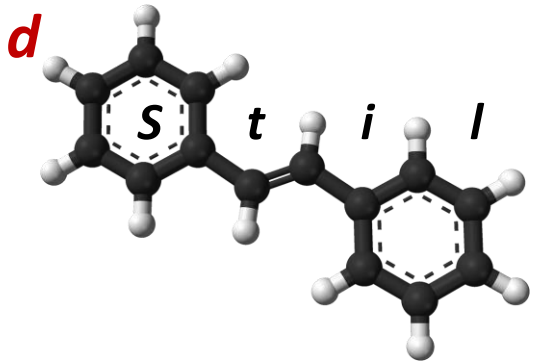
d-Stil report (*beyond C6D6*)



Reporting last preliminary d-Stil setup

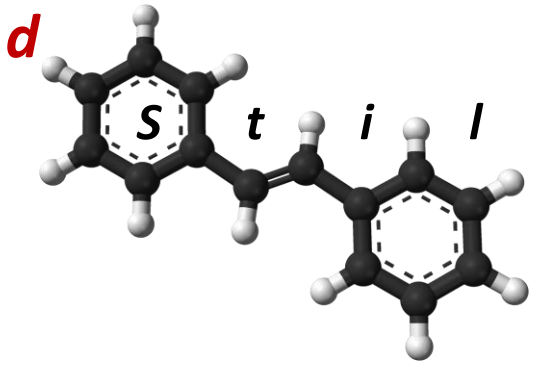
First d-Stilbene + PM test on-beam with a brand new setup

- *Overall d-Stil structure and signals*

- *Nice analysis by Javi and Riccardo (S-TED vs d-Stil vs C6D6)*

We can declare the test was promising (still some aspects to investigate)

d-Stil philosophy



- Make it simple:

  Just three basic elements

  1) Stilbene-*d12* (LLNL & INRAD - *Nikolas*)
  2) PM (experience on laser facility - PALS)
  3) Active base DC-DC converter (Sens-Tech)

As a result for n_TOF:

- compact and lightweight device (less material)
- not expensive (2 Keuro/module)
- reliable (no liquid – sturdy - atoxic)
- easy assembly (two days) and deployment

STILBENE,OD31.75X10MM,P1S, W,T	**715.00**	**$715.00**

SCINTINEL (STILBENE) DISC
DIAMETER: 31.75MM ±0.15MM
THICKNESS: 10MM ±0.35MM
FINISH: S1: COMMERCIAL POLISH
S2: FINE GRIND
BEVEL: MINIMUM BREAK EDGE

WRAPPED IN PTFE TAPE, AND A BONDED FUSED SILICA WINDOW ON S1

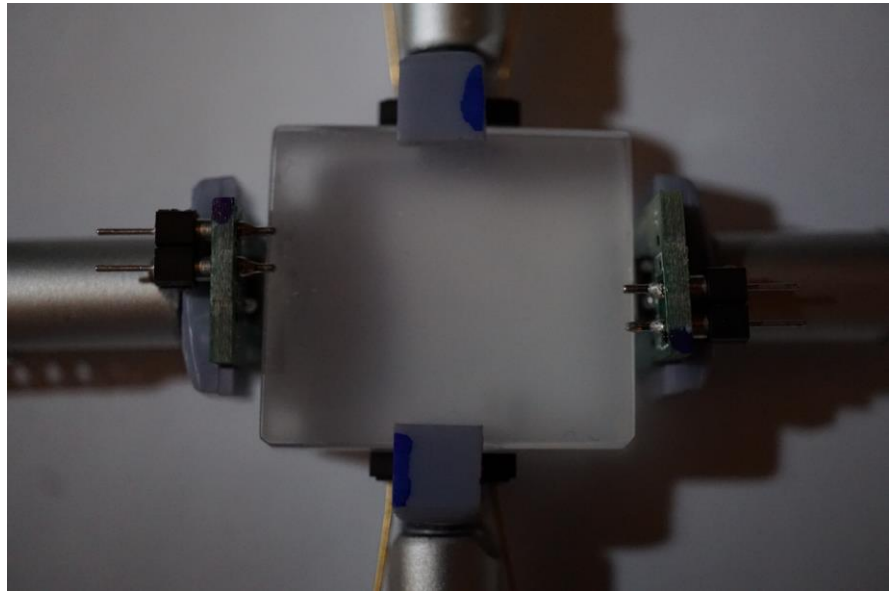
The deuterium filling-factor must be characterized

Stilbene-d12 by LLNL

Natalia P. Zaitseva

developing new technologies for improving crystal performances

26 x 23 x 11 mm^3



Photomultiplier: HAMAMATSU R1924A

FEATURES

- For scintillation counting
- For photon counting
- Ruggedized, low profile structure

APPLICATIONS

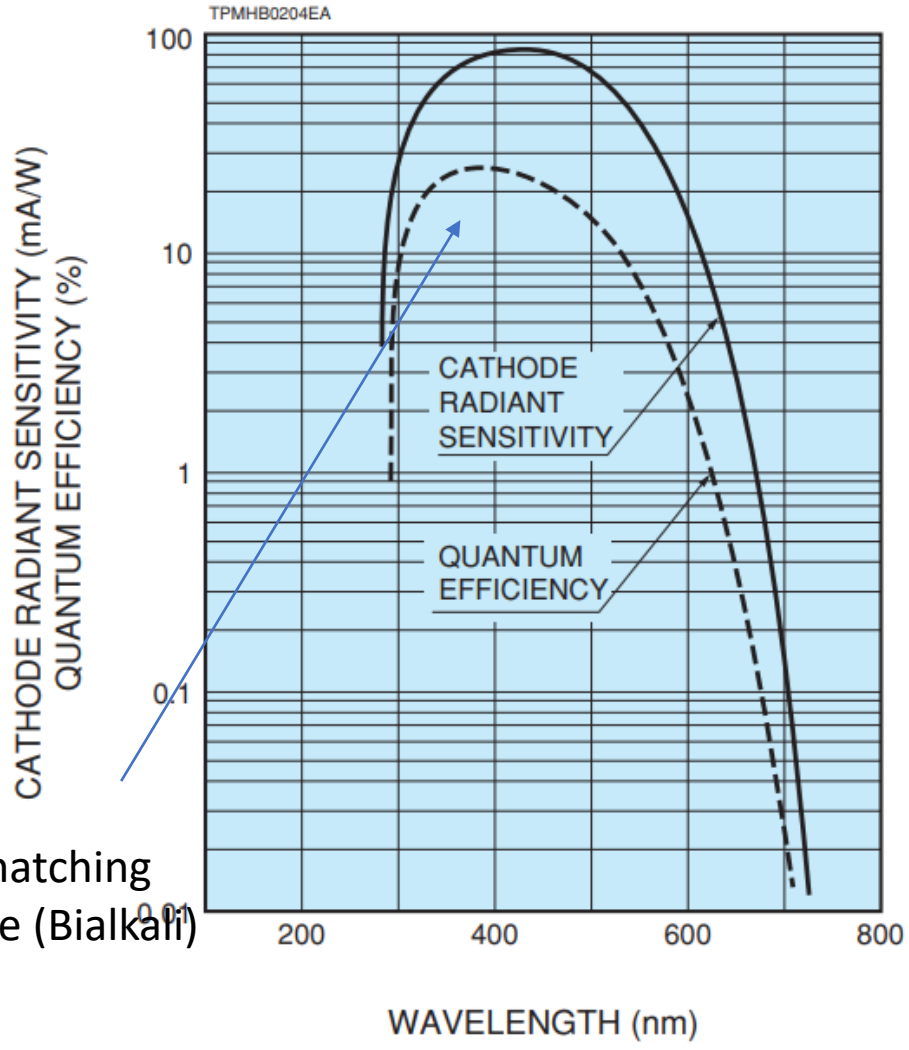
- Radiation measurement
- Particle counter

SPECIFICATIONS

GENERAL

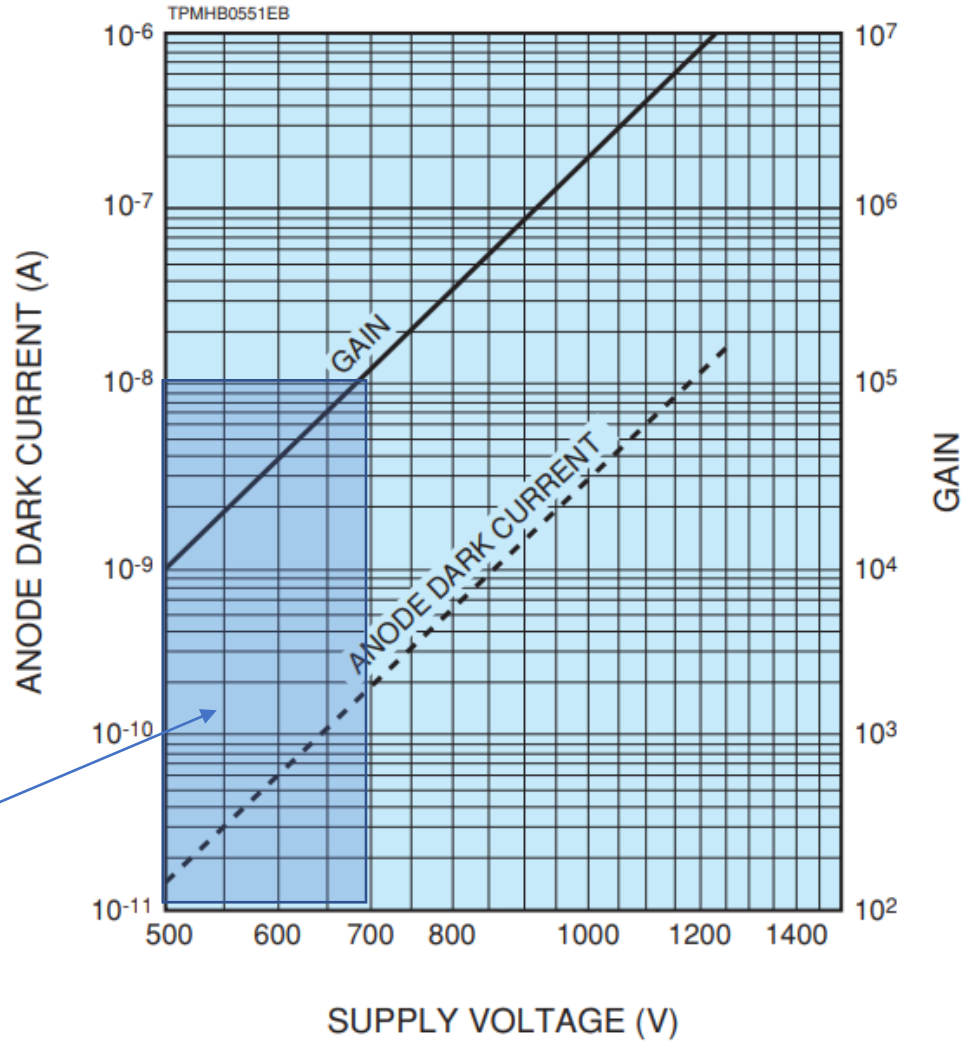
Parameter		Description	Unit
Spectral response		300 to 650	nm
Wavelength of maximum response		420	nm
Photocathode	Material	Bialkali	—
	Minimum effective area	ϕ22	mm
Window material		Borosilicate glass	—
Dynode	Structure	Circular and linear-focused	—
	Number of stages	10	—
Base		14 pin glass base	—
Suitable socket		E678-14C (supplied)	—
Operating ambient temperature		-30 to +50	°C
Storage temperature		-80 to +50	°C

Figure 1: Typical spectral response



SR matching
Silbene (Bialkali)

Figure 2: Typical gain and dark current characteristics



Low gain
HV regime

Combination of large scintillation light yield and low PM gain is the key

And a bit of high-tech…

photomultiplier power base (negative) PS1807 data sheet

SENS-TECH
SENSOR TECHNOLOGIES

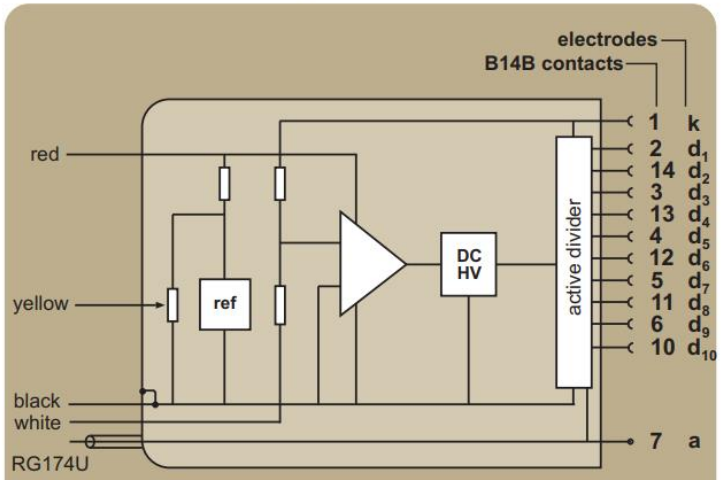
3 features

- compact design
- freedom from high voltage cables
- extremely low ripple
- exceptional voltage divider stability with varying anode current
- excellent pulse height linearity
- sleep mode

4 specification

input power at V_{max} = -1800 V	+5 V, 65 mA
power conversion efficiency, P_O/P_{in}	40 % for +5 V
input power at V_{max} = -1800 V	+12 V, 20 mA
power conversion efficiency, P_O/P_{in}	50 % for +12
output voltage range	-100 V to -1800 V
line regulation	0.05 % /V
temperature coefficient	<0.02 % $°C^{-1}$
warm up time to 0.3 % of final o/p	< 2 s
discharge time to <40 V with no load	< 2 s
maximum anode current, continuous	100 µA
anode ripple with 100 kΩ //5 pF load	100 µV
weight	60 g

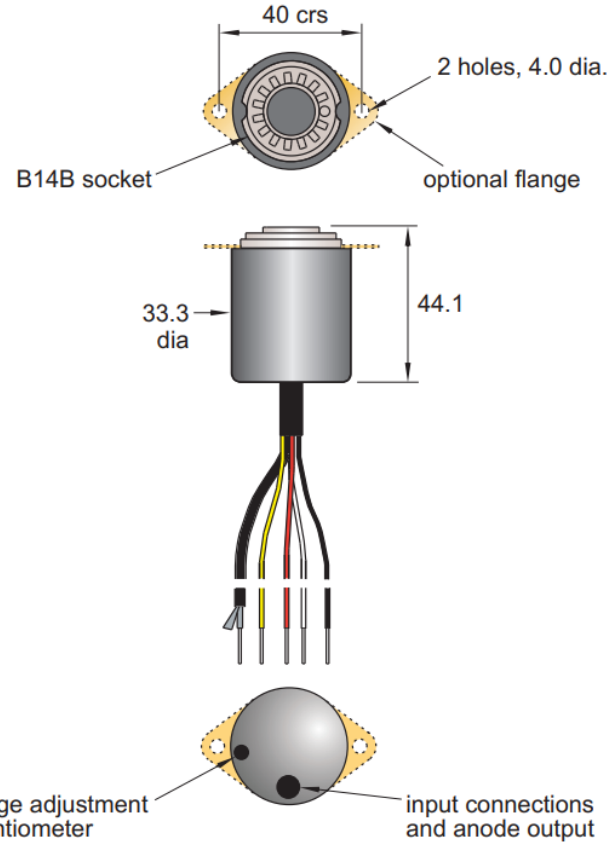
6 schematic diagram



example of output voltage with 1.300 volts applied to control (white) wire

contact	electrode	voltage	contact	electrode	voltage
1	k	-1300	8	nc	-
2	d_1	-1000	9	nc	-
3	d_3	-800	10	d_{10}	-100
4	d_5	-600	11	d_8	-300
5	d_7	-400	12	d_6	-500
6	d_9	-200	13	d_4	-700
7	a	floating	14	d_2	-900

nc - no connection



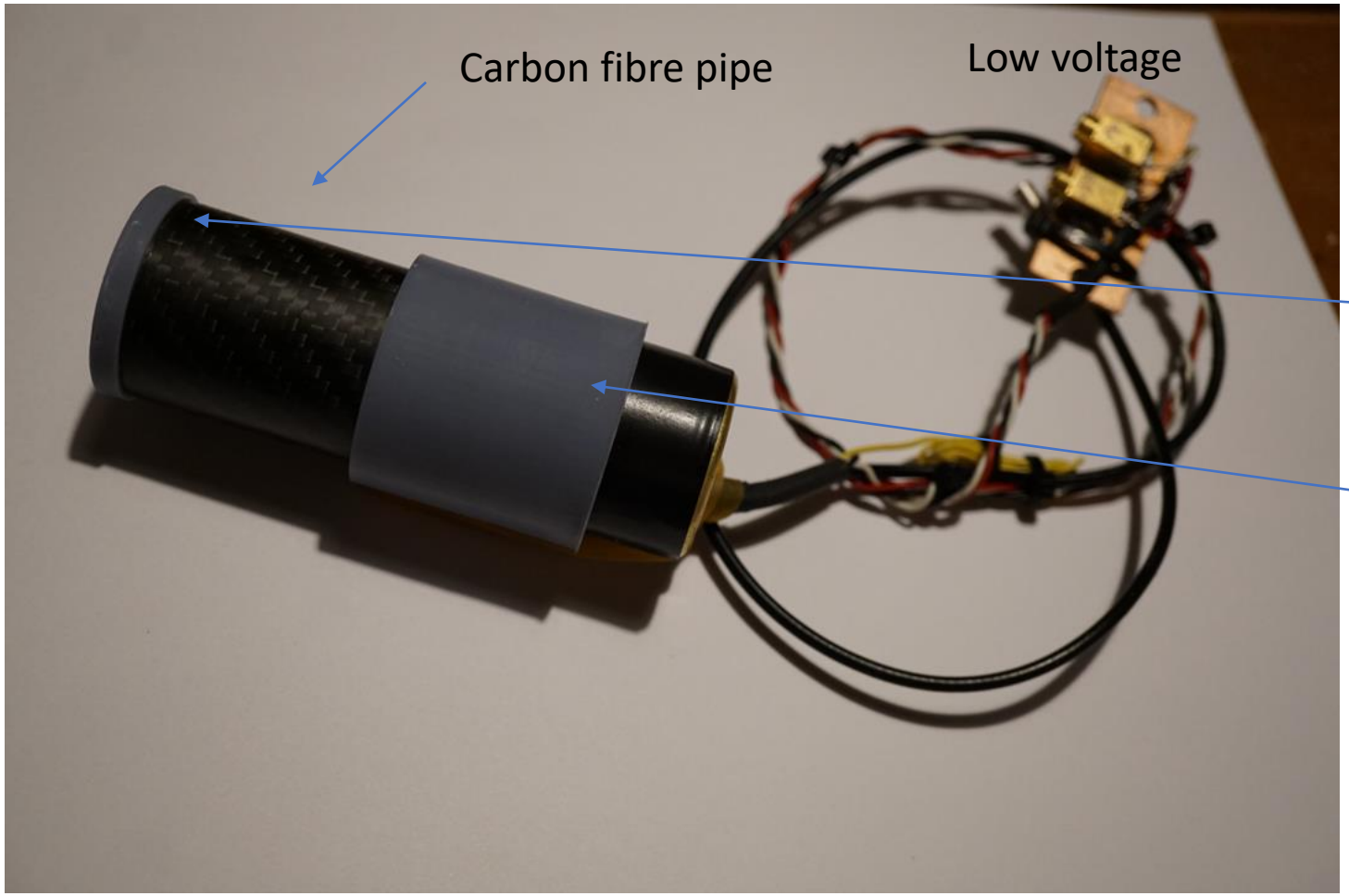
Ultra compact active base with DC-DC converter
no HV needed

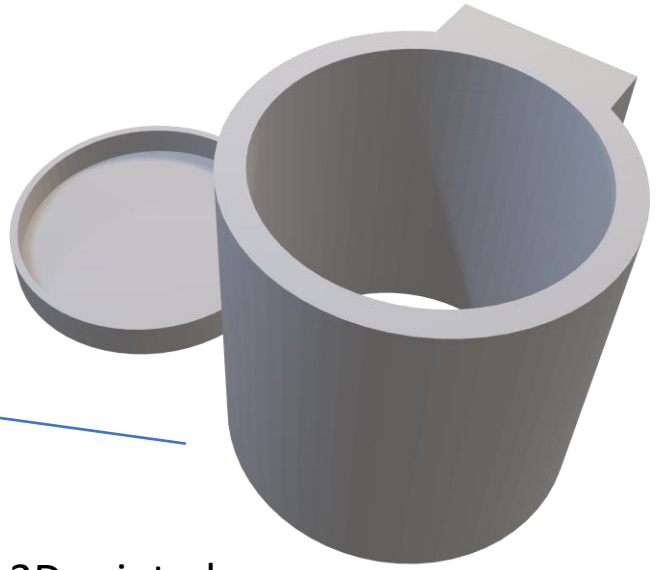
This power base was tested for a self-powering device and high counting rate

The detector holder has been assembled by using just three pieces

- Standard carbon pipe
- Holder and cup by 3D printing

The design can be rearranged on-the-fly
obtaining maximum flexibility
for any set-up





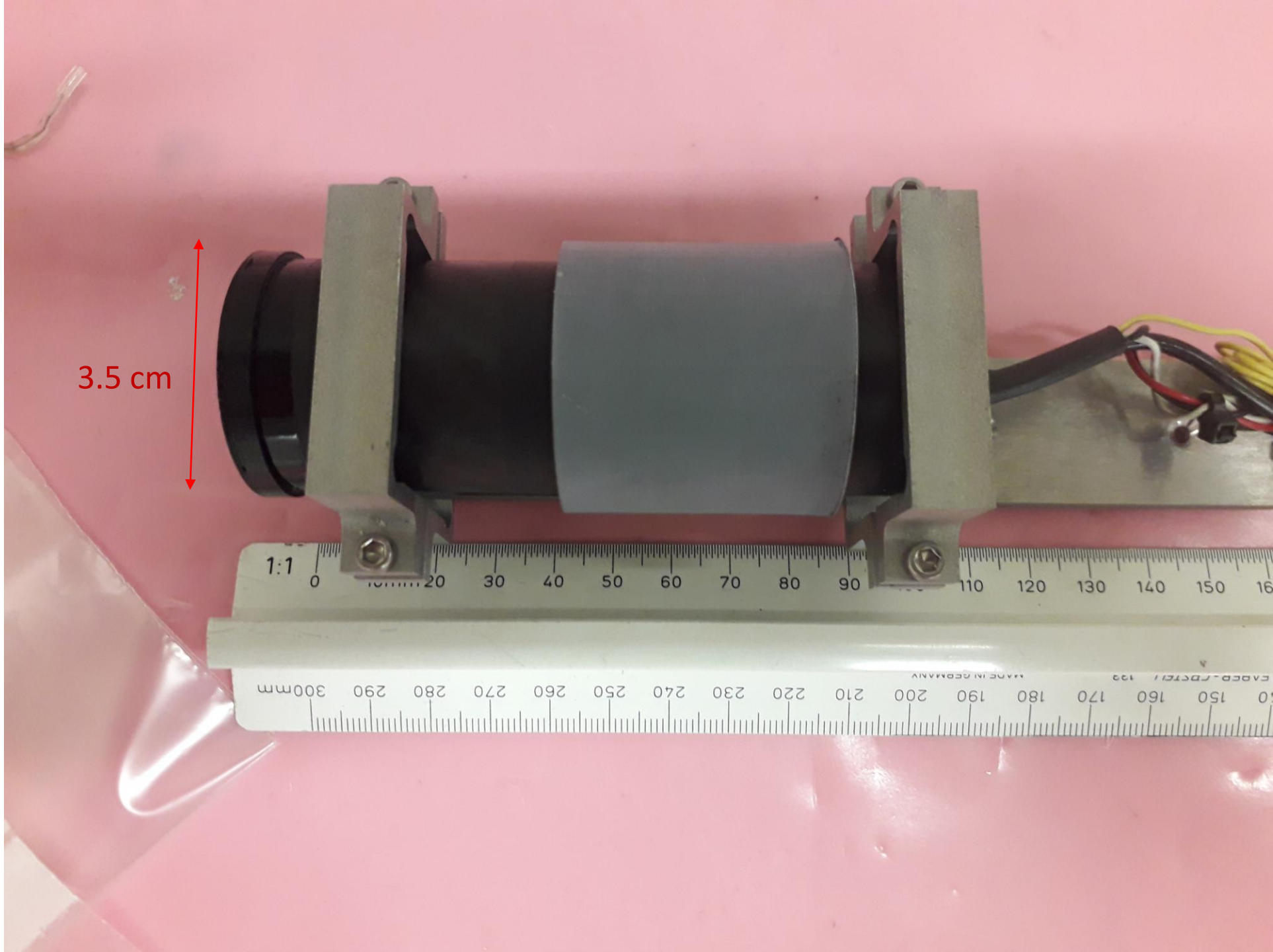
3D printed
holder
and cup

As a sign of destiny

we nicely discovered
it fits with
the S-TED frame

main geometry
unchanged
for the test

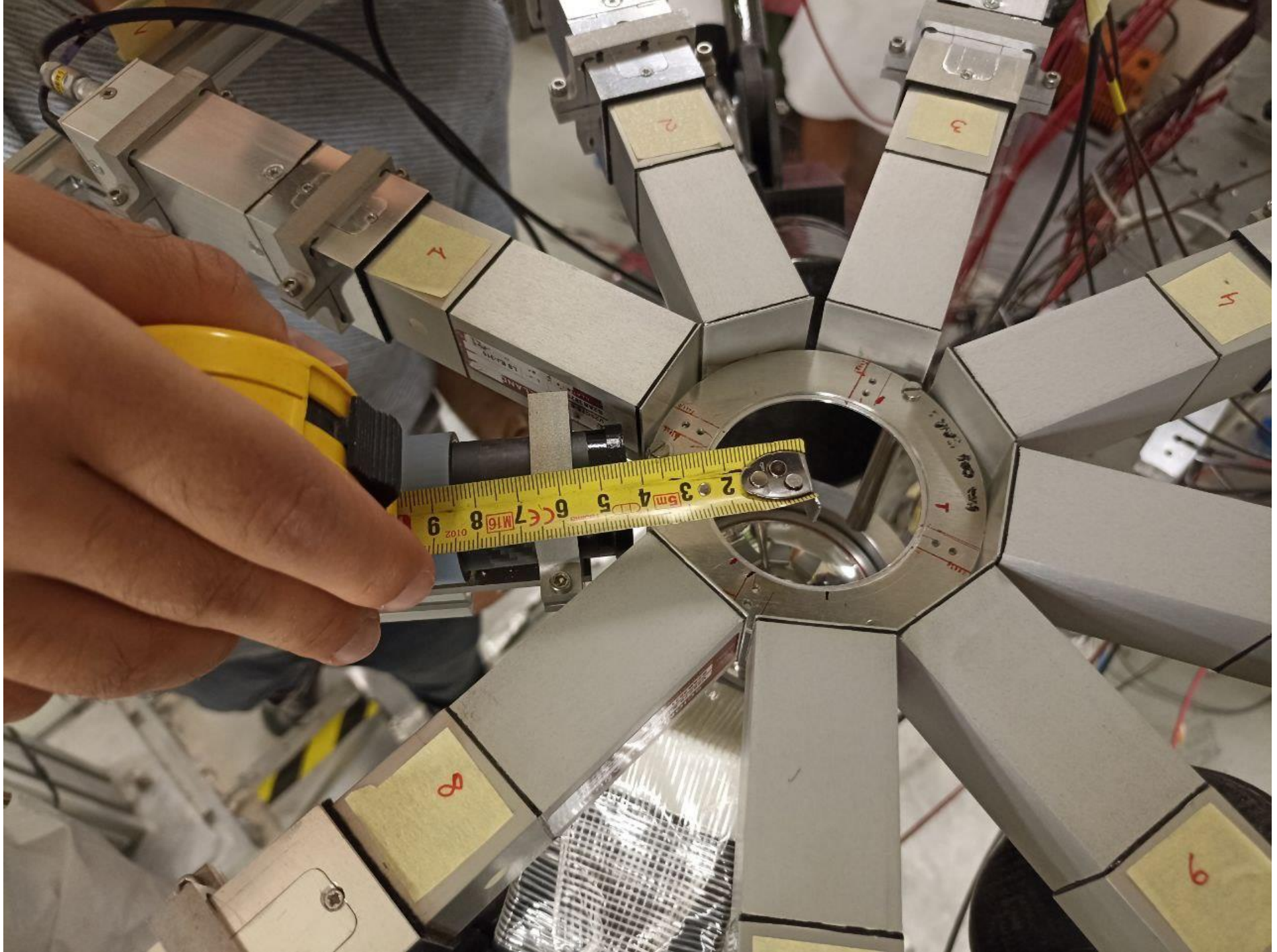
relaxed mechanical
constraints



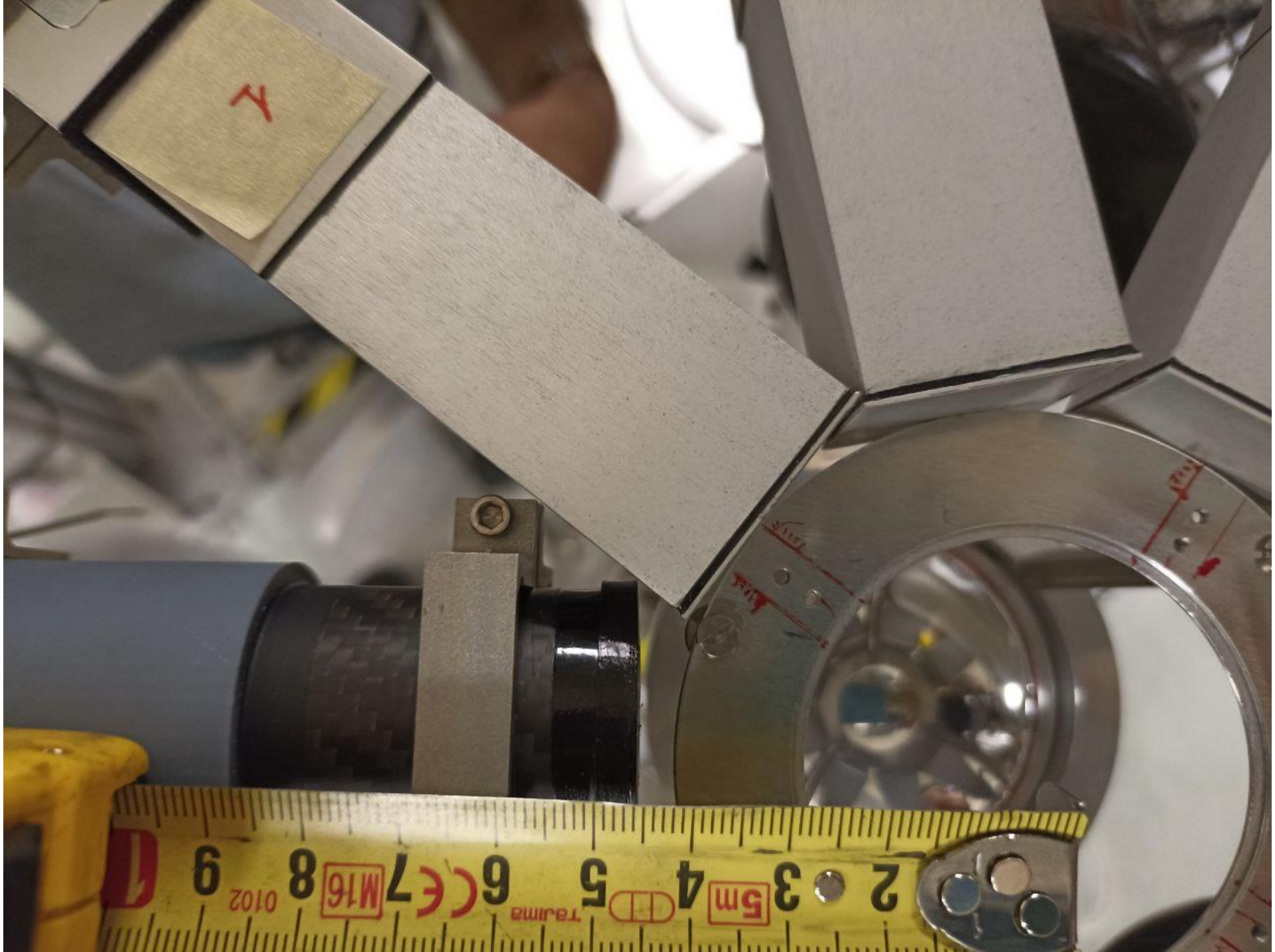
Front window was aligned with respect to the S-TED modules

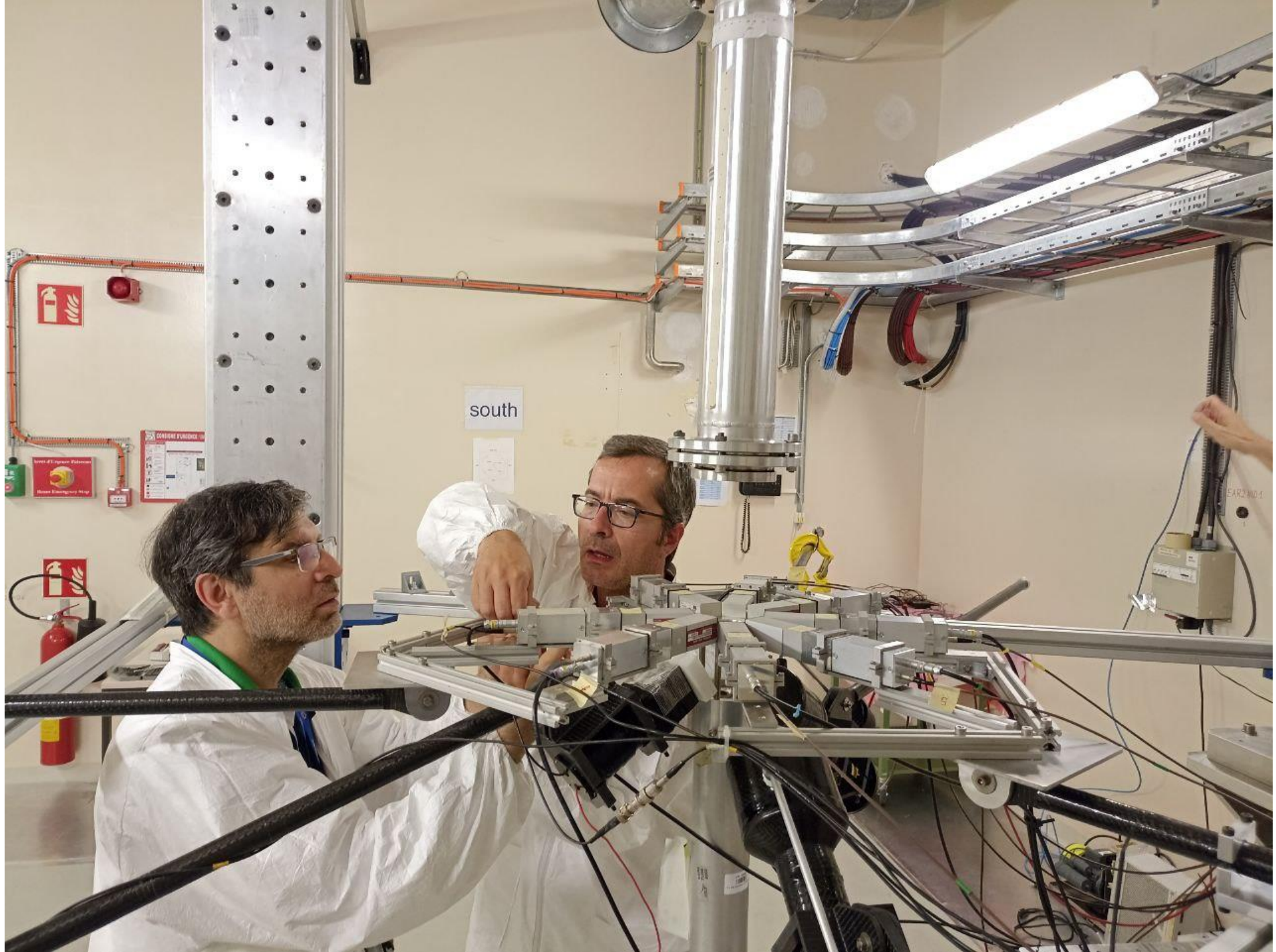
Same distance from the beam

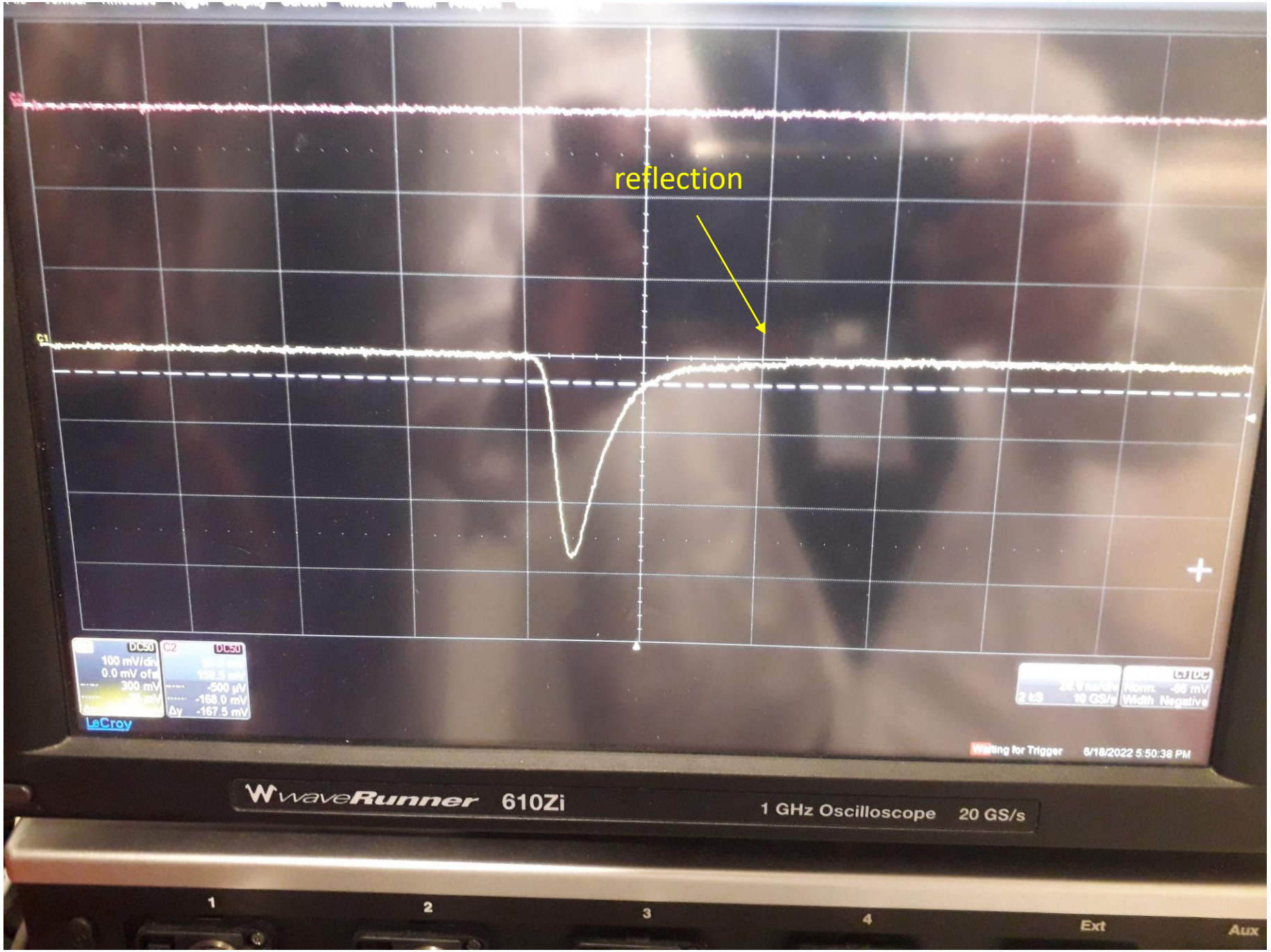
Further info in Javi presentation



photocathode
just 6 cm away
from the beam axis




south



first light after mounting

very fast signals (20 ns)

S-TED cabling was used

A better cabling will improve time performances

File display [GL]

File Options ?

Main info

Experiment	EAR2
Run number	213578
Trigger number	6
Segment number	6
Triggers in run	
BCT	8.09668e+12
T gammma	10200 ns
L	19 m

Positions

Position X	653,994.0582 ns
Position Y	-50.1766 mV
E(eV)	4.555e+0 eV
TOF	643857 ns

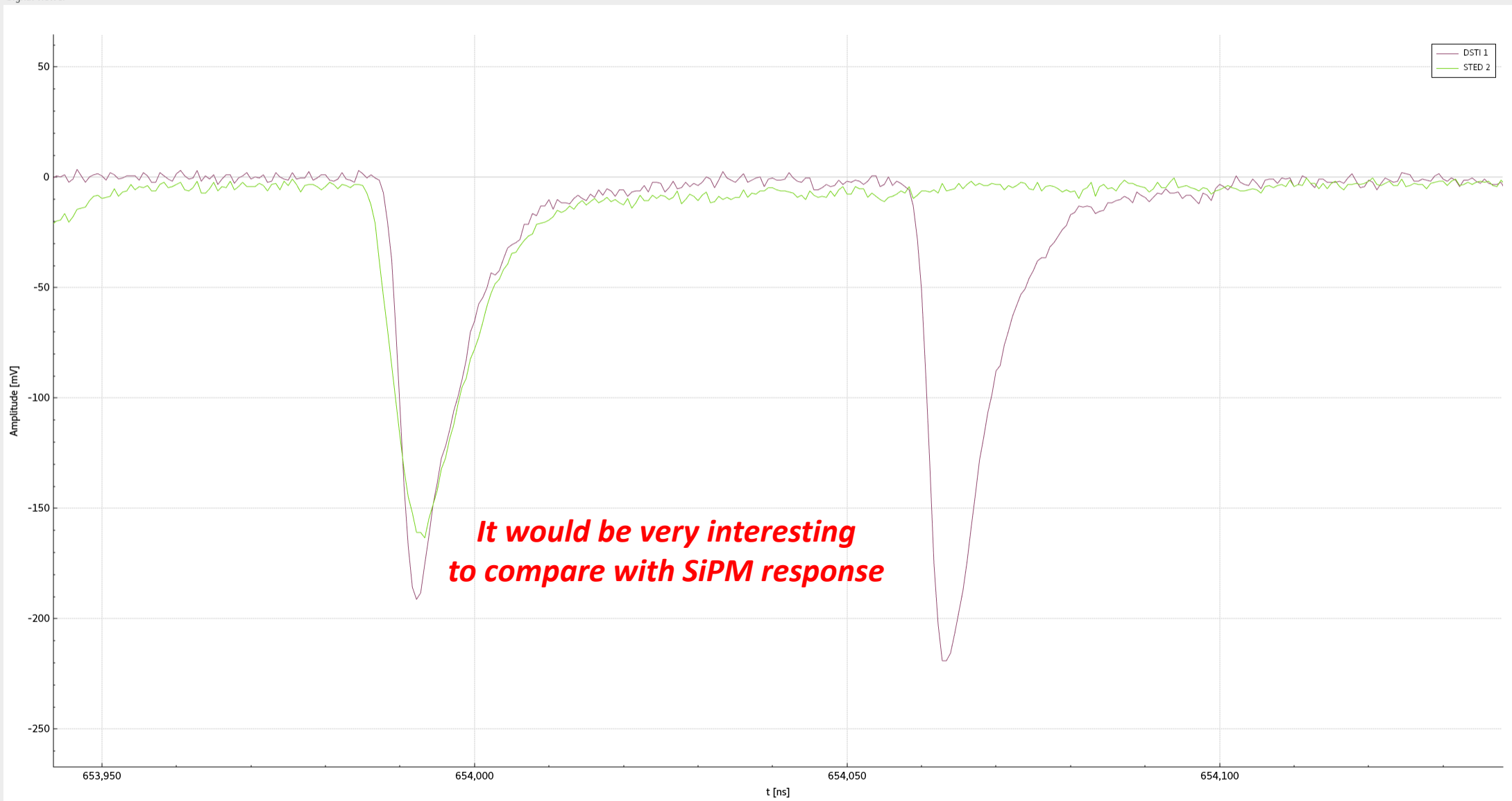
Detectors list

- [ ] SILI_2
- [ ] SILI_3
- [ ] SILI_4
- [ ] STED_6
- [ ] STED_7
- [ ] STED_8
- [x] DSTI_1
- [ ] PKUP_1
- [ ] STED_5
- [ ] STED_1
- [x] STED_2
- [ ] STED_3
- [ ] STED_4
- [ ] C6D6_1
- [ ] C6D6_2

Select all | Clear selection

Apply selection

Signal viewer



Previous trigger

Next trigger

File display [GL]

File Options ?

Main info

Experiment	EAR2
Run number	213578
Trigger number	6
Segment number	6
Triggers in run	
BCT	8.09668e+12
T gammma	10200 ns
L	19 m

Positions

Position X	654,014.6094 ns
Position Y	-171.45 mV
E(eV)	4.554e+0 eV
TOF	643877 ns

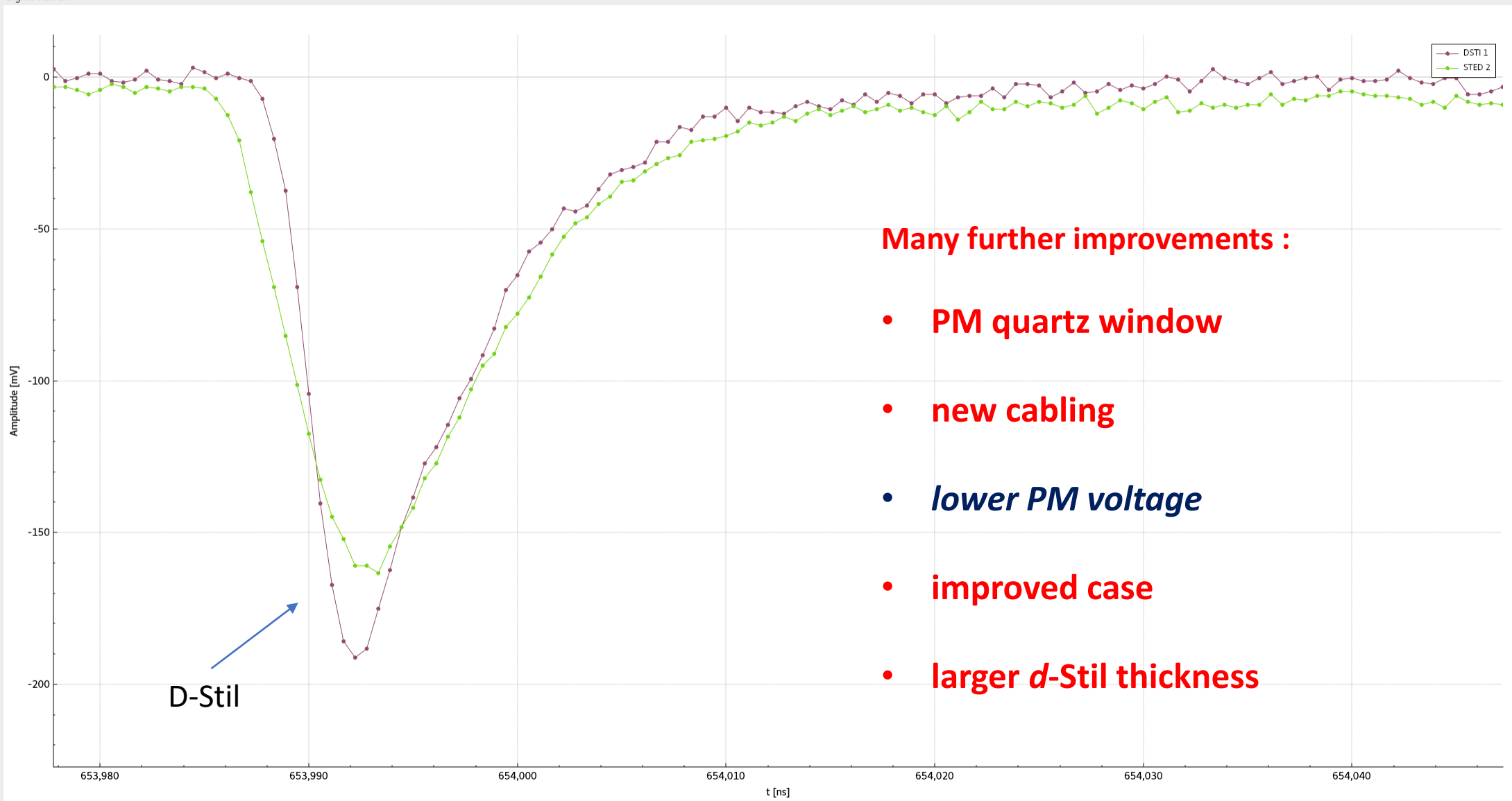
Detectors list

- SILI_2
- SILI_3
- SILI_4
- STED_6
- STED_7
- STED_8
- DSTI_1
- PKUP_1
- STED_5
- STED_1
- STED_2
- STED_3
- STED_4
- C6D6_1
- C6D6_2

Select all | Clear selection

Apply selection

Signal viewer



Previous trigger

Next trigger

File display [GL]

File Options ?

Main info

Experiment	EAR2
Run number	213578
Trigger number	6
Segment number	6
Triggers in run	
BCT	8.09668e+12
T gammma	10200 ns
L	19 m

Positions

Position X	10,694.82072 ns
Position Y	-1182.34 mV
E(eV)	6.137e+6 eV
TOF	557.397 ns

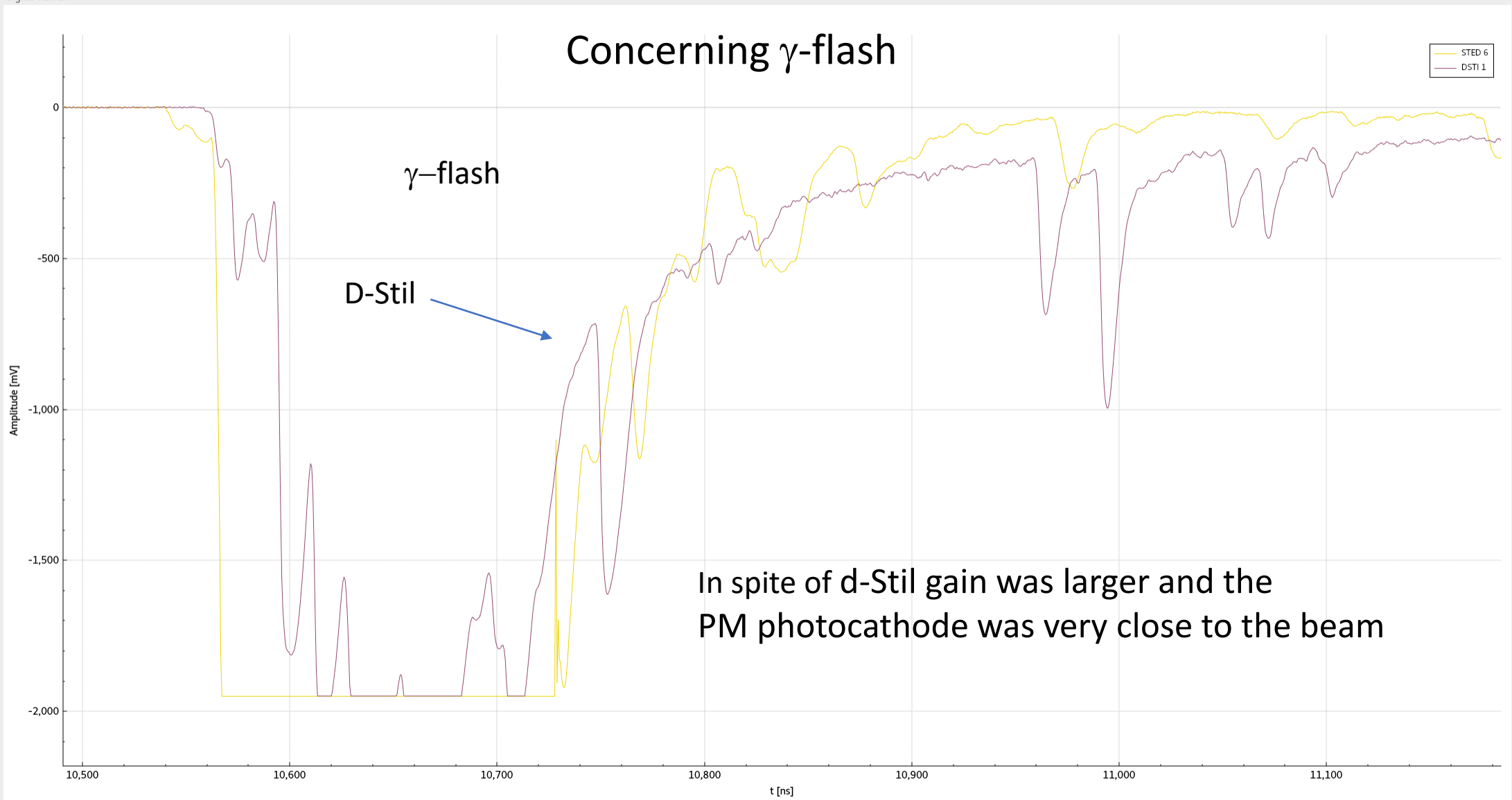
Detectors list

- [ ] SILI_1
- [ ] SILI_2
- [ ] SILI_3
- [ ] SILI_4
- [x] STED_6
- [ ] STED_7
- [ ] STED_8
- [x] DSTI_1
- [ ] PKUP_1
- [ ] STED_5
- [ ] STED_1
- [ ] STED_2
- [ ] STED_3
- [ ] STED_4
- [ ] C6D6_1

Select all | Clear selection

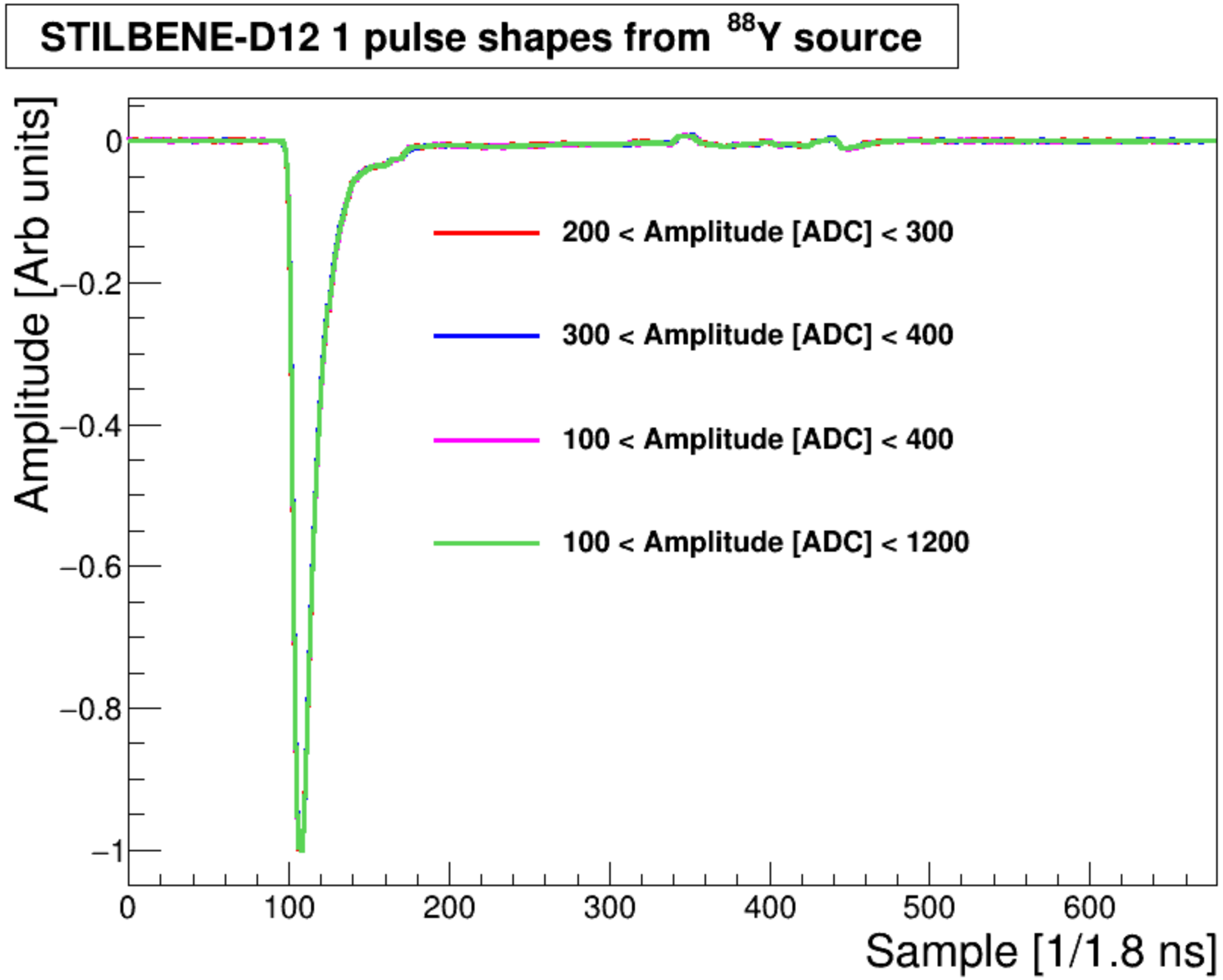
Apply selection

Signal viewer

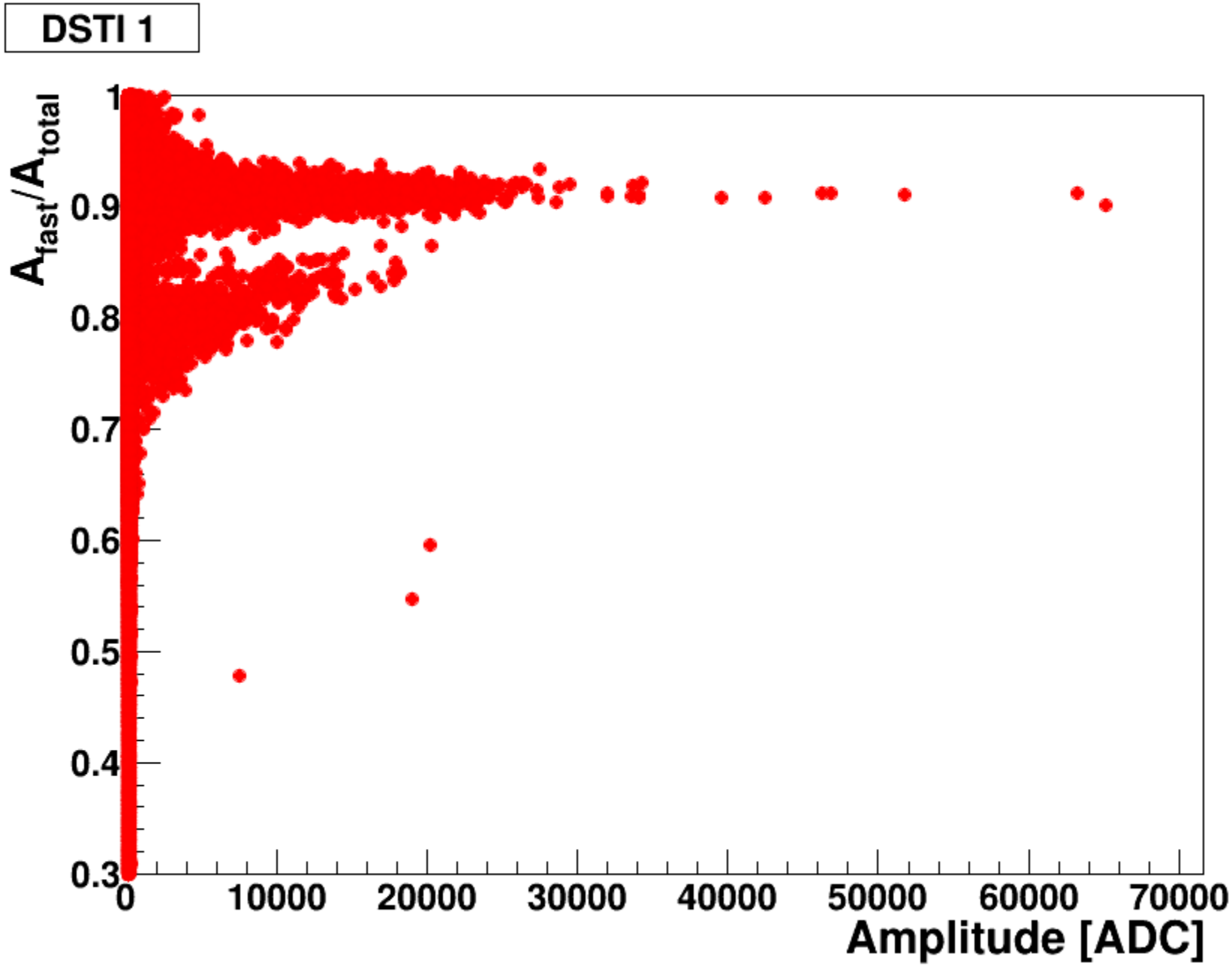


Previous trigger

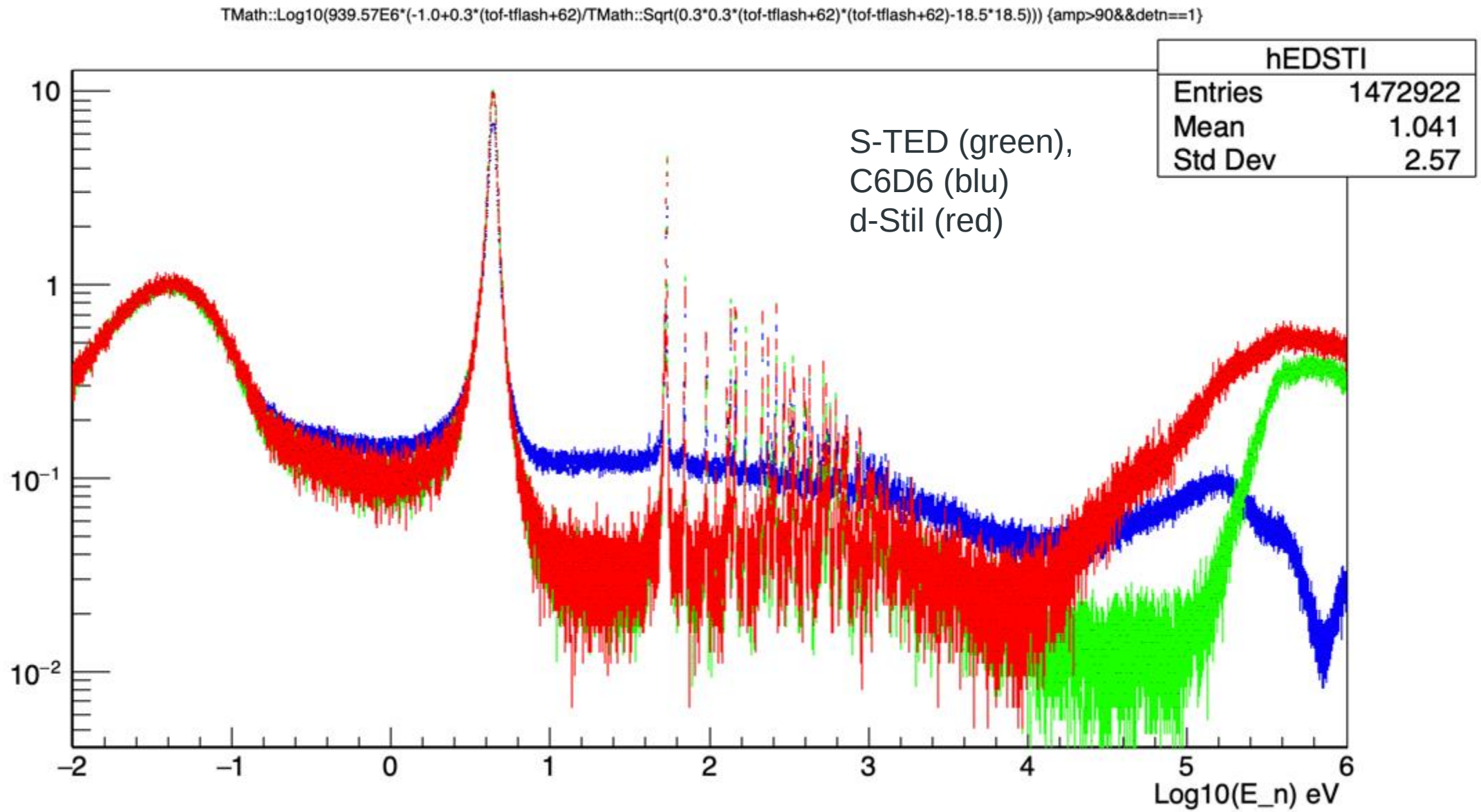
Next trigger

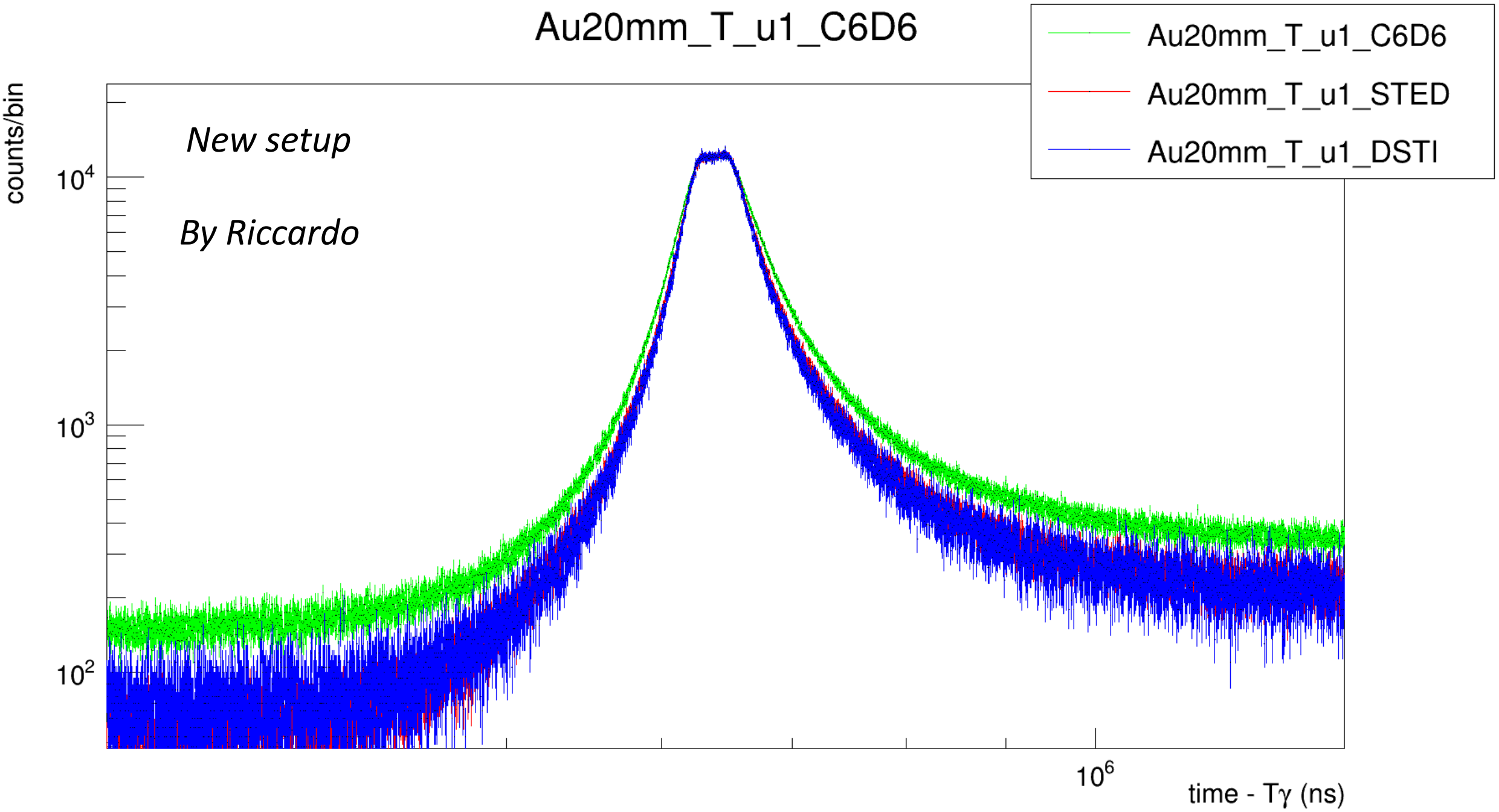

STILBENE-D12 1 pulse shapes from ^{88}Y source
Amplitude [Arb units]
0
−0.2
−0.4
−0.6
−0.8
−1
0
100
200
300
400
500
600
Sample [1/1.8 ns]
200 < Amplitude [ADC] < 300
300 < Amplitude [ADC] < 400
100 < Amplitude [ADC] < 400
100 < Amplitude [ADC] < 1200

By Javi


DSTI 1
A_{fast}/A_{total}
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0
10000
20000
30000
40000
50000
60000
70000
Amplitude [ADC]

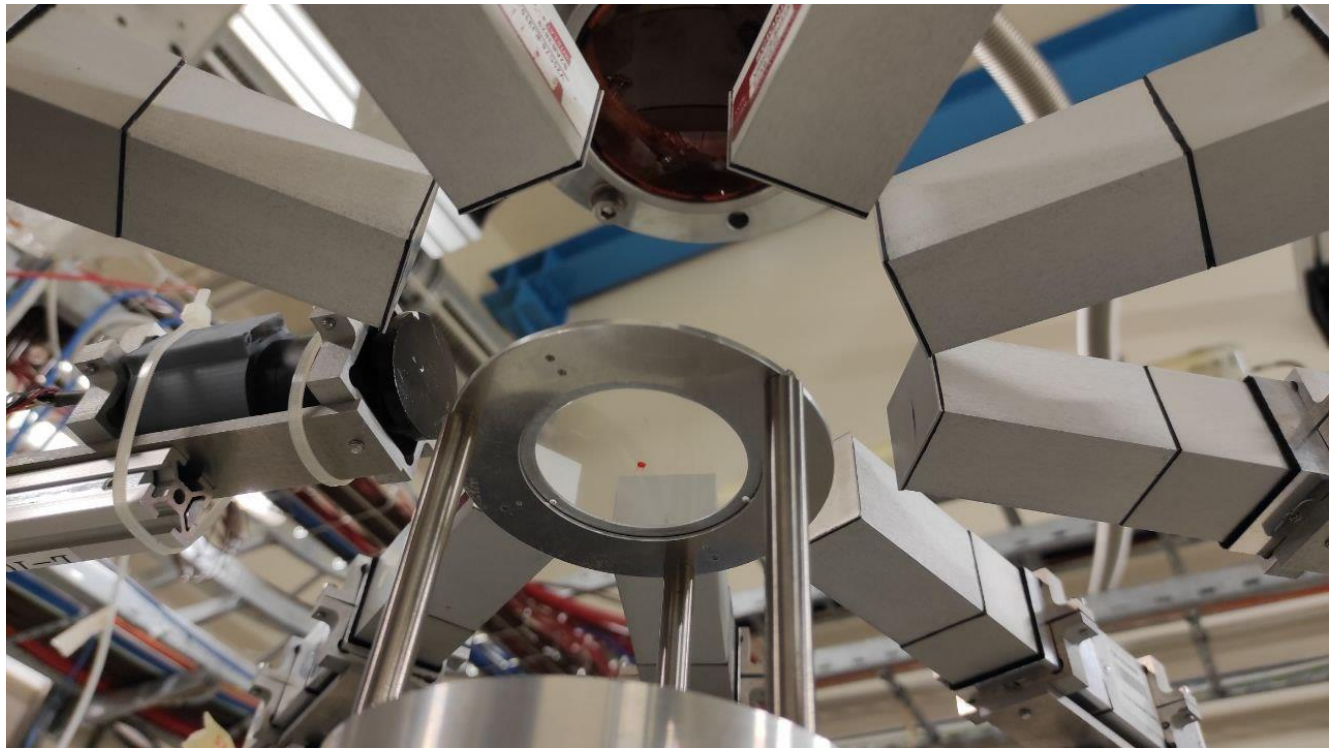
By Javi

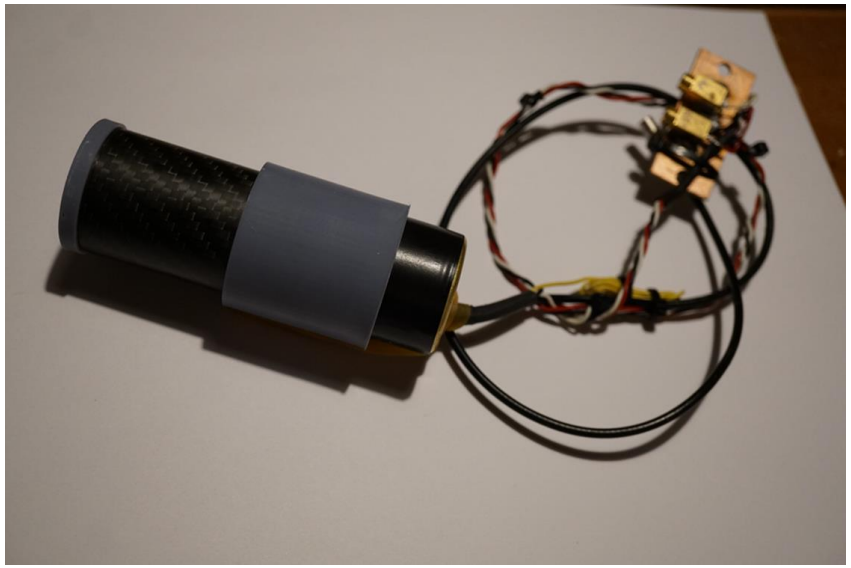

TMath::Log10(939.57E6*(-1.0+0.3*(tof-tflash+62)/TMath::Sqrt(0.3*0.3*(tof-tflash+62)*(tof-tflash+62)-18.5*18.5))) {amp>90&&detn==1}
hEDSTI
Entries 1472922
Mean 1.041
Std Dev 2.57
S-TED (green),
C6D6 (blu)
d-Stil (red)
10
1
10^{-1}
10^{-2}
−2
−1
0
1
2
3
4
5
6
Log10(E_n) eV


Au20mm_T_u1_C6D6
Au20mm_T_u1_C6D6
Au20mm_T_u1_STED
Au20mm_T_u1_DSTI
New setup
By Riccardo
counts/bin
10^4
10^3
10^2
10^6
time - Tγ (ns)

d-Stil setup status (INFN-CT)

- ***A request for financial support by INFN-CT fulfilled (5 keuro) + 5-10 keuro are in progress***
- ***According to the schedule we have the material to mount 4 modules within october-november (new holder)***



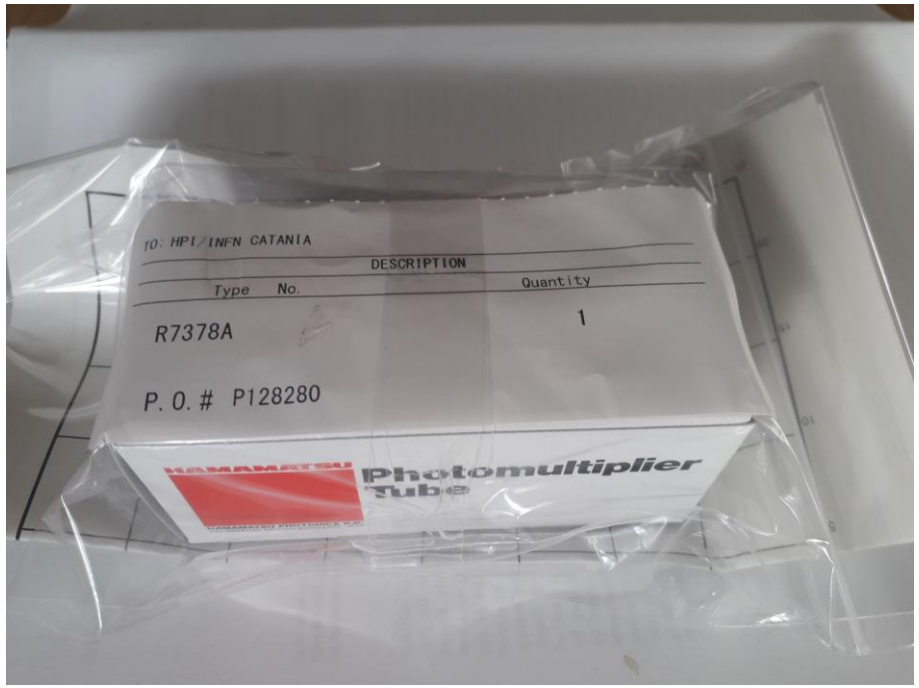


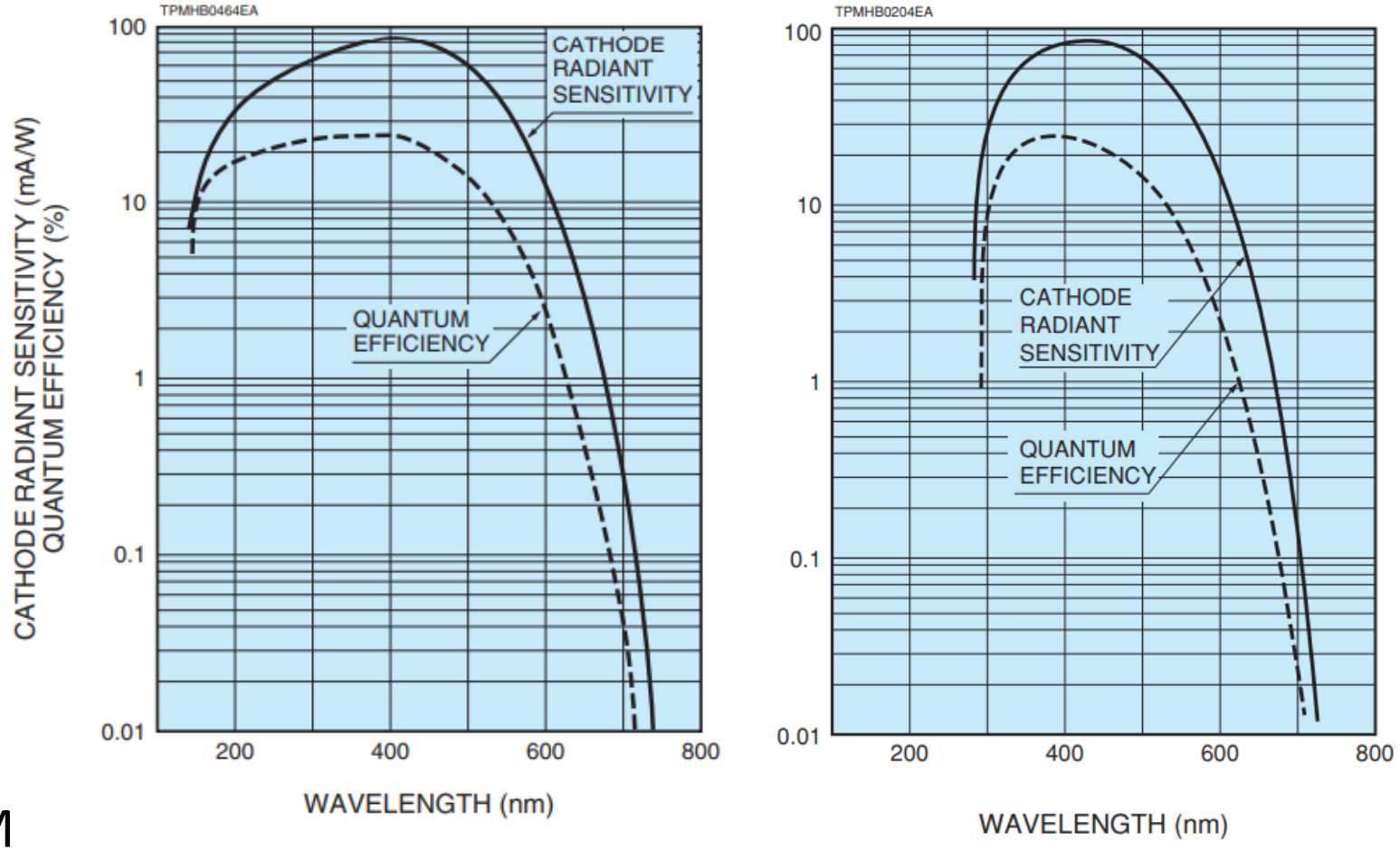
The Sens-Tech PS-1807 x 4 *DC-DC* converters (we got on July)

A new HAMAMATSU *R7378A vs R1924A*

Synthetic silica vs borosilicate

no Boron - more light





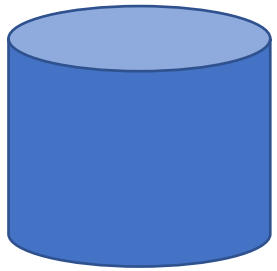
1 R7378A + 3 R1924A standard PM

The Inrad crystals (shipment on 13 of october)

Standard type «Scintinel» (no deuterated) – «*problem to afford the production*» -

ITEM	QTY	U/M	DESCRIPTION	UNIT PRICE	TOTAL
1			XT2358 STILBENE,OD25.4X 25.4MM,P1S SCINTINEL (STILBENE) DISC DIAMETER: 25.4MM ±0.15MM THICKNESS: 25.4±0.35MM FINISH: S1: SMOOTH, FLAT FACE S2: FINE GRIND BEVEL: MINIMUM BREAK EDGE NOTE: STILBENE CRYSTALS MAY EXHIBIT INCLUSIONS. ** INCLUDE HANDLING INSTRUCTIONS WITH CRYSTAL SHIPMENTS**		
	4			1,000.00	$4,000.00

ESTIMATED DELIVERY SCHEDULE
(subject to confirmation at time of order):
8 wks



Scintillators status (INFN-CT):

1 *d-Stilbene from LLNL (TARAT-Nikolas)*

2 cyclidrical d(p)-stilbene (d-Stil prototype)

4 cylindrical p-stilbene (incoming)

We can implement various combinations of PM and crystals – ***d*-crystal supply can be a problem**

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journal homepage: www.elsevier.com/locate/nima

Gamma-response characterization of a solution-grown stilbene based detector assembly in the 59 keV–4.44 MeV energy range; an alternative low-resolution gamma spectrometer

Augusto Di Chicco [a,d], Alix Sardet [b,*], Michaël Petit [c], Robert Jacqmin [a], Vincent Gressier [c], Brian Stout [d]

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[b] CEA, DES, IRESNE, DTN, SMTA, LMN, 13108 Saint-Paul-Lez-Durance CEDEX, France
[c] IRSN Cadarache, SDOS/LMDN, 13115 Saint-Paul-Lez-Durance, France
[d] Aix-Marseille University, Institut Fresnel - UMR 7249, 13397 Marseille, France

ARTICLE INFO

Keywords:
Organic scintillator detector
Solution-grown stilbene
Energy calibration
γ-ray response matrix
Spectra unfolding
GRAVEL
Crystal scintillator
Gamma spectrometer

ABSTRACT

The photon response characterization of a Ø 25.4 mm × 25.4 mm solution-grown stilbene based detector assembly was performed in the 59 keV–4.44 MeV energy range. Energy calibration was carried out using not only direct measurements but also via coincidence measurements in order to obtain more reliable results. Both methods gave consistent results. To establish an accurate model of the detector, its energy resolution was determined and included in MCNPX-PoliMi simulations. This model served to compute the gamma-response matrix in the 0.1–7.3 MeV energy range. This matrix was used as an input of the GRAVEL spectrum unfolding code when attempting to unfold the measured spectra of well-known sources. Despite a few discrepancies concerning peak intensities, the main gamma peaks were successfully identified in the 0.059–4.4 MeV energy range, thus confirming the utility of solution-grown stilbene as a low-resolution gamma spectrometer, especially for identifying the gamma component in neutron fields.

2. Experimental details

2.1. Organic scintillator detectors

Two cylindrical organic scintillators, listed in Table 1, are used in this work. The main detector is a Ø 25.4 mm × 25.4 mm solution-grown [5] stilbene, produced by InradOptics [6] and encapsulated in a 0.5 mm thick aluminum cylinder.