Once upon a time in Americium

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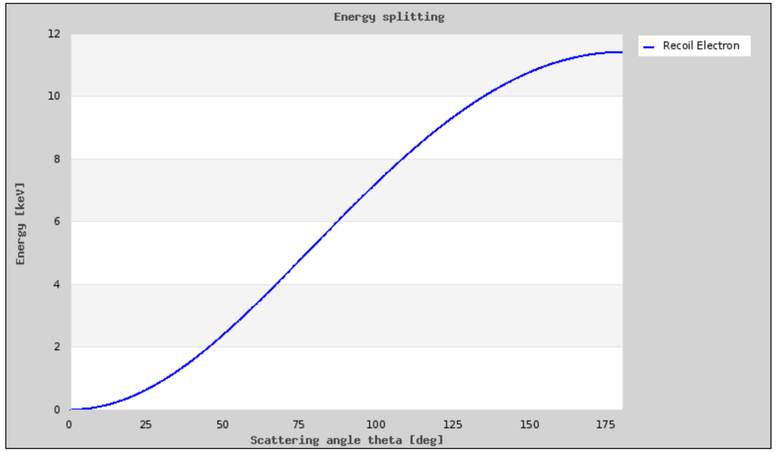
Am source

- We used an incapsulated Am source with 40 kBq activity;
- Only gammas are expected to be produced;
- According to nuclear-data the main X ray emissions are:

Gammas from ^{241}Am (432.2 y 7)

Eg (keV)	Ig (%)	Decay mode
59.5412 *2*	35.9 *4*	a
26.3448 *2*	2.40 *2*	a
33.1964 *3*	0.126 *3*	a

- Absorption length at 26 keV is 14 m
- Absorption length at 59 keV is hundreds of meters
- The maximum recoiling energy for the Compton electron is around 11 keV



Data set and daily scan

- We took data at 5 different distances of the source from the GEM: 5cm (Step1), 15 cm (Step2), 25 cm (Step3), 35 cm (Step4), 45 cm (Step5);

- In each position about 300 runs were collected for a total of 120k pictures each;

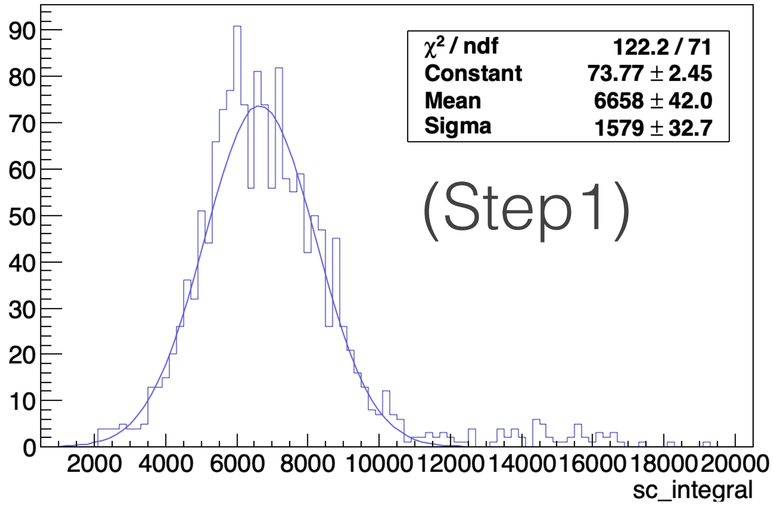
- Several runs seem corrupted and are skipped. Statistics not equalised so far;

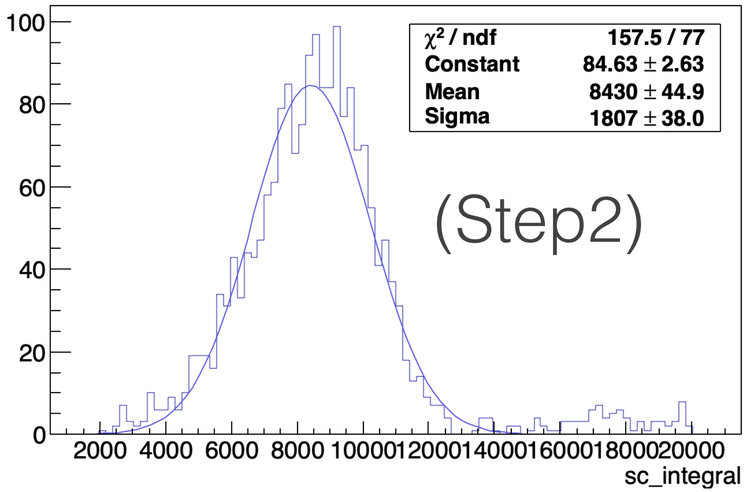
- Daily scan performed with ^{55}Fe source (5.9 keV) provides the responses in the 5 steps: 6657, 8429, 10169, 10786, 11037 cnts;

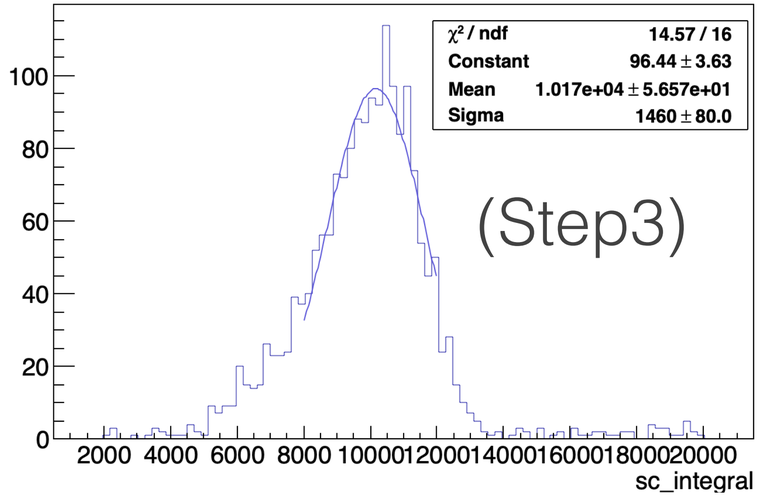
- Calibration constants are therefore: 0.88, 0.70, 0.58, 0.54, 0.53 eV/cnts

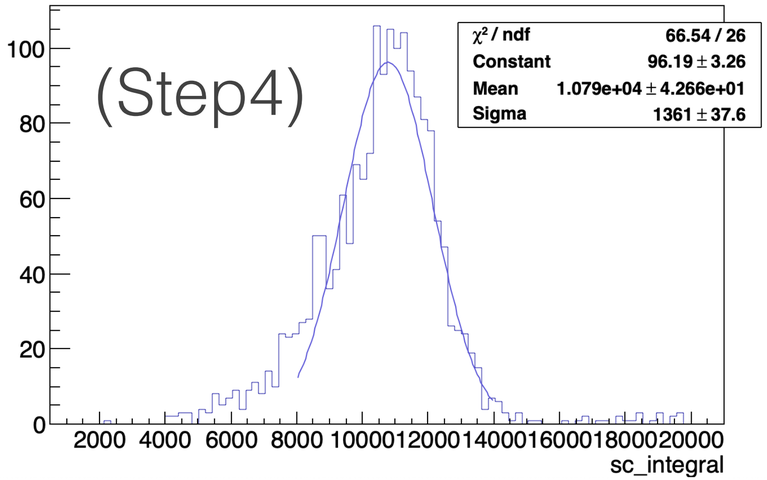
- We can assume not saturated signals in steps 4 and 5 with about 5.4 keV every 10k cnts

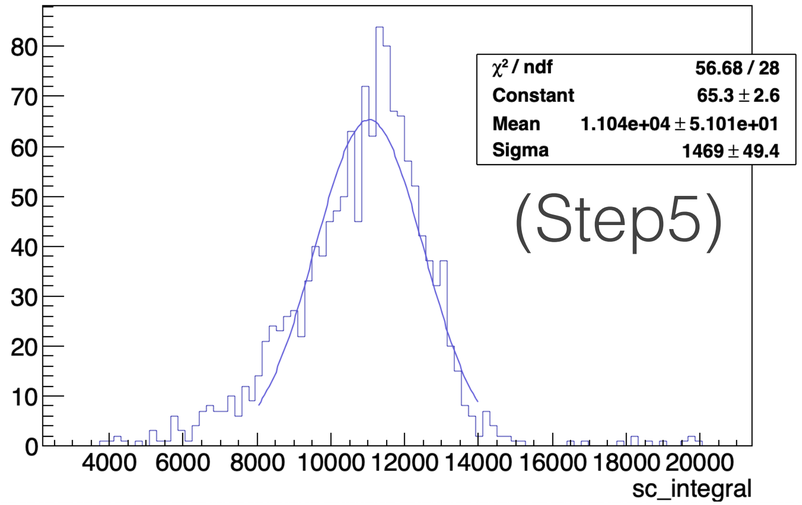
Daily scan


χ² / ndf 122.2 / 71
Constant 73.77 ± 2.45
Mean 6658 ± 42.0
Sigma 1579 ± 32.7
(Step1)
sc_integral

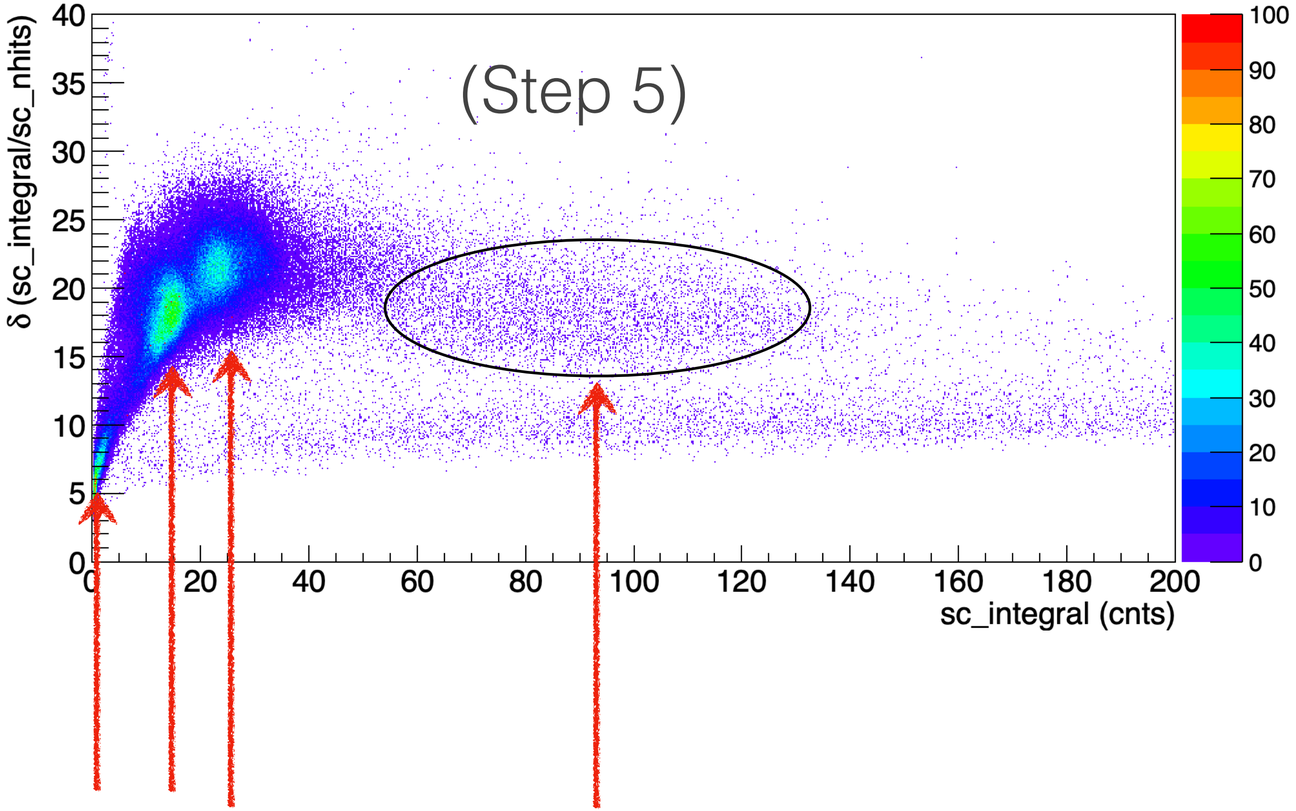

χ² / ndf 157.5 / 77
Constant 84.63 ± 2.63
Mean 8430 ± 44.9
Sigma 1807 ± 38.0
(Step2)
sc_integral


χ² / ndf 14.57 / 16
Constant 96.44 ± 3.63
Mean 1.017e+04 ± 5.657e+01
Sigma 1460 ± 80.0
(Step3)
sc_integral

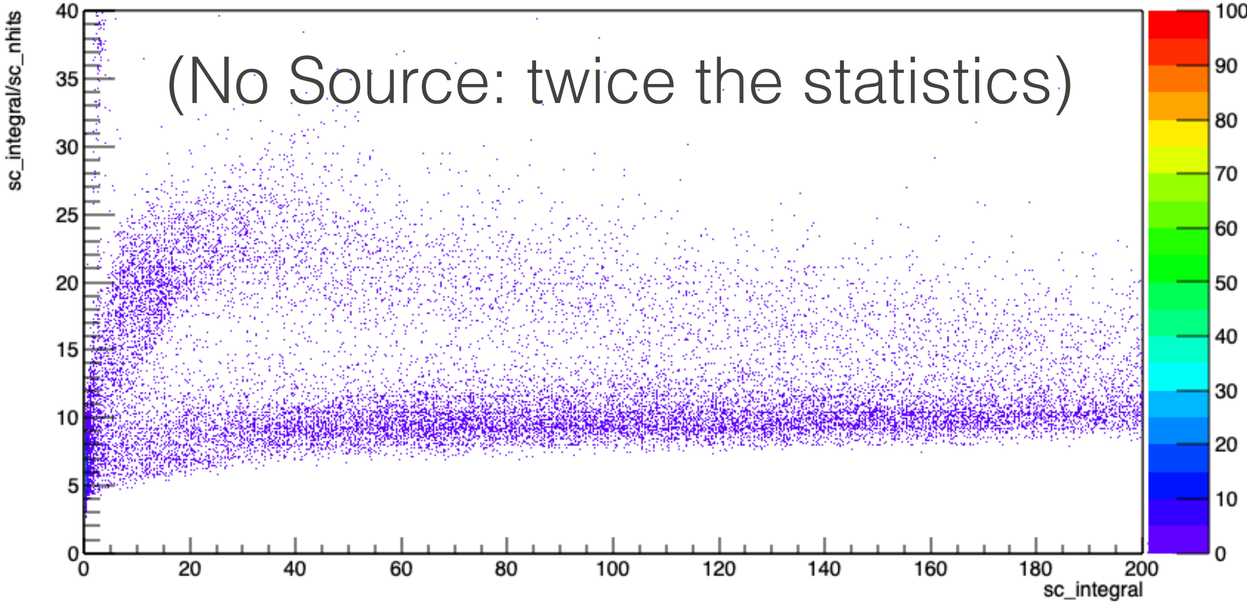

χ² / ndf 66.54 / 26
Constant 96.19 ± 3.26
Mean 1.079e+04 ± 4.266e+01
Sigma 1361 ± 37.6
(Step4)
sc_integral


χ² / ndf 56.68 / 28
Constant 65.3 ± 2.6
Mean 1.104e+04 ± 5.101e+01
Sigma 1469 ± 49.4
(Step5)
sc_integral

Analysis

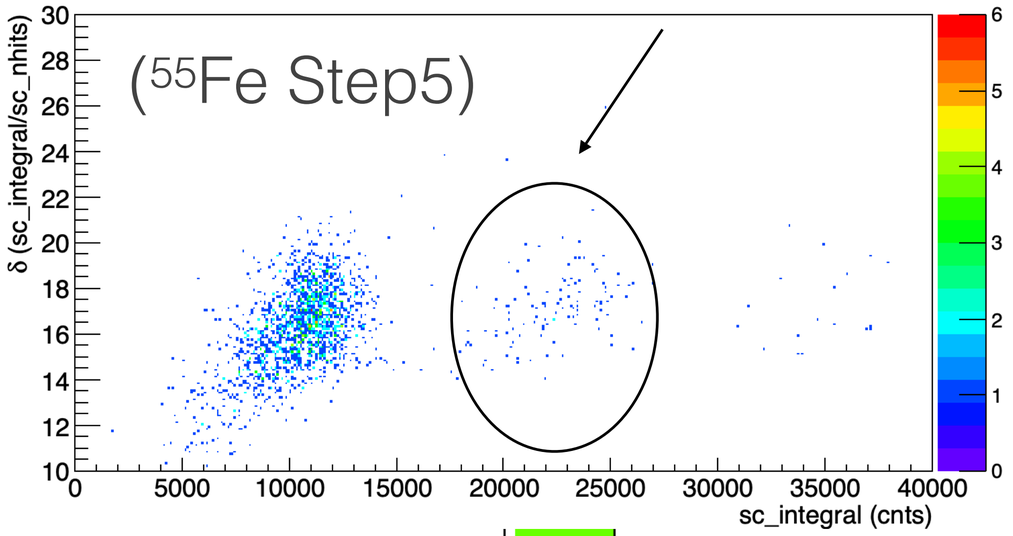


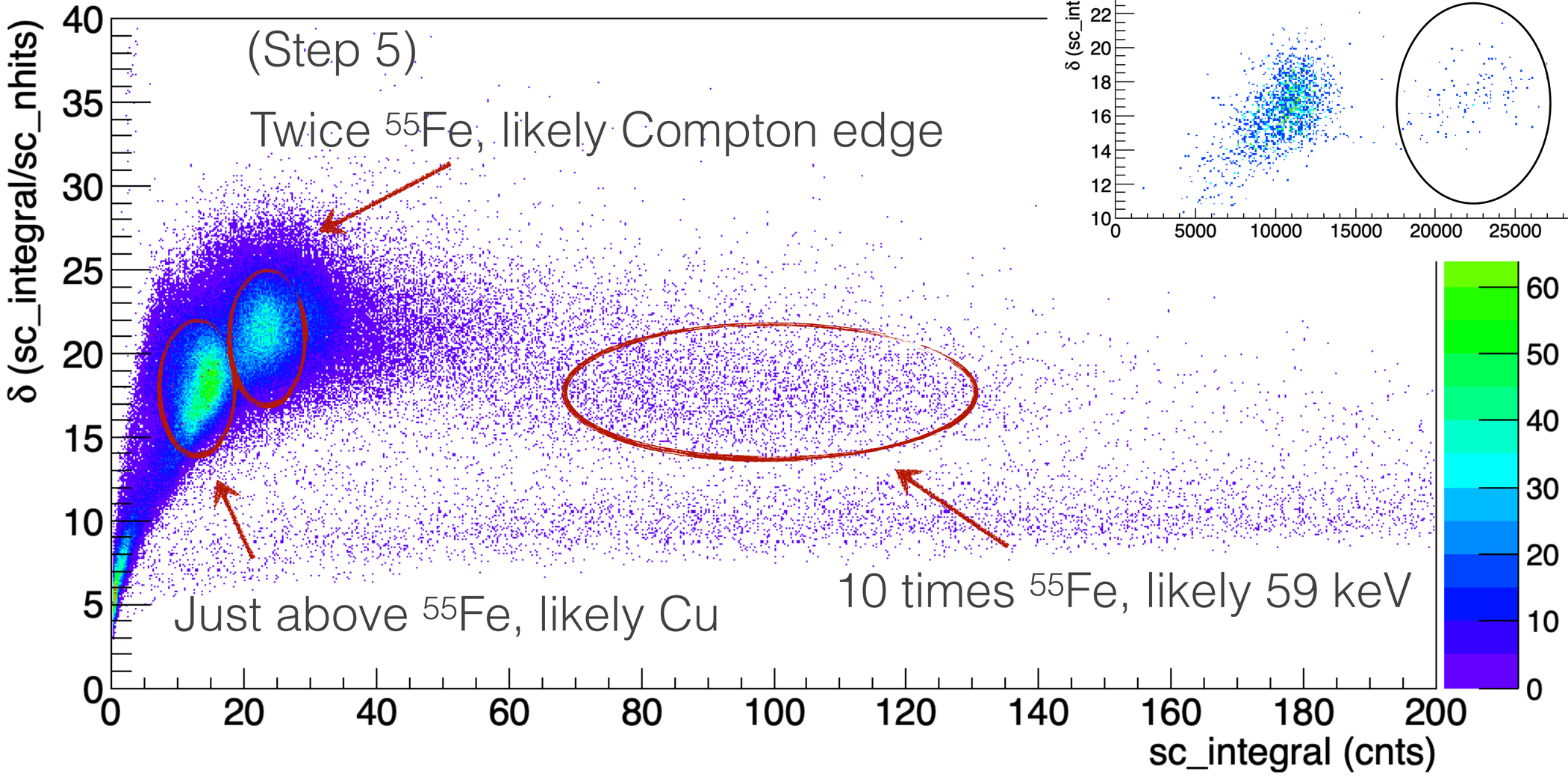
Effects of the Am source



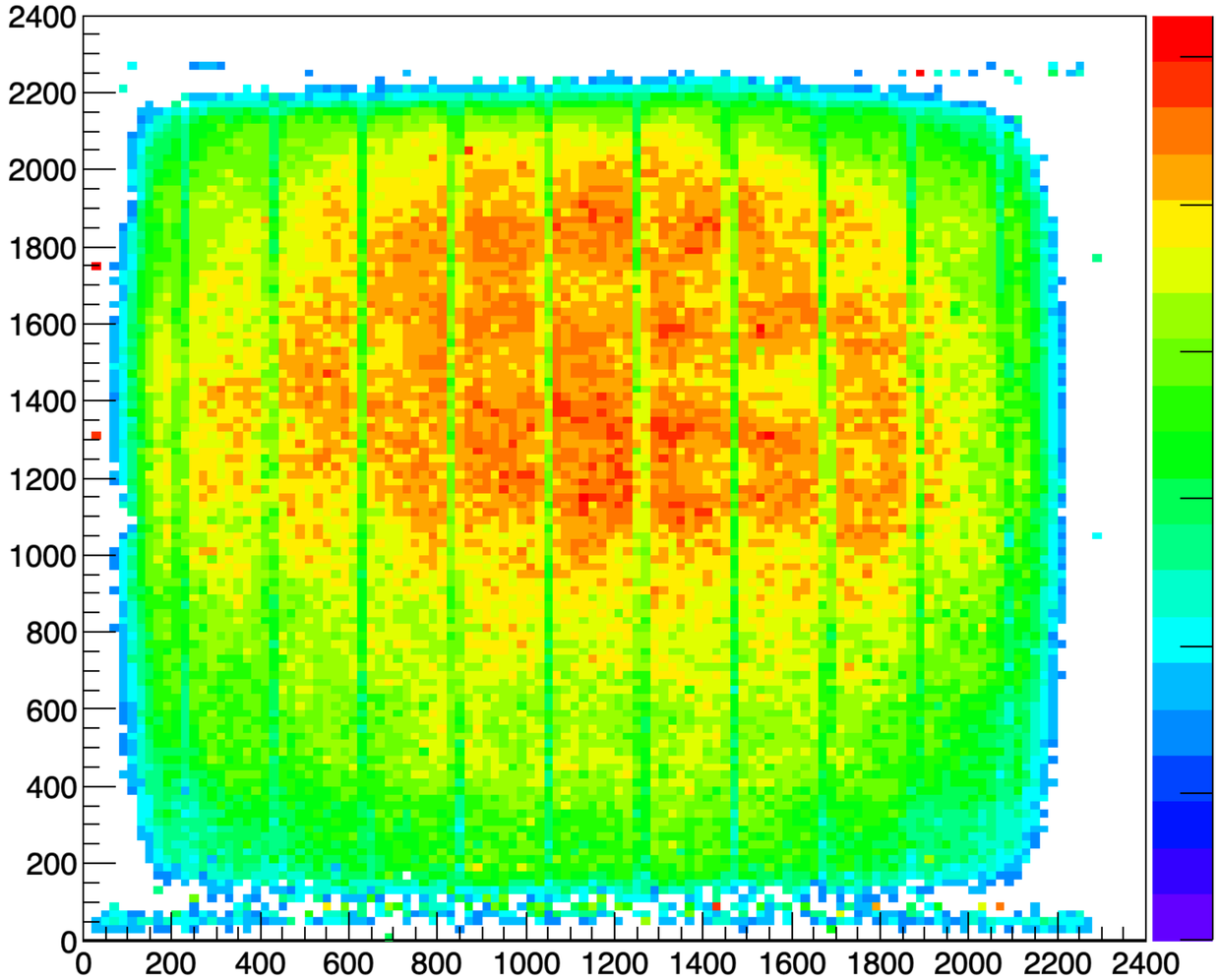
Analysis

Double un-resolved ^{55}Fe spots

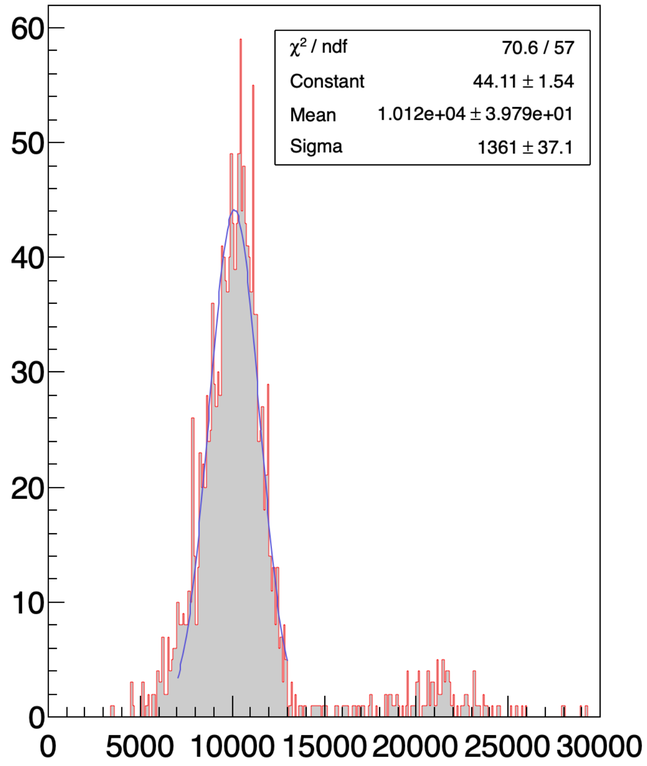


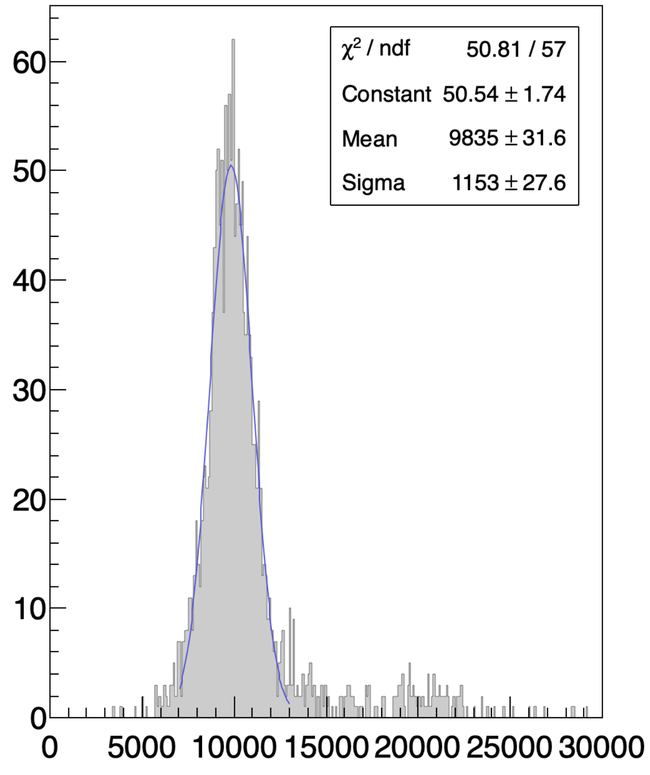


Correction map



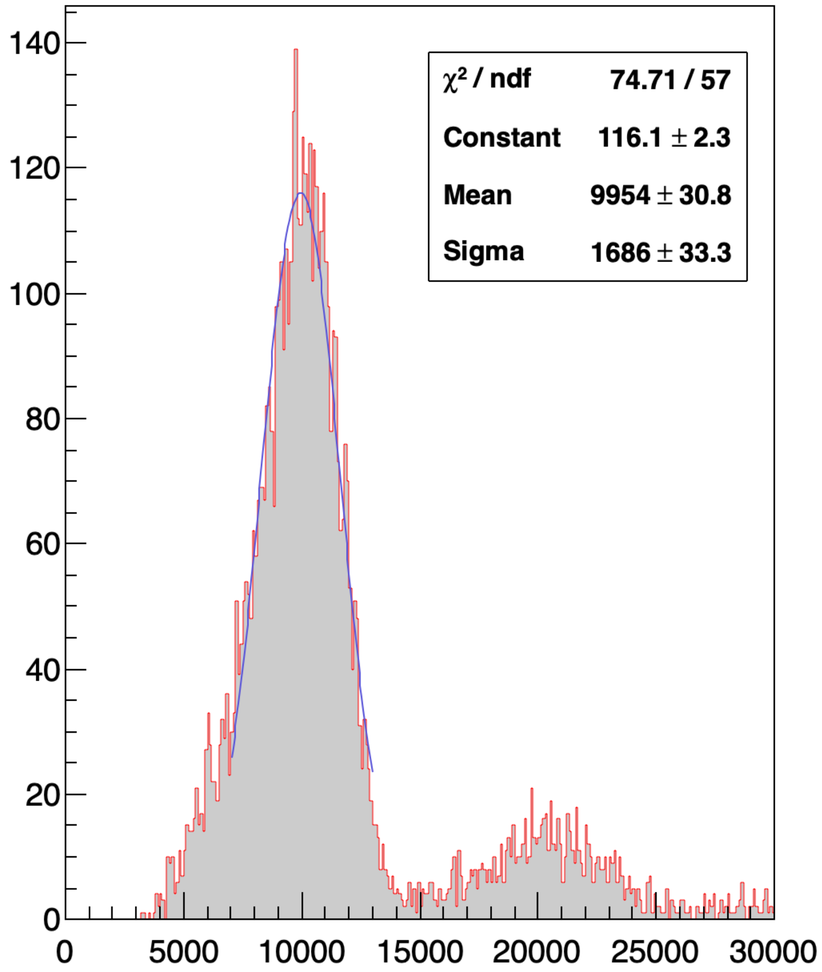
37950 - Fe collimated step 3

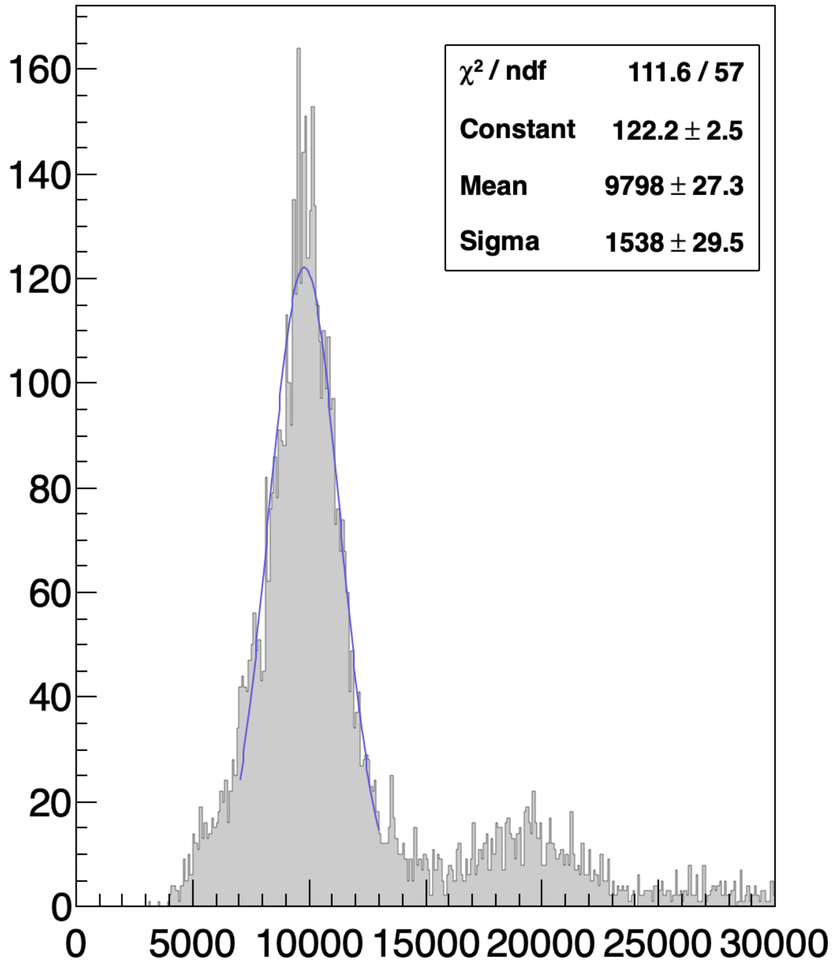




Correction map

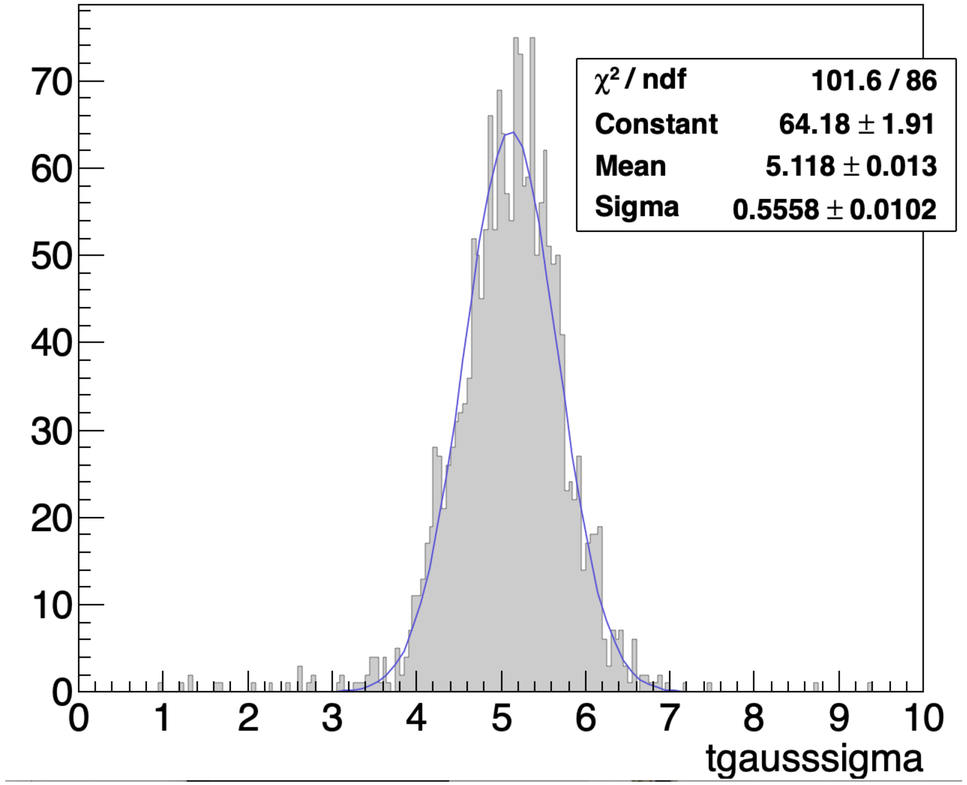
35160 - Fe No Collimator step 3



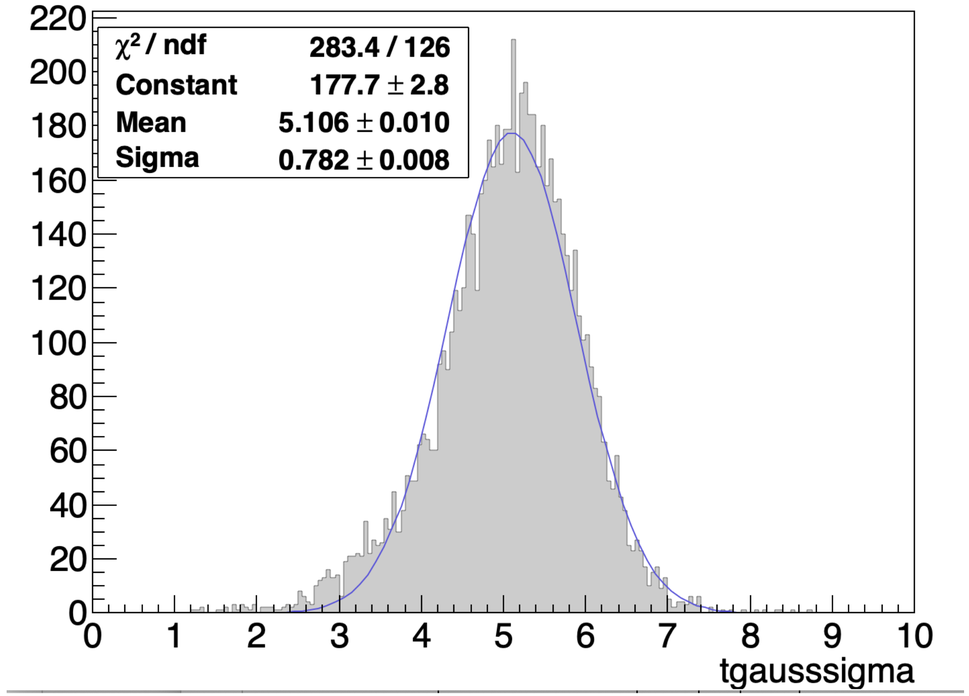


Diffusion and collimation - Tgaussigma

37950 - Fe collimated step 3



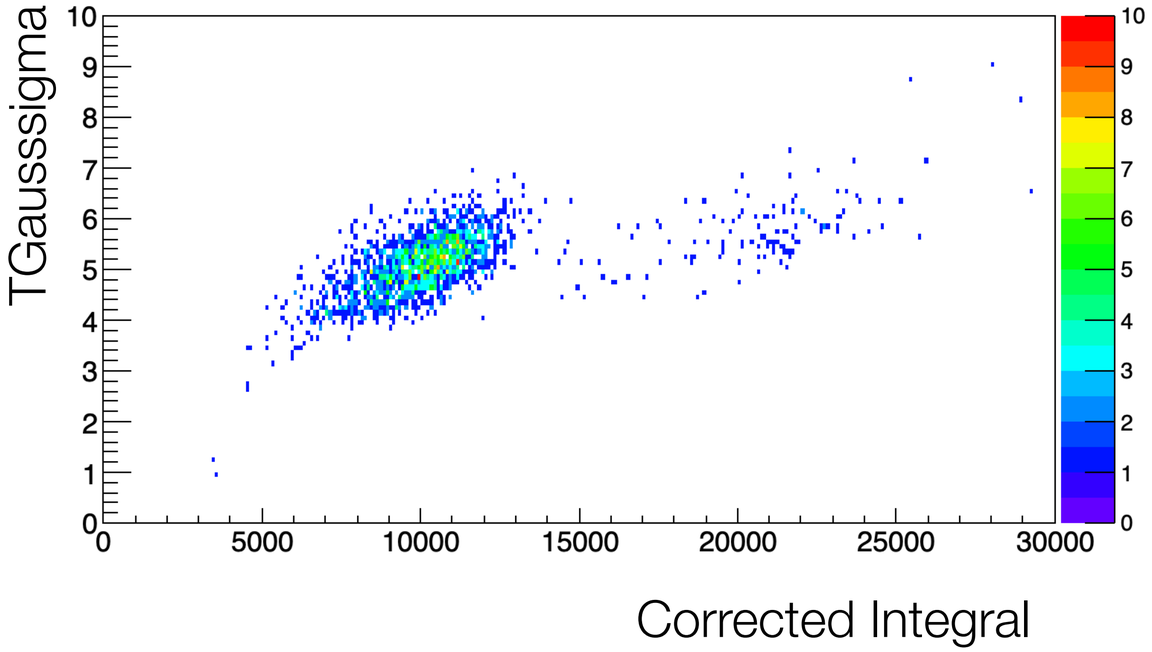
35160 Calibration - No Collimator step 3



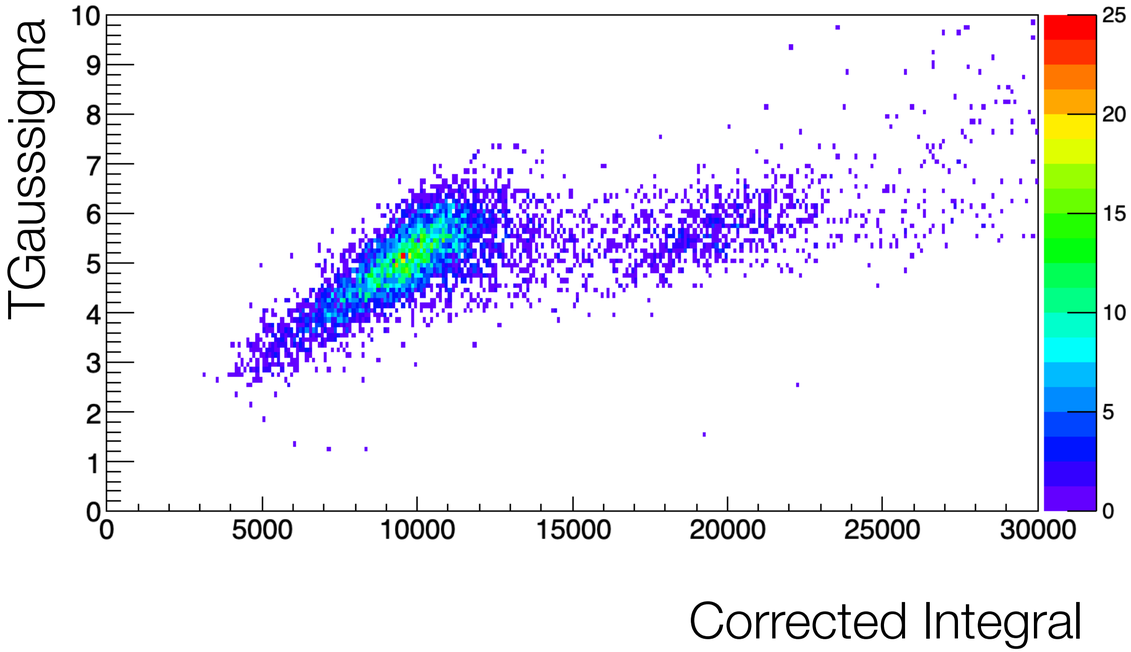
- The sigma of the gaussian fit to the transverse light profile (**Tgausssigma**), is a rough estimator of the **diffusion** and thus of the event **z**;

Diffusion and collimation - Tgaussigma

37950 - Fe collimated step 3

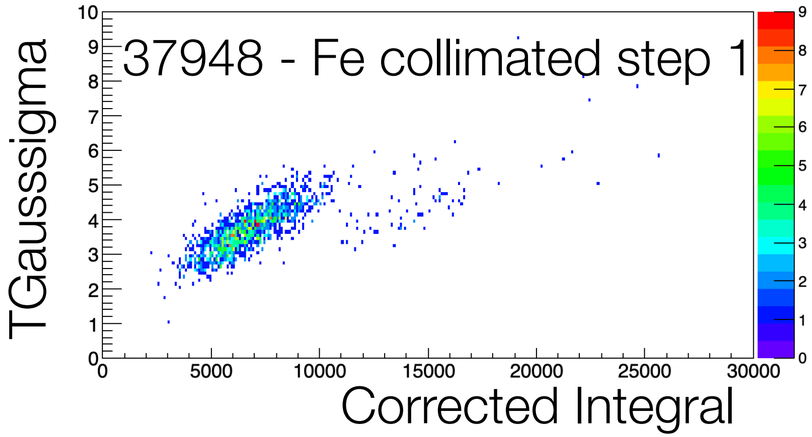


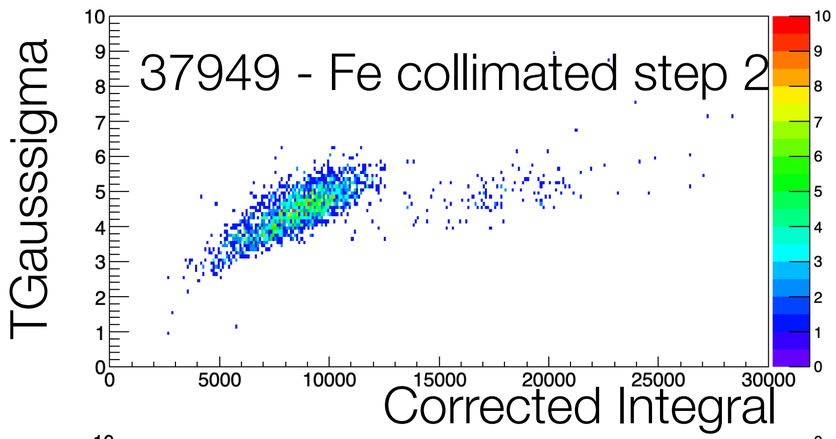
35160 - Fe No Collimator step 3

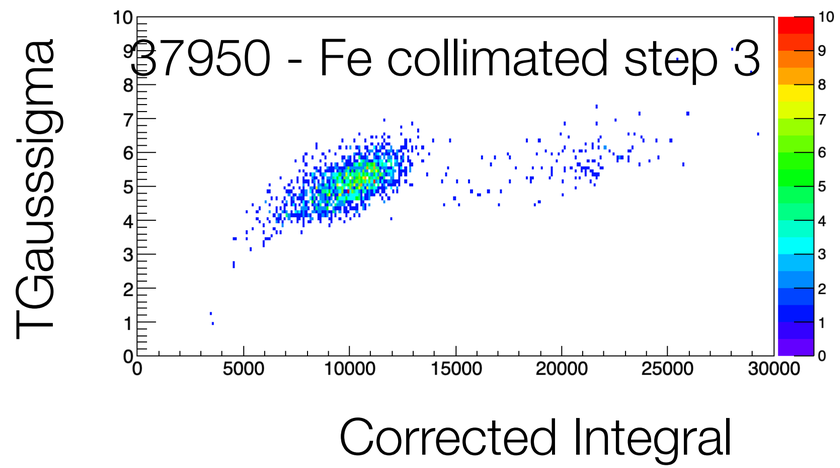


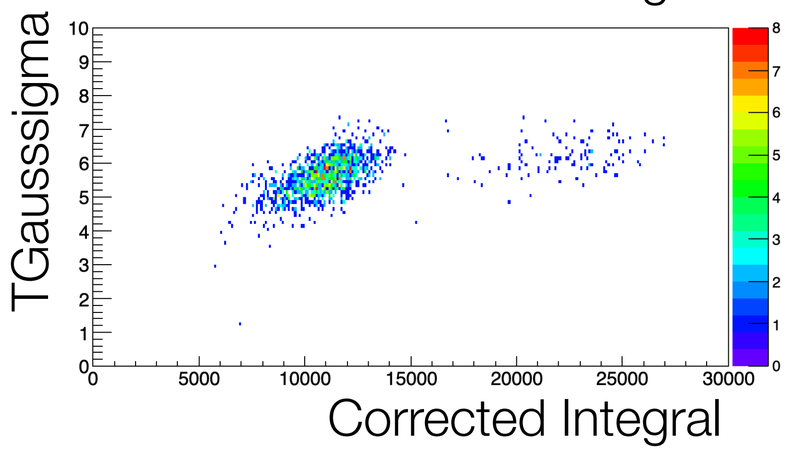
- In the ^{55}Fe runs without collimator, it spans over a larger range

Diffusion and collimation: ^{55}Fe

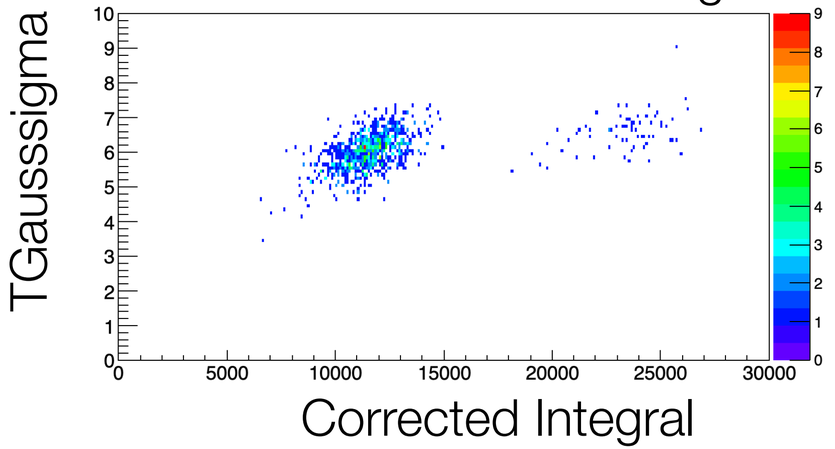






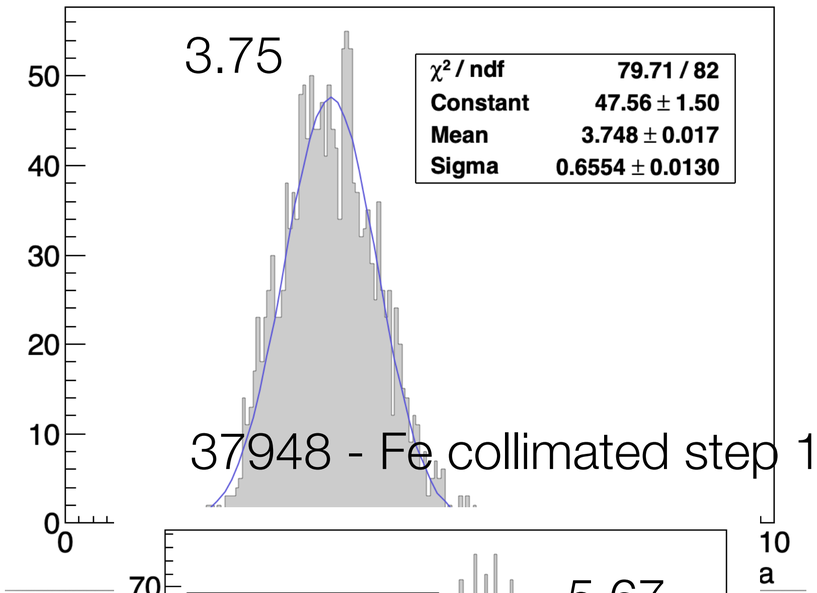


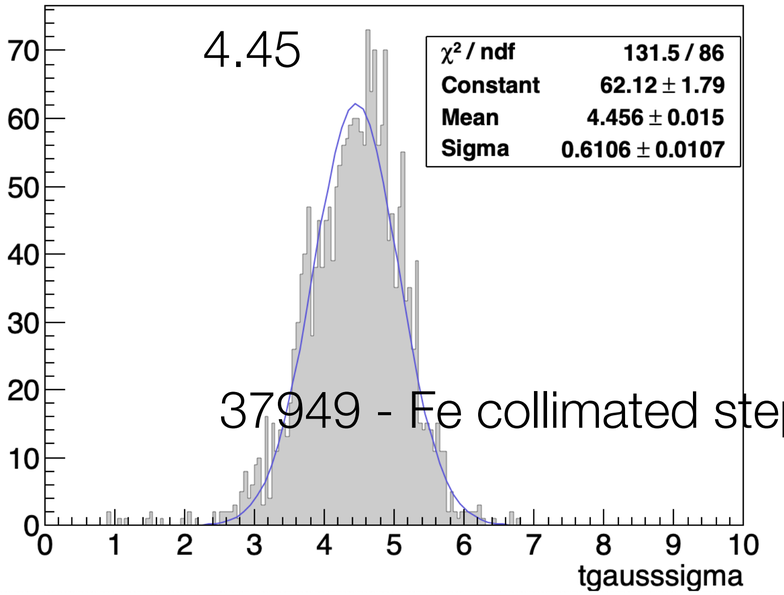
37951 - Fe collimated step 4

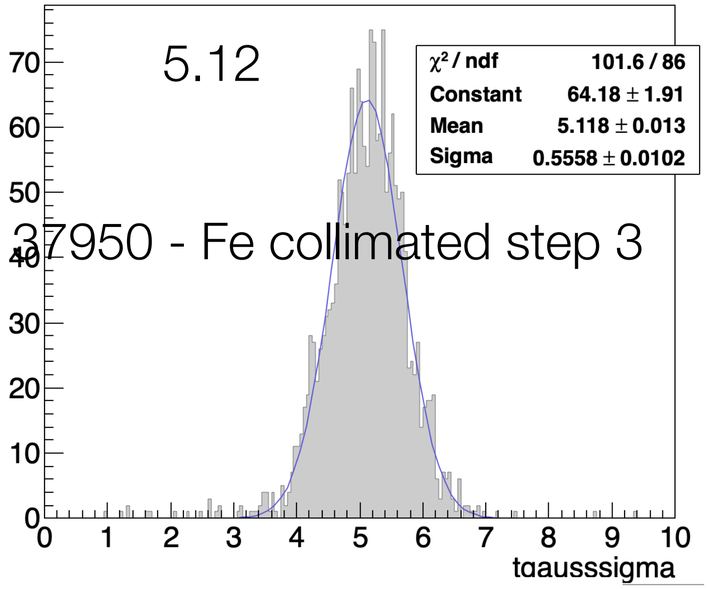


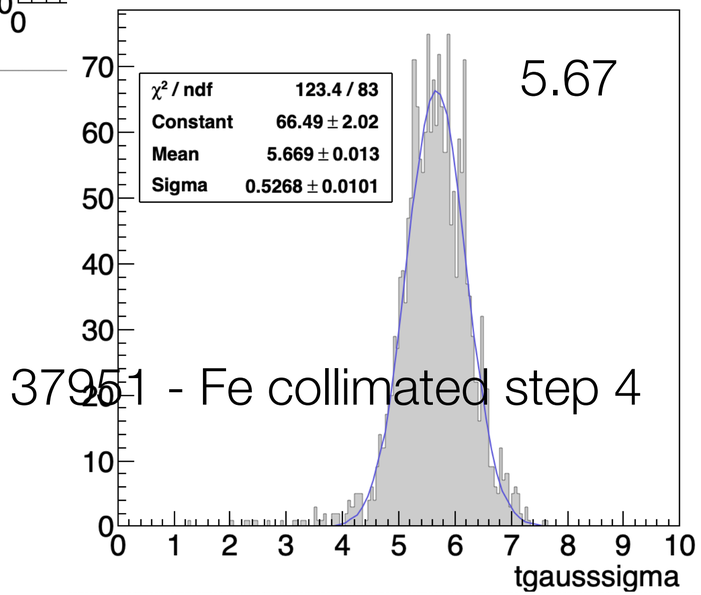
37952 - Fe collimated step 5

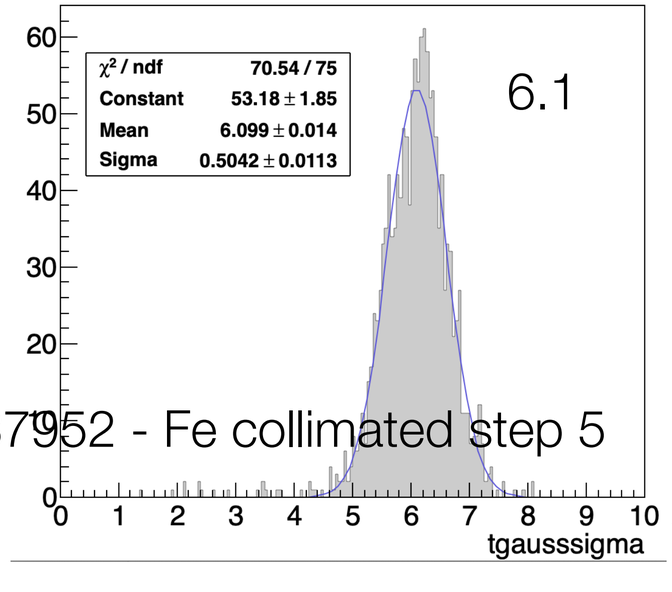
Diffusion and collimation: ^{55}Fe





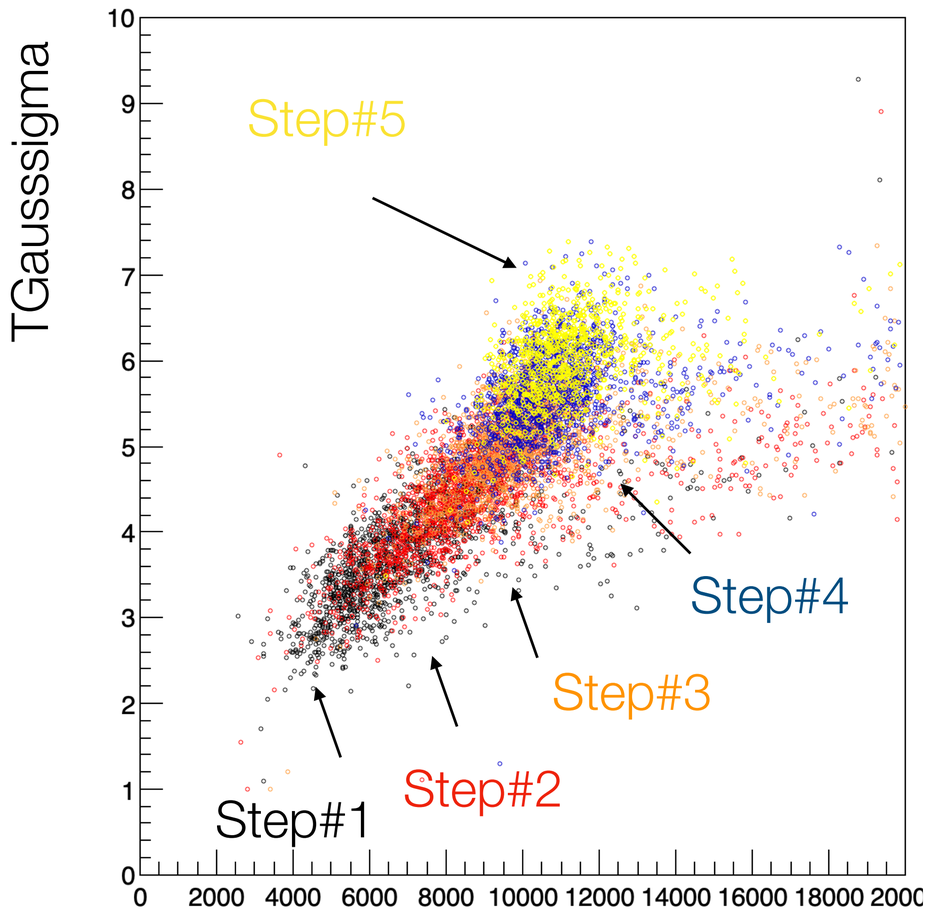




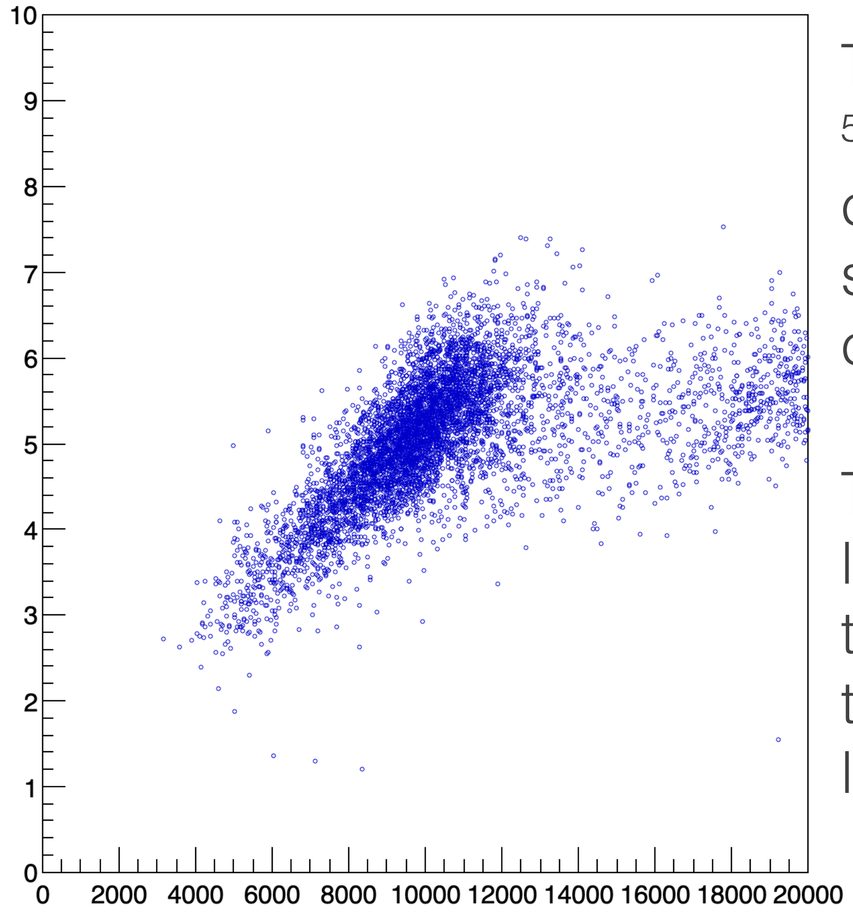


Diffusion and collimation: ^{55}Fe

Fe collimated



35160 - Fe No Collimator step 3

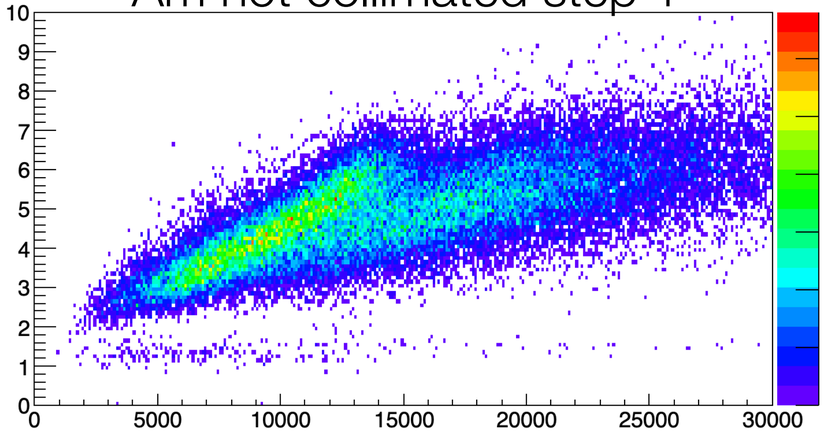


The range spanned in the ^{55}Fe runs without collimator, can be obtained by superimposing the collimated runs at different z;

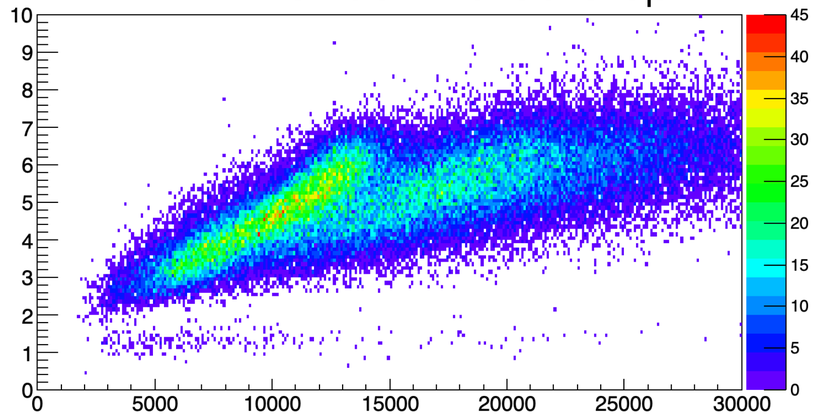
The farer the events from the larger the sigma because the diffusion and the larger the response because of a lower saturation

Diffusion and collimation: ^{241}Am

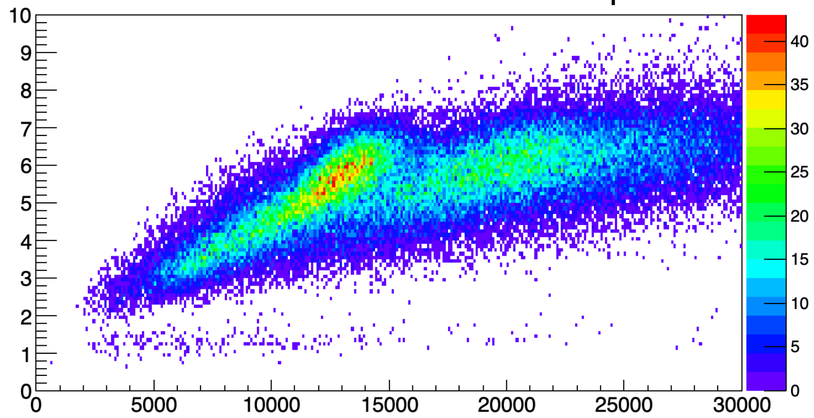
- Am not collimated step 1

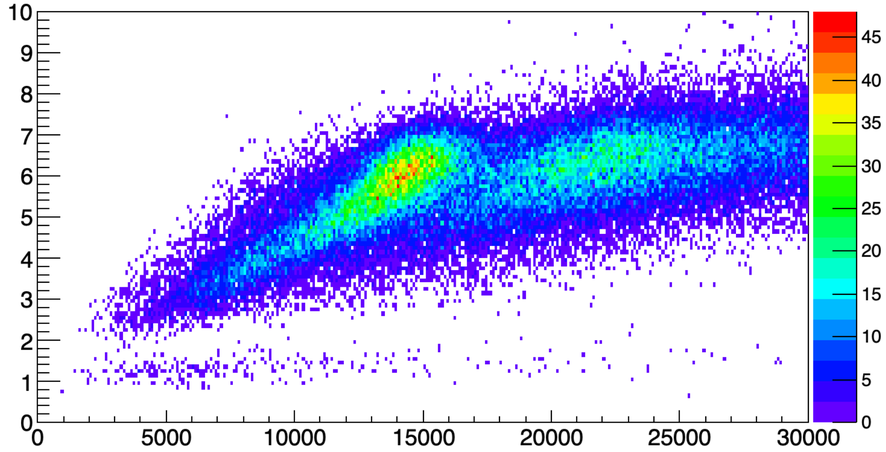


- Am not collimated step 2

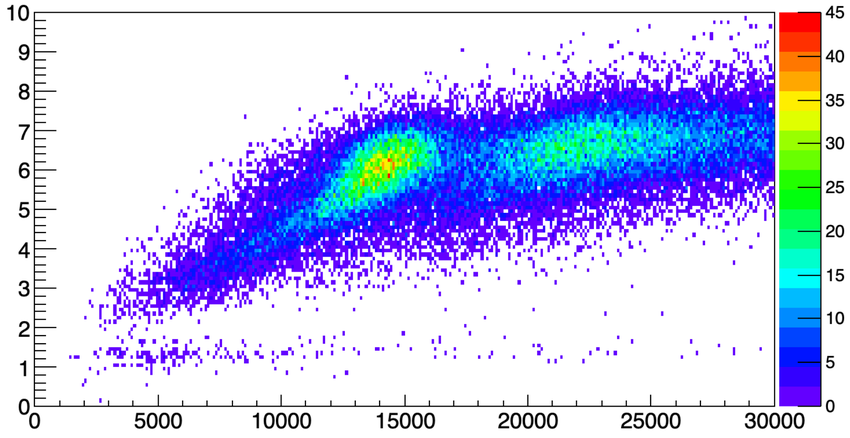


- Am not collimated step 3



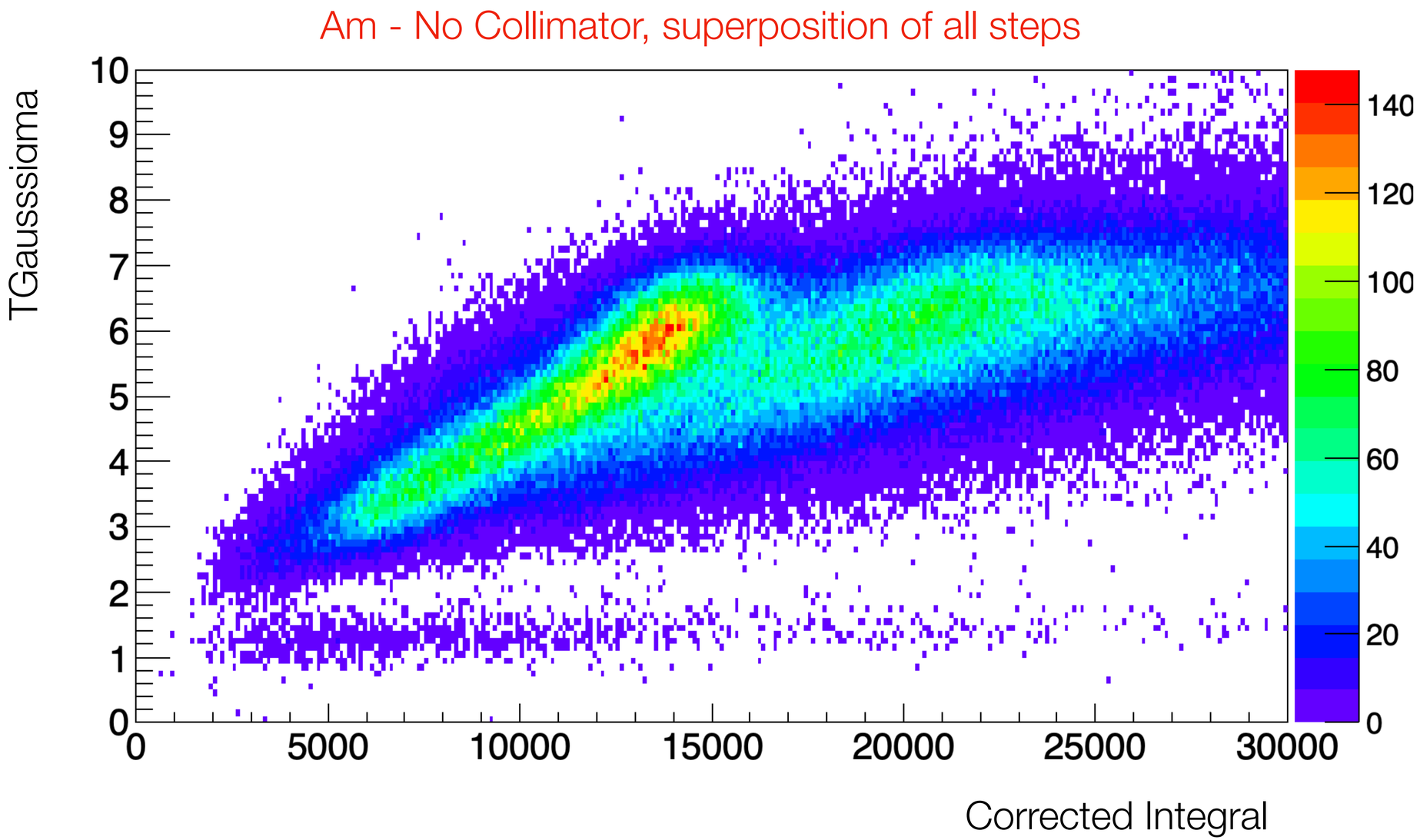


- Am not collimated step 4



- Am not collimated step 5

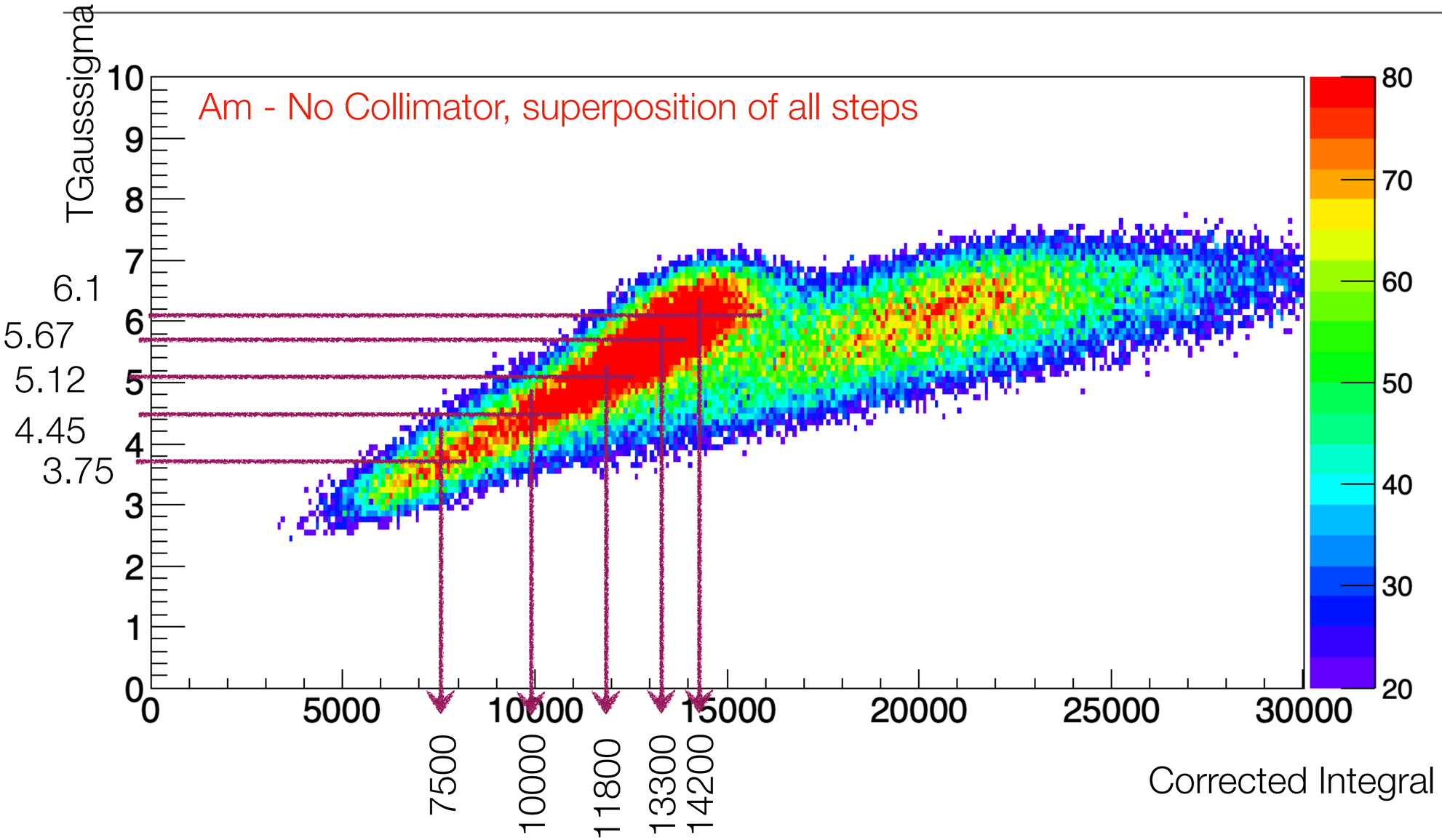
Diffusion and collimation: ^{241}Am



TGausssigma is a good indicator of the spot z

Without collimator, the spots are spread on a large area

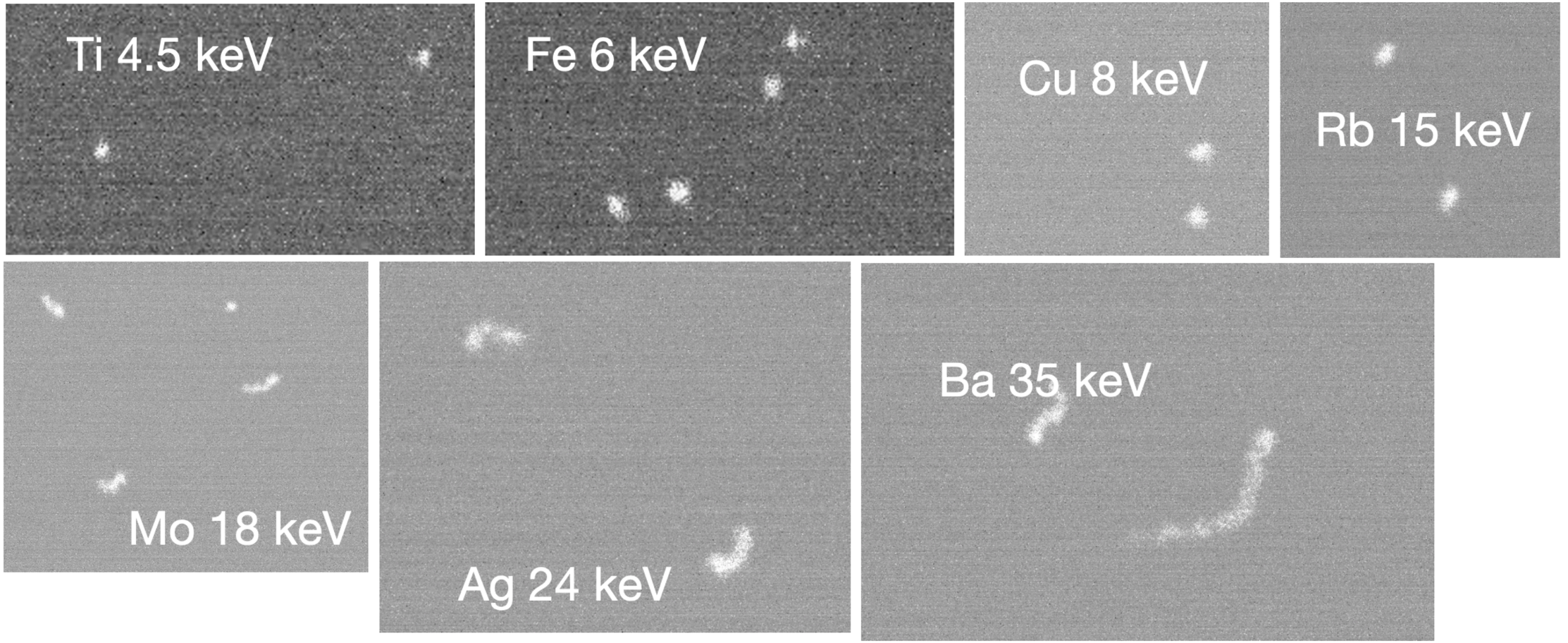
Diffusion and collimation: ^{241}Am



Let's suppose that TGausssigma has in average the same specra as a function of the spot **z at 8 keV**

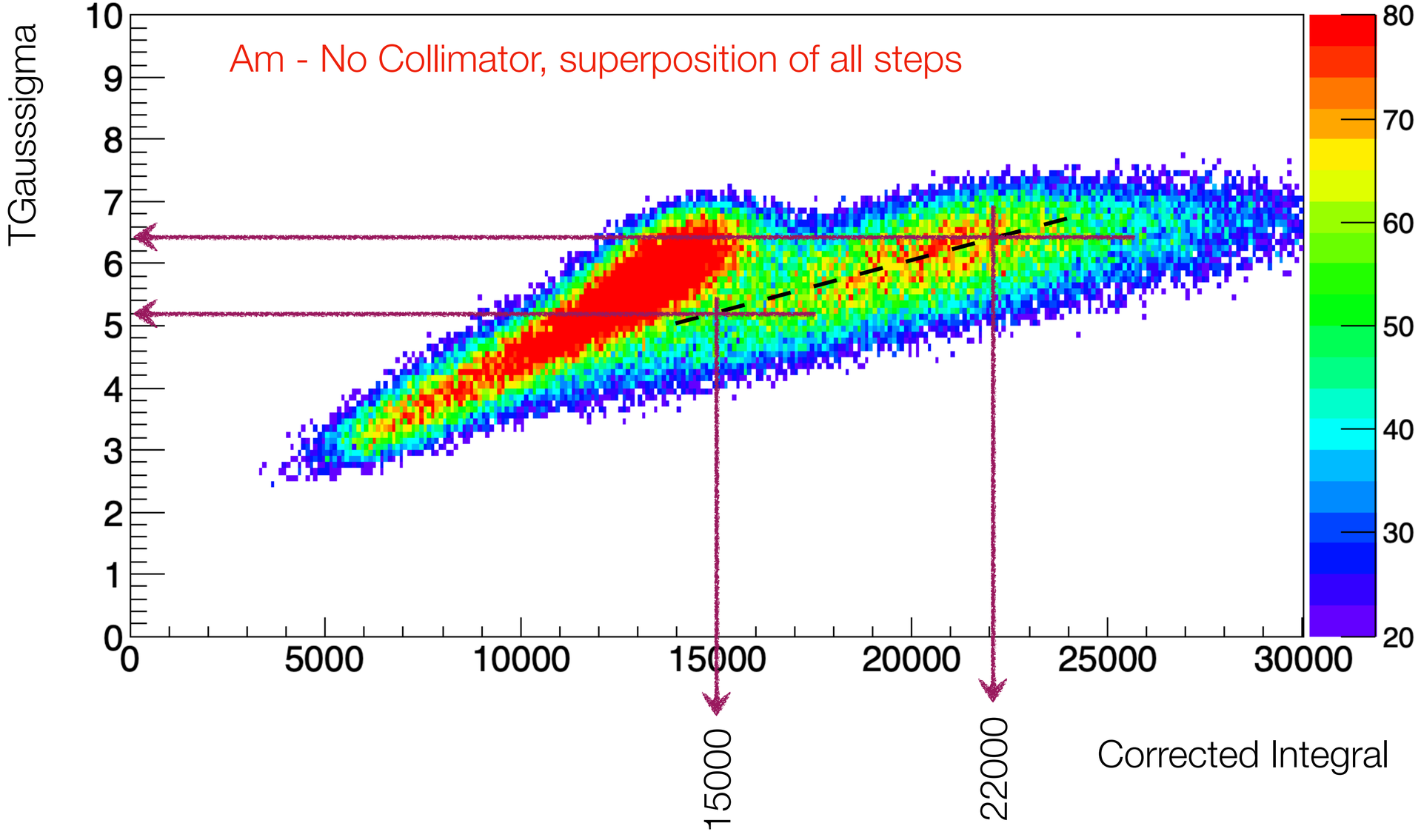
We can try to estimate the average values of integral expected for a collimated 8 keV source

Energies and shapes



While below **8 keV signals** are **spot-like**,
electrons with larger energies **travel in gas**.

Diffusion and collimation: ^{241}Am

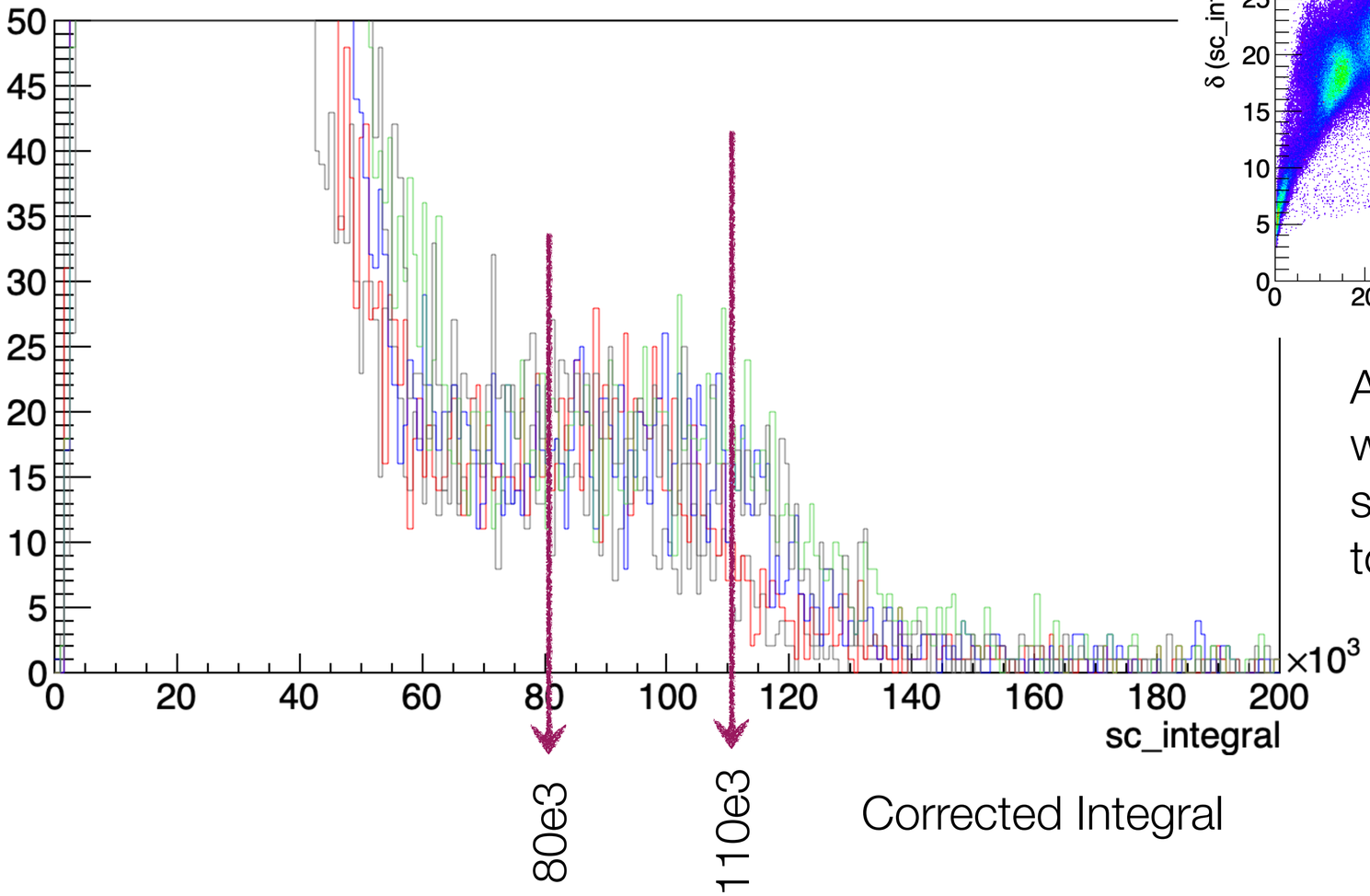


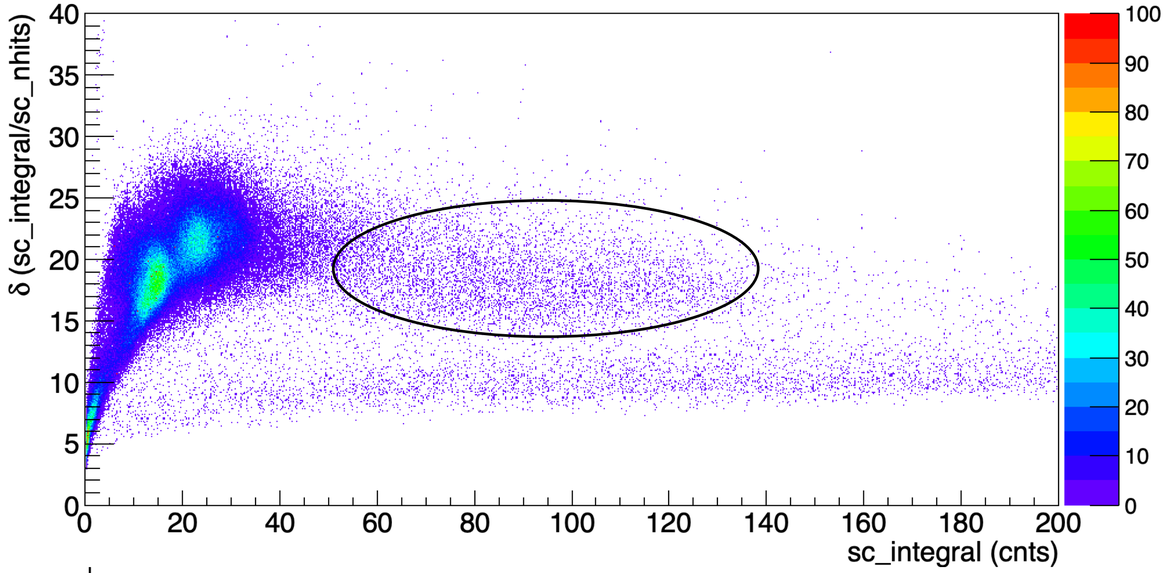
At hight energies we can suppose that the span in integral is due to different “saturation”

We can therefore expect a minimum response close to the GEM and a large response far from the GEM.

Diffusion and collimation: ^{241}Am

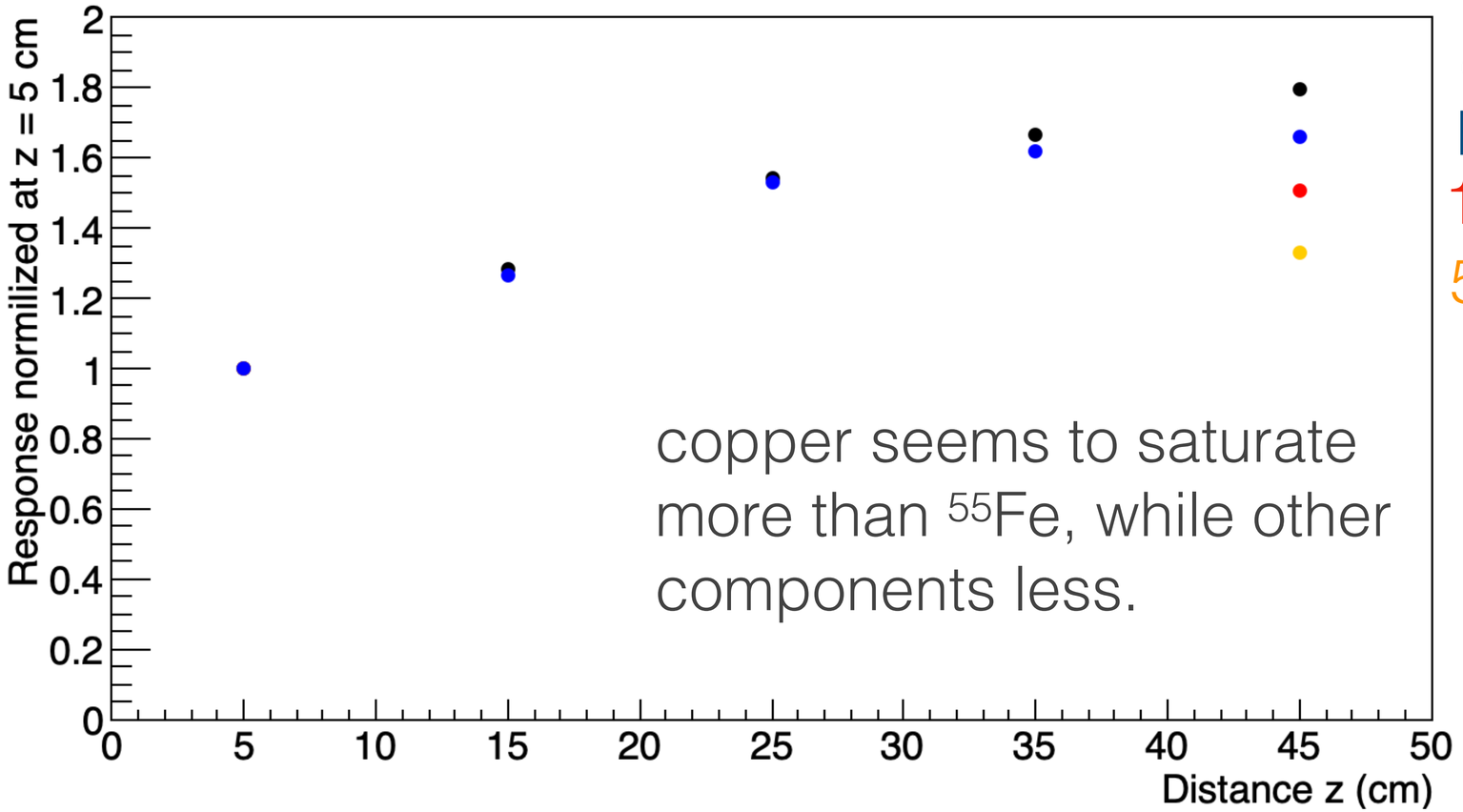
Am - No Collimator, superposition of all steps





At high energies the peak moves slightly while changing the source position. By superimposing all peaks we can expect them to move from about 80e3 to about 110e3

The z scan



8 keV = +80%

Fe = +65%

11 keV = +46%

59 keV = + 32%

What do we expect from the simulation?

Conclusion

- The ^{241}Am runs are promising to study our capability in reconstructing the energy scales;
- The un-collimation of the source spoils the knowledge of the z of the interactions;
- Need of a complete MC simulation of 59 keV photons in He/CF_4 60/40 to evaluate the shape of energy spectrum:
  - why a peak at 12 keV?
  - where are the 26 keV?
- Results of a digitization, starting from a reliable ^{55}Fe simulation, will then compared with data to asses the quality of out MC