



Status SmallPMT & SSDPMT

L. Valore, R. Colalillo, F. Guarino

Status SmallPMT (1308 di 1608)

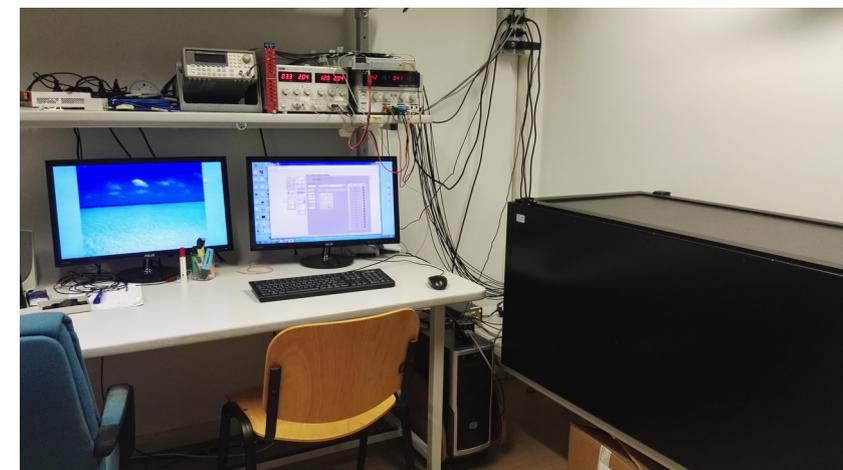
1308 SmallPMT : 16 iniziali + 1290 + 2 scartati

1290 SmallPMT sono a Malargue (ultimi 636 consegnati il 12/3/21)

2 spedizioni : settembre 2020, settembre 2021 (container da Lecce)

Attualmente abbiamo altri 300 SmallPMT (100 pagati da KIT, 200 da noi) assemblati e pronti per essere testati → appena finiamo i test dei PMT_SSD iniziamo a testarli.

Prevediamo di finire tutto entro l'estate.



Software di analisi (Catania, M. Buscemi)

AugerPrime PMT Test Facility
Gain Analysis Tools

Analysis

Choose Files: /home/auger/Desktop/QT-analisi-v2.2/NA_03_2018/RUN_003

Analysis Status: Completed

Draw Gain Curve

Select PMT ID: RY4404

Draw All

Charge and Amplitude Histograms

Choose File

Analysis Status

Analyze SPE

Connect to DB DB Status: Disconnected

User:

Password:

Connect Disconnect

Store Data

	PMT ID	p0	p1	HV (G=6x10 ⁴)	HV (G=7x10 ⁵)		PMT ID	p0	p1	HV (G=6x10 ⁴)	HV (G=7x10 ⁵)
ch00	RY4481	2.94e-17	7.44	732	1019	ch08	RY4401	1.11e-17	7.63	707	976
ch01	RY4435	2.63e-17	7.5	706	980	ch09	RY4406	1.57e-16	7.22	710	998
ch02	RY4405	2.27e-17	7.51	715	992	ch10	RY4485	3.95e-17	7.43	711	990
ch03	RY4399	4.11e-17	7.41	718	1001	ch11	RY4420	8.28e-18	7.64	724	999
ch04	RY4407	5.09e-17	7.41	695	968	ch12	RY4457	2.89e-17	7.44	733	1021
ch05	RY4419	2.36e-17	7.47	731	1016	ch13	RY4404	1.6e-17	7.59	697	964
ch06	RY4439	4.28e-17	7.36	743	1038	ch14	RY4410	4.45e-17	7.43	695	967
ch07	RY4397	9.97e-17	7.29	705	988	ch15	RY4447	7.77e-18	7.63	741	1023

Store All Store Selected PMT Clear

Read DB Data

PMT ID:

Read

p0: p1:

HV: HV:

(G=6x10⁴) (G=7x10⁵)

SAVING DATA ON a
TEMPORARY
LOCAL MySQL
DATABASE

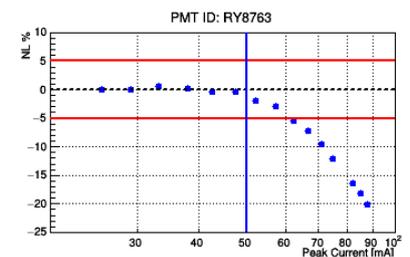
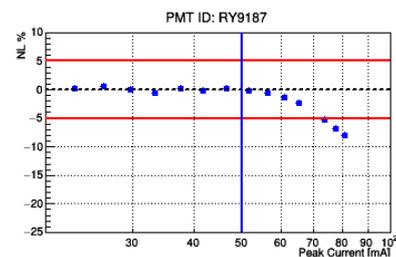
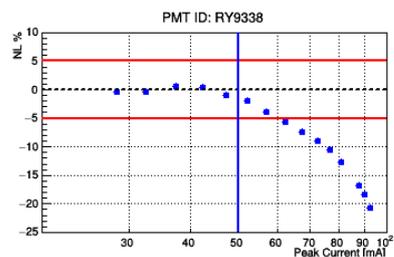
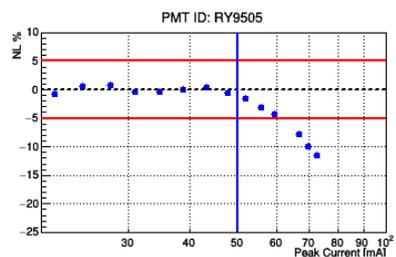
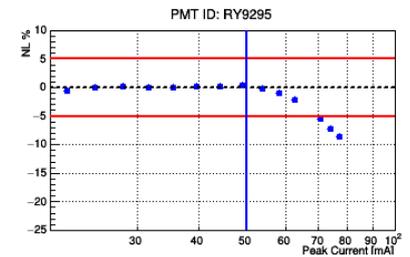
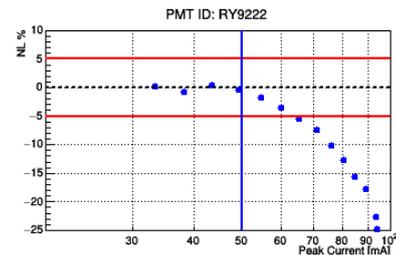
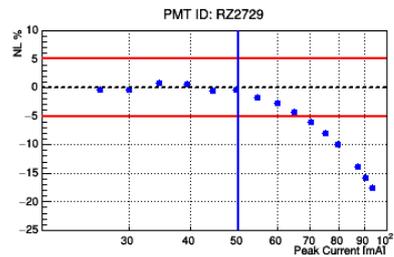
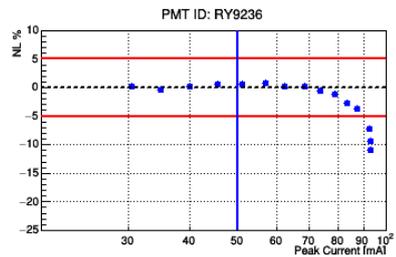
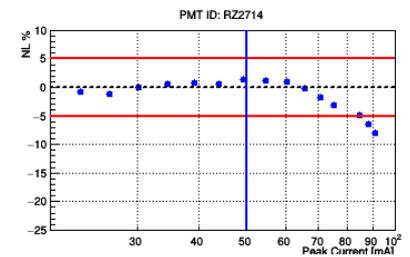
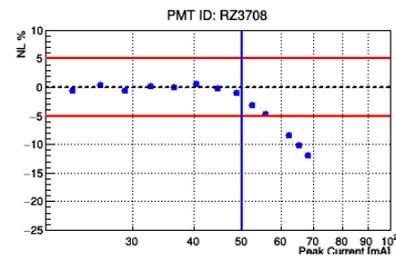
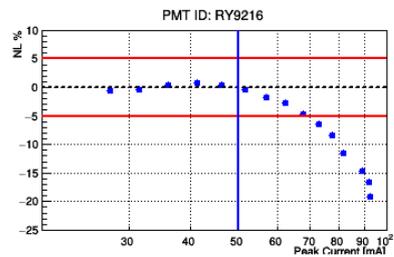
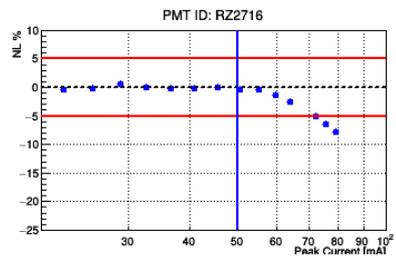
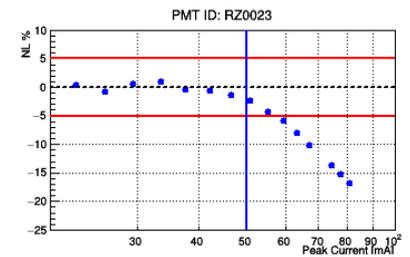
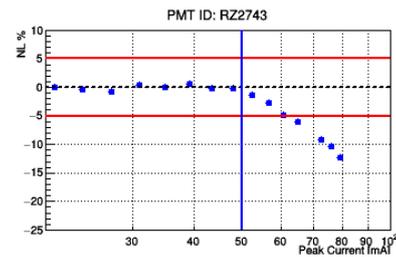
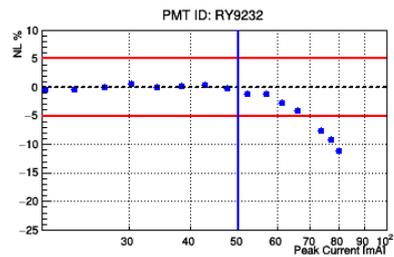
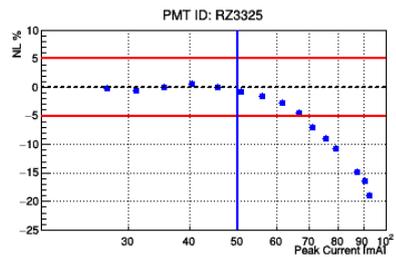
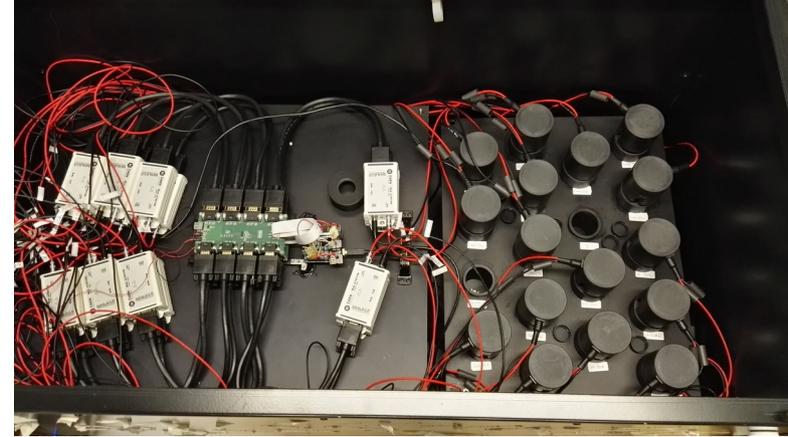
In view of the final
common database

ID	PMT serial number
p0	Gain fit parameter
p1	Gain fit parameter
HV1	HV@G=6x10 ⁴
HV2	HV@G=7x10 ⁵
I	Peak current [mA] @5% NL

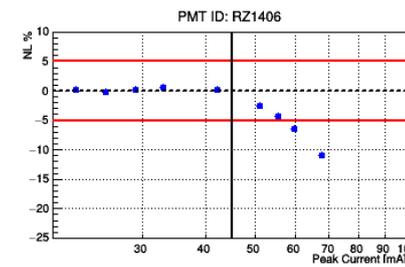
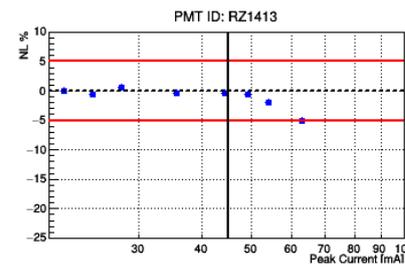
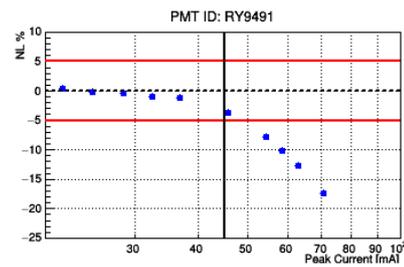
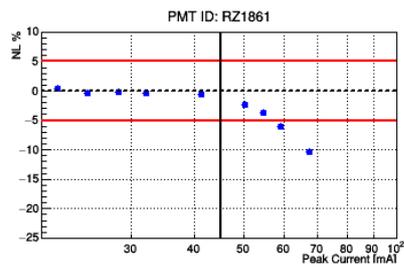
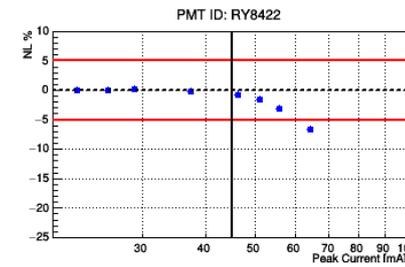
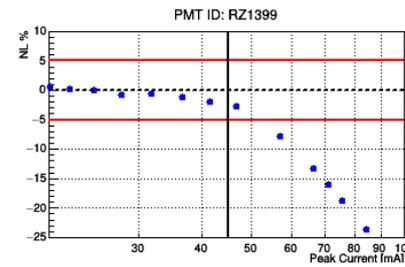
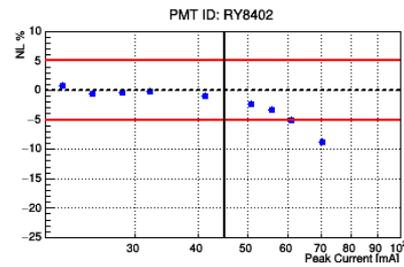
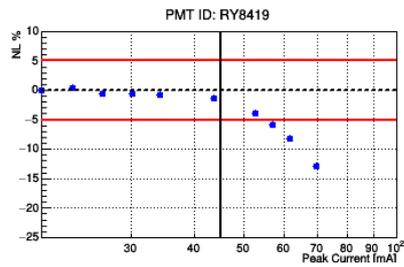
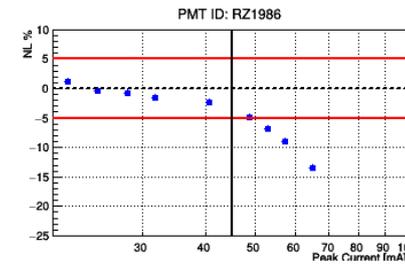
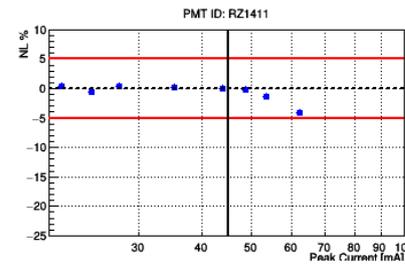
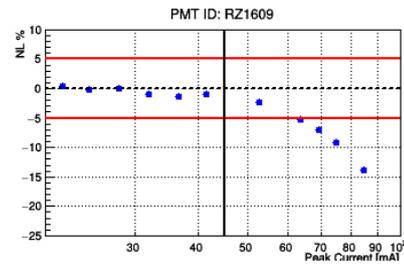
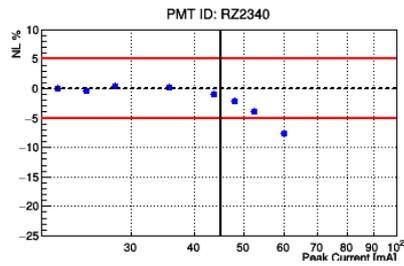
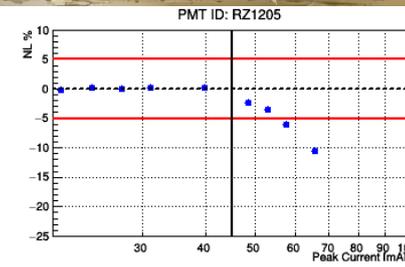
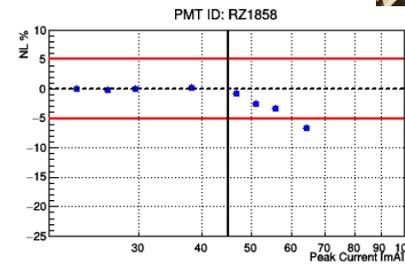
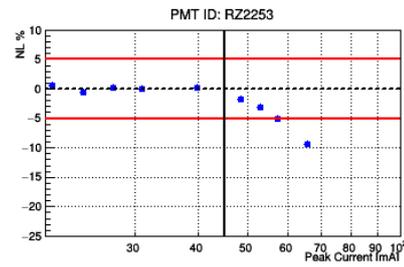
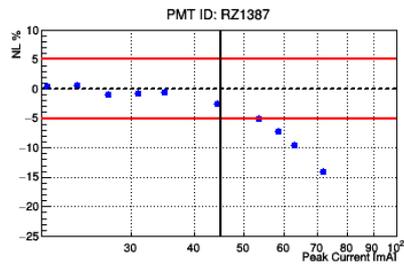
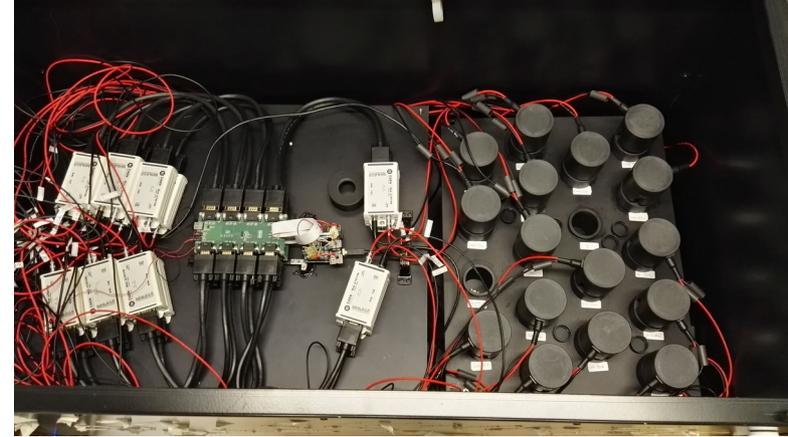
Graphical user interface written using QT libraries (C++ based)

- integrated with **ROOT** for data analysis
- integrated with **MySQL** database for data storage

Test NL, gain 7×10^5



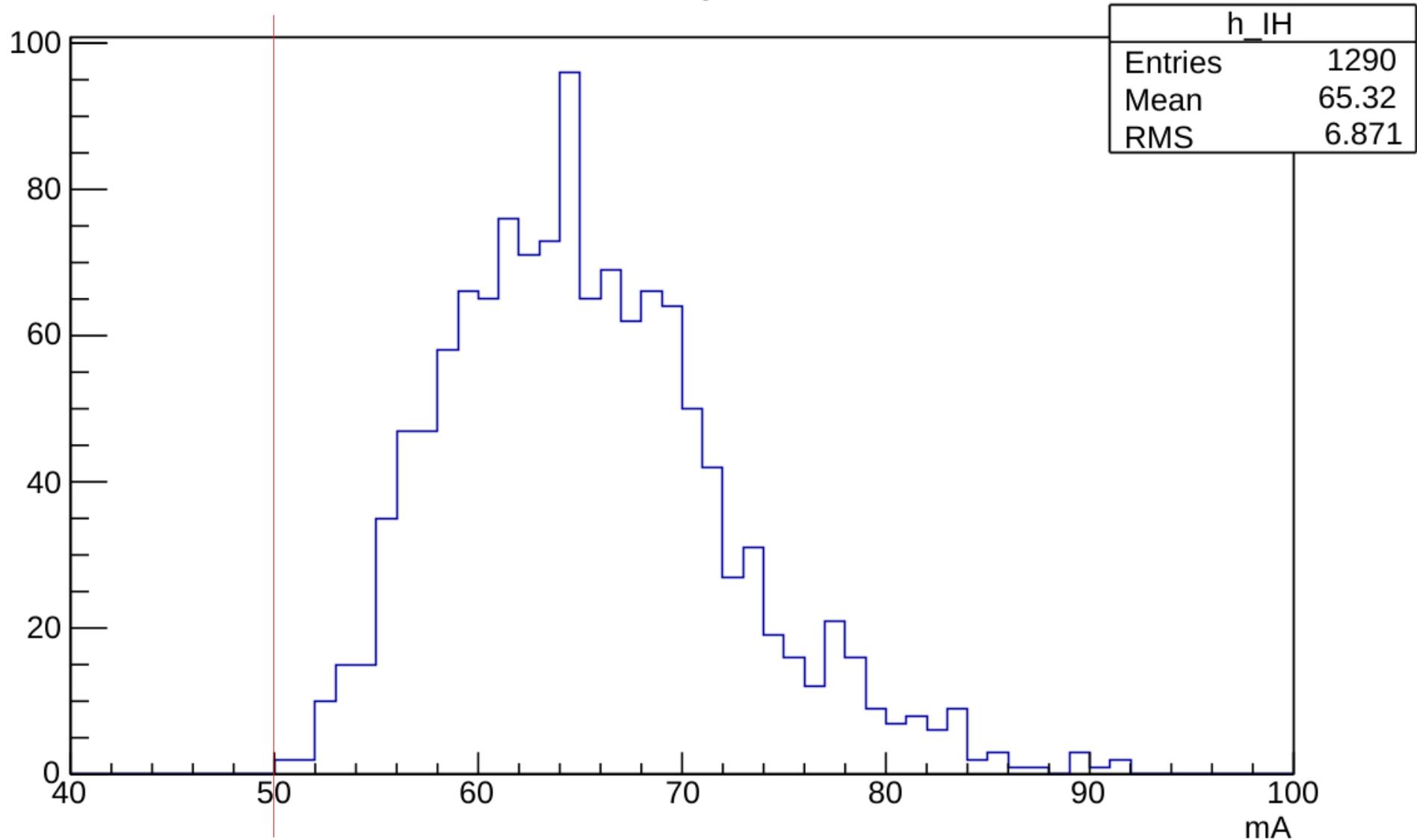
Test NL, gain 3×10^5



1290 pmts checked

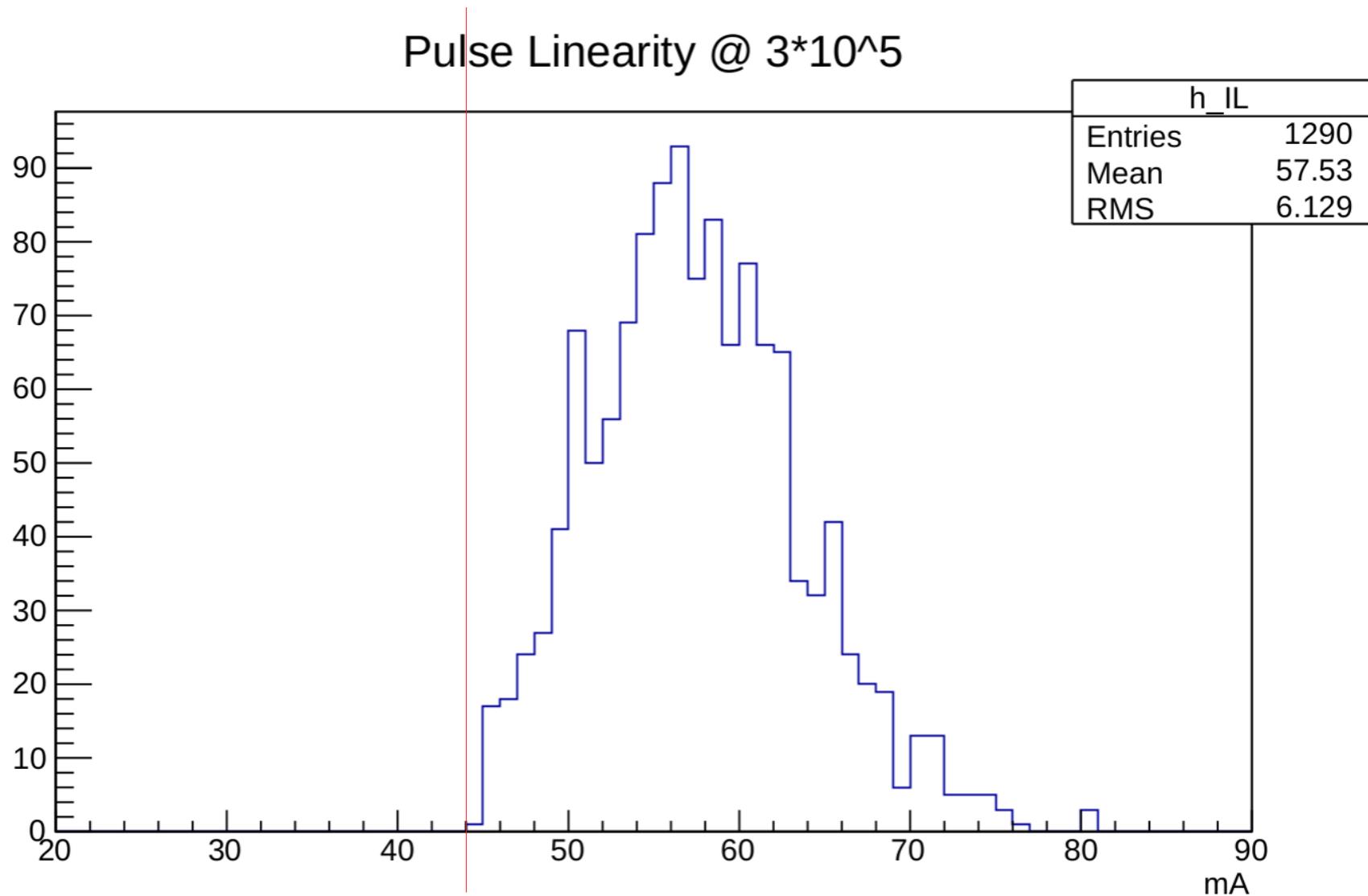
@ 7×10^5 , deviation from linearity lower than 5% up to 50 mA for all pmts

Pulse Linearity @ 7×10^5



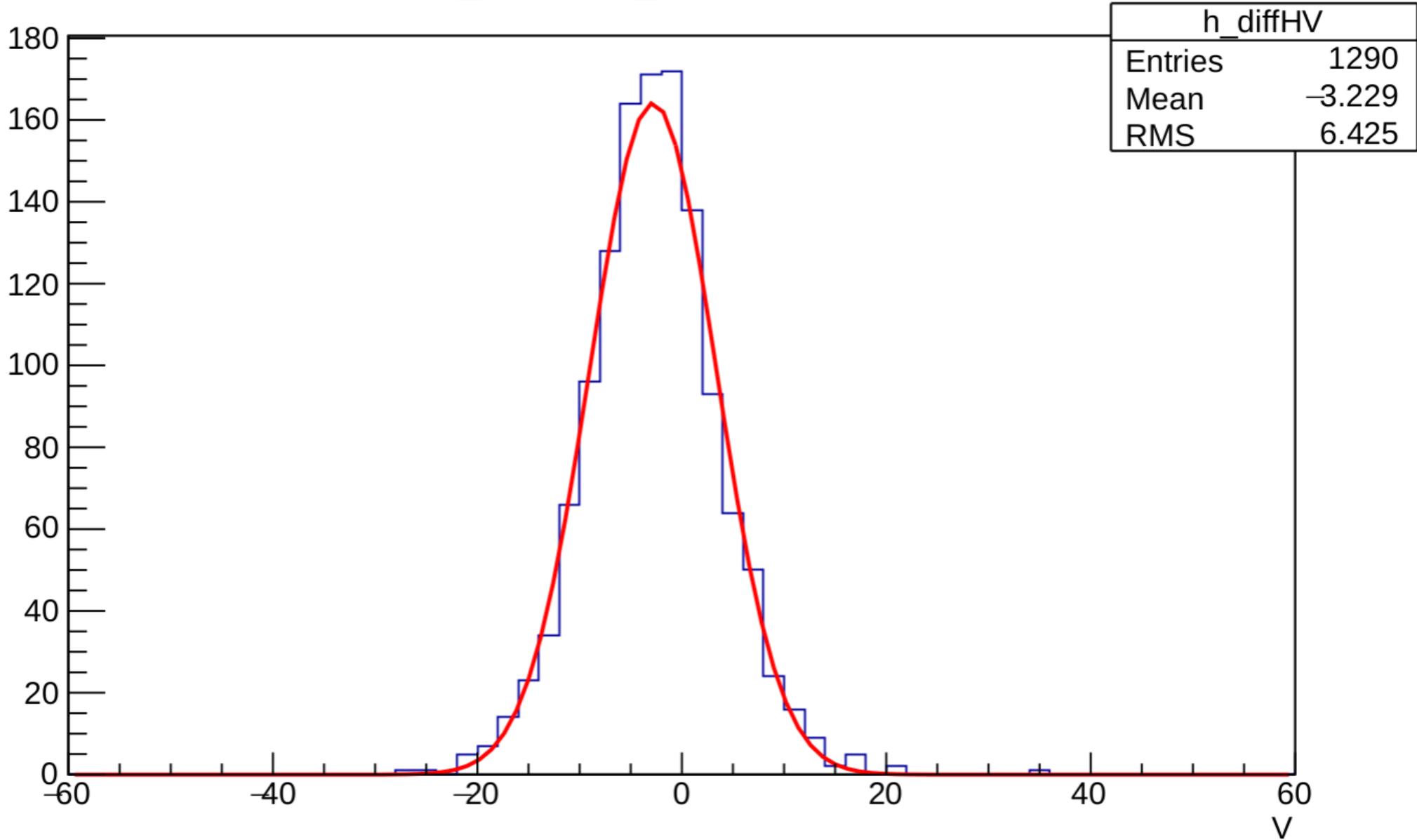
1290 pmts checked

@ 3×10^5 , deviation from linearity lower than 5% up to 45 mA for all pmts

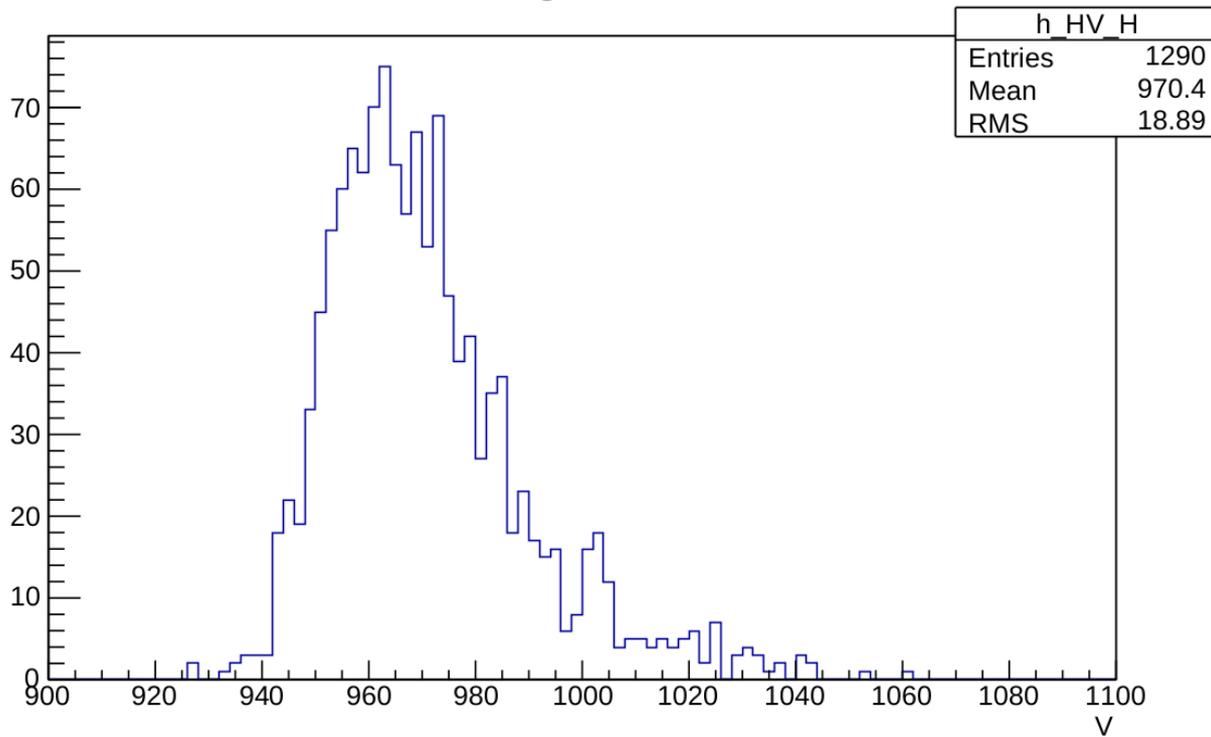


HV difference Napoli - Hamamatsu @ 7×10^5

HV_mis-HV_Ham @ 7×10^5

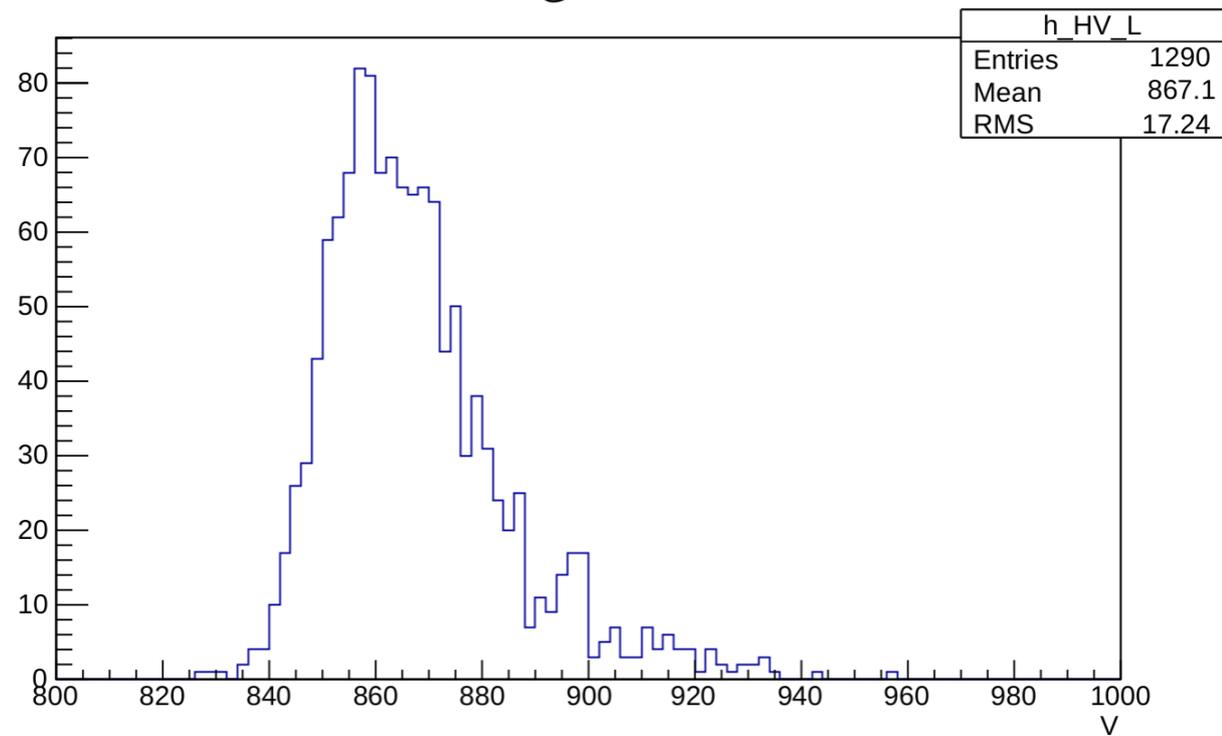


HV @ $7 \cdot 10^5$



Measured HV

HV @ $3 \cdot 10^5$



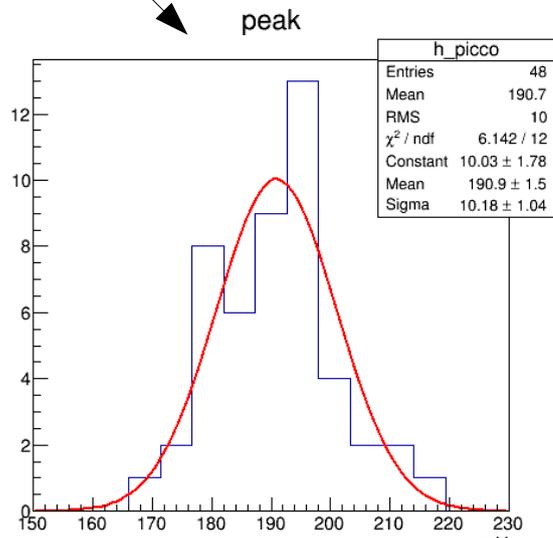
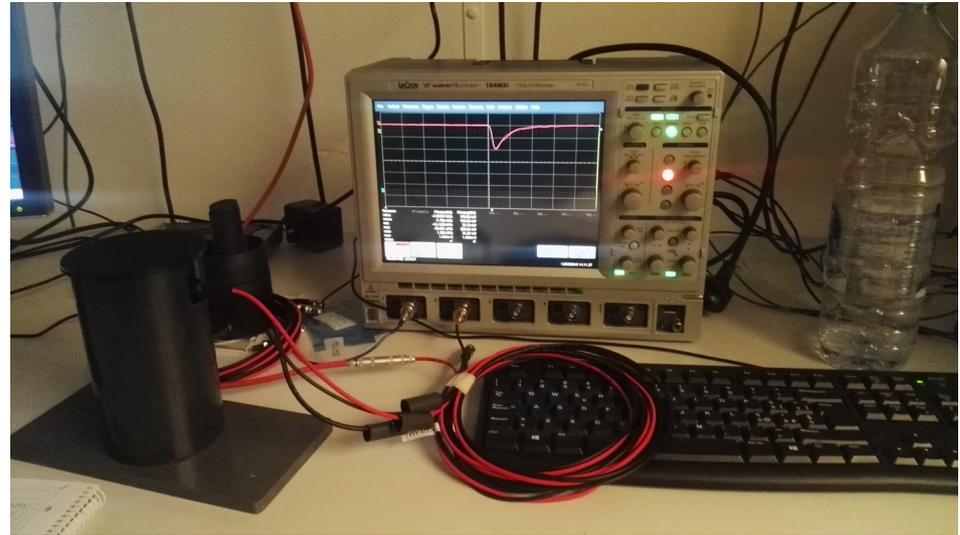
Measurements with light pulser ²⁵¹Am-YAP

TEST on 48 PMTs

the light emitted is constant

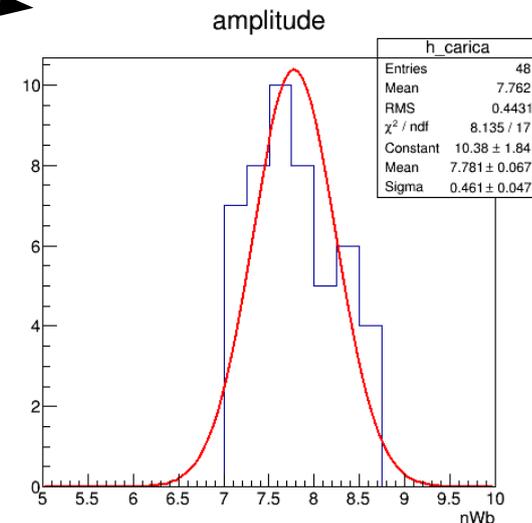
The HV of each PMT is set according to the 7×10^5 gain request

The output peak signal and amplitude must be the same



Average dispersion on peak \rightarrow 5.2 %

Maximum dispersion \rightarrow 10%



Average dispersion on charge \rightarrow 5.7%

Maximum dispersion \rightarrow 9,5%

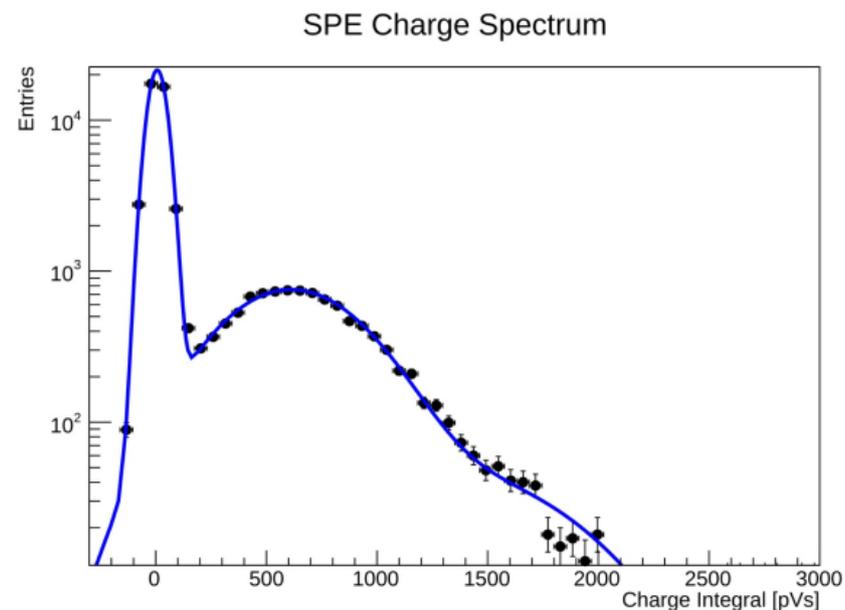
Status SSD PMT (400)

- 40 PMT avuti da Wuppertal per un primo test, analizzati per il meeting di Novembre 2020. Rispediti a gennaio 2021 a Wuppertal per confrontare i risultati alla tensione misurata da noi e non alla tensione nominale di Hamamatsu (*ancora non abbiamo avuto riscontri, ultima mail di Julian 15/2/21*)
- 400 PMT sono a Napoli. Zener sta assemblando e consegnando ogni settimana
- Test iniziati questa settimana; prevediamo di finire i test entro l'estate.



The measurement

- A first acquisition cycle (Gain) is performed to reconstruct the gain curve.
- The gain is measured at 1480 V using single photoelectron pulses.
- A fit returns the gain curve parameters and allows to estimate the operation voltages to achieve the gains of $7 \cdot 10^5$ and $5 \cdot 10^4$ required for the linearity tests.
- After that, the Non-Linearity acquisition cycles at the two gains are performed.
- Procedures and results described in [GAP2020-060](#)

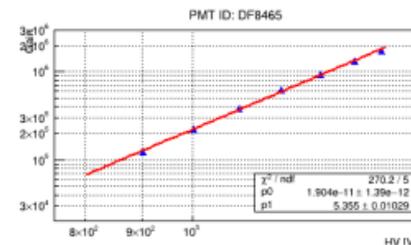
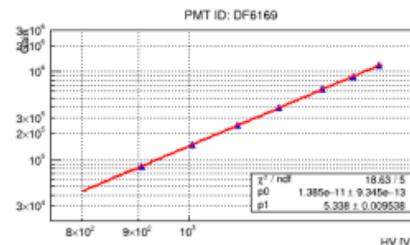
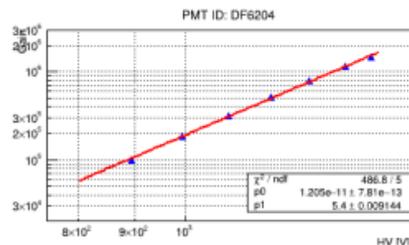
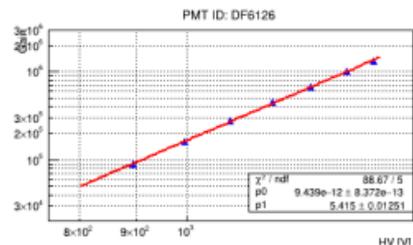
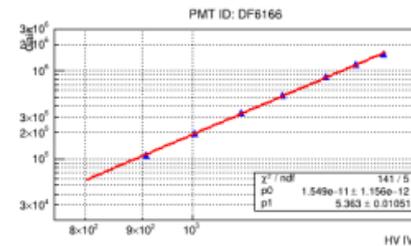
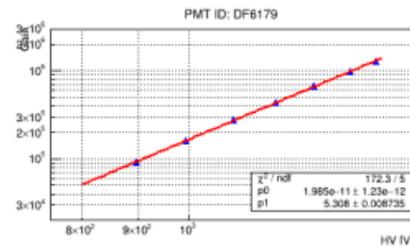
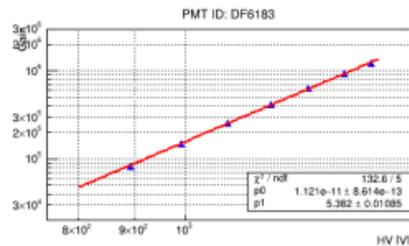
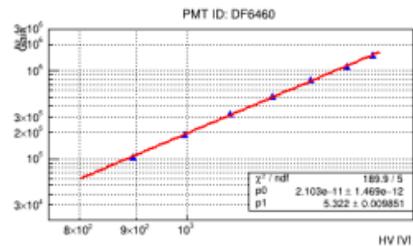
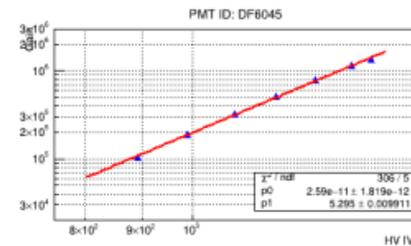
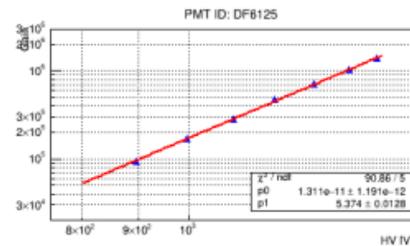
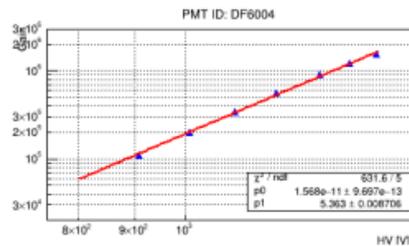
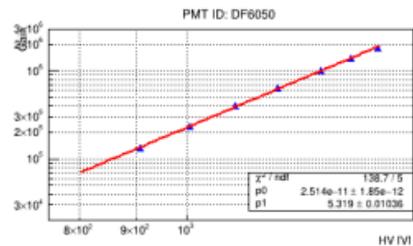
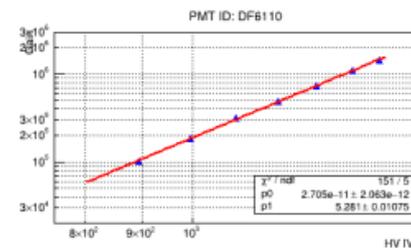
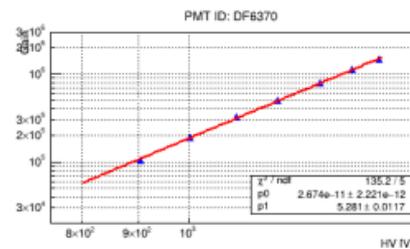
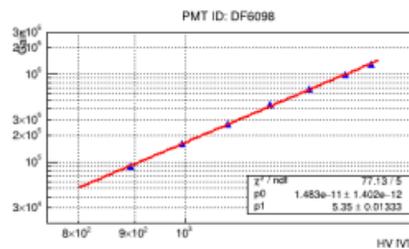
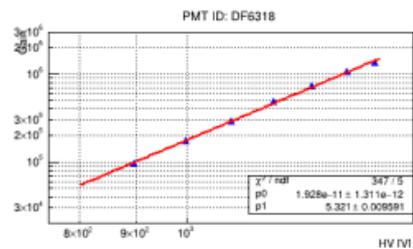


Nota :

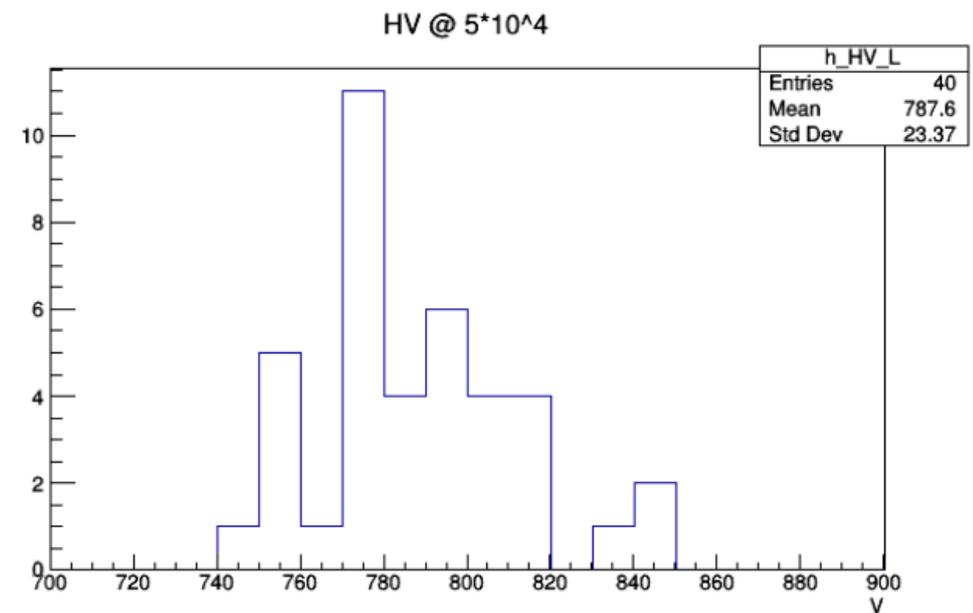
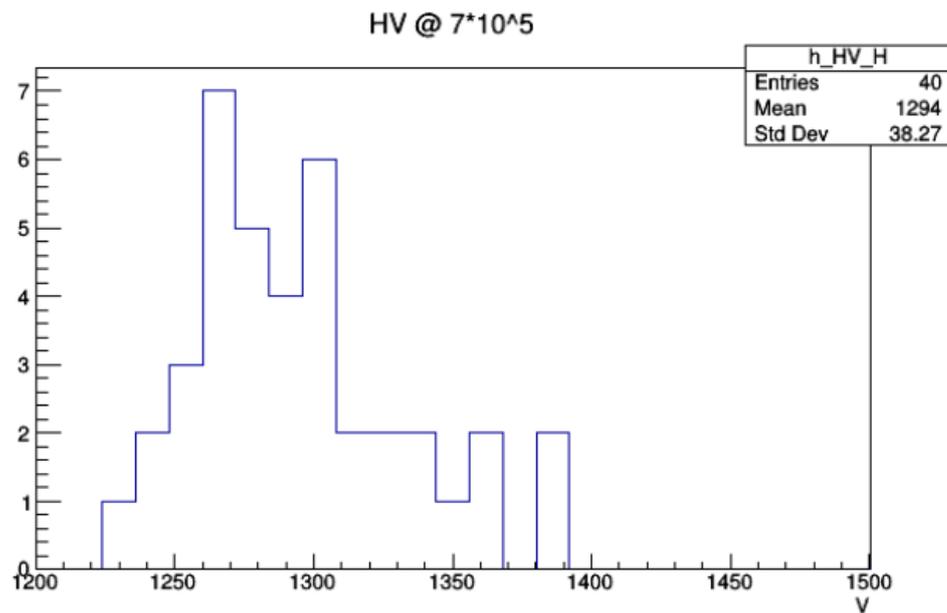
Il gruppo di Wuppertal non misura il gain. Tutte le loro misure di NL sono state effettuate alla tensione nominale indicata da Hamamatsu.

→ per uniformità, anche noi faremo i test di NL alla tensione nominale di Hamamatsu, ma faremo ugualmente la misura di GAIN come informazione aggiuntiva.

Gain curves

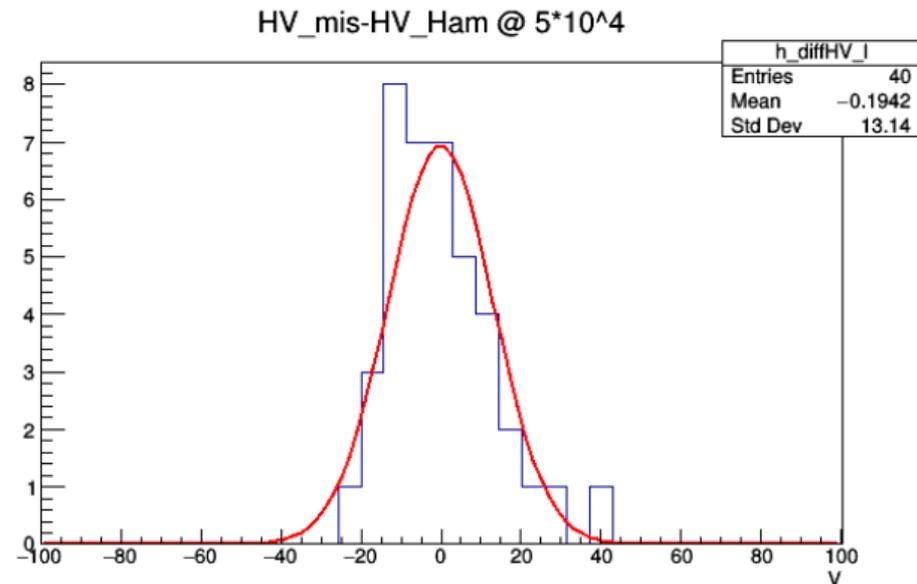
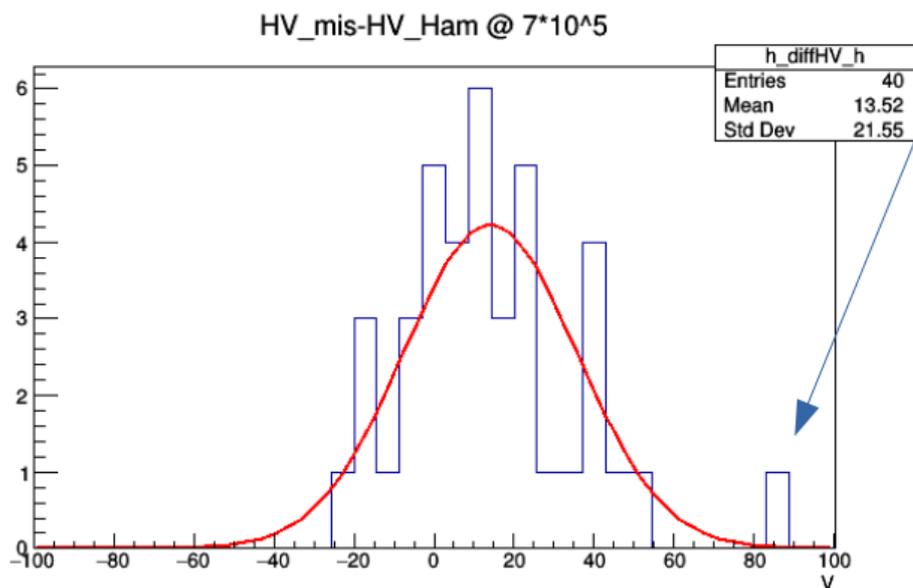


HV settings for the two gains

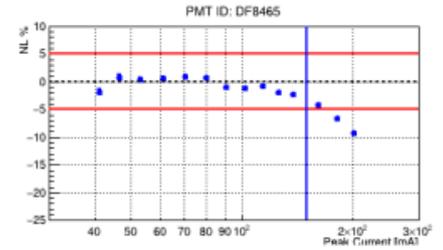
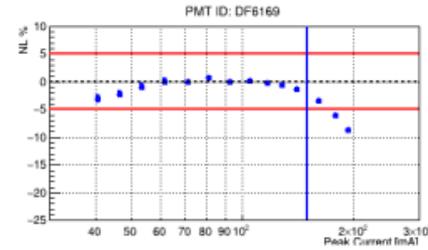
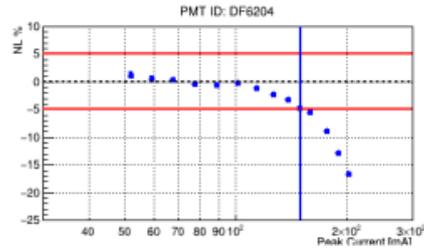
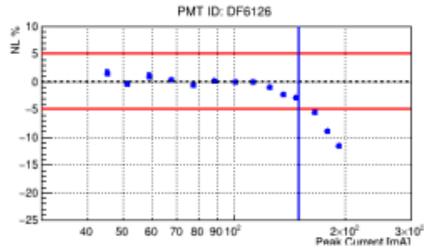
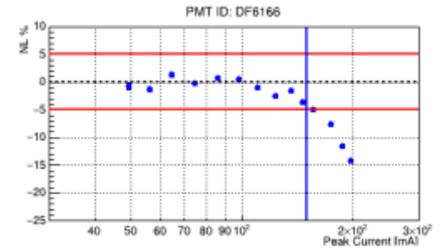
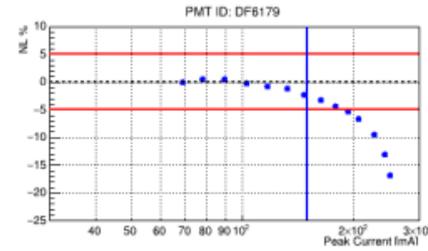
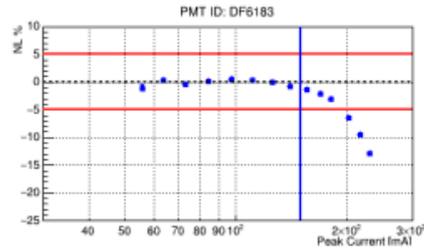
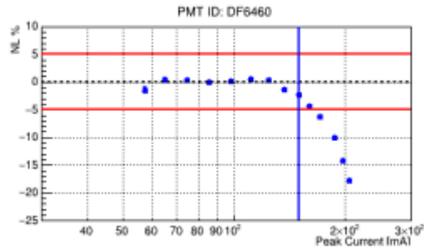
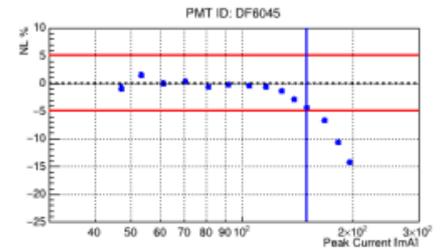
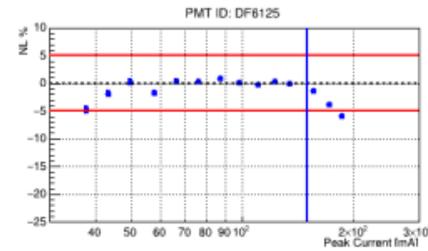
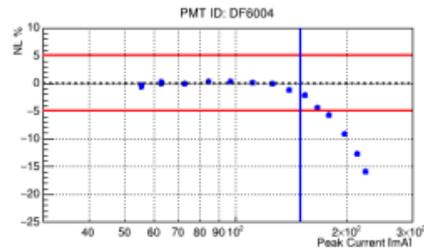
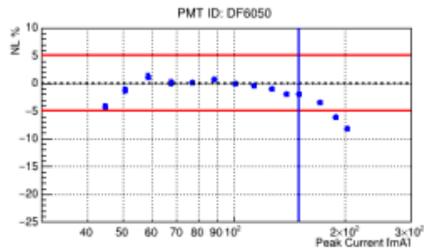
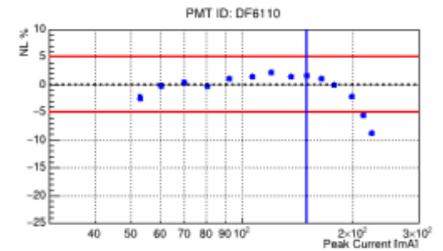
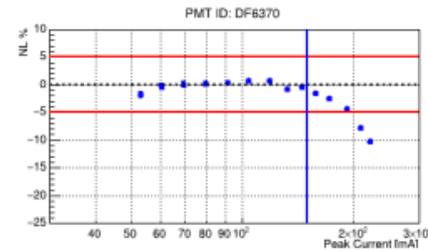
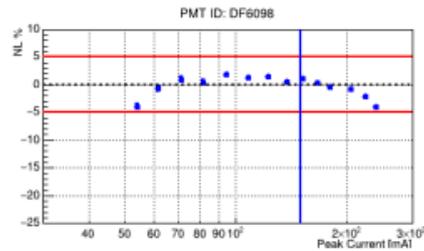
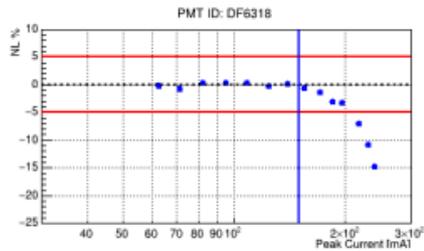


Residuals with respect to Hamamatsu data at the two gains

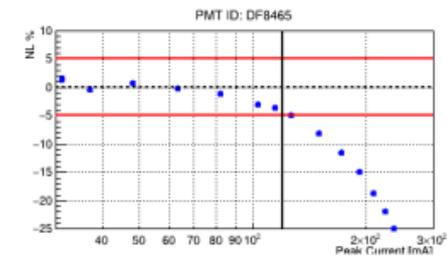
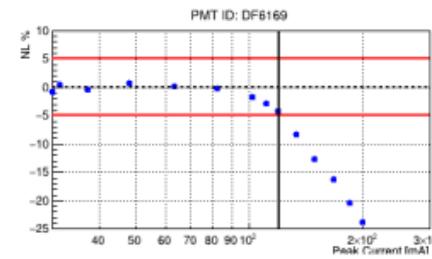
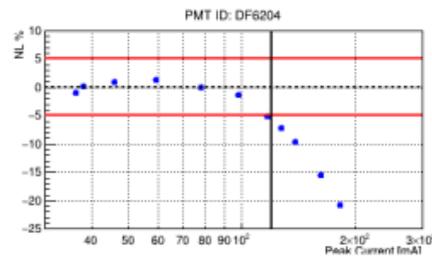
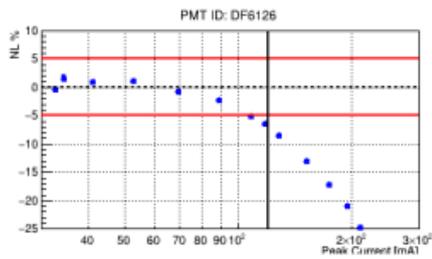
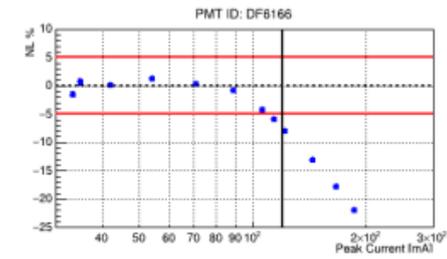
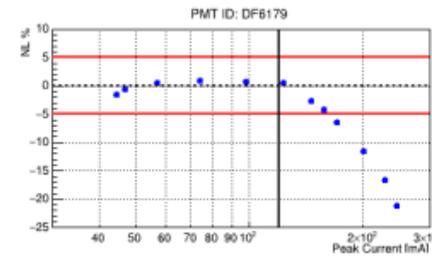
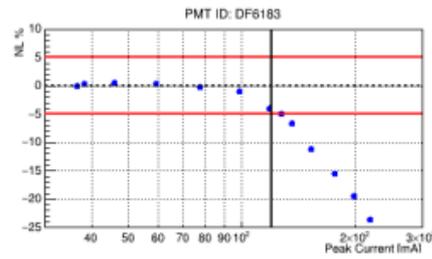
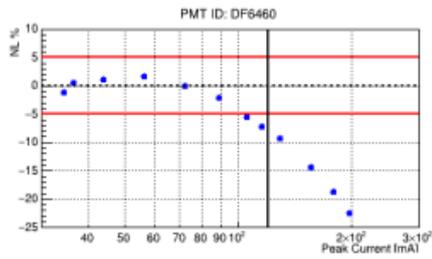
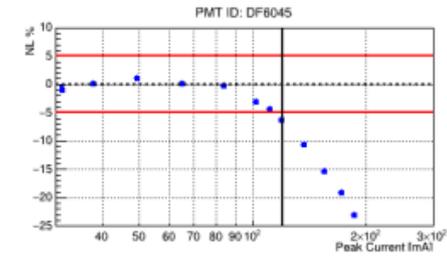
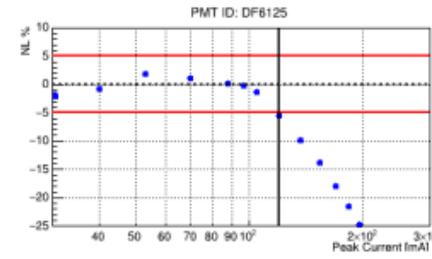
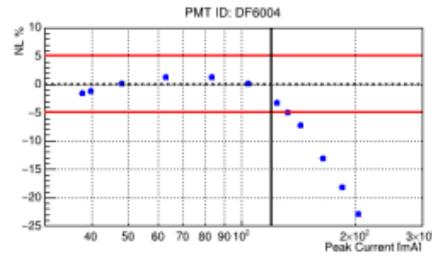
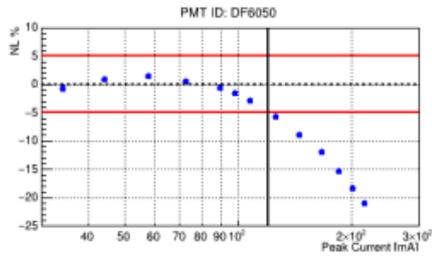
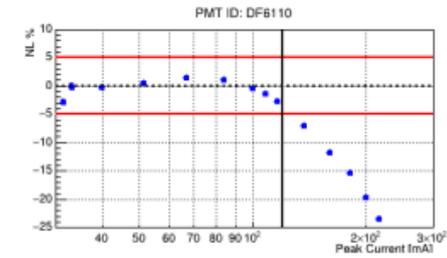
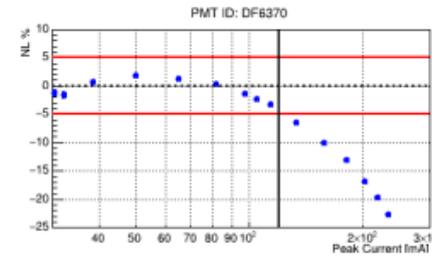
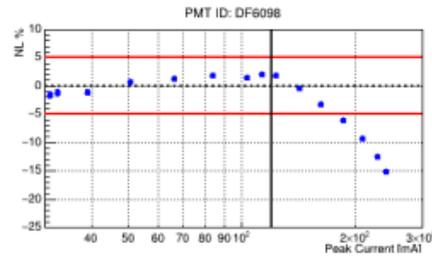
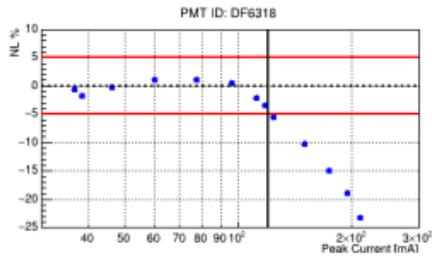
- Standard deviation at $G=7 \times 10^5$ is about 20 volts, larger than the one obtained on the corresponding distribution obtained for the full sample of 1308 tested SPMTs which is 6.5 V. This could be due to the fact that each SSD-PMT uses its own power supply introducing an additional spread.
- Repeated measurements were performed on DF9252 which is more than 80 V far from the factory value, in different conditions and using different channels of the test system; all the tests return values for the HV at the far tail of the distribution



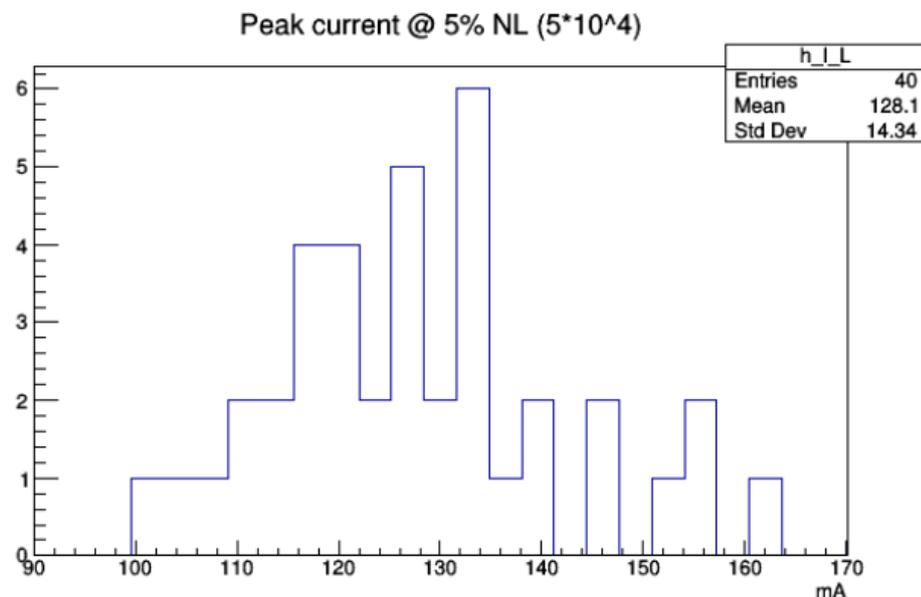
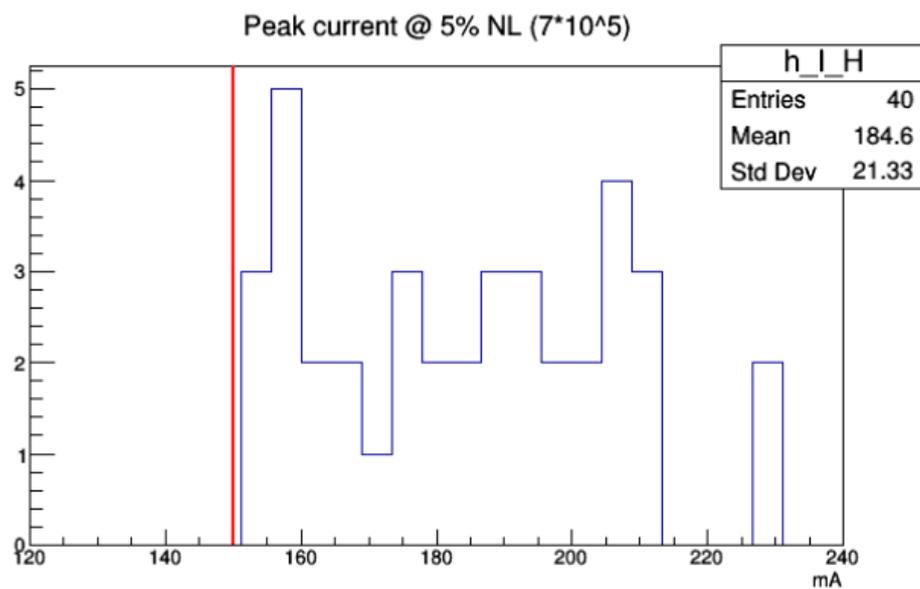
Linearity curves @G=7x10⁵



Linearity curves @G=5x10⁴



Peak current at 5% non-linearity at the two gains



- The first 40 SSD-PMTs have been tested using the Napoli test facility. Operation was basically successful
- HV setting at the gain of $5 \cdot 10^4$ is accurate with respect to Hamamatsu factory data, some offset appears at larger gains
- The spread with respect to Hamamatsu data is larger than the one observed in the case of the Small-PMTs
- Linearity extends beyond 150 mA in all cases at $G=7 \cdot 10^5$.

Backup

SmallPmt (R8619-22) procurement

Update May 6th 2021

Year	Pieces	Status
2016	20	16/20 In Malargue 3/20 in Napoli 1/20 in Torino (?)
2017 (order placed on May 15 th , 2018)	508	508/508 in Malargue
2018	300	300/300 in Malargue
2019	480	480/480 in Malargue (12/3/2021)
Sep 2020	last 636	Shipment with Lecce container