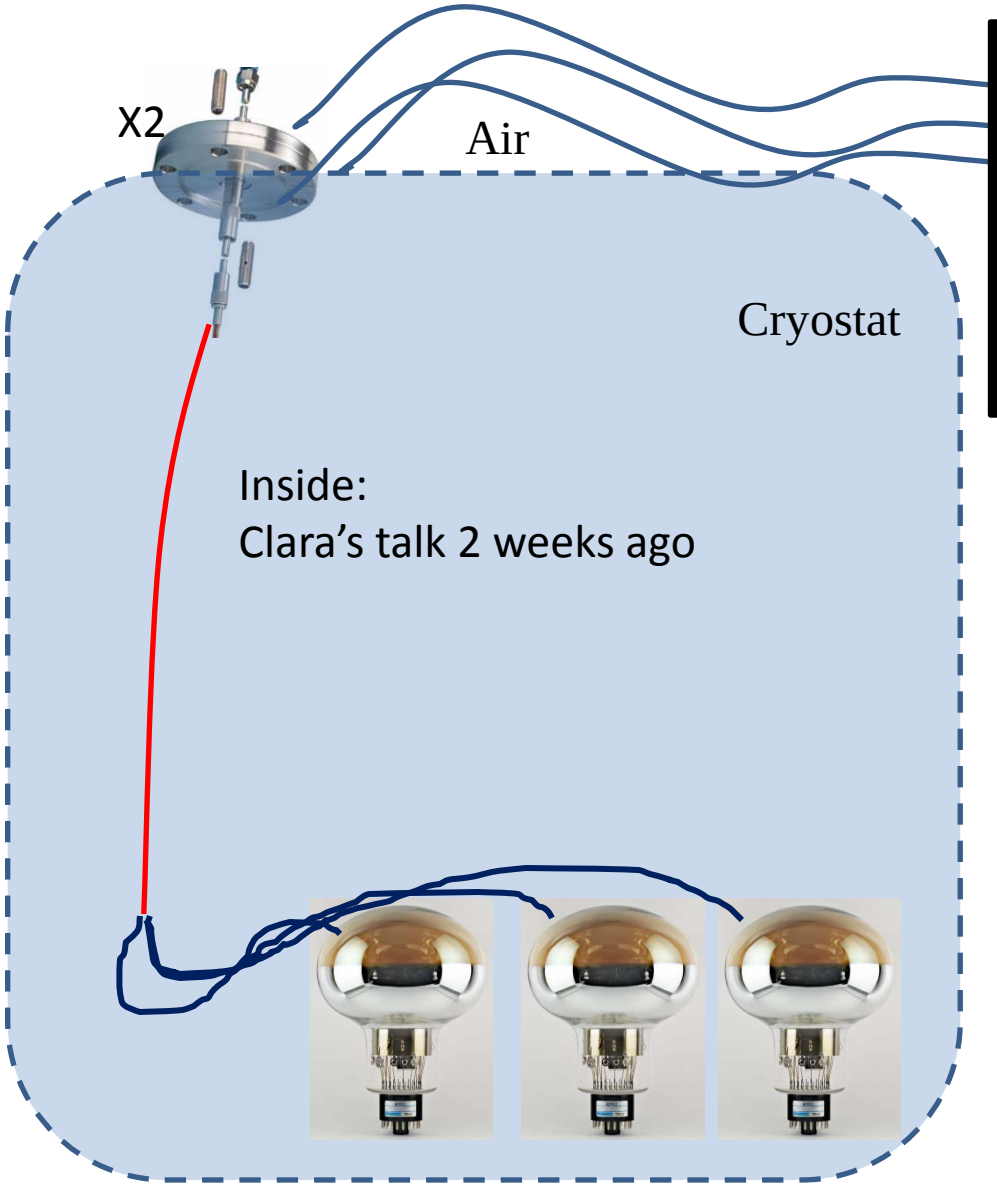
# Light Calibration System

**Thorsten Lux**

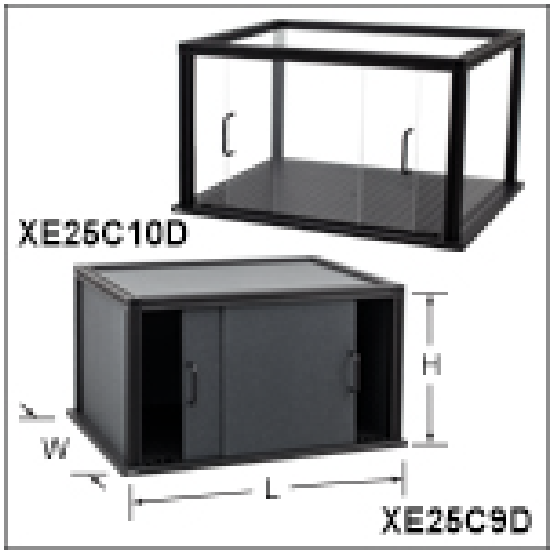
# Overall Conceptual Design

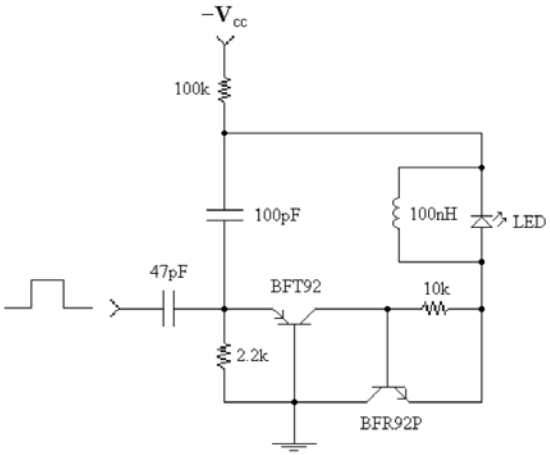



Black Box

- 2 feedthroughs CF40, each with 3 optical feedthroughs
- 6 SMA optical fibers from feedthrough to black box
- black box containing light source
- black box on top of cryostat

# Components



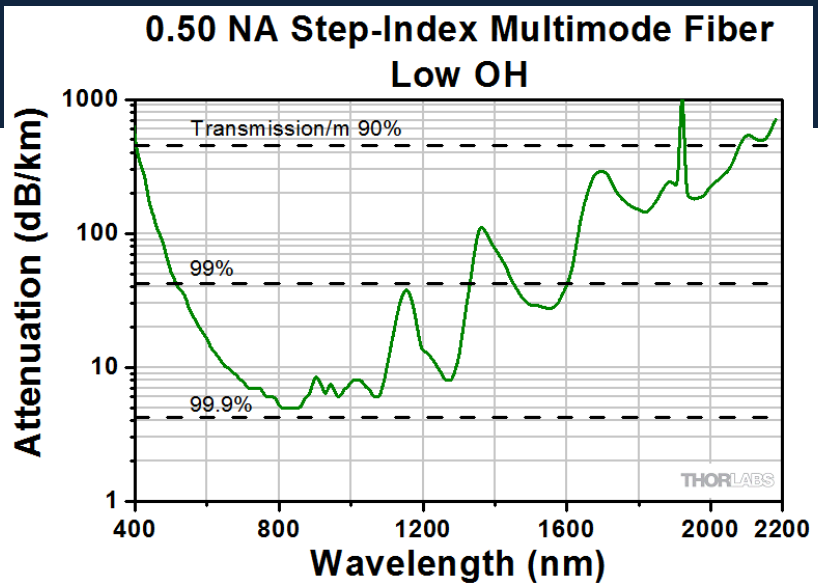




- Commercial box from Thorlabs: 525 mm x 375 mm x 300 mm (L x W x H)

- Kaputschinsky LED drivers as light source (https://arxiv.org/ftp/physics/papers/0410/0410281.pdf)
- Provides fast pulses of few ns
- Rate: 1 kHz (possible to increase to around 10 kHz)
- 2 voltages needed:
  - DC between 0 and -20 V for intensity
  - pulsed to trigger light pulse
- Default LED: NSPB300B (465 nm) (more later)

- BeagleBoard (BeagleBoard.org)
- Easy control via ethernet e.g. with Python
- 8 outputs to provide pulses for Kaputschinsky and also TTL signal for trigger
- 7 ADC channels e.g. to read temperature sensor

# Components

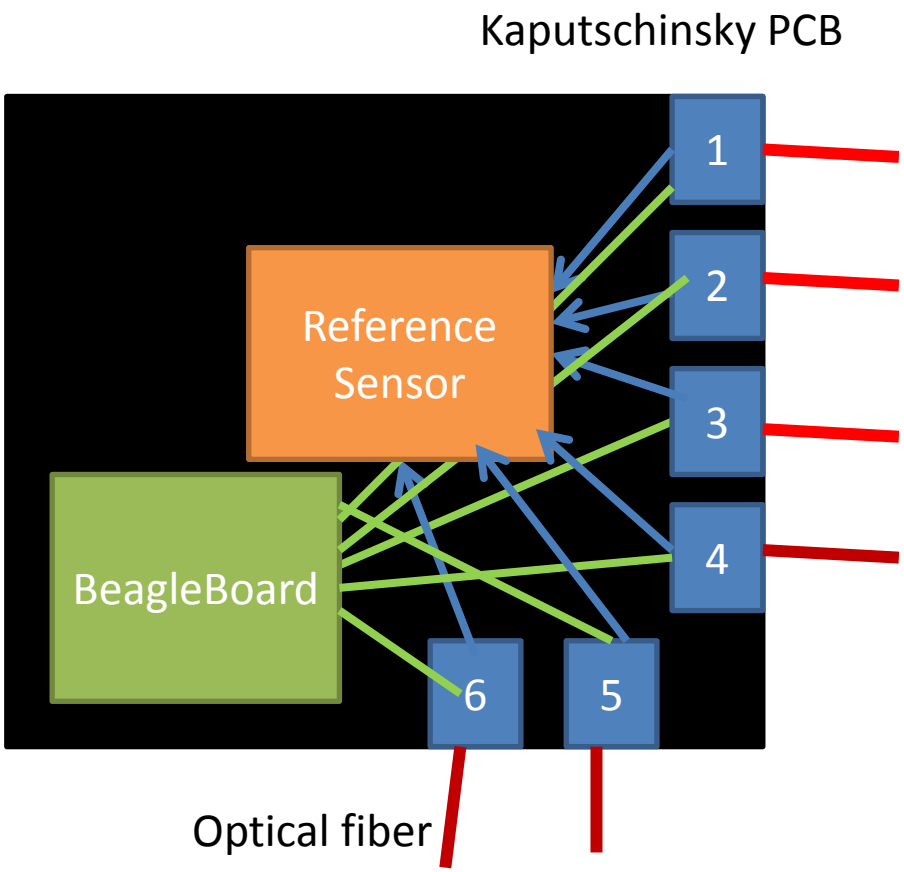



- SMA-SMA fiber from Thorlabs (1000 um diameter): **M59L**

- SMA-SMA feedthrough from Thorlabs: **ADASMA**
- Optical fiber on one side – LED directly on other side

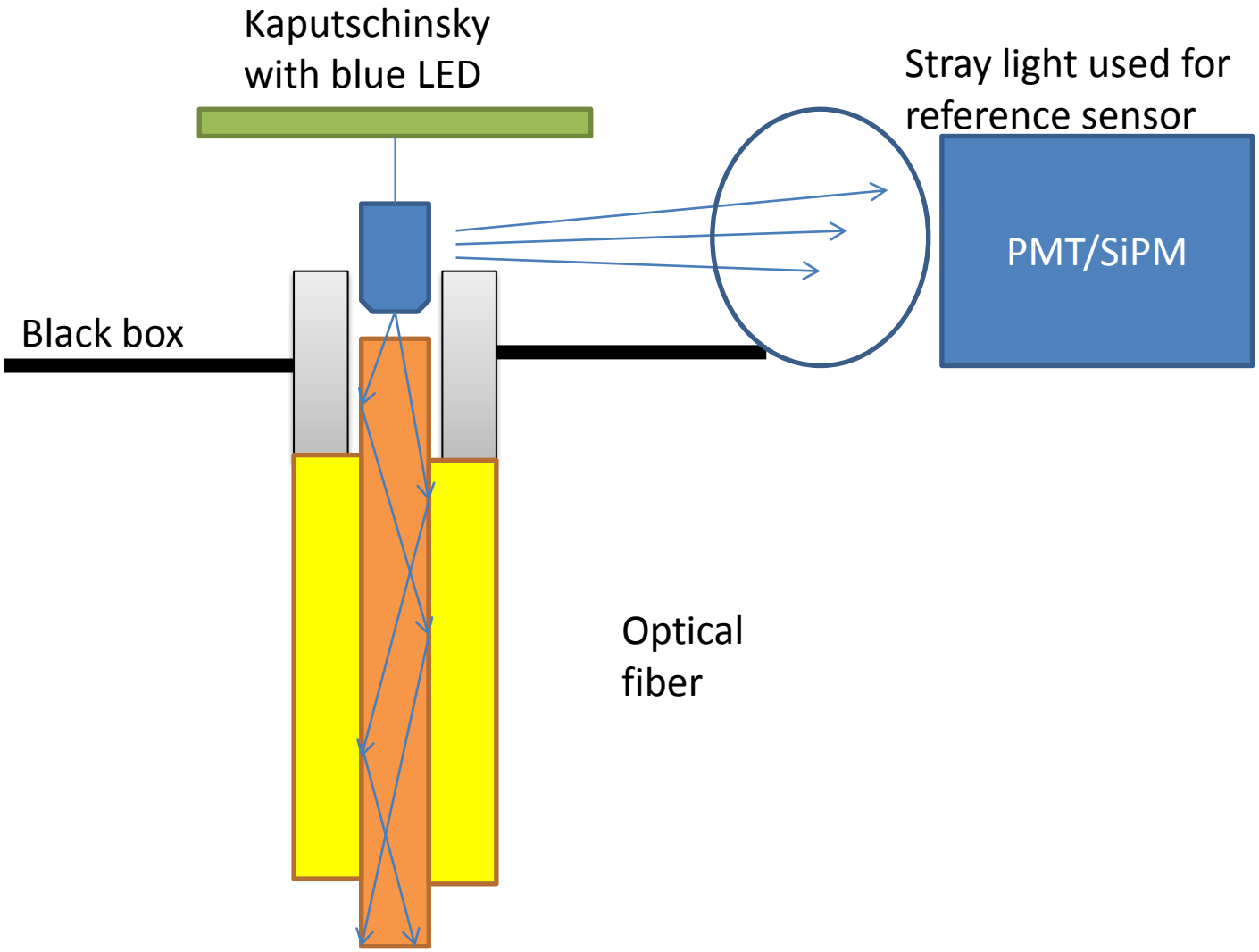
- Reference sensor still open point
- Powermeter seem not to work (see later)
- Either SiPM or PMT
- In contact with Cayetano to check if spare readout channel is available to digitize reference sensor
- Alternative: use ADC of BeagleBoard

# Black Box

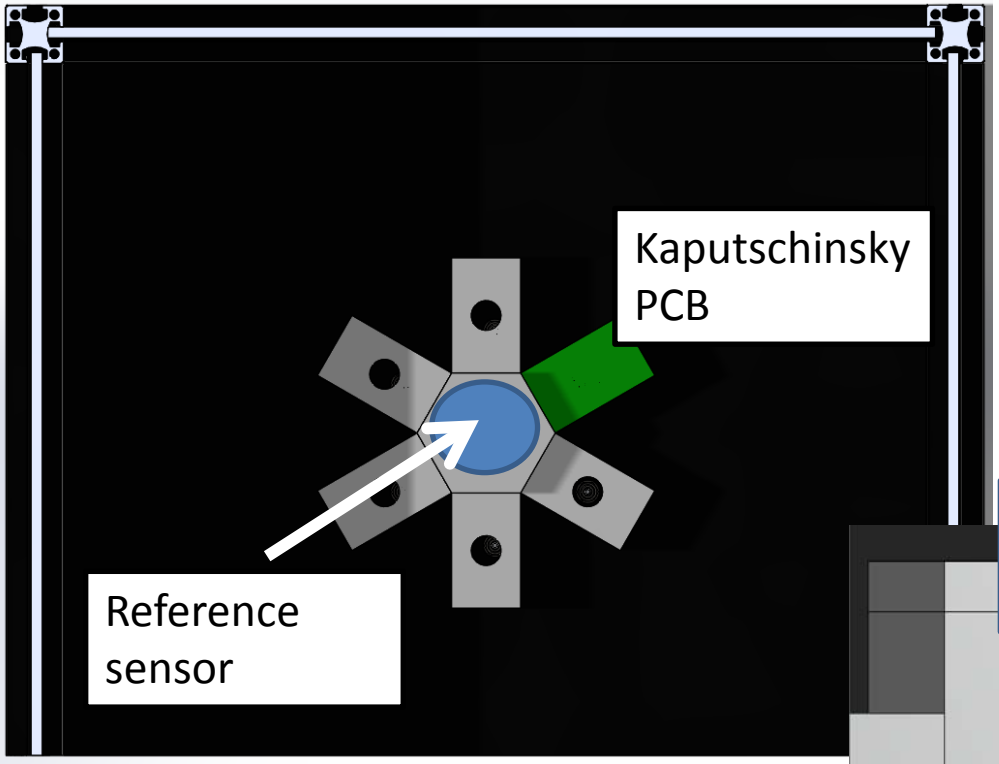



- 6 Kaputschinsky LED driver
- All 6 controlled by 1 BeagleBoard
- LEDs can be switched on individually, in groups or all together
- each LED coupled to an individual SMA optical fiber
- 3 fibers going to one CF40 flange
- One DC voltage for all 6 Kaputschinsky

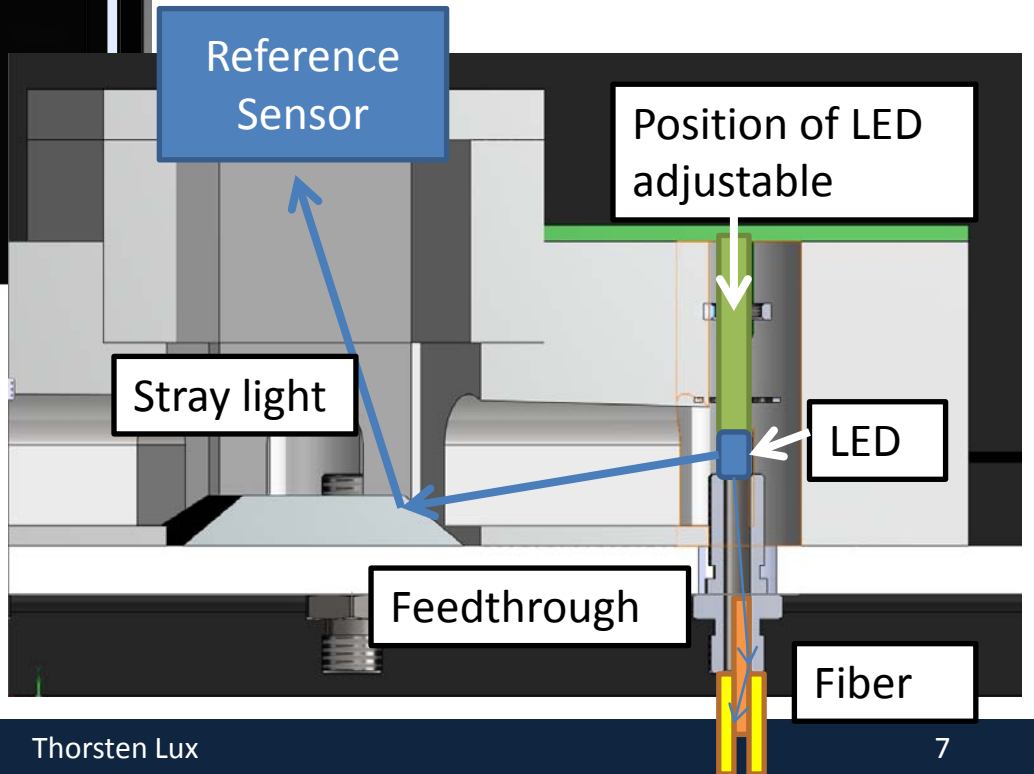
# LED Coupling to Optical Fiber



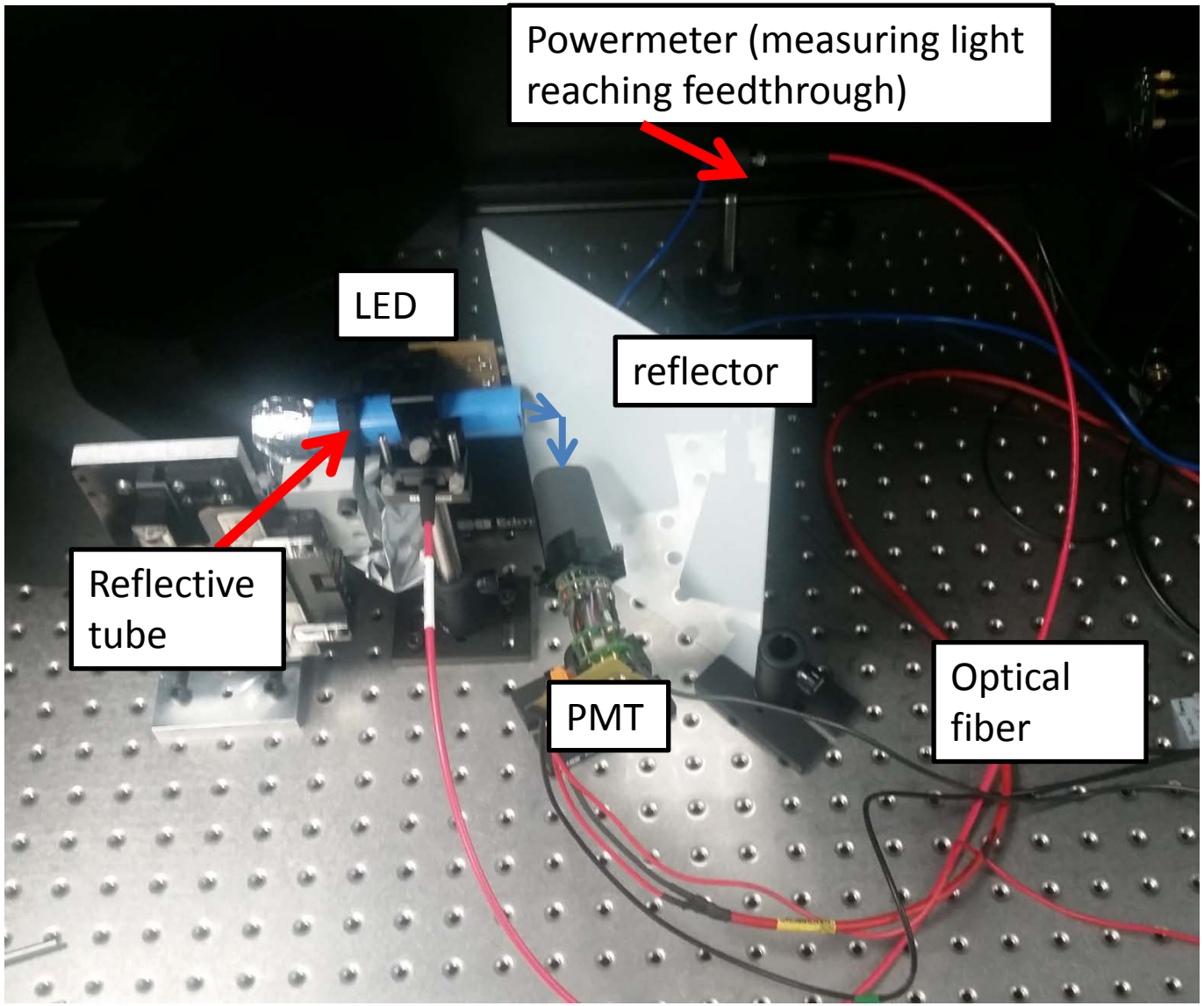
# Implementation (Conceptual)




- central reference sensor
- 6 Kaputschinsky PCBs around
- each Kaputschinsky with light cavity to guide light to reference sensor
- material: either 3D printed plastic or aluminium



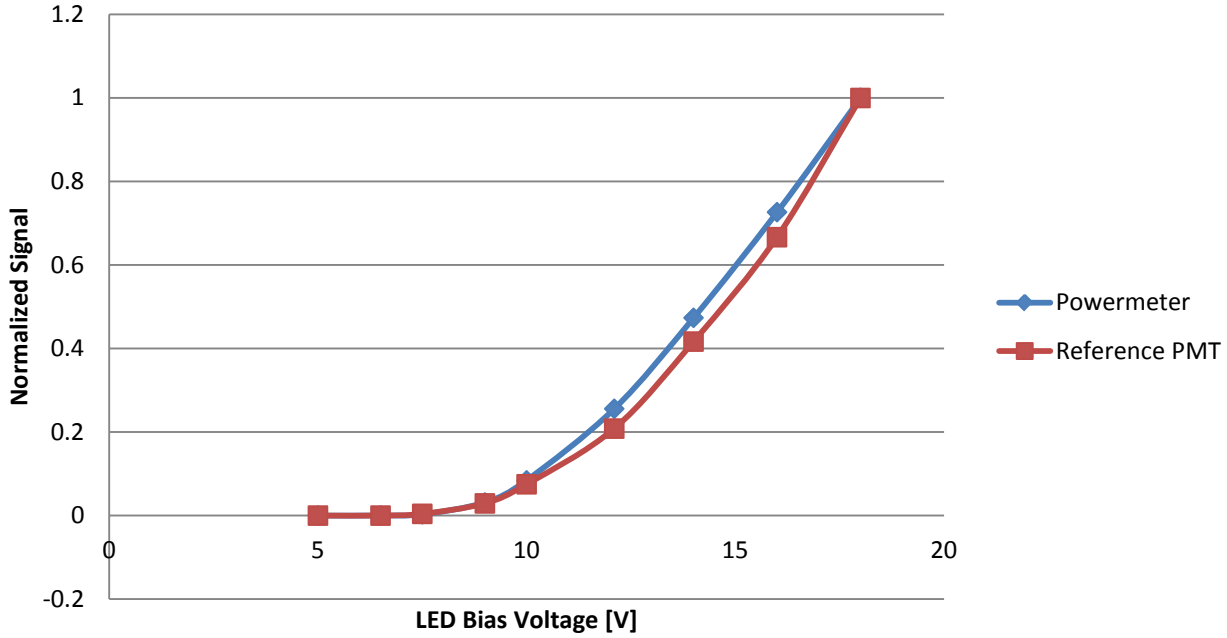
# Proof-of-Principle Tests



# Comparison PMT and Powermeter

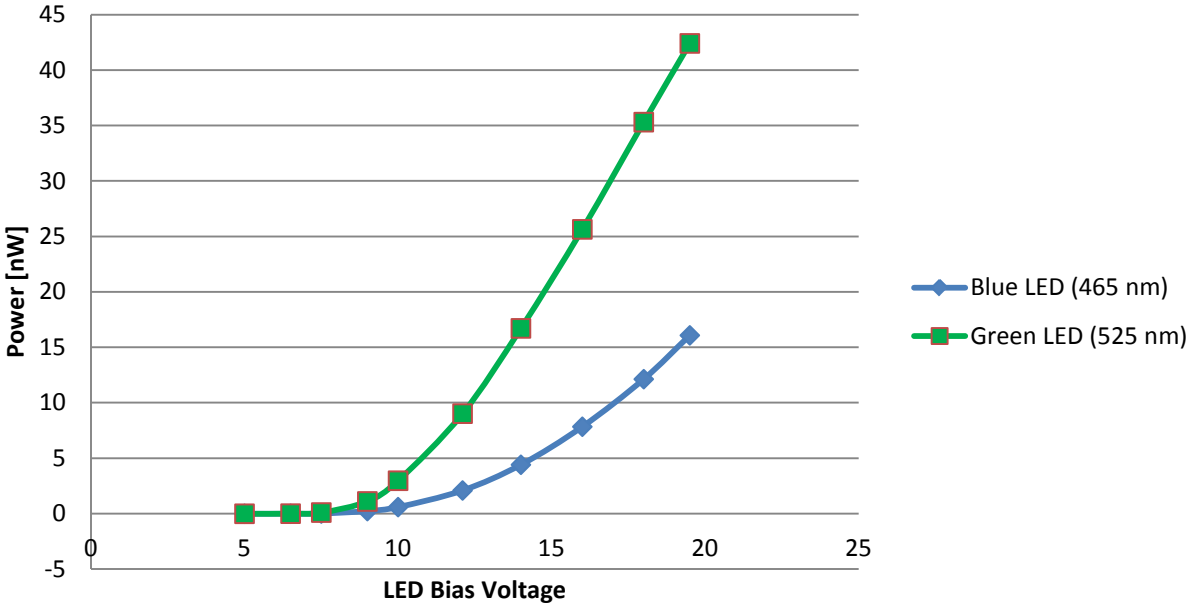
- Signal from PMT compared with signal from powermeter
- normalized to largest signal
- similar shape (amplitude of PMT read by eye from oscilloscope => large error)

=> “stray light” detected by reference light will allow to estimate injected light to PMTs

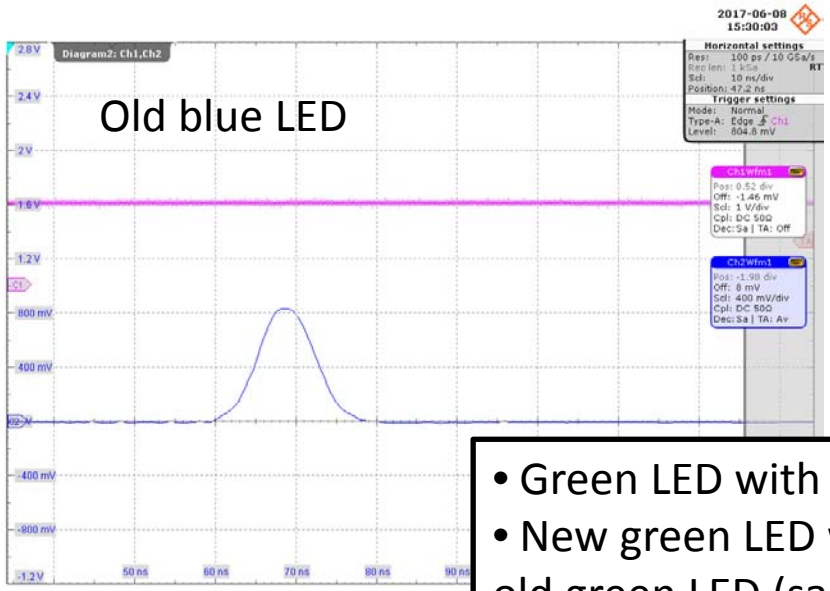


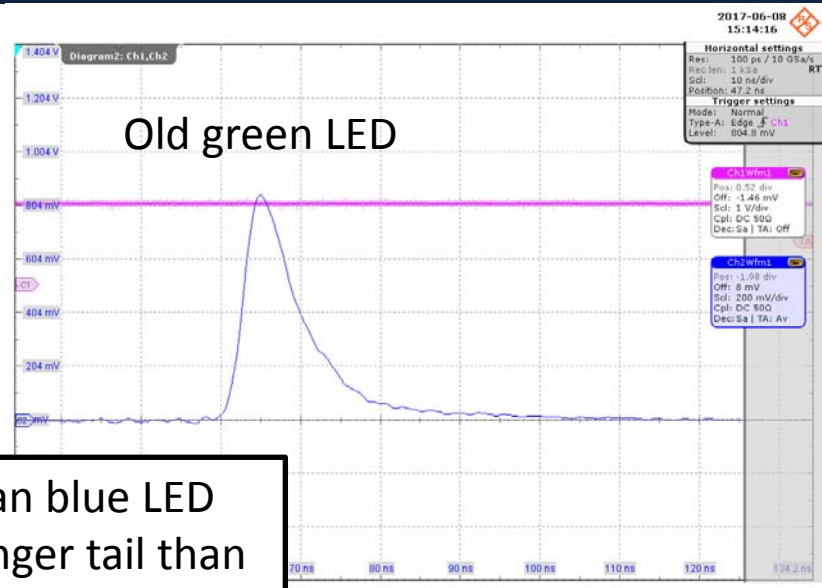
# Testing various LEDs

- Testing various LEDs: 465 nm, 525 nm, 3 of 430 nm
- the 3 LEDs of 430 nm do not/ almost not work with Kaputschinsky
- Trying to find other 430 nm LEDs
- Green LED more power than blue LED
- 15 nW (blue) correspond to 3.5E10 photons of 465 nm per pulse (1 kHz) reaching the feedthrough on top of the cryostat



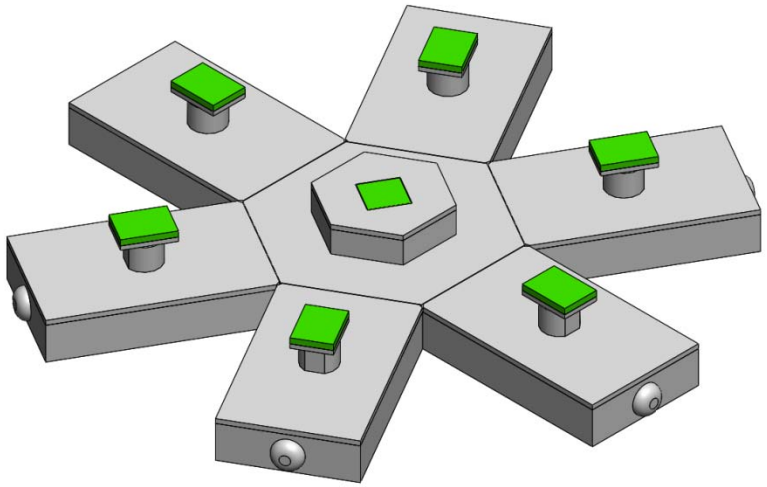
# Time Structure of Light Pulse



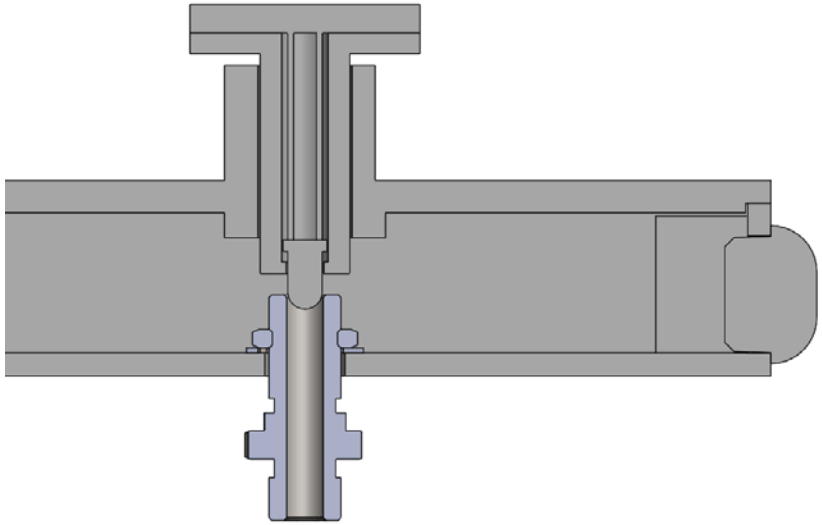



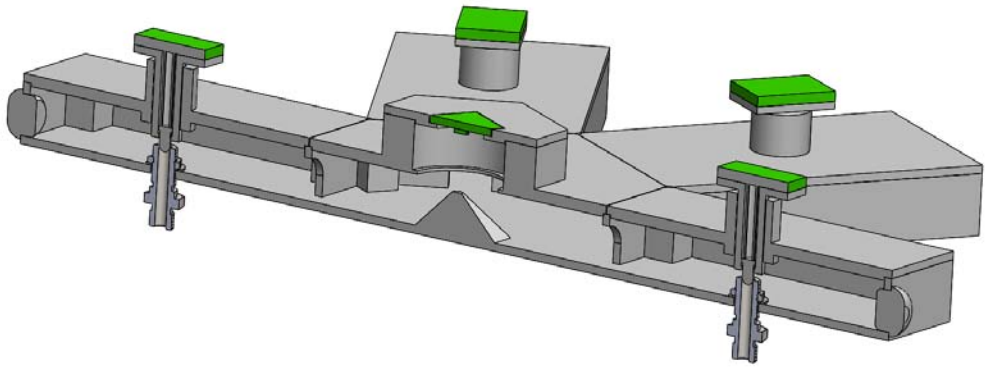

- Green LED with longer tail than blue LED
- New green LED with much longer tail than old green LED (same model)
- No difference for blue LEDs
- Pulse width: 15 ns for blue LED


# CAD Drawings from Juli



- drawings from Juli already done
- small changes to light cavity necessary
- if Joan agrees on PCB size, soon being printed full system
- central part flexible so that can be adjusted to SiPM or PMT choice for reference sensor





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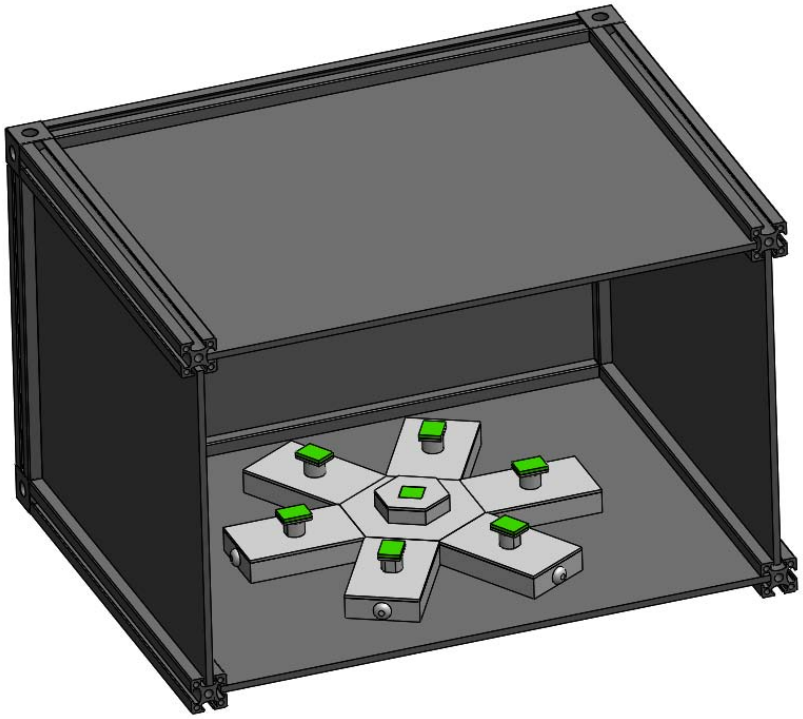

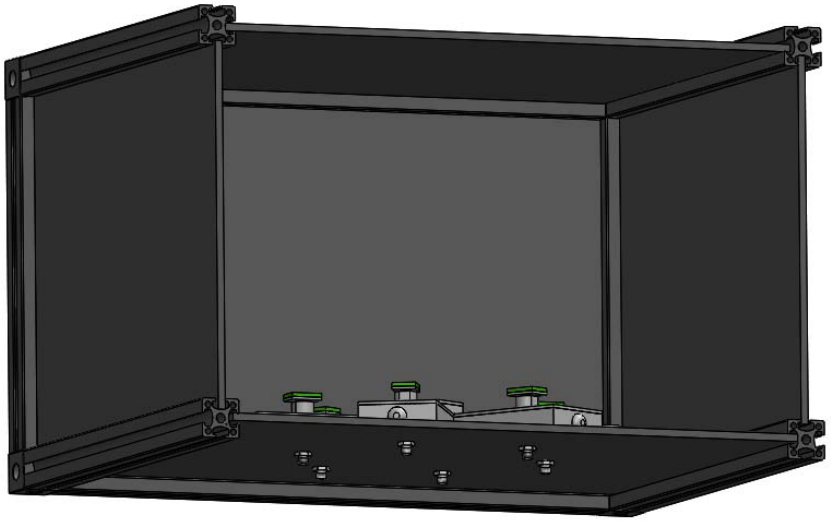

# Summary

- The light calibration system be based on 6 Kaputschinsky LED driver
- Blue LED (465 nm) default choice currently
- BeagleBoard will allow to control drivers (individually, groups, all together)
- 1 reference sensor: **SiPM** or PMT
- Either standard ADC to digitize signal or built-in ADC
- Simplified test of the principle performed successfully
- Most of the commercial parts ordered
- Production drawings in process for light cavity and LED driver PCB

- MWPC: CO2 gas will arrive this week, mixture in 3 weeks
- DNA Setup: will try to use EL PMTs to avoid noise ripple