

Updates on LG measurements

Maryna

22/09/2021

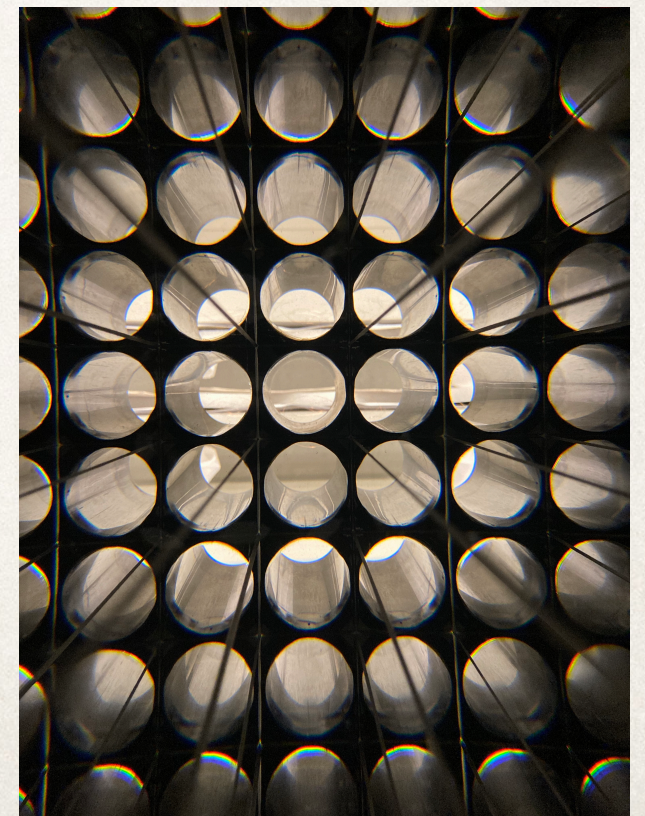
Wrapping

Felix, Sasha, Maryn

the light tight box cannot be a part of the detector setup -> needed some protection from possible external light for lead glass blocks.



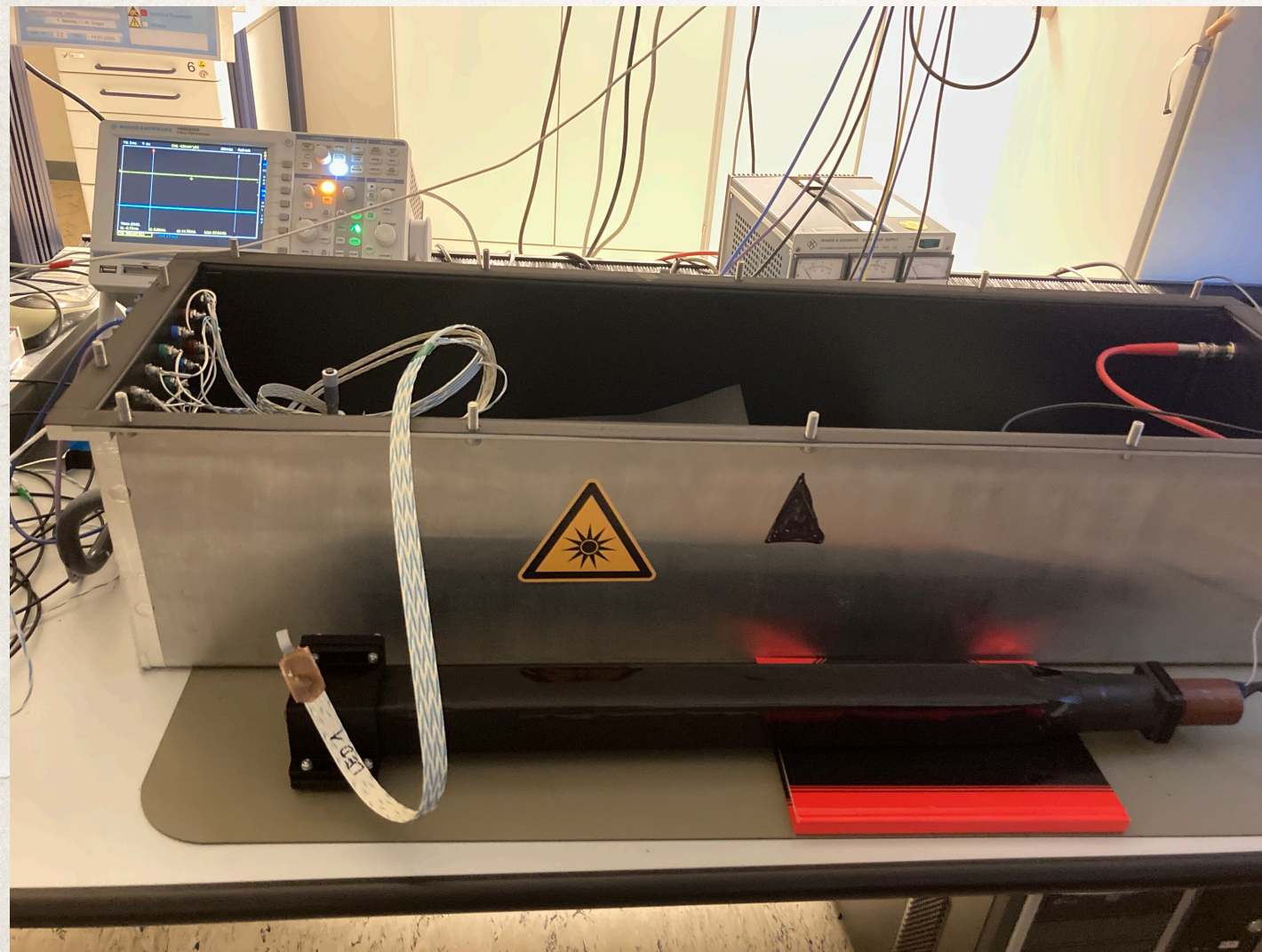
- ~2 layers of vinyl + 1 layer of Al



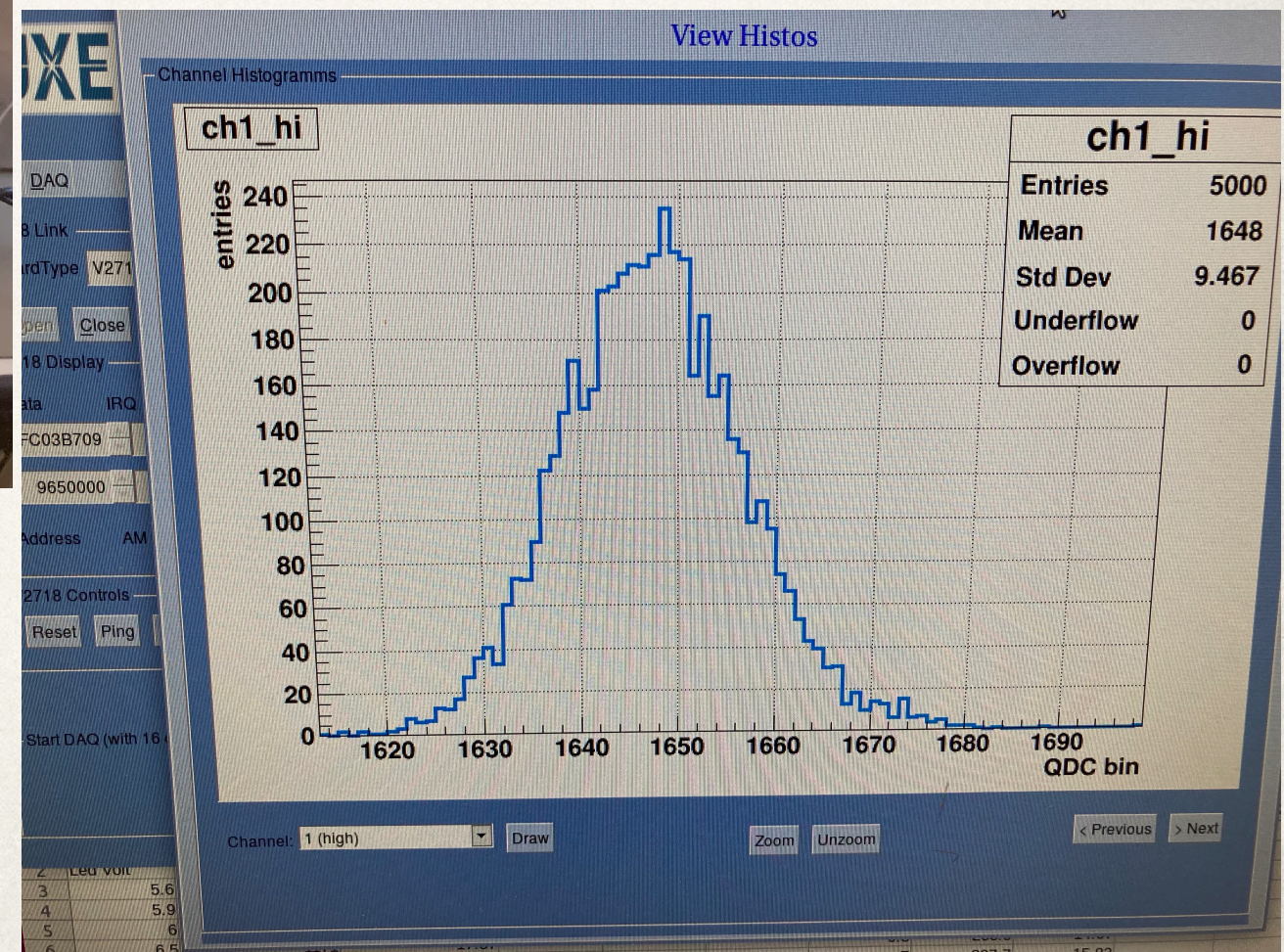
Out of the box

Felix, Sasha, Maryn

Wrapping worked out => we see the signal from LED

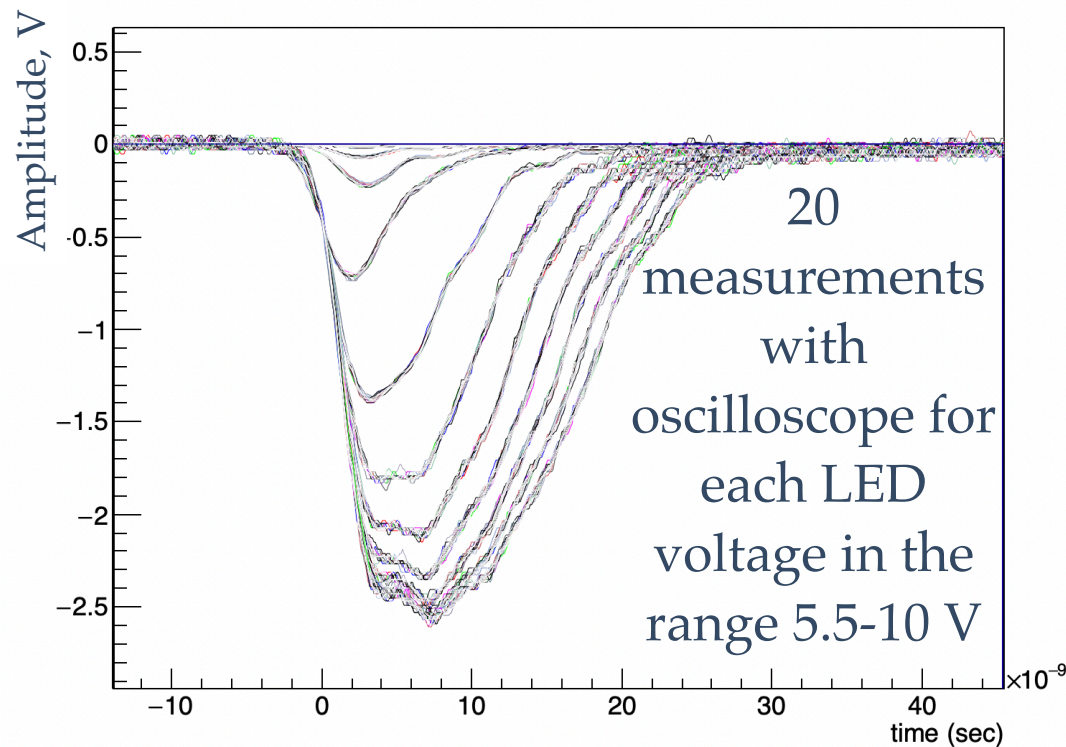


- Slowly increased HV up to 1kV
- Current remained 500 μ A (as in the box)
- Collected signal from LED (7 V) attached to the front side of LG

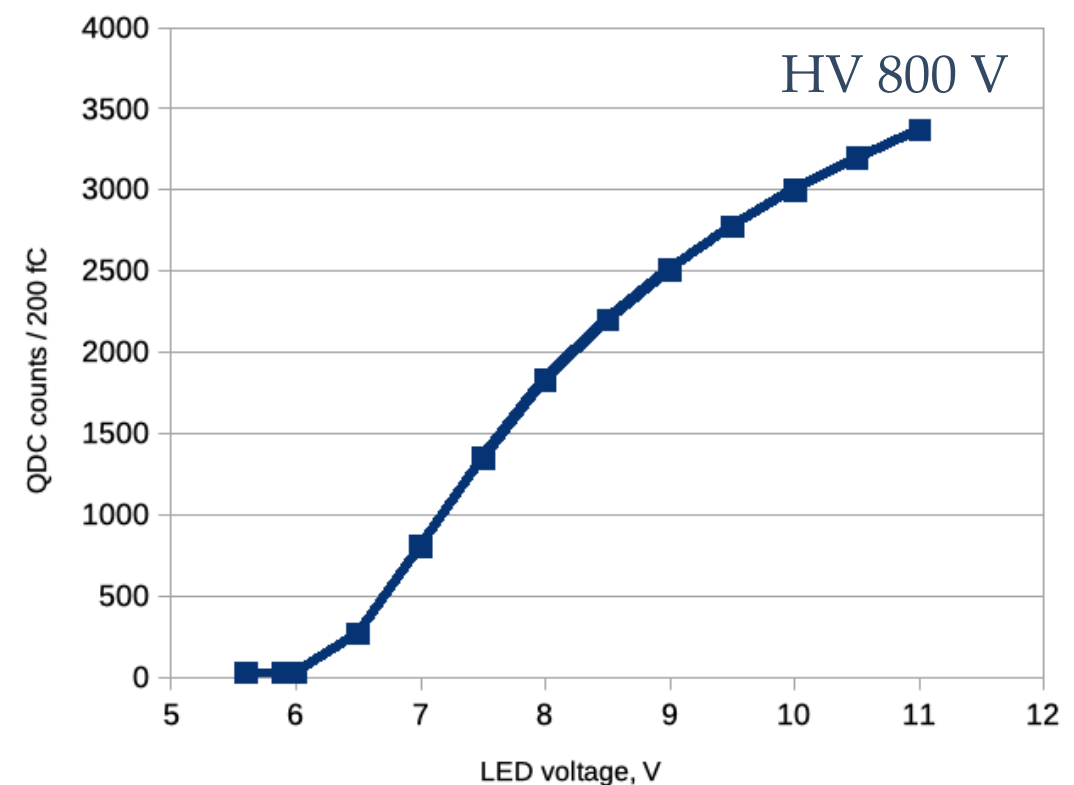
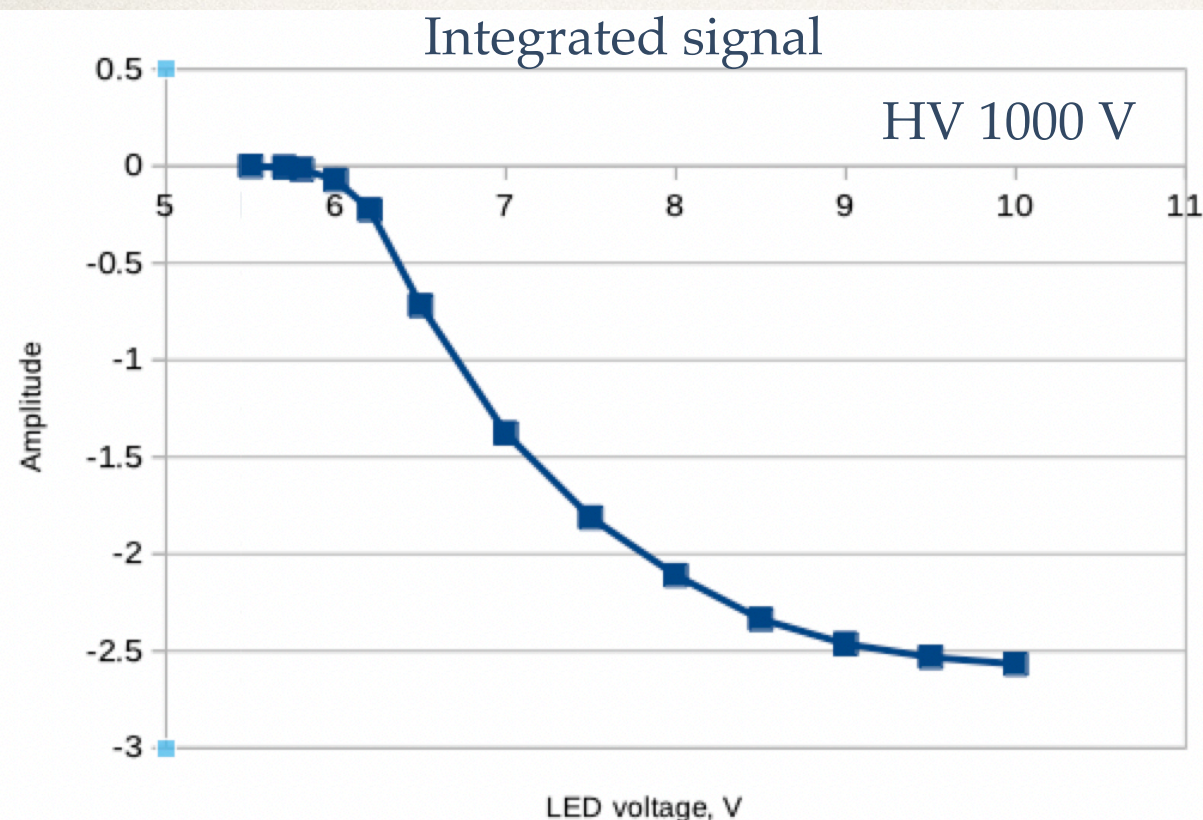
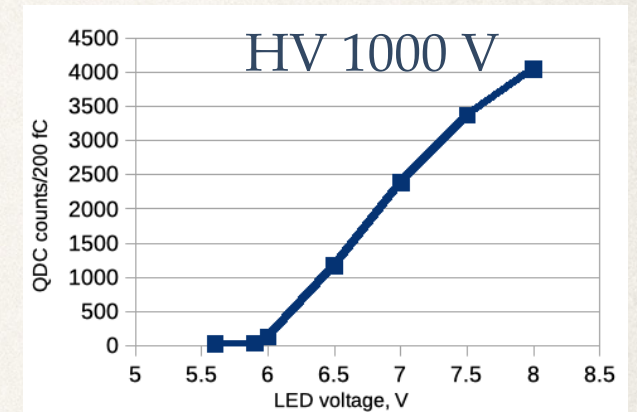


Signal dependance on LED voltage

Felix, Sasha, Maryn



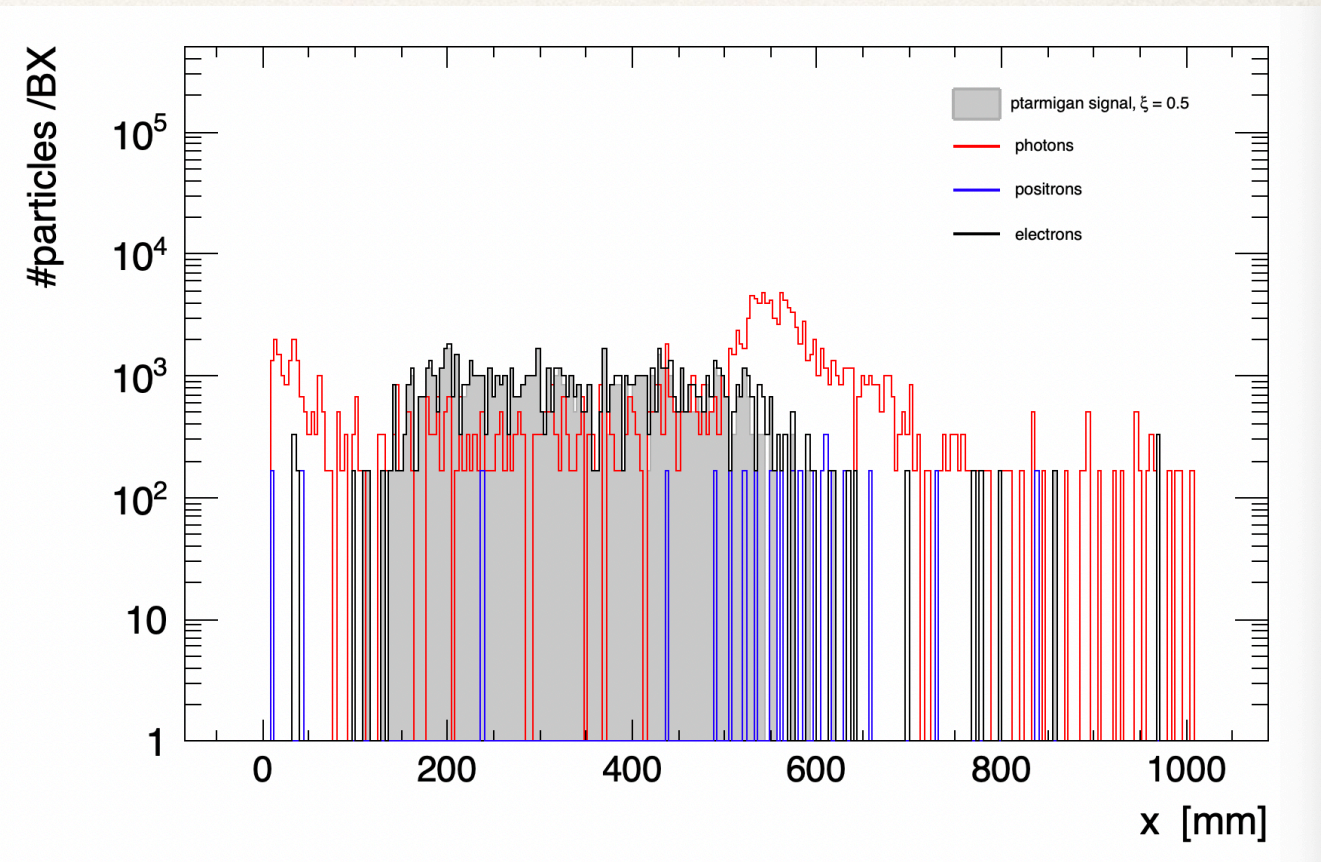
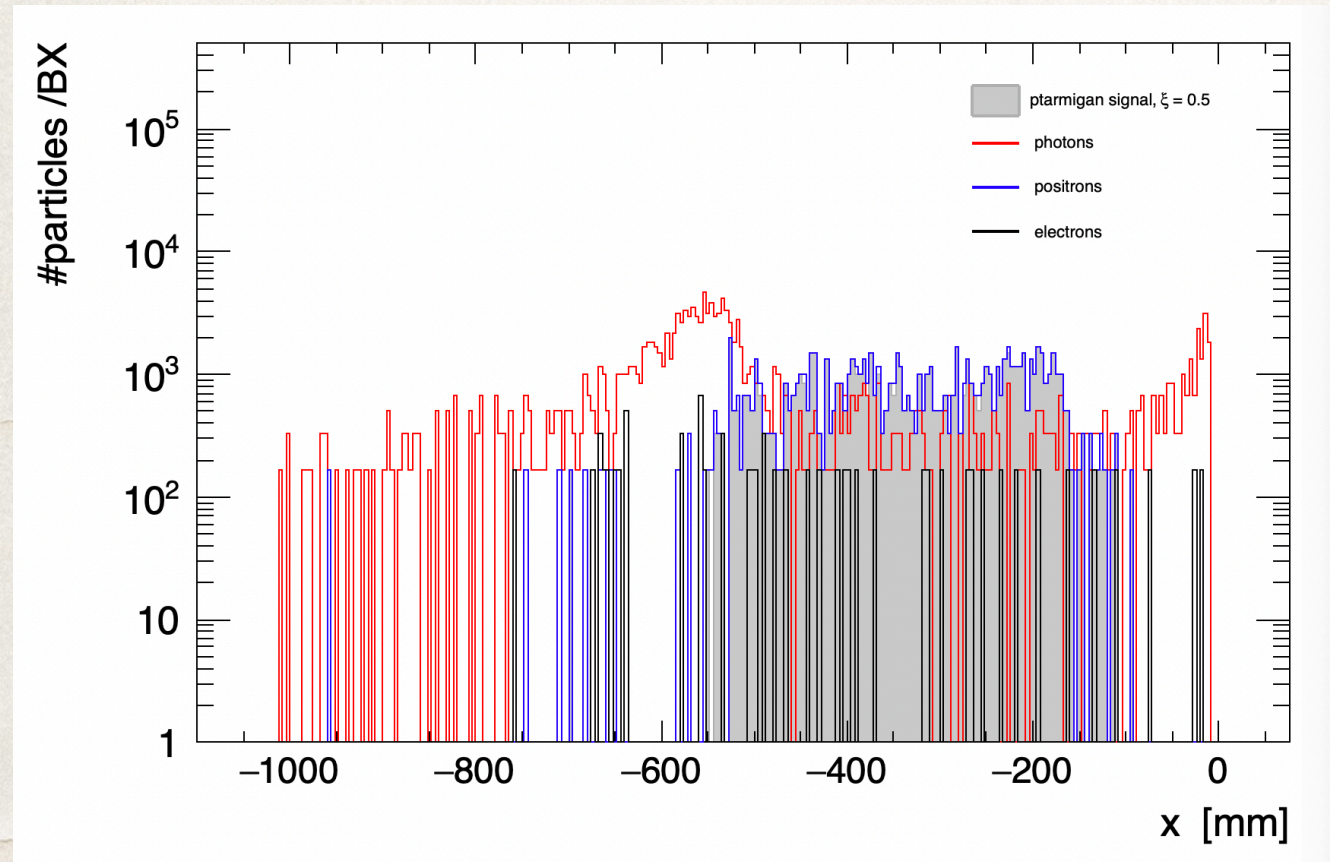
5000 measurements with VME QDC for each LED voltage in the range 5.5-11 V
At 1 KV saturating was observed at LED of 8V



First glimpse at new MC signal

[/nfs/dust/luxe/group/MCProduction/Signal/g4/ptarmigan-v0.8.1/e-laser/phase0/gpc/e0gpc_0.5](#)

9 BX, $\xi = 0.5$



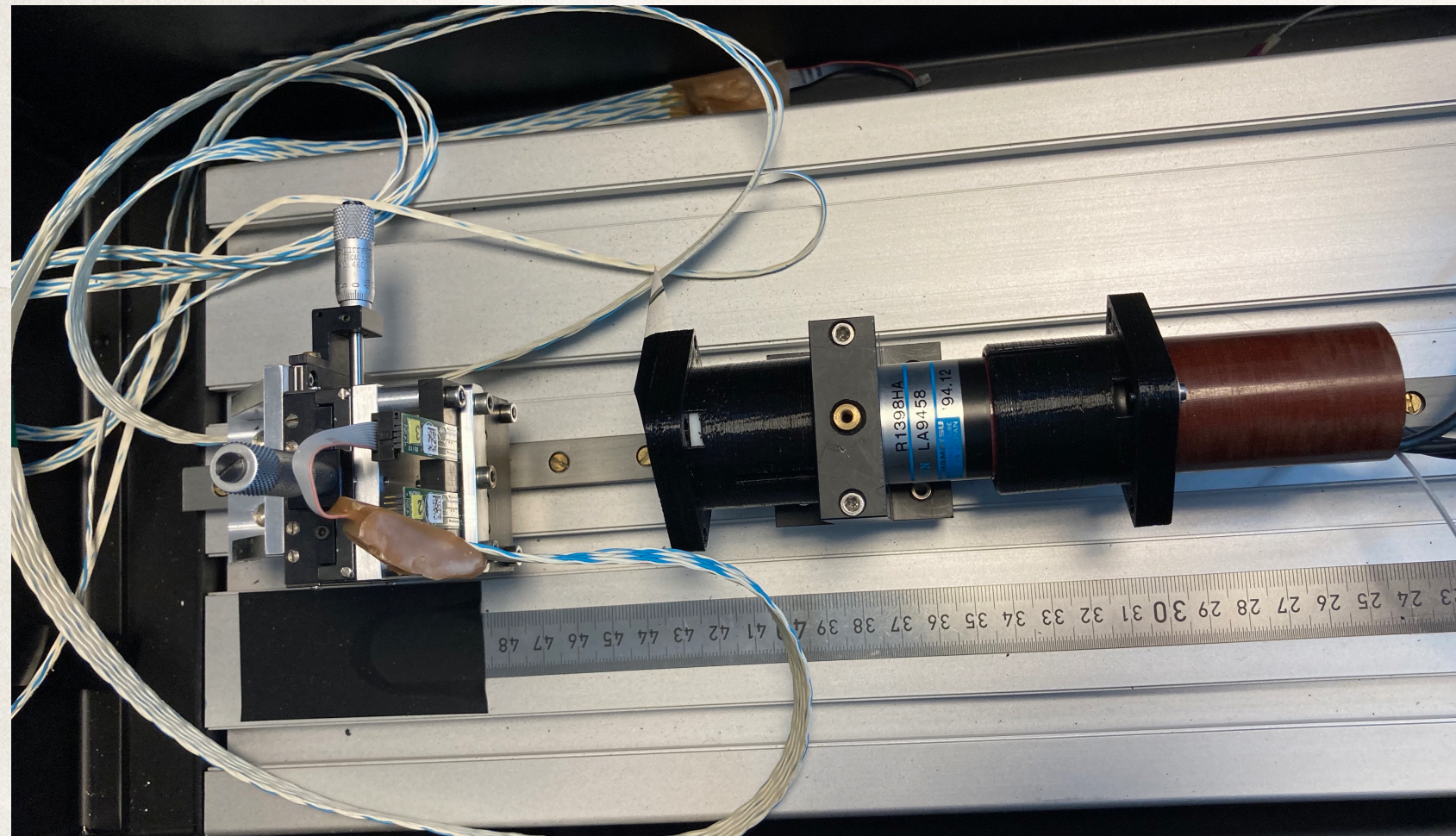
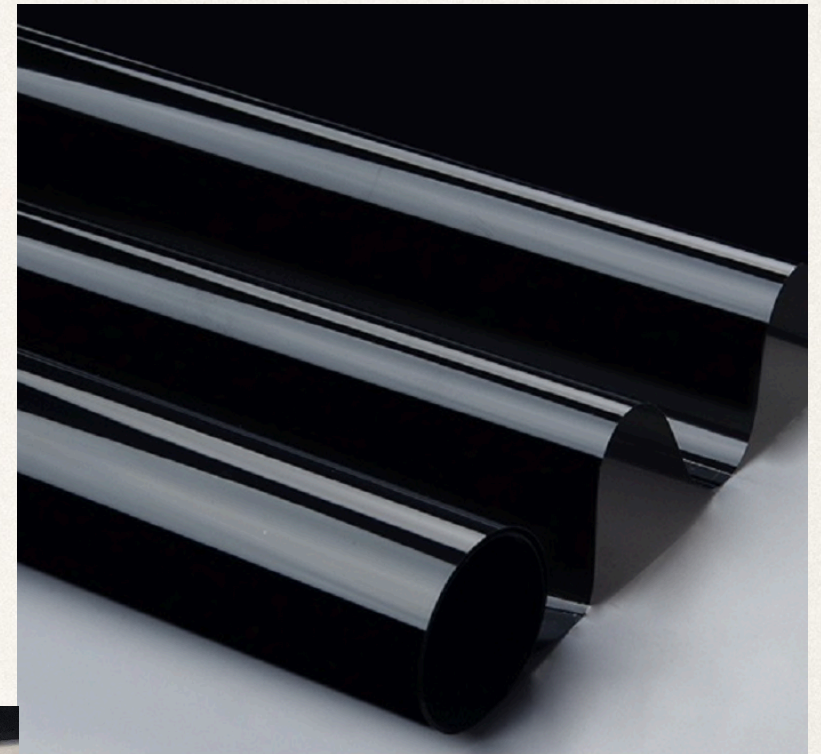
Outlook

Wrapping tests

the light tight box cannot be a part of the detector setup -> needed some protection from possible external light for lead glass blocks.
bought -> Black Sunscreen Glass Film Self-Adhesive Vinyl Light-Blocking Decals UV-Prevention

https://de.aliexpress.com/item/4000291790932.html?spm=a2g0o.productlist.0.0.3e4b27d3K5WbLy&algo_pvid=168a71b4-f661-4dca-bd13-d8aae83240fe&aem_p4p_detail=202109130211244909578030537600070388886&algo_exp_id=168a71b4-f661-4dca-bd13-d8aae83240fe-0&pdp_ext_f=%7B%22sku_id%22%3A%2210000001212891508%22%7D

It is not designed for the detectors, so we tested it with LEDs and PMT.

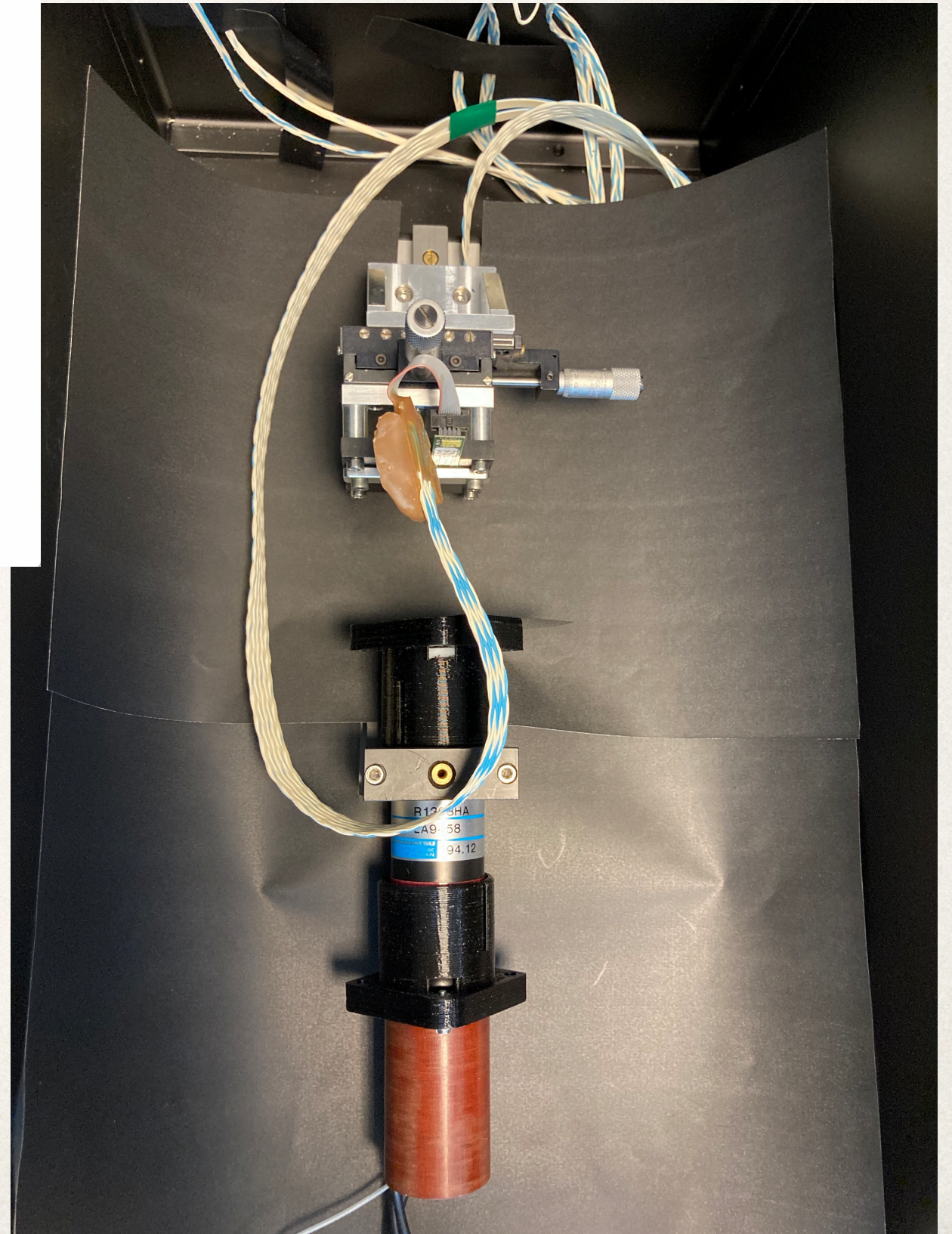
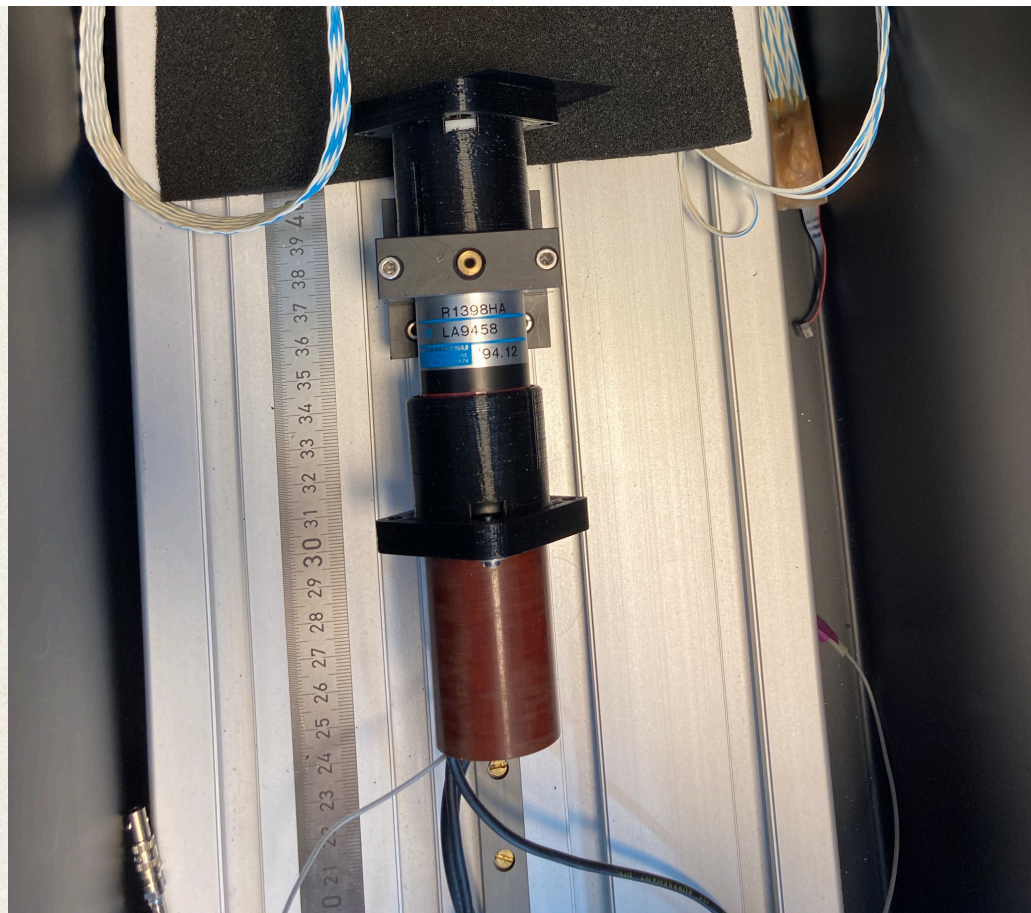
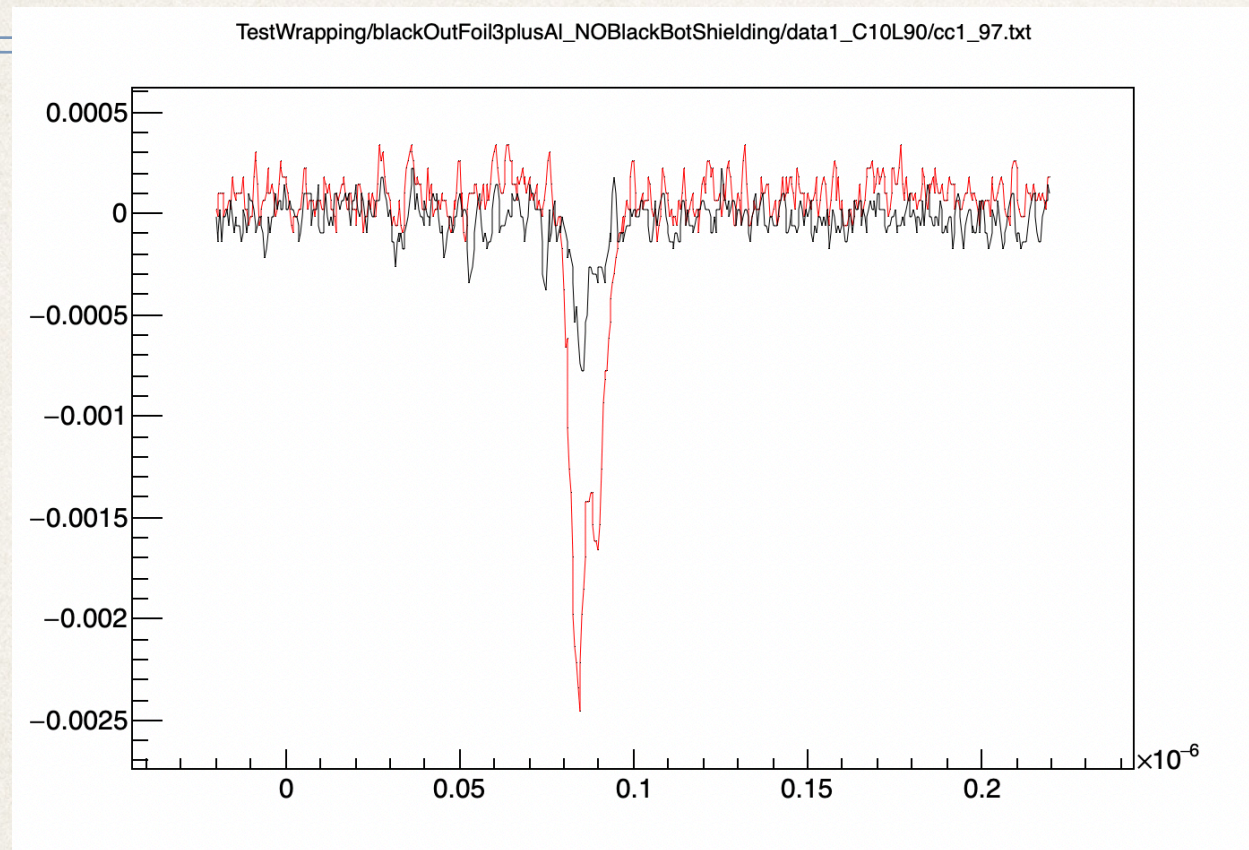


3 configurations:

- No wrapping
- 1 layer of vinyl
- 2 layers of vinyl
- 2 layers of vinyl + 1 layer of Al



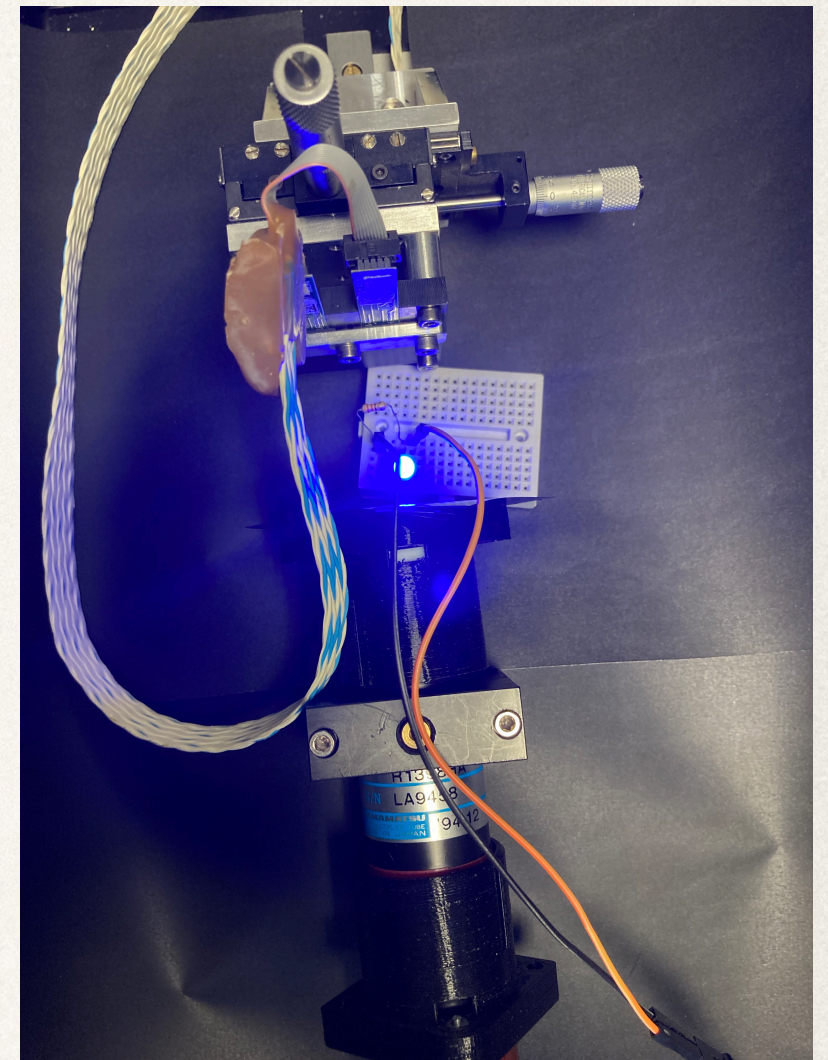
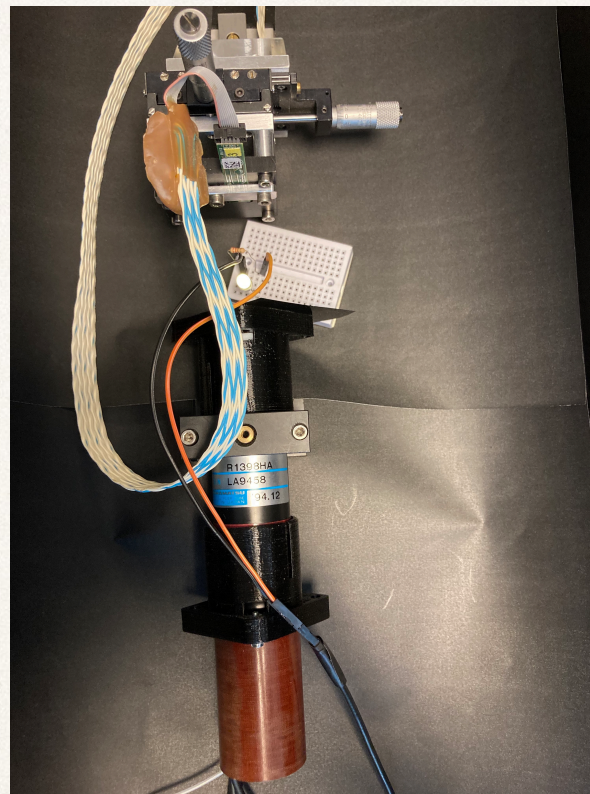
Effect of shining rails in the light tight box



Tests with visible light

We tried to see the effect of ambient light on PMT using LEDs of different colours (blue, white, red)
PMT + 2 layers of vinyl+1 layer of Al foil
At HV 1000V on PMT

	$I, \mu\text{A}$
LED off	500
LED blue	516
LED white	507
LED red	500



Blue Visible light increased the dark current

Blackout solution in Thorlabs

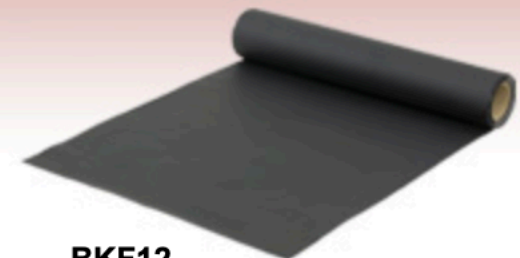
- ▶ Block Stray or Unwanted Light
- ▶ Build Light-Tight Structures
- ▶ Protect Light-Sensitive Equipment



BK5
Blackout, Nylon Fabric with
Polyurethane Coating



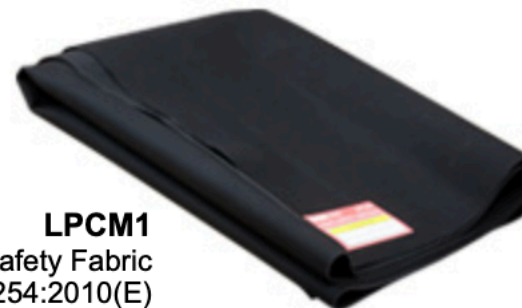
VBB060
Vertical Blackout Blinds



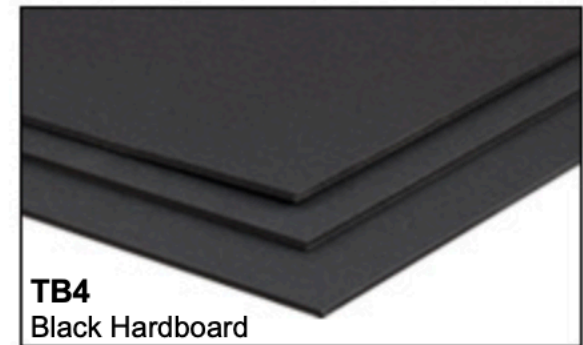
BKF12
Black Aluminum Foil



T743-2.0
High-Performance
Black Masking Tape



LPCM1
Laser Safety Fabric
Certified to EN 12254:2010(E)



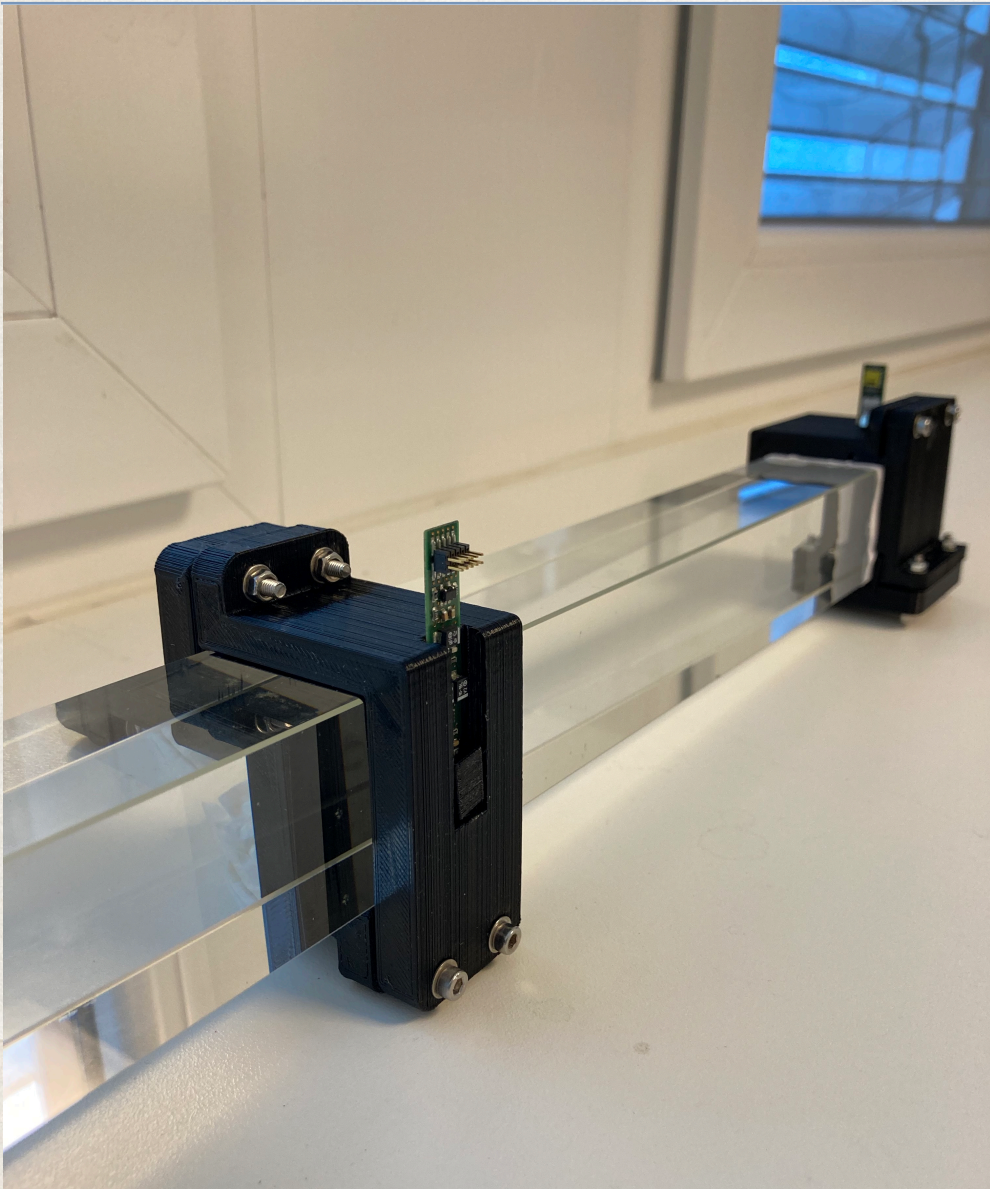
TB4
Black Hardboard

https://www.thorlabs.de/newgrouppage9.cfm?objectgroup_id=190

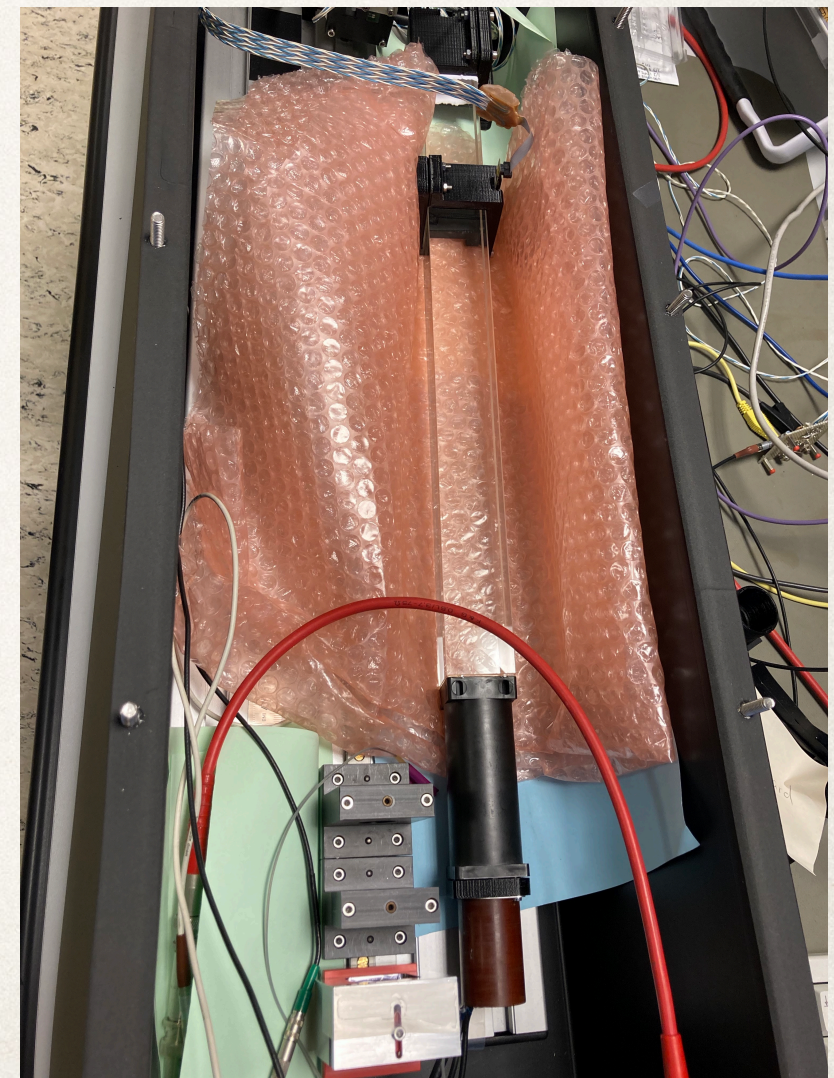
a bit more expensive, but probably better. This we might want to ask to buy.

Testing the response depending on the LED position

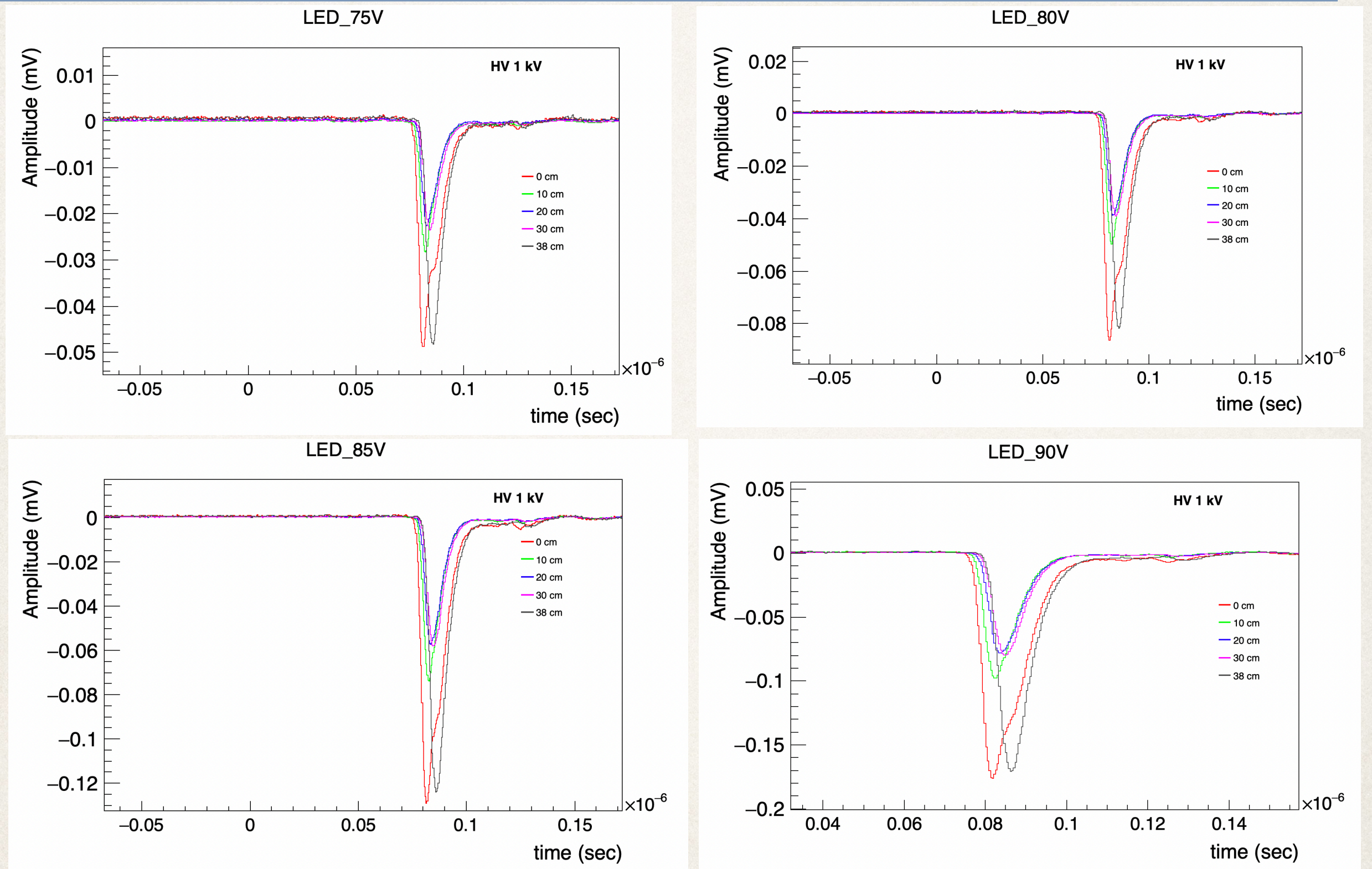
5 locations: close to PMT, 10 cm, 20, 30 cm and 38cm
LED voltages in the range 7.0-9.0 V



In previous measurements with and w/o wrapping we didn't see the difference when shining LED through the crystal's end which is explained by the total internal reflection (LG refraction index is 1.65, angle 37 grad or 53 grad with respect to surface.)

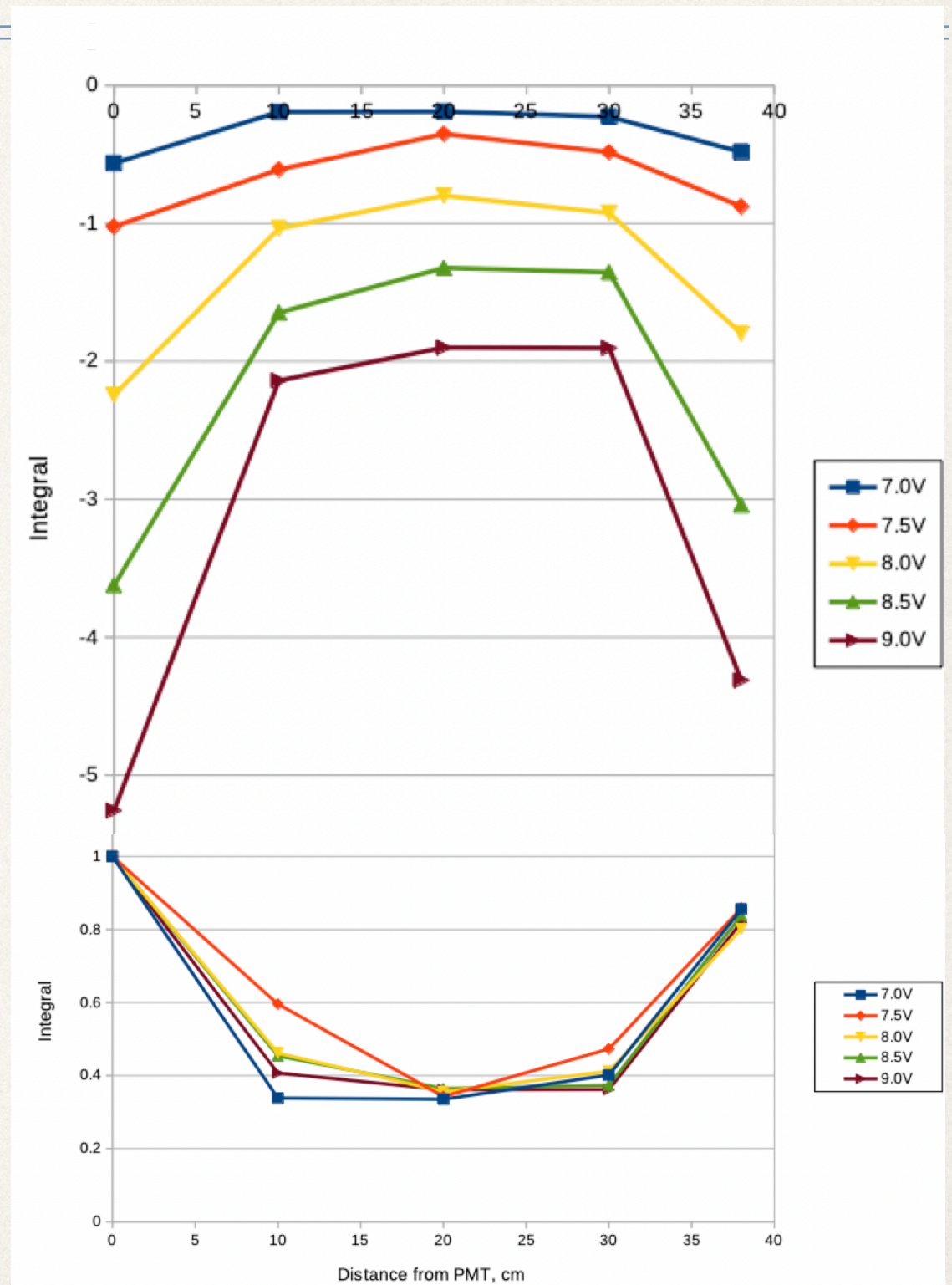
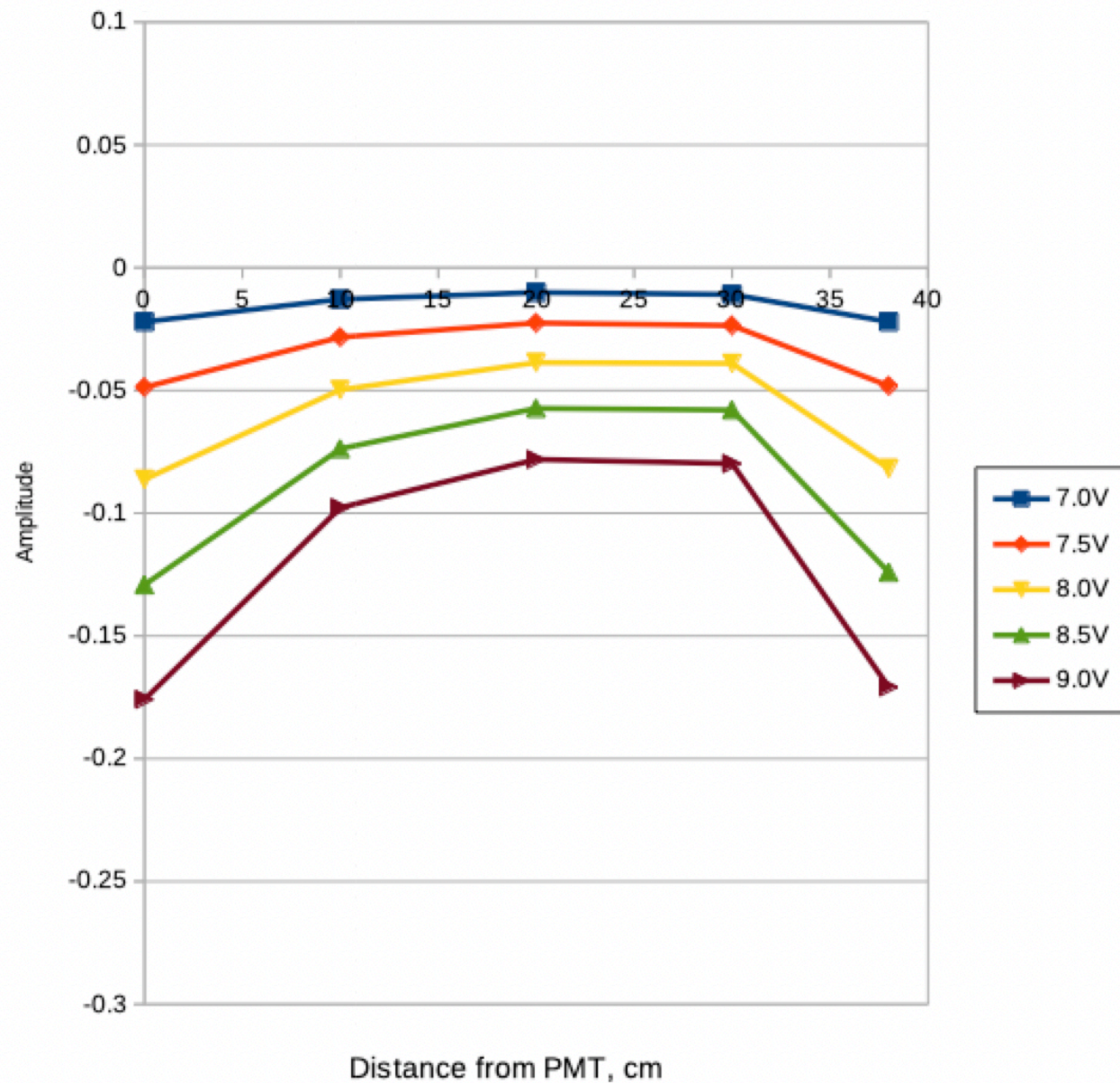


Signal depending on LED voltage and position



The displayed pulse shapes are obtained from averaging 50 recorded waveforms per LED voltage.

Signal depending on LED position

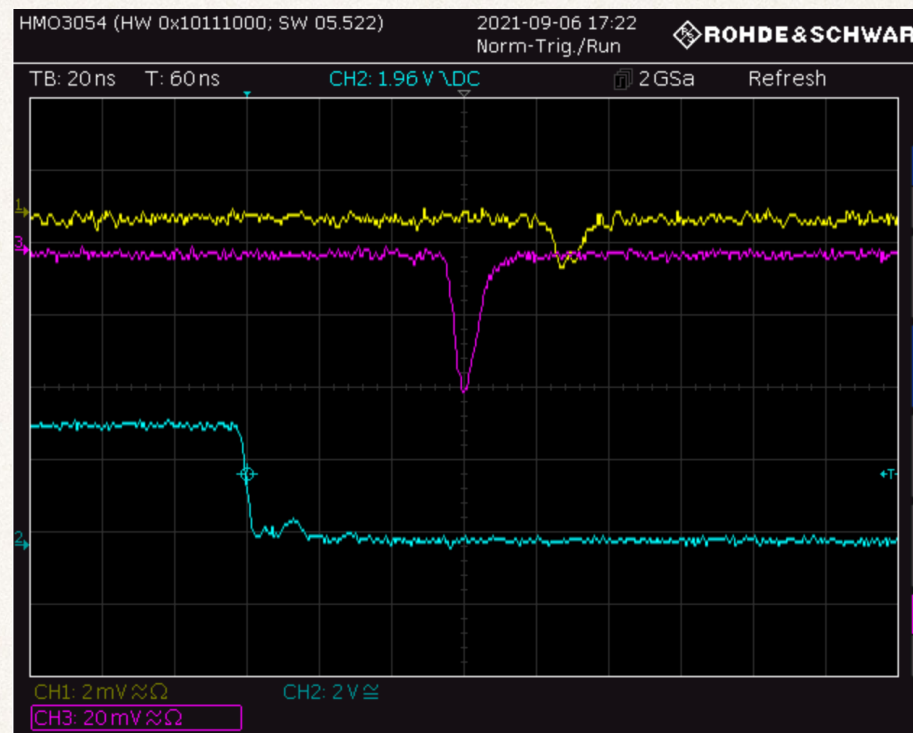


Signal is the lowest in the middle of the crystal, while the highest when the LED is located either close to PMT /or at the end of the block. This is due to the fact that light is leaking from the sides.

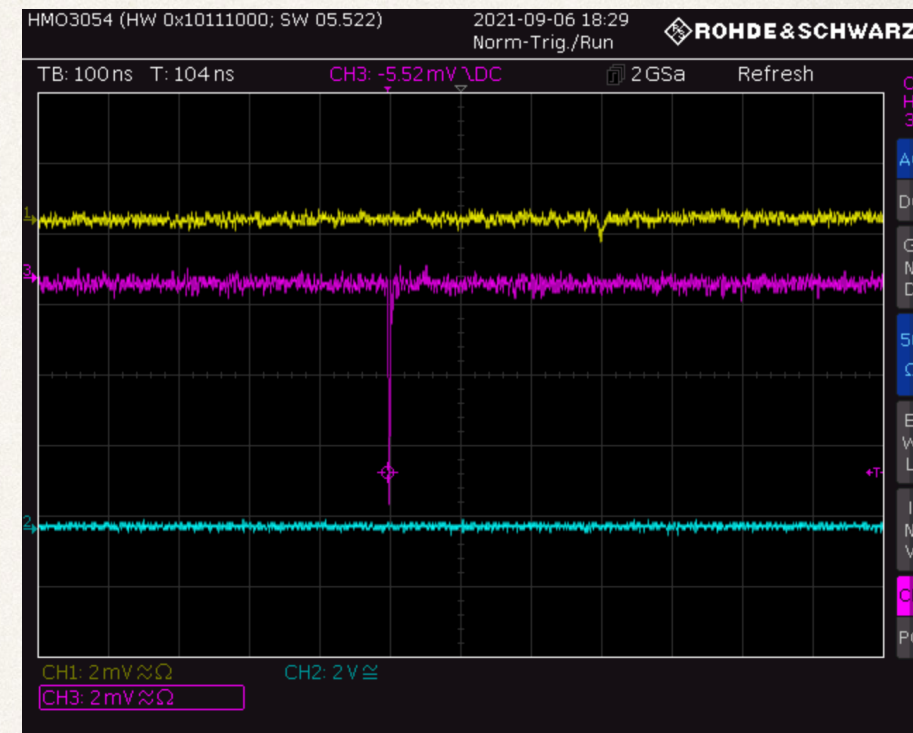
It is important to shield crystal from external light sources

Attempt to catch cosmic muons

Cosmic muon test runs (5-7/09/21)



Both crystals see signal from LED when we read out 2 crystals laying in light tight box;
They are wrapped with plastic and not at all aligned with LED;
Different cables length cause delay;



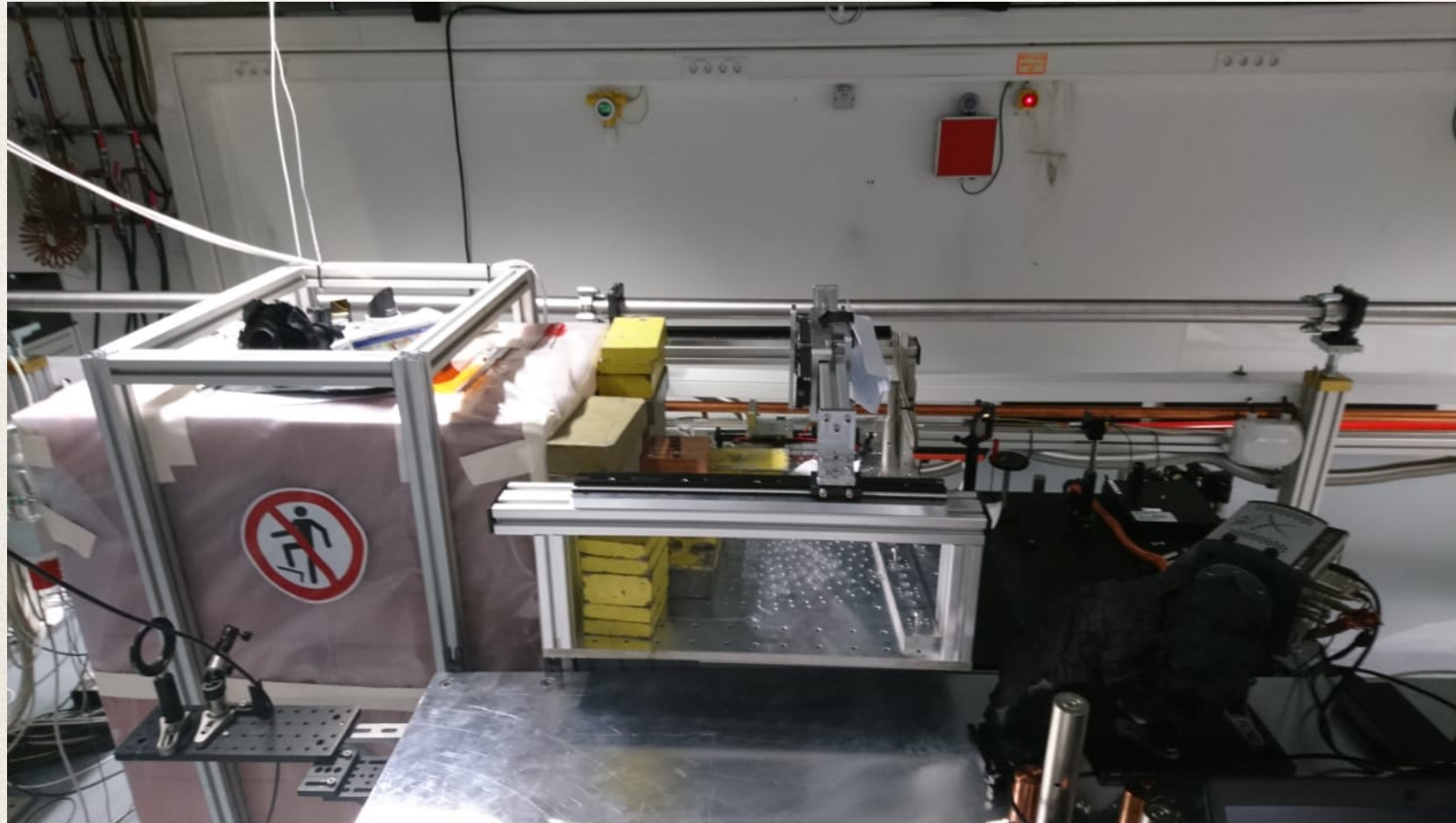
there is no coincidence when we read out 2 crystals - one on top of another.
1 muon per cm² per s.
We might expect 10-20 muons/min

- ▶ We could be dominated by the Dark current noise
- ▶ For 4 cm LG ~ 12 p.e. per muon are expected
- ▶ One of the used PMTs was the random one from the box (no info)
- ▶ Good optical interface between PMT and LG block is needed (grease)
- ▶ Crystal could be rotated to increase photon yield 10 times
- ▶ Need to better understand the noise; verification in simulations

Plan on LG tests

- I. **Test LED light (attached to the side) depending on the distance from PMT** - could be used for monitoring, calibration and cosmic detection (1-3/09/21) -> Done
- II. **To study and to purchase suitable PMTs**
- III. **To understand thermal dark current noise**
- IV. **Cosmic muon test runs**
- V. **Test with the radioactive source (Sr-90, Y-90) together with Cherenkov** (at the end of 09/21)
- VI. **To prepare DAQ for beam tests at Laser Plasma accelerator** - to see real particles and to perform irradiation of the crystal? - (11/21)
- VII. **To test at R-Weg facility** - to perform irradiation of the crystal - (11/21)
- VIII.

Visit to Laser Plasma accelerator

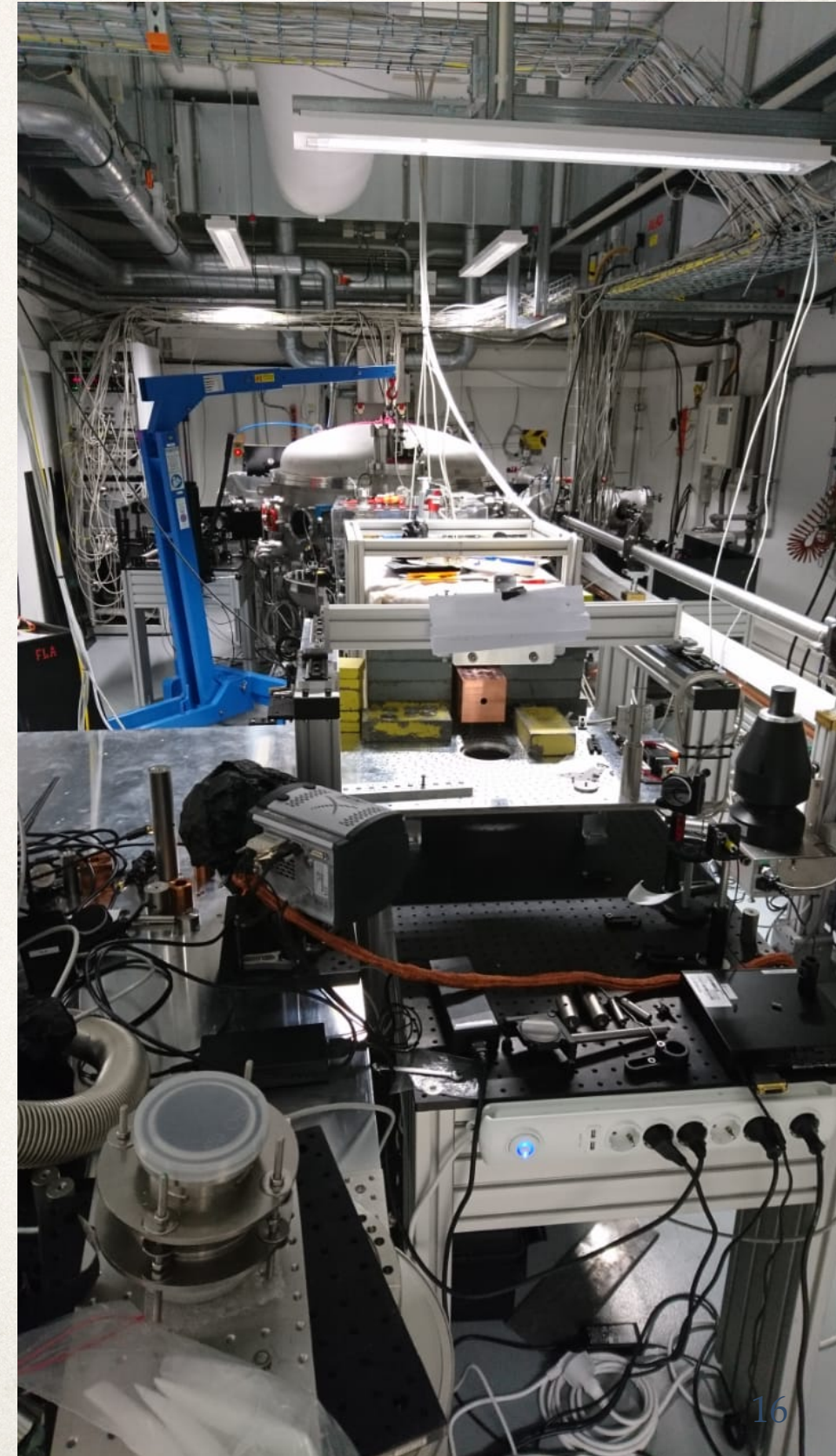


60 MeV 10 pC

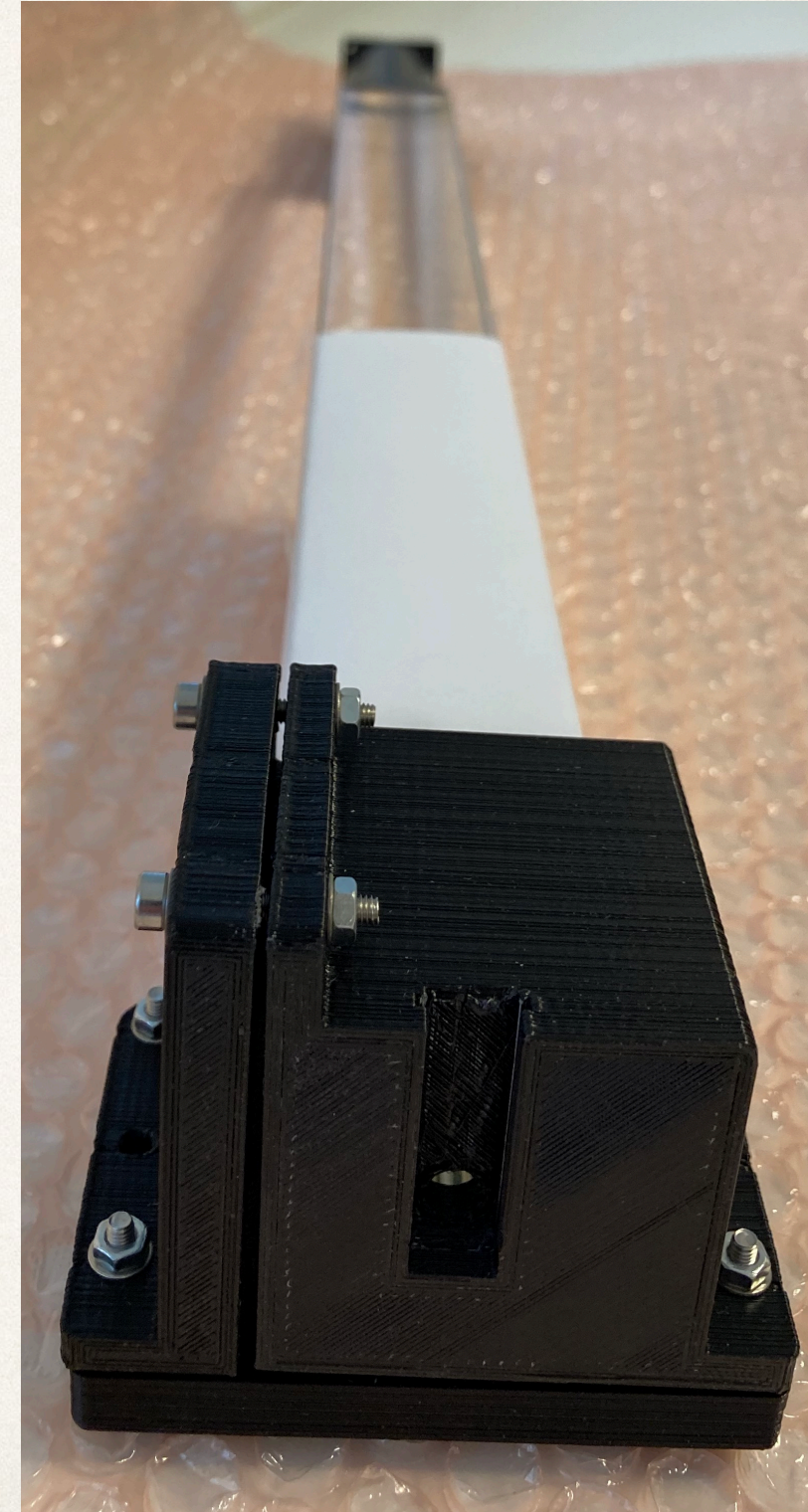
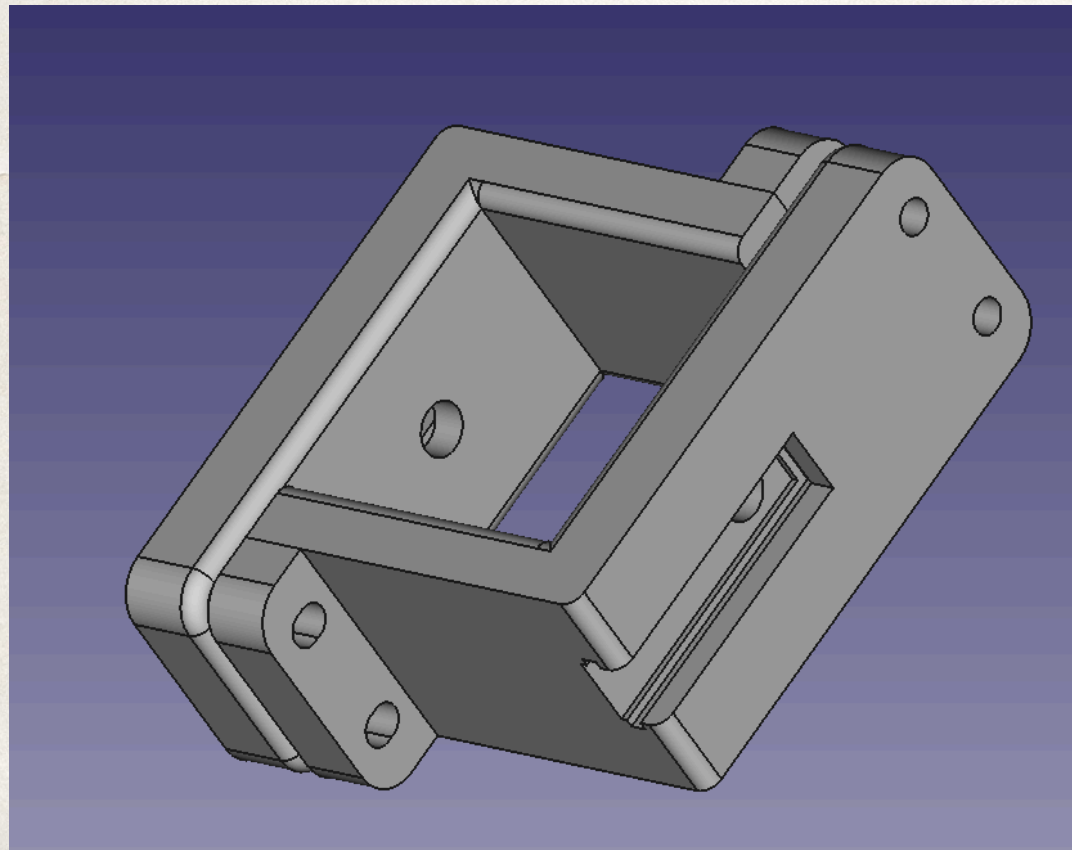
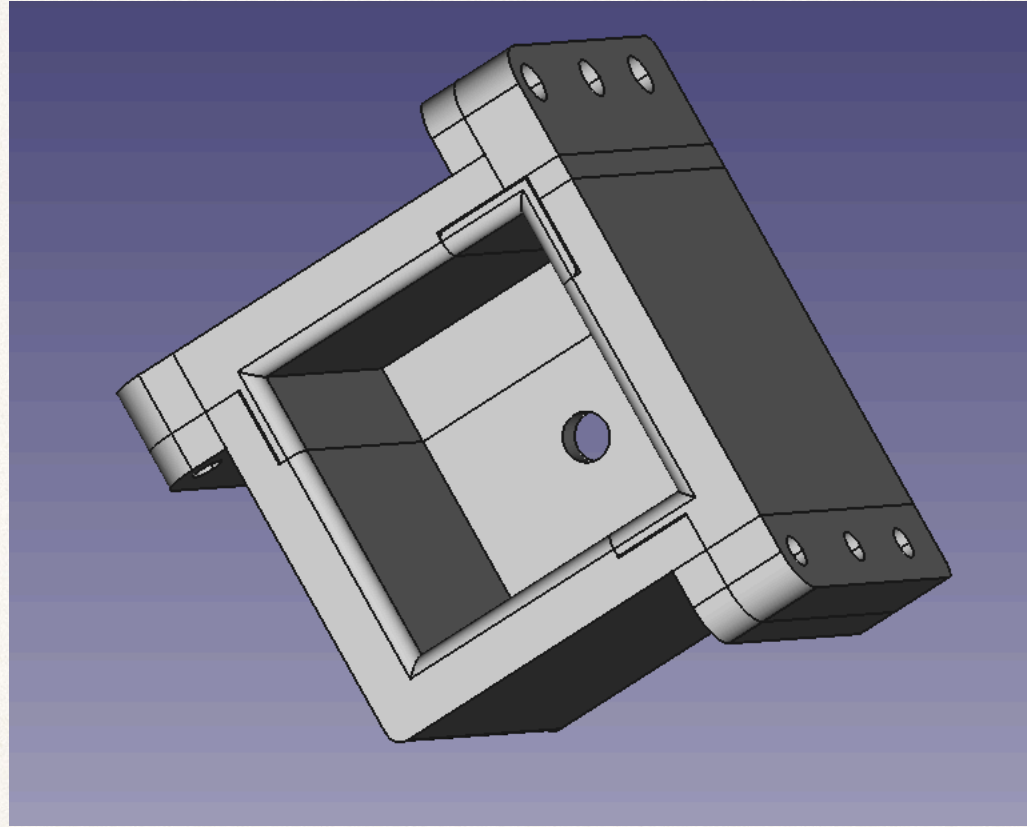
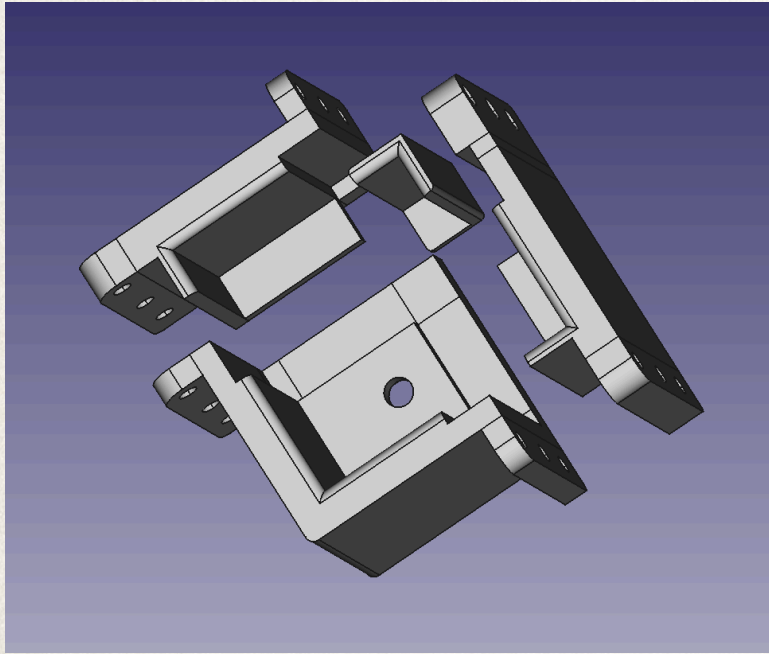
Max 10 (2.5 stable) Hz of 6×10^7 electrons at 0.06 GeV

In laser-plasma acceleration, a strong laser pulse generates a plasma wave in hydrogen gas by stripping electrons from gas molecules. This pushes them to high energies extremely quick.

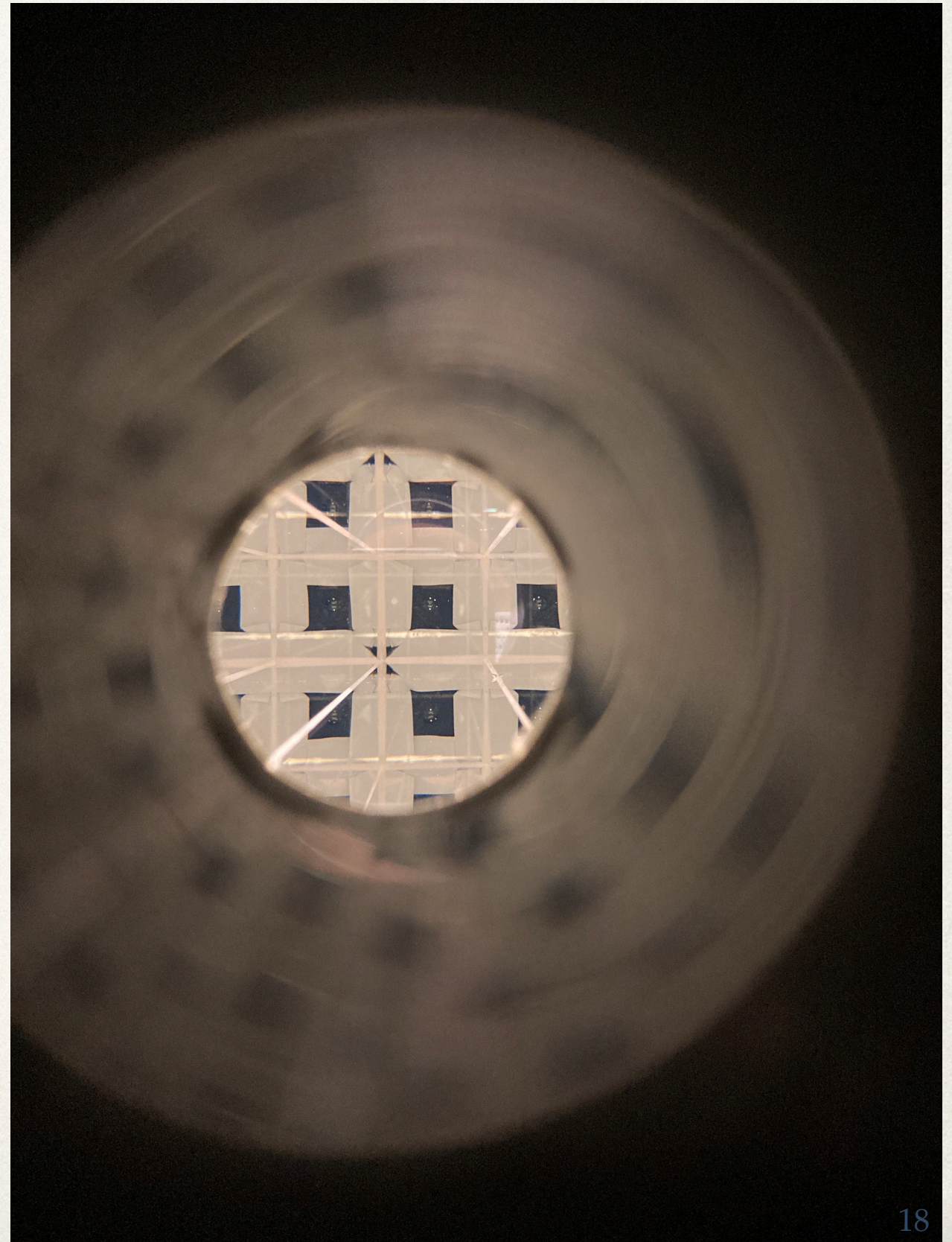
- Discussed possible placements of the crystal and intercalation into the available DAQ system
- Beam tests are possible in 11 / 21



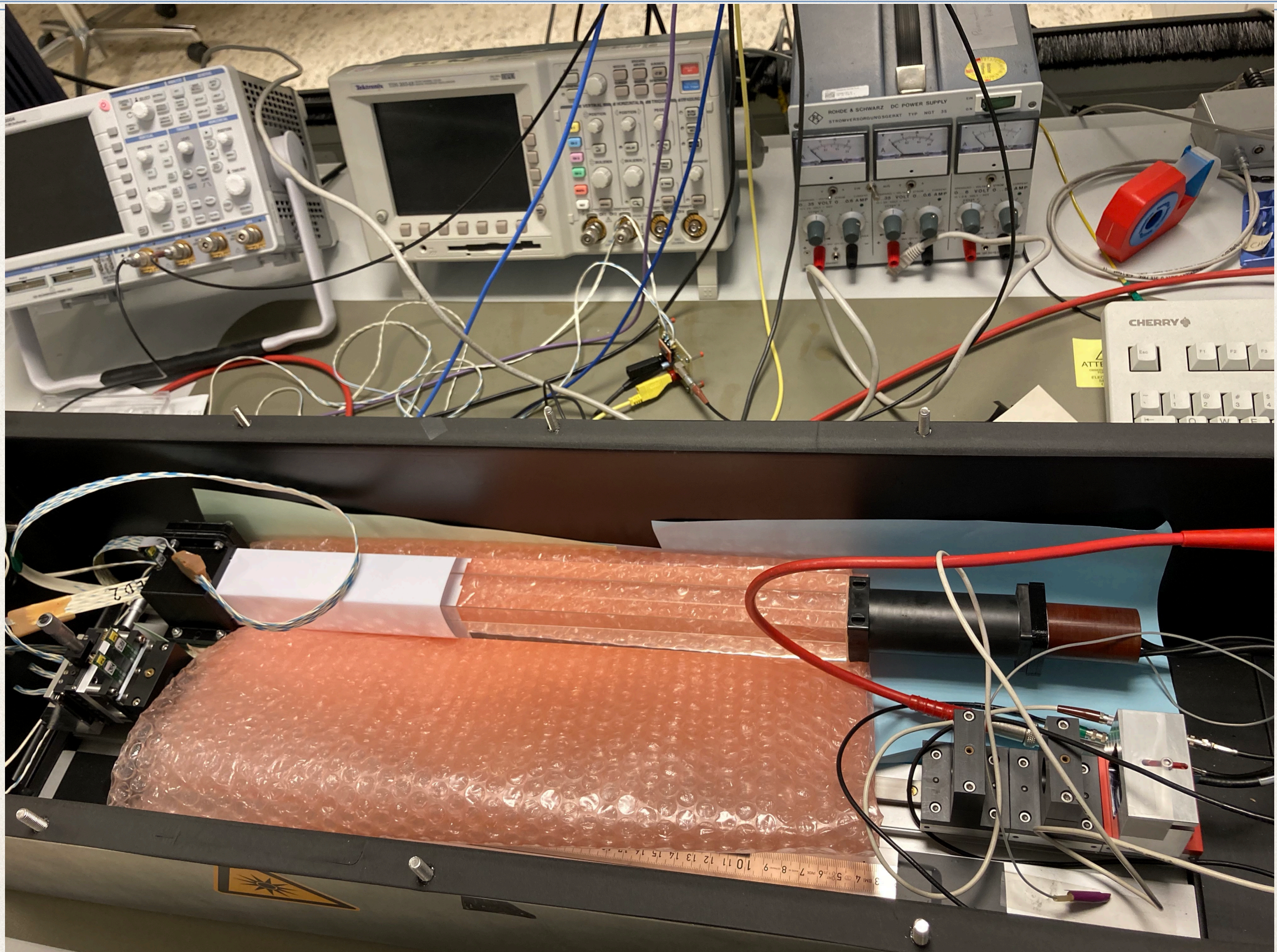
Cad model of Supporting structure



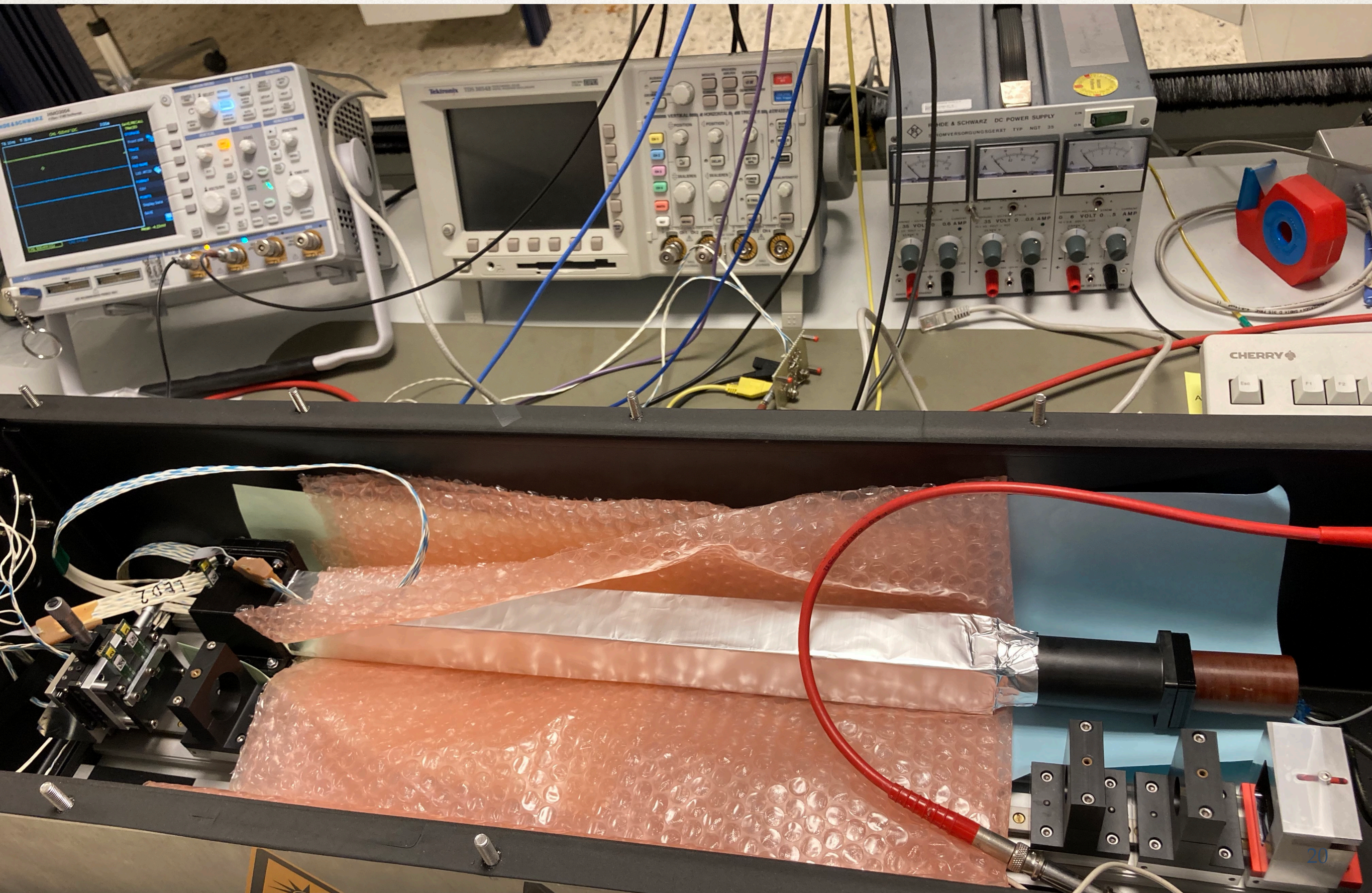
Supporting structure with LED



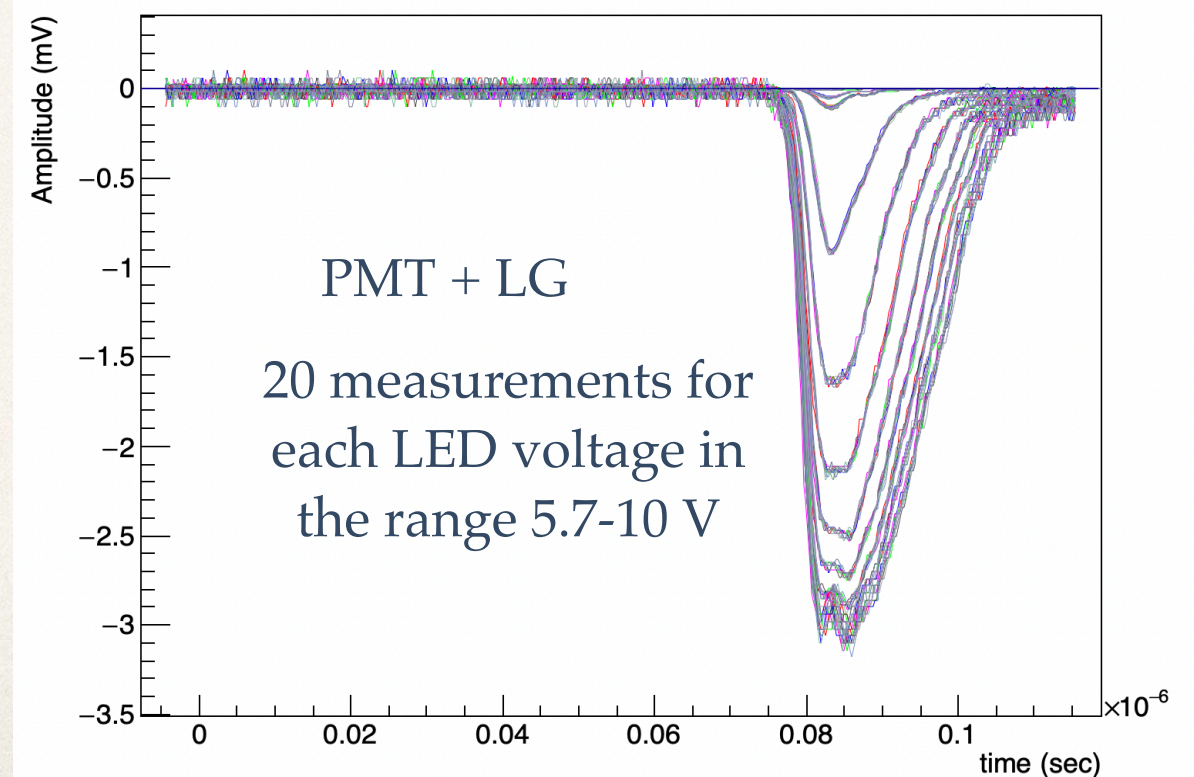
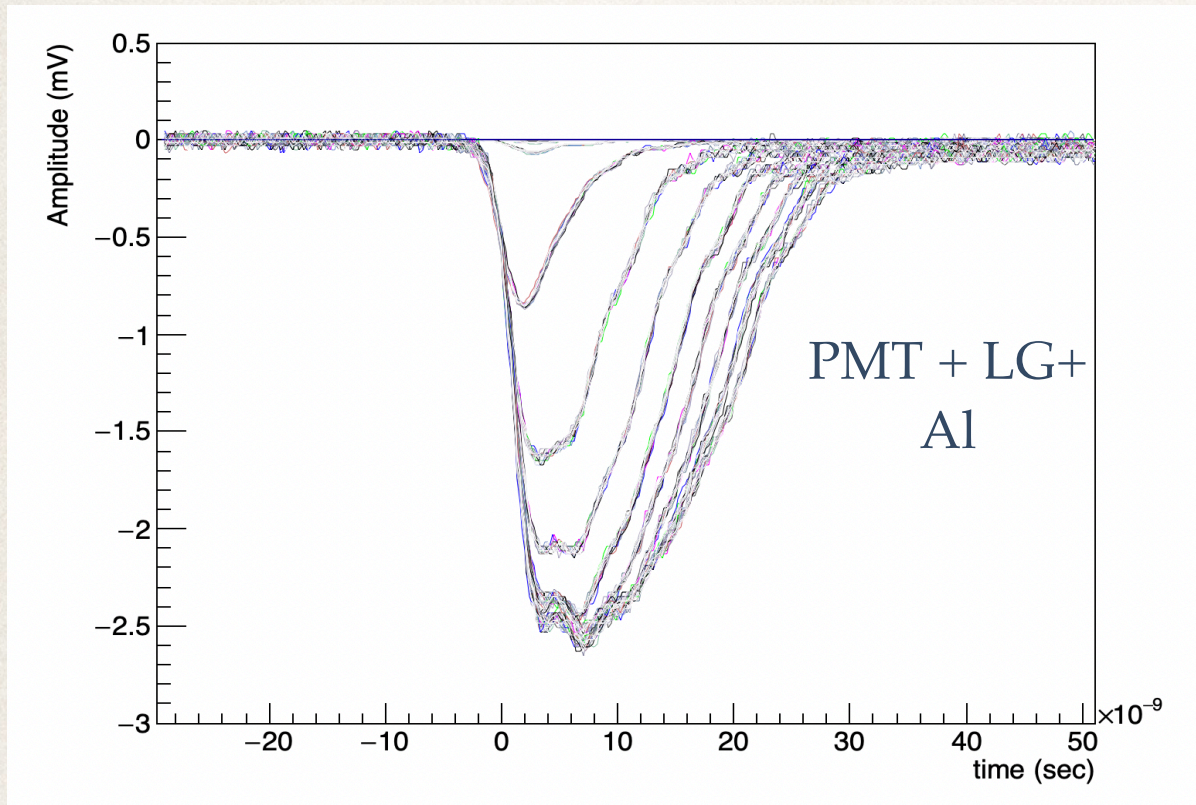
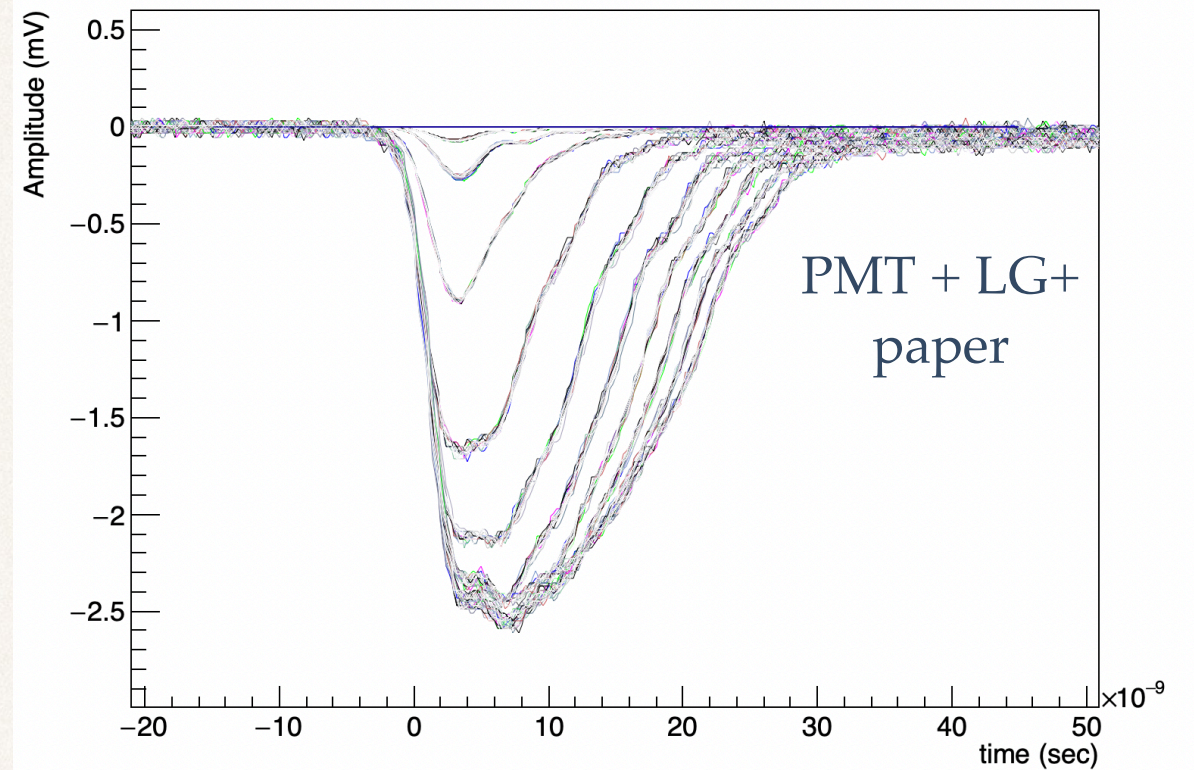
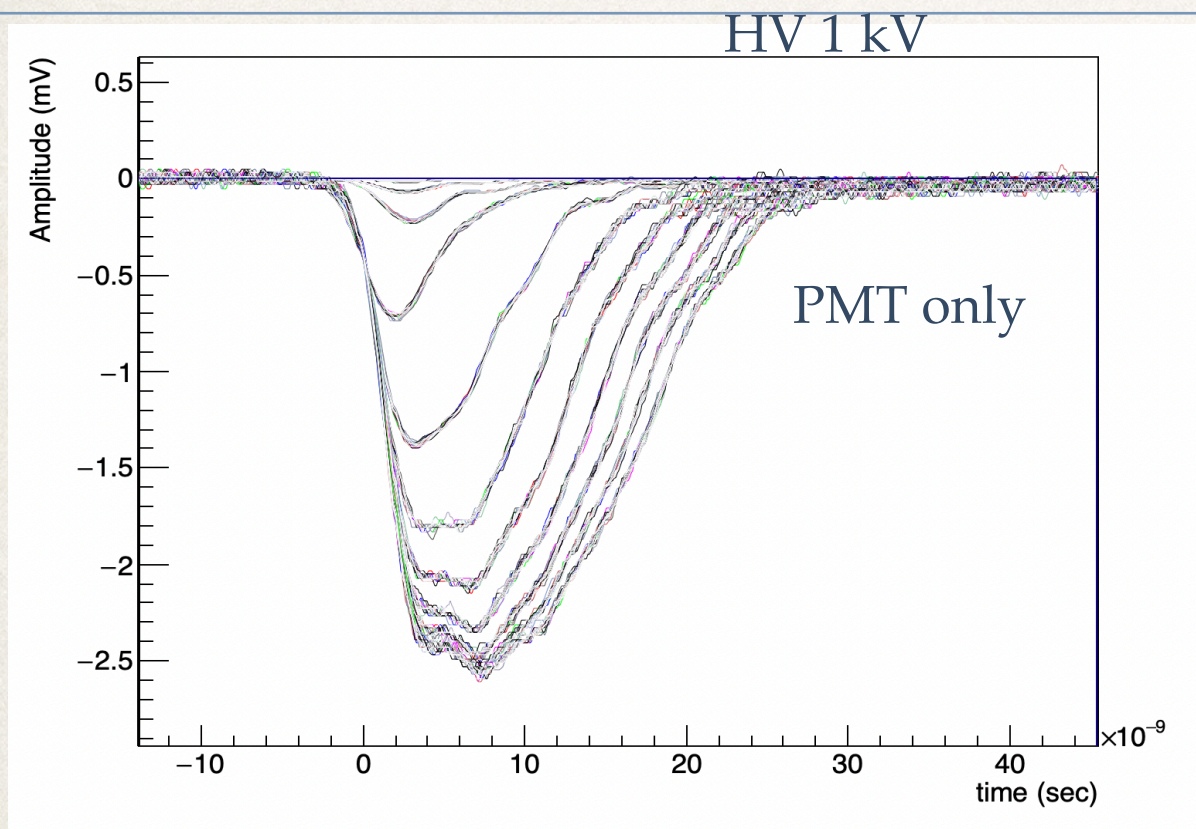
Test setup with crystal partially wrapped in paper



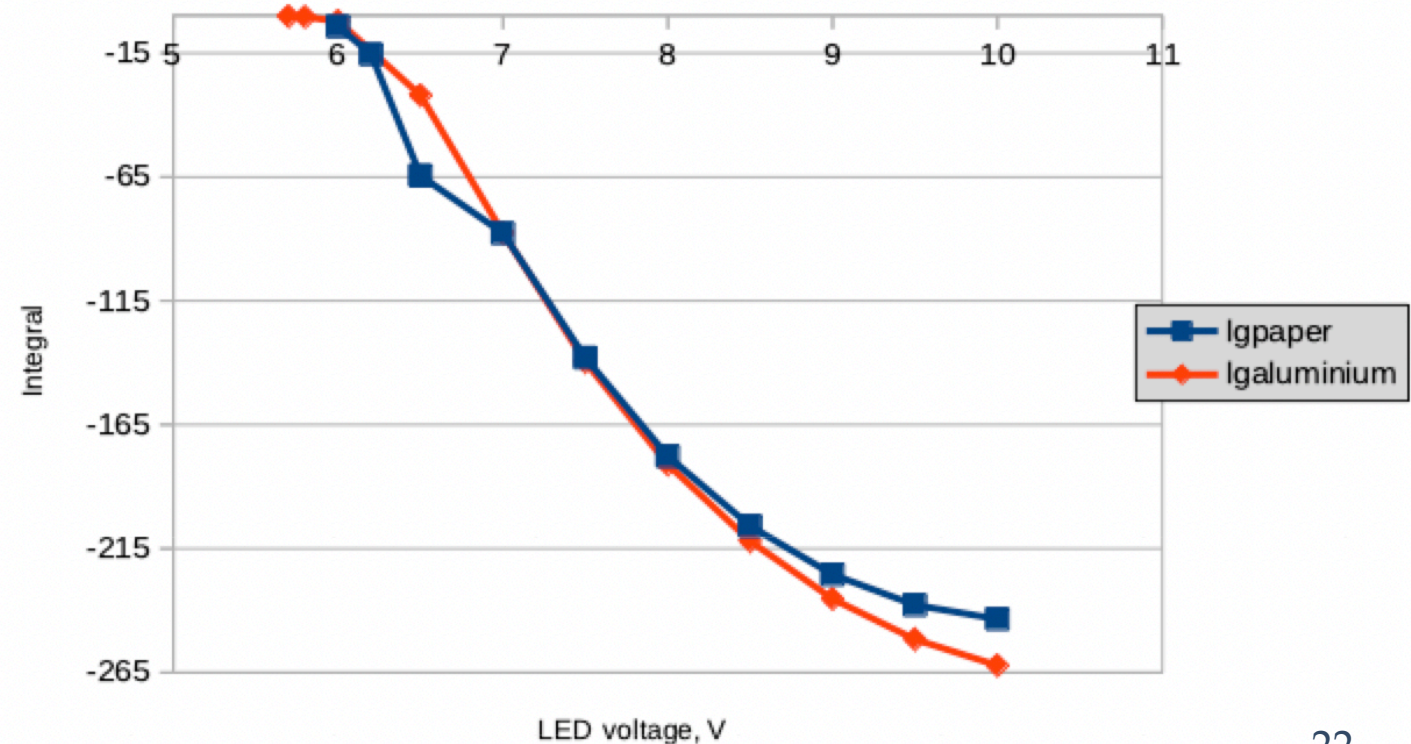
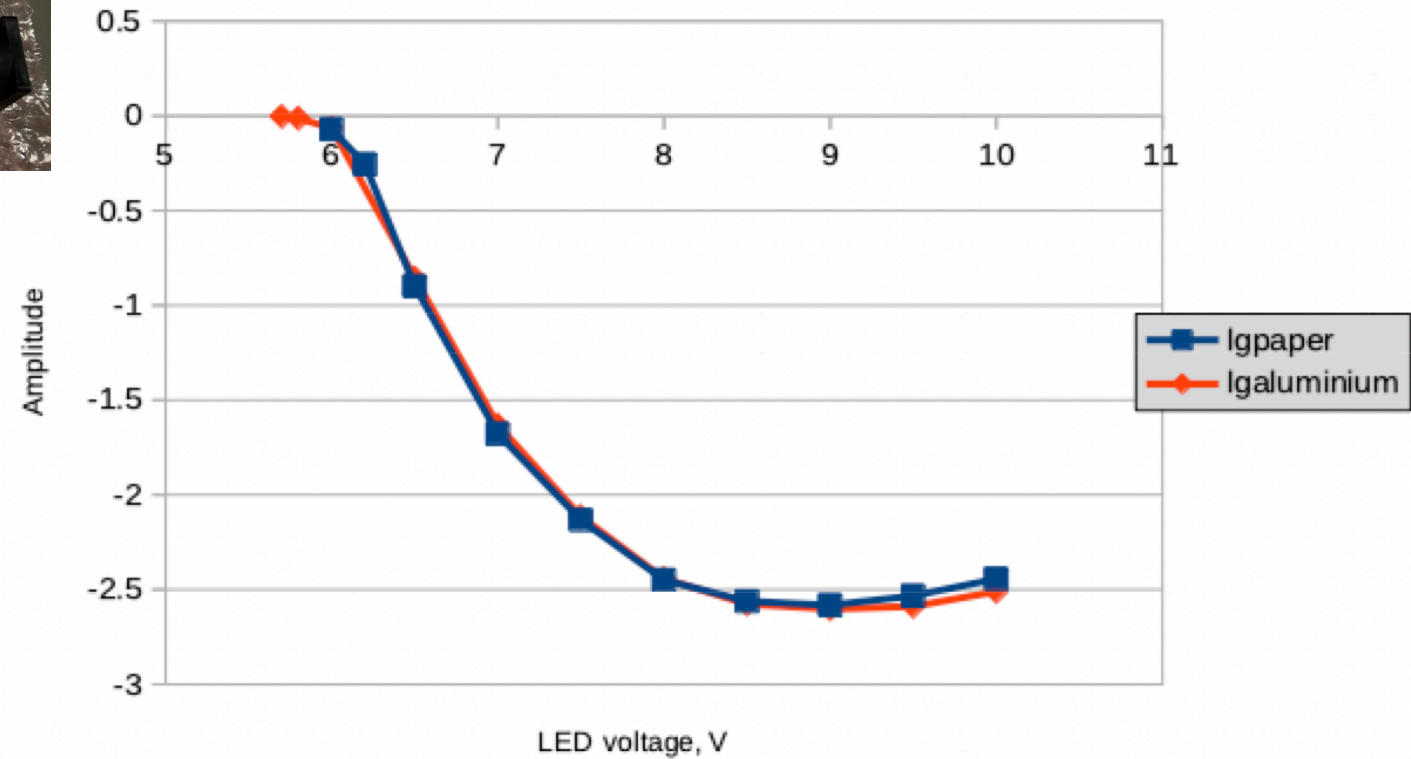
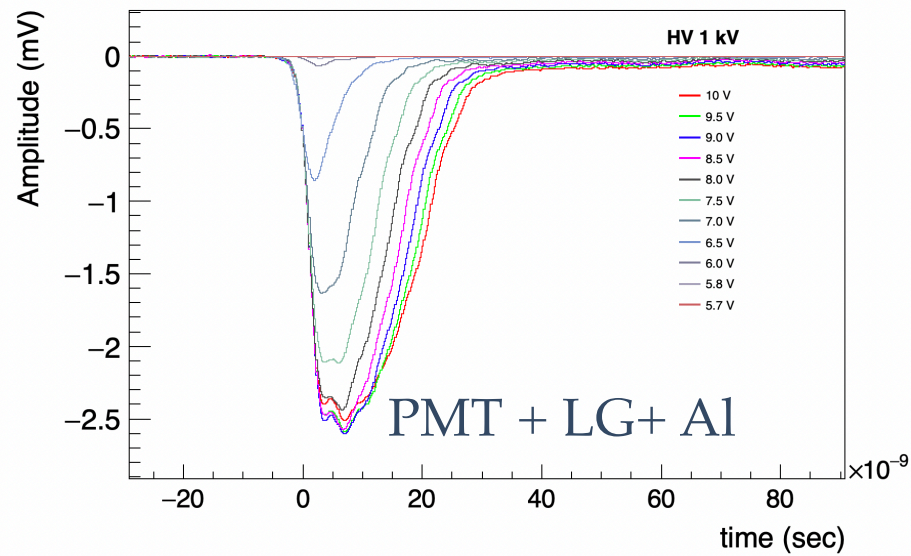
Test setup with crystal wrapped in Al



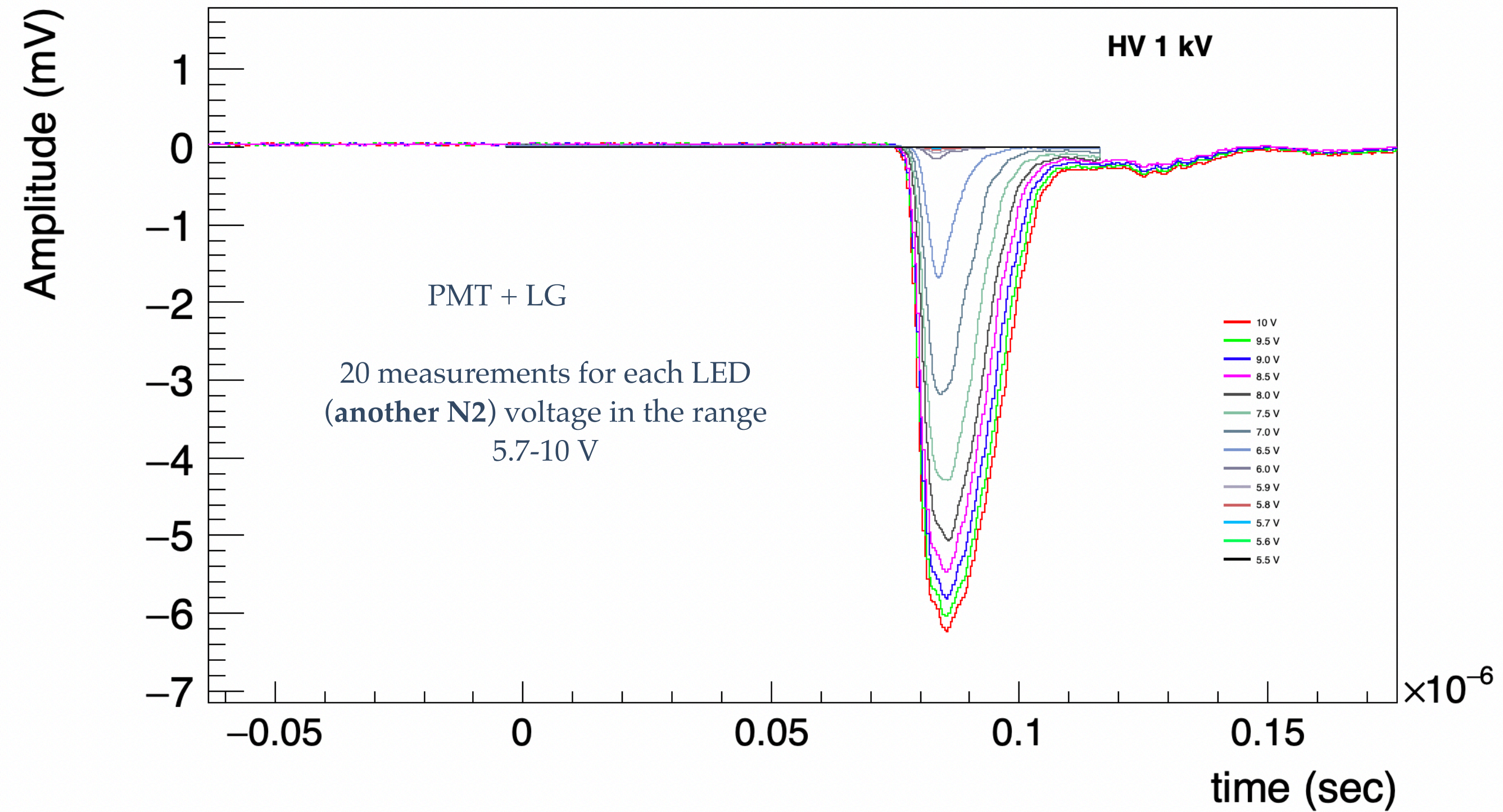
Signal Measurements with crystals



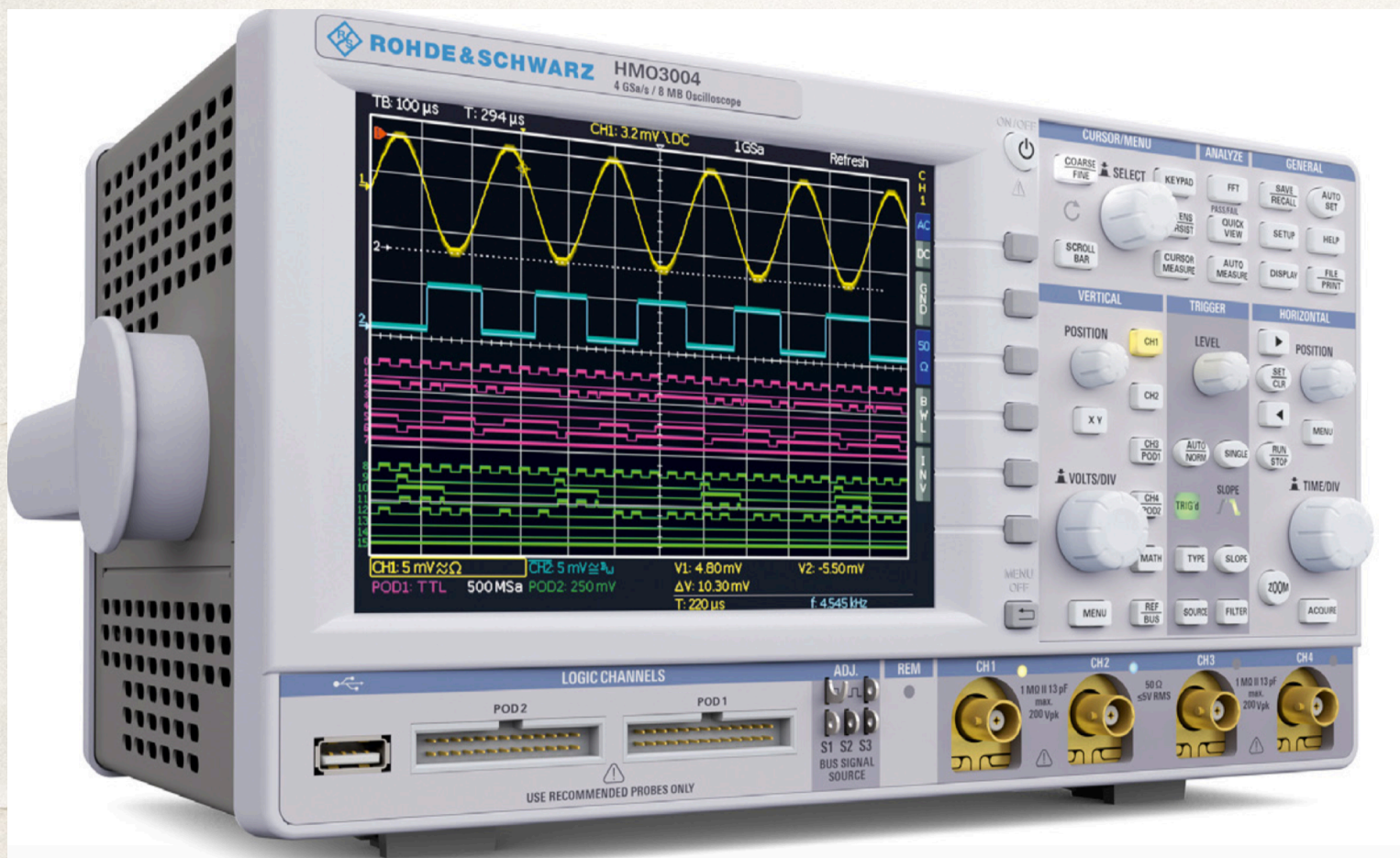
Signal dependance on LED voltage



To be continued.....



Signal readout



Digital Oscilloscope HMO3004
4 GSa/sec
4 analog channels
USB interface for signal storage

Controls light output

LV
range 5.5-10 V

Trigger Pulse

LED
Controller

LED

PMT

Divider

HV
range 0.8-1.5 kV

New PMT



ФОТОУМНОЖИТЕЛЬ

ФЭУ 84-3

ПАСПОРТ

1. ОБЩИЕ СВЕДЕНИЯ

Фотоумножитель ФЭУ 84-3 имеет сурьмяно-калиево-натриево-цезиевый фотокатод и предназначен для регистрации направленных световых пучков с широким динамическим диапазоном яркостей.

Индивидуальный № 03594 Дата изготовления 02.92

Схема соединения электродов с выводами

Обознач. вывода	Наименование электрода	Обознач. вывода	Наименование электрода
1	Динод 2	12	Динод 1
2	Динод 4	13	Не подключать
3	Динод 8	14	Фотокатод
4	Динод 12	15	Не подключать
5	Не подключать	16	Динод 6
6	Анод	17	Динод 10
7	Свободный	18	Динод 11
8	Динод 9	19	Динод 7
9	Динод 5	20	Динод 3
10	Не подключать	21	Модулятор
11	Не подключать	22	Не подключать

Типовой делитель напряжения

Схема расположения выводов

Примечания:

1. Запрещается использовать свободные лепестки панели и выводы умножителя, обозначенные словами «Не подключать» и «Свободный», в качестве опорных точек для монтажа.

2. $R1=R2=R3=R4=R5=R6=R7=R8=R9=R10=R11=R12=R13=R14$.

