PMT @ LNGS

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Discriminating Fe signals

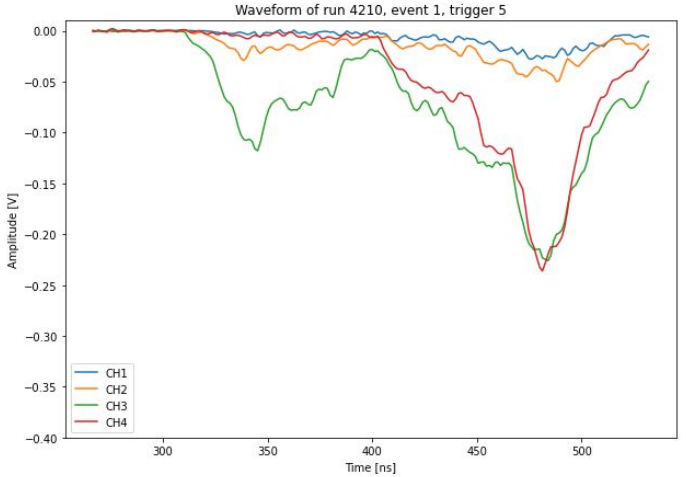
Quasi-equalized PMTs, tensions at:
(813, 836, 774, 770) V.

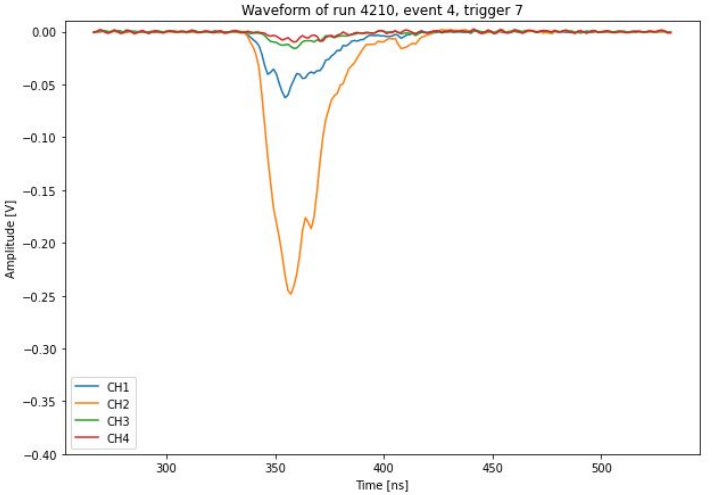
Runs:

- 4210 - 4218 **Fe**
- 4304 - 4308 **no Fe**.

Selection on signal:

- V th = 30 mV
- length th = 15 samples (1 sample ≃ 1.33 ns).



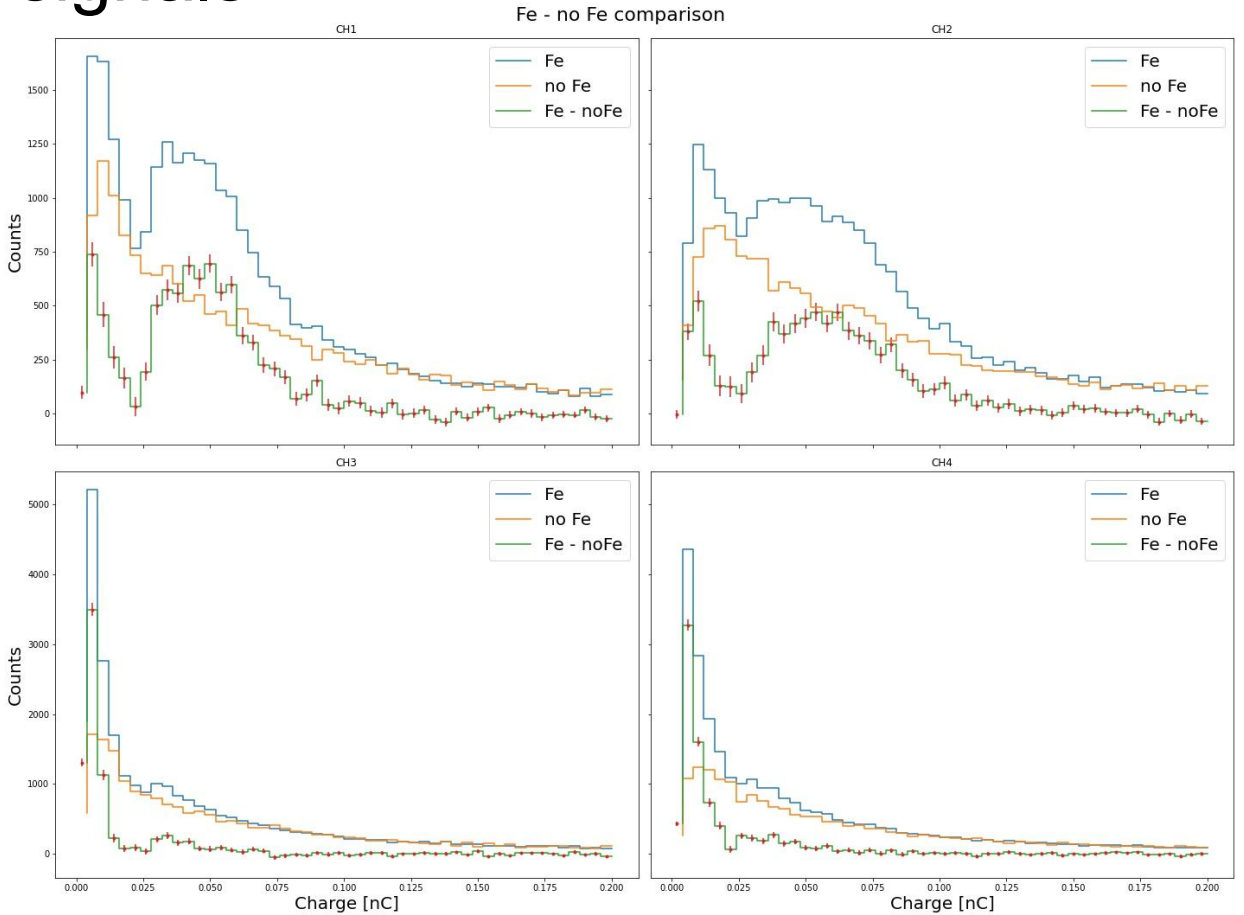


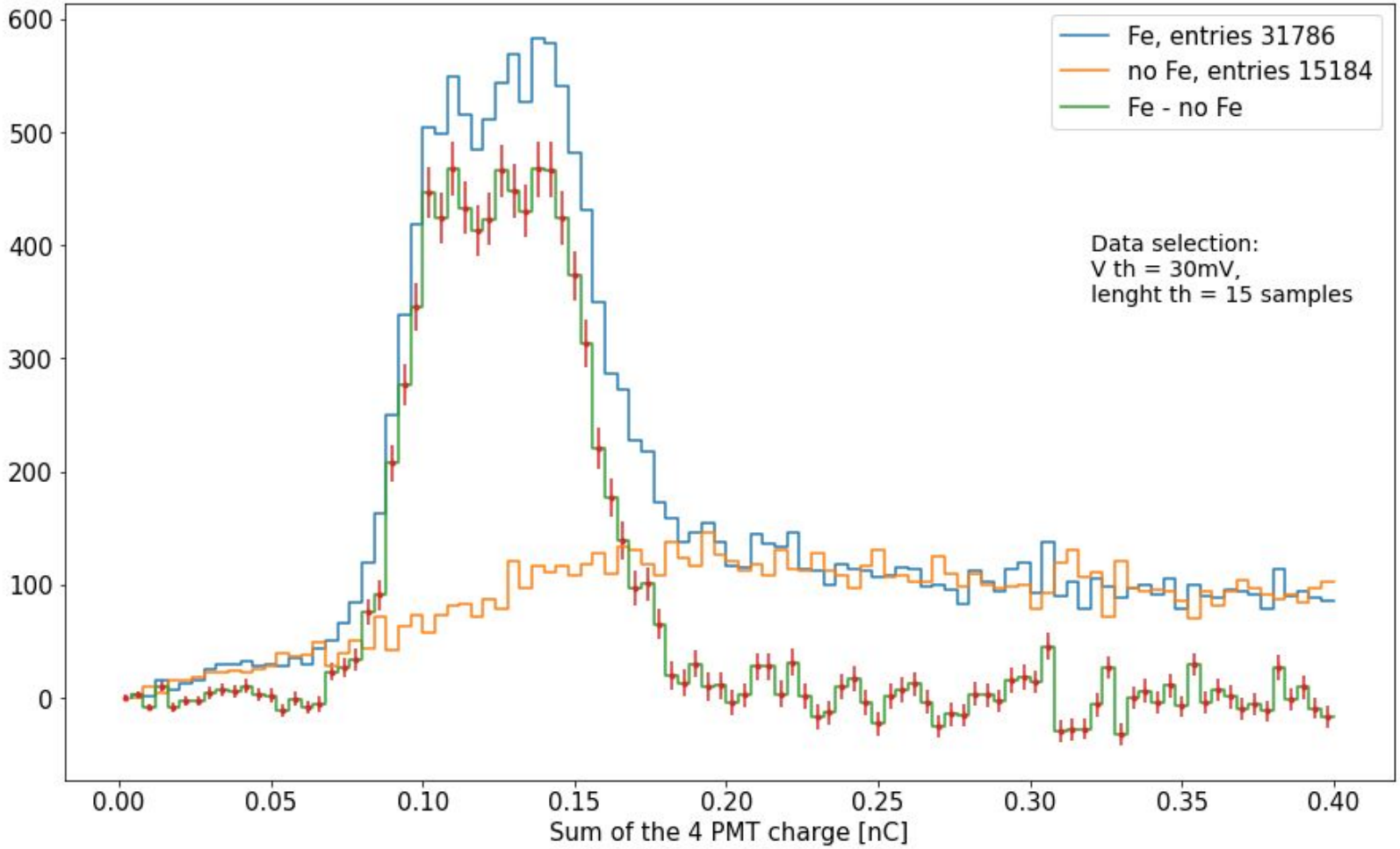
Discriminating Fe signals

Calculating waveforms integrals:

- selected waveforms
- Integrating on the peak
- Charge collected = integral/50Ohm

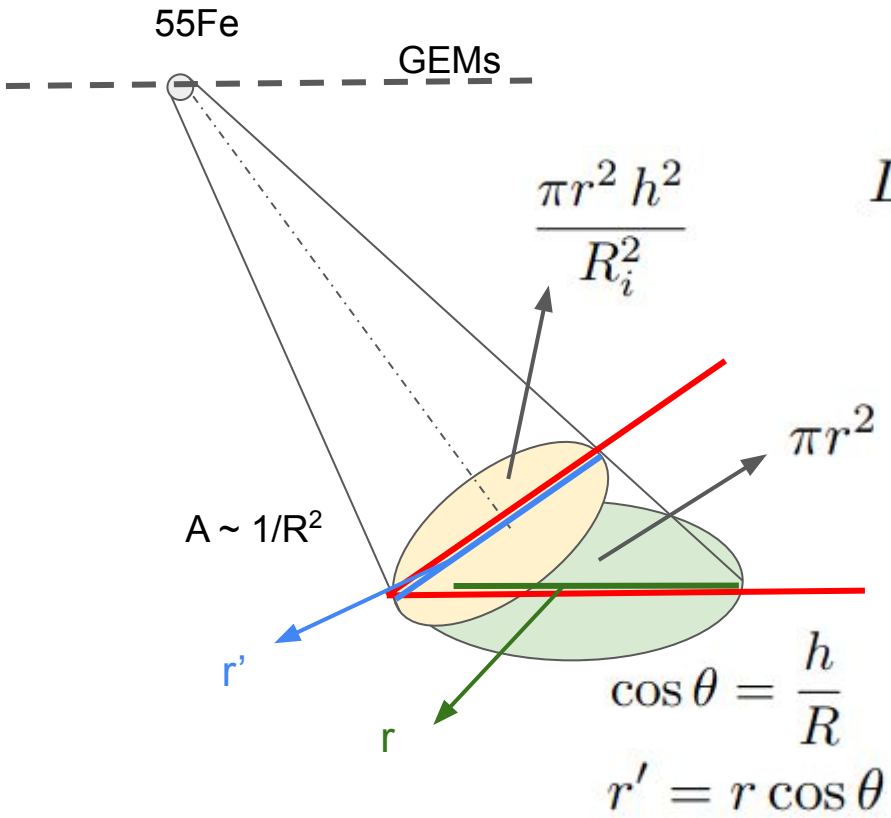
The **selection was the same for runs with and without the Fe source**.




Fe, entries 31786
no Fe, entries 15184
Fe - no Fe
Data selection:
V th = 30mV,
lenght th = 15 samples
600
500
400
300
200
100
0
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Sum of the 4 PMT charge [nC]

PMT light collection

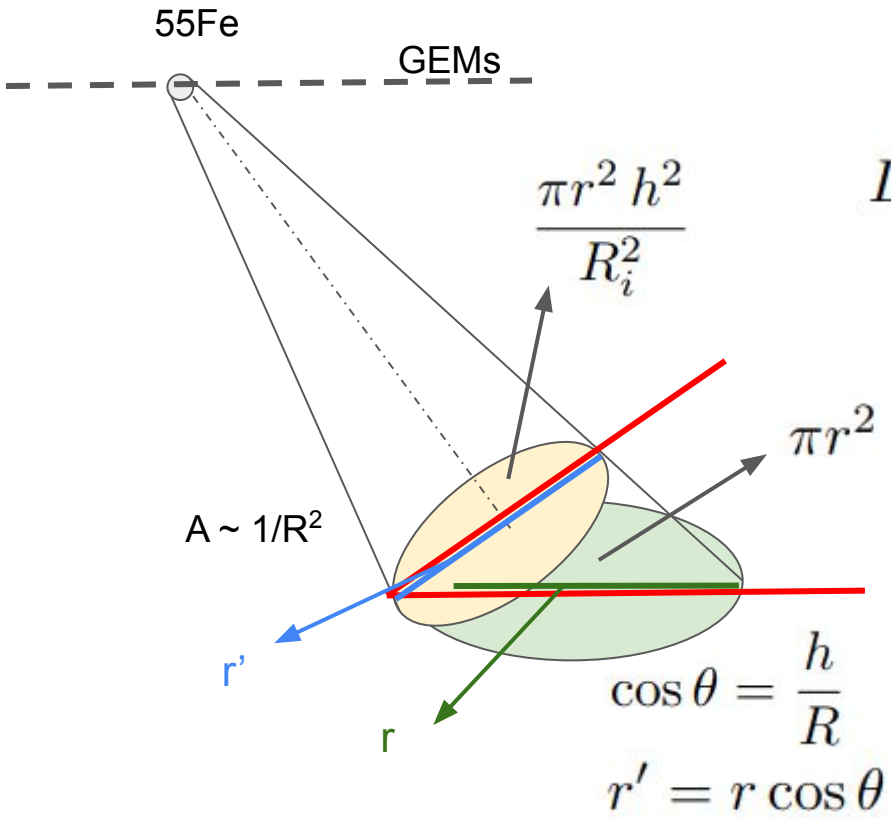
h: distance from the GEM plane
r: sensor radius



$$L_{PMT} = \frac{L_{spot}}{4\pi R_i^2} \frac{\pi r^2 h^2}{R_i^2}$$

PMT light collection

h: distance from the GEM plane
r: sensor radius



$$L_{PMT} = \frac{L_{spot}}{4\pi R_i^2} \frac{\pi r^2 h^2}{R_i^2}$$

Measure:

L_1, L_2, L_3, L_4

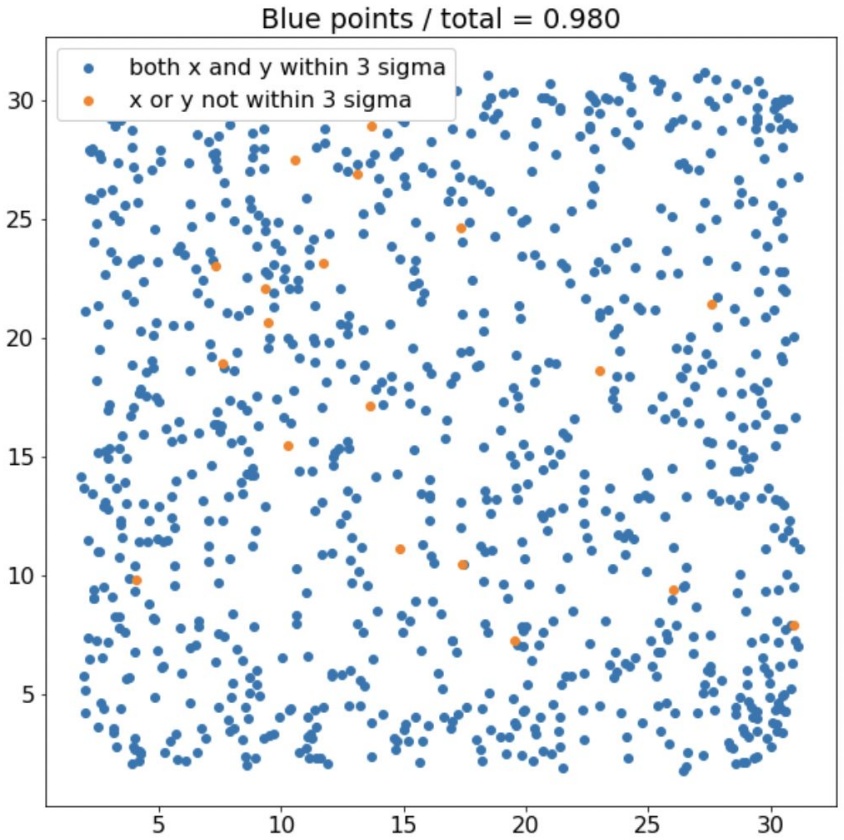
Infer:

L_{spot}, x, y

Fit implementation

Using the charge collected by the PMTs is possible to reconstruct the position in the GEM plane and the light emitted by the spots.

For testing we simulated spots in the GEM plane, calculated the charge collected by the 4 pmts, reconstructed the positions and **then compared with the ‘real’ ones**.



Fitting PMTs calibration const

Using L_1, L_2, L_3, L_4 is it possible to reconstruct the x-y position and the gain of each PMT.

Strict selection on the waveforms to take possibly only Fe spots.

4 spots for each fit. L_{spot} considered uniform for every spot.

The fitted parameters are:

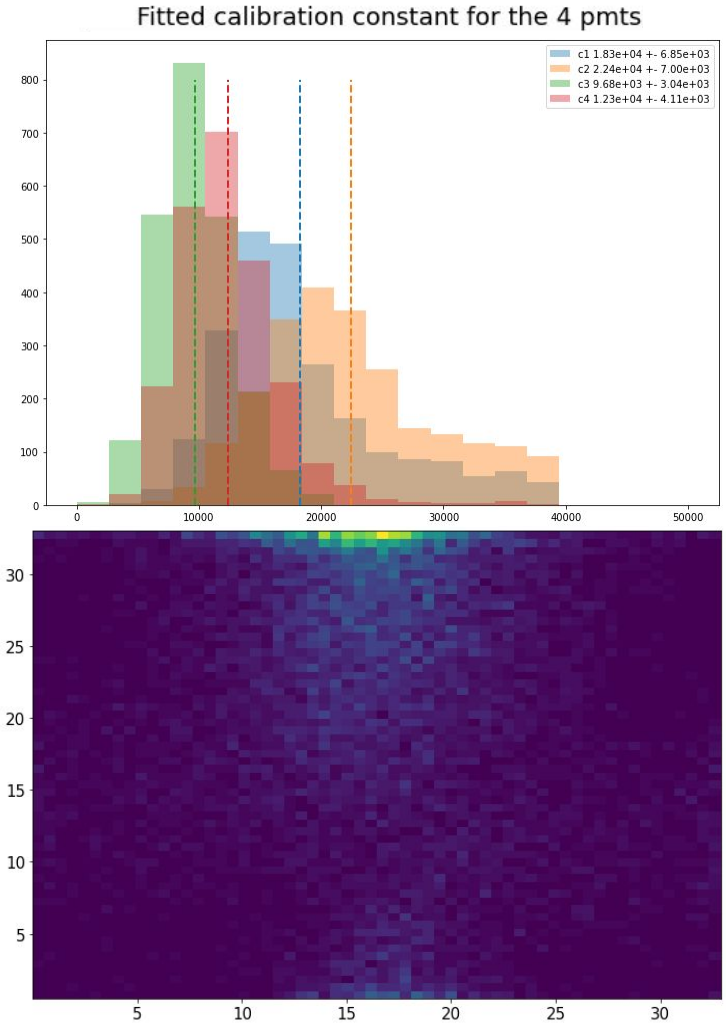
- $(x, y)_{i = 1\text{-}4}$
- c_1, c_3, c_3, c_4.

$$\frac{c1}{c1} = 1,$$

$$\frac{c2}{c1} = 1.22,$$

$$\frac{c3}{c1} = 0.529,$$

$$\frac{c4}{c1} = 0.672$$



Same fit, new data with ‘new equalization’

Setting the PMT in the **new ‘equalized’ workpoint**: (803, 803, 833, 800) V

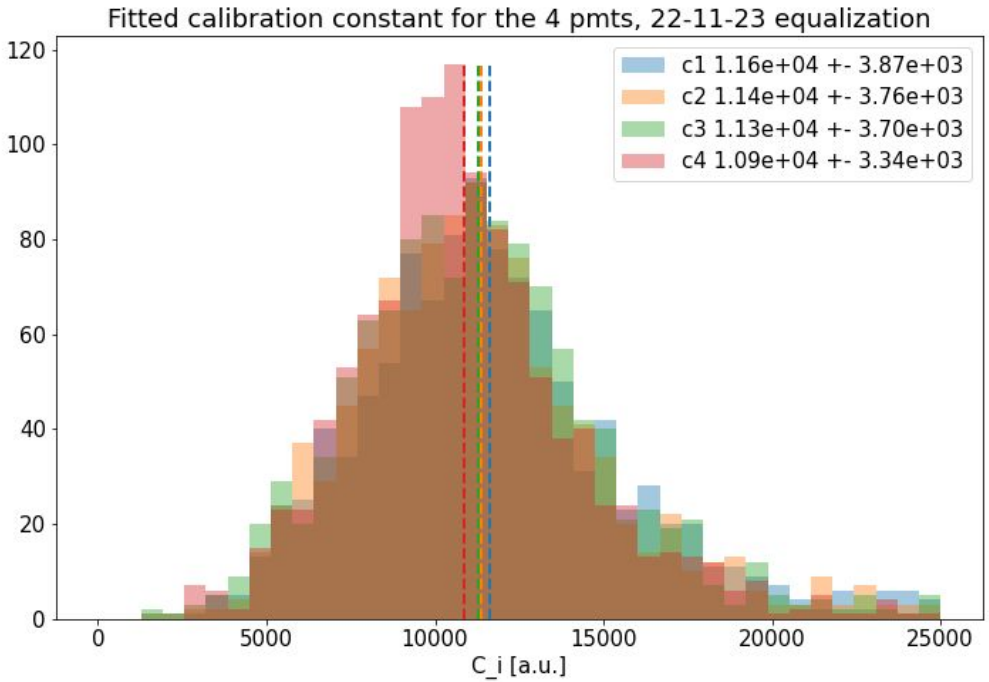
Taking **new data** to check if the fit is consistent.

Fitting again:

- $(x, y)_{i = 1\text{-}4}$
- c_1, c_3, c_3, c_4

$$\frac{c1}{c1} = 1, \qquad \frac{c3}{c1} = 0.968,$$

$$\frac{c2}{c1} = 0.975, \qquad \frac{c4}{c1} = 0.935$$



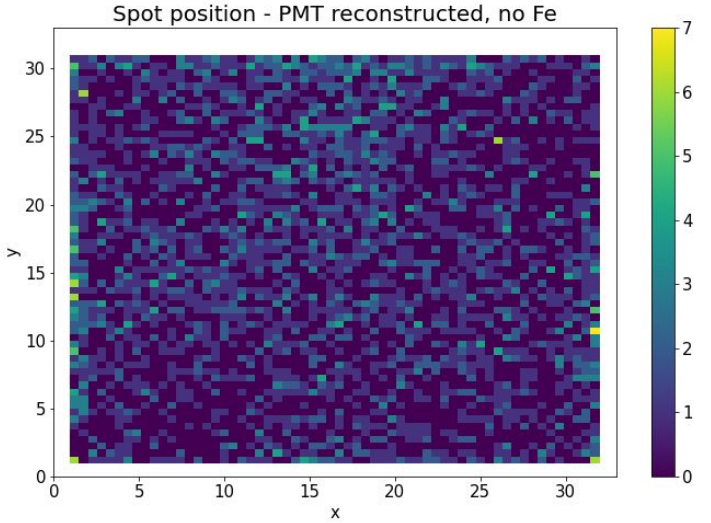
Reconstruction

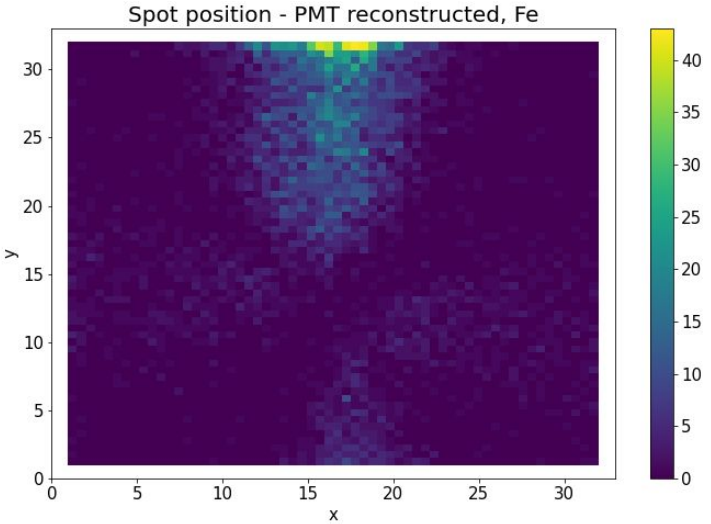
Fixed calibration constant, fitting a **single spot**, parameters:

- **x, y;**
- **L.**

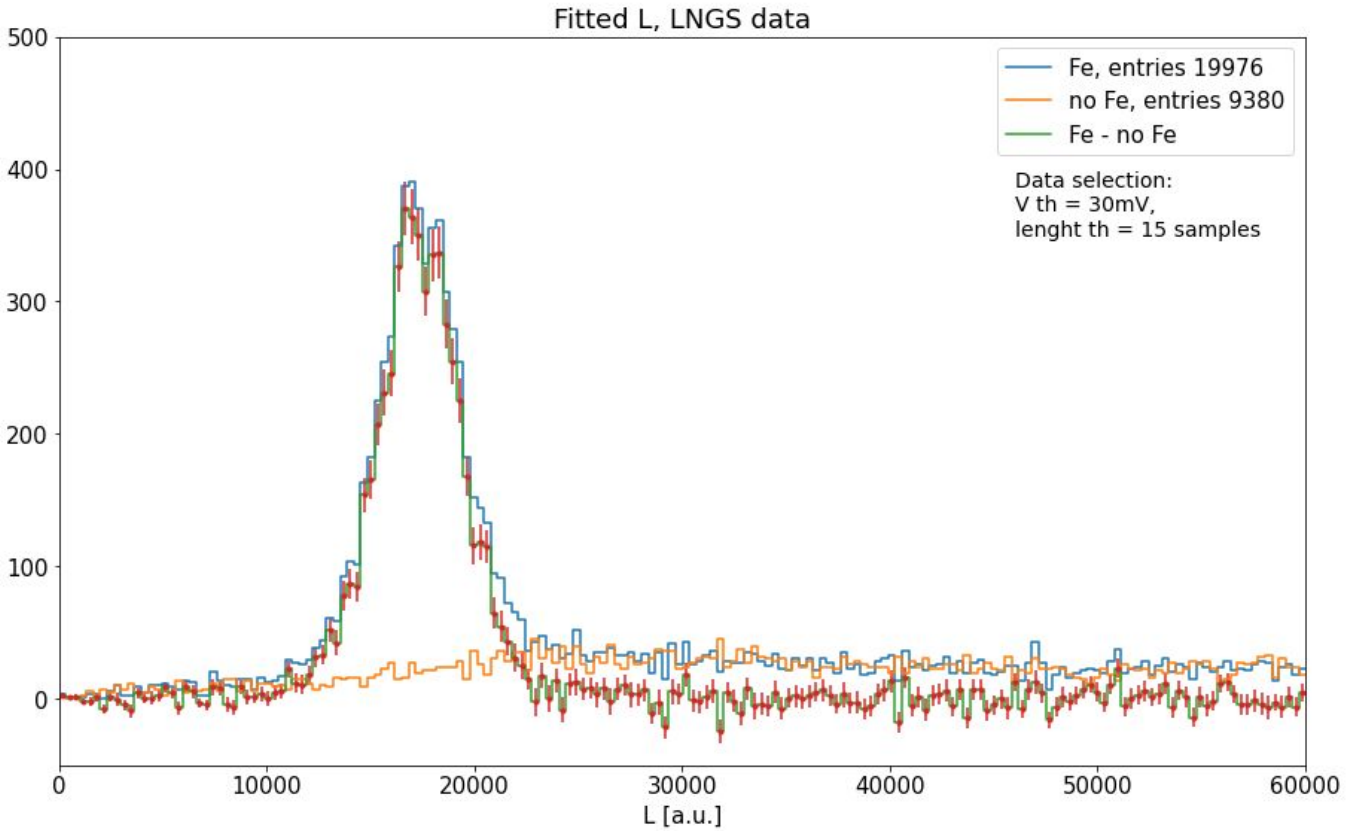
The dataset used for this reconstruction was, on purpose, **loosely selected**, to ensure that the BKG data was enough.

In the picture is evident that some points are badly reconstructed → **working on it**

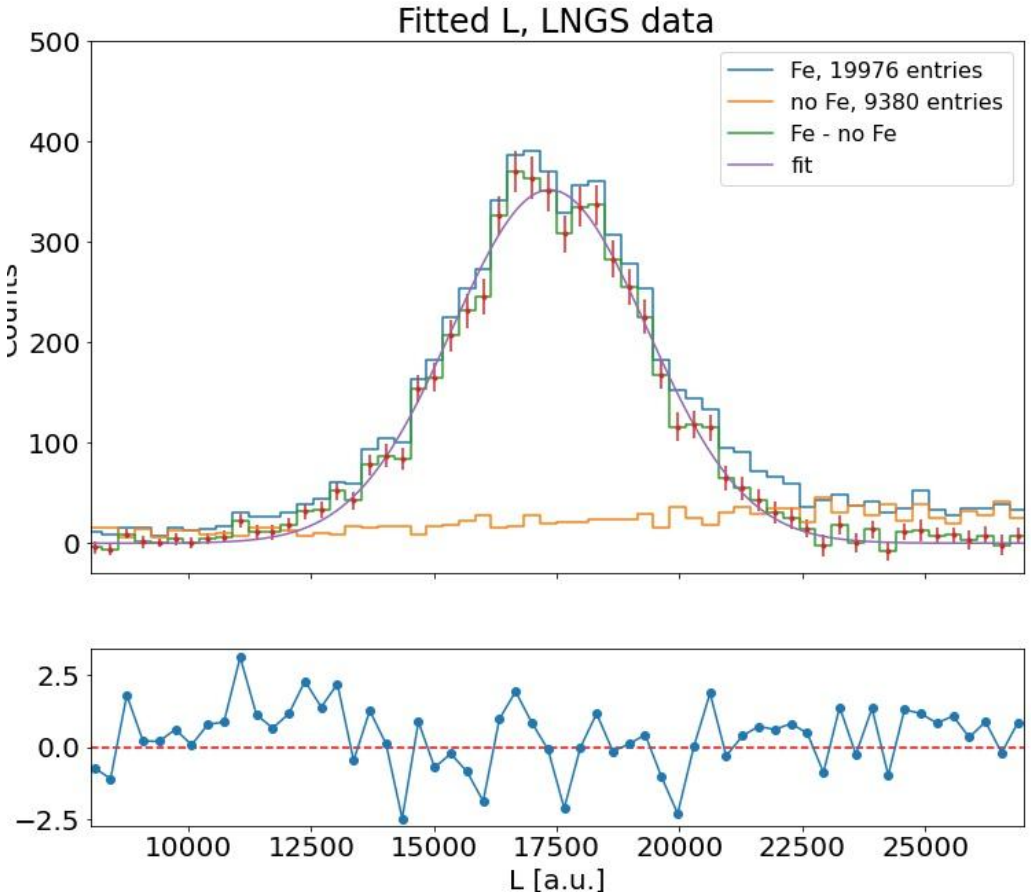




Fitted L histogram



Reconstructed Fe light

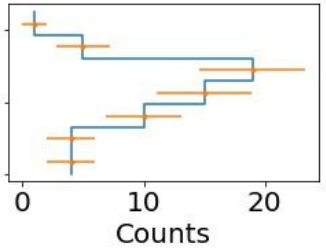


Runs: 4210 - 4218

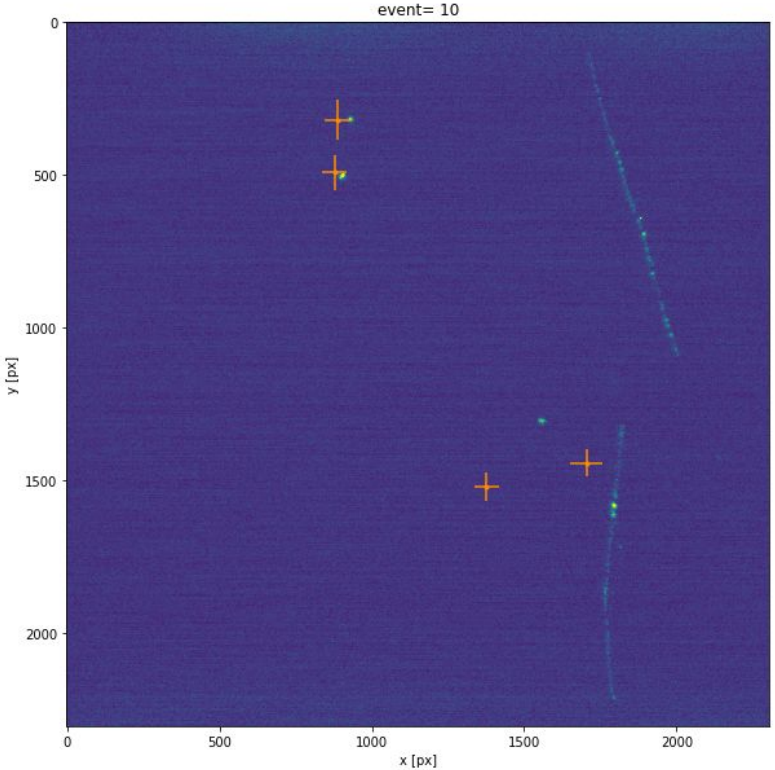
Data selection:
Trigger:
- majority 2,
- th = -15mV

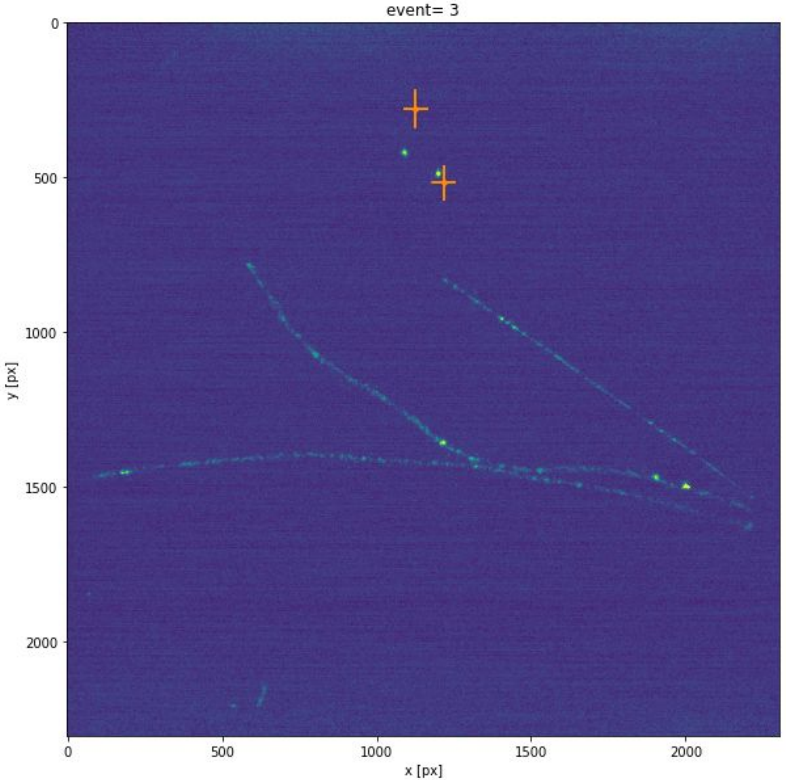
Offline selection
- V th = -30mV,
- lenght th = 15 samples
- Selection efficiency = 0.41
- (Fe - noFe)/Fe = 0.53

Fit
- fitted mean = 17.4e3
- fitted sd = 2.0e3
- resolution = 0.11

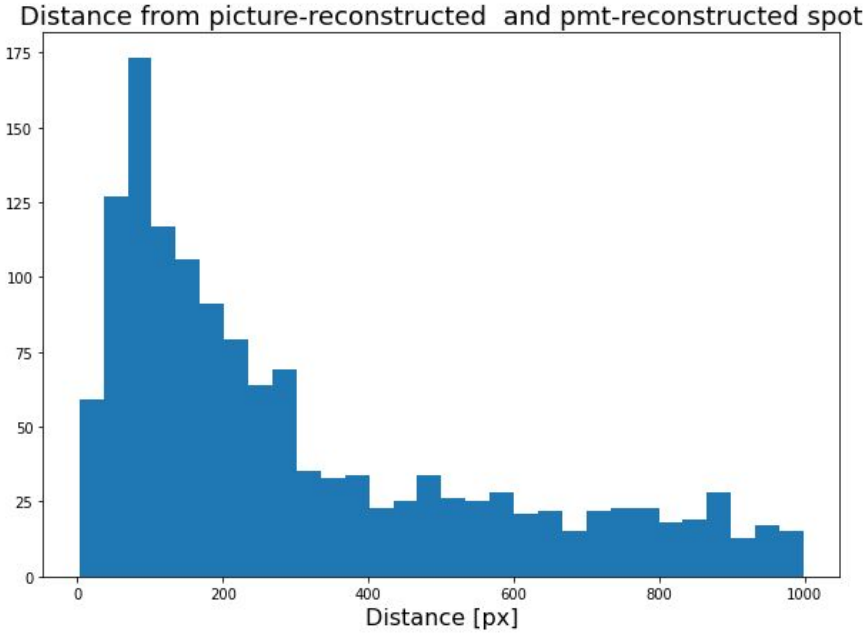


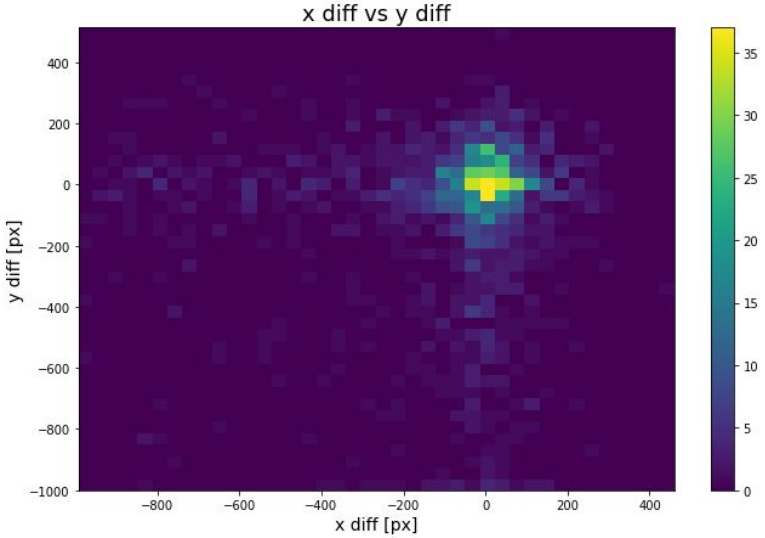
Matching with pictures

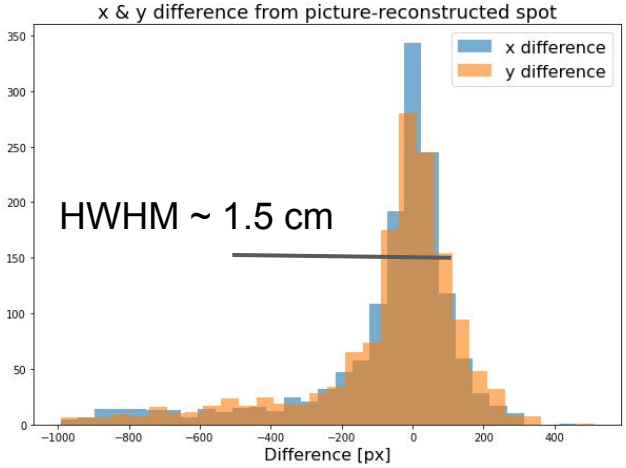




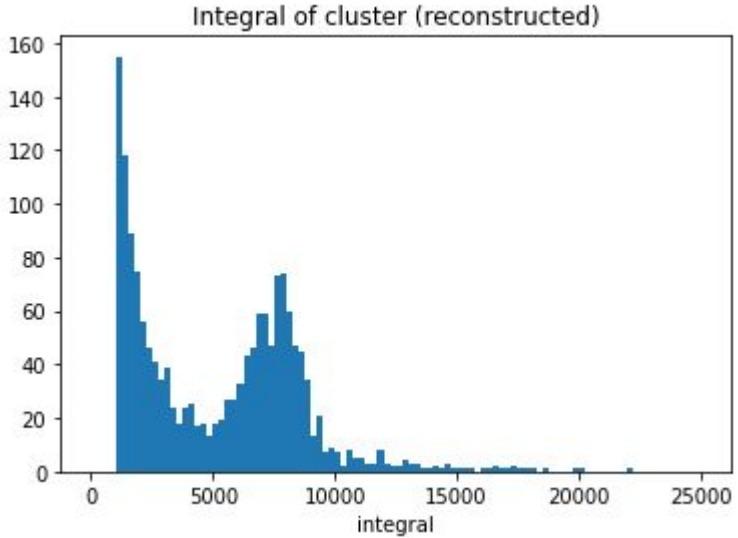
Matching with reconstructed variables (1)

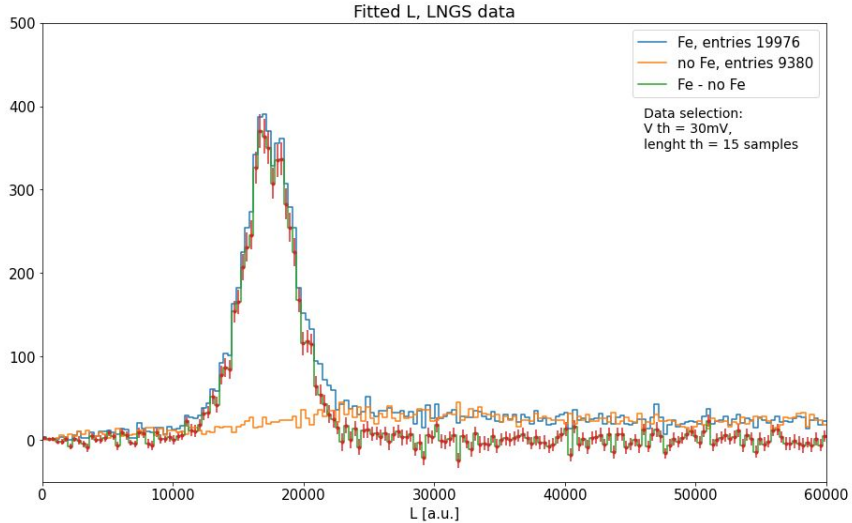






Matching with reconstructed variables (2)





Conclusions

- Calibration of PMTs with the fit seems working → **need more analysis** with the new calibration

- **L** reconstructed has an **excelent resolution** (11%)

- For a limited fraction of spots, **(x,y)** position not correctly reconstructed. Issue has be fully understood yet (the geometry has various symmetries)

- First results on **matching the pmt-reco position with camera-reco position**