Preliminary results on PDE measurement of the VD-XA in Napoli

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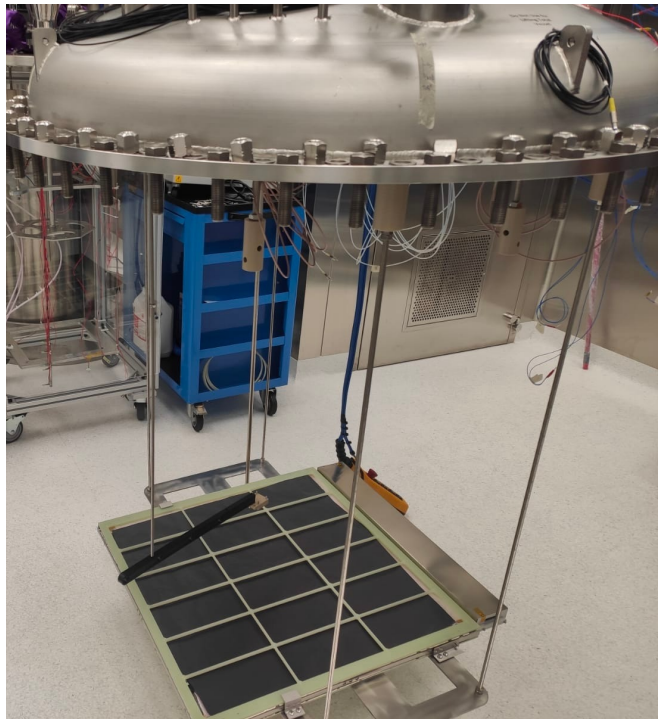
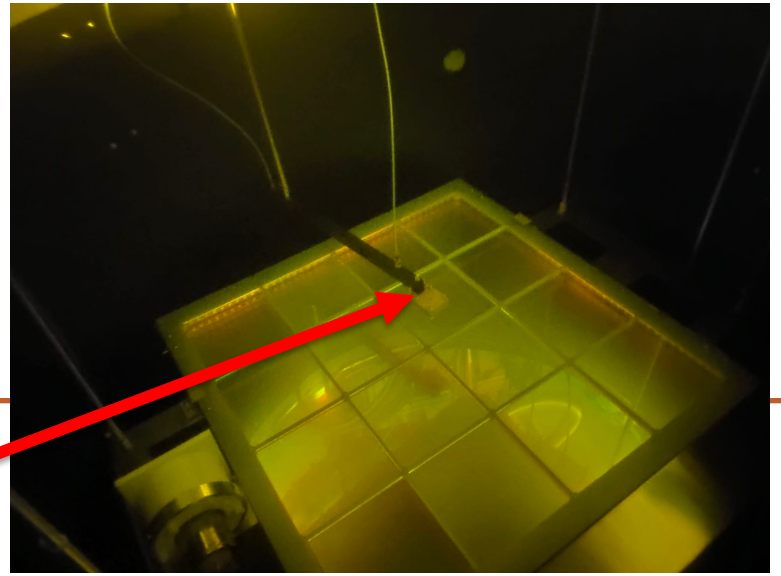
Outline

- Experimental setup for PDE Measurement
- Cryostat LAr filling
- Argon purity evaluation
- SPE (Single PhotoElectron) measurement
- Simulation
- Preliminary result for PDE

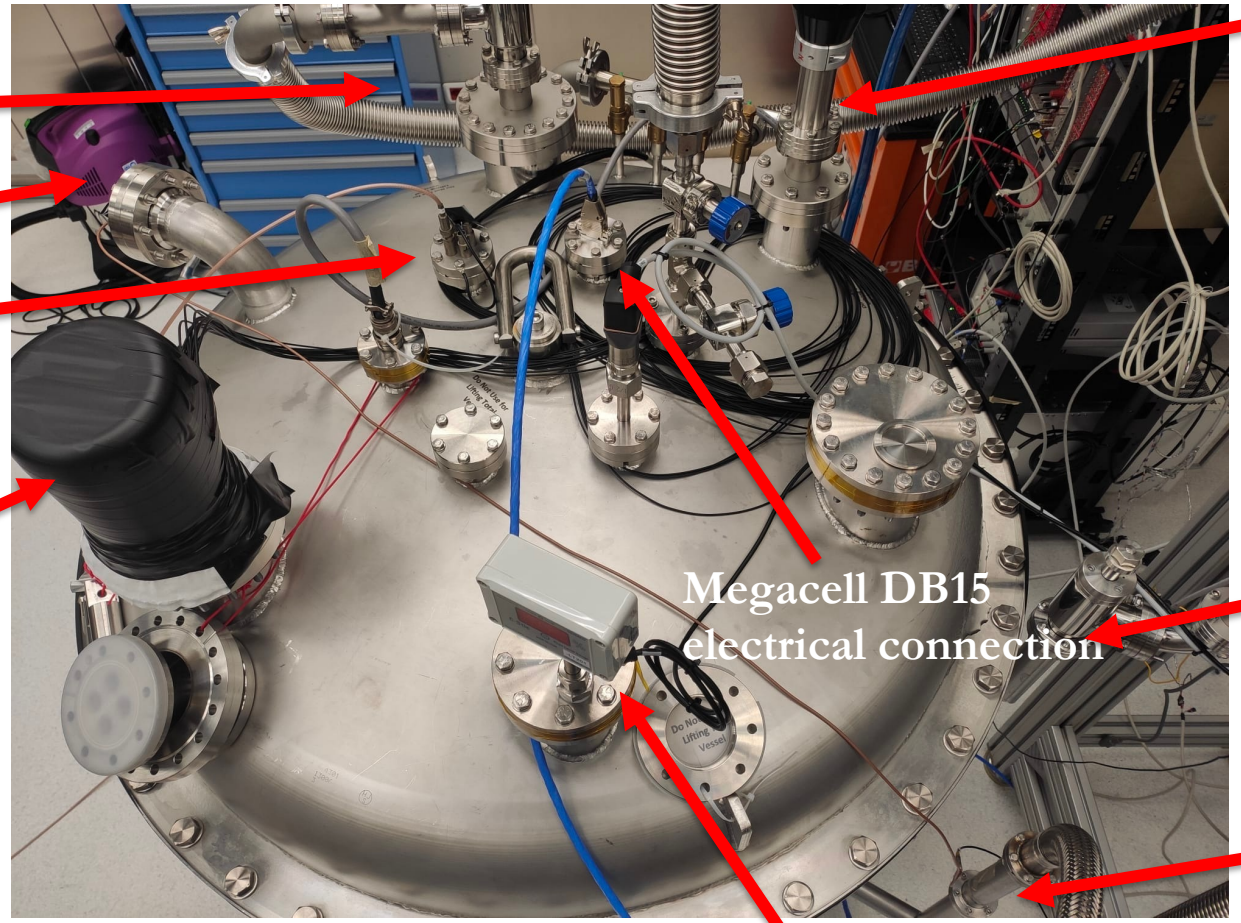
XA-VD measurement setup





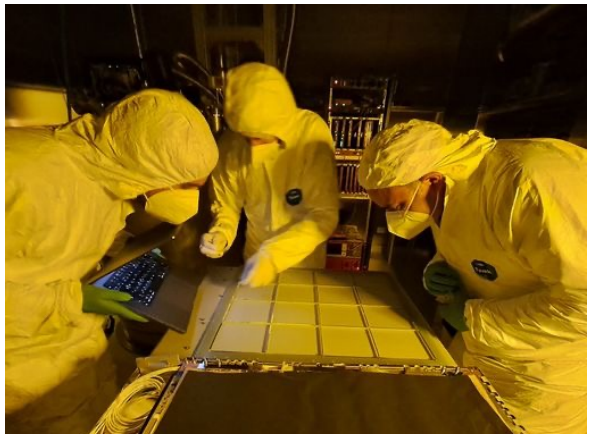
- Megacell on mechanical structure connected to dome
- ^{241}Am source in Peek frame holder and connected to roto-translator
- Inside the cryostat has been inserted a black shielding made by Delrin along the cryostat mantle and on the top cover

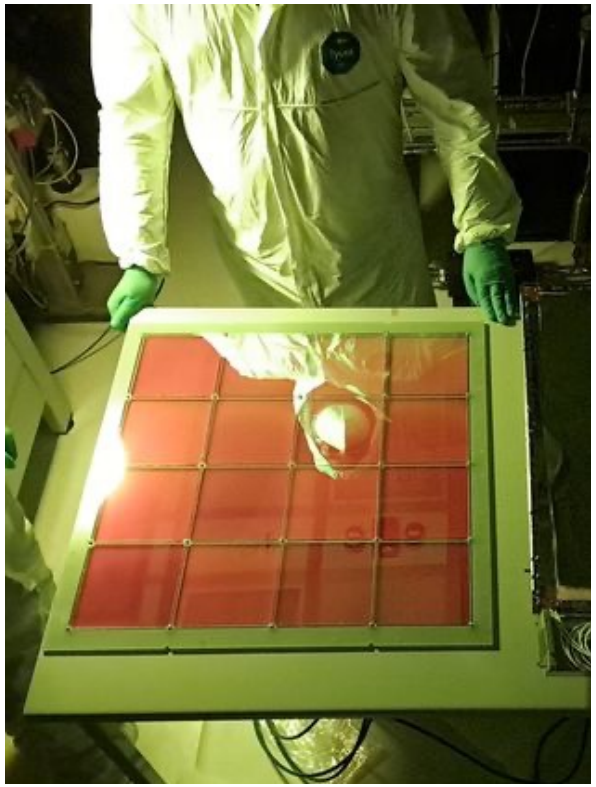
XA-VD measurement setup

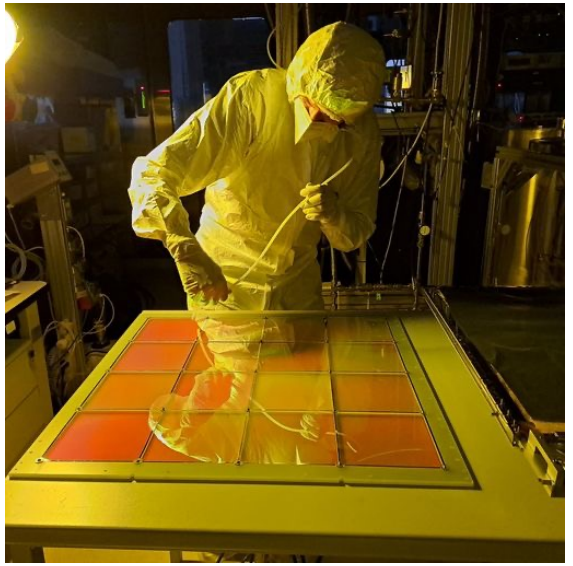


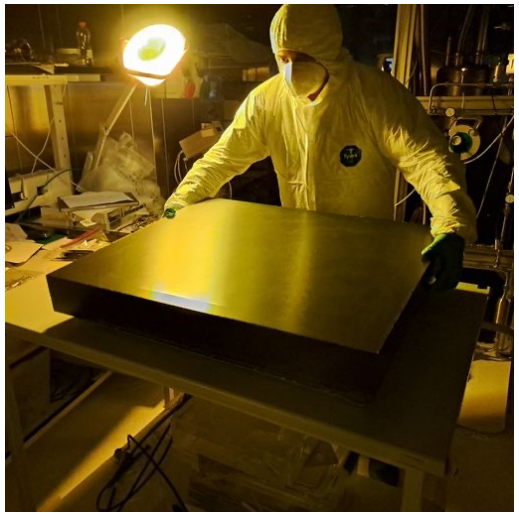
Dichroic filters mounting

- ZAOT filters evaporated in Campinas
- Mounted in Napoli clean room
- Light UV shielded during operations

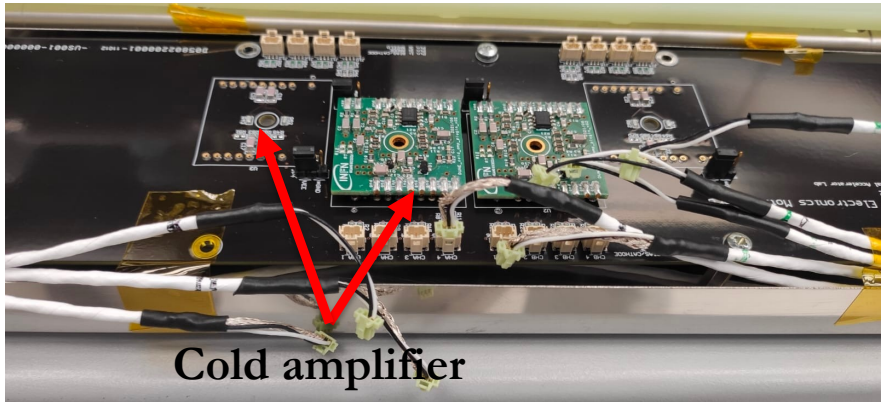






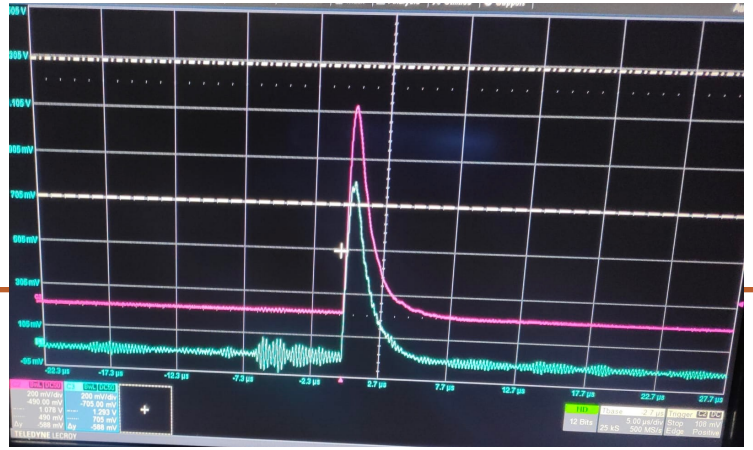


Electrical connection and DAQ



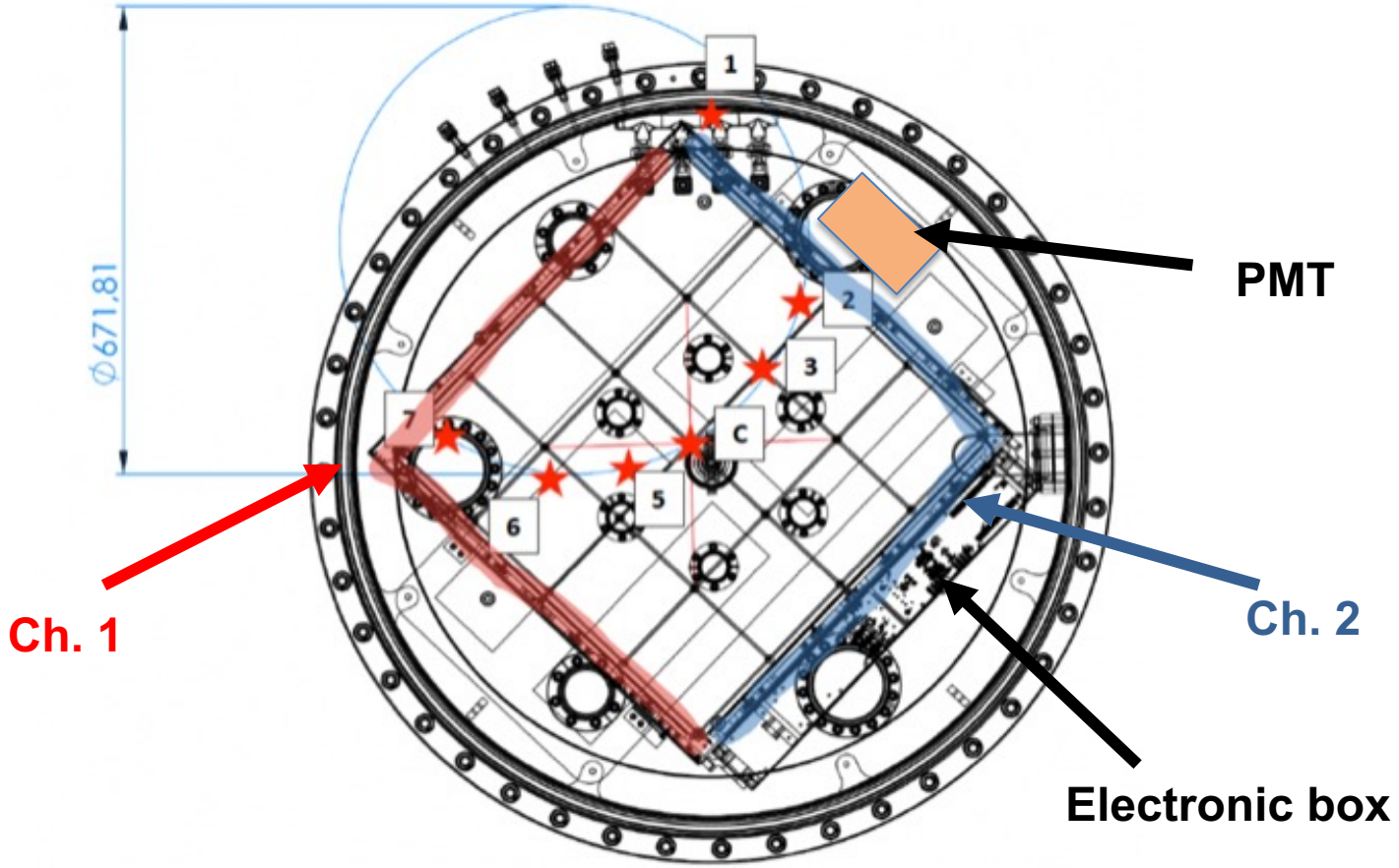
- DMEM with two cold amplifier: preliminary tested in LN_2 : both channels working
- just before to close the cryostat one of two signal is not present: we changed position of one cold amplifier
- After LAr filling discovered that one channel is very noisy
- Output signals from second stage amplifier sent to CAEN V1725B digitizer

Warm second stage amplifier



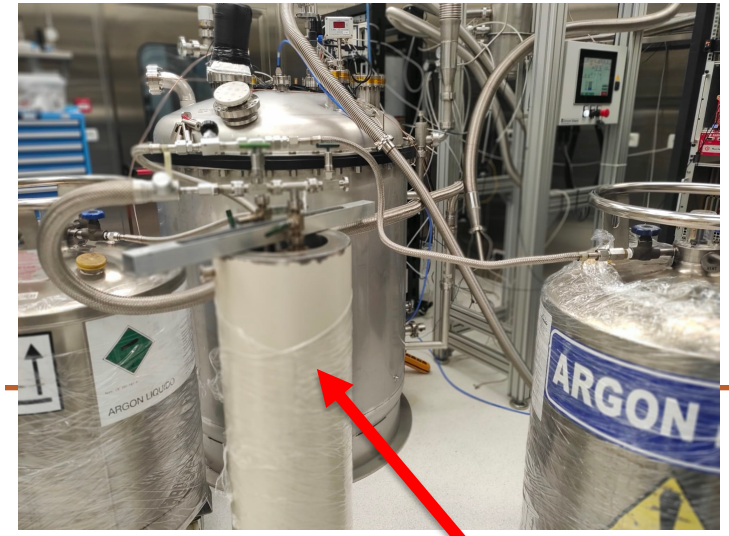
Measurement positions

- Ch1: square dimples
- Ch2: cylindrical dimples
- PMT for purity monitoring



Vacuum operations and LAr filling

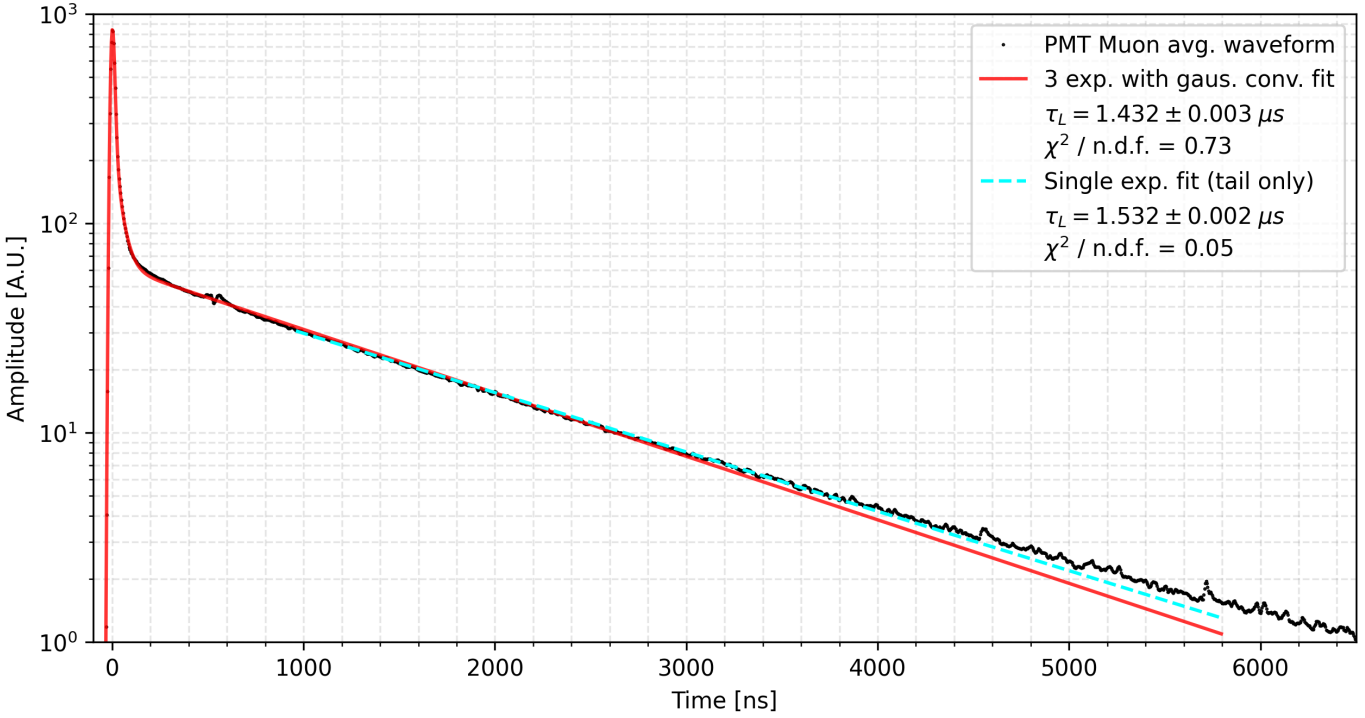
- Pump and purge cycles before filling
- Due to large amount of materials vacuum level not better than 10^{-4} mbar
- The cryostat has been filled with LAr5.0 filtered by an in-line Trigon (Engelhard Q5-Cu0226)
- During all measurement operations cryostat is in overpressure (1.2 atm) with respect to external pressure



Trigon filter

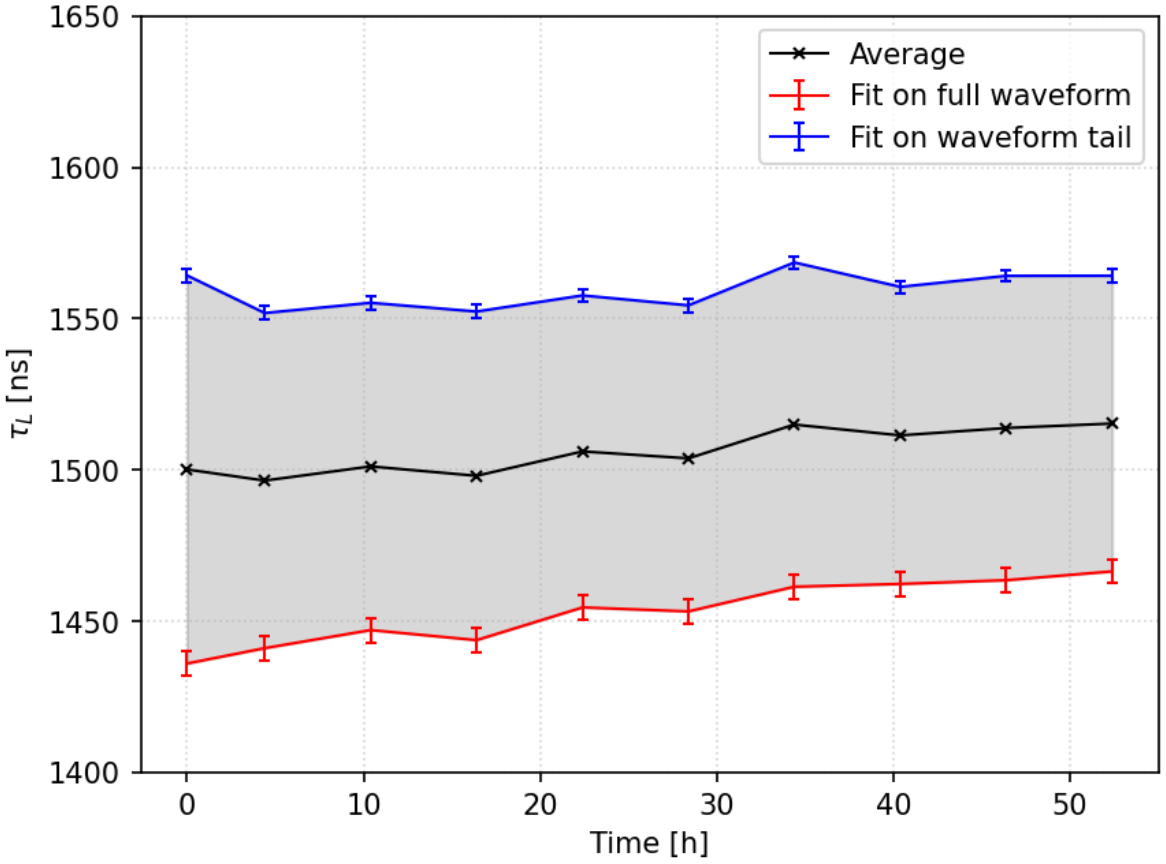
- Capacimeter level: the maximum correspond to 25 cm of LAr above Megacell
- Evaporation rate 4 cm/24h

LAr purity estimated with PMT



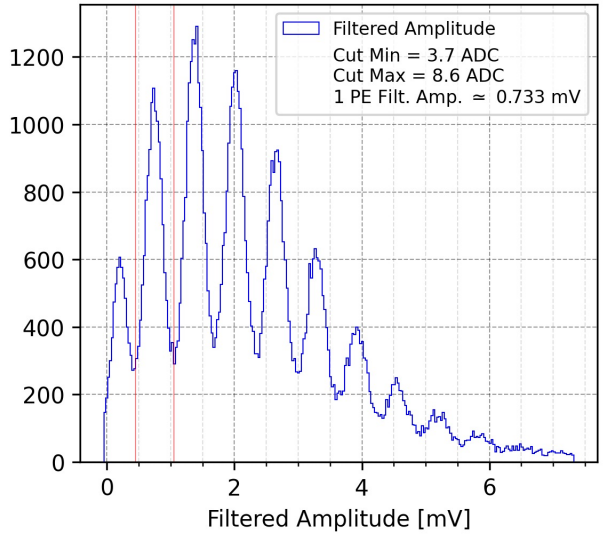
- Two fitting procedures_
  - 3 exp. + gaussian
  - Single exp (tail only)
- **Result of long tau component between 1.4-1.5 us**
- Fit executed on muon sample

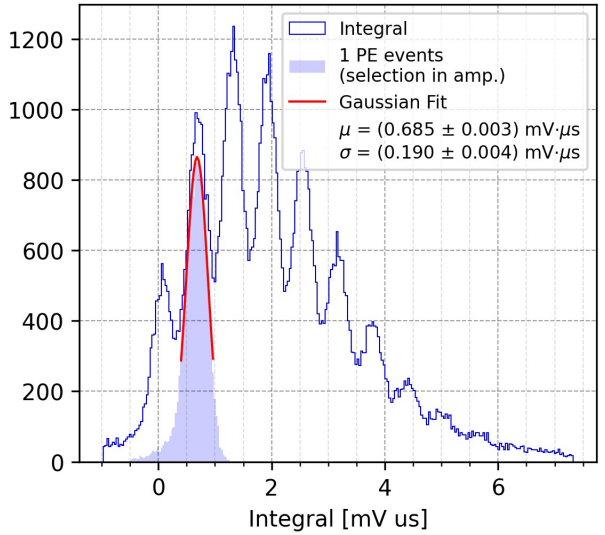
Monitoring of stability of LAr purity

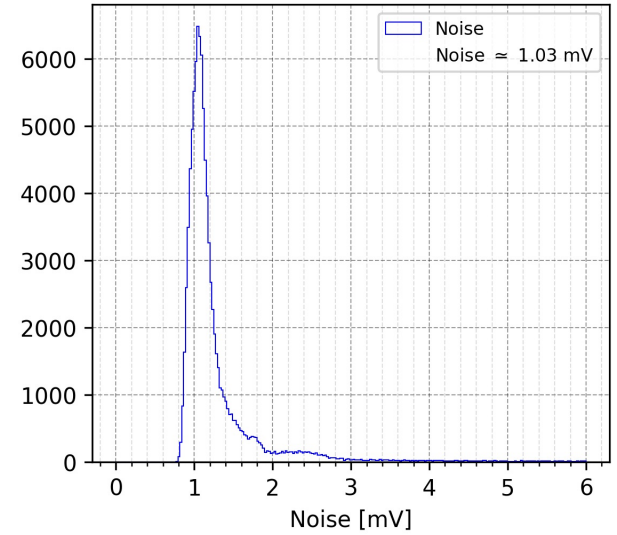


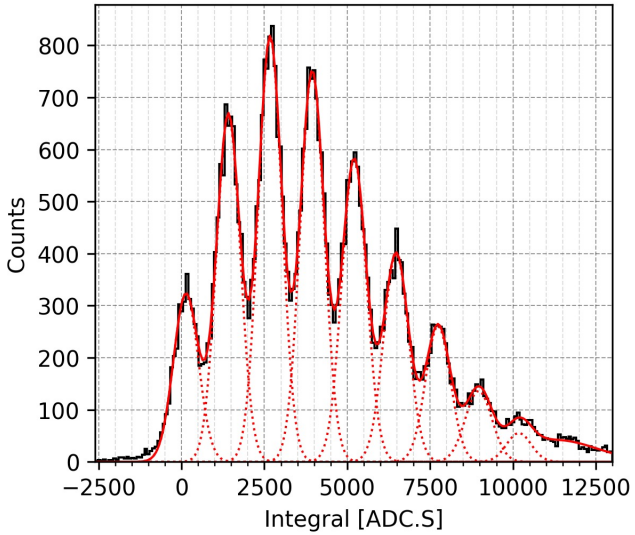
- Purity is found stable in all the measurement period
- No purity correction to the measurement are required

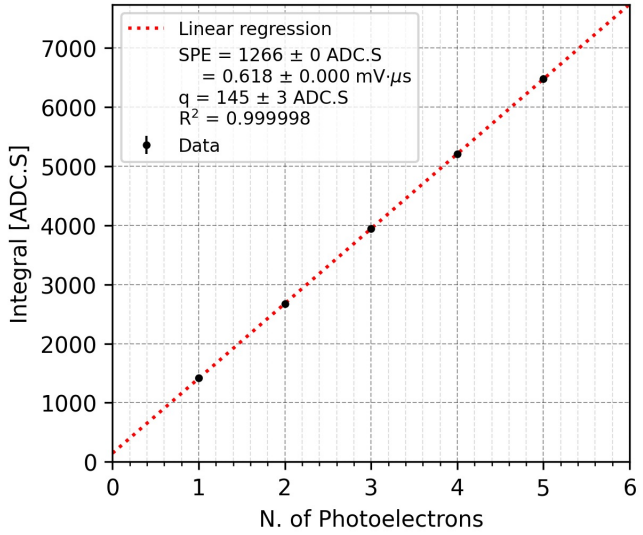
SPE response at OV=4.5V

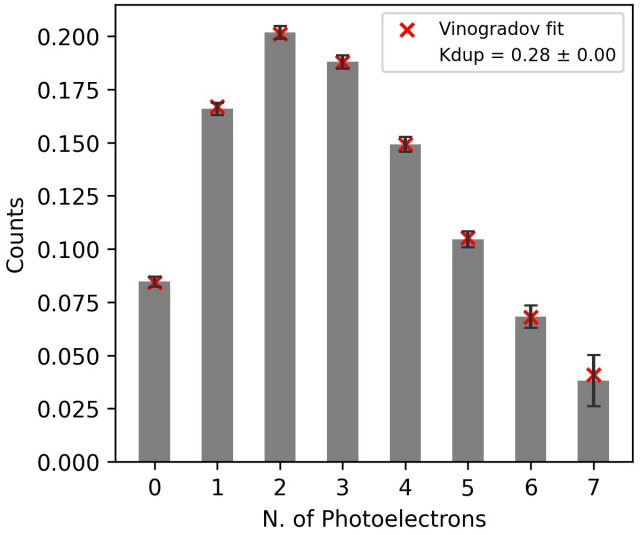










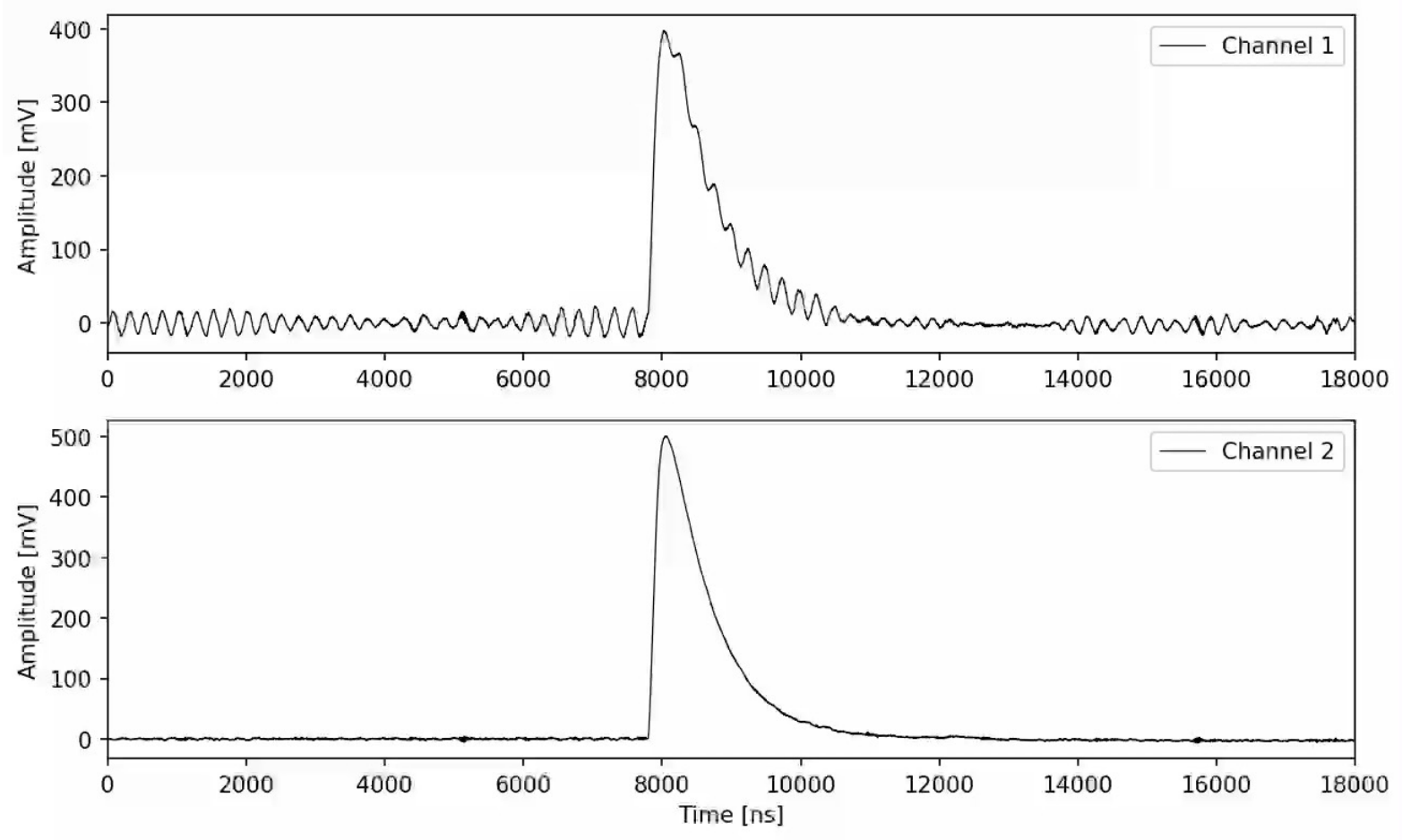


Channels: 1,2

Filter moving average

- Channel 1 very noisy → **impossible to retrieve SPE**
- Channel 2 is ok
- Vinogradov fit to photon statistics
- duplication factor 0.28
- f_{CTAP}=1.28

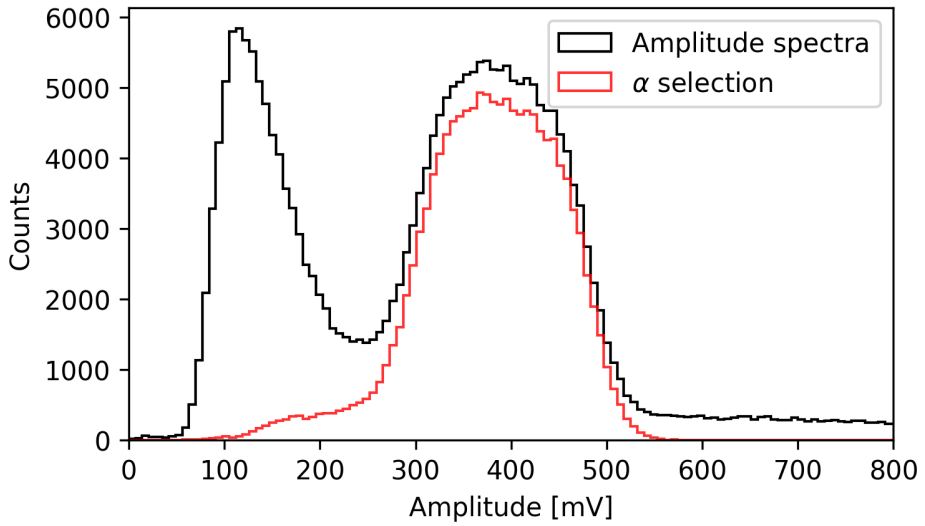
Alpha signal waveforms

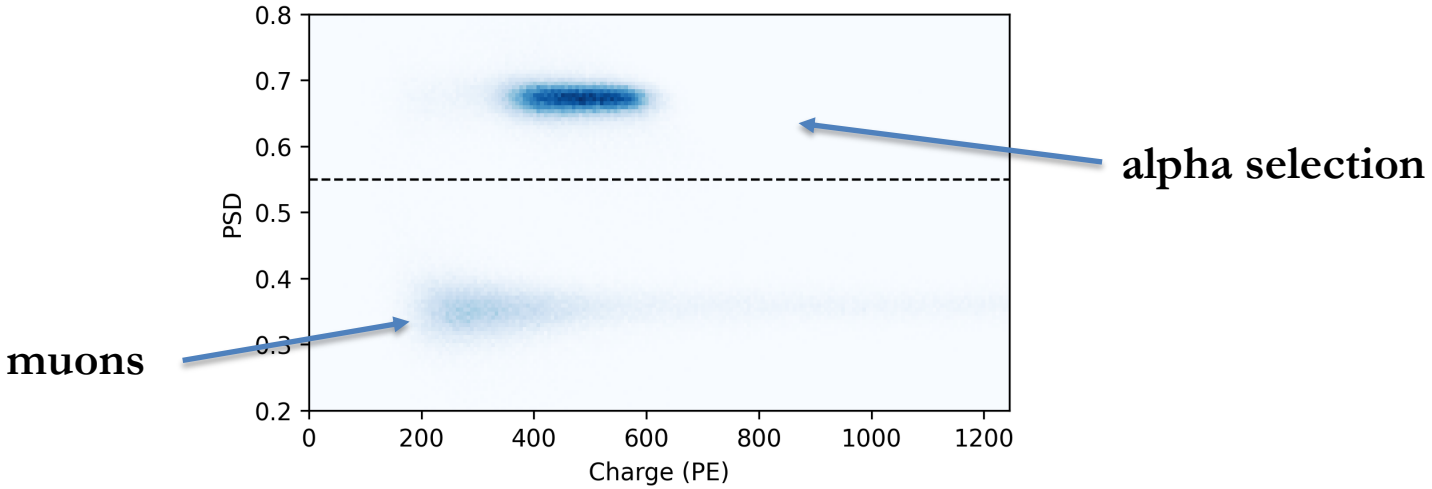


Channel 1 noisy

Trigger on Channel 2

Alpha source events

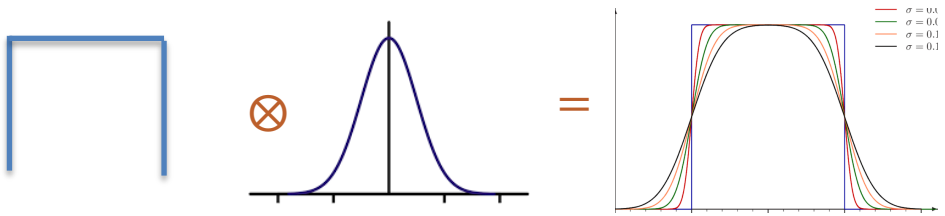


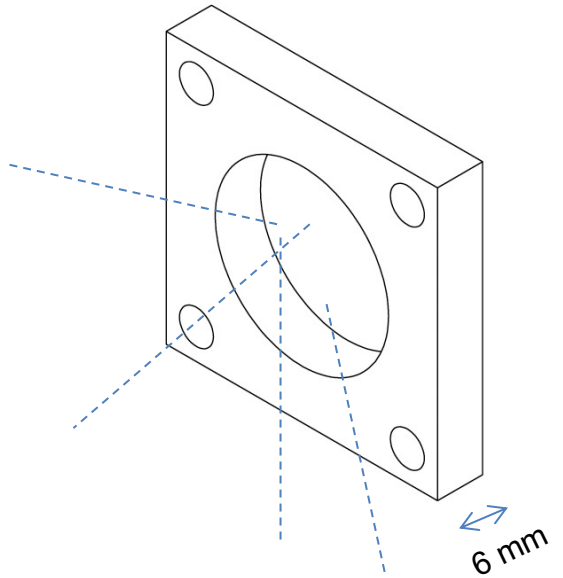


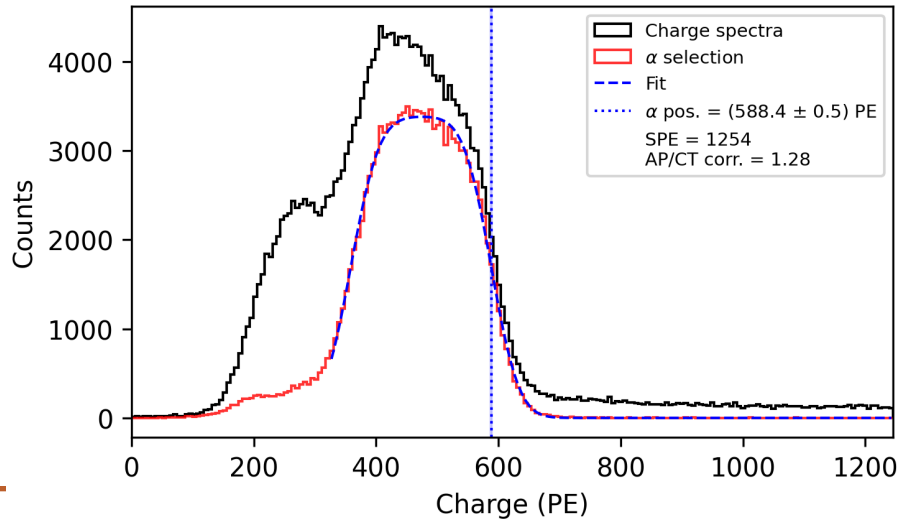
- Non-gaussian shape of the amplitude spectrum
- Most likely this the effect of self-shielding of the source holder

Source holder geometry

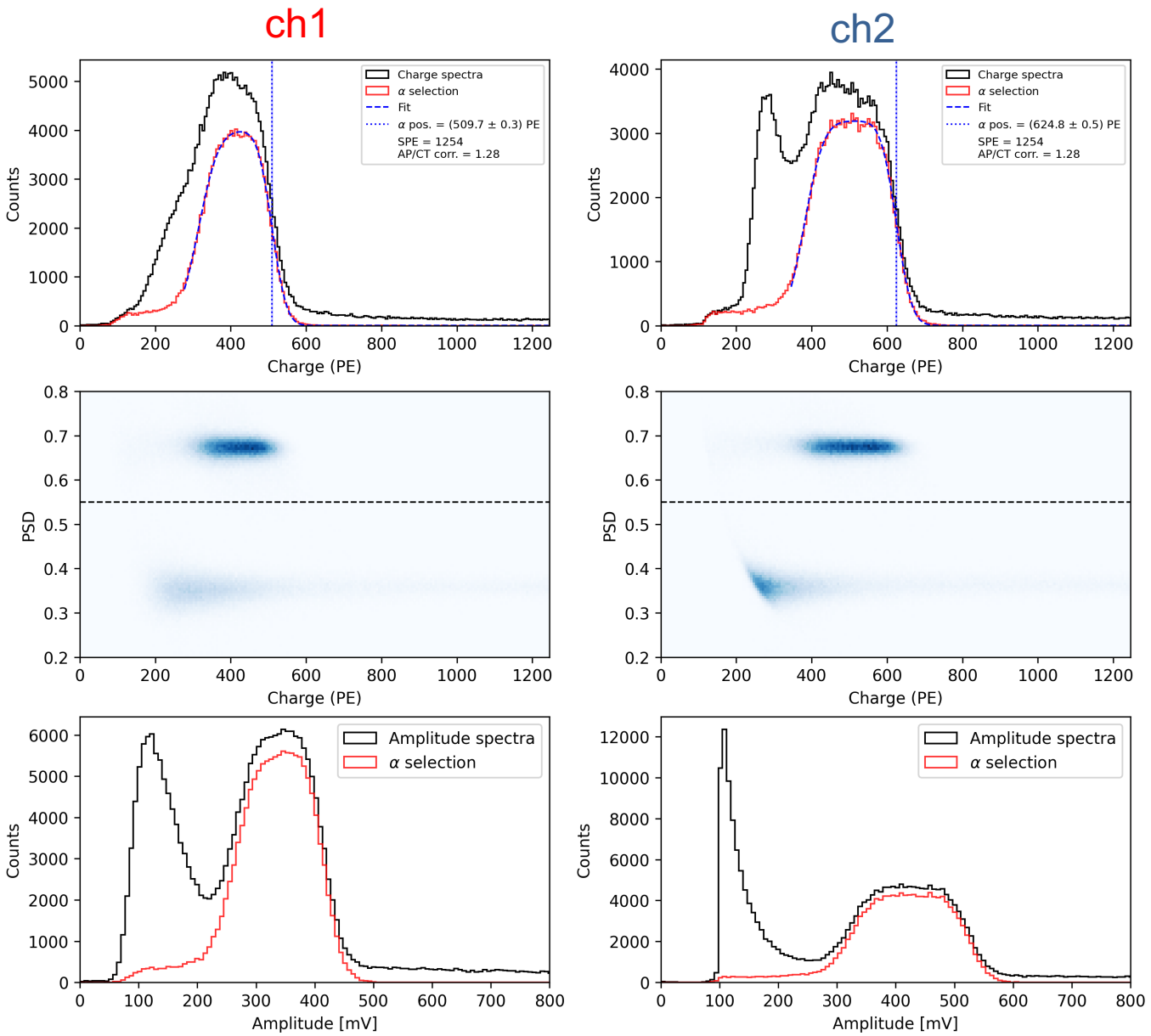
- Source holder window is 23 mm diameter
- Thickness of the holder edges is 6 mm: this induce a shielding of alpha particles
- Due to the holder shielding the alpha spectrum becomes flat
- **Charge spectrum** fitted with the convolution of a box function and a gaussian
- **Alpha yield: 50% of right tail**
- Alpha Spectrum has been corrected for secondary pulses (AP/CT)





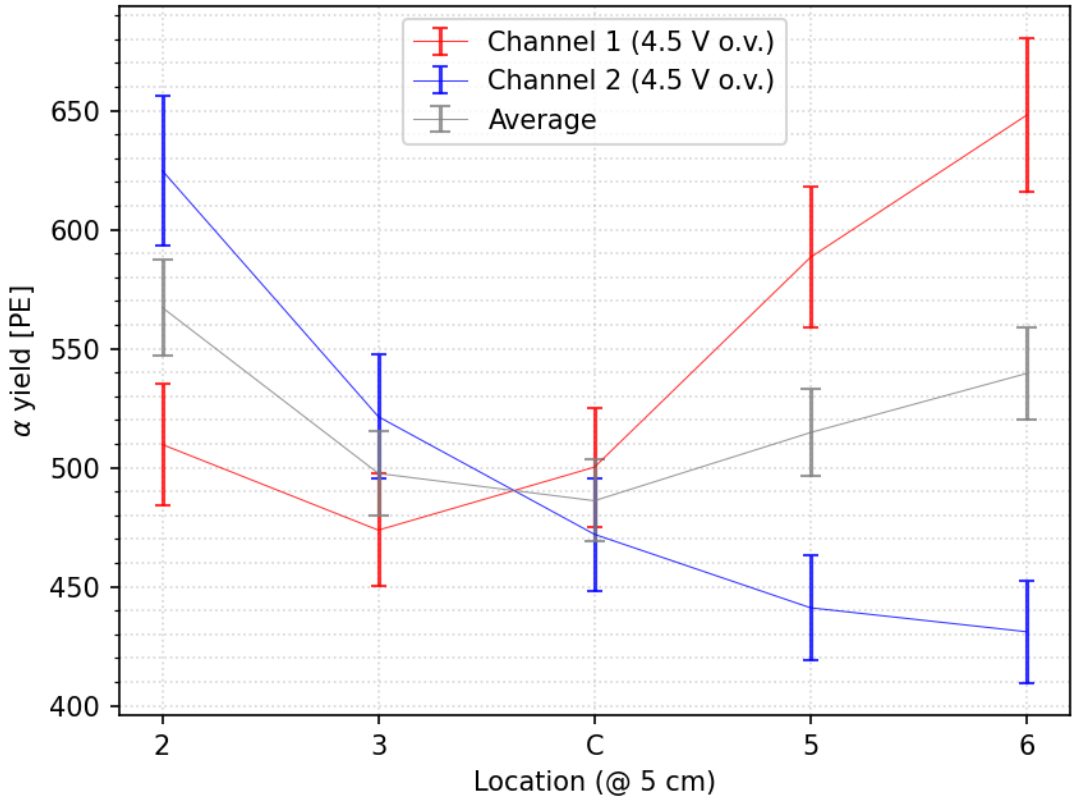


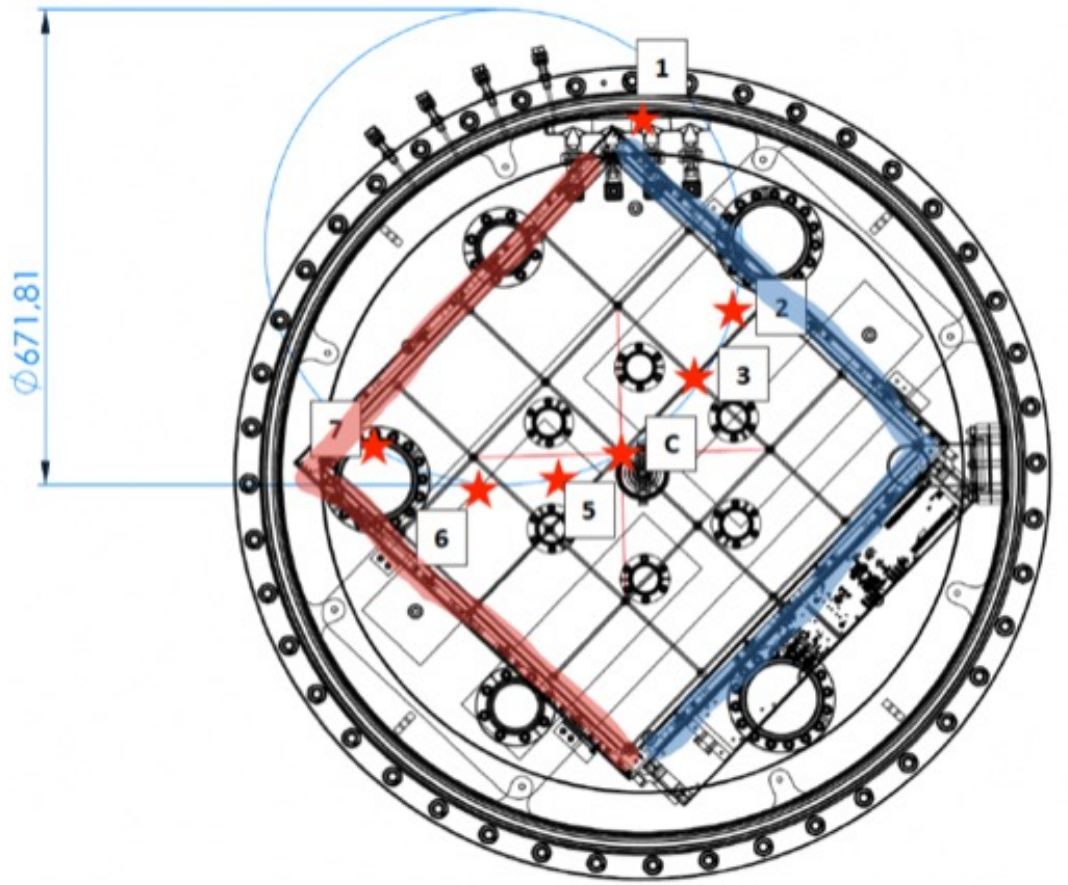
Alpha spectrum: OV=4.5 V

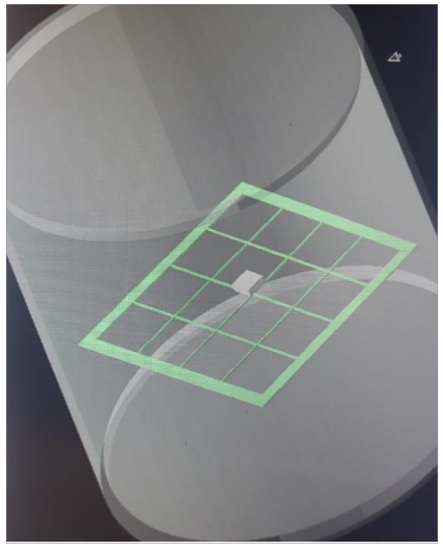


- Trigger on ch2 due to lower noise
- Alpha events selected via prompt light (PSD)
  - Alpha distribution appears non-gaussian due to source holder shielding
  - Alpha yield = fitted tail with the convolution of constant + gaussian distributions=50% of the maximum on the right tail
- Measurement in six different locations for the source
- Error (systematic) estimated by varying cuts

Alpha spectrum: PEs vs position@ OV=4.5V



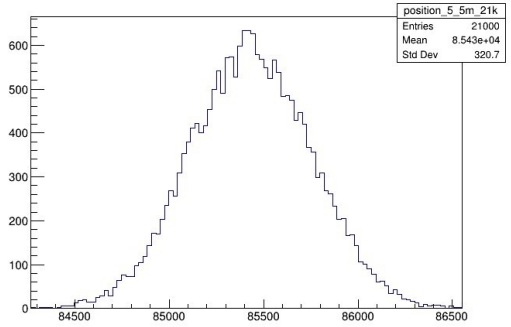




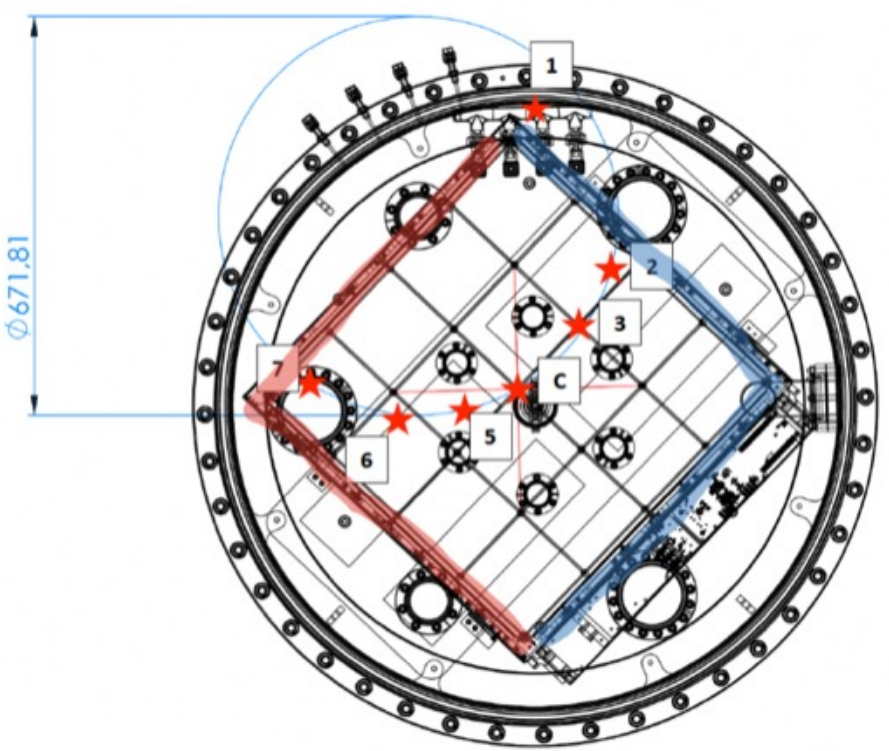
Simulation (A. Machado, G. Valdiviesso)

$$PDE = \frac{N^{PE}}{N^{Ph}{}_{SIM}}$$

Position	Average number of photons@ 5 cm
P2	8.698 E+04
P3	8.611 E+04
C	8.057 E+04
P5	8.543 E+04
P6	8.338 E+04
P7	5.367 E+04



number of photons in P5

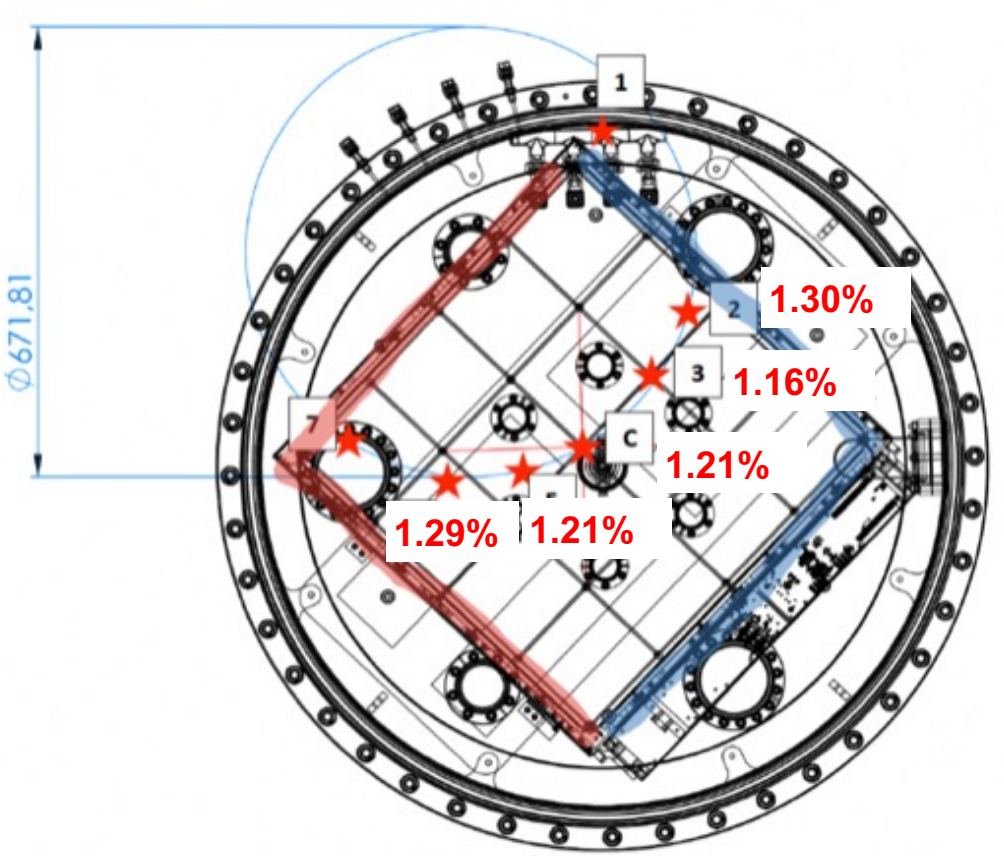


Initial LY = 36000ph/MeV

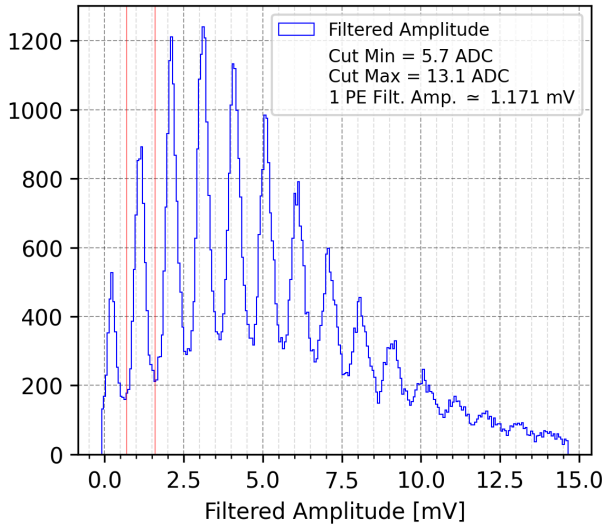
Preliminary results for PDE@OV=4.5V

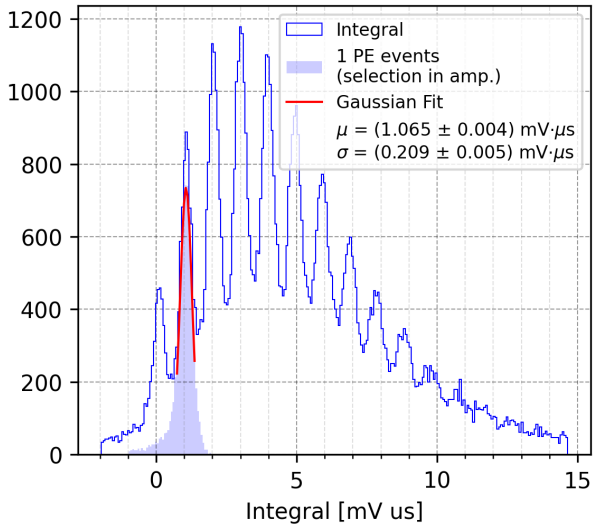
- Secondary pulse correcttion factor 1.28
- PDE found to be about 1.2-1.3 %

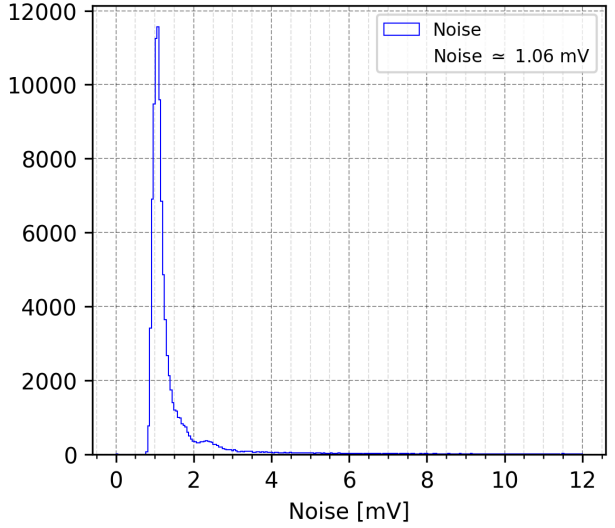
	PDE(%) @ OV=4.5V
Position	5 cm
P2	1.30 ± 0.08
P3	1.16 ± 0.08
C	1.21 ± 0.08
P5	1.21 ± 0.08
P6	1.29 ± 0.08

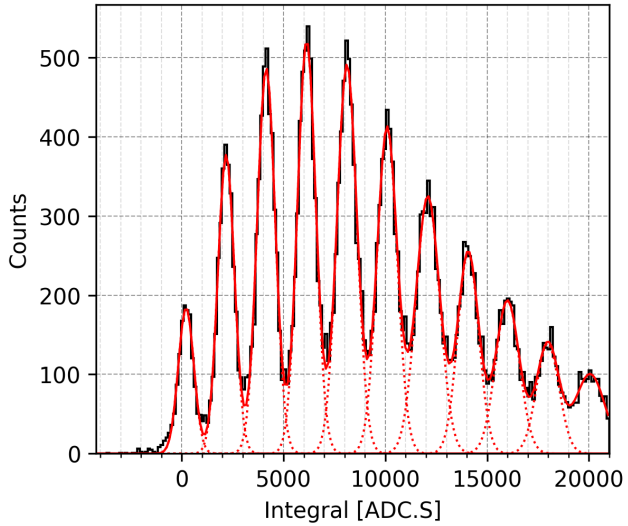


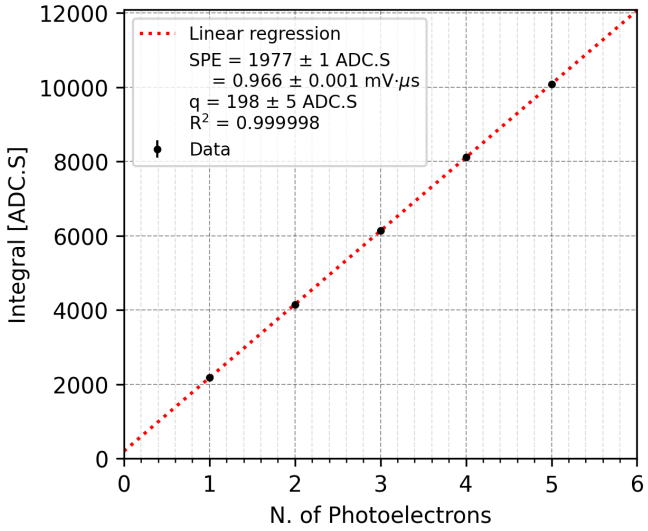
SPE response at OV=7.0V

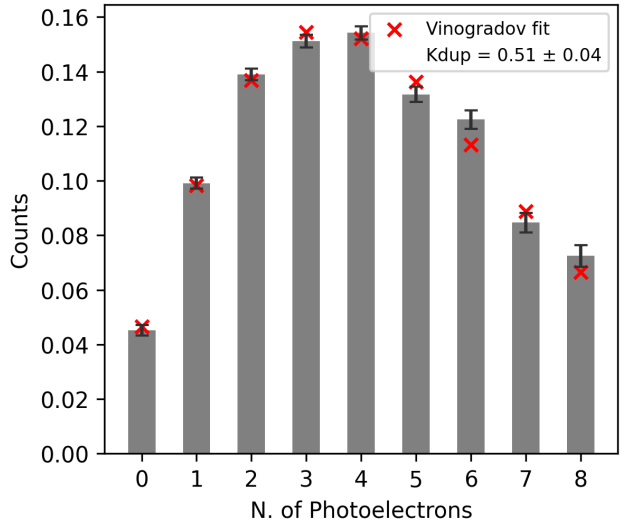






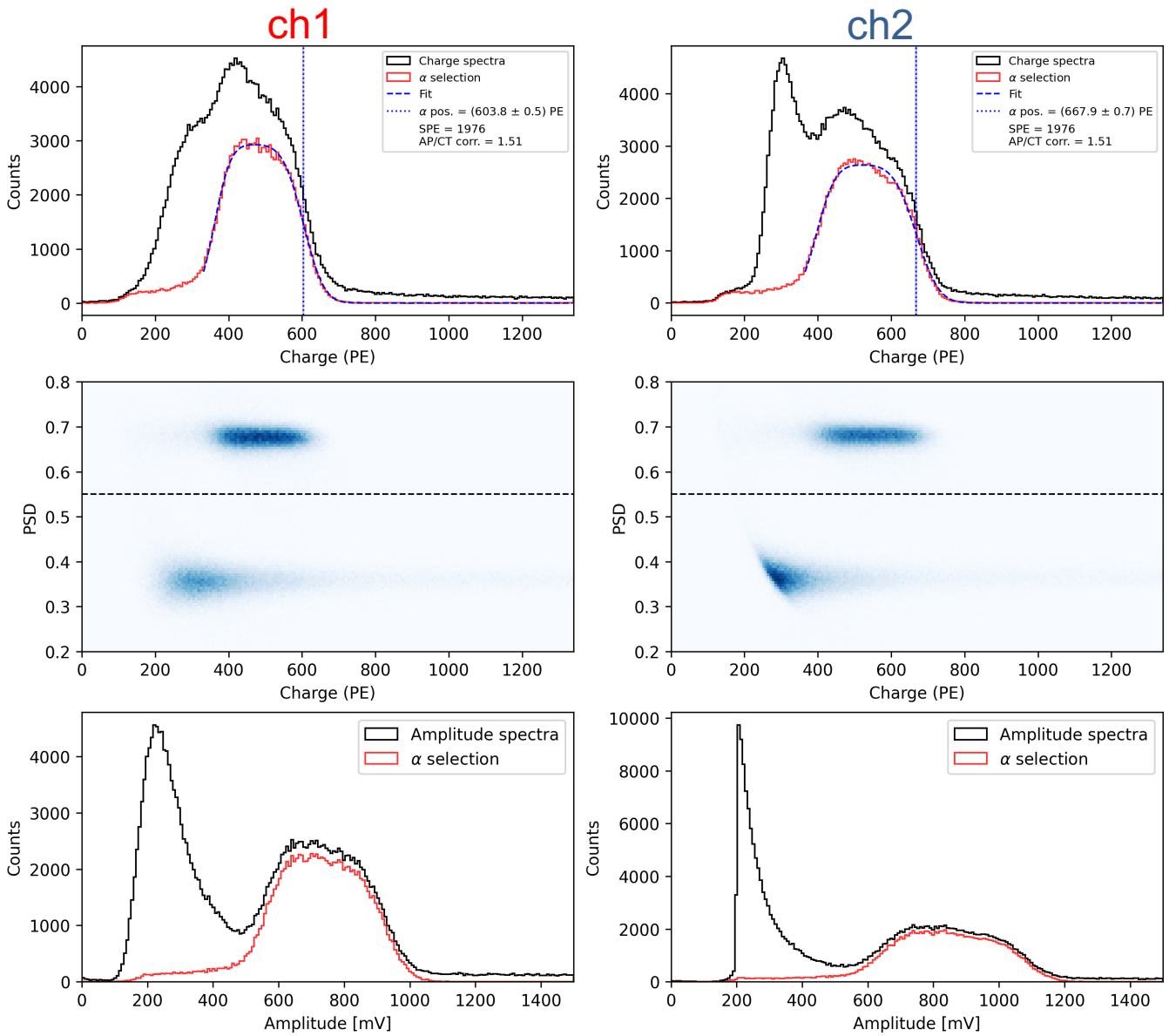






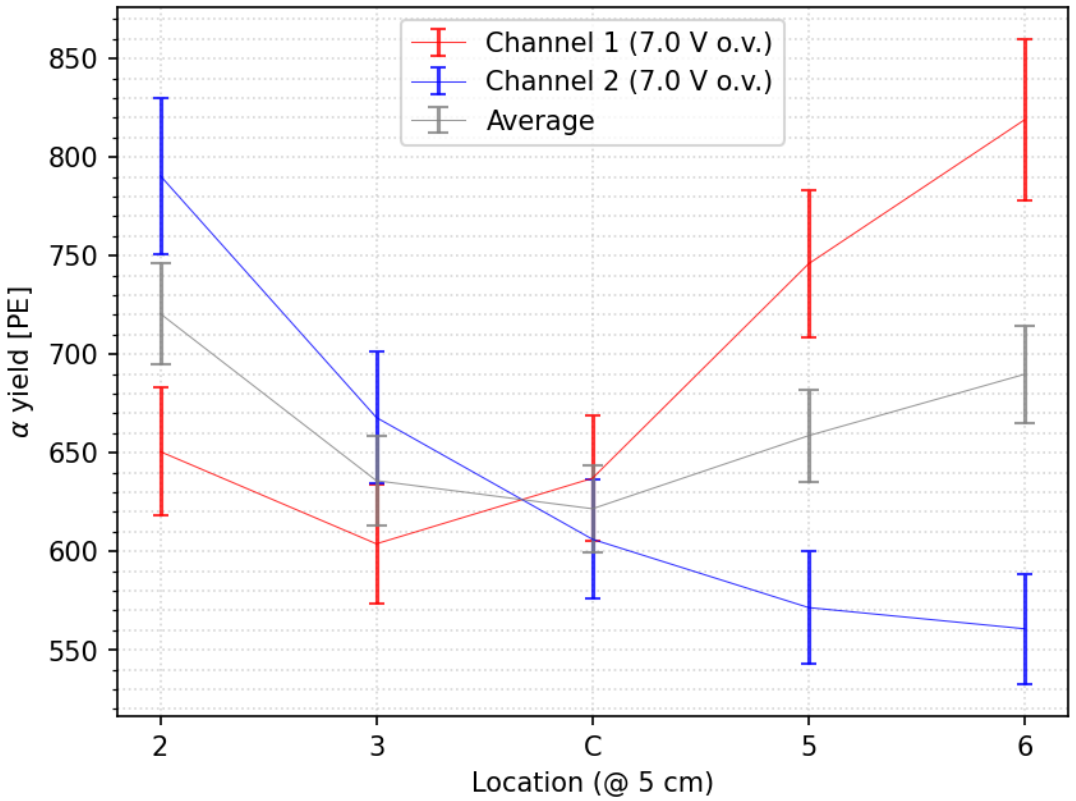
- SPE fitted at OV=7.0V
- Vinogradov fit to photon statistics
- duplication factor 0.51
- f_{CTAP}=1.51

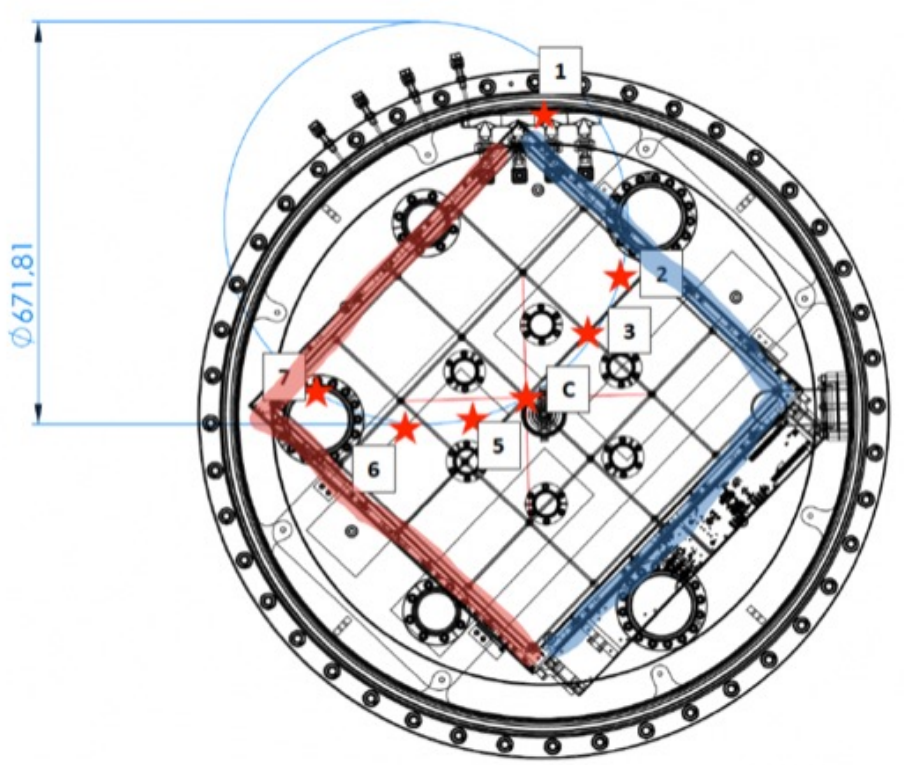
Alpha spectrum: OV=7.0 V



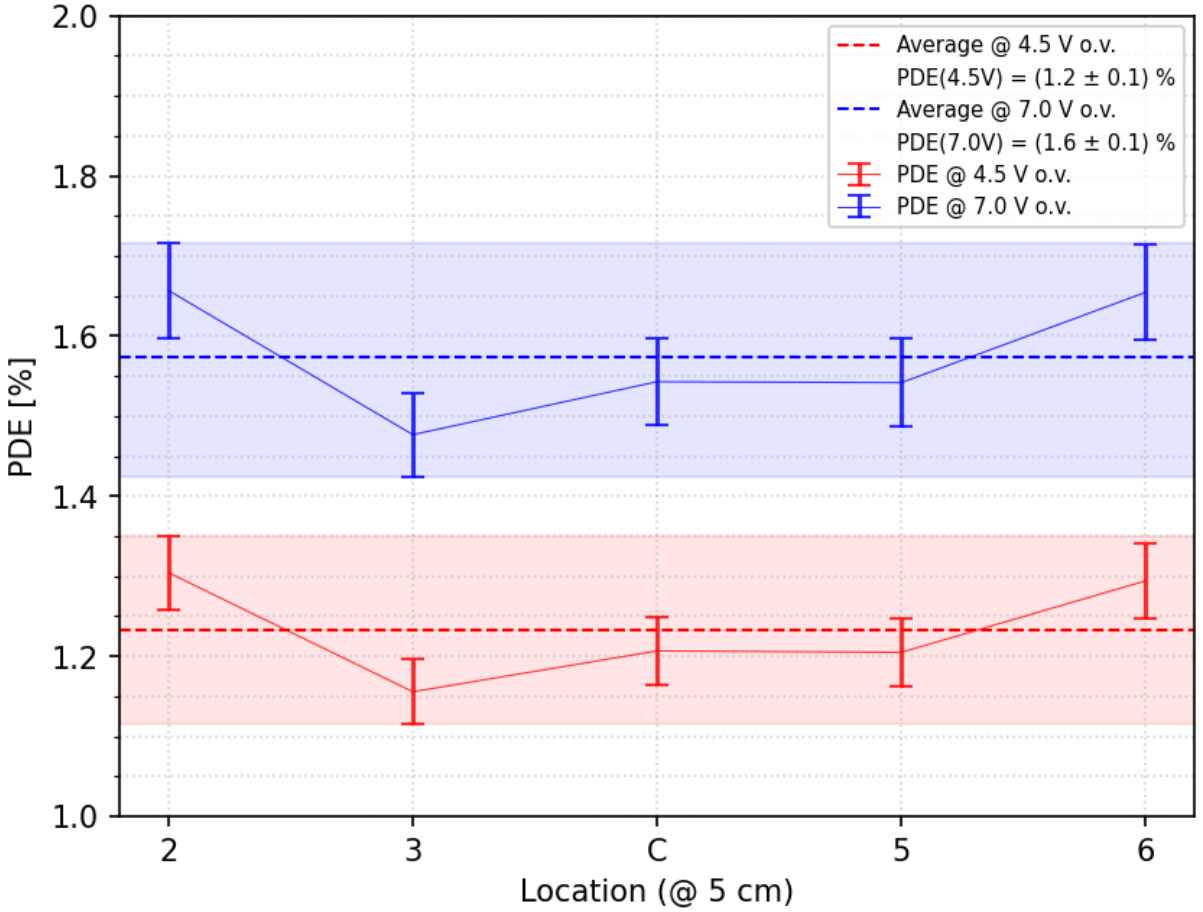
- Alpha source analysis at OV=7.0V
- Spectrum includes corrections for secondary pulses (AP/CT)

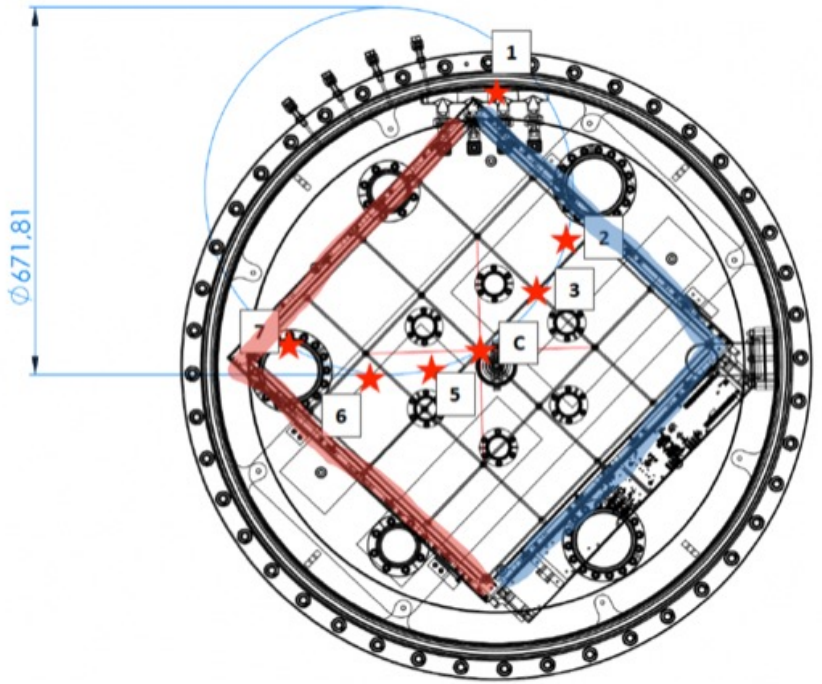
Alpha spectrum: PEs vs position@ OV=7.0V





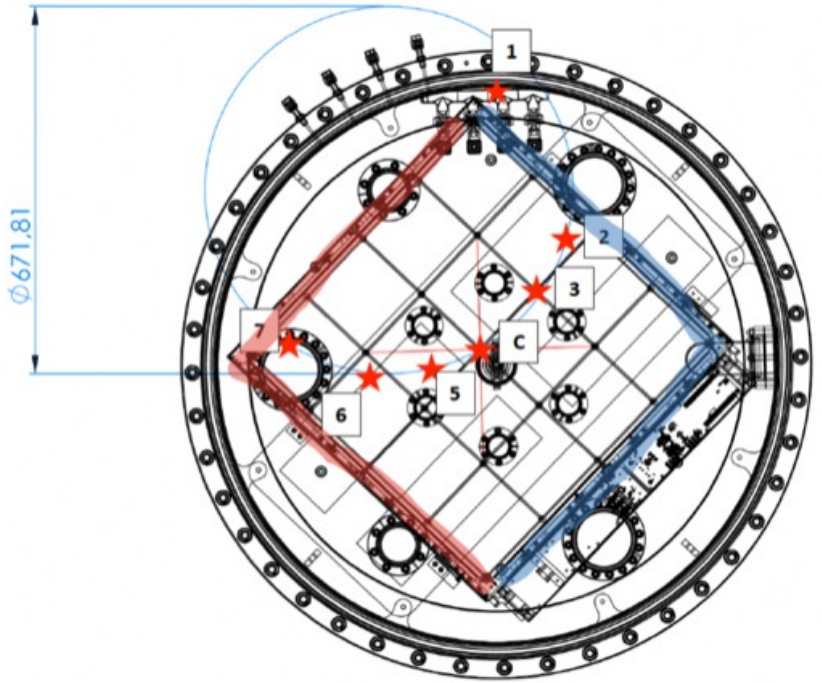
PDE summary (preliminary)





PDE summary (preliminary)

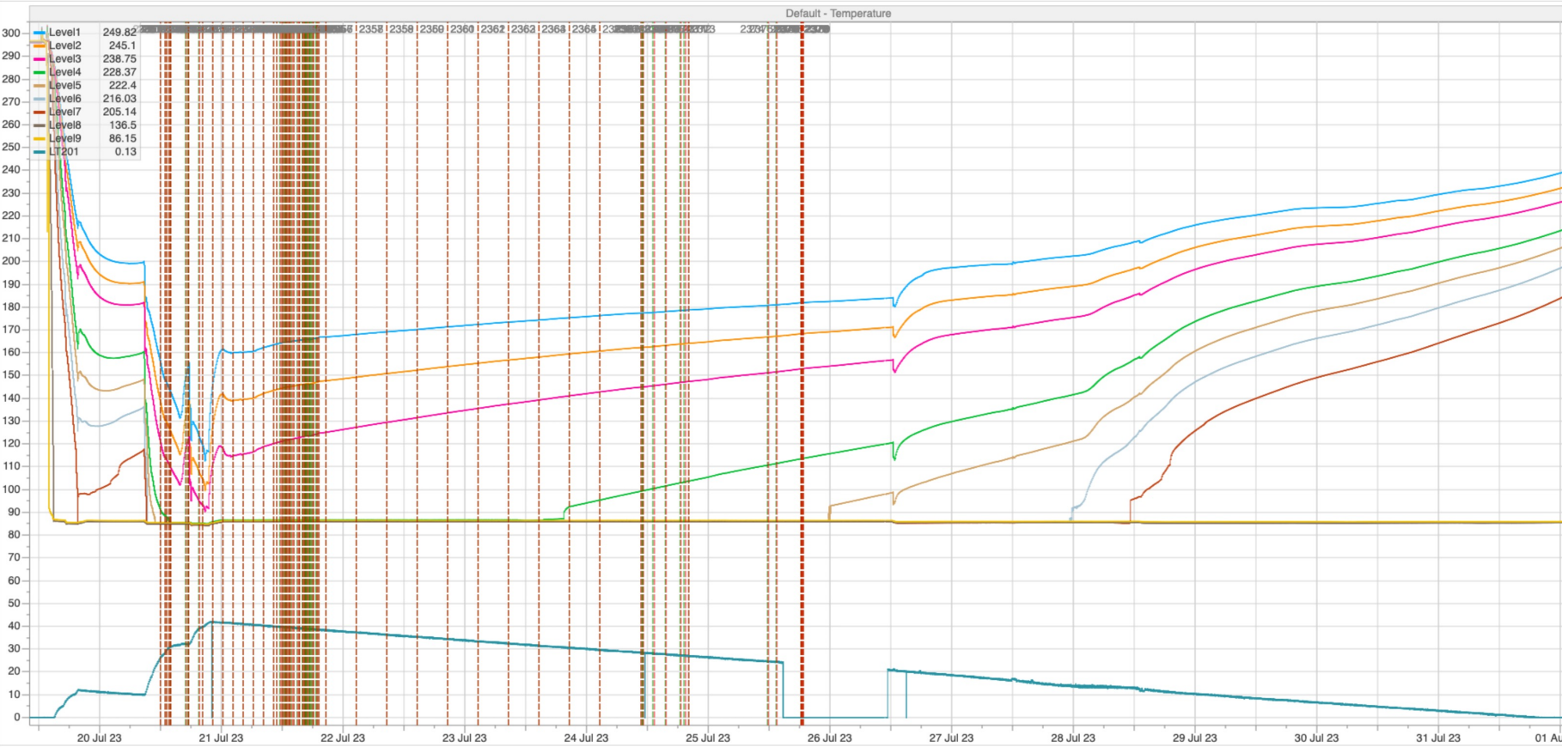
	PDE(%) @ OV=4.5V	PDE(%) @ OV=7.0V
Position	5 cm	5 cm
P2	1.30 ± 0.08	1.66 ± 0.12
P3	1.16 ± 0.08	1.48 ± 0.12
C	1.21 ± 0.08	1.54 ± 0.12
P5	1.21 ± 0.08	1.54 ± 0.12
P6	1.29 ± 0.08	1.65 ± 0.12



Error evaluation is very preliminary:

- SPE response: 5%
- Source PE fitting procedure: <5%
- Simulation: initial LY???
- Systematics in source positioning to be evaluated

Megacell warming



- At the moment the Megacell is still in the cryostat
- LAr evaporated and the level is now below the X-Arapuca
- Nitrogen gas flushing during warmup phase
- Environment full saturated with Argon and Nitrogen gas

Conclusions

- A preliminary evaluation of the PDE of XA-VD system equipped with ZAOT filters and FBK SiPM has been performed
- Self shielding of the source holder introduced some issue in the analysis
- One channel found to be very noisy: SPE evaluated only on the good channel
- Attempt to re-schedule a new measurement in September, changing the holder and collimating the source, check if there is no filter degradation