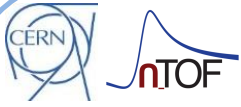


Status of L6D6 detectors



Recap L6D6 n_TOF Ph-3: EAR1

PMT (model 9829QSB, 12 dynodes BeCu) + VD (model E628BSN2, anode read-out) from ET-Enterprise

The detectors were used all along n_TOF-Ph3 in most of the capture measurements in **EAR1**

Issues and actions:

- gain shifts over time observed (up to 8-10%) with sources: **managed with 1h long daily calibrations**
- Occasional sudden huge gain shift (40%) for a specific detector: **replaced**
- 2 groups of rebounds at different time-delays, especially in the last part of Ph3 (after-pulses, impedance mismatch?): **thresholds in deposited energy at 150 keV clean the spectra**
- Small leakages (trace level) observed in some case

Recap L6D6 n_TOF Ph-3: EAR2

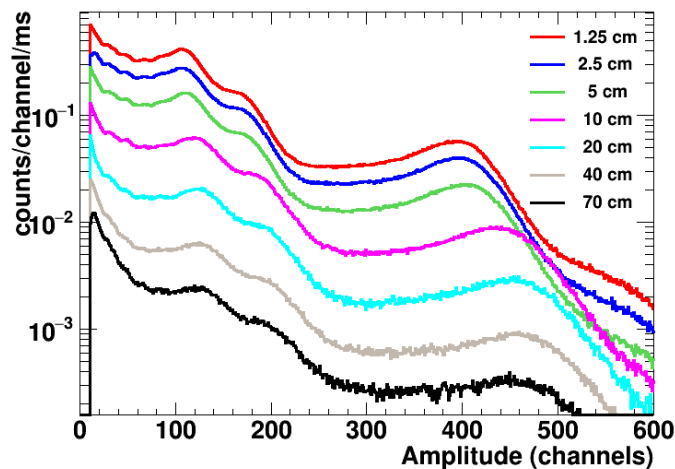
PMT (model 9829QSB, 12 dynodes BeCu) + VD (model E628BSN2, anode read-out) from ET-Enterprise

The detectors were initially used in a capture measurement in EAR2, but soon replaced with Bicron detectors as a consequence of gain shifts. (Bicrons neither operated perfectly)

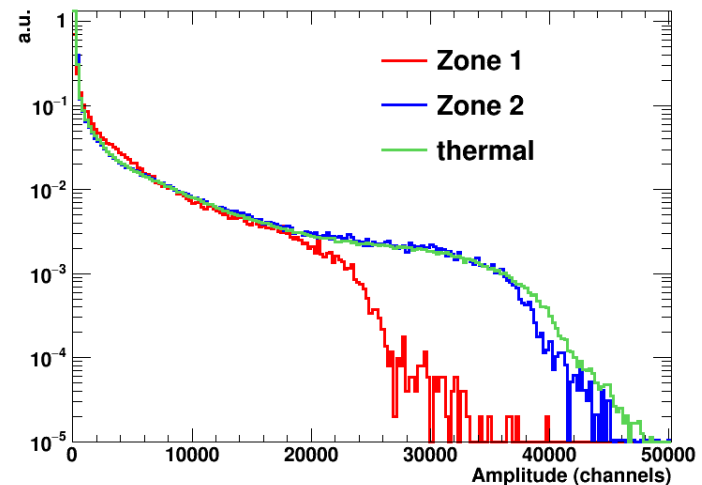
Issues

- In steady conditions, source test: gain shifts towards lower amplitudes when counting-rate increases
- In beam conditions: gain shifts toward higher amplitudes passing over high counting-rate regions

Cs137+Y88 sources, 400 KBq each, **Rate 0.7-50 kHz**



Au197 in beam, **Rate 14 MHz**



Recap L6D6 n_TOF Ph-3: EAR2

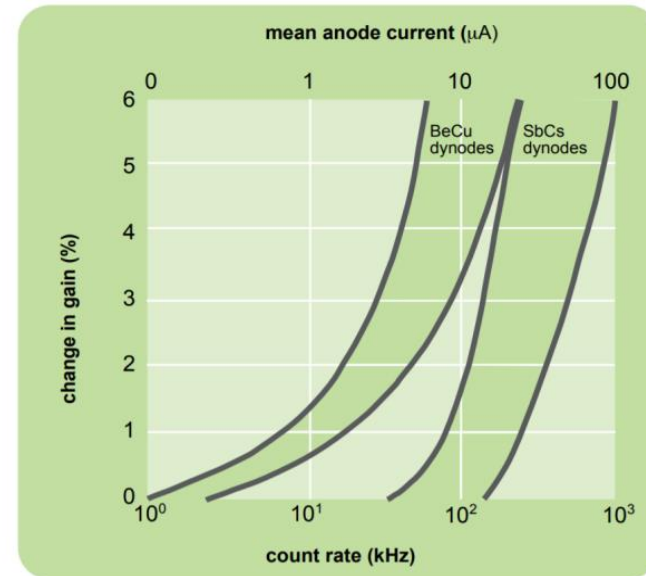
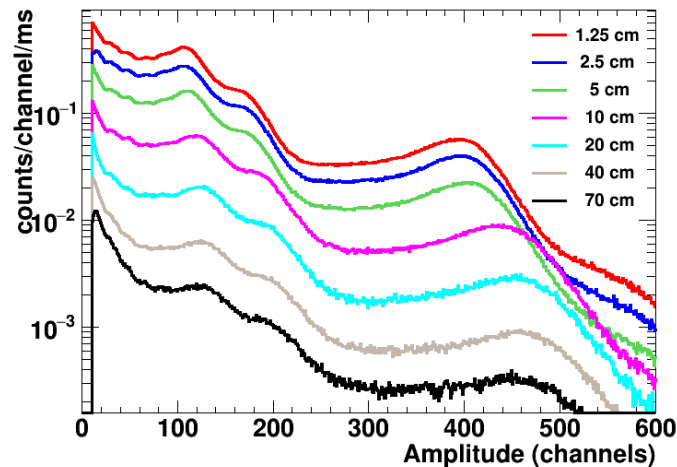
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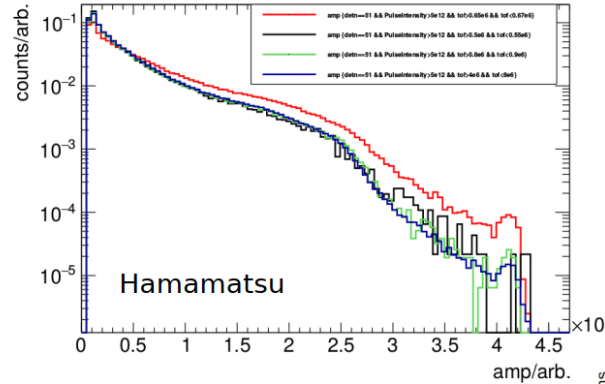
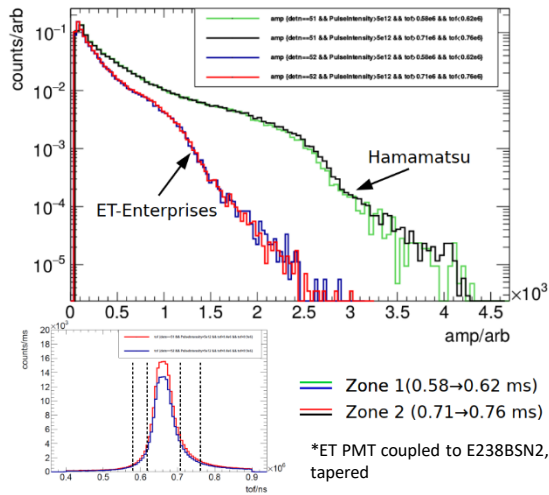


Actions: replace PMT and VD (two different PMT/VDs, and repeat the tests.

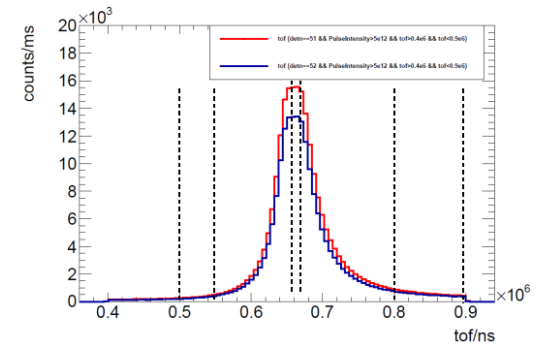
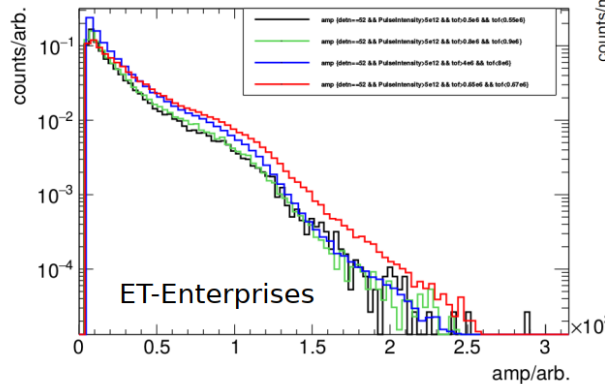
- Voltage dividers: E238ASN2 (active, **optimized for steady rate effect**, E238BSN2 (active, **optimized also for high pulse linearity**)
- Photomultipliers: ET-Enterprises SbCs 12 dynodes 9214QSB, Hamamatsu R13435Q-100-11, both **better anode current recovery**

Recap L6D6 n_TOF Ph-3: EAR2

Repeat the test in EAR2 in similar conditions to the previous test but with the new assemblies.



- Plateau (0.65→0.67 ms)
- Zone 1 (0.5→0.55 ms)
- Zone 2 (0.8→0.9 ms)
- Thermal (4→8 ms)



Conclusions:

Clear indication that there is an improvement with both PMT/VD assemblies

Probably due to pile-up, the shape at the top of the resonance looks different with respect to the other regions.

To repeat the test in a systematic way, including tests with sources, different voltages applied.

L6D6 n_TOF during LS2: with Beam

3 detectors shipped from CERN to Gelina, standard PMT/VD assembly (det C) + new ET PMT/VD tested in EAR2 (dets A-B)
+ 1 L liquid + spare PMT/VD

+ Hamamatsu assembly already tested in EAR1 and coming from LNL

2017-1-RD-EUFRAT-GELINA

Characterisation of a new C_6D_6 detection system for time-of-flight (n,γ)
cross section measurement

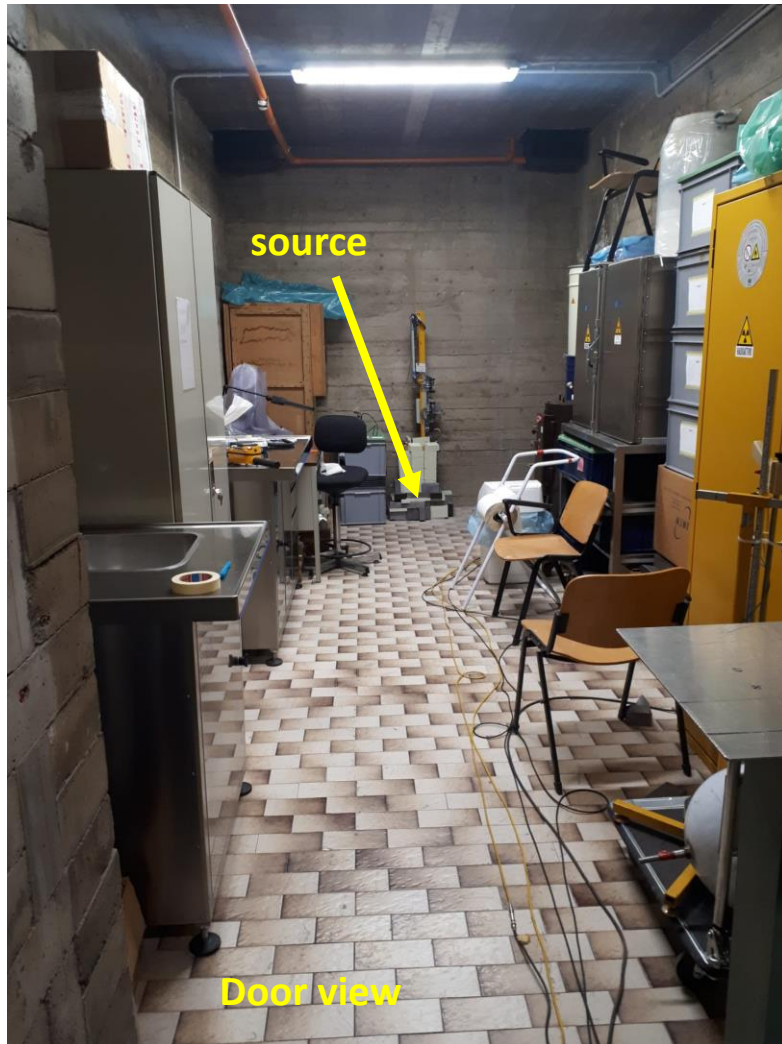
	Action	Name	Dates
1	Sent the C_6D_6 liquid together with the detector components to JRC Geel	F. Mingrone (CERN)	August 2018
2	Fill detector cell and assemble detection system	P. Mastinu (INFN, Legnaro) P. Milazzo (INFN, Trieste) F. Mingrone (CERN) M. Mastromarco (CERN) P. Schillebeeckx (JRC Geel)	August 2018
4	Test detection system under different count rate conditions	P. Mastinu (INFN, Legnaro) P. Milazzo (INFN, Trieste) F. Mingrone (CERN) M. Mastromarco (CERN) C. Paradela (JRC Geel)	September 2018
5	Capture cross section measurements - Au samples - Background measurements: without sample - Background measurements: ^{208}Pb sample	P. Mastinu (INFN, Legnaro) P. Milazzo (INFN, Trieste) F. Mingrone (CERN) M. Mastromarco (CERN) C. Paradela (JRC Geel)	October 2018
6	Data reduction and analysis	F. Mingrone (CERN) M. Mastromarco (CERN) C. Paradela (JRC Geel)	November - December 2018

Test pending, Spring 2020? **

In the meanwhile, the material shipped to INFN-Laboratori Nazionali del Sud to perform test with an intense ^{137}Cs source

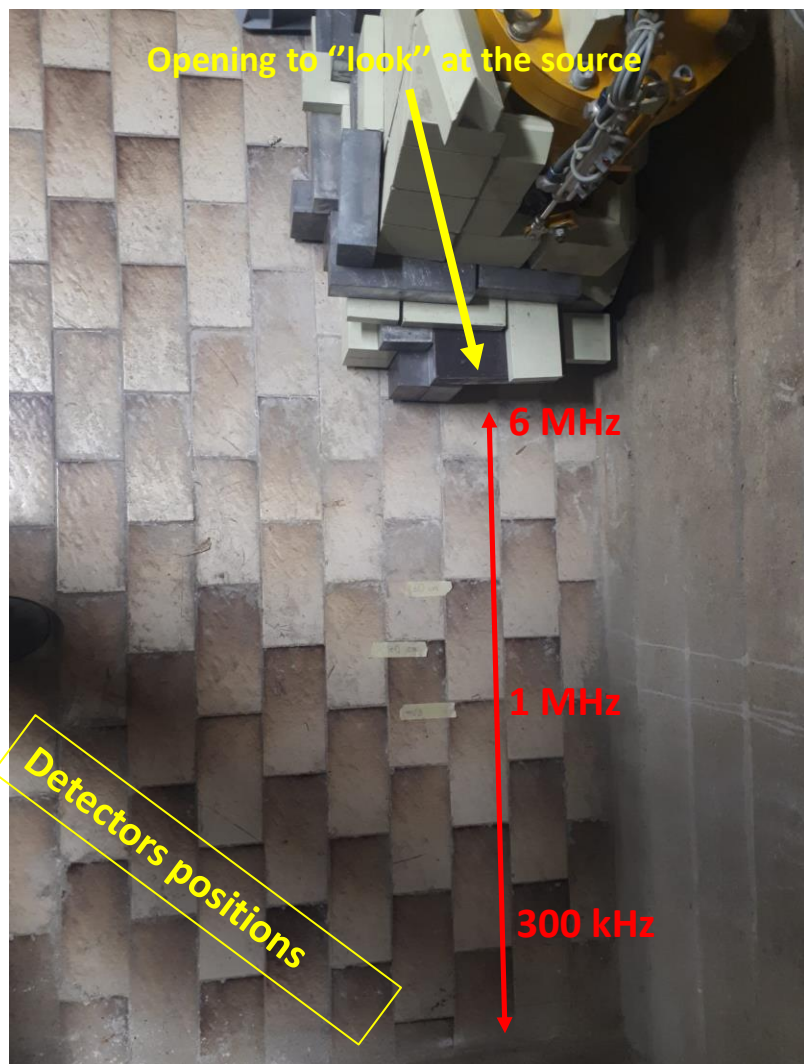
L6D6 n_TOF during LS2: with Source

Test in "hot-room" with a 35.4 GBq ^{137}Cs source at LNS



L6D6 n_TOF during LS2: with Source

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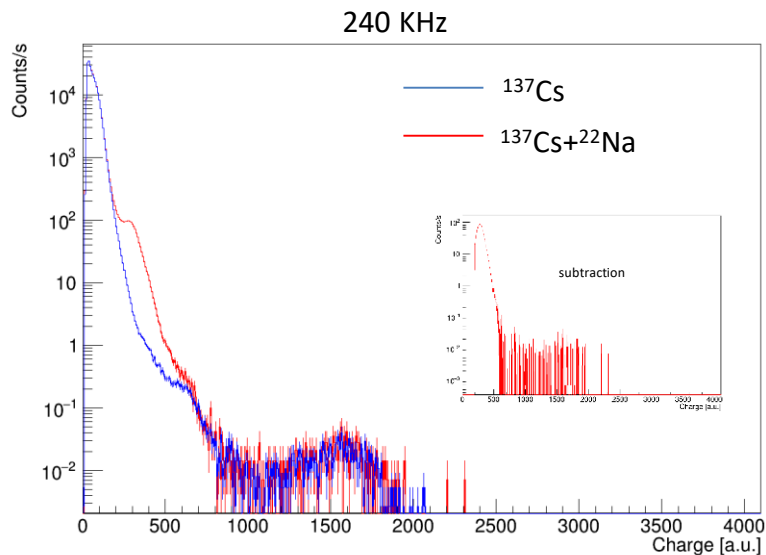
Signals acquired with portable CAEN-DT5751 module

Limitation in the rate the daq system can stand to (<350 KHz)

(distances not smaller than 1.2 m therefore)

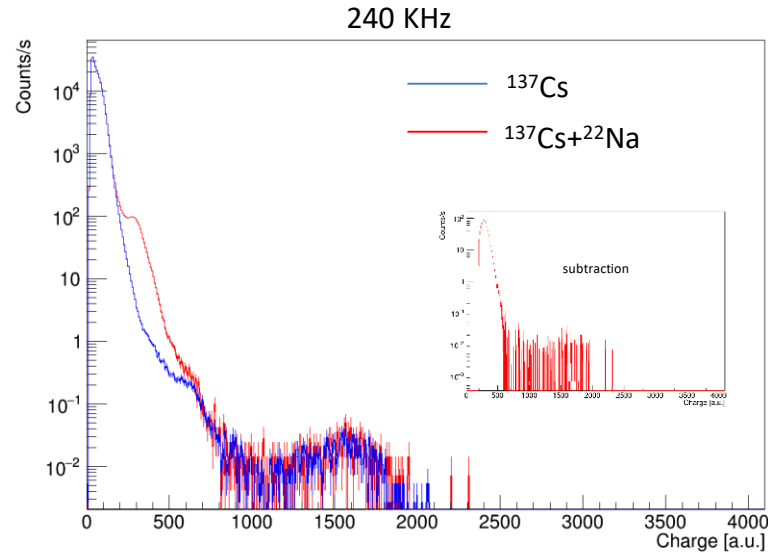
L6D6 n_TOF during LS2: with Source

To check the stability of the gain we exposed the detector to the intense ^{137}Cs source and a standard ^{22}Na source, at several positions, at one fixed voltage value (-1120 V).



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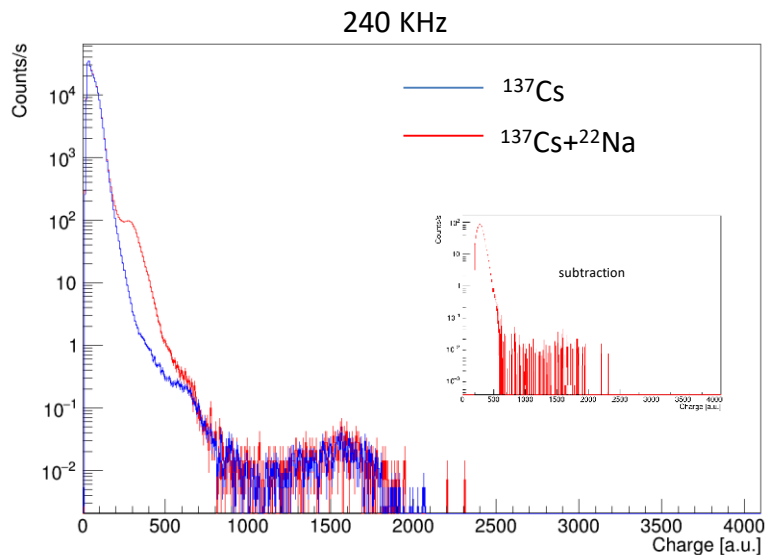


What we learned in the given time (bad news):

- L6D6-C underwent some issue probably in travelling between LNS/Gelina, it is leaking → repair
- All detectors (A-B-C) weight less then what they should → refill
- Fragile connections at the VD level in some case
- Hamamatsu assembly from LNL (PMT+VD) not working

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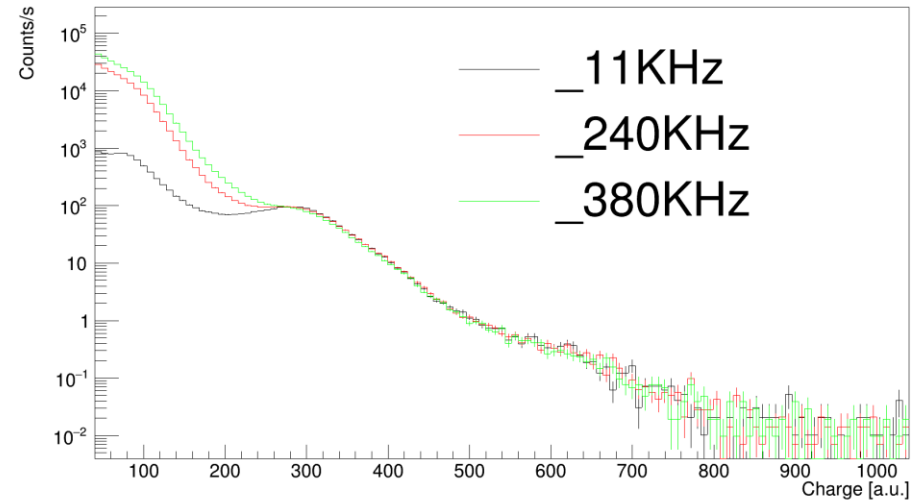
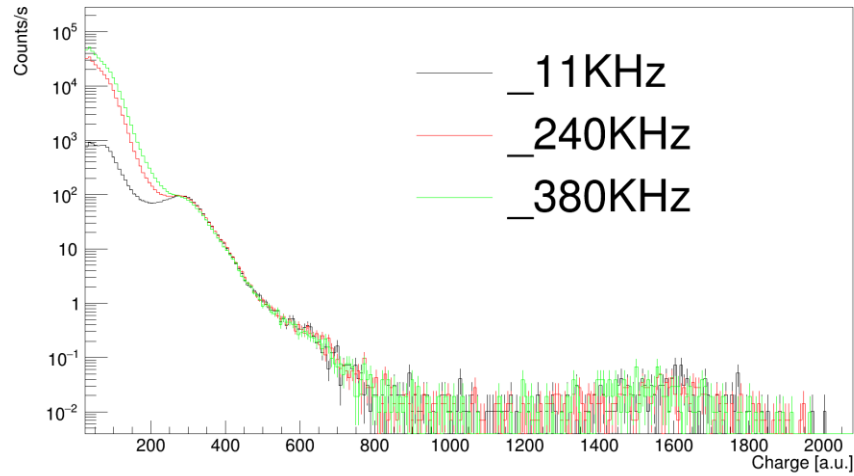
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- Coupling active VD ET-E238ASN2 with SbCs photomultiplier seems to solve the problem of gain shift in steady conditions.



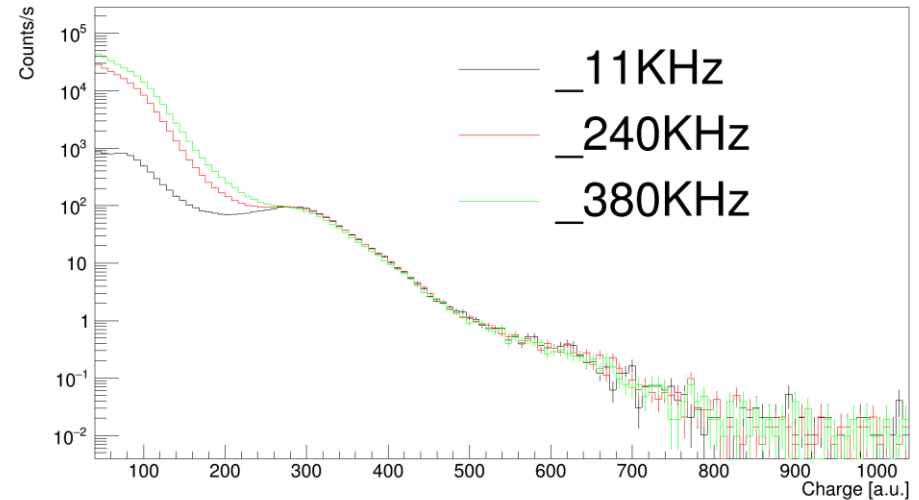
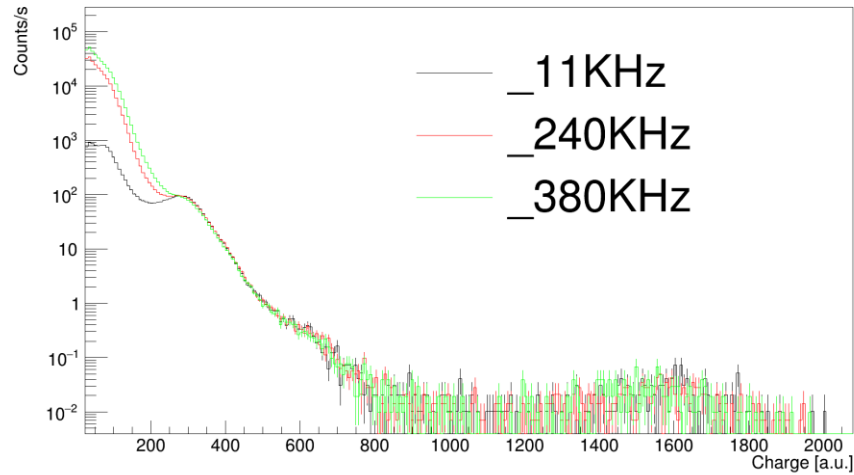
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- Scan over different voltages and more rates
- Test in beam

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Other next steps:

- To be investigated if this VD operate well also with standard BeCu PMT we have.
- Refill the other detectors and extensively test the many configurations we are able to assembly

L6D6 n_TOF during LS2: with Source

Waiting for a neutron beam facility to be ready, perform a test at CERN with sources. After **refilling** the detectors:

- Scan over voltages
- Scan over rates
- “Scan over” several assemblies for PMT and VD

Currently at CERN there are:

^{137}Cs : 2.2 MBq, 342 KBq, 210 KBq

^{60}Co : 30 KBq

^{22}Na : 50 KBq

AmBe: 370 MBq*

Usable in the n_TOF laboratory,
i.e. n_TOF DAQ + CAEN DT5751 in parallel

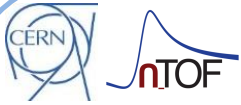
^{137}Cs : 2 TBq, 300 GBq, ...

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RP Test Facility, building 272, 15x15m² room
Accessible out of working hours.
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Facility GIF++, 6x20m²



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~~Mid April?~~

L6D6 handling

“If possible, all the operations should be done in a glove box under Ar-atmosphere so to avoid the contact with oxygen and humidity, which will degrade the detector resolution due to the highly hygroscopic nature of benzene. If such a glovebox is available, before filling the detector let the Ar bubble through the EJ-315 liquid to saturate it and eliminate oxygen and humidity.

If there is no access to such an equipment, the operations should be done under a vented cupboard, wearing two pairs of gloves, ideally normal plastic gloves below chemical resistant gloves (recommended Vitoject 0.7 mm, SCEM 50.43.20.A)”

“If not used for more than 1 month, the detectors should be emptied, as the benzene is highly corrosive and can damage the shell”.

<https://edms.cern.ch/ui/#!master/navigator/document?D:100374613:100374613:subDocs>



CERN
CH1211 Geneva 23
Switzerland

EN Engineering Department

Date : 2019-05-02

EDMS NO. 2114663	REV. 1.2	VALIDITY RELEASED
REFERENCE TOF-L-SF-0031		

<p>DETECTOR PROCEDURES</p> <p>C6D6-Legnaro handling procedures</p>		
<p>DOCUMENT PREPARED BY: F. Mingrone (EP-UNT)</p>	<p>DOCUMENT CHECKED BY: M. Barbagallo (EP-SME) D. Macina (EN-STI-BMI) P.F. Mastinu (INFN-LNL) M. Mastromarco (EN-STI-BMI) P.M. Milazzo (INFN-Trieste) J. Gulley (HSE-OHS)</p>	<p>DOCUMENT APPROVED BY: S. Gilardoni (EN-STI) R. Folch (EN-DHO)</p>
<p>DOCUMENT SENT FOR INFORMATION TO: e-group: ntof-localteam, S.F. Cherault</p>		

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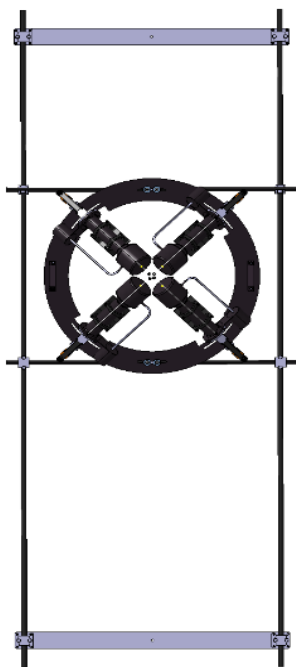
Thanks for your attention

L6D6 Support for EAR1

In order to improve stability of the detectors a new support system has been designed.

The new support will also offer more degree of freedom in terms of different axis of translation or rotation.

Reproducibility of the setup



Details (and approval) to be discussed at the next n_TOF Collaboration Board in May 2020