Update on the LAPPD activity at Trieste

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Overview:

- **The routine exercises at Trieste**
- **The first joint efforts between Trieste and Genova**

The entire setup in four main parts:

The detector setup

- LAPPD: #87
- A dark-box (adhoc)
- The CAEN HV supply N8033N

Light source (and trigger)

- A Pulser: Agilent 33220A
- A green LED (adhoc)
- Recently received LDH-PC-405 LASER

To study dark pulse rate & Photon-Signal

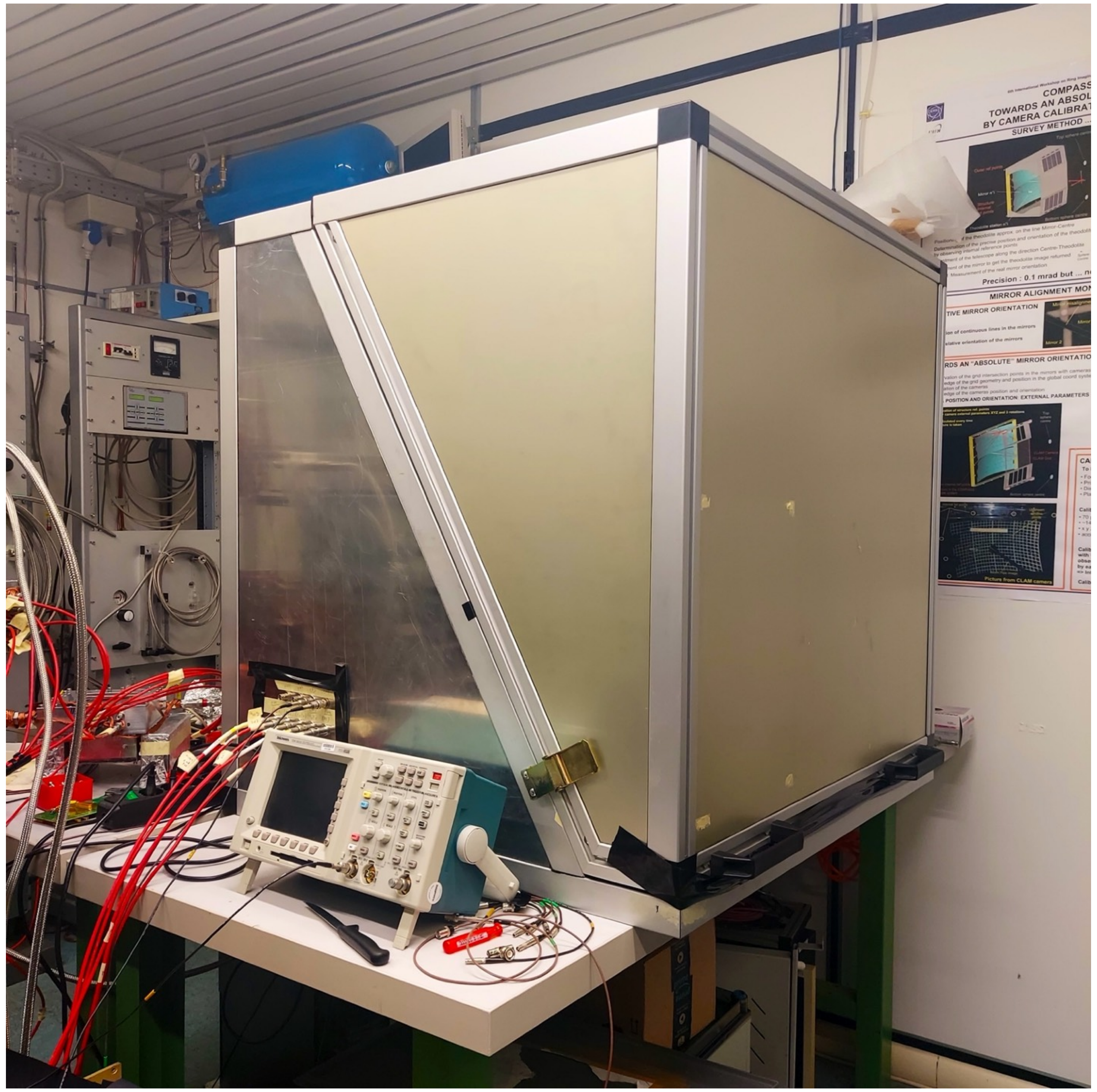
- Oscilloscope: LeCroy 6200A (2 GHz)
- Discriminator: CAEN N417
- Scalar Counter: CAEN N145
- Coincidence: LeCroy 465
- Delay/width for gate pulse: Dual Timer CAEN 2255B

To study the charge spectrum from PE

- VME Crate: CAEN 8004X
- Controller (Bridge): CAEN V1718
- Digitizer: CAEN V1742

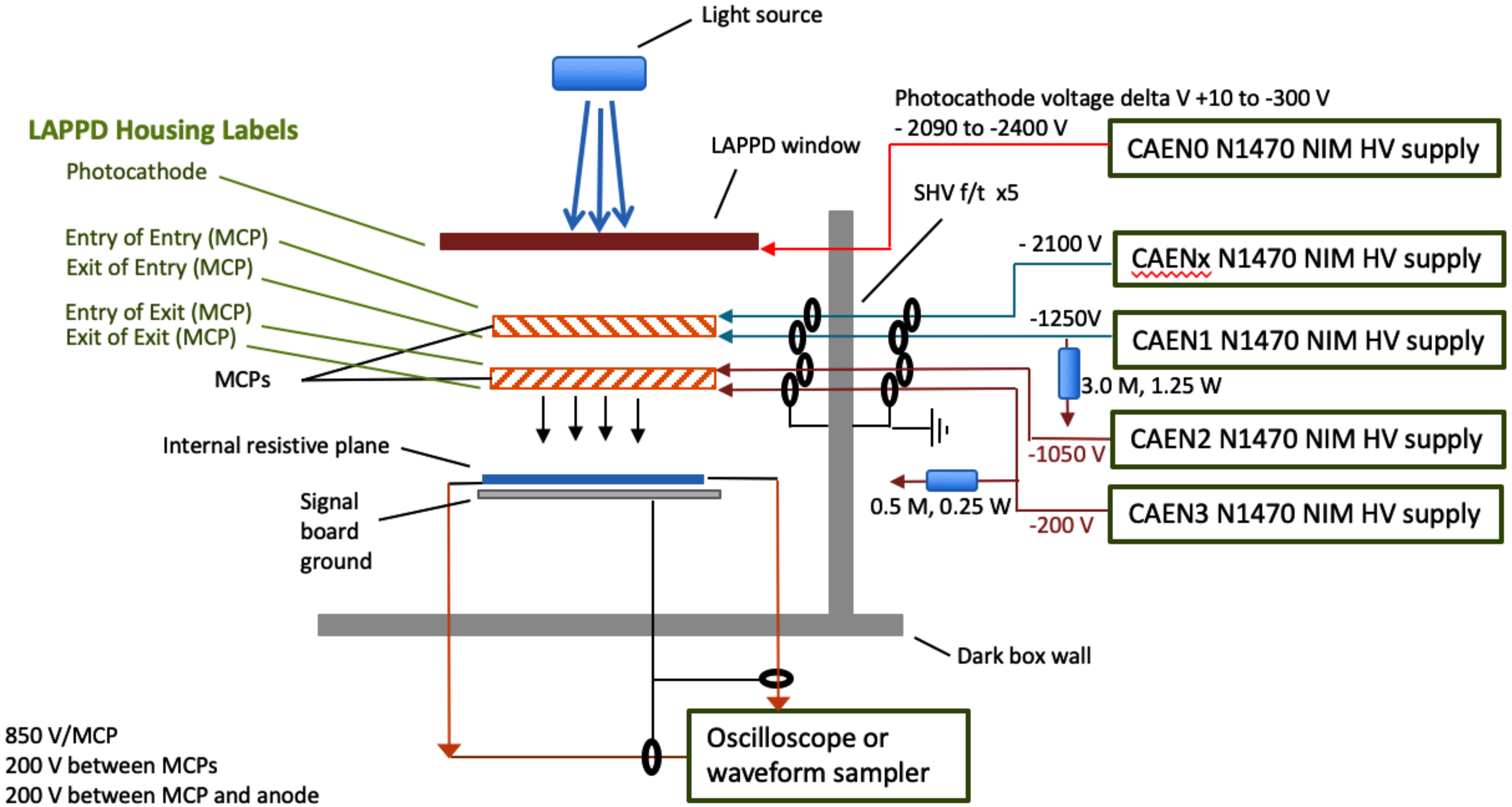
(with our Genova colleagues
Mikhail, Saverio)

The detector



The dark-box: temporary arrangement

HV scheme as suggested by Incom. We are using 5 different HV channels.



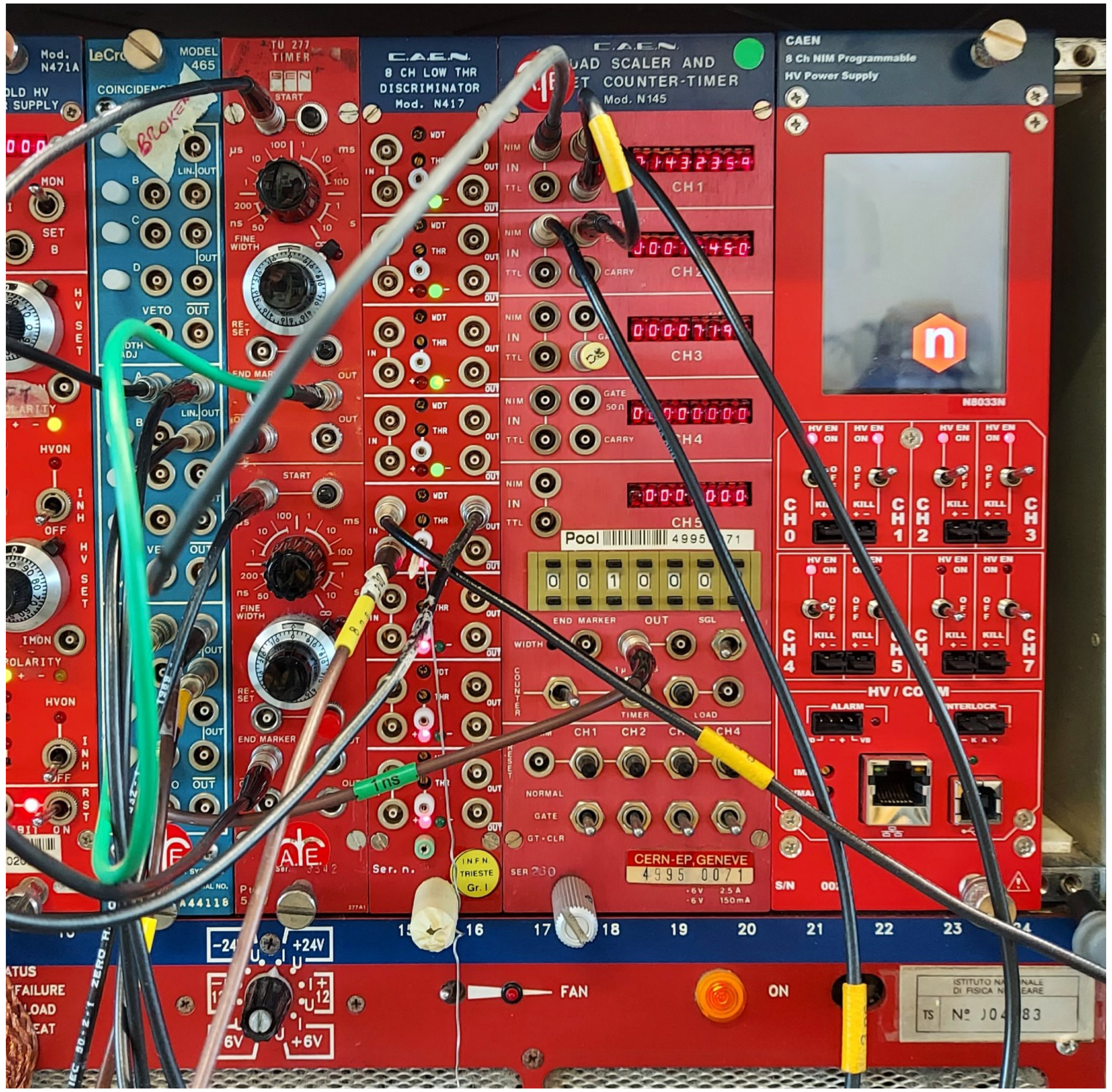
- 850 V/MCP
- 200 V between MCPs
- 200 V between MCP and anode
- 6.2 M entry MCP R
- 5.7 M exit MCP R

LAPPD 87

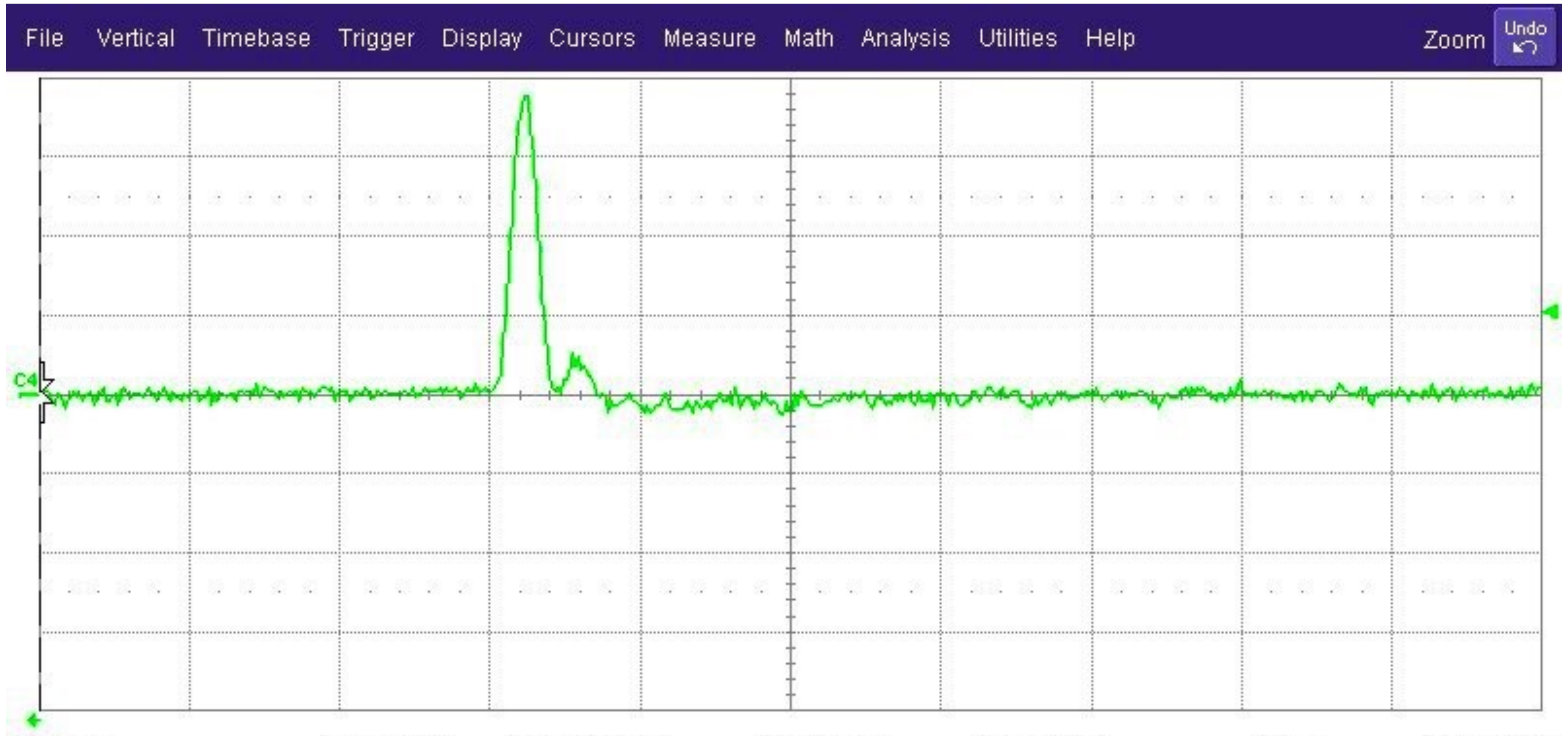
The grounding scheme is modified:

- all the HV grounds are connected to the common detector ground
- more stability
- better safety

To study dark pulse rate:



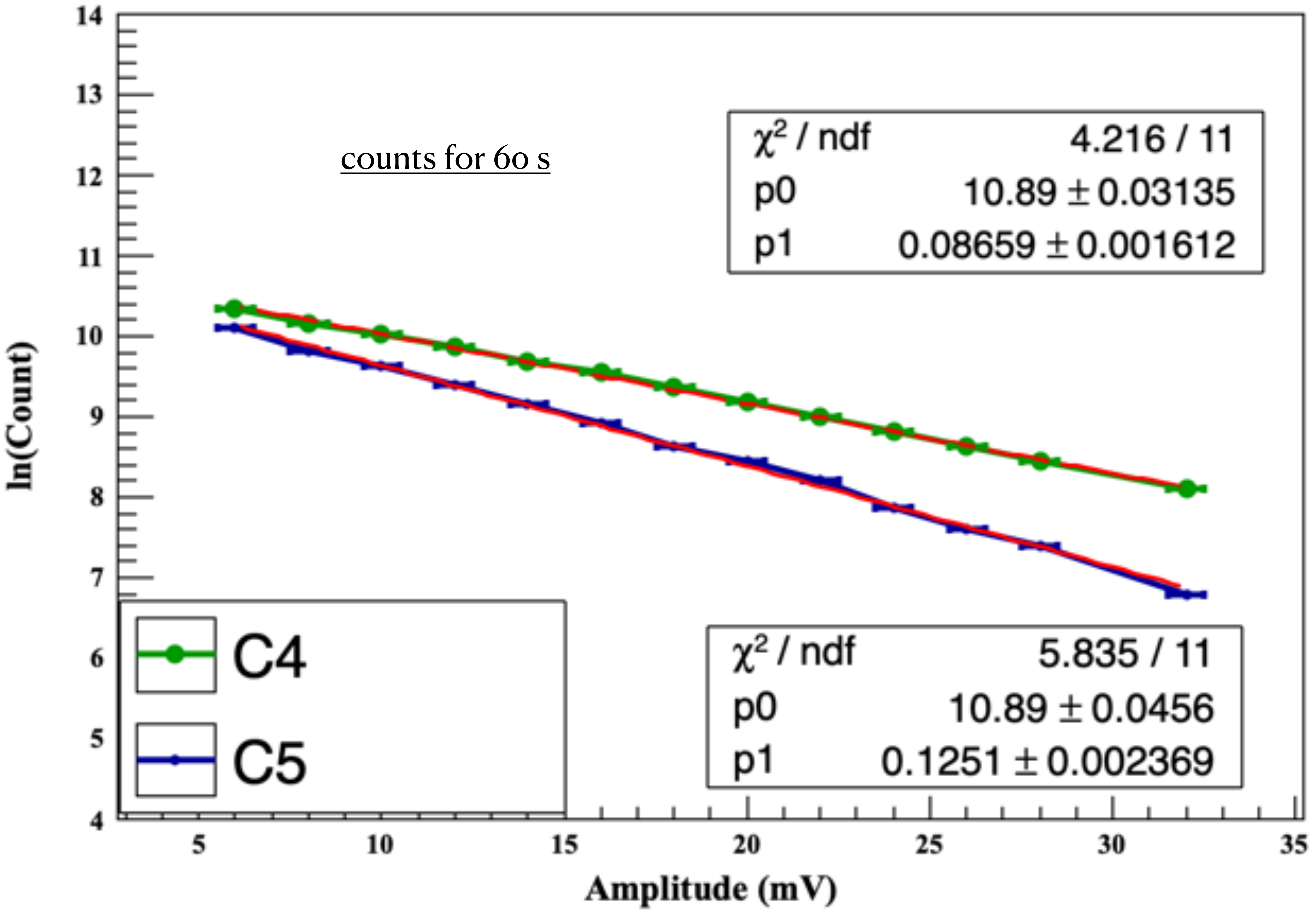
Classical setup for counting dark pulse



An example of a 'Dark Pulse' (due to thermal noise)

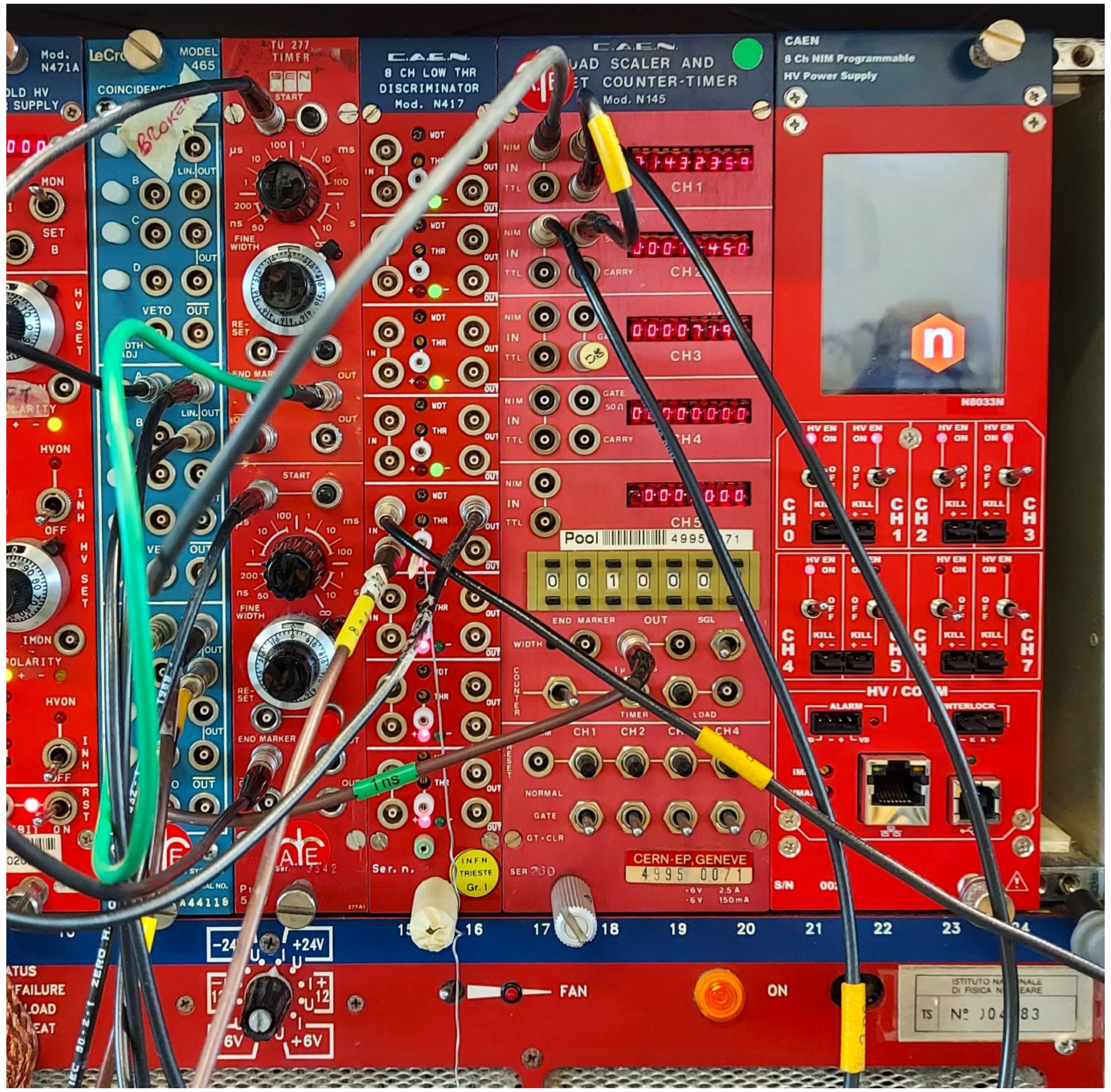
To study dark pulse rate

voltages: 2160 V, 2150 V, 1275 V, 1075 V, 200 V
PC = -10V, MCP = 875 V, Transfer gap = 200 V;

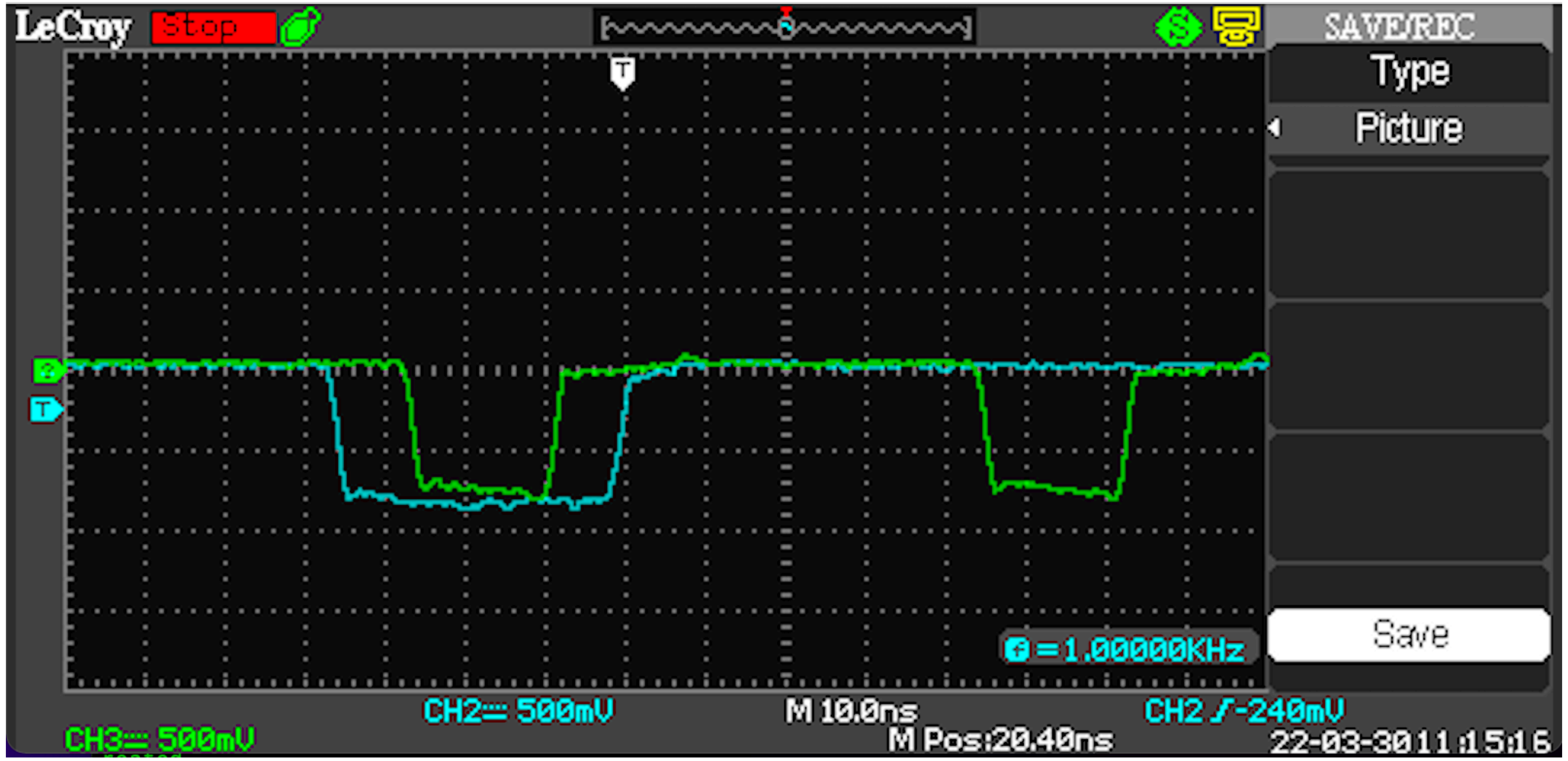


- **The 'Count Vs Threshold' is exponential in nature**
- **A linear fit in log scale gives intrinsic dark rate (independent of the threshold)**
- **Intrinsic dark rate = 900 Hz/Pixel = 140 Hz/cm^2**
- **The rate is similar over a few pads**
- **Measured dark rate matches with Incom results for #87**

The same setup can be used to count PE signals at different amplitude threshold



Classical setup for counting PE signal pulse

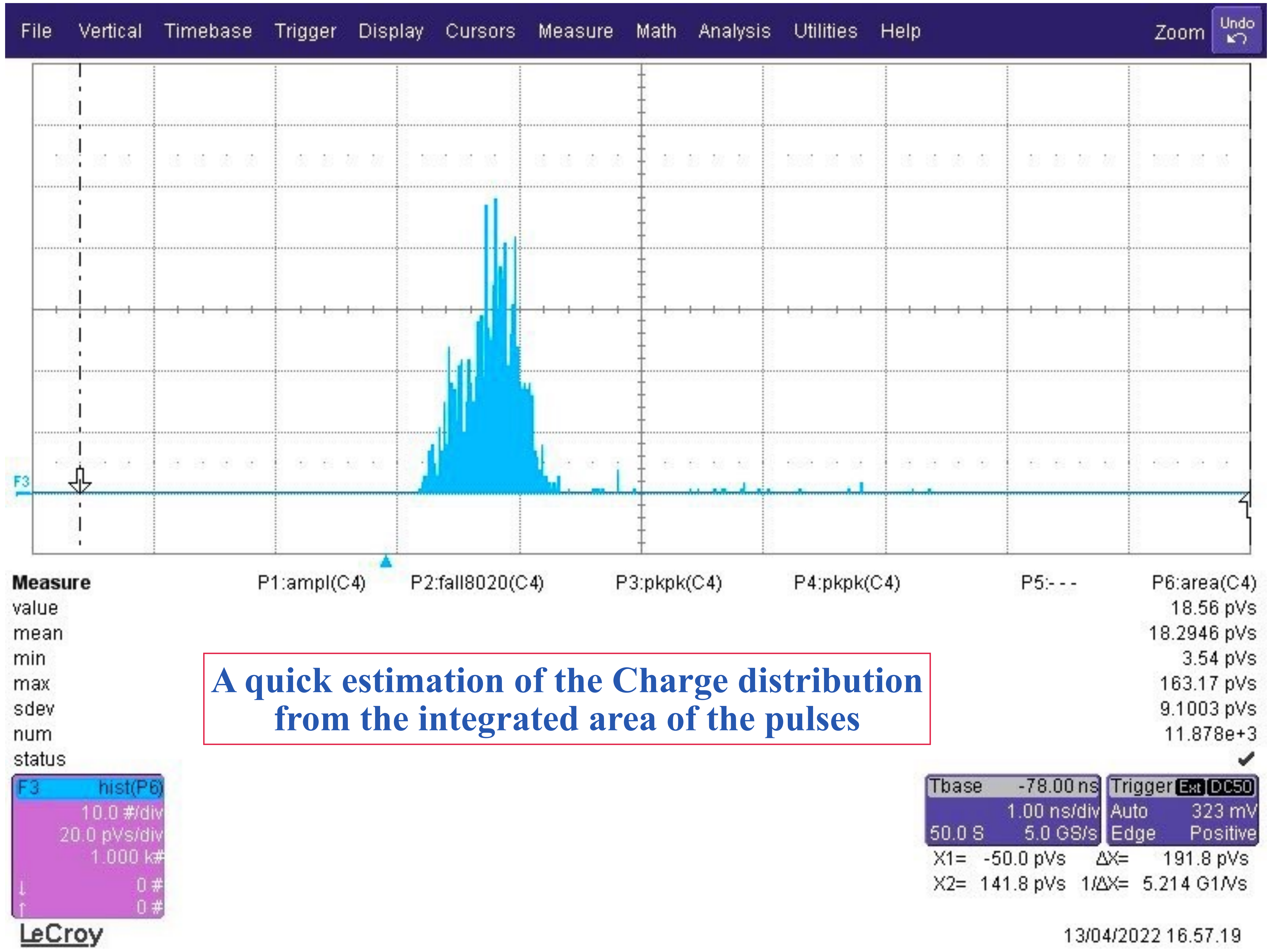


Green => output of the discriminator (PE signal)
(note the possible ion feedback pulse, ~60 ns apart)
Blue => gate pulse for the Scalar-Counter

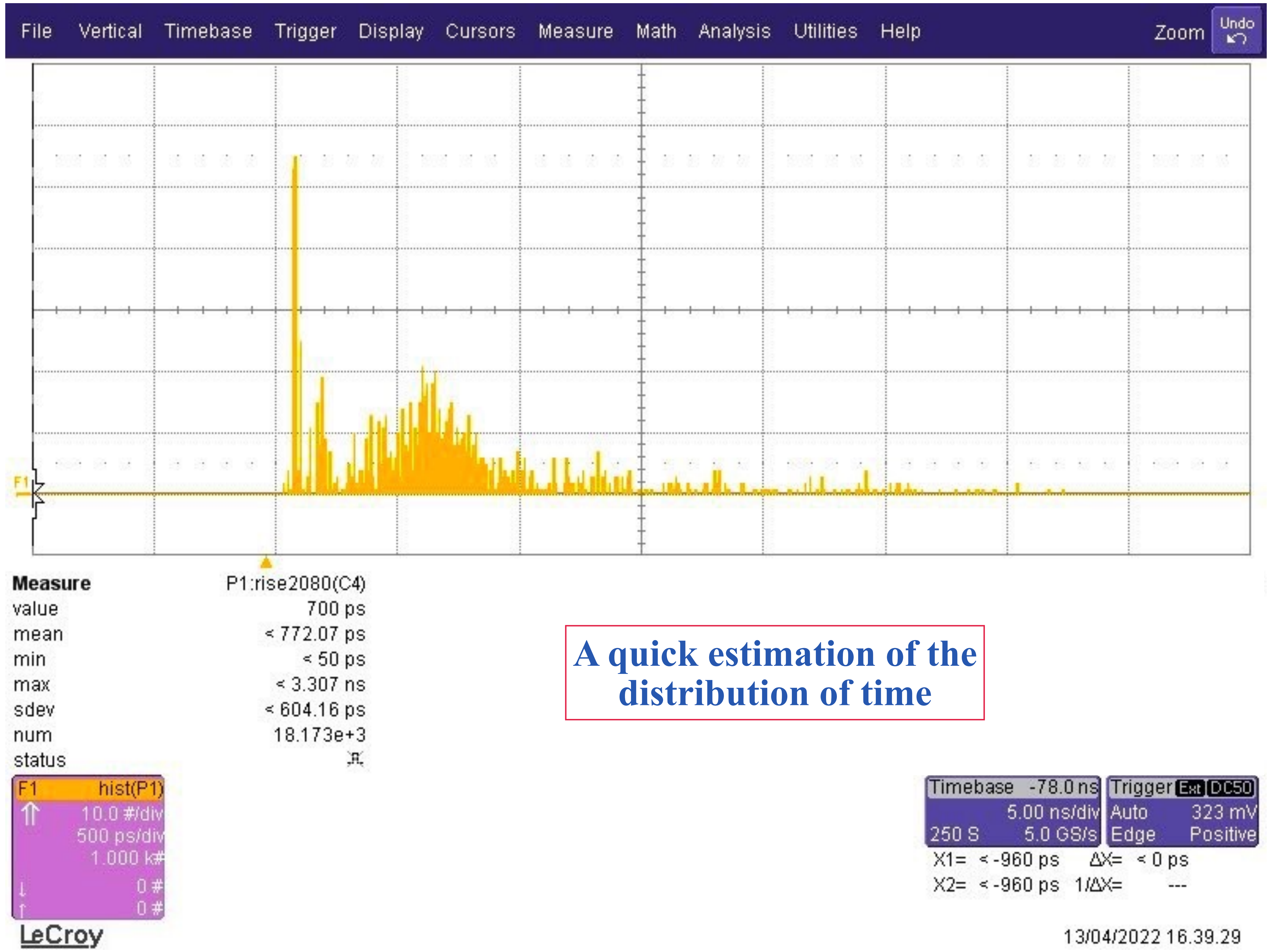
A digitizer is the right solution to study the PE pulse amplitude/charge
However, this is a good way to make sure that we are close to single-PE condition

Quick Inspection of the PE signal on the Oscilloscope: LeCroy 6200A (2 GHz)

- **A Pulser: Agilent 33220A [minimum width is limited by 20 ns]**
- **A green LED (adhoc)**



A quick estimation of the Charge distribution from the integrated area of the pulses

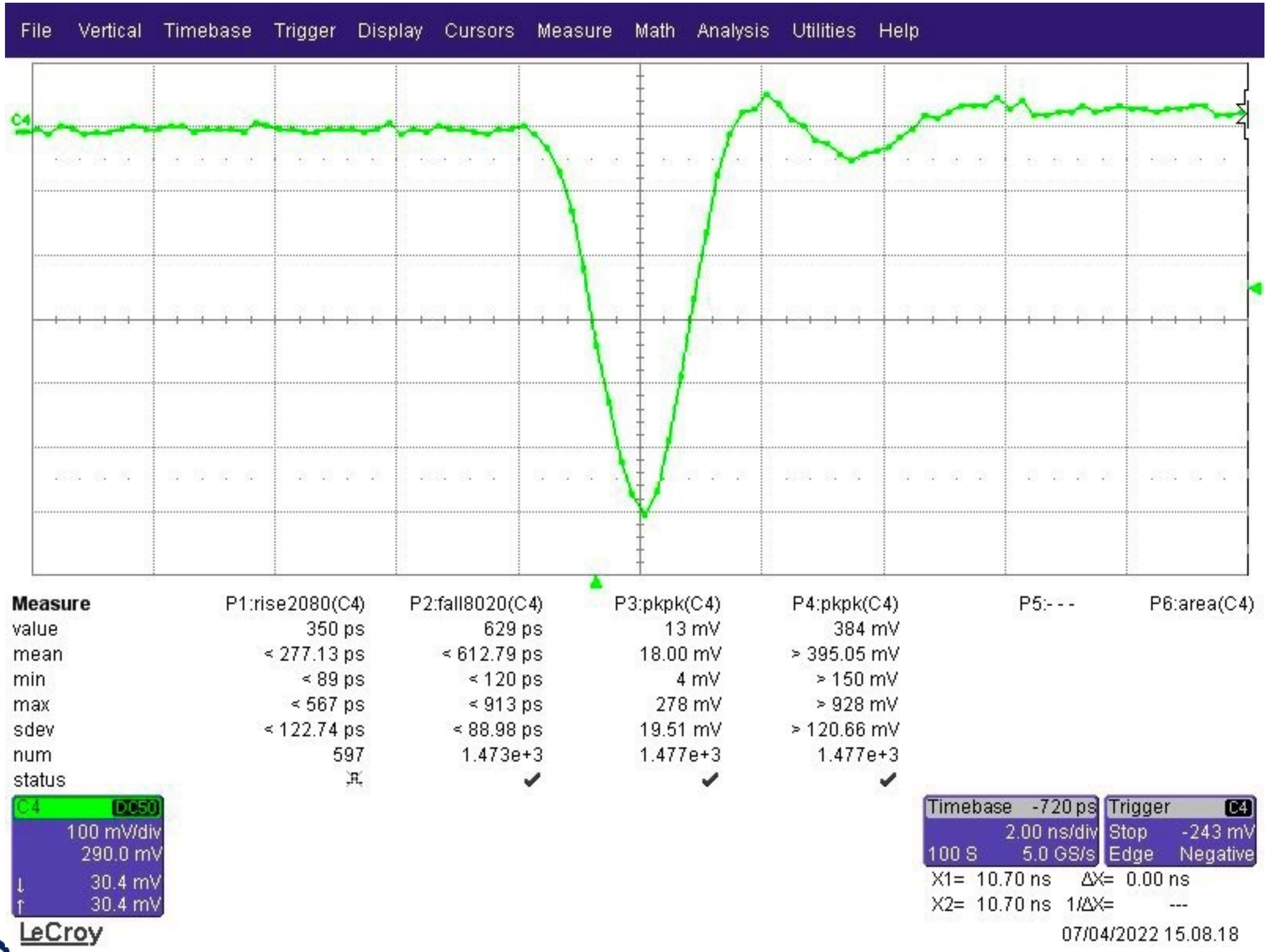


A quick estimation of the distribution of time

- **An LED has a broad time distribution for photon emission**

Quick Inspection with the Oscilloscope: LeCroy 6200A (2 GHz)

- **A Pulser: Agilent 33220A**
- **A green LED (adhoc)**



LED = 1V (Collimated)

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Each MCP = 900 V

two gaps = 200 V

PC at +10 V (magnitude).

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Signal => Inverting Amplifier (Genova) with gain ~10

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Analysis on the Oscilloscope

Fall(Rise) time (20-80%) = 612.8 ps

Noise rms = 18 mV; (peak to peak = 9 mV)

Signal (peak to peak) = 395 mV

Signal to Noise Ratio = 395/9=43.89

(S/N is better with this additional amplifier)

Time Resolution = 612.8/43.89 = 13.96 = 14ps.

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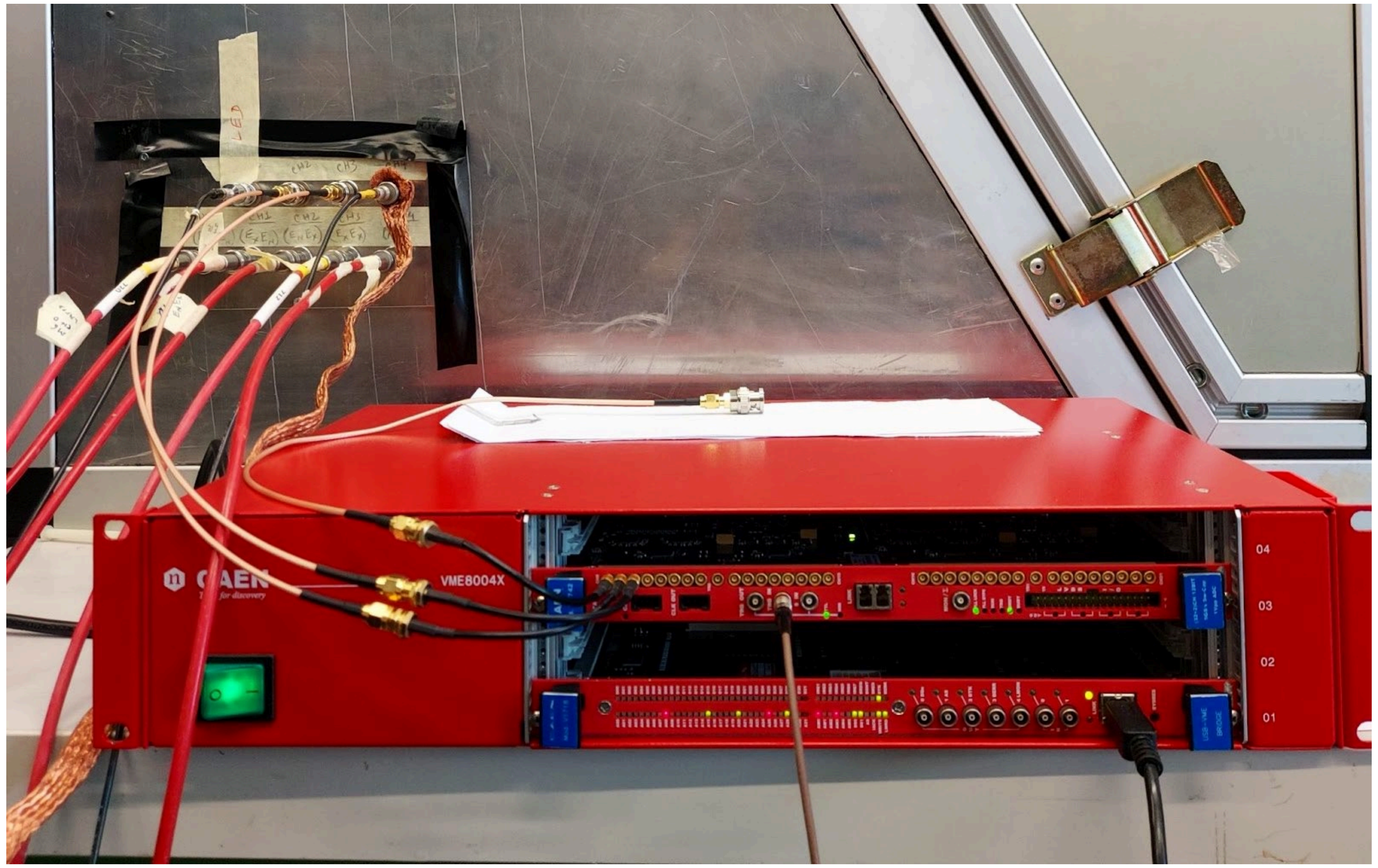
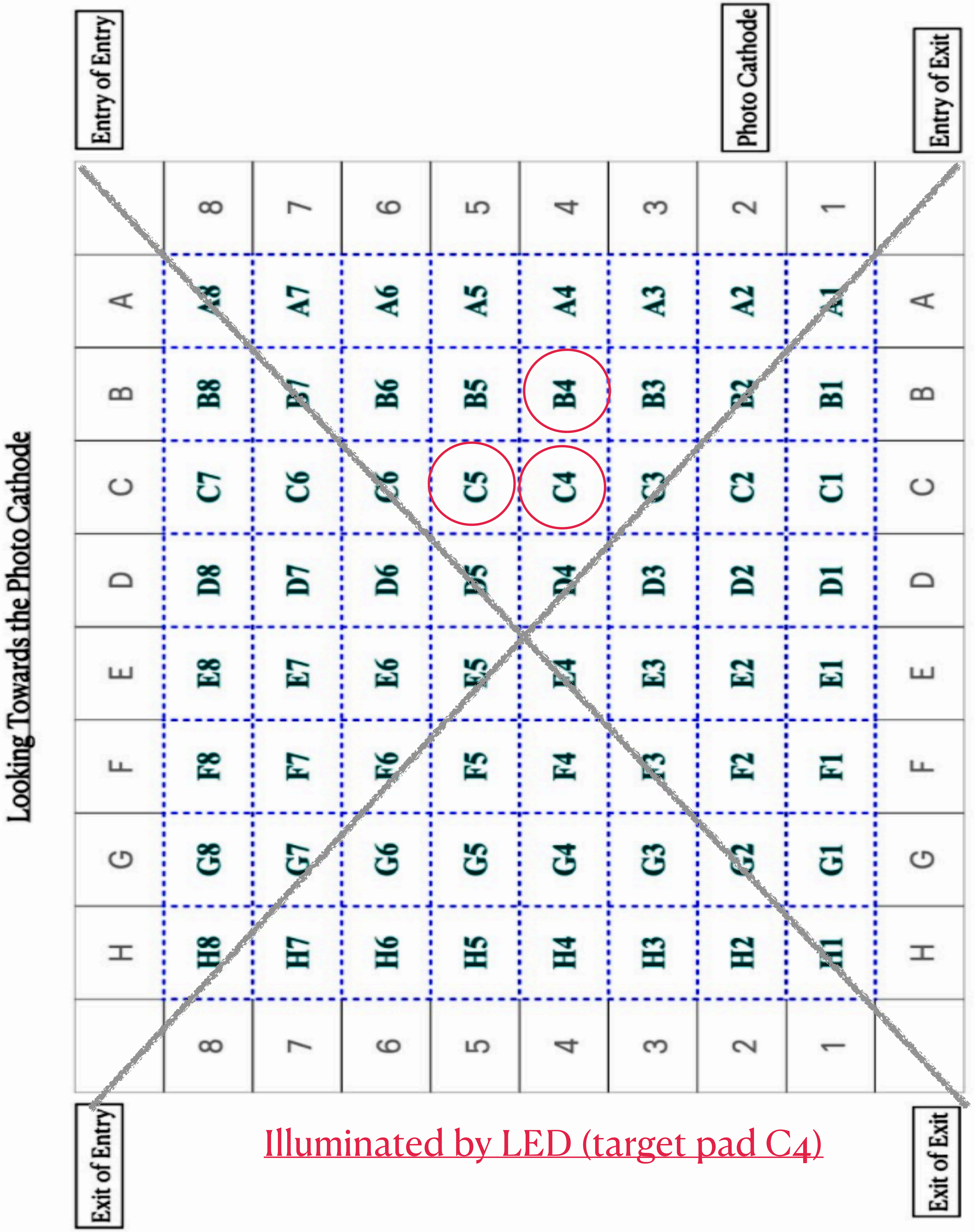
Time Resolution (without amplifier) = ~35 ps

To study the charge spectrum from PE

VME 8004X





Illuminated by LED (target pad C4)

To study the charge spectrum from PE

PC = -10V, MCP = 900 V, Transfer gaps = 200 V

Example Photon-Event from Digitizer

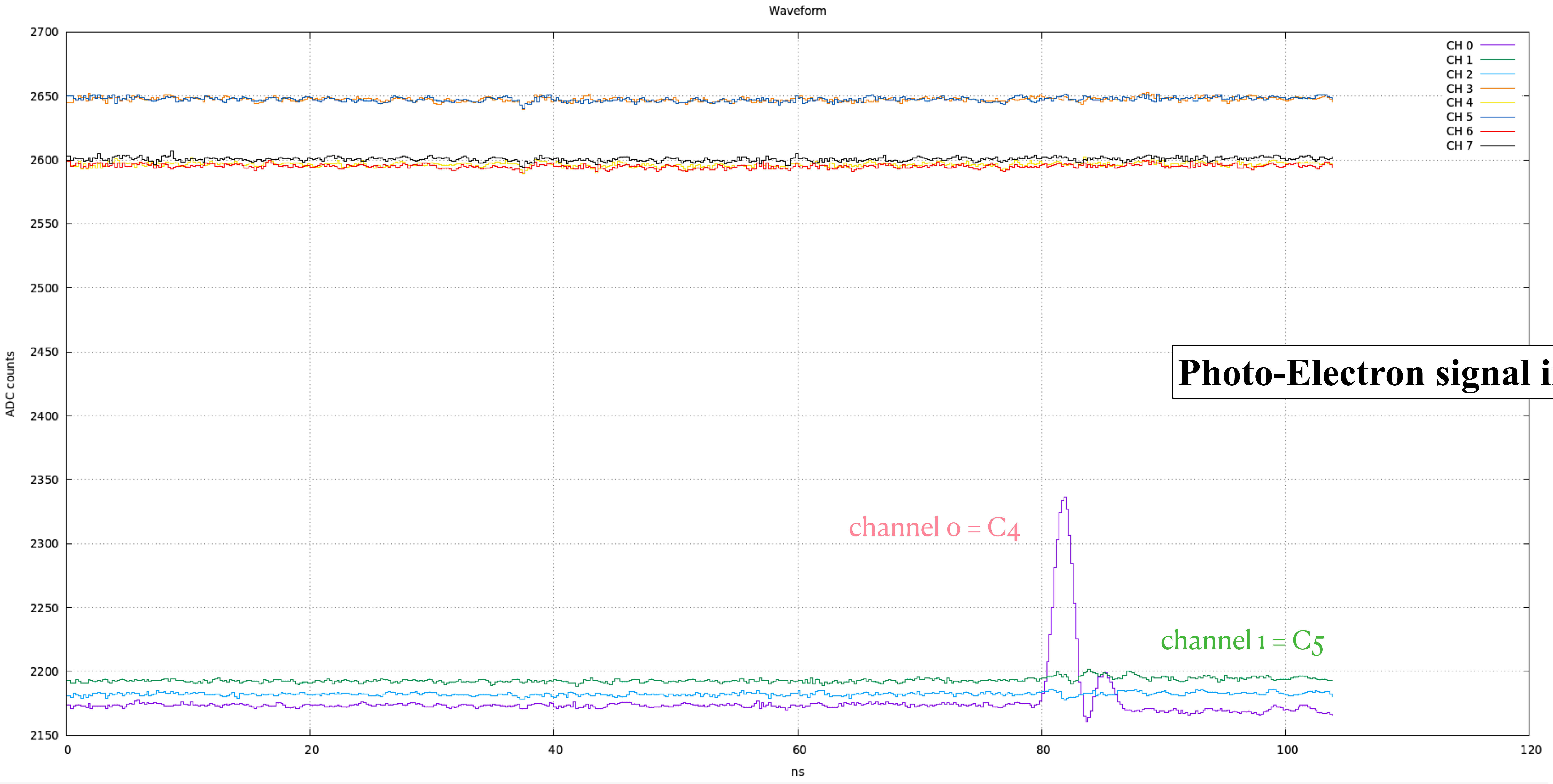
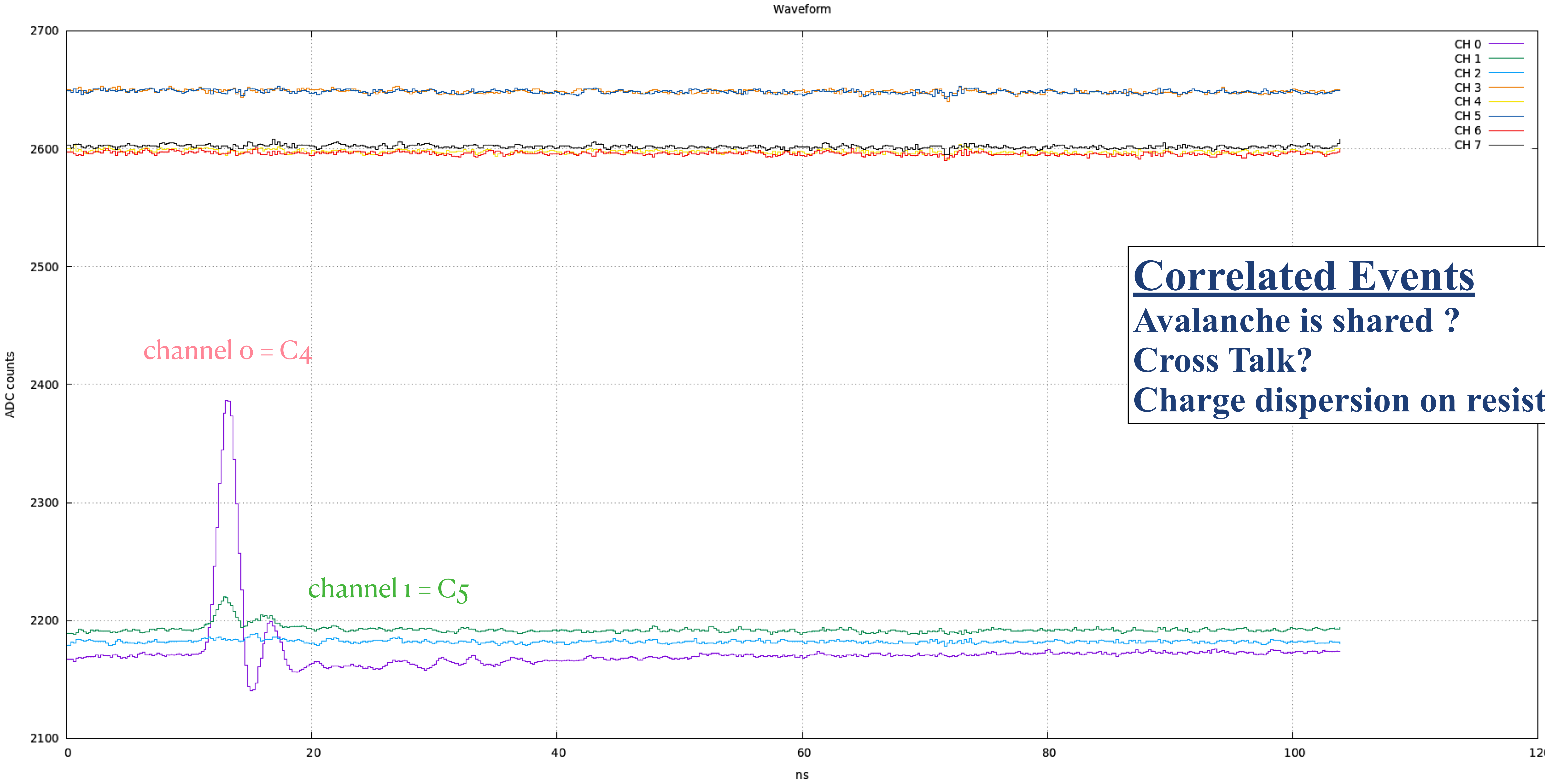


Photo-Electron signal in channel 0 (pad C4)

To study the charge spectrum from PE

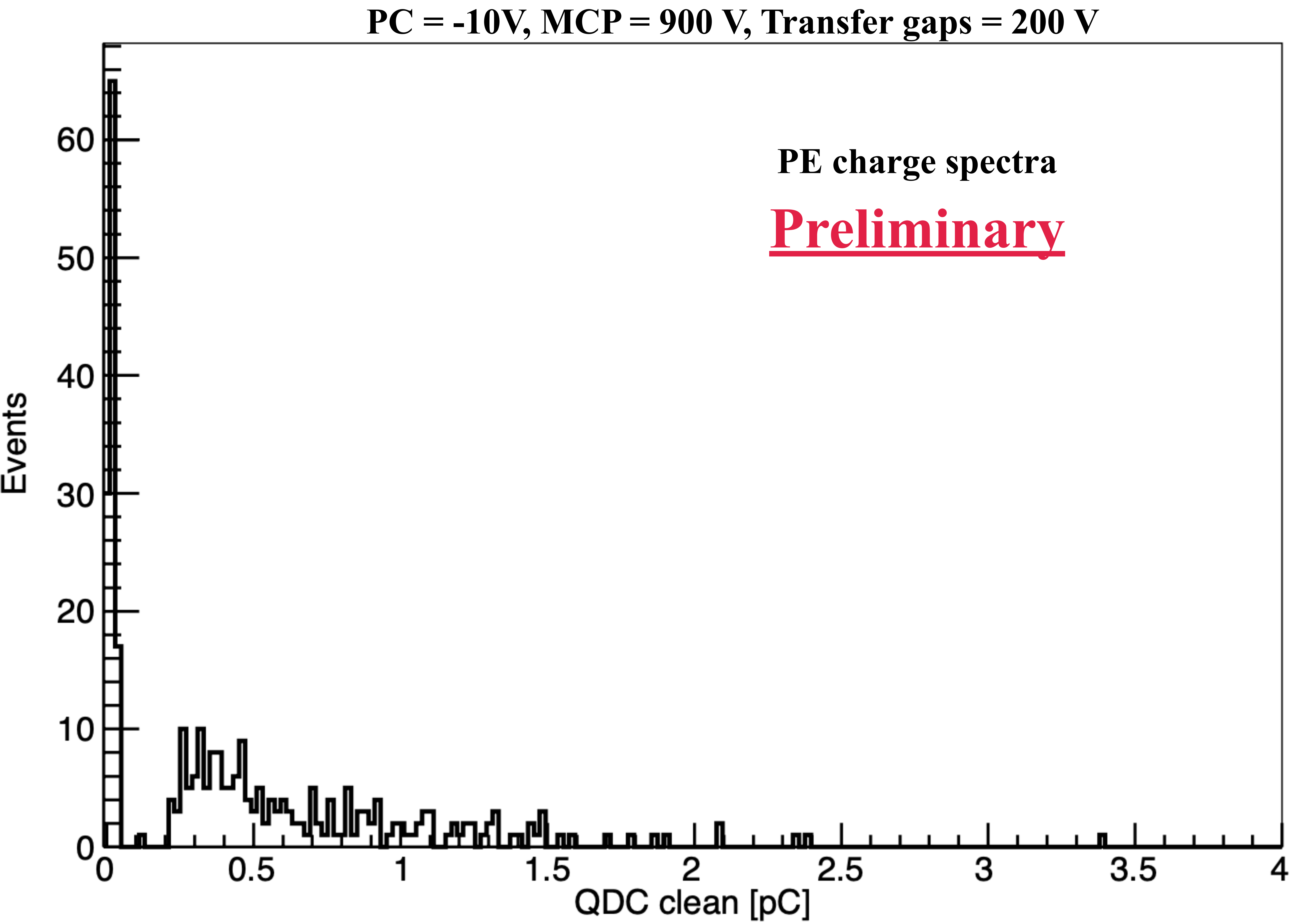
PC = -10V, MCP = 900 V, Transfer gaps = 200 V

Example Photon-Event from Digitizer



Correlated Events
Avalanche is shared ?
Cross Talk?
Charge dispersion on resistive layer?

To study the charge spectrum from PE

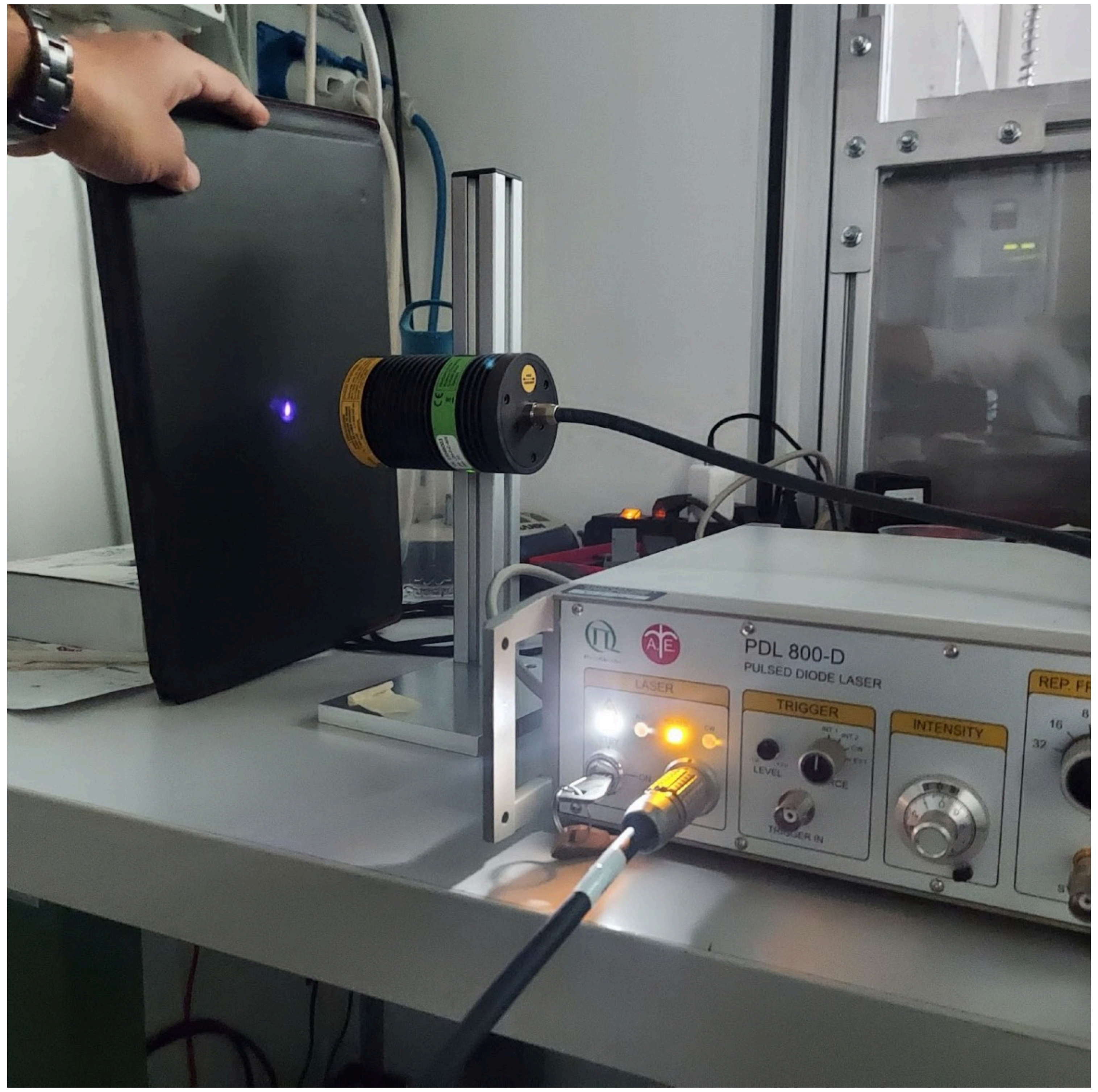


- Charge calculated from all the pulses collected from Ch_0.
- LED can illuminated more than one pad.
- Correlated signals are observed.
- Fully uncorrelated signals on a single pad has to be better understood.

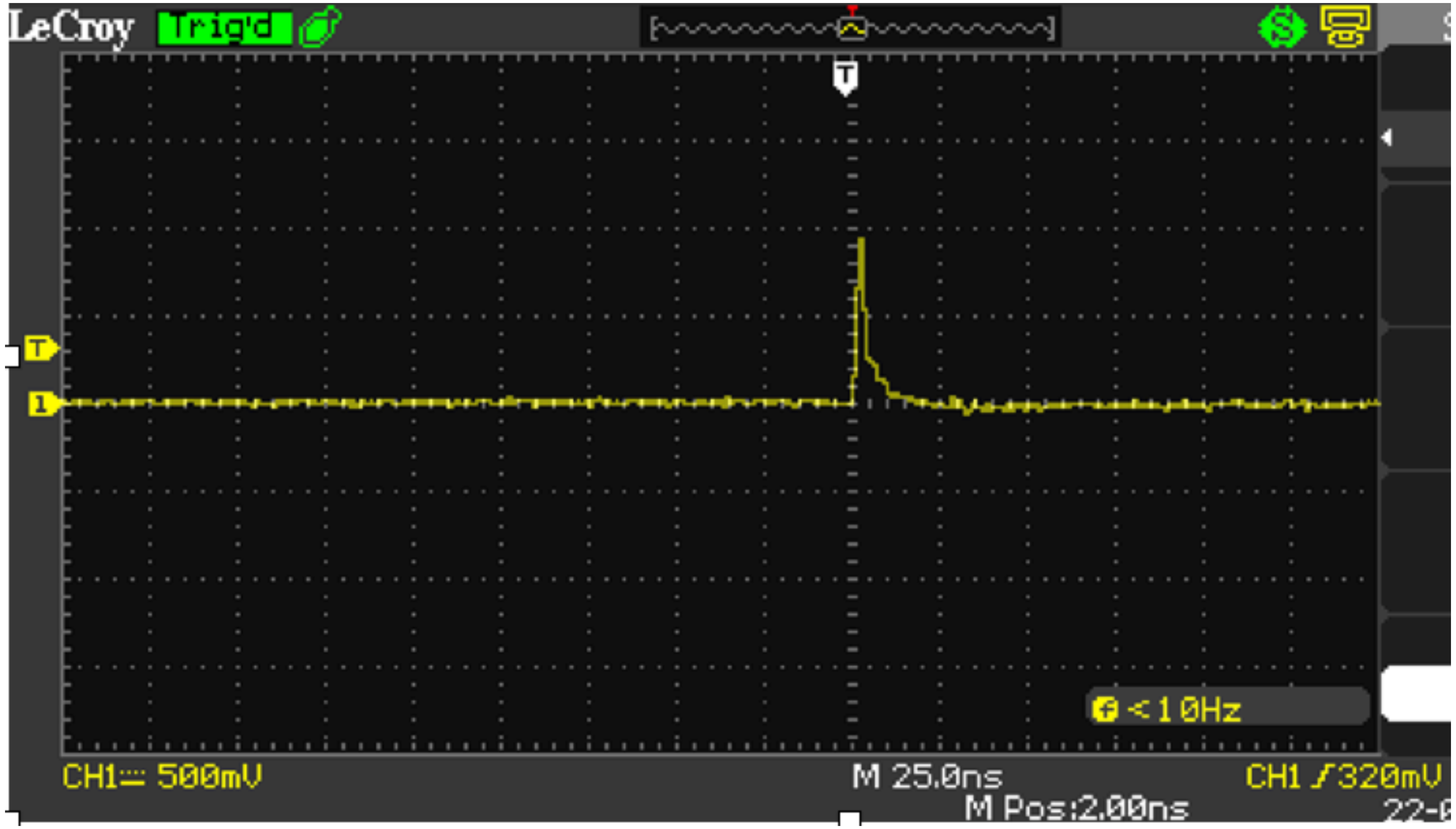
Some useful details:

- V1742 runs at 5 GHz => 1 time_bin = 0.2 ns.
- Trigger window = 520 time_bins = 104 ns.
- 1 ADC = 1000 mV/4096 = 0.2441 mV
- Threshold (analysis) = 10 ADC of noise_rms
- Count Signal if, base_width > 6 time_bins

We just have the LASER working



The LASER as we received is working fine



The pulse from the LAPPD with the LASER incident on it

- **In near future:**

  - **We are soon going to move to a LASER + DAQ set up.**
  - **We are (logistically) improving the setup with dark box, LASER table etc**
  - **The analysis code will also improve.**
  - **Crosstalk, charge sharing, etc would be understood better.**
  - **Then, we have more general agenda: Pad size, magnetic field etc.**

Conclusion:

- Intrinsic thermal noise (dark count rate) of the LAPPD is 140 Hz/cm^2 at room temperature
- Studying Photo-Electron signal with a Pulsed-LED (20 ns) is ongoing
- Mikhail Osipenko and Saverio Minutoli from Genova visited us for a week (4th April)
- The VME digitizer is now operational and the related softwares are being improvised
- First PE charge spectrum (LED) is obtained but needs to be better understood
- PE (LED) signal on the oscilloscope reveals a time resolution of ~35 ps.

- A lot more is to come!

Thank you!