

General status and plans of light readout system

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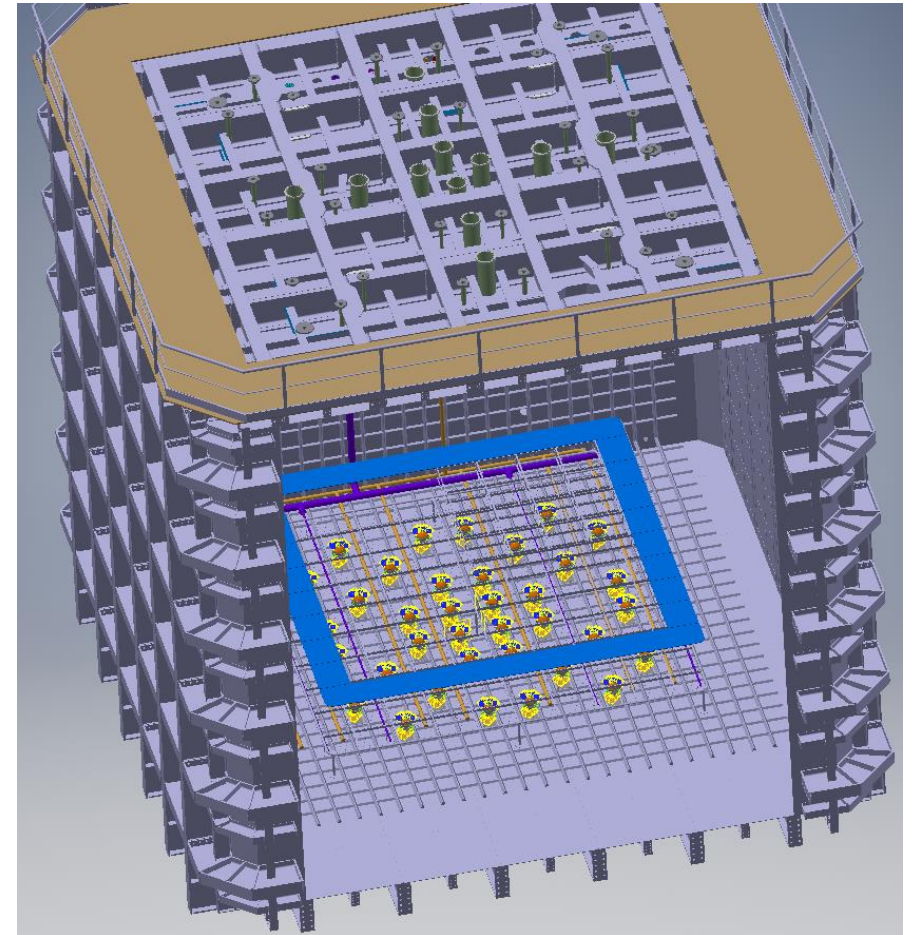
September 1st, 2017



Light Readout System Status

1. Procurement of 40 8” Hamamatsu R5912-20mod PMTs (**DONE**)
2. Design, production and tests of the PMT bases (**DONE**)
3. Design, construction and assembly of the PMT mechanics (**DONE**)
4. Characterization of the PMT system at dedicated setup @CIEMAT at room and cryogenic temperature (**Almost finished, sept**)
5. Design and validation of the light calibration system (**on-going, sept**)
6. Training people for installation at ENH1 (**on-going**)
7. HV splitters production and tests (**Sept-Nov**)
8. PMT TPB coating at CERN (**Oct-Nov**)

PMTs ready for installation in Dec 2017 at CERN



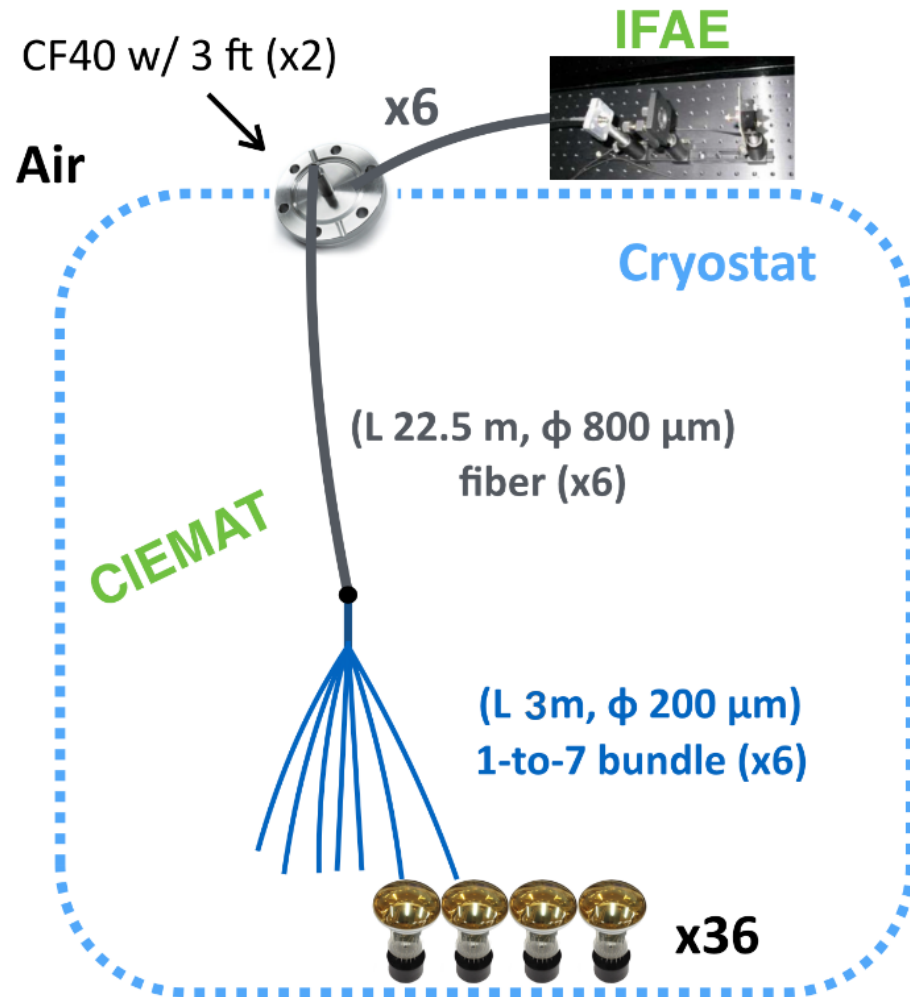
PMT Characterization Status

40 PMTs tested at RT and CT:

- 33 PMTs: DC and gain ok
- 1 PMT returned to Hamamatsu as gave no signal -> replaced and tested ok
- 1 PMT returned to Hamamatsu due to high DC at RT -> replaced and tested ok
- 5 PMTs under further study due to high DC
- Operating voltage determined
- Information about measurements to be added to the database.
- Usually tested in LN₂ (77 K), also an overpressure test (+1 bar, 83 K) at to study gain dependence with temperature
- Detailed results can be presented anytime

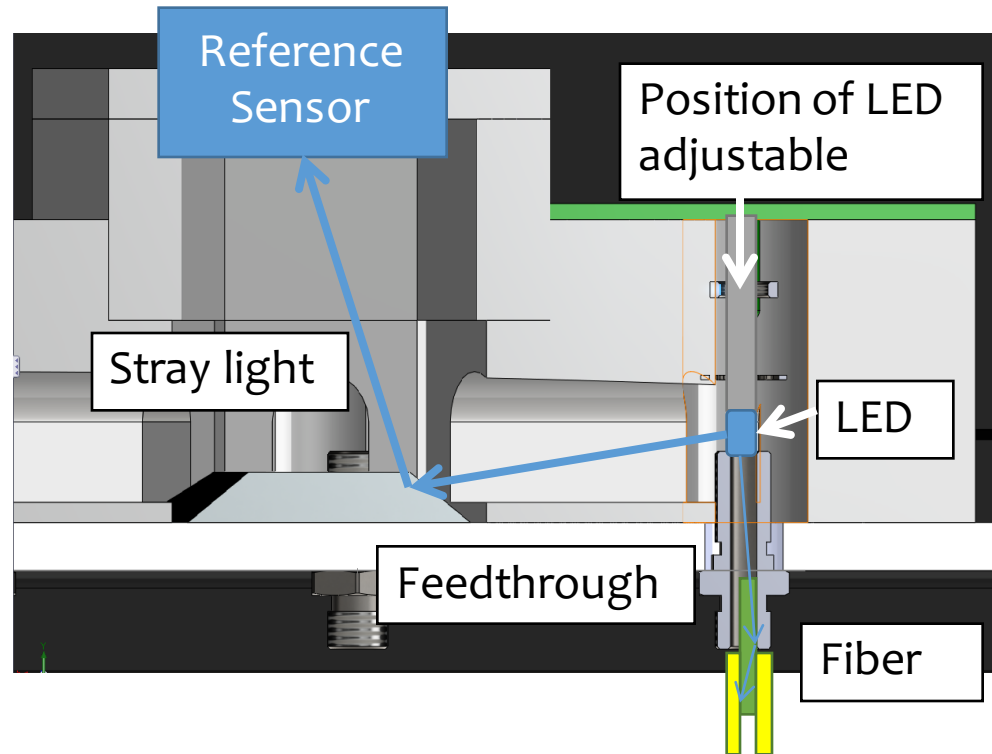


Light Calibration System



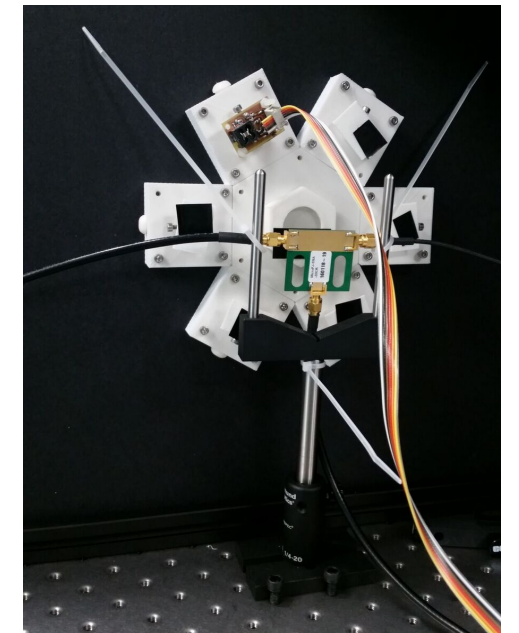
- Black box with **light source** (Kaputschinsky LEDs) outside of cryostat
- **6 fibers** going to cryostat - ϕ 1000 mm, M59L01
- **2 CF40**, each with 3 optical feedthroughs
- Inside the cryostat (**6x**):
0.39 NA TECS™ Hard Clad, Step-Index, Multimode Fiber from Thorlabs
 - 22.5 m **fiber** - ϕ 800 mm, FT800UMT, SS jacket
 - 3 m **1-to-7 bundle** – ϕ 200 mm, FT200UMT SS jacket common end, black jacket at split ends
 - Vacuum compatible SMA to SMA matting sleeve
- All fibers with **SMA** connectors

Light Source



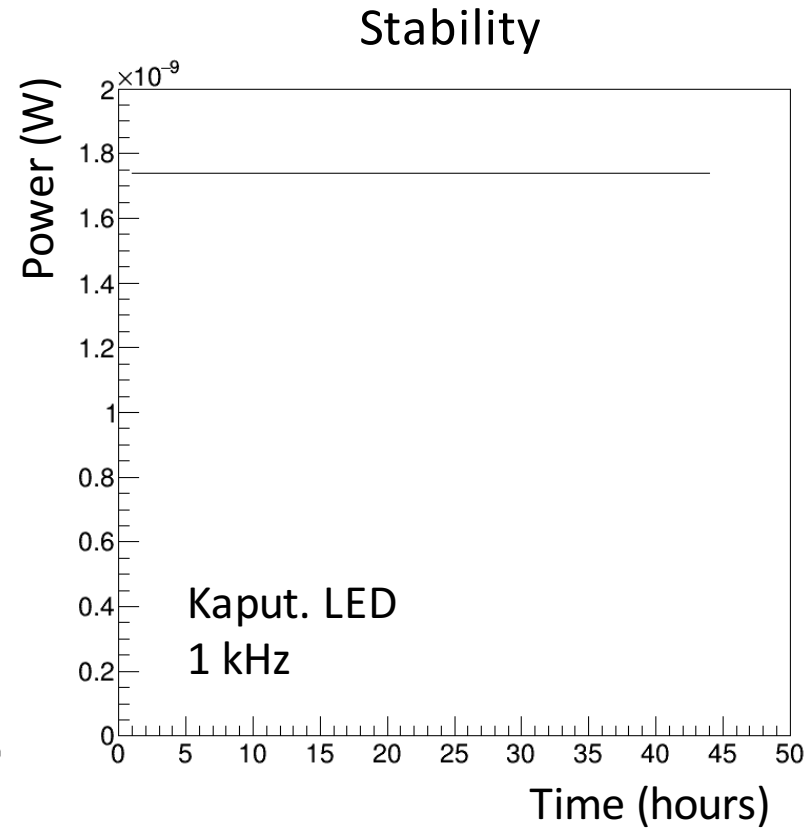
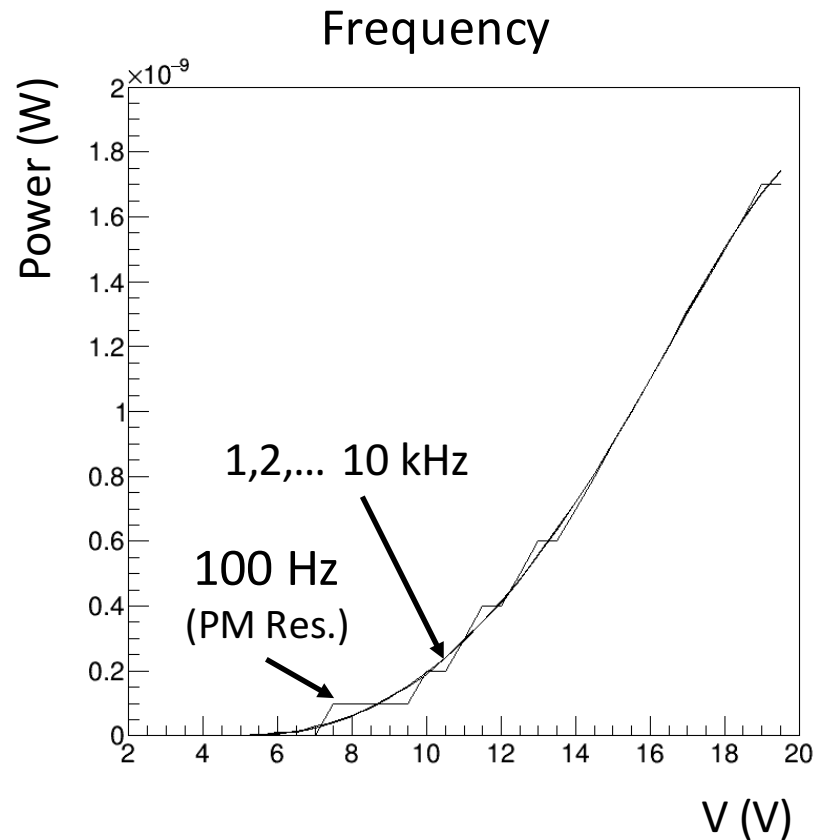
- **Blue LED** of 470 nm for calibration
- **Kapuschinski circuit** as LED driver:
 - 15-20 ns total width
 - intensity tunable
- 1 LED connected to 1 **fiber** going to one optical feedthrough

- **6 LEDs in total** placed in an hexagonal geometry
- Direct light to fiber, stray light to **reference sensor**
- 1 reference sensor in center: **Sensl SiPM** (2 outputs: fast and slow)
- Controlled by **BeagleBone** (pulsing, ADC for SiPM, DAQ)



Light Source

Kapuschinsky LED tests:



To do

- Assemble the final LED PCBs (6x)
- Characterize them the same way

Inner Fibers

Almost complete setup under testing in LN₂:

optical
feedthrough*

22.5 m **fiber**
 ϕ 800 μ m, FT800UMT

Vacuum compatible
SMA to SMA
matting sleeve

1 m** **1-to-7 bundle**
 ϕ 200 μ m, FT200UMT

8" PMT

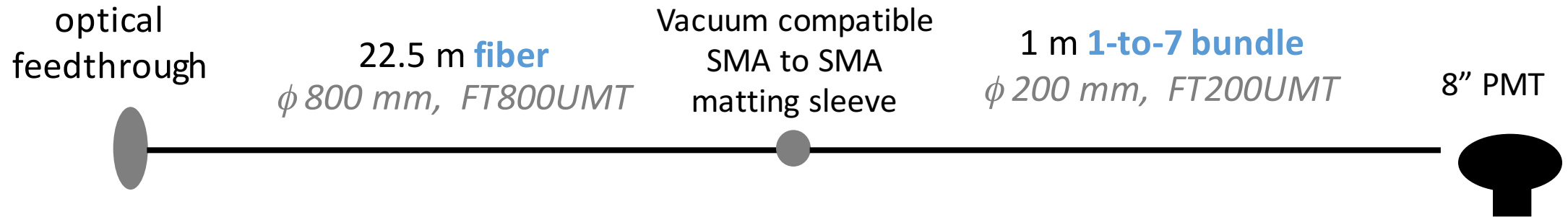


*Final design 3 feedthroughs per flange

**Final design 3 m

Inner Fibers

Light transmission has been measured:



Light transmission:

RT:	0.7	x	0.117	x	0.7	x	0.06	=	0.003 total
CT:	0.7	x	0.08	x	0.6	x	0.05	=	0.002 total

On-going measurements at CT to determine light range required at flange to see SPE – 200 PE at PMTs

Summary

- 36 8" cryogenic photomultipliers
 - 40 PMT finishing characterization at RT and CT
 - Information will be in database
- PMT mechanics: final support assembled
- PMT bases soldered to PMTs
- Wavelength-shifter: TPB coating on PMT at CERN (Oct-Nov)
- Light calibration system validation (Sept)
- HV splitters production and tests (Sept-Nov)
- PMT TPB coating at CERN (Oct-Nov)
- Training people for installation

PMTs ready for installation
in Dec 2017 at CERN