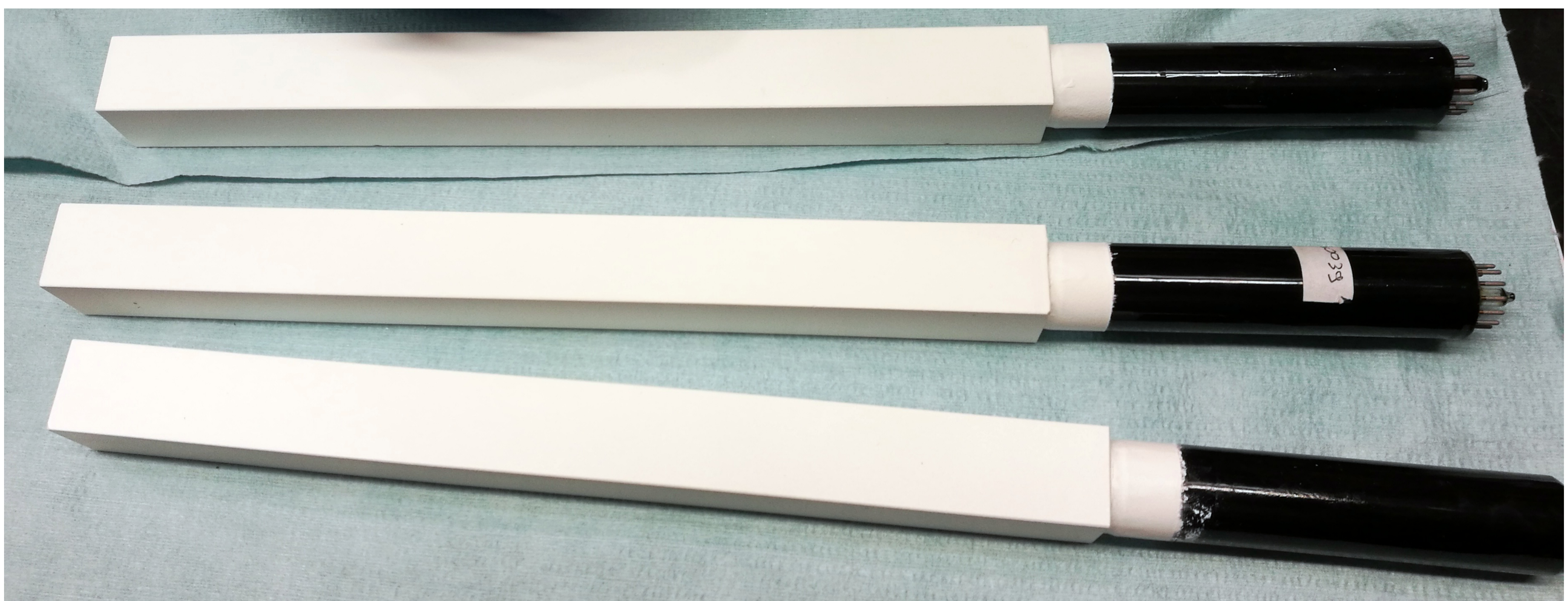
Scintillating units test status

Gabriele Piperno



PADME general meeting - LNF - March 8, 2018

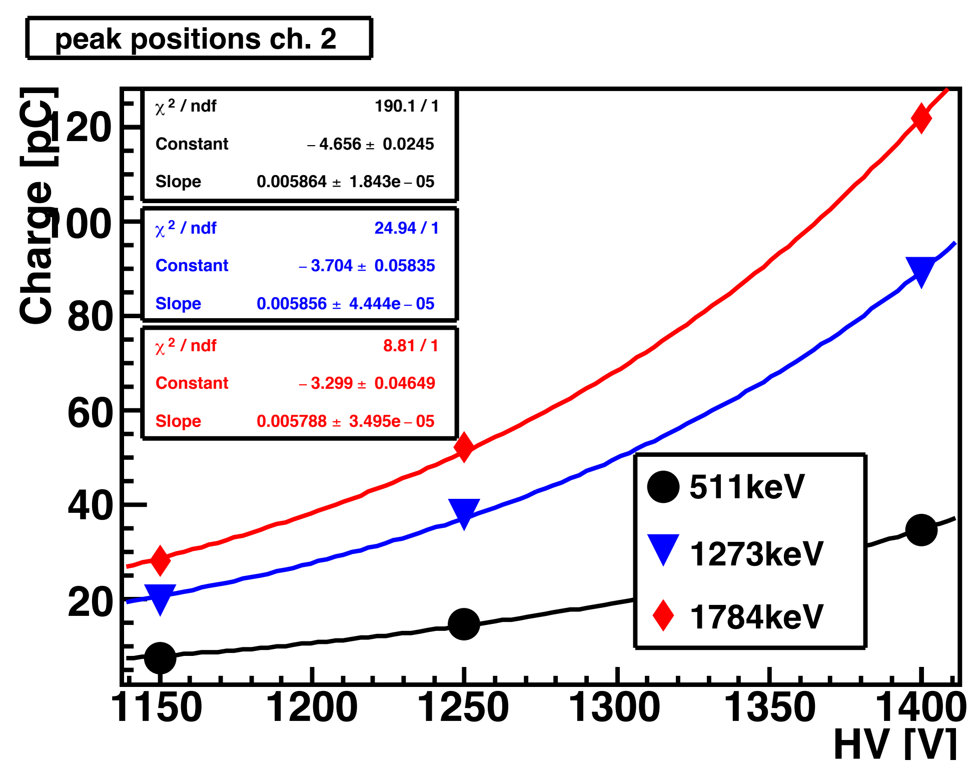
Aim of the test

There are 3 main goals for the Scintillating Units (SU) test:

- measure the gain of each SU, to characterise it
- have a calibration function for each SU, in such a way to have the right HV to set and equalise the SU gains
- study the threshold

At the moment we have not tested any final SU with this system, only minor tests.

Example of calibration curve (produced for a previous SU version)



How we do it

We can calibrate using a ^{22}Na source faced singularly to each SU for 5 differs PMT HVs.

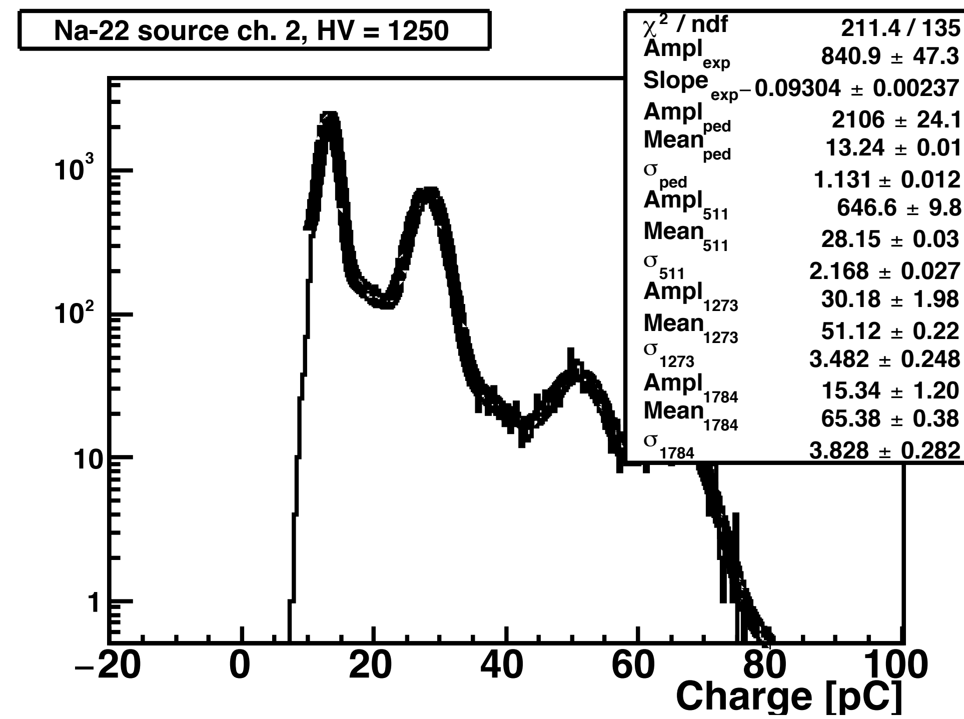
The SU spectra will present 3 peaks:

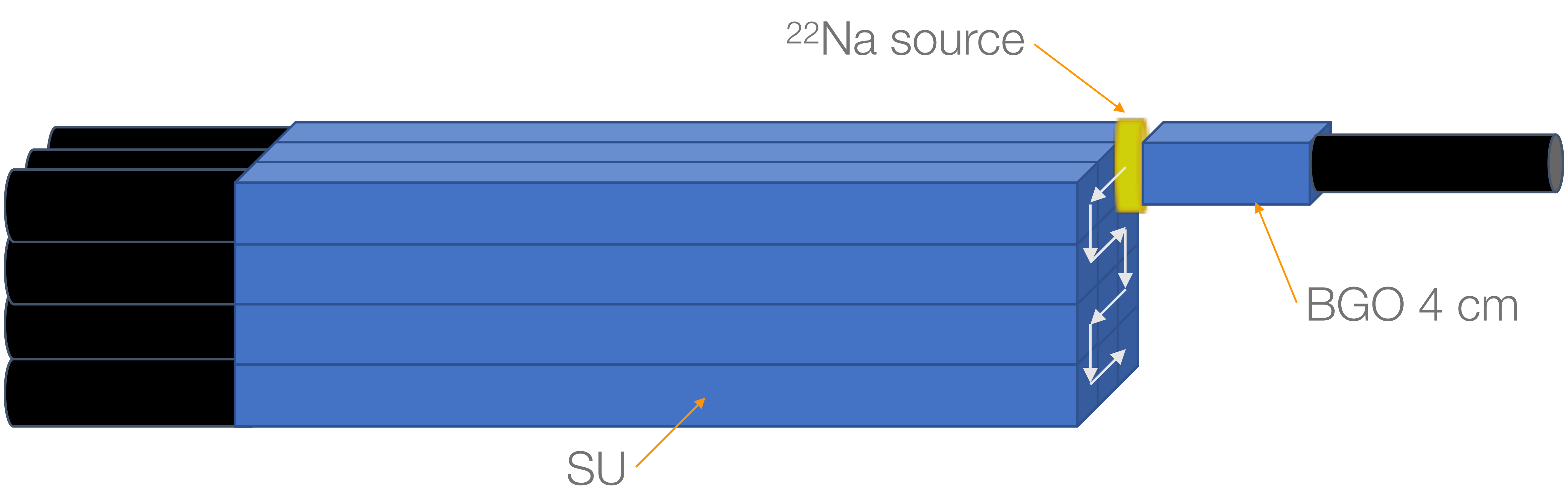
- 511 keV (1 of 2 γs emitted back-to-back)
- 1273 keV
- 1784 keV (= 511 keV + 1273 keV)

A 4 cm long BGO is used as trigger.

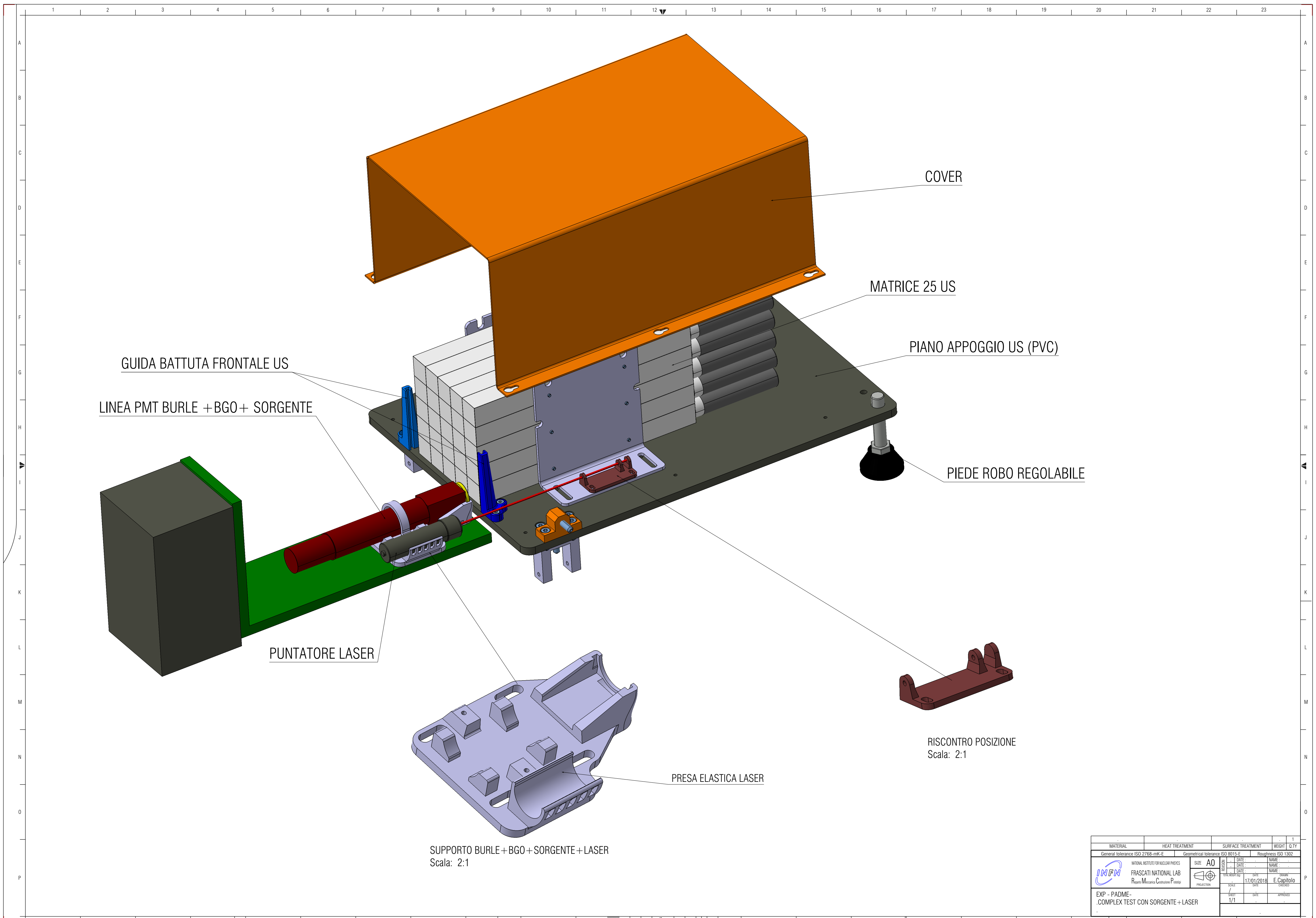
Putting all the runs together for a SU we can obtain its calibration curve (see previous slide).

Expected spectrum

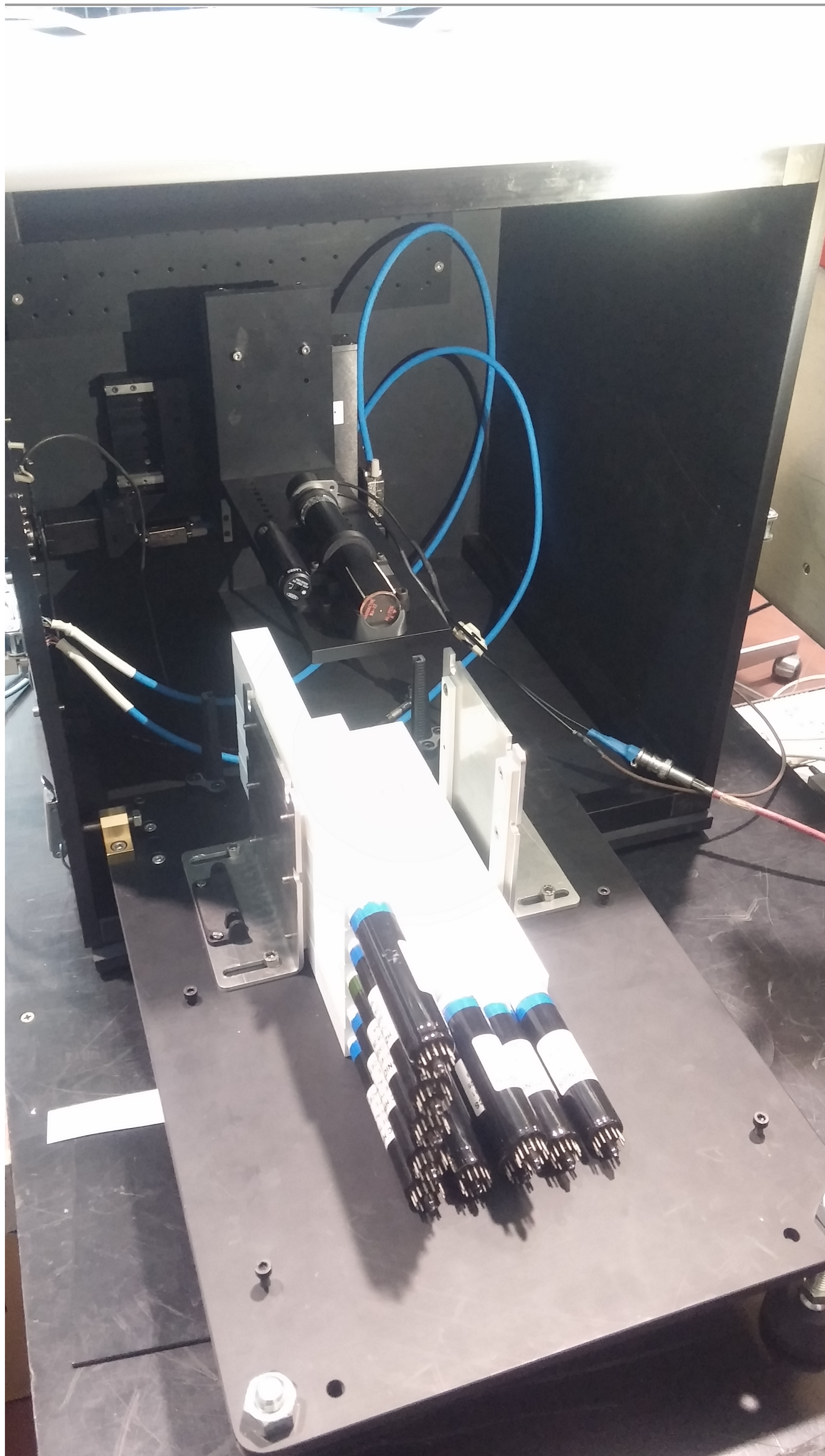


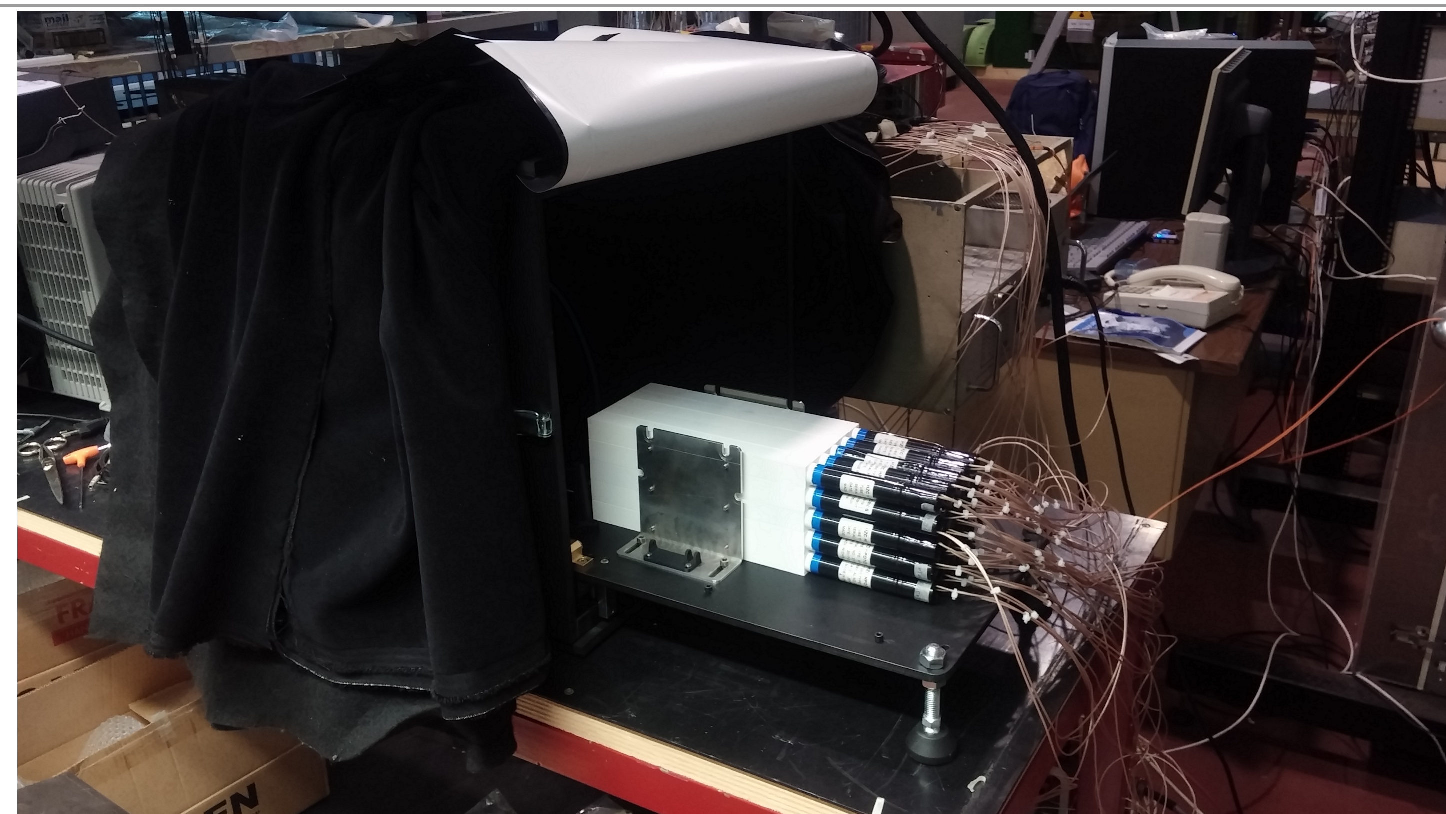


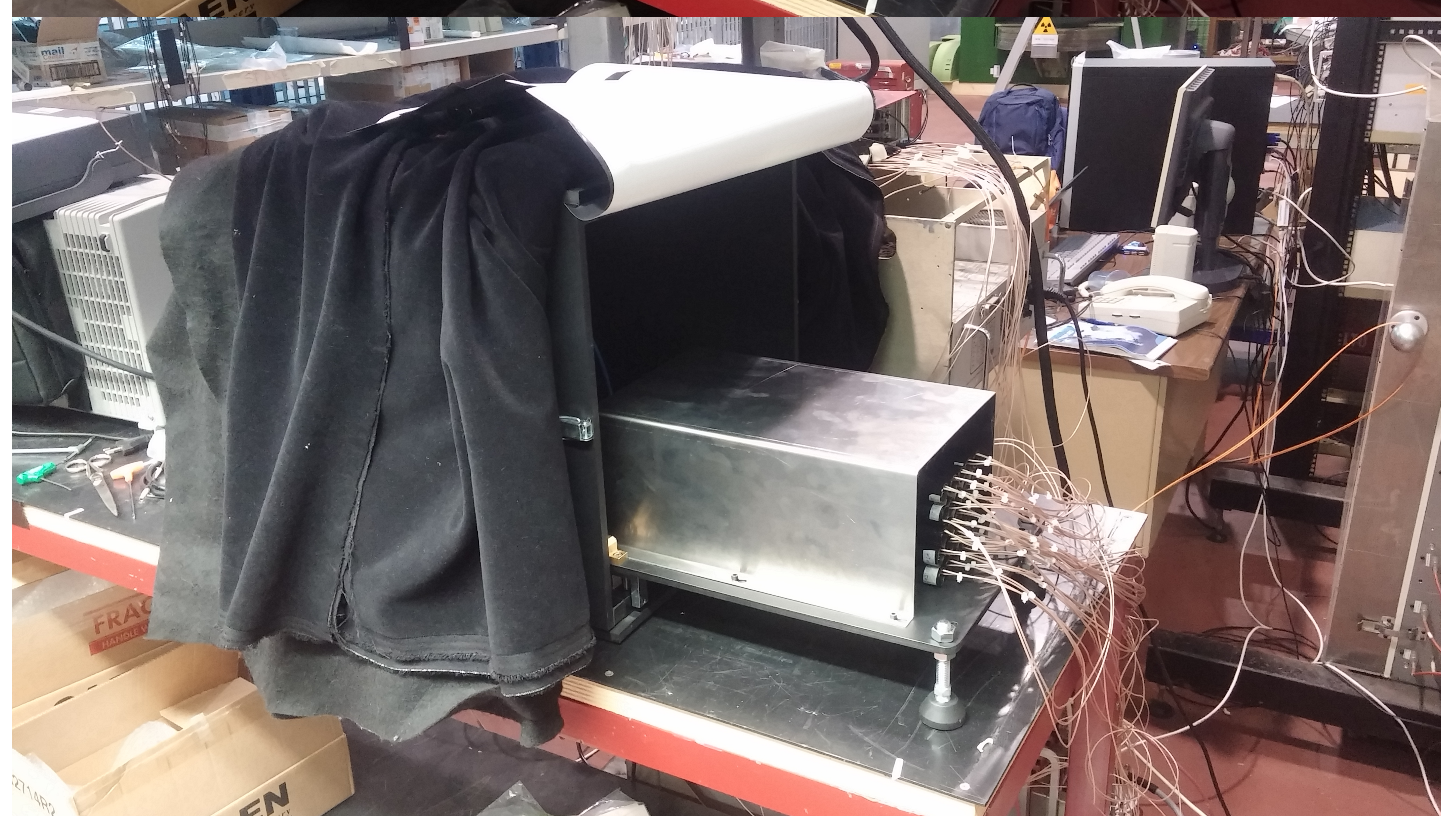
The test box


COVER
MATRICE 25 US
PIANO APPOGGIO US (PVC)
GUIDA BATTUTA FRONTALE US
LINEA PMT BURLE +BGO+ SORGENTE
PIEDE ROBO REGOLABILE
PUNTATORE LASER
RISCONTRO POSIZIONE
Scala: 2:1
PRESA ELASTICA LASER
SUPPORTO BURLE+BGO+SORGENTE+LASER
Scala: 2:1
MATERIAL
HEAT TREATMENT
SURFACE TREATMENT
WEIGHT
Q.TY
1
General tolerance ISO 2768-mK-E
Geometrical tolerance ISO 8015-E
Roughness ISO 1302
NATIONAL INSTITUTE FOR NUCLEAR PHISYCS
FRASCATI NATIONAL LAB
Reparto Meccanica Costruzione Prototipi
SIZE A0
PROJECTION
REVISION
DATE :
NAME :
TOTAL WEIGHT (Kg)
DATE
17/01/2018
DRAWN
E.Capitolo
SCALE
CHECKED
SHEET
1/1
APPROVED
EXP - PADME-
.COMPLEX TEST CON SORGENTE+LASER

Some images

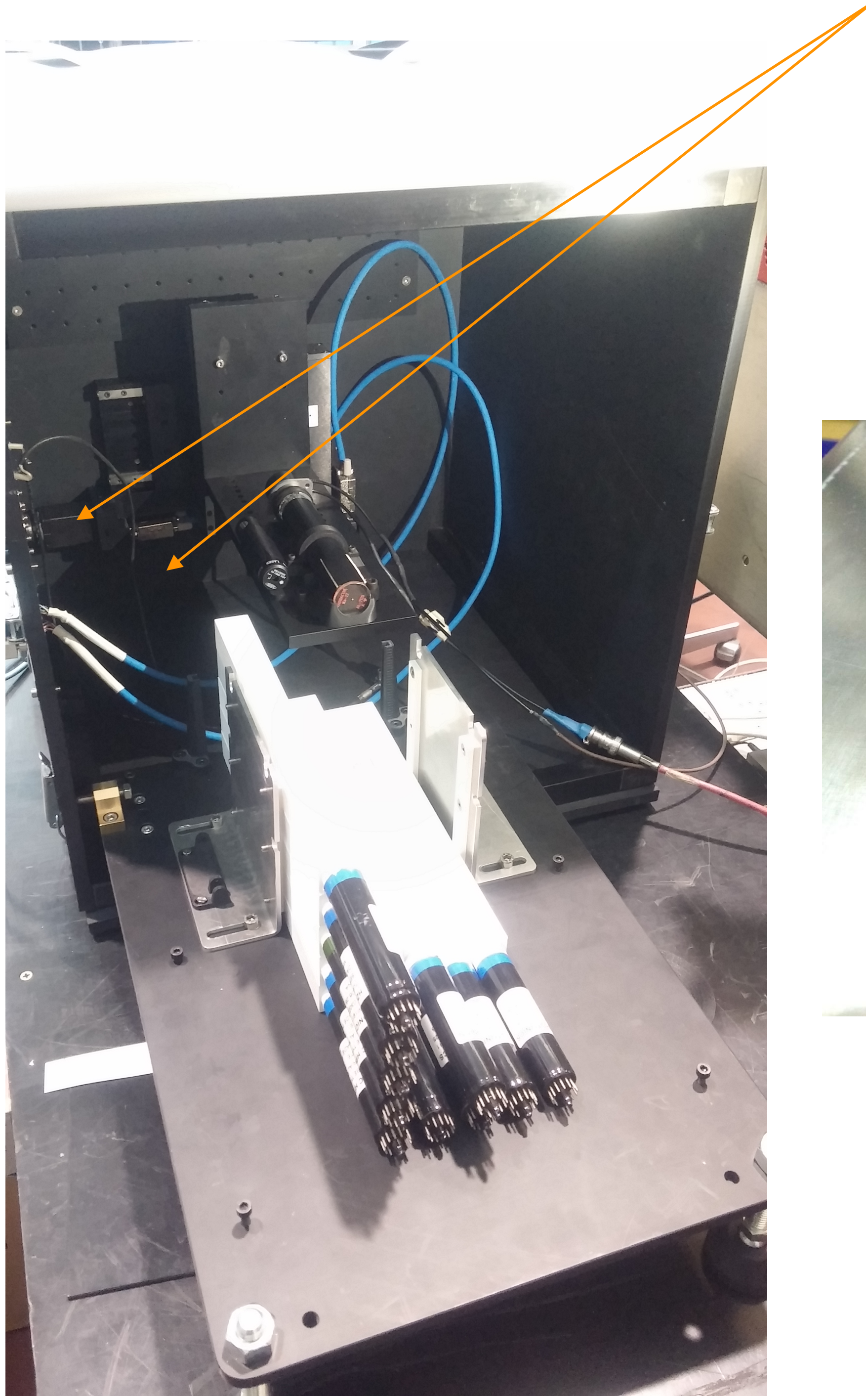


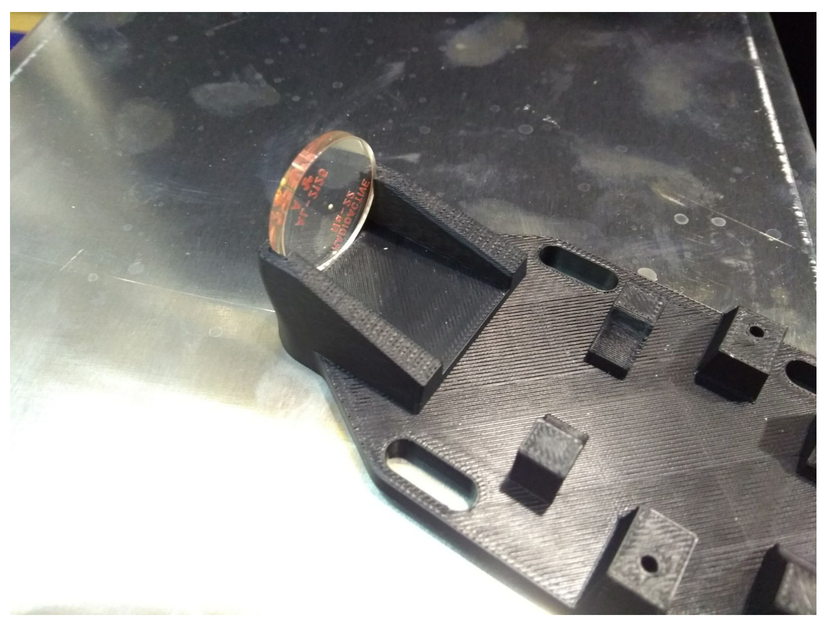


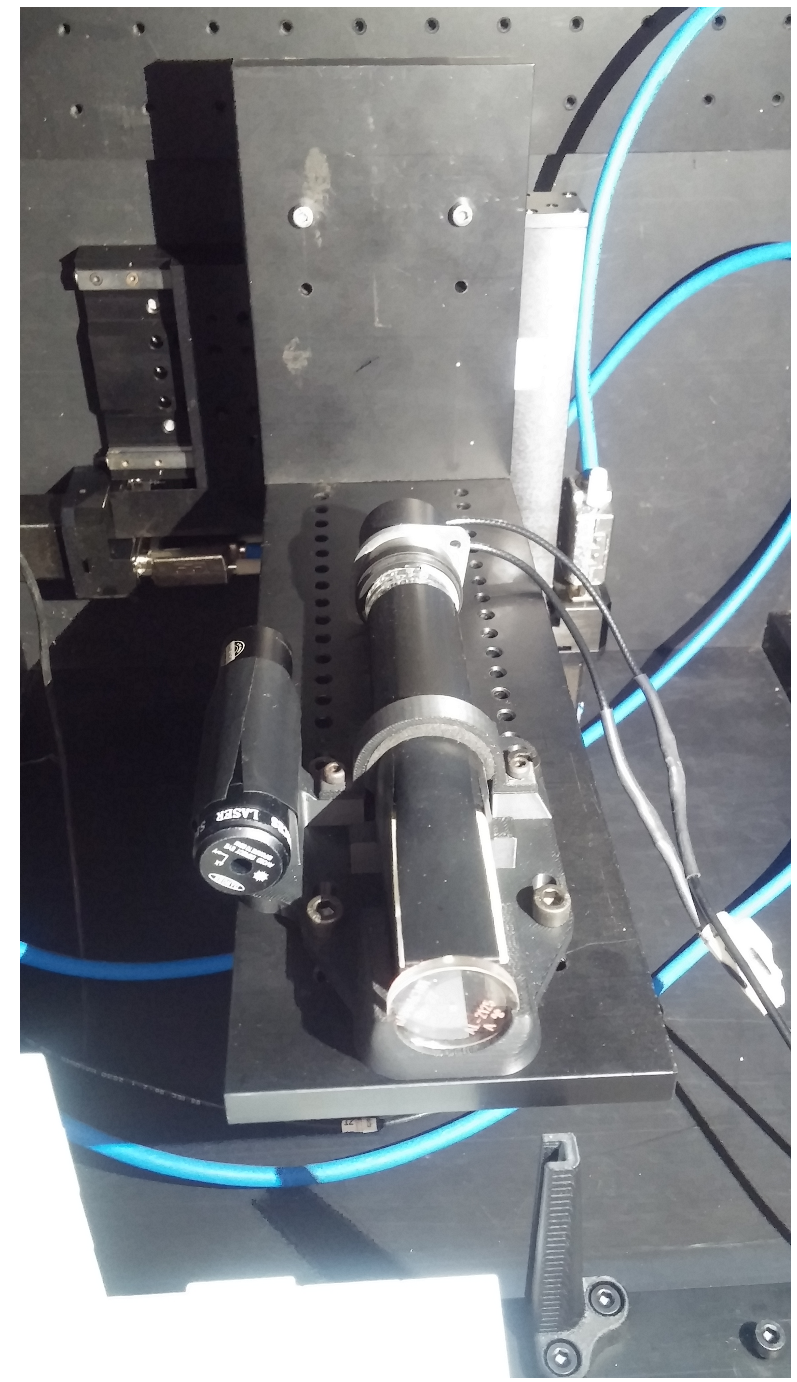


Source movement

To automatise the test we use 2 step motors to move the source in front of each crystal





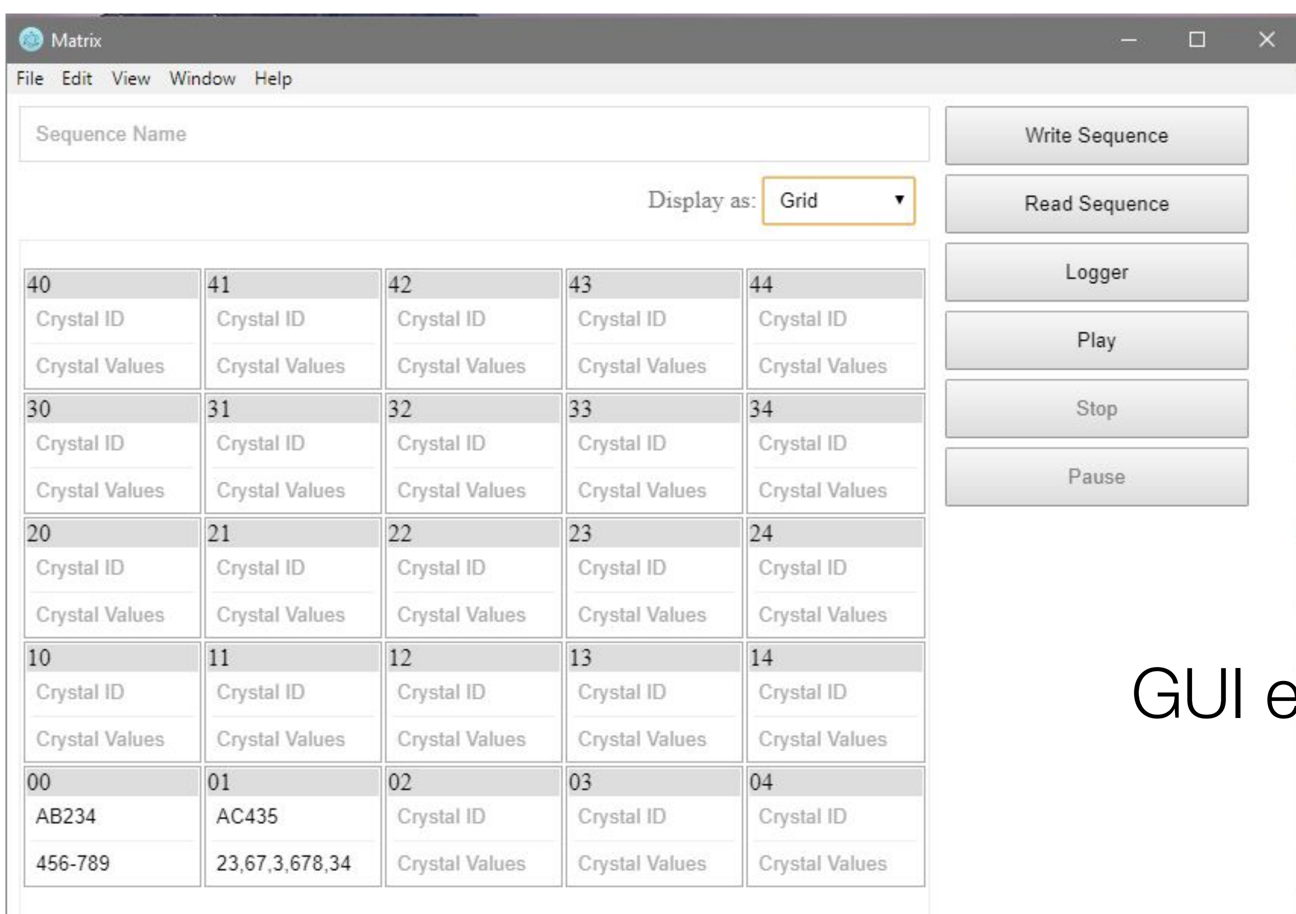


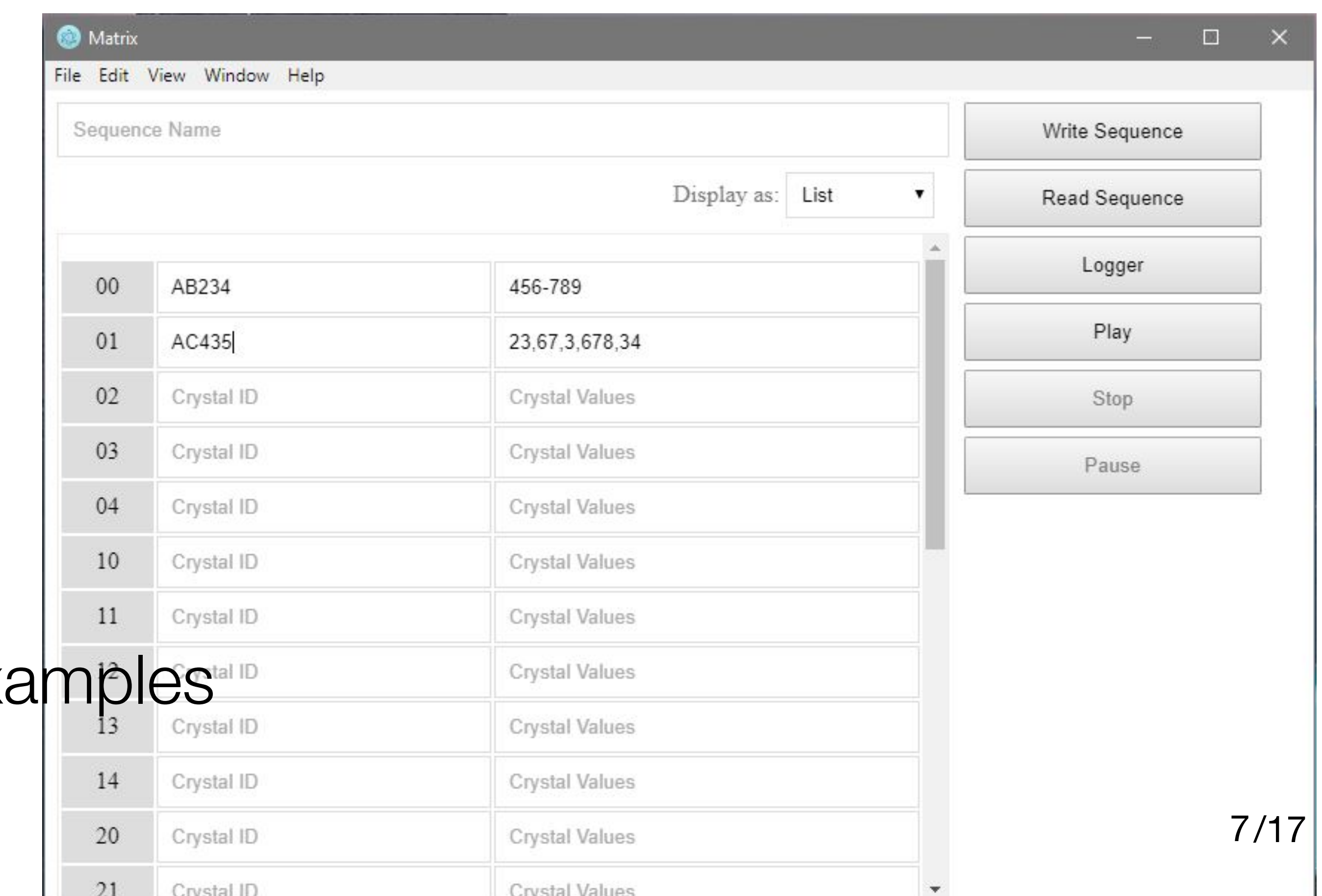
How the code works

Current situation:

- test control system practically ready
- all the **functionalities** have been implemented and **tested** (apart from pause and anticipated stop)
- **graphical interface** is being ultimated
- needed a dry run to **test everything**, the previous ones were sucessful

Many thanks to Emanuele Leonardi (daq), Francesco Safai Tehrani (overall control system and source movement) and Alessandro Ruggieri (GUI)!





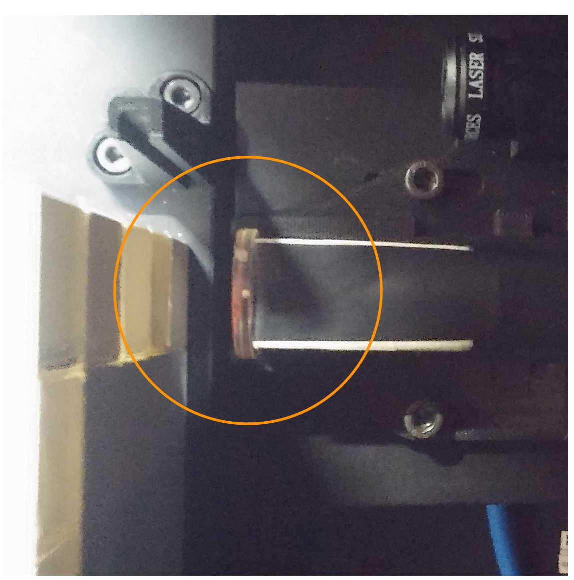
GUI examples

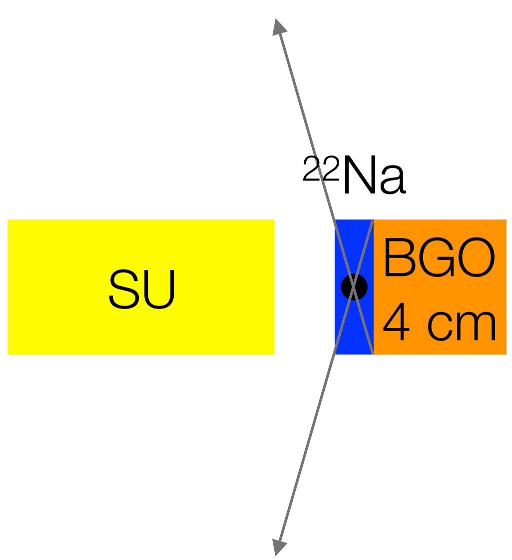
What we have done so far

Using this test box we performed some tests:

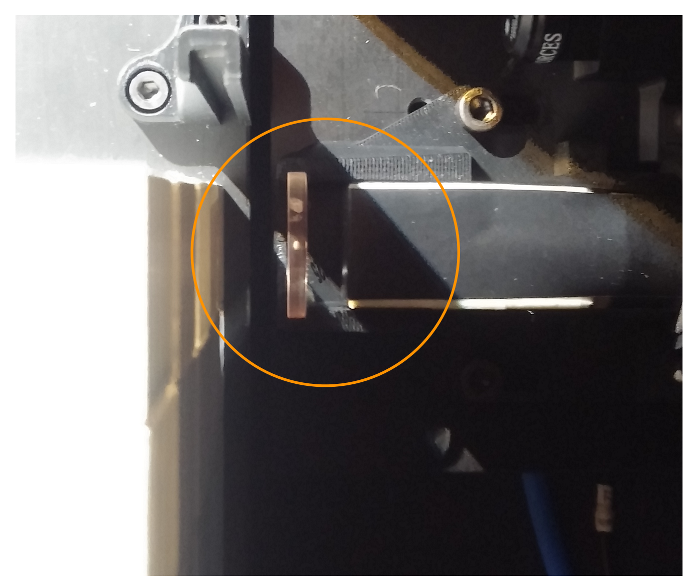
- acquisition rate scan
- ^{22}Na source positioned close and far from the trigger crystal second one is to reduce the solid angle and to improve the quality of the triggered events
- double threshold, to select signals in between two amplitudes

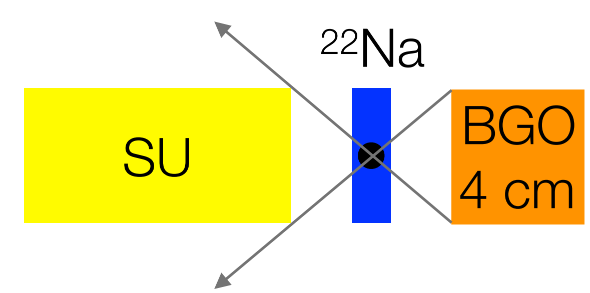
^{22}Na close





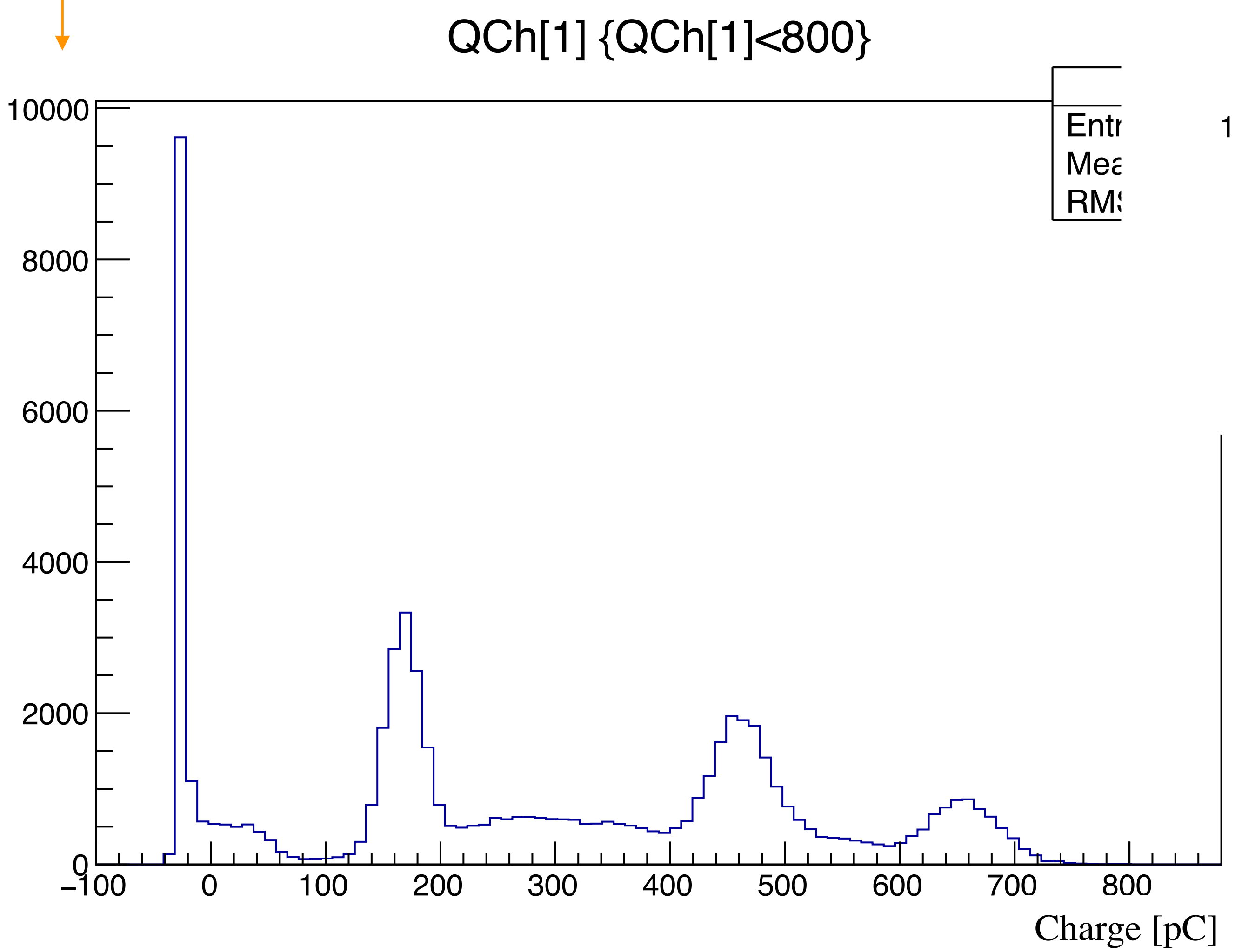
^{22}Na far

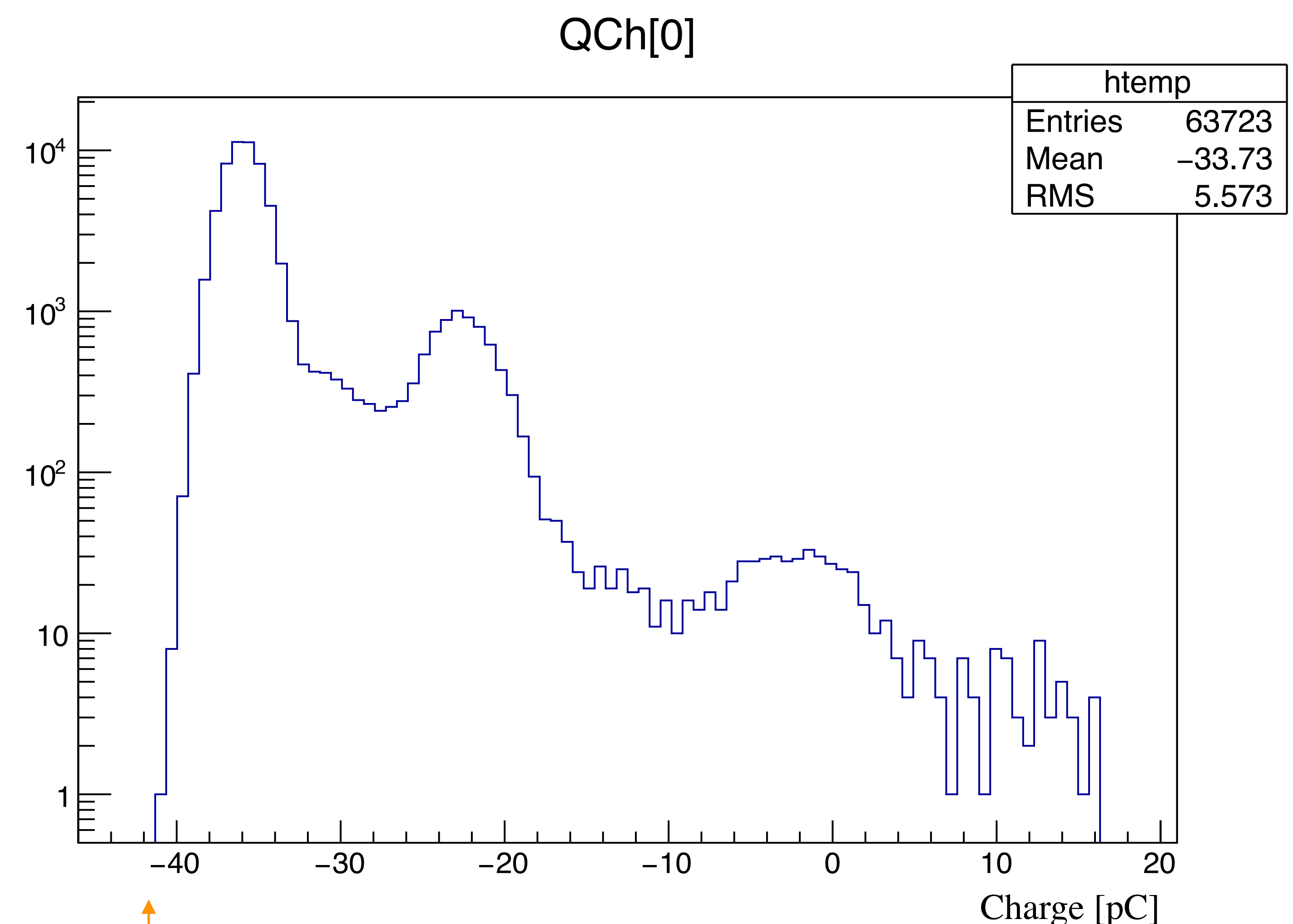




The charge spectra

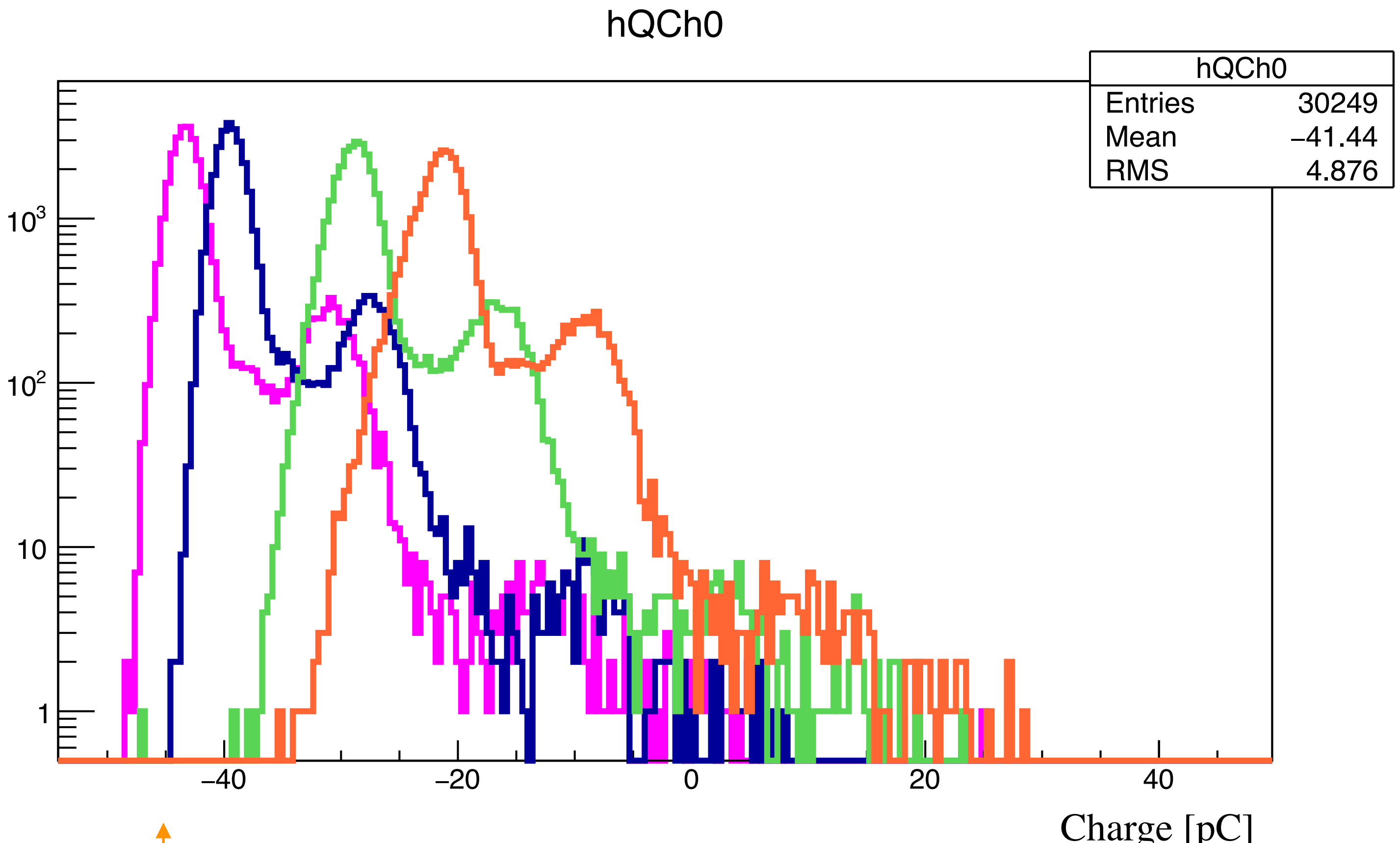
Trigger BGO (4 cm BGO + Burle @ 900 V) 50 Hz





SU (23 cm BGO + HZC @ 1300 V) Hz

Close and far source comparison at different rates



trigger rate (modulated by a death time window):

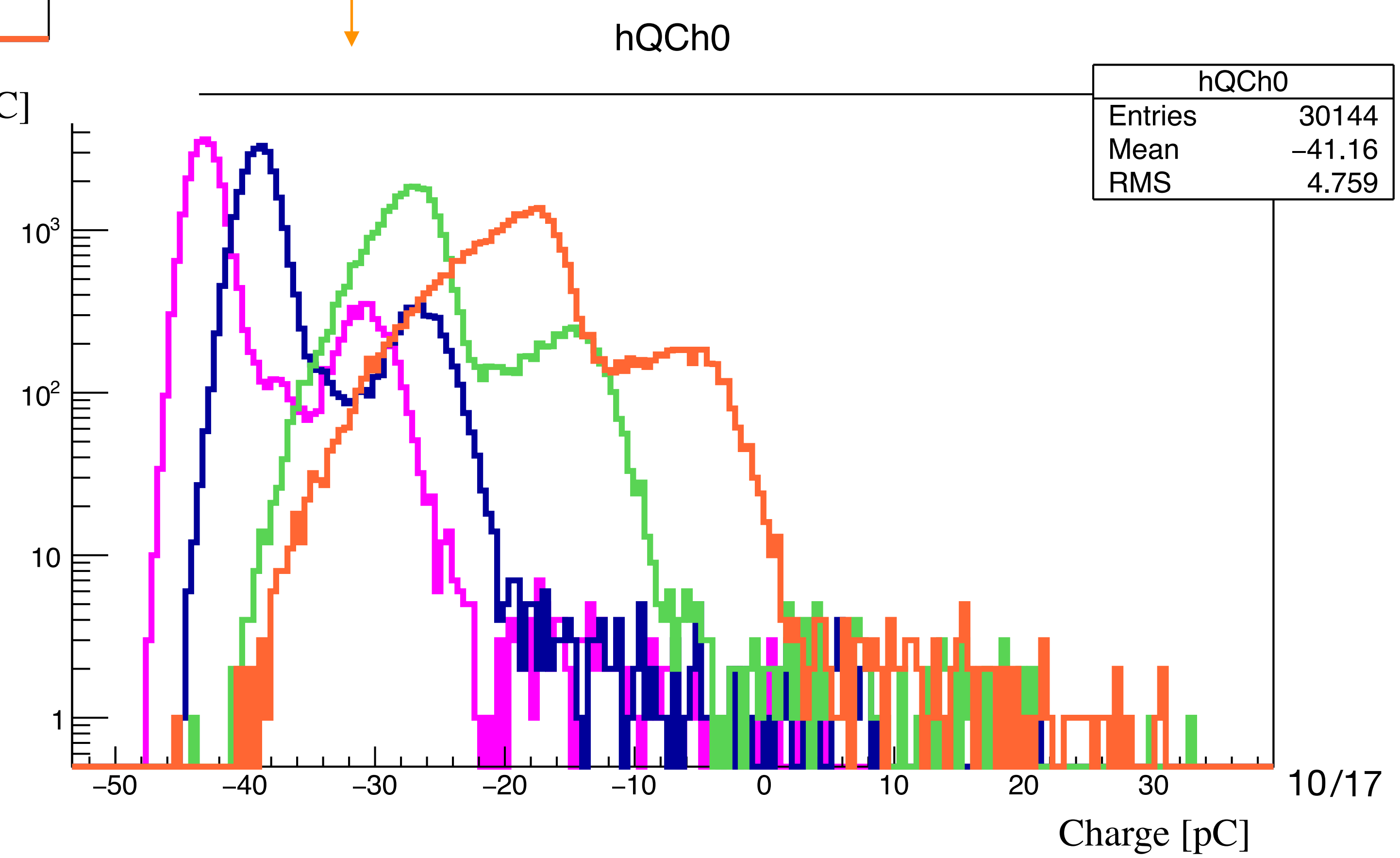
25 Hz

50 Hz

100 Hz

150 Hz

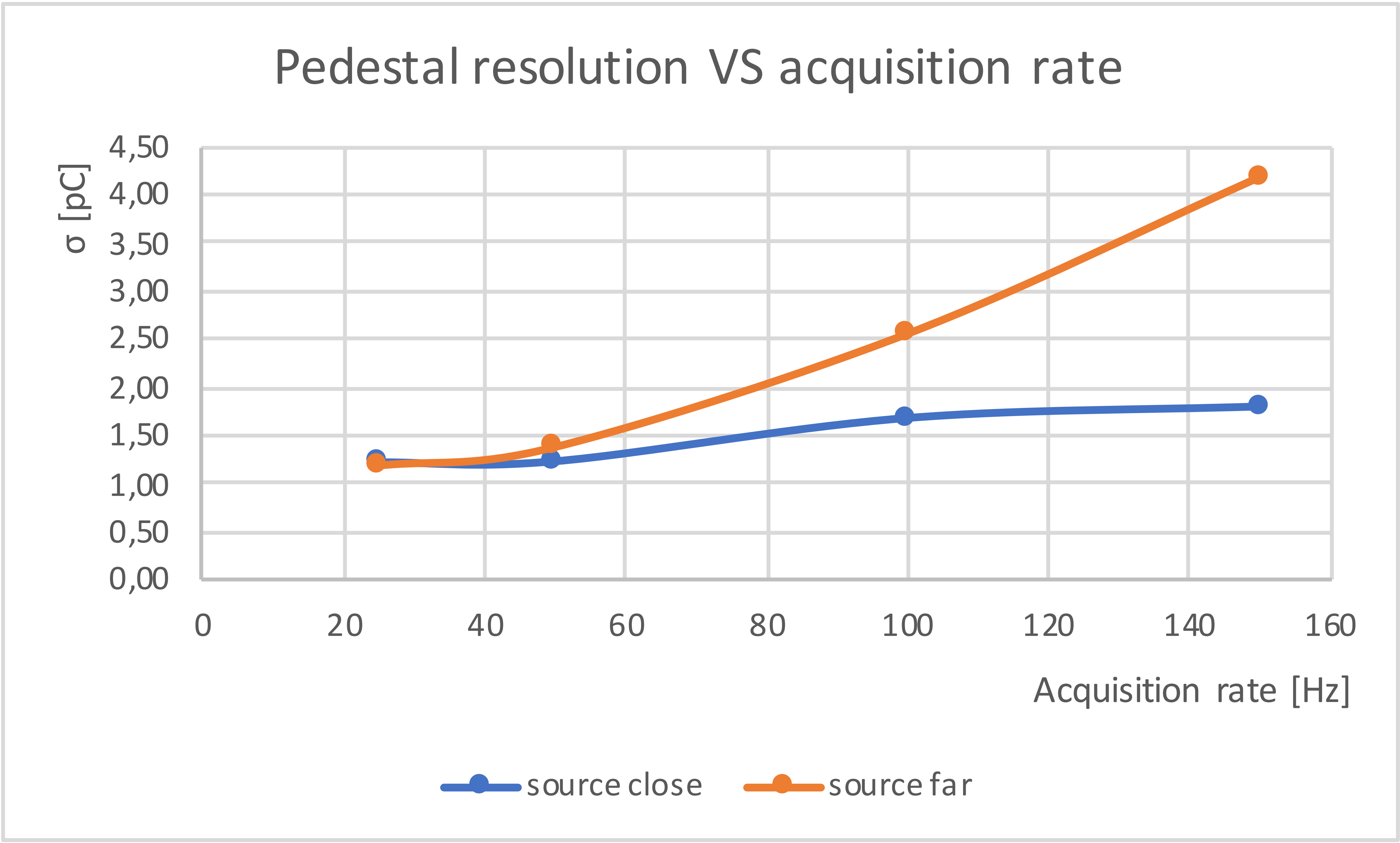
^{22}Na far from trigger BGO



^{22}Na close to trigger BGO

Rising the frequency the spectra shape get worse

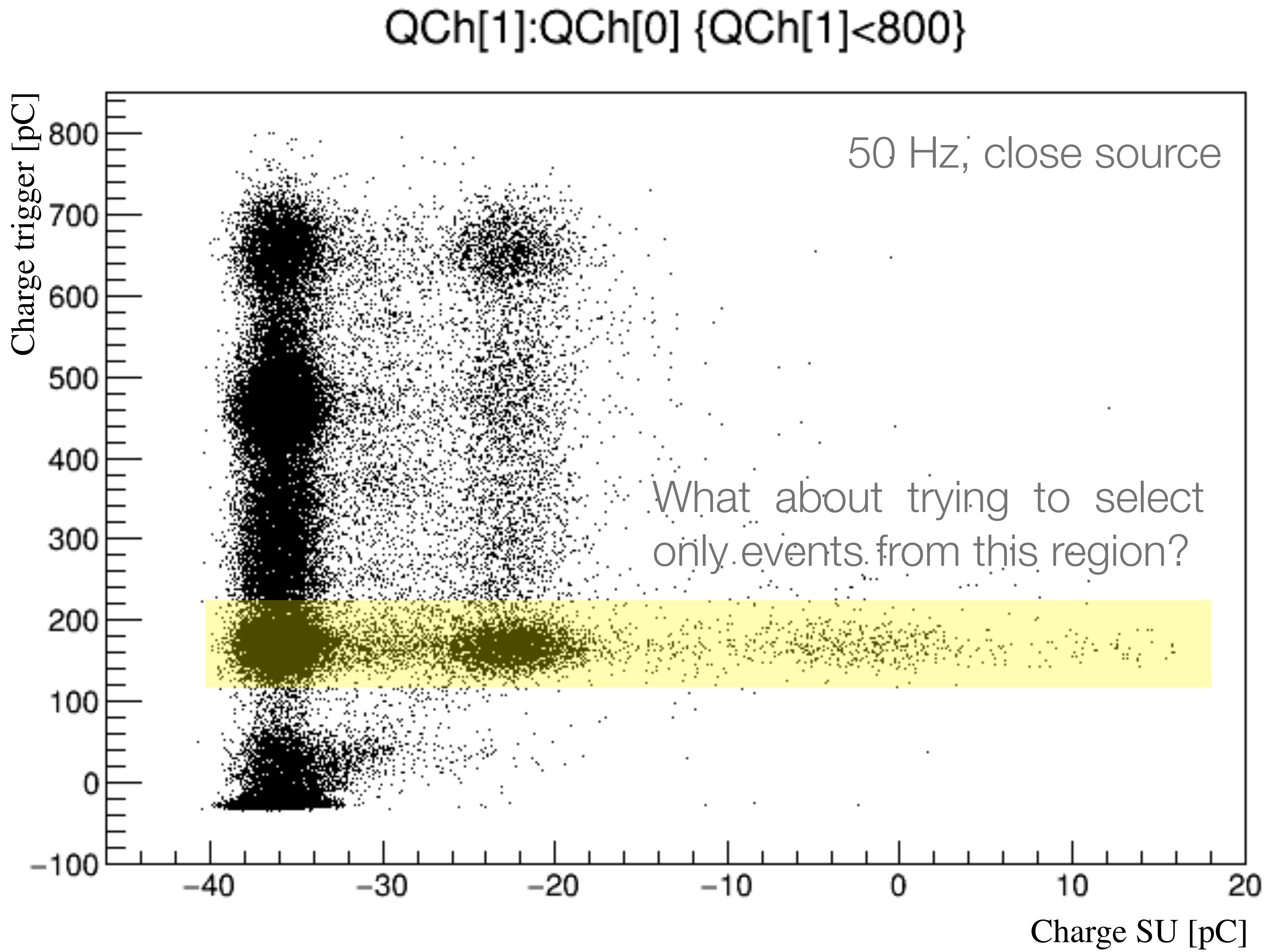
Close and far source resolutions comparison



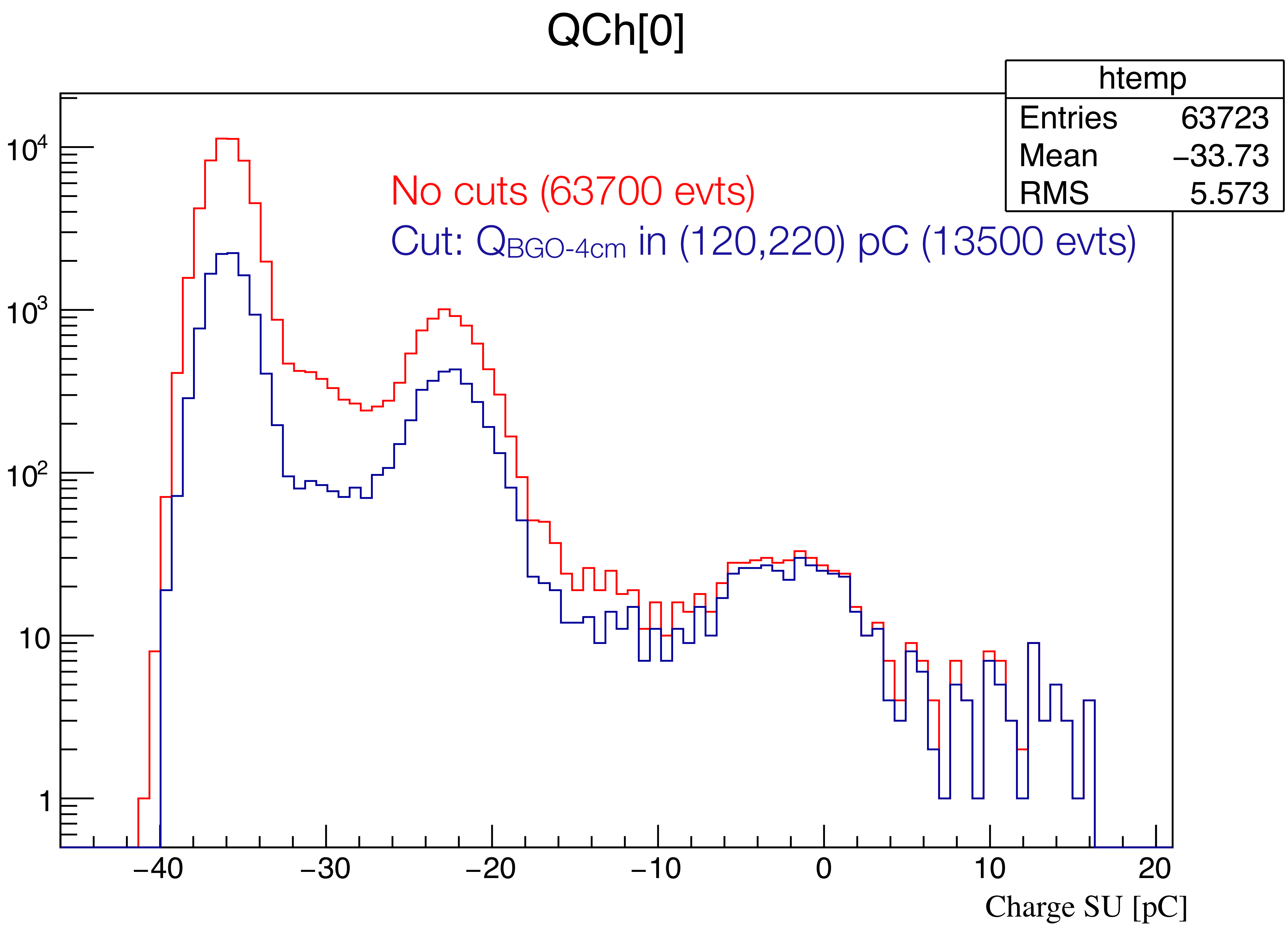
Rising the frequency the resolution get worse

- Min 40/45k events & 70/75 Hz max rate → 10 min run × 25 SU × 5 HV = 21 h for a test
- ^{22}Na must be close to the trigger BGO

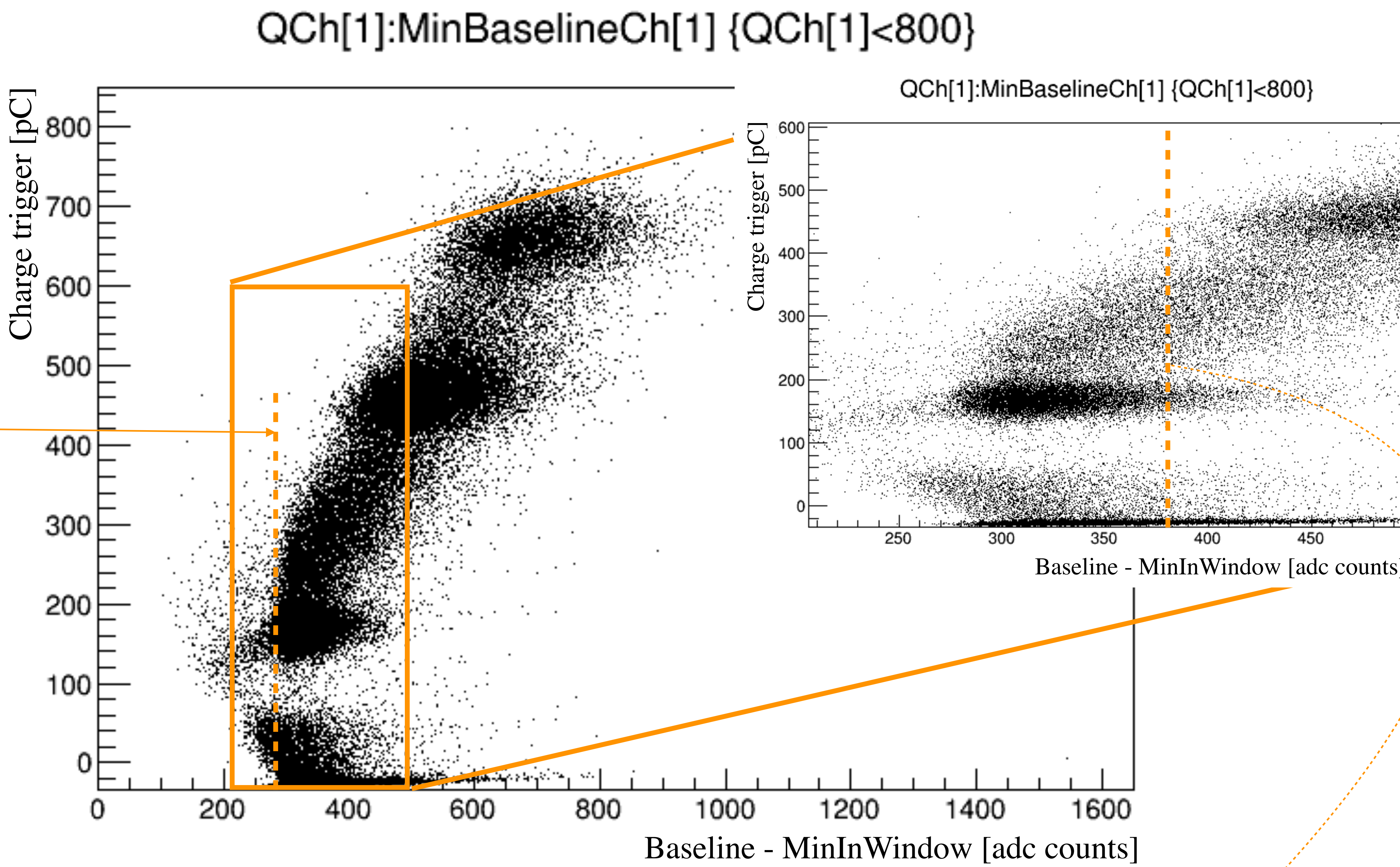
Charge VS charge



SU charge spectra



Trigger BGO charge VS amplitude



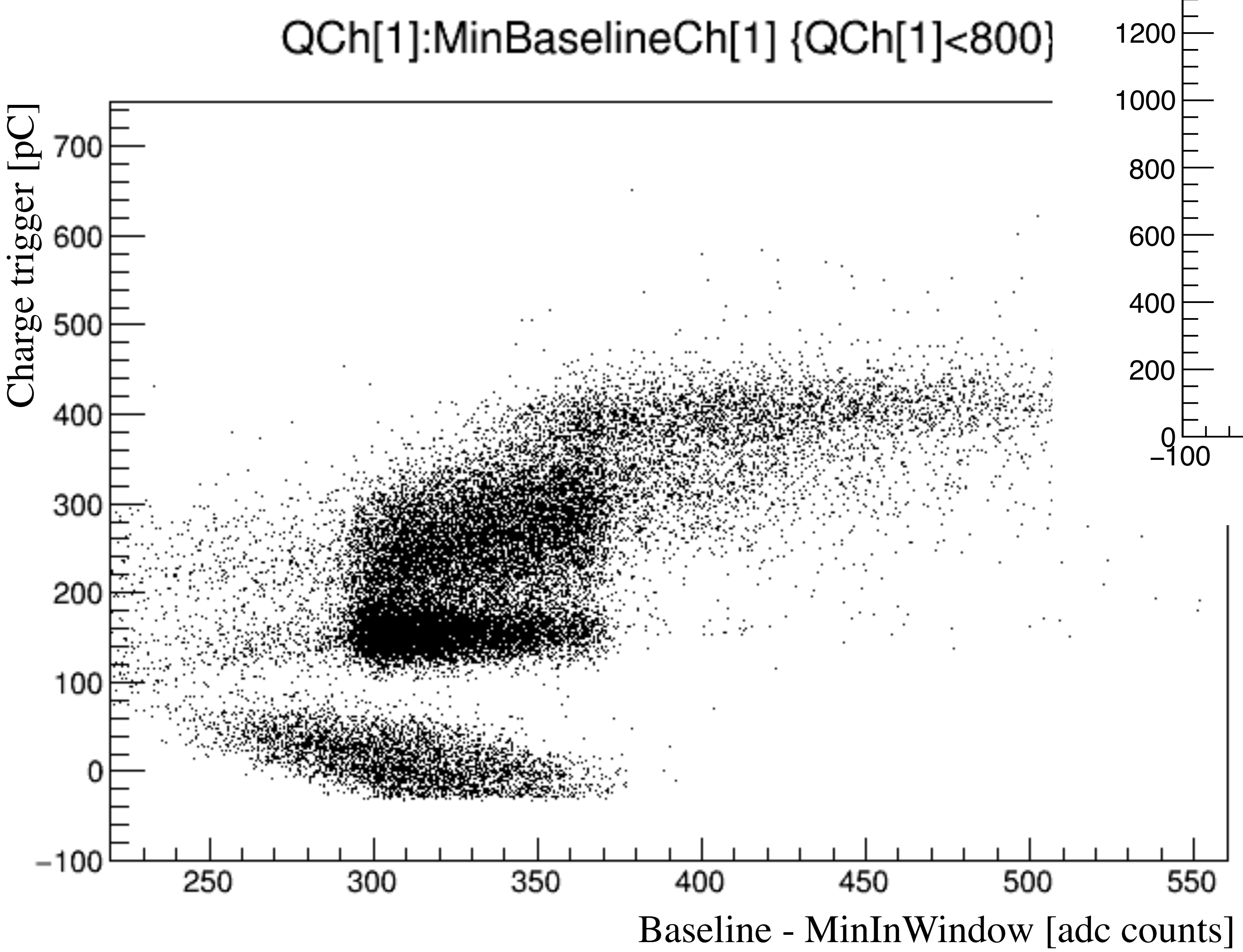
70 mV threshold: average between pulse amplitude, acq. rate and percentage of pedestal events

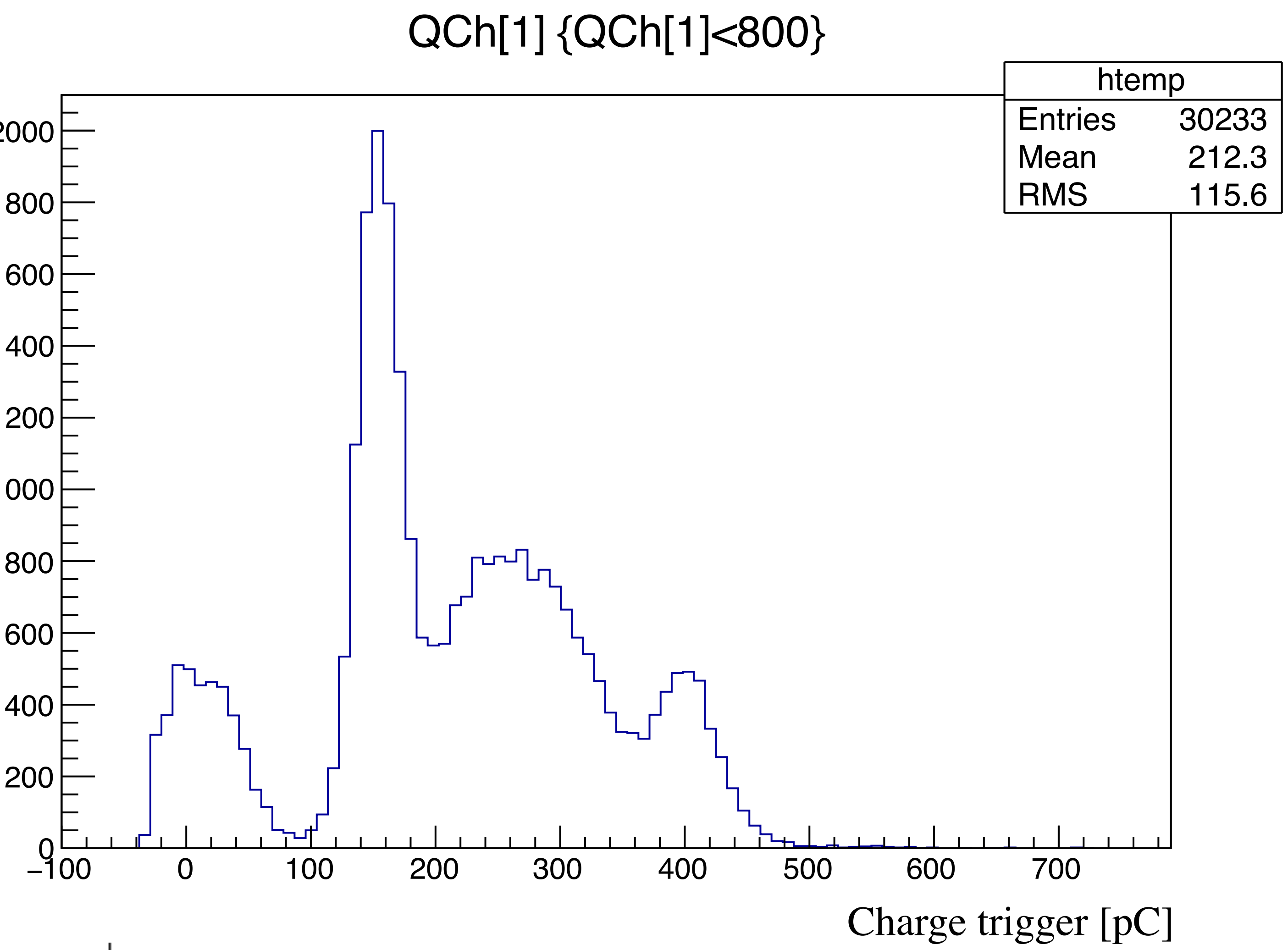
380 adc counts = 93 mV: upper threshold (no signals large than this)

Double threshold results for trigger BGO

Selected events in trigger BGO with pulses in the range (70, 93) mV

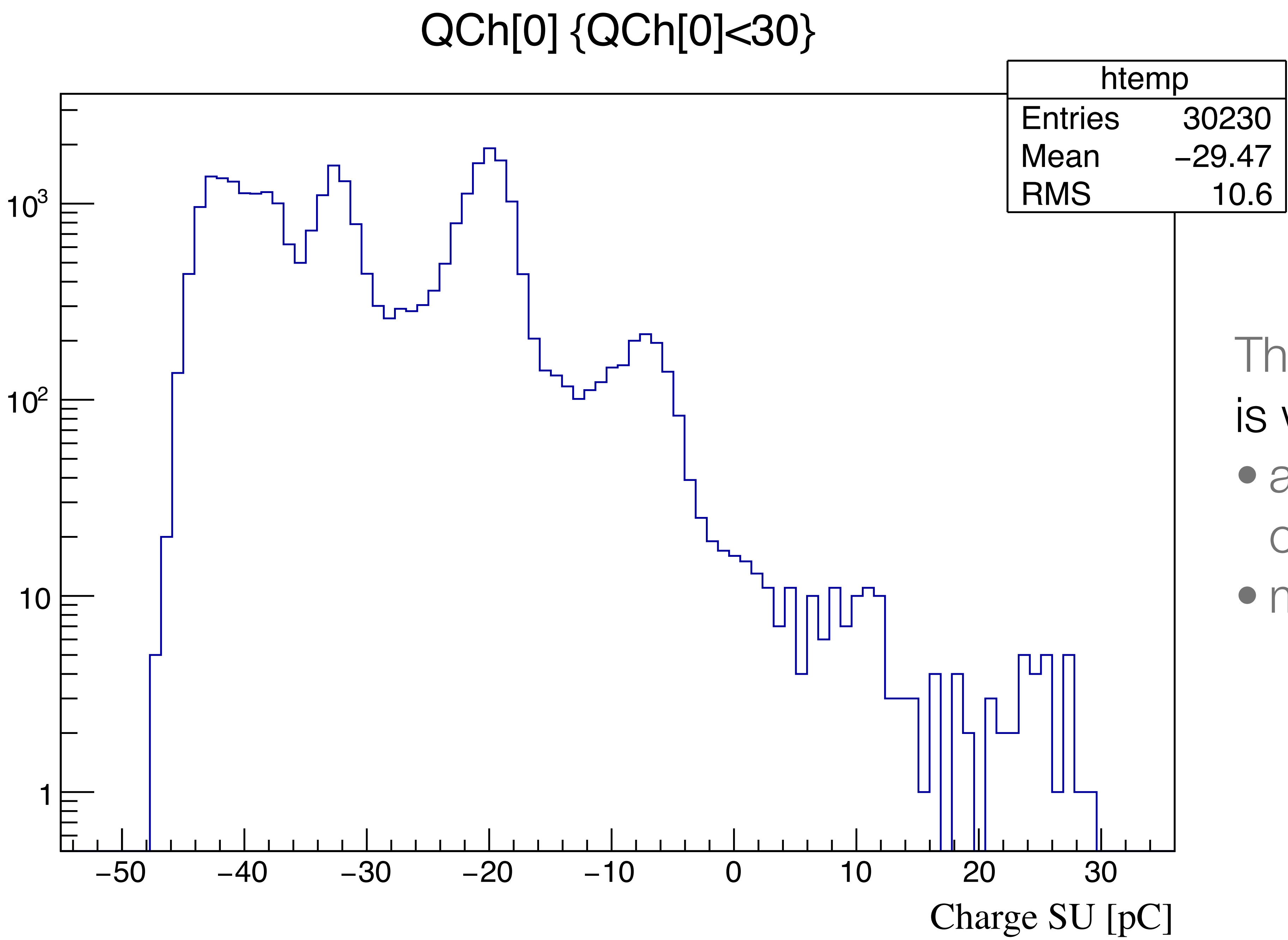
The 93 mV threshold is correct, but, since signal amplitudes are small, the charge spectrum still presents many peaks.





Double threshold results for SU

Selected events in trigger BGO with pulses in the range (70, 93) mV



The resulting **SU spectrum is worse:**

- additional peak at the left of the pedestal
- much less defined peaks

Conclusions

- Soon we will have the setup ready for the tests

- Best test conditions:
  - 40/45k events at 70/75 Hz = 21 h for a test (25 SU)
  - ^{22}Na close to trigger BGO

- It seems to be not helpful to use a double threshold system

- There are many not well understood things:
  - data acquisition maximum rate, in previous runs with the same configuration we had no problems up to 300 Hz
  - in previous test we performed 30k events were enough to completely define the SU spectrum, now they are not
  - the same crystal in the same conditions has too large performances variations

- We have to decide where to store tested SU

Backup

Scintillating units status

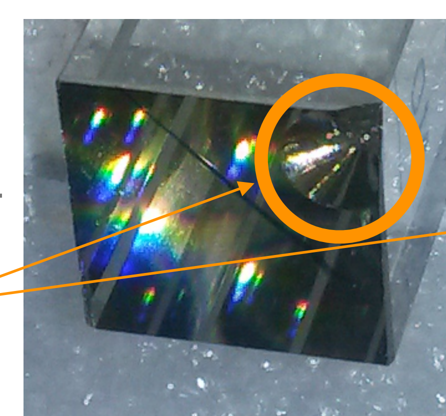
Delivered PMTs to SILO: 628. Needed scintillating units: 616.

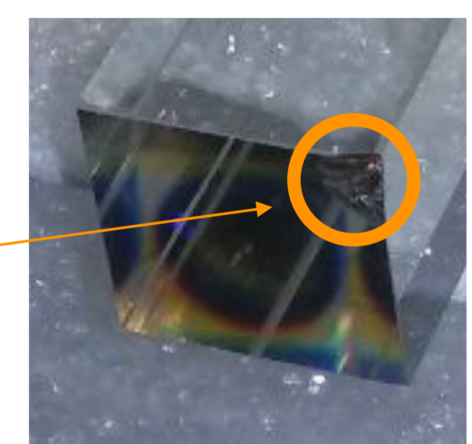
Complete Scintillating Units (SU) at LNF:
- 32 delivered the 20/10/17
- 42 delivered the 17/11/17
- 60 delivered the 29/11/17
- 11 delivered the 20/12/17 (painted with BC 620)
- 150 delivered the 09/02/18

Total: 295 SU at LNF

The other SU:
- Emilio tomorrow is going to SILO to take ≈130 SU
- the deliver of the rest strongly depends on the paint order (if everything goes well at the middle of the next month), but more in general there are things not understood about their work (paint, time scales, produced units)…

Problematic SU:
- 2 broken SU at SILO
- 1 (over 72 tested) non working SU found at LNF
- 2 glued crystals a little ruined (I think usable)
- 2 SU with PMT out of crystal shape



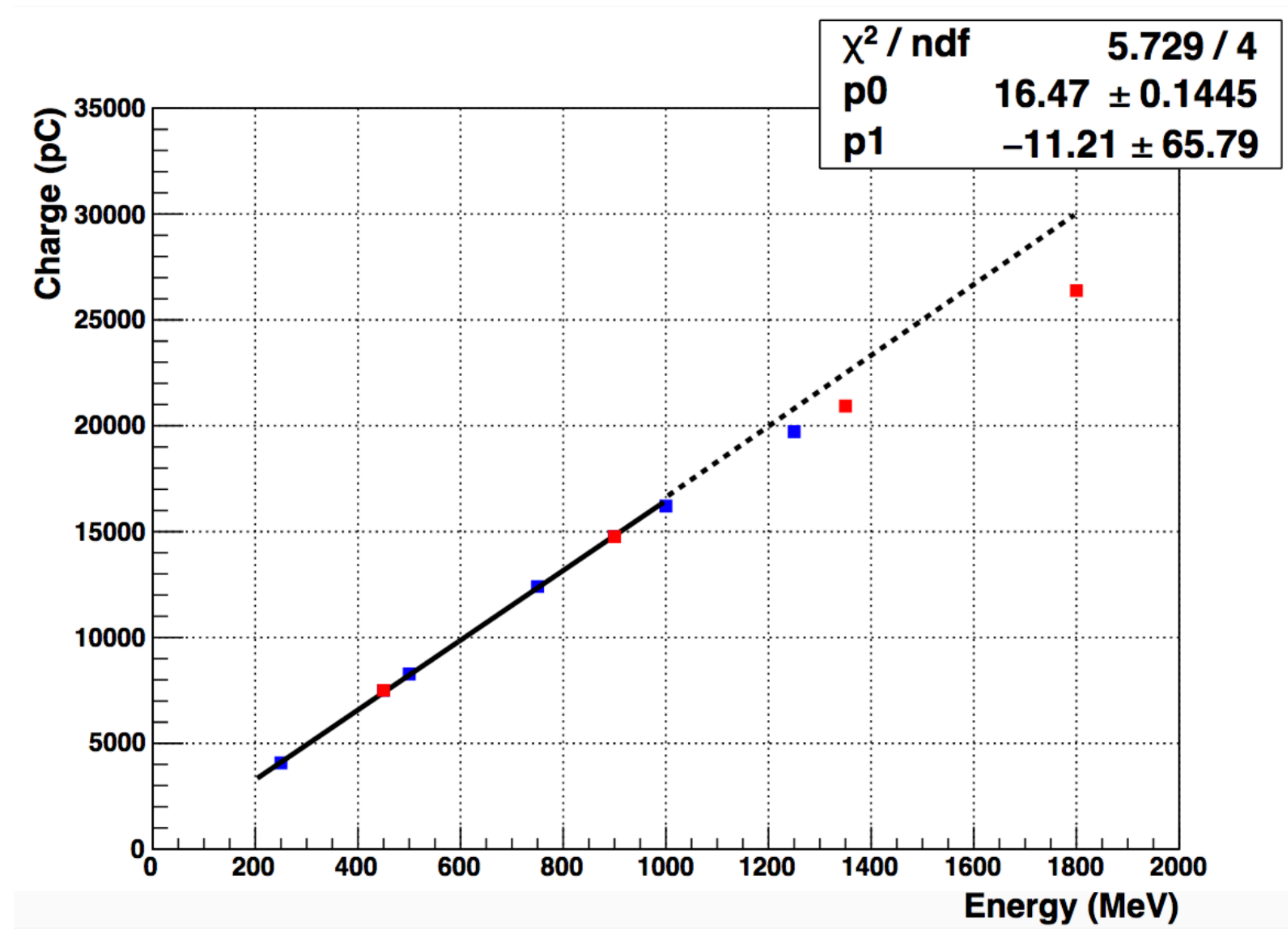


Scintilating units at LNF

HV scan interval

PMT 2103037 (an average one) @ 1300 V → ~20 pC/MeV

From the article:
we saturate at about 15000 pC → 15000 pC @ 600 MeV (≳ γ maximum energy) corresponds to 25 pC/MeV



Our suggestion: scan starting from 1200 V up to 1400 V