## A fast LED driver prototype for HCAL calibration HCAL meeting DESY HH

### **Proposal for calibration system**

- New LED driver with reduced crosstalk
- A tunable calibration light in the range 0 to 100MIP
- Simplification of the optical system: one LED -> one side emitting fibre, one row of scintillator tiles
- PIN photo diode, do we need them?

## LED driver strategy for SiPM calibration

- At AHCAL prototype (uses SiPM), we used CMB, calibration system with UV-LED 400nm driven by very fast rectangular pulses (1ns rise/fall time).
- Steep Rectangular waveform satisfied the needs to vary pulse-width, BUT creates lots of harmonics → electromagnetic crosstalk!
- We have found fixed pulse-width to about 6ns, we can go to use narrow band ->smooth waveform ≈ less RF interference = Quasi Resonant LED driver (single pulse)

### Quasi-Resonant LED driver LC circuit, heavily dumped

•Simulation pulse-width 5ns with 33nH inductance

- Prototyping
- Used my lovely single side copper foil PCB
- We need more work on components
- optimization

- 2CH board
- primary tested
- With printed indictor 2ns pulse-width

#### QR LED driver Simulation



# Simulation at 1.5V amplitude

- XSC1:
- Upper trace sync pulse
- Lower trace voltage at LED hot end



 XSC2: Lower trace LED current

## Simulation at 3V

- XSC1:
- Upper trace sync pulse
- Lower trace voltage at LED hot end



• XSC2: Lower trace LED current

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 $V_1 = 3V$ 

#### Prototype of QR LED driver



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#### Tests shows more power on LED

- We see response of PIN photodiode at oscilloscope
- Amplitude up to 2mVpeak @ 50  $\Omega$

#### Response to low amplitude

- LED current (cyan) (voltage @ **100hm)**
- **PIN response** ٠ (yellow)
- LED anode • (violet)



#### Response to middle amplitude



#### Response to high amplitude

**200mA** • current at LED



#### Response to high amplitude

The Light ۲ from LED was optically blocked to PIN.



## 2CH prototype



Double sided PCB
2 QRLED driver
2PIN photodiode preamp
Rate generator 1Hz to 10kHz
Voltage regulators
Amplitude control
V-calib and T-calib interface

## 2CH QRLED board



There is a detail of two QRLED driver

Printed inductors with taps, left is connected by tin joint

Two trimmers equivalise delays between CH A and B

#### Principal schema of QRLed driver



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## LED Current



View of the LED pulse for a small amplitude (0.6 A)

Measured with 1GHz voltage differential probe and 1GHz scope TDS4104 at  $1\Omega$  smd resistor

4ns/div 0.5A/div

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## LED current



View of the LED pulse for a middle amplitude (1.0 A)

Measured with 1GHz voltage differential probe and 1GHz scope TDS4104 at 1Ω smd resistor

<sup>4</sup>ns/div 0.5A/div

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## LED current



- View of the LED current pulse for the highest amplitude (2.3 A)
- Measured with 1GHz voltage differential probe and 1GHz scope TDS4104 at 1Ω smd resistor
- 4ns/div 0.5A/div

## Conclusion

- QR LED driver is very promising technique to reduce Electro-Magnetic-Interferences
- PCB of the two-channel QR LED driver is ready to further test
- January more test with Photodetectors
- February more assembled PCBs available
- May designing of multichannel system with light transfer in side-emitting fibres, mechanical integration to a new detector design