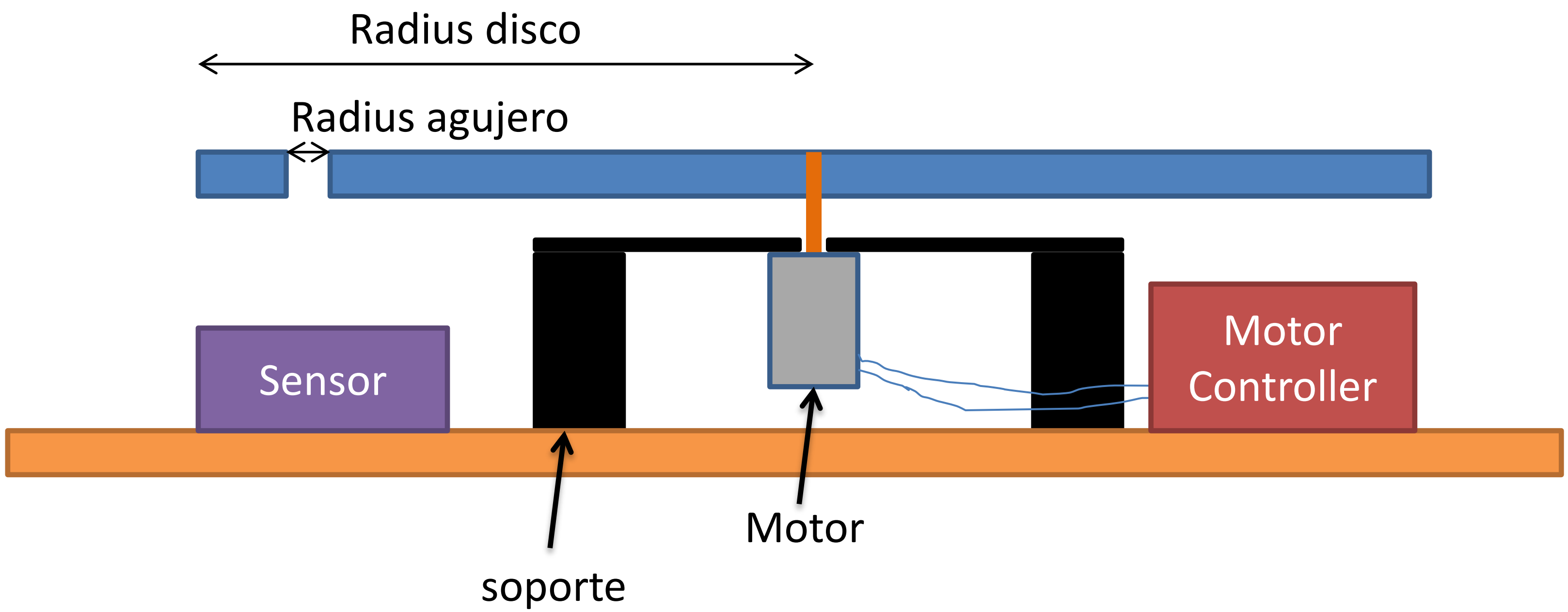
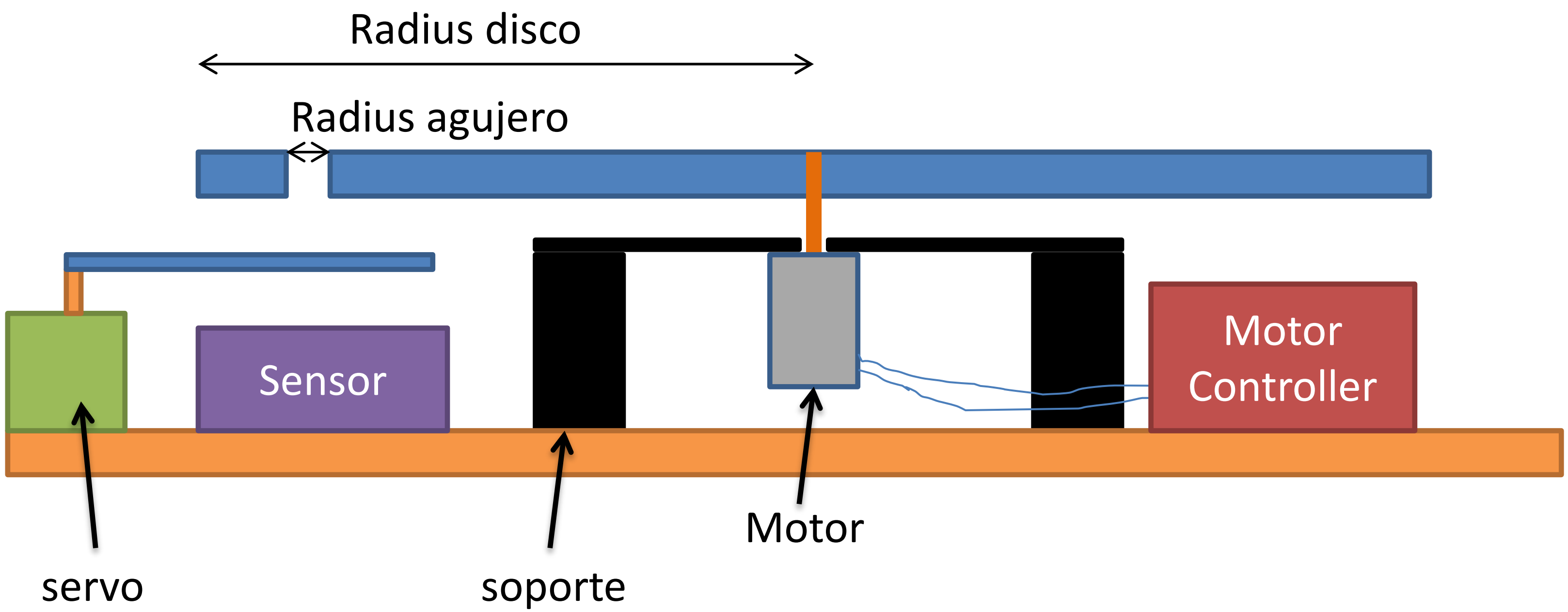
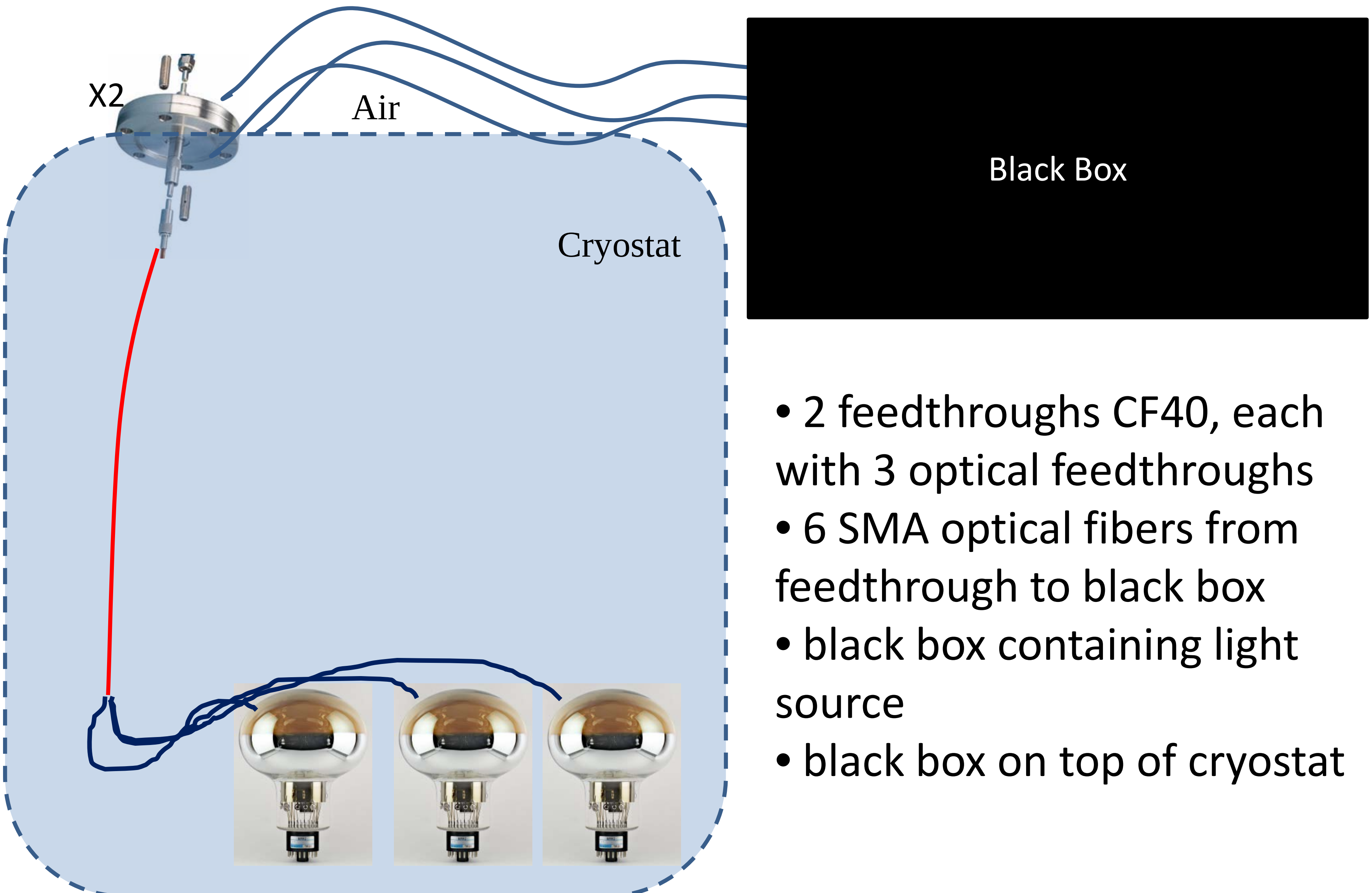

Radius disco
Radius agujero
Sensor
Motor Controller
Motor
soporte

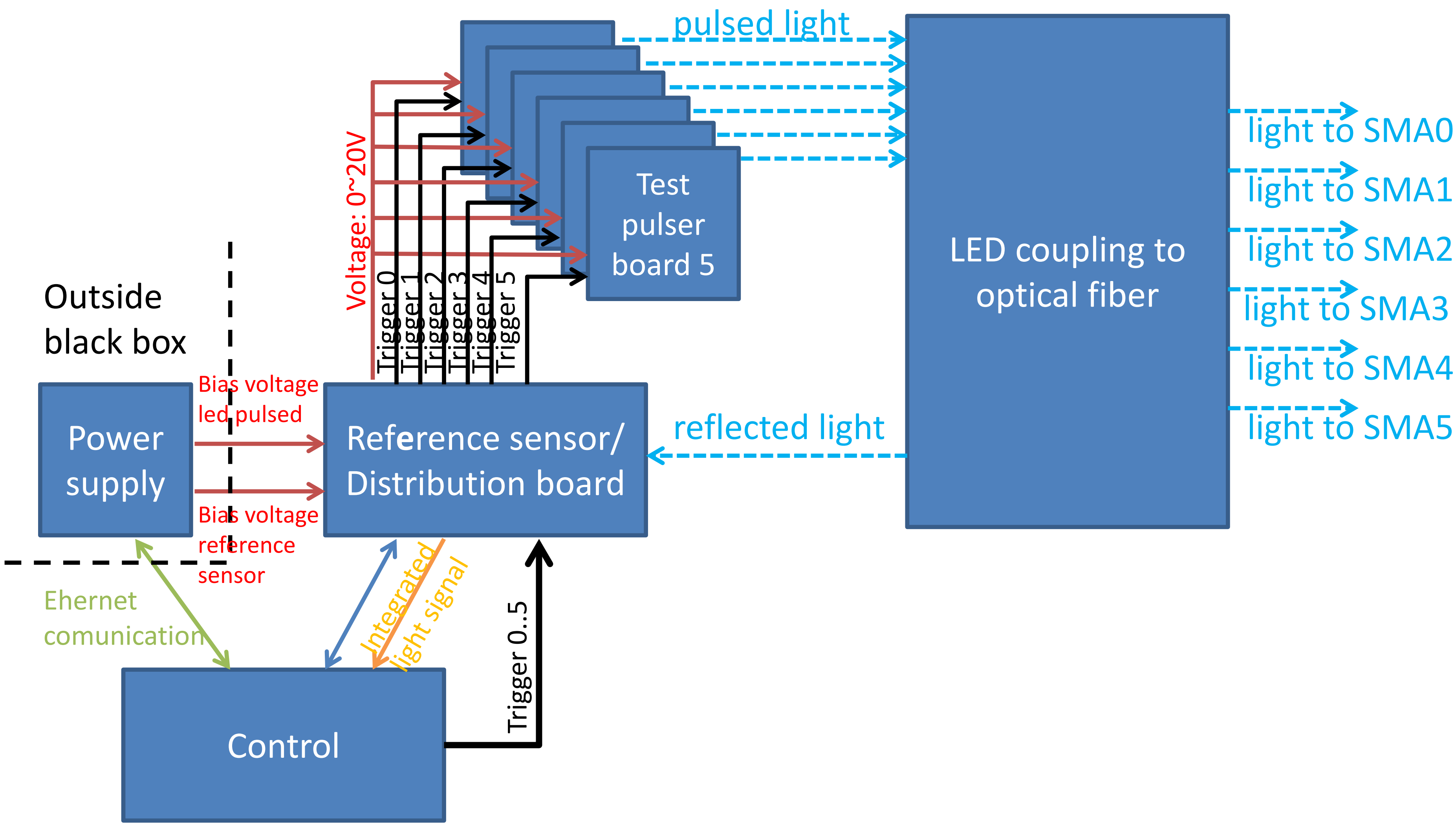

Radius disco
Radius agujero
Sensor
Motor Controller
servo
soporte
Motor

Overall Conceptual Design



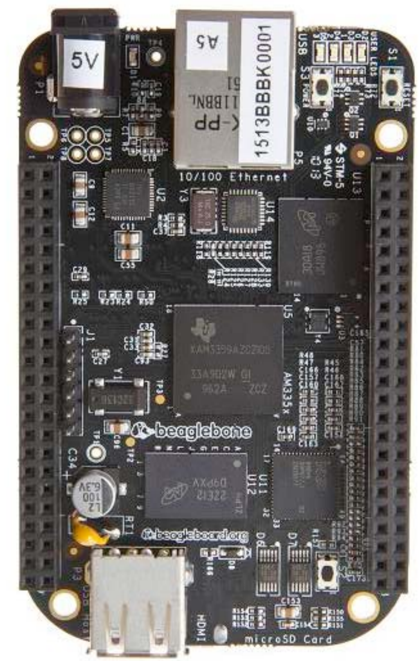
- 2 feedthroughs CF40, each with 3 optical feedthroughs
- 6 SMA optical fibers from feedthrough to black box
- black box containing light source
- black box on top of cryostat

Black box concept



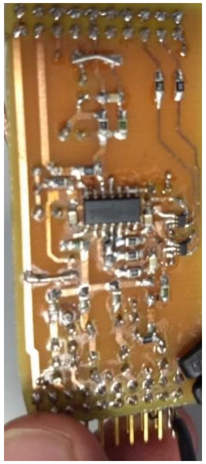
Control board

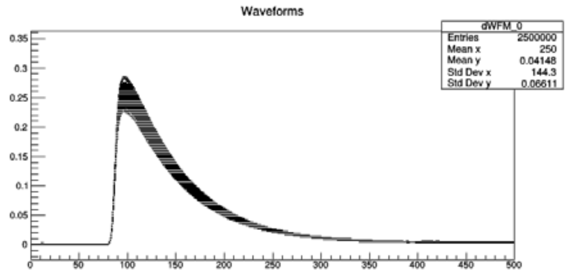
- Beagle bone black
  - Embedded linux inside
  - 7 Channels ADC
    - Reference ouput sensor
    - Temperature
  - Comunication with Power supply
    - Python library
  - PWM to trigger pulsed LED boards
  - Control integration window.
    - Timing has to be improved
    - Developing code for real time units inside beaglebone
  - To be develop the user control software.
    - Web server interface through wireless (general network)
    - OPC-UA server though tehcnical network (evaluating)

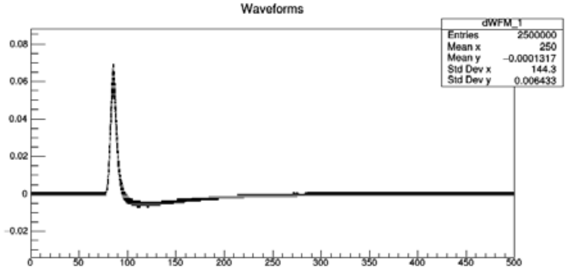


Reference sensor/ distribution board

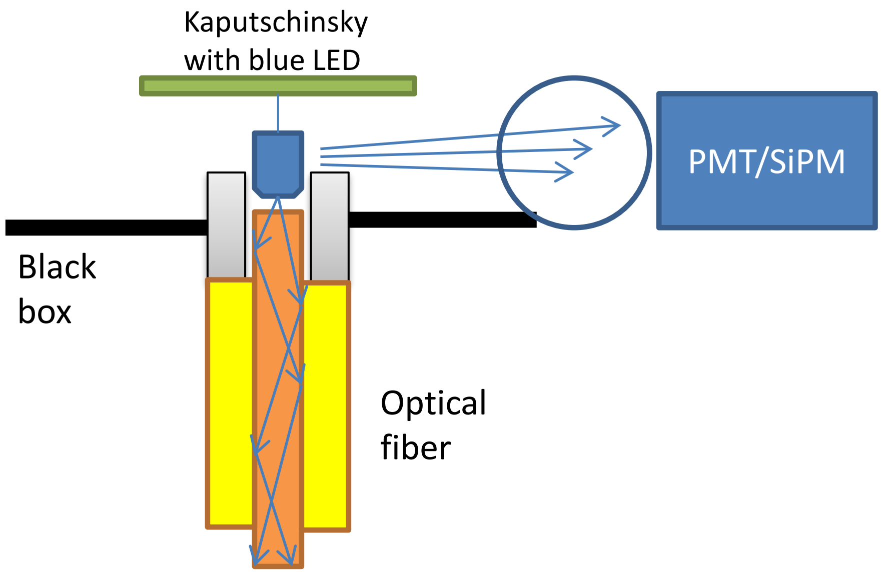
- Reference sensor
  - SensL SiPM (up left)
    - Fast output (down)
    - Slow output (to be used)
  - Integrator (up right)
    - Limited sampling rate in control board (200kS)
    - Developing control for integrator window.
    - Analog output to control board
  - Developing test to adquire the full channel (sensor + integrator + ADC)
- Distribution board
  - Distribute Bias voltage
    - Common to all LED pulser boards
  - Distribute trigger
    - From the control board to each connector to LED pulsed board.
  - TTL trigger for the charge readout
  - Control comunication through TTL signals
    - 6 trigger, 2 for integrator, 2 analog signals
- Both functionlities will be implemented in one board
- To be designed as soon as finished the test with the full chanel

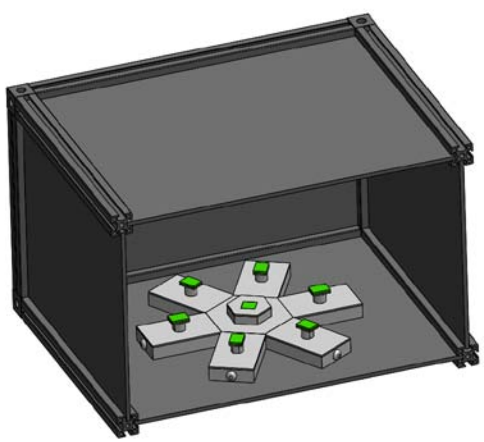


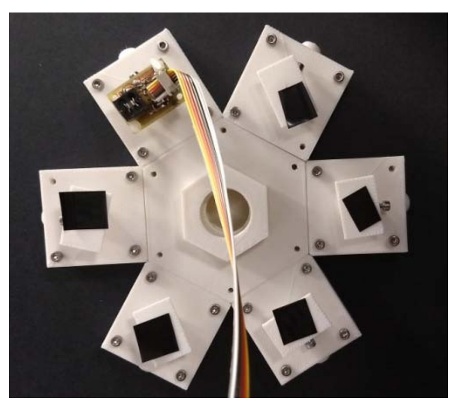




LED coupling cavity





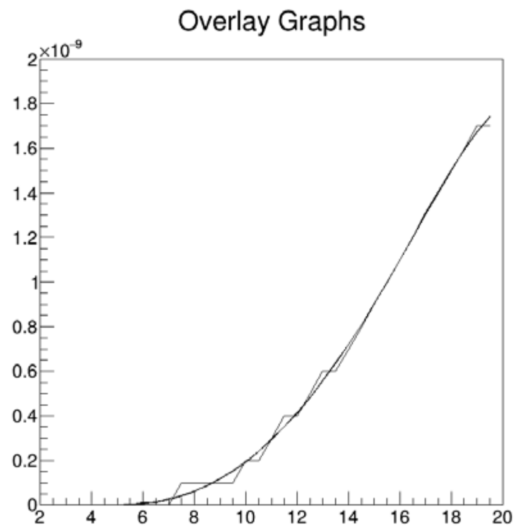


- Based on Thorsten idea
- 3D printed
- Tested in all 6 positions and measured power entering fiber with powermeter
- Large variations from position to position: ~2 factor
- Tested same position several times: roughly the same

=> Sensitive to placing of Kaputschinsky PCB but might be better with final PCBs and long LEDs (by mistake legs of these was cut)

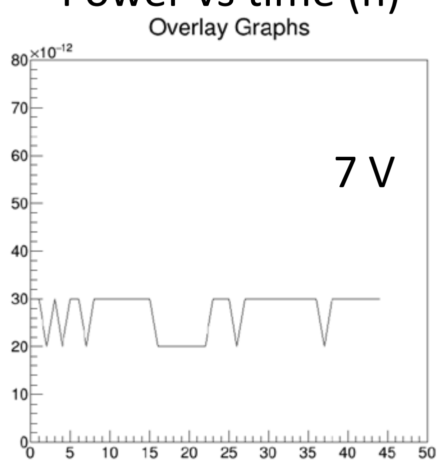
LED pulsed light board result

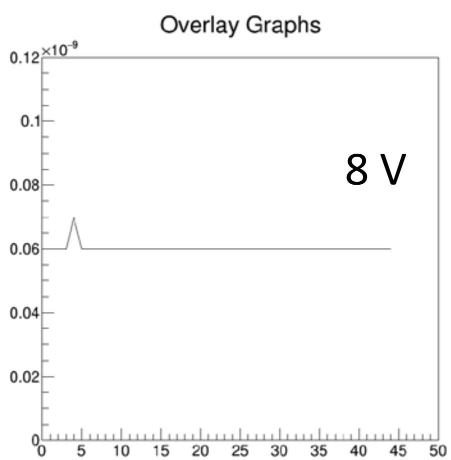
Power vs voltage

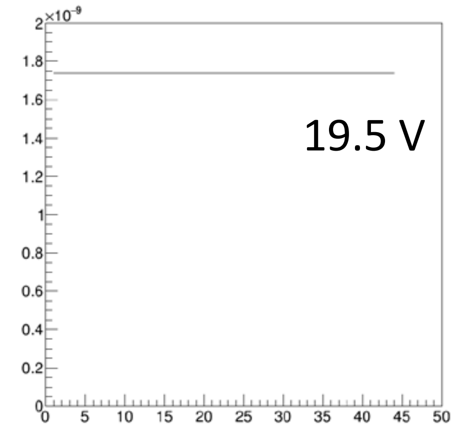


- All measurements has been done with a powermeter bought for the test
- Overlayed measurements for diferent frequencies (100 .. 10kHz)
- Power normalized to 1kHz
- It doesn't depend of pulse frequency
- There are not time dependency
- at 1 kHz up to 1.8 nW

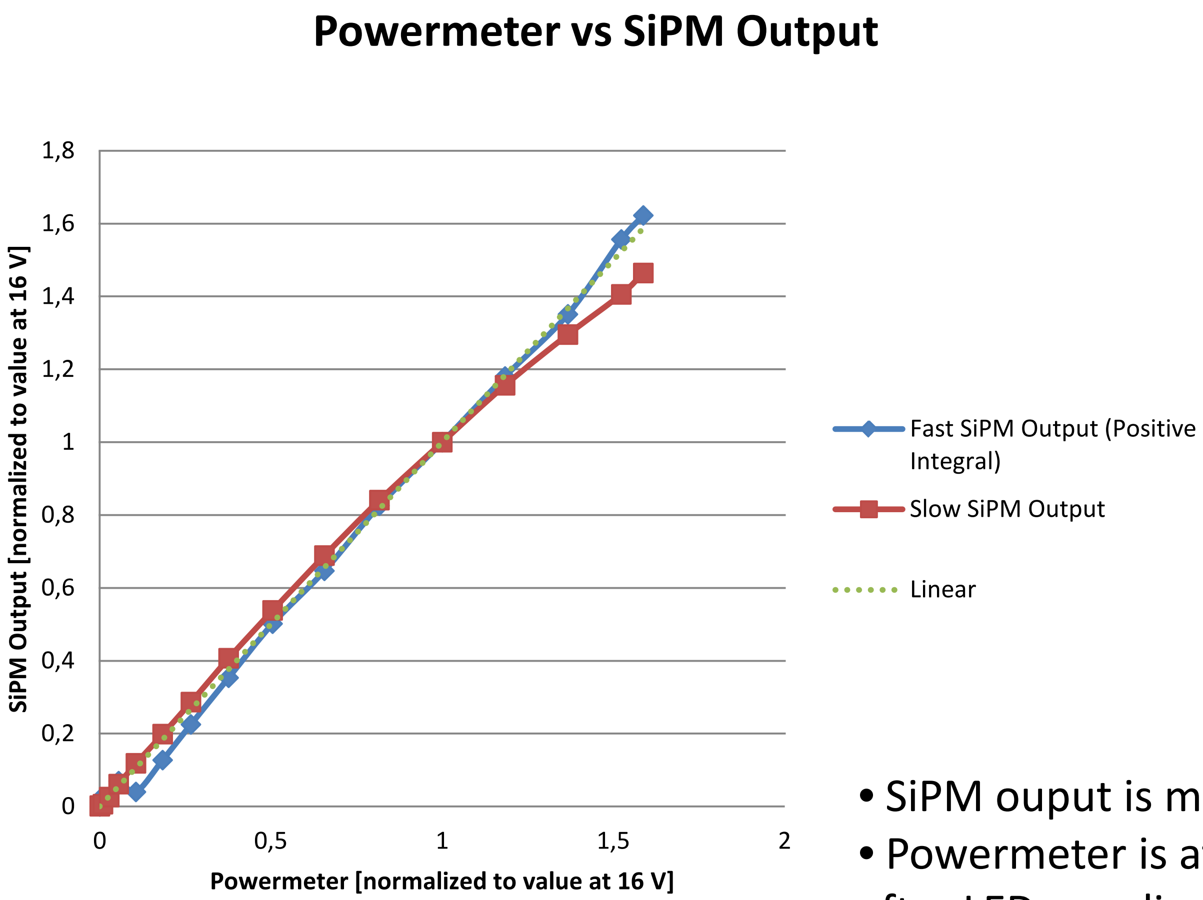
Power vs time (h)

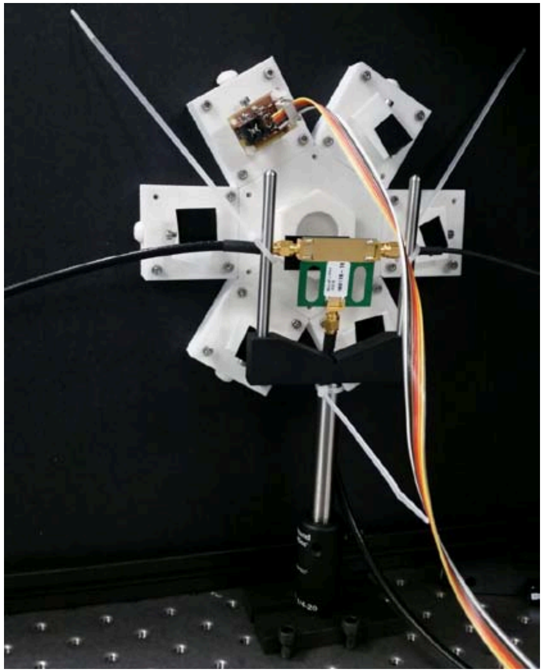






Powermeter vs SiPM Output





- SiPM ouput is measured with an oscilloscope
- Powermeter is at the end of optical fiber after LED coupling
- Positive integral by computing
- Slow output is no lineal at high power

Results from CIEMAT:

Inner Fibers attenuation

Almost complete setup under testing in LN_2:

*Final design 3 feedthroughs per flange

**Final design 3 m

Results from CIEMAT:

Results Kaput

PMT Measurements taken on 29/8 at 1300 V and on 31/8 at 1200 V
PM taken on 23/8

Number of PE:

V_{Kapu} (V)	P (pW) @ flange	PMT #1 (V_{PMT} = 1300 V)		PMT #1 (V_{PMT} = 1200 V)		PMT #2 (V_{PMT} = 1300 V)		PMT #2 (V_{PMT} = 1200 V)		PMT #3 (V_{PMT} = 1300 V)		PMT #3 (V_{PMT} = 1200 V)		
	f_{Kapu} = 1 kHz*	f_{Kapu} = 200 Hz	f_{Kapu} = 1 kHz	f_{Kapu} = 100 Hz	f_{Kapu} = 200 Hz	f_{Kapu} = 200 Hz	f_{Kapu} = 1 kHz	f_{Kapu} = 100 Hz	f_{Kapu} = 200 Hz	f_{Kapu} = 200 Hz	f_{Kapu} = 1 kHz	f_{Kapu} = 100 Hz	f_{Kapu} = 200 Hz	**Average**
5	8	0.32	0.31	0.23	0.39	0.3		0.19	0.19	0.32		0.25	0.25	**0.3 ± 0.1**
6	12	17	17	14	14	15	15	12	12	15	14	13	13	**14 ± 2**
7	39	86	79	87	84			66	66	71	58	74	72	**76 ± 9**
8	84			216	211					154	133	191	180	**190 ± 25**
9	137											315	303	**315**

Gain monitored between measurements.
Results in red indicate that NPHE is underestimated due to PMT saturation.
PMTs 4 and 5 not considered as they have less gain.
* Power for 100 Hz and 200 Hz can be extrapolated.

Recommendation: Do not calibrate with 1 kHz, rather use **100 Hz** (200 Hz also saturates the PMT earlier)

If true, calibration will take long => All PMTs should be calibrated simultaneously

Although still not sure how this should work in a LAr TPC with Ar-39 + Saturation sets in a very small Nphe values

Status and Plans

- Pulsing all 6 LEDs at the same time makes idea of reference sensor useless in principle
- Options:
  - Measure power for each LED first and then switch on all LEDs at the same time
  - Use only one of the LEDs and a 1-7 splitter as in the cryostat => 1 LED to rule them all
- Will continue to develop the system for 6 LEDs