Update on laser system

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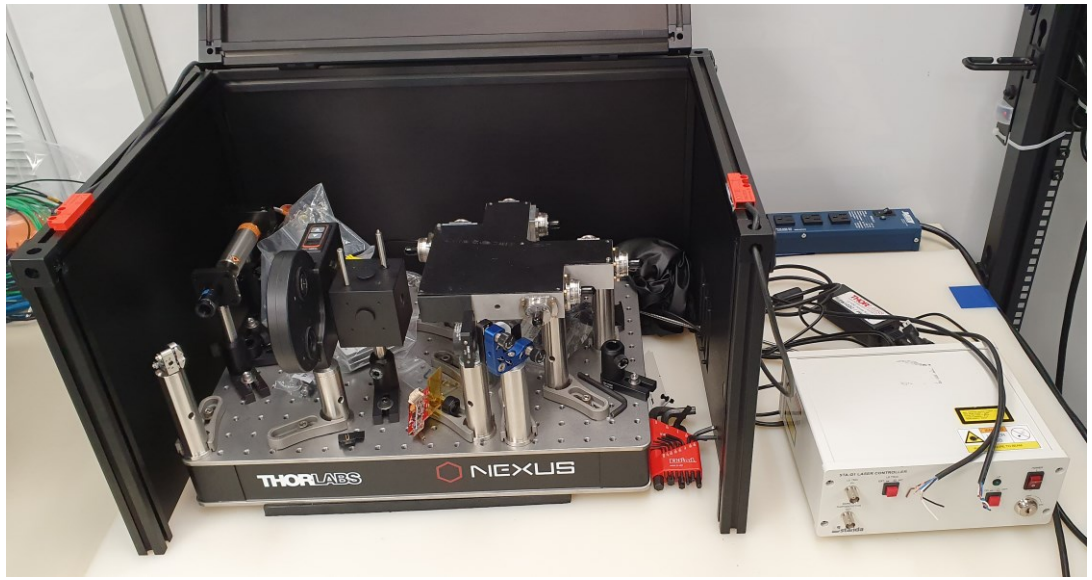
Meeting Mu2e, 30/01/2024

Riassunto situazione

- **Andrea Fioretti (INO-CNR) è disponibile a collaborare a Mu2e**
- Tutto il materiale per l'installazione è stato acquistato (anche fotodiodi mancanti)
- Misurata trasmissione delle 1870 fibre ottiche dei bundles
- Il sistema funziona correttamente a SiDet
- Eleonora ha verificato la procedura di calibrazione su 2 SiPM
- Retta di calibrazione (σ^2 vs M) perfettamente lineare
- **N.B. il laser Standa acquistato nel 2020 non funziona più**



Bundles, Luglio 2023:

- At Fermilab there are 17 bundles of 110 fibers each.
- 16 bundles are needed for the construction of the two discs
- 2 more bundles to be delivered (one already made)
- The test on the transmission of the 1870 optical fibers was carried out:
  - Approximately 1% were blind (connectors to these fibers were removed)
  - Approximately 5% were found to have low transmission (fibers reported)
  - Each bundle has at least 100 fibers

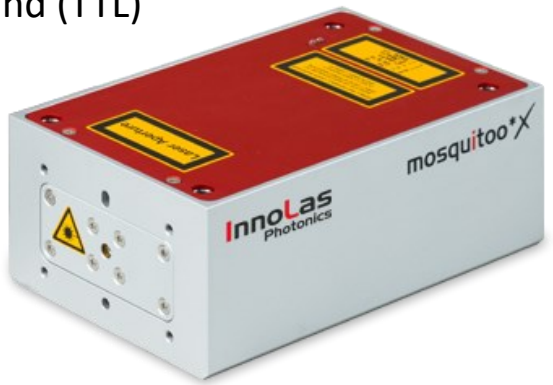
Laser

We choose laser from Standa mod. STA-01HS2

- Frequency: not measured (rated 532 nm)
- Output power: 42 mW (Class 3B)
- Repetition rate: 5.0 kHz
- Energy/pulse: 9 uJ/pulse
- Beam diameter: 2 mm
- Divergence: 10 mrad
- Pulse Width (FWHM): < 5 ns (affected by the photodiode rise time)
- Delay between trigger and laser pulse: 19 us
- Jitter: 60 ns
- Pulse on demand (TTL)

Alternative (Innolas, suggerito da F. Scuri):

Modello 532-2-V (40 uJ/pulse), trigger TTL, 200 kHz, Classe 4
http://www.innolas.co.uk/lasers/mosquitoo-x/
http://www.innolas.co.uk/app/uploads/2016/09/MOSQUITOO-X.pdf



Della stessa ditta c'è un modello differente (forse classe 3B)
Modello picolo-100, repetition rate 100 kHz, 5 µJ/pulse a 532 nm
http://www.innolas.co.uk/lasers/picolo-aot-sub-ns-lasers/
http://www.innolas.co.uk/app/uploads/2016/09/picolo.pdf

Il modello a diodo della Picoquant più potente non ha energia per impulso sufficiente (almeno credo, nella selezione viene dato a 150 nJ ma dal calcolo mi viene < 10 nJ).
VisUV-532-HP, 80 MHz, 750 mW, trigger TTL o NIM, Classe 4
https://www.picoquant.com/products/category/high-power-and-uv-lasers/visuv-versatile-picosecond-laser-module#description

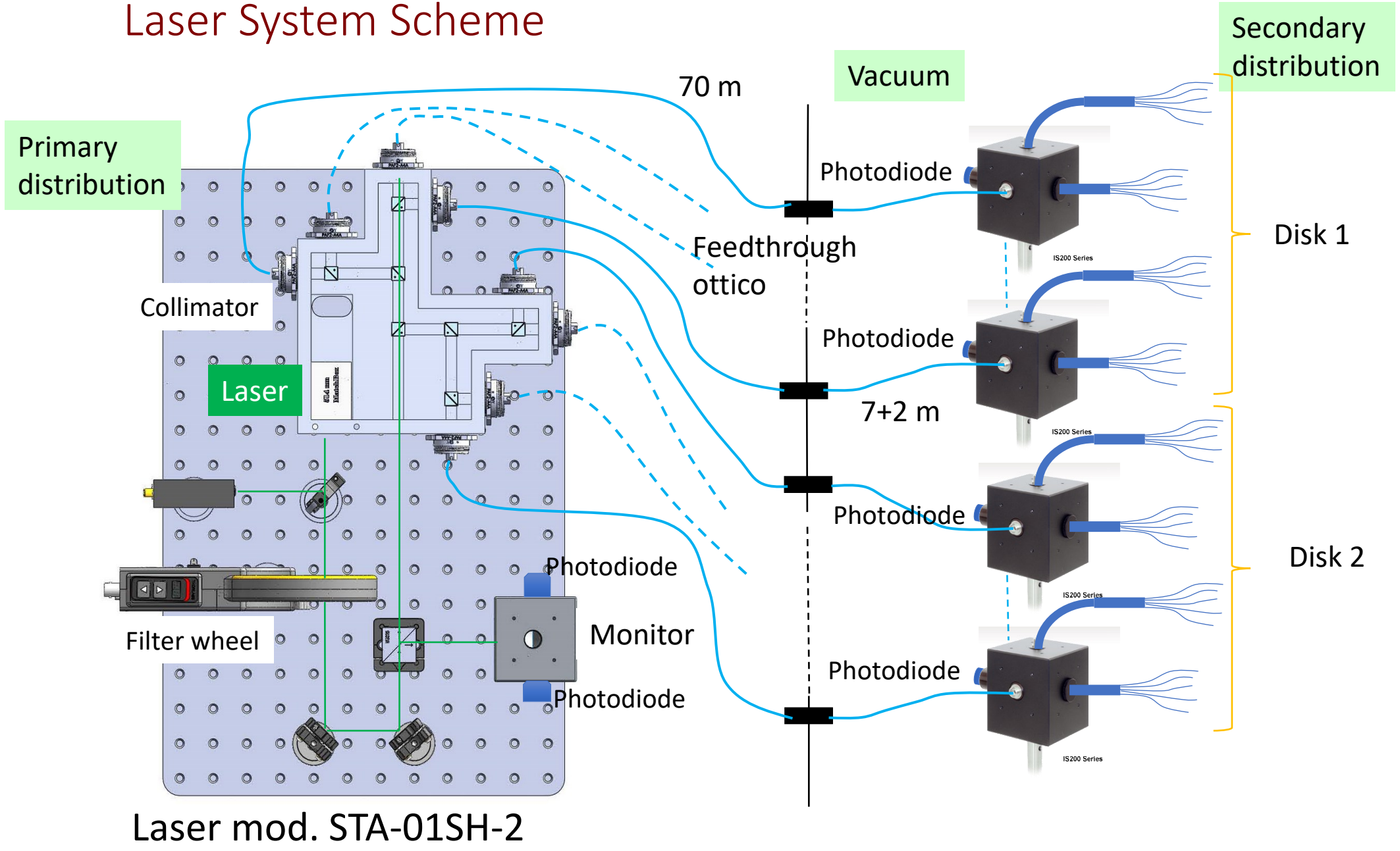
Conclusions

- The laser system works quite well, basically completed
- All the material necessary for the installation has been purchased (almost, see below laser)
- Measured the transmission of 17 bundles (2 spare bundles delivered, to be measured)
- Defined the position of the integrating spheres on the discs, holders and Farady cages to be built
- **Issue**: The laser is dead

- **There are still a few things to fix:**
  - Building the Aluminum Faraday cages → In progress (Daniele)
  - FFE shapers monitor signals not optimized (factor 3 less than SiPM signal)
  - Check the transmission of optical feedthroughs (already done in the past)
  - s1296 photodiodes procured - They should work w.o. bias
  - **Select and procure a new laser – adapt the black box/safety issue (Class 4 laser)**
  - **Discuss and organize routing of Laser Bundles after FEE-MB routed (DIRAC assembled)**
  - **Design the Laser-Hut table in the TDAQ room**
  - **Test Laser running with DIRAC and DAQ**

SPARE

Laser System Scheme



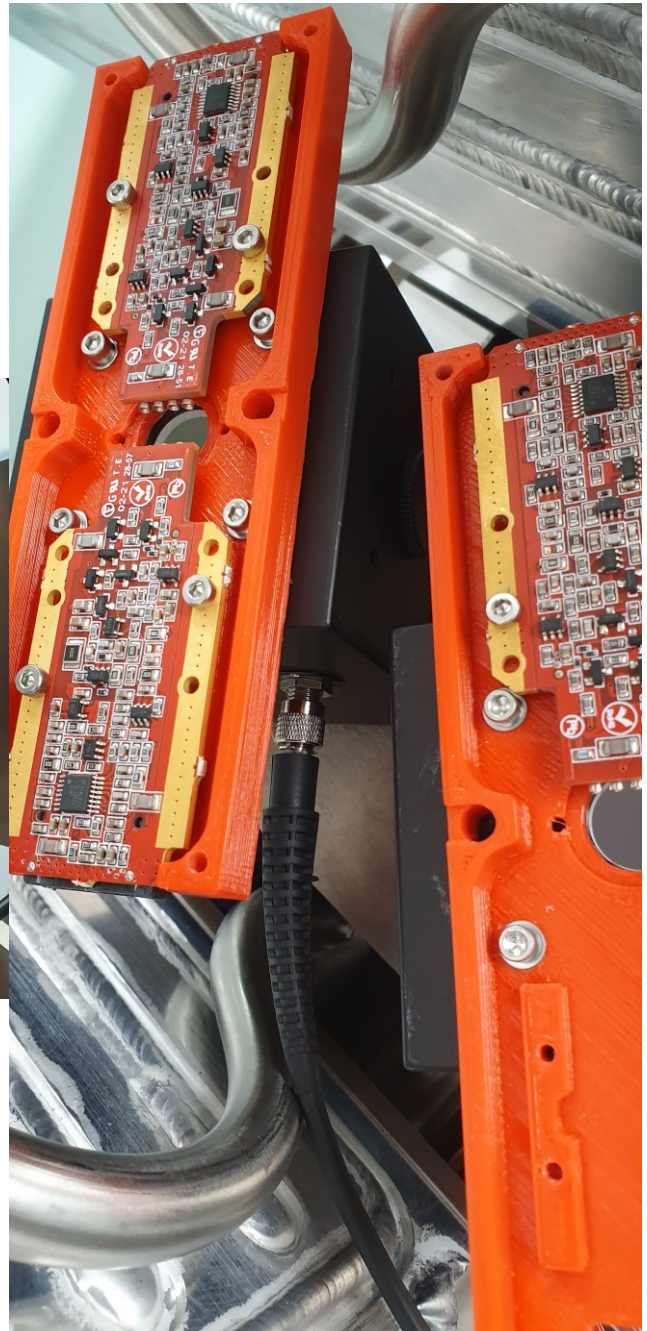
Laser mod. STA-01SH-2

Integrating sphere placement

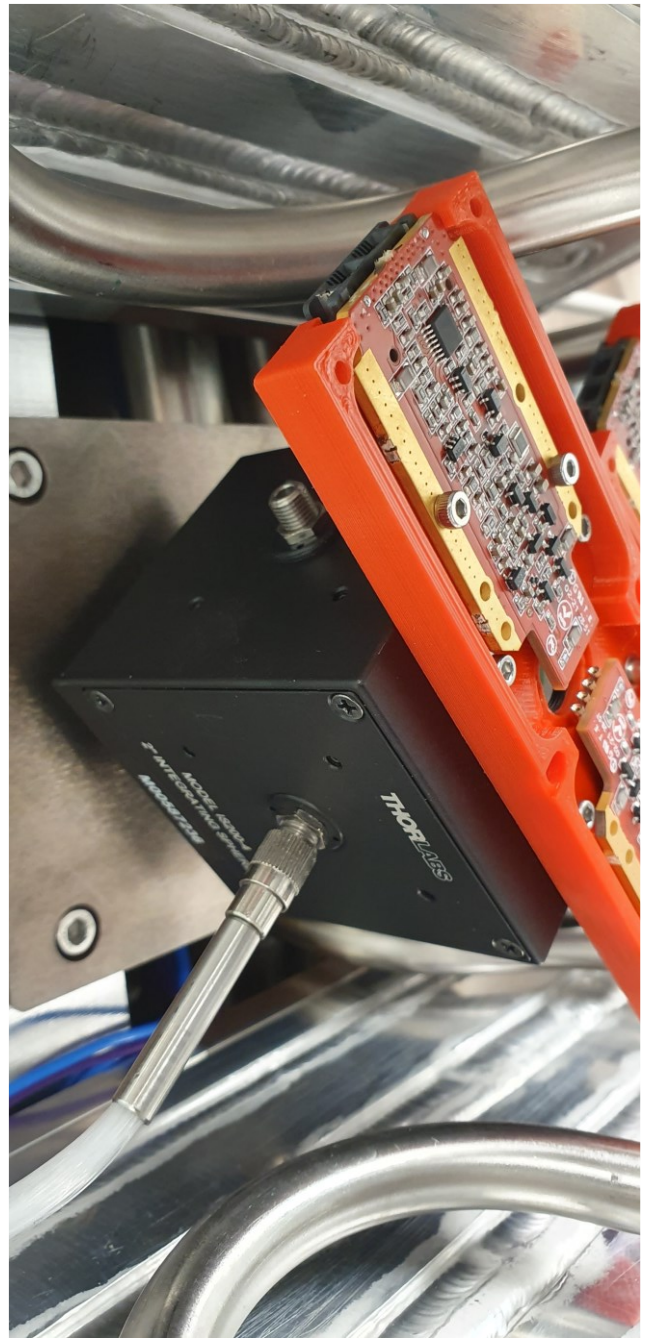
Daniele Pasciuto defined the position of the spheres on the discs

Front view

Bottom view



Left view

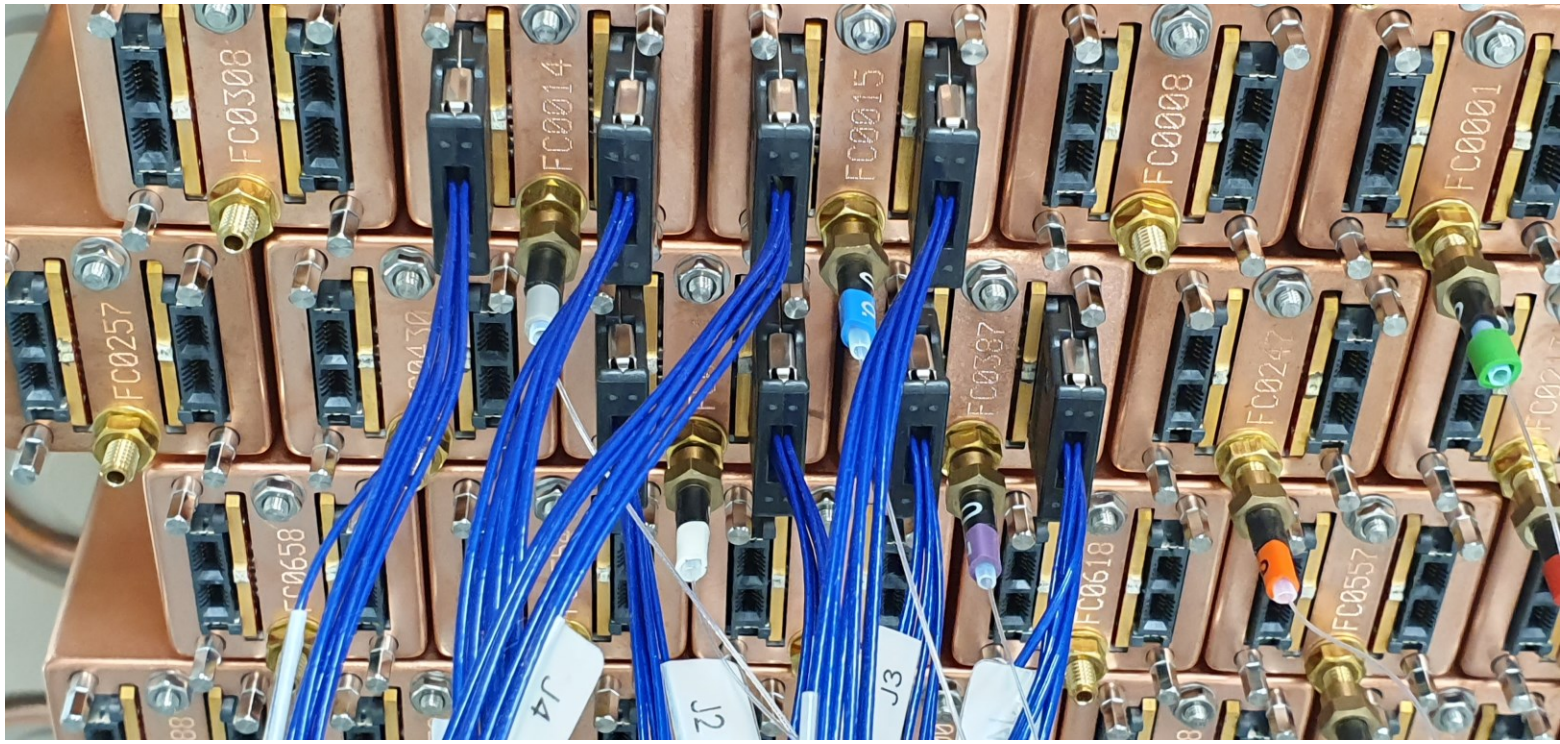


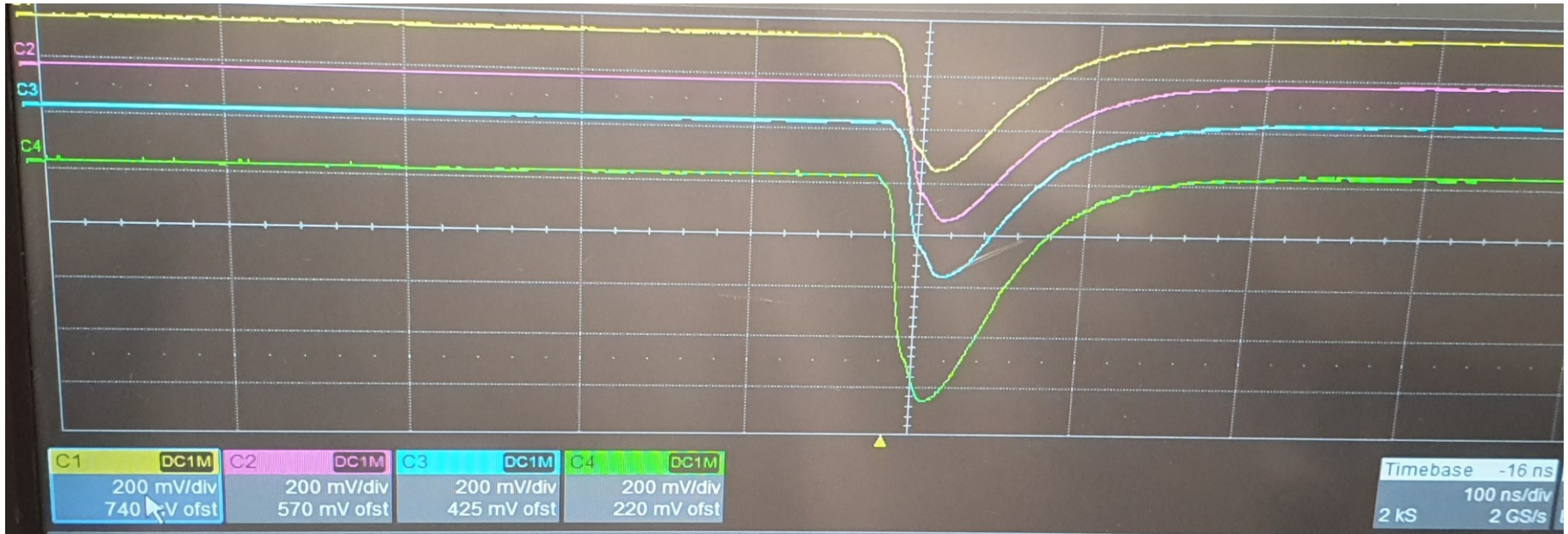
Aluminum Faraday cages have yet to be made

SiPM calibration test

Procedure:

- 4 fibers connected (8 SiPMs)
- Acquisition of 100.000 laser pulses
- Change of filter wheel position
- Amplitude analysis
- Gaussian distribution of the amplitude for each filter wheel position
- Plot σ^2 vs. mean for each SiPM
- Linear fit to obtain the linear parameter k = ADC/photoelectron (SiPM gain)
- The constant photelectron/MeV depends on the crystal yield (laser not useful)

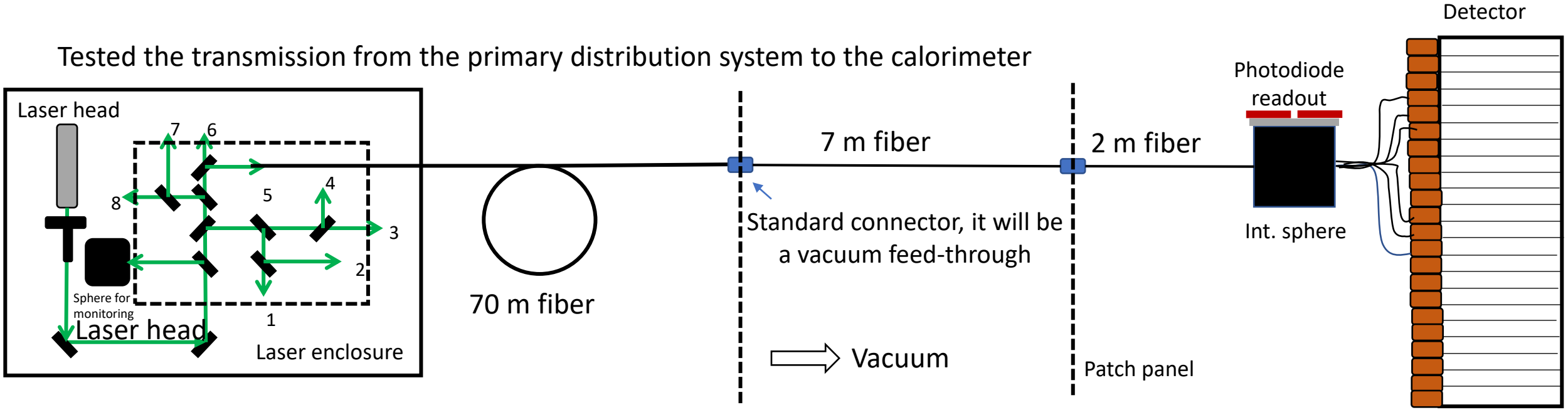




Many thanks to Eleonora!

Nov. 29, 2022 : test of the full optical chain from the primary distribution to the calorimeter

Tested the transmission from the primary distribution system to the calorimeter



Power output of primary distribution ch.5 : 40.4 uW (without power meter filter and with 2.6 OD filter on the laser head)
Power output after the full fiber chain (70 m + 7 m + 2 m + 2 connectors): 3.0 uW (with power meter filter and OD=2.6 …)
Power output after the full fiber chain (70 m + 7 m + 2 m + 2 connectors): 10.4 uW (with power meter filter and OD=1.8 …)
Power output after the full fiber chain (70 m + 7 m + 2 m + 2 connectors): 76.0 uW (without power meter filter and OD=1.8 …)

Power meter filter attenuation: 76.0 / 10.4 = 7.3
Optical chain attenuation: 3*7.3/40.4 = 0.54