Characterization of LIME PMTs

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The PMT Hamamatsu R7378A:

Parameter		Description	Unit
Spectral response		160 to 650	nm
Peak wavelength		420	nm
Photocathode	Material	Bialkali	—
	Minimum effective area	ϕ 22	mm
Window material		Synthetic silica	—
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

MAXIMUM RATINGS (Absolute maximum values)

Parameter		Value	Unit
Supply voltage	Between anode and cathode	1250	V
	Between anode and last dynode	250	V
Average anode current		0.1	mA

CHARACTERISTICS (at 25 °C)

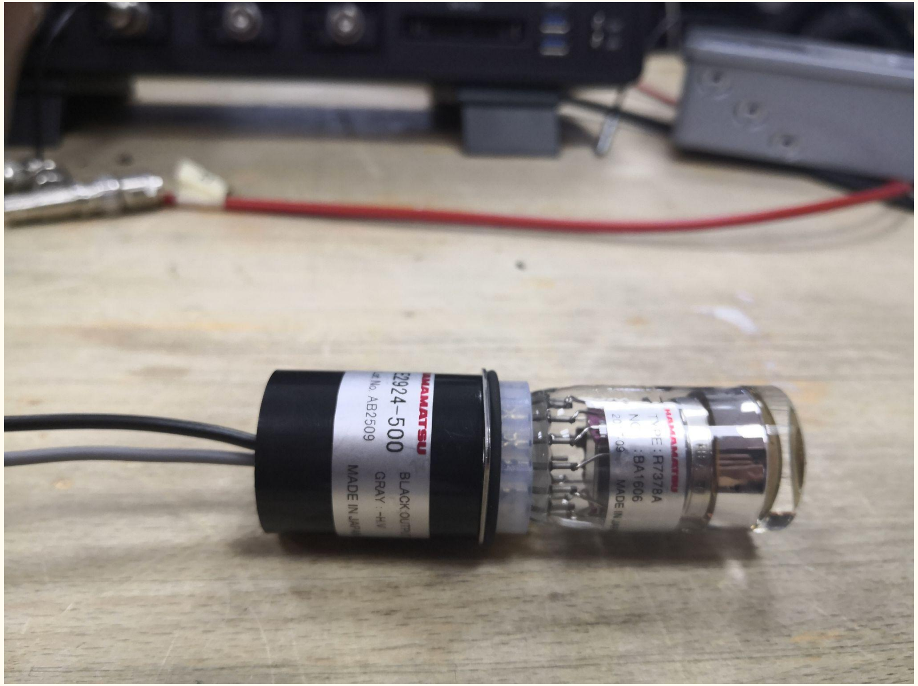
Parameter		Min.	Typ.	Max.	Unit
Cathode sensitivity	Luminous (2856 K)	60	90	—	µA/lm
	Radiant at 420 nm	—	85	—	mA/W
	Blue sensitivity index (CS 5-58)	9	10.5	—	—
Anode sensitivity	Luminous (2856 K)	50	180	—	A/lm
Gain		—	2.0×10^6	—	—
Anode dark current (after 30 min storage in darkness)		—	3	20	nA
Time response	Anode pulse rise time	—	1.5	—	ns
	Electron transit time	—	17	—	ns
	Transit time spread (T.T.S.)	—	0.9	—	ns
Pulse linearity at ±2 % deviation		—	30	—	mA

NOTE: Anode characteristics are measured with the voltage distribution ratio shown below.

STANDARD VOLTAGE DIVIDER AND SUPPLY VOLTAGE

Electrodes	K	Dy1	Dy2	Dy3	Dy4	Dy5	Dy6	Dy7	Dy8	Dy9	Dy10	P
Ratio	3	1	1	1	1	1	1	1	1	1	1	

Supply voltage: 1000 V, K: Cathode, Dy: Dynode, P: Anode



The experimental setup:

- PMTs are inserted in a cylindrical box with a central hole for the optical fiber;
- Oscilloscope Teledyne Lecroy WaveSurfer 4101 HD
- CAEN HV programmable power supply N470

The experimental setup:

- LED driver CAEN SP5605:

  This LED driver was also used for the external trigger (lever on INT, trigger wire in OUT)

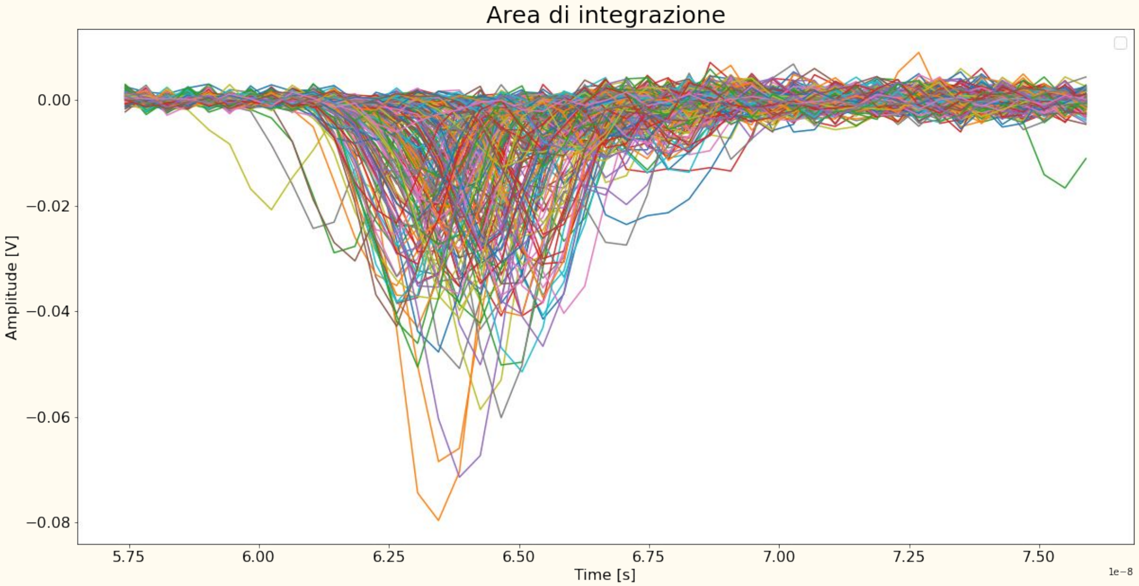
  All the measurements were done at low frequency.

Repeatability

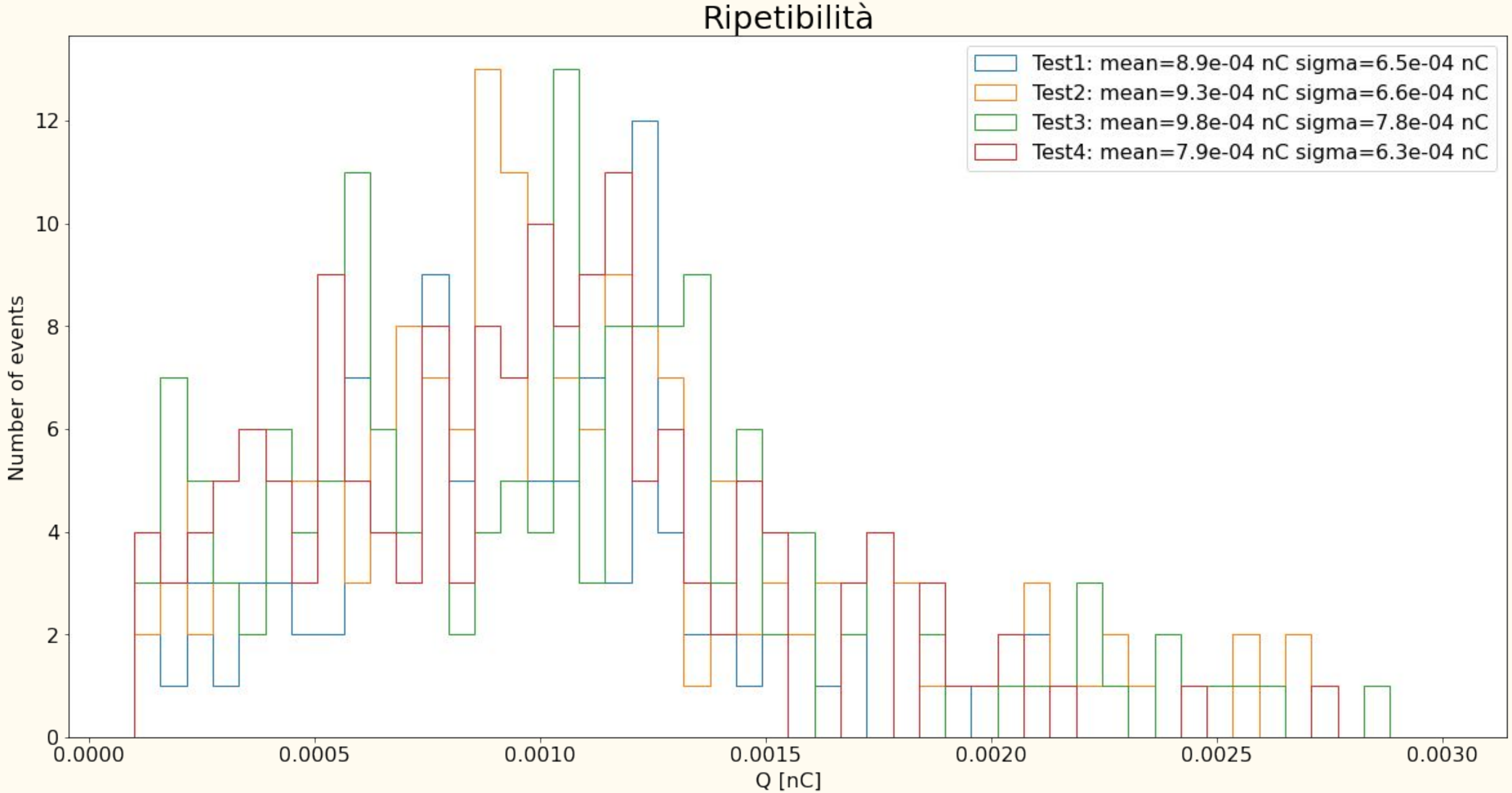
The offset was, for all the measurements, the media of points in an interval proportional to the integration area before the trigger.

It was subtracted for each waveforms.

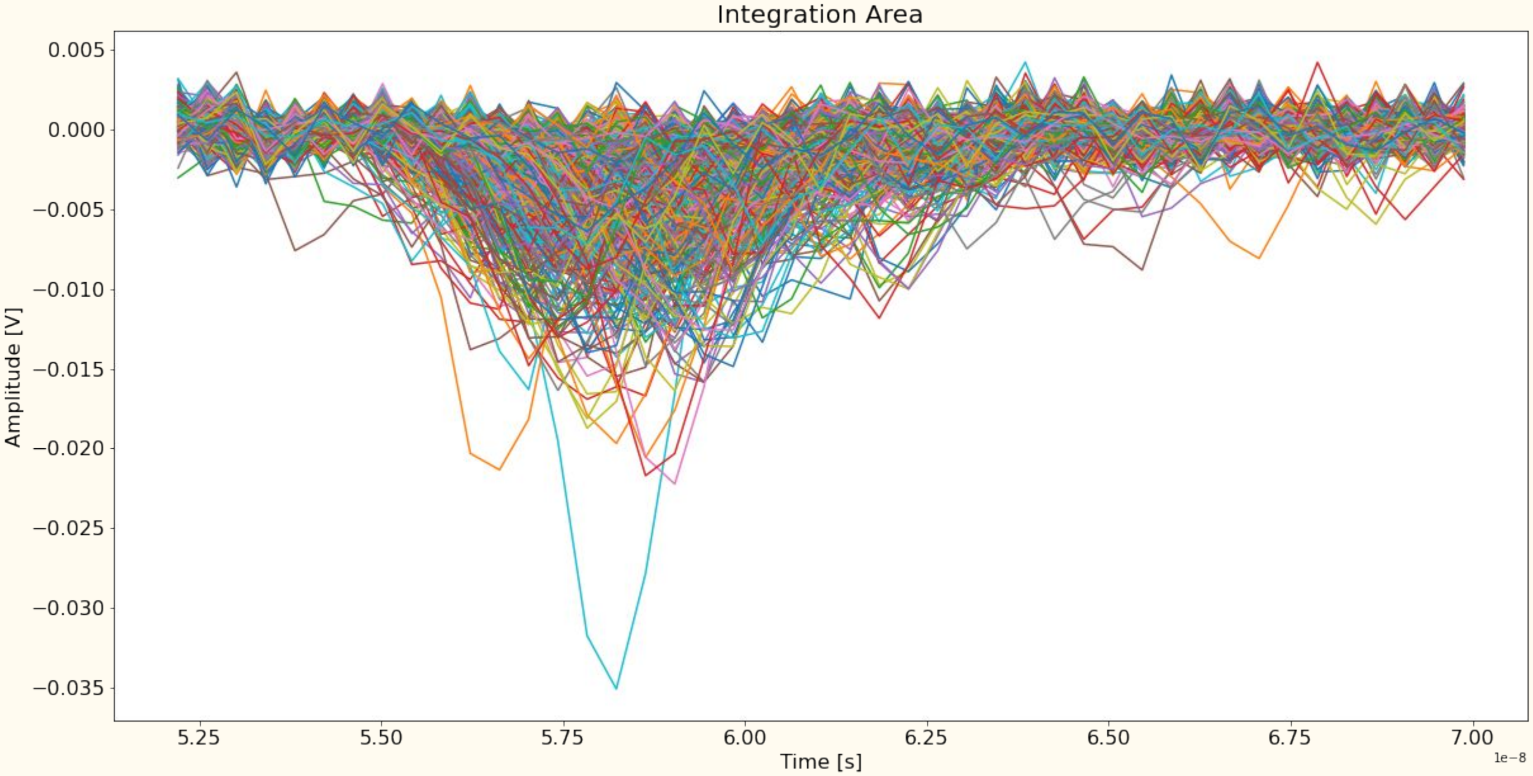
The integration was done with the numpy.trapz(y,x) (PYTHON) and the charge was obtained by the division for the resistance of the oscilloscope=50Ω



Repeatability:

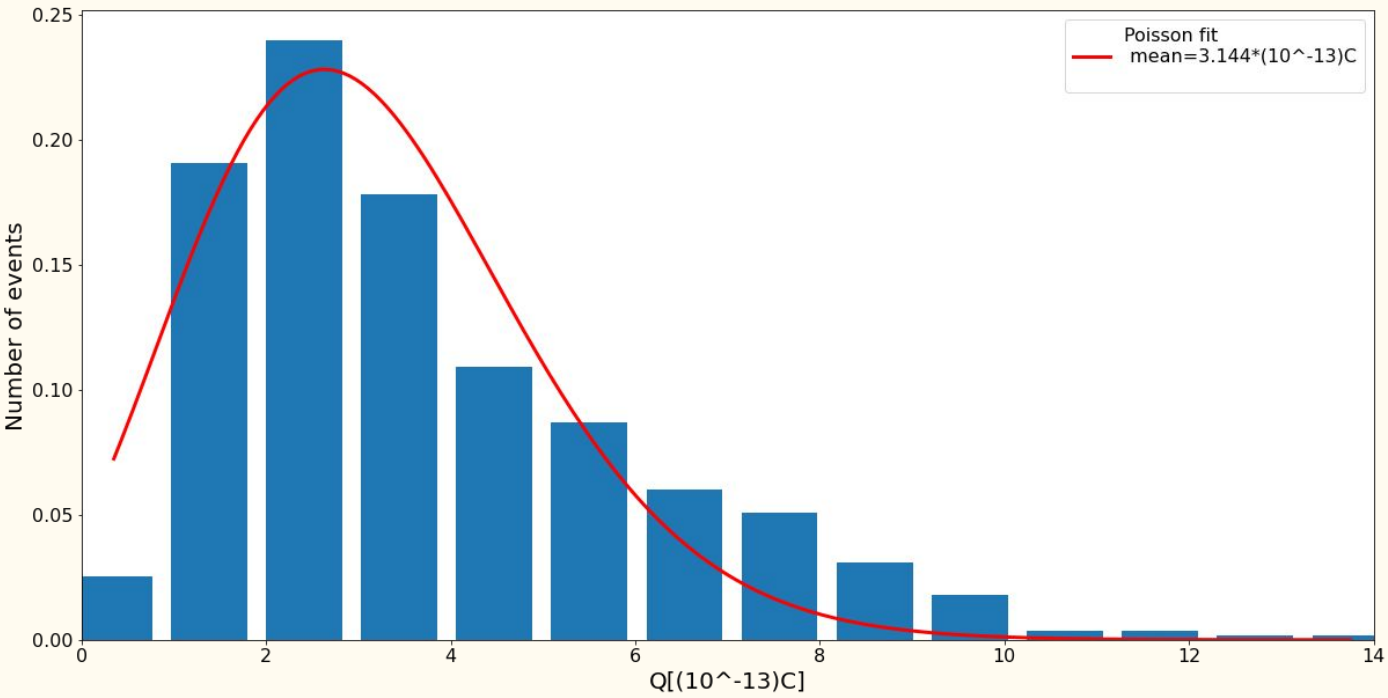


Low-amplitude study:



Low-amplitude study:

The charge spectrum resulted poissonian.



Low-amplitude study:

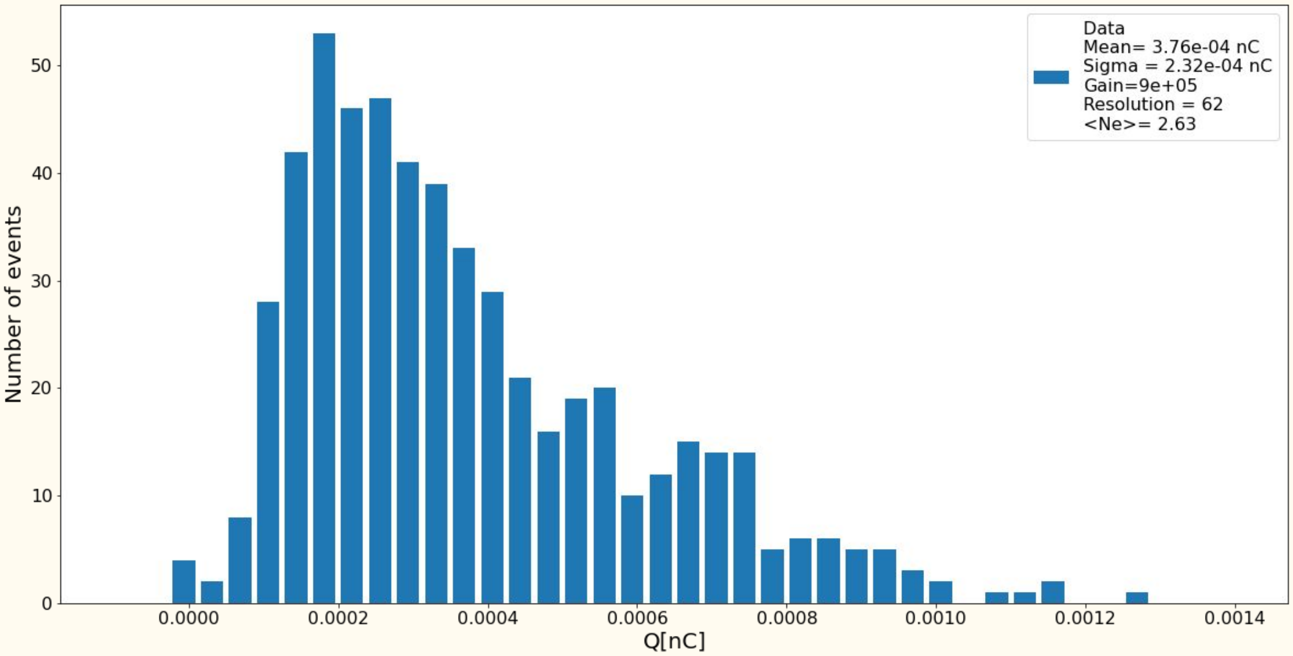
The following values was obtained from the data:

Ne=(<Q>/rms)^2

Gain=rms^2/(<Q>*e)

Res=(sigma/<Q>)

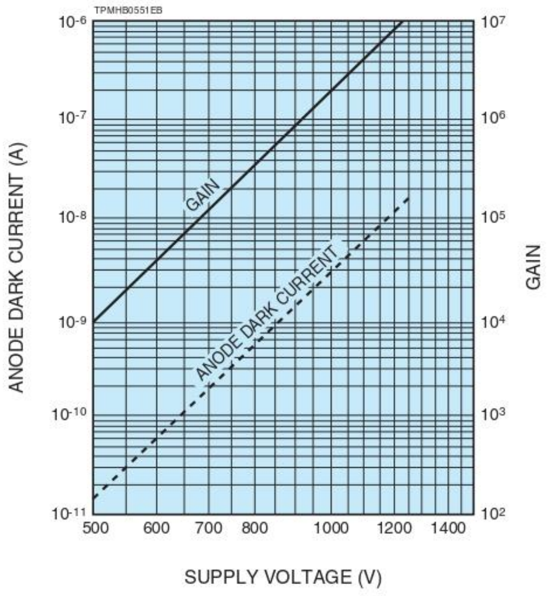
Ne_expected=1.15 =(<Q>/e*Gain_datasheet)



Low-amplitude study:

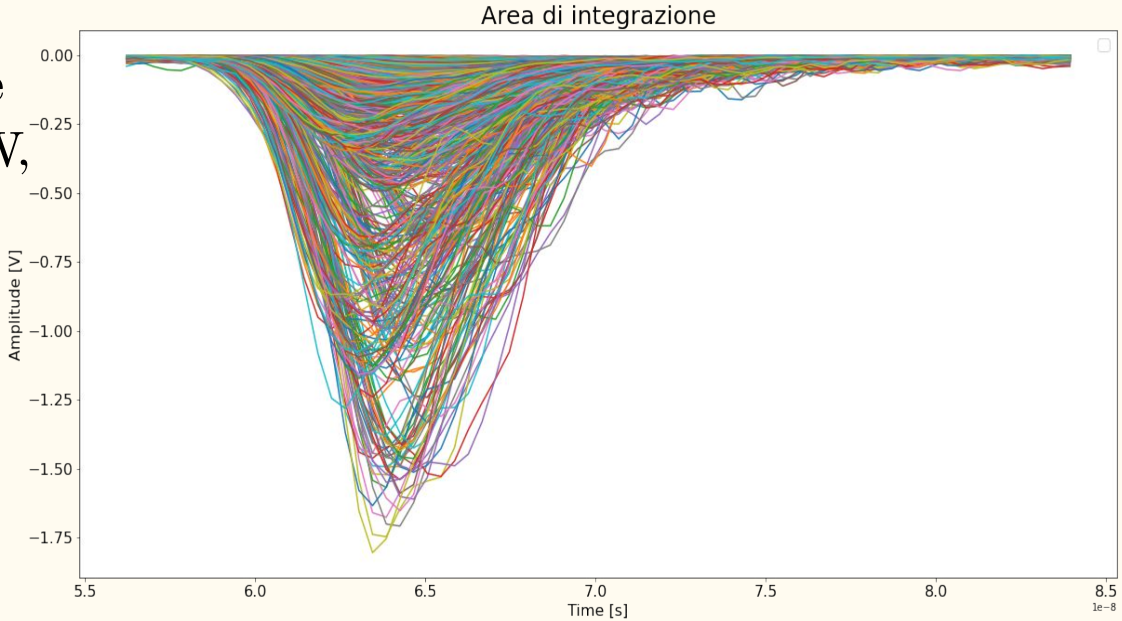
This study was made at a supply voltage of 1000 V. The gain agrees with the Datasheet provided by Hamamatsu.

Figure 2: Typical gain and dark current characteristics



Equalization:

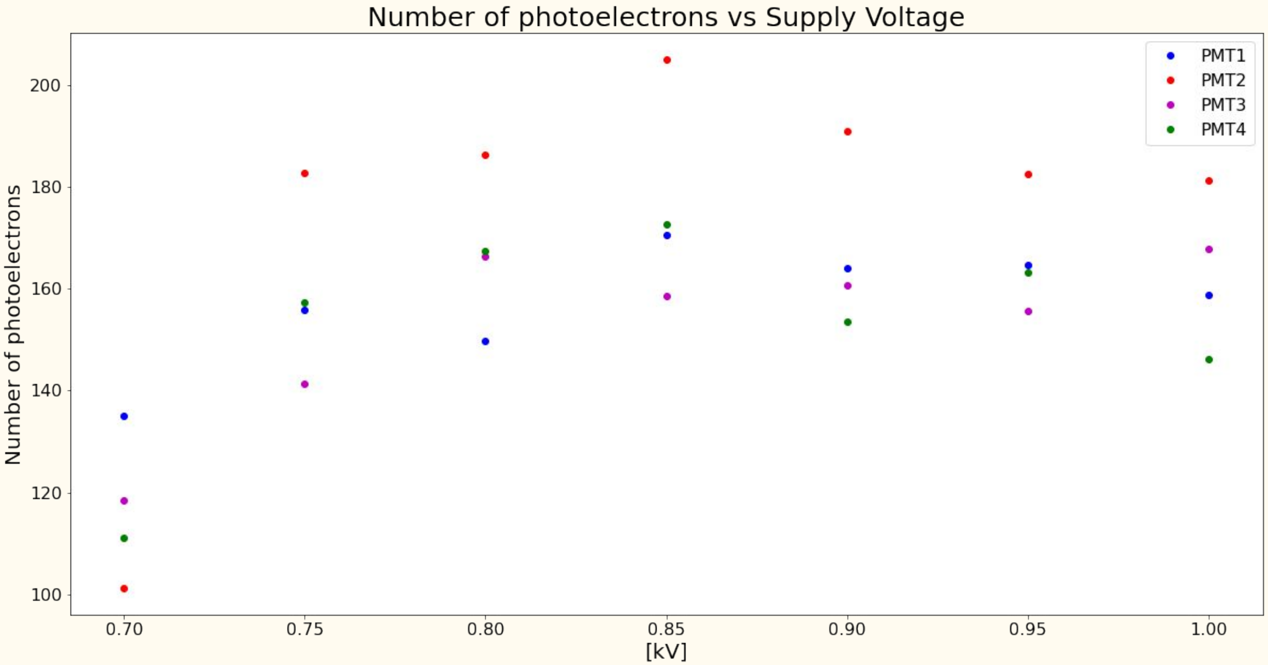
The equalization study was made at supply voltage of 700 V, 750 V, 800 V, 850 V, 900 V, 950 V, 1000 V.



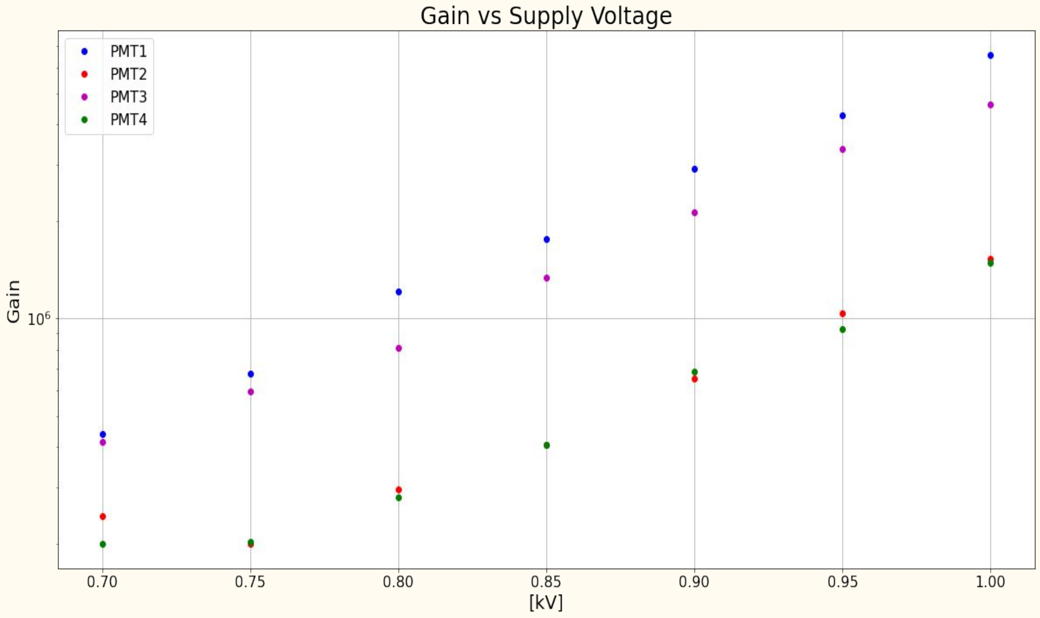
Equalization:

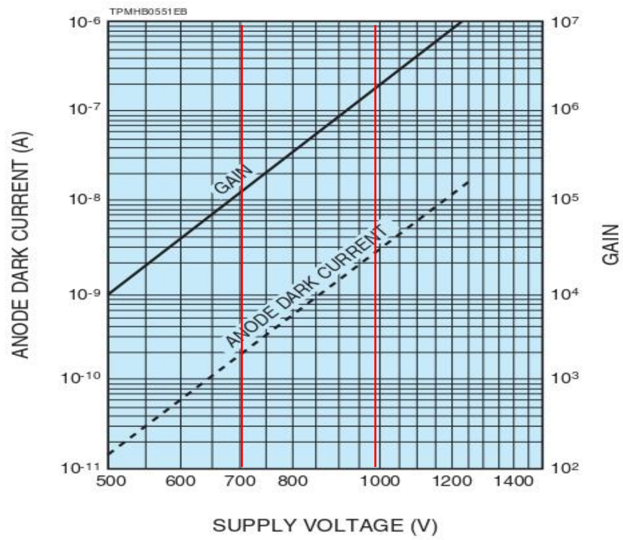
We expected a constant number of photoelectrons because the amplitude of LED driver was kept constant.

Ne= (<Q>/rms)^2



Equalization:





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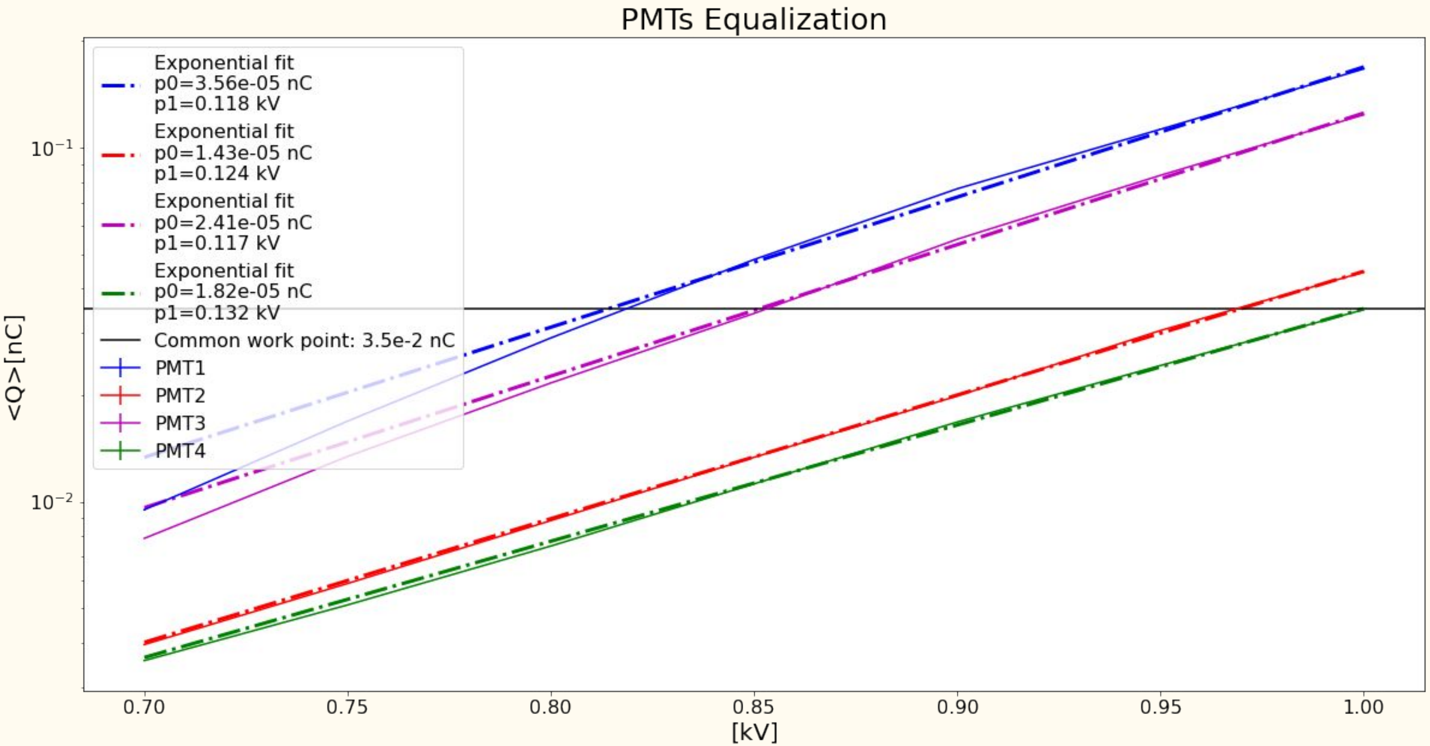

PMT	kV
1	0.82
2	0.97
3	0.85
4	1.00

Thanks for your attention