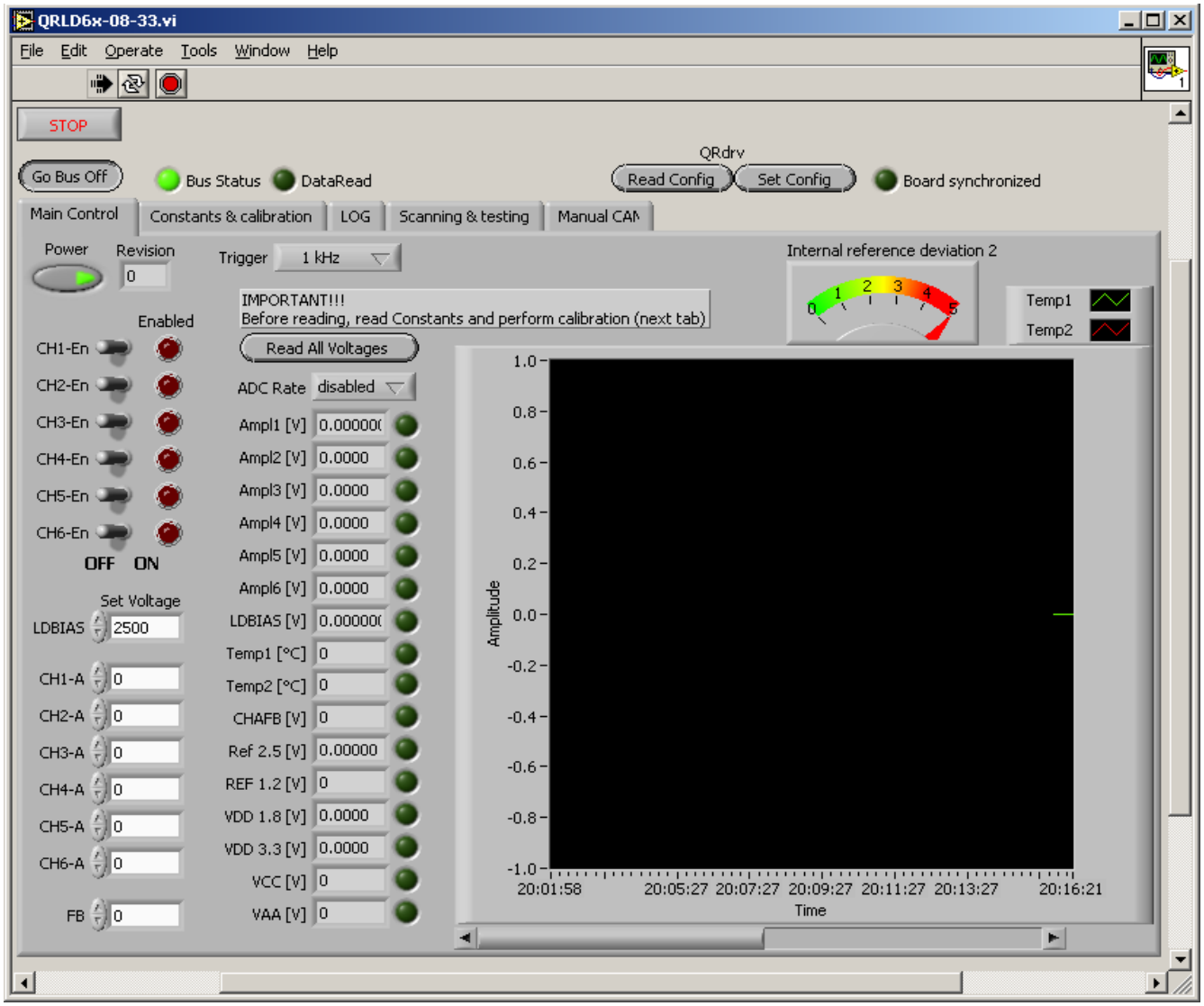
OFF means +15V power off



NO pedestal shift

NO unwanted ground coupling

Control panel of QMB6



Written in Labview 8.2

CANbus control

Controls for each channel:
- LED Enables
- LED amplitude
- Trigger frequency

Monitor of
- all voltages
- temperatures

Program can work as Exe file

Conclusions of the HBU0 test with QMB6

- Easy implementation, almost **plug and play** installation
- QRLED driver has tunable light amplitude
- Both methods of light distribution are tested in HBU0 EUDET prototype
- With QMB6 we can see a nice single p.e. spectra, similar to distributed LEDs
- We do not see saturation of SiPM yet, better optical coupling is necessary. We have to focus on this detail.
- We plan to continue tests in April 2010 at DESY, focusing on the optical coupling.
- Special thanks to Mathias Reinecke and FLC group.

Plans for the 2010

Main focus: Increase of the optical performance:

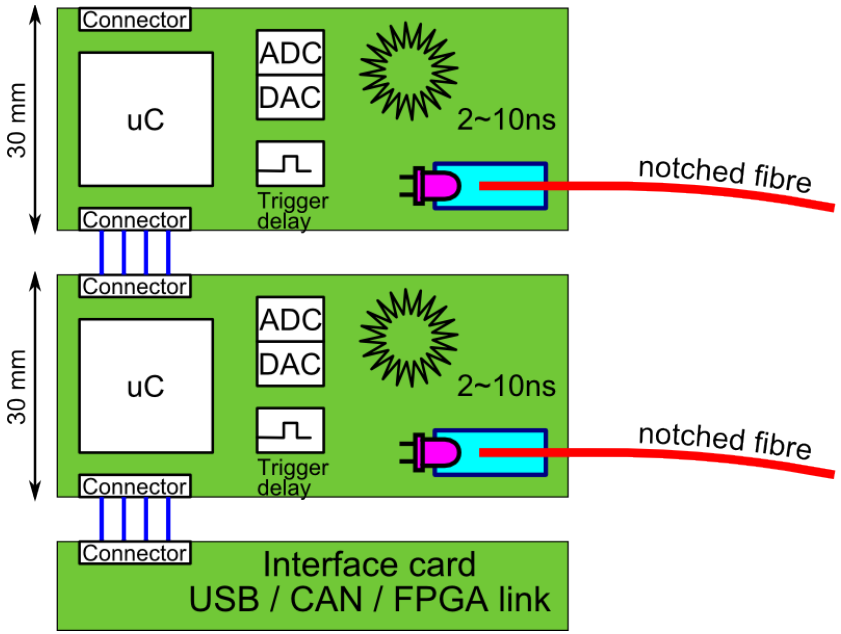
- Extend the pulse width from current 3.5 ns
- improve optical coupling from LED into the fiber
- improve the transmission to the scintillation tile

New QR LED driver prototype (Q3/2010)

- only 1 channel per board
- different onboard inductors for different pulse width in range of 4 ~ 10 ns
- 3cm PCB width to match the tile size

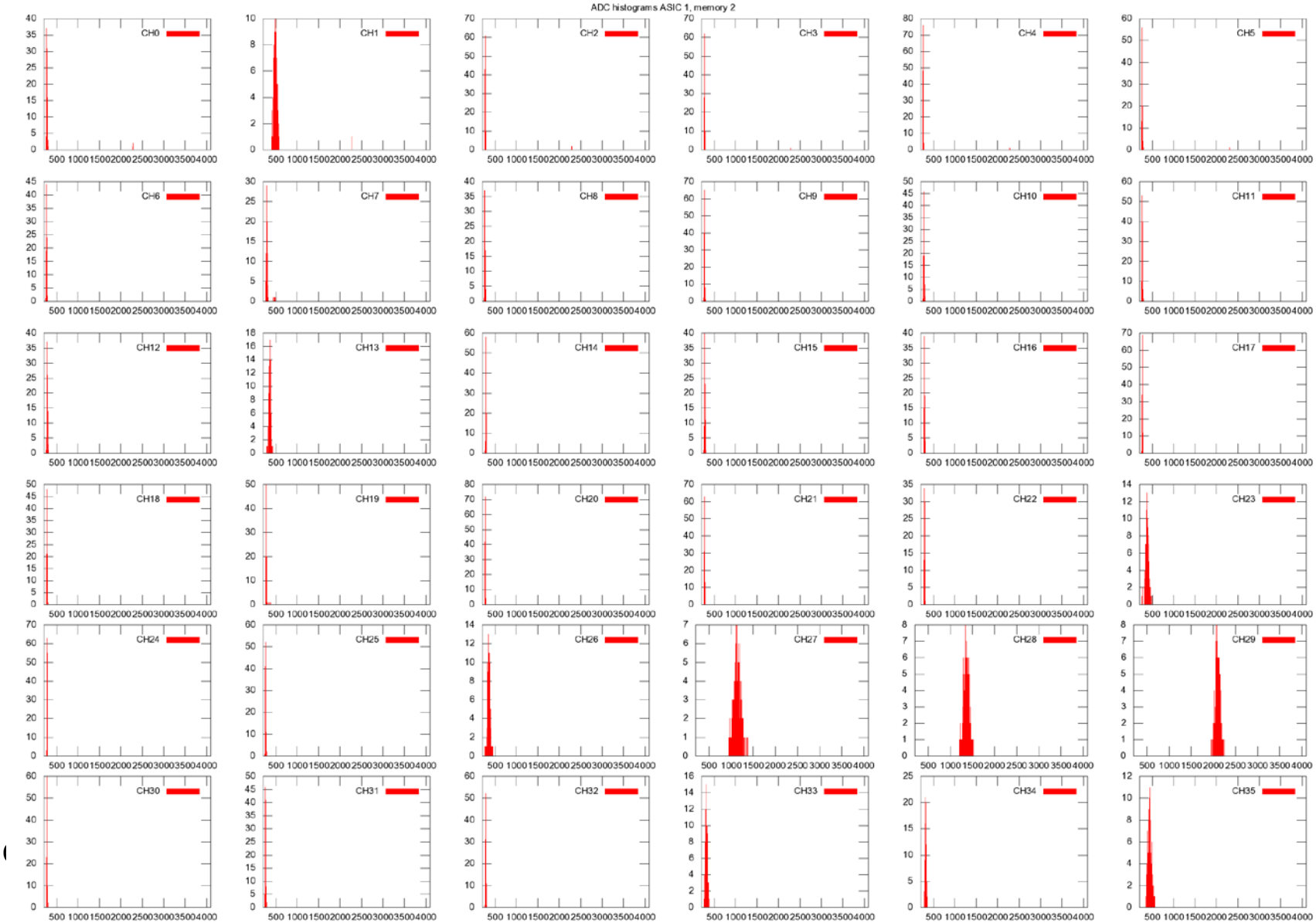
Notched fiber production (Q4/2010)

- 6 new notched fibers with 72 notches each
- dimensions of the notches need to be synchronized with HBU

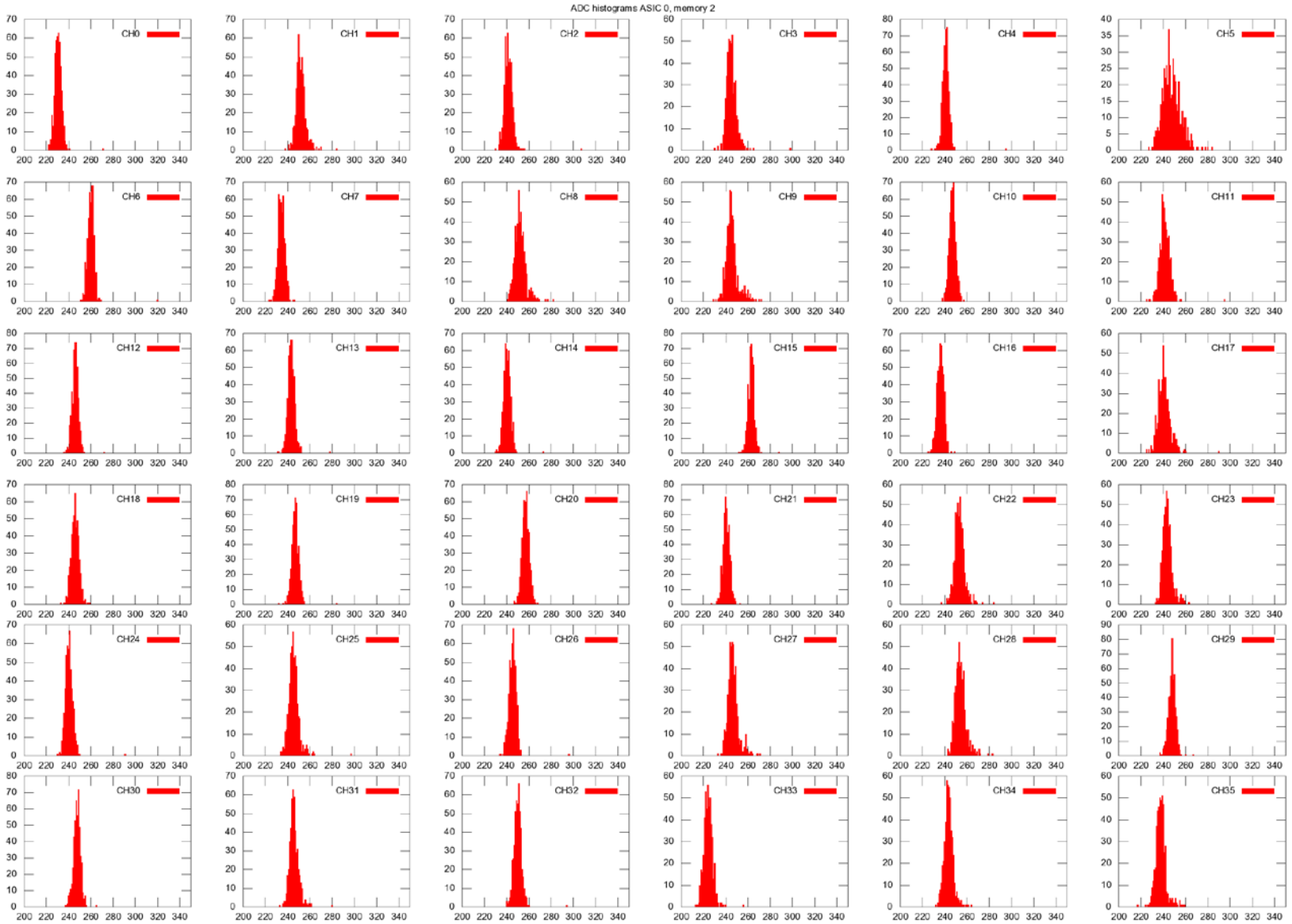


Back up

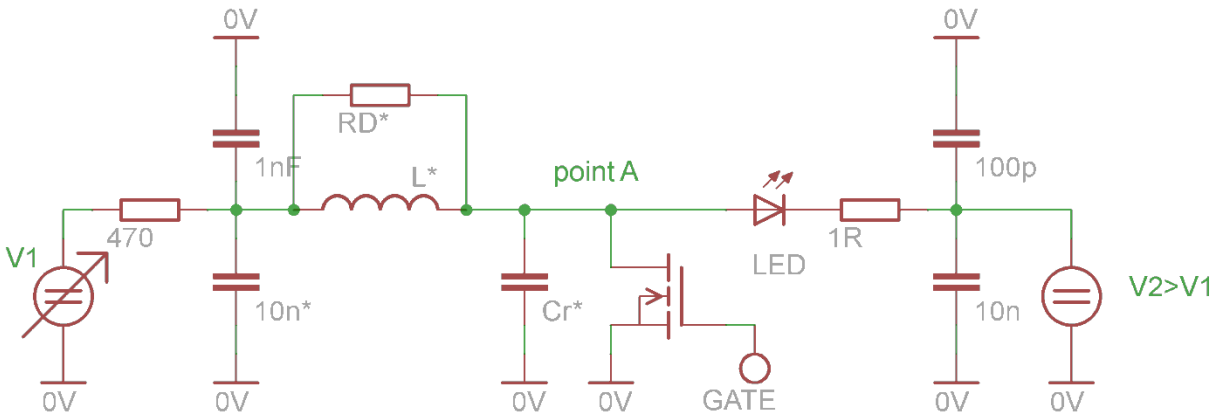
Max. Optical power, ASIC 0 histograms

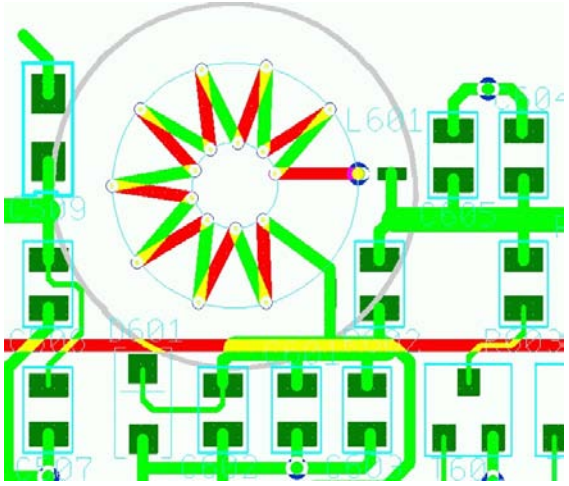


Pedestal ASIC 0, channel 1..36

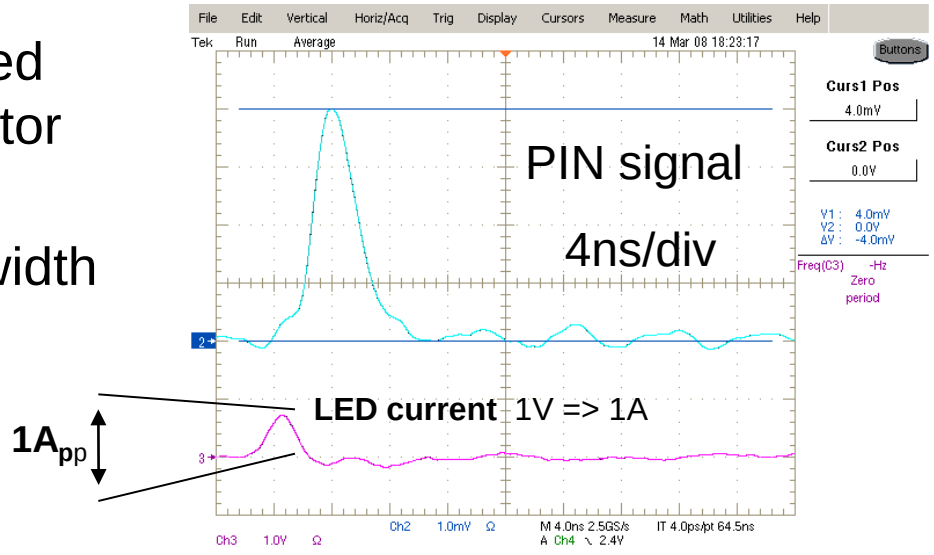


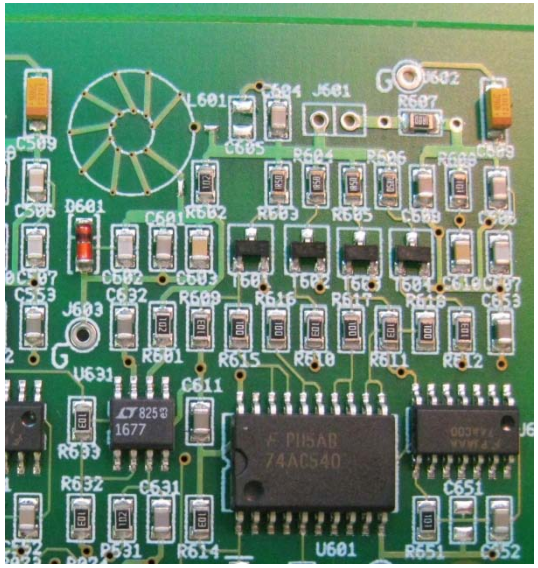
Quasi-Resonant LED driver



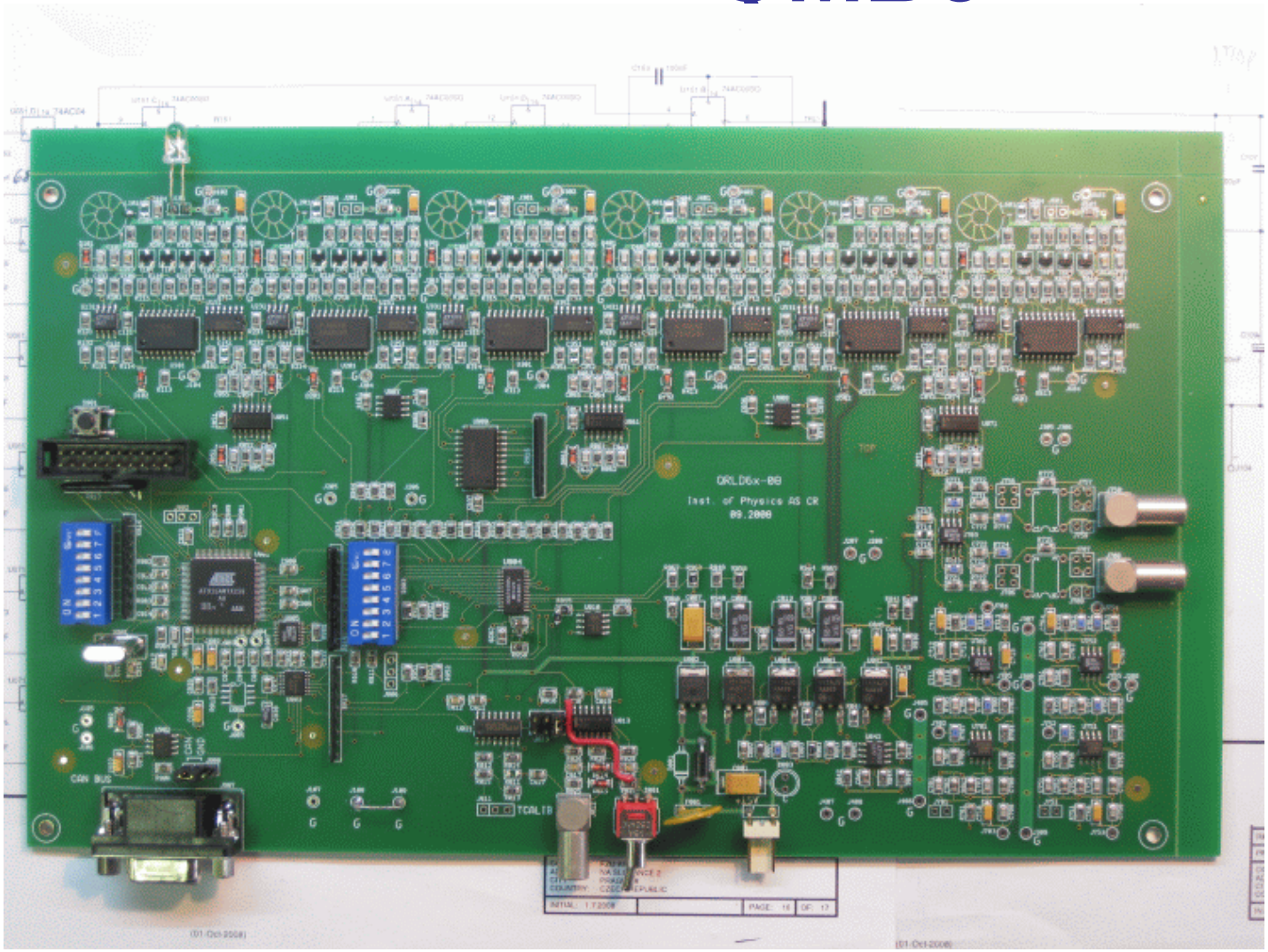


- Less RFI
- PCB integrated toroidal inductor (~35nH)
- Fixed pulse-width (~4ns)





6-LED QR driver Main Board = OMB6

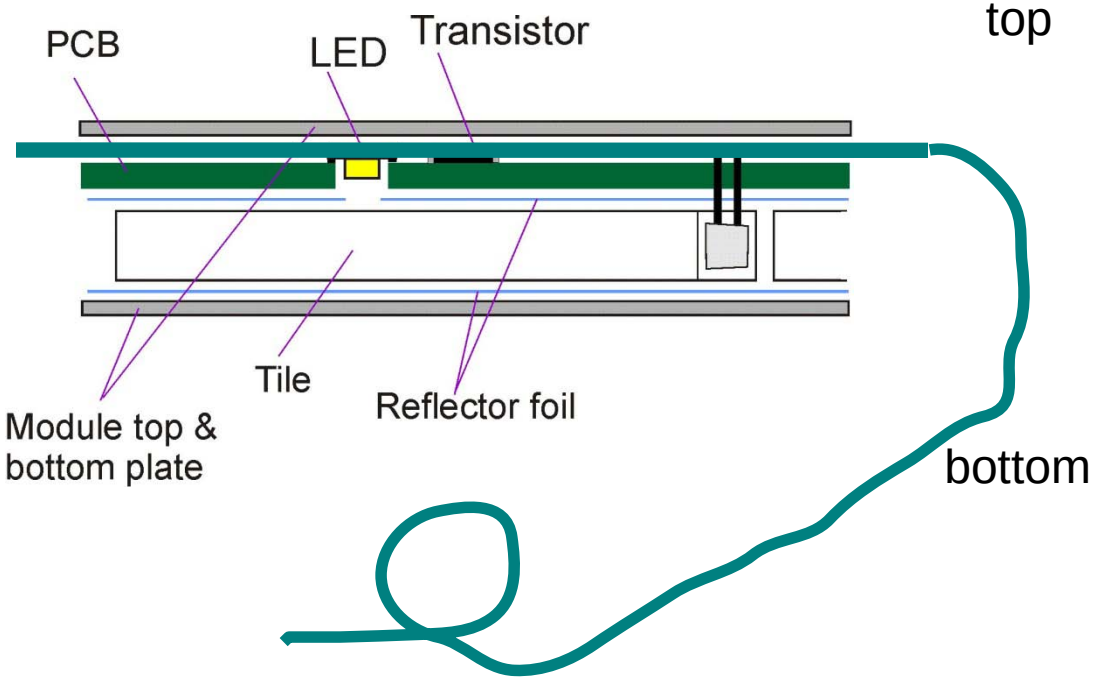


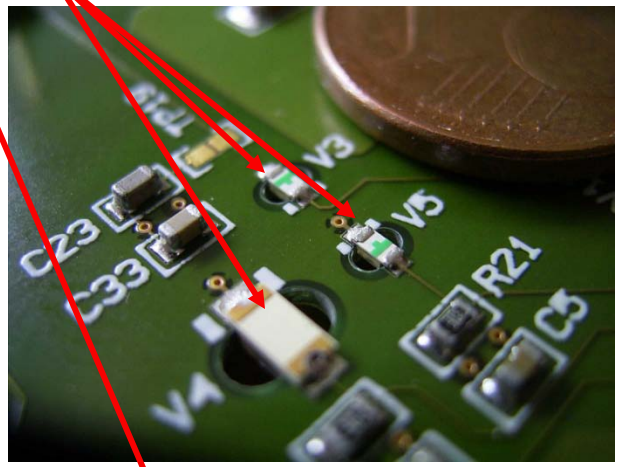
Consists:

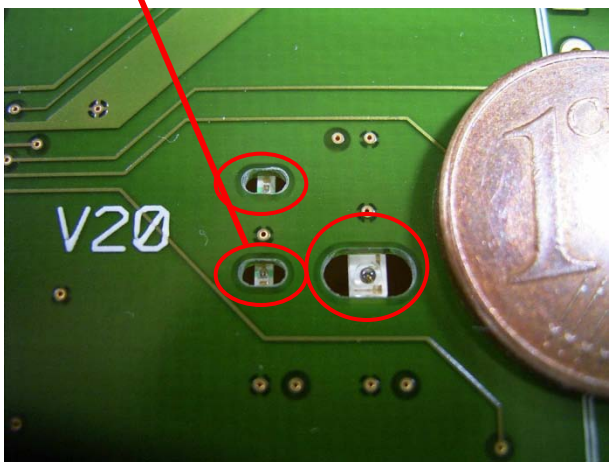
- 6 QR LED drivers
- 2 PIN PD preamps
- CPU + communication module, CANbus
- Voltage regulators
- temperature and voltage monitoring

Details of distributed LEDs

Small UV LED, smd size 1206 and 0603







QMB6 Linearity (V1 scan)