The size of ^{55}Fe spots

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Does the spot size depend on GEM gain?

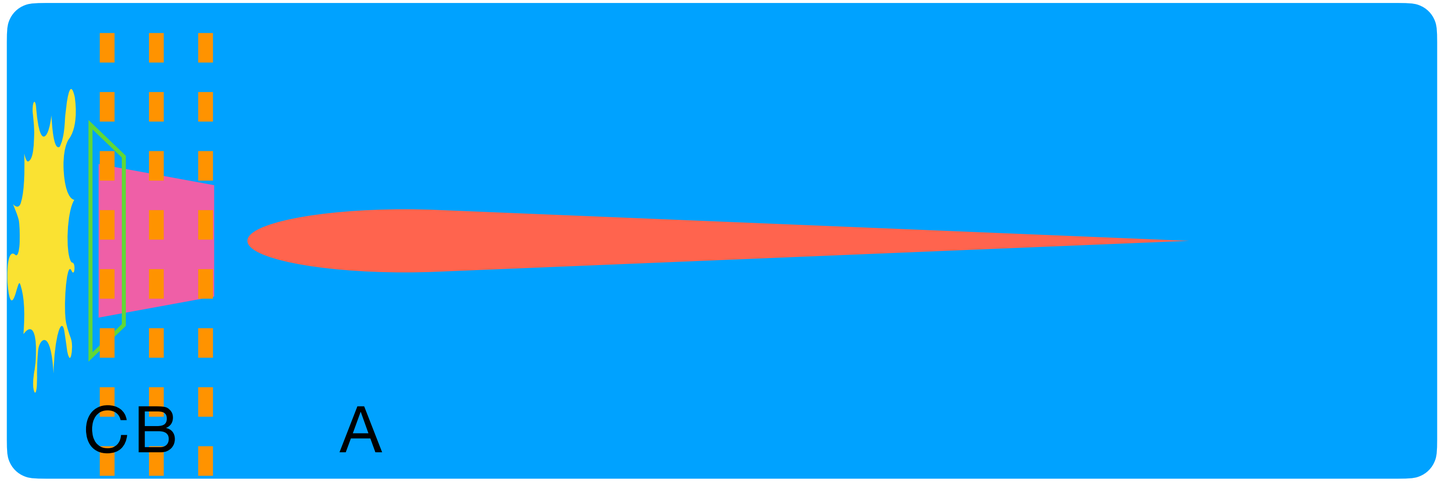
- The physical size of the region occupied by the electrons “emitting” light on GEM#3 can, in principle, depend on 3 effects:

  A. Diffusion in the drift volume: increasing with z;

  B. Diffusion in the multiplication region: depending on V_{GEM} and transfer fields between the GEM;

  C. Electrical repulsion within the electron cloud that depends, at least linearly, on the total number of electrons in the cloud;

Does the spot size depend on GEM gain?



By keeping constant the z and the drift and transfer fields, and changing the GEM#1 gain, the total amount of electrons in the cloud increases and we should see only the effect of C: electrical repulsion within the electron cloud that depends, at least linearly, on it;

Isc is proportional to the number of electrons in the cloud;

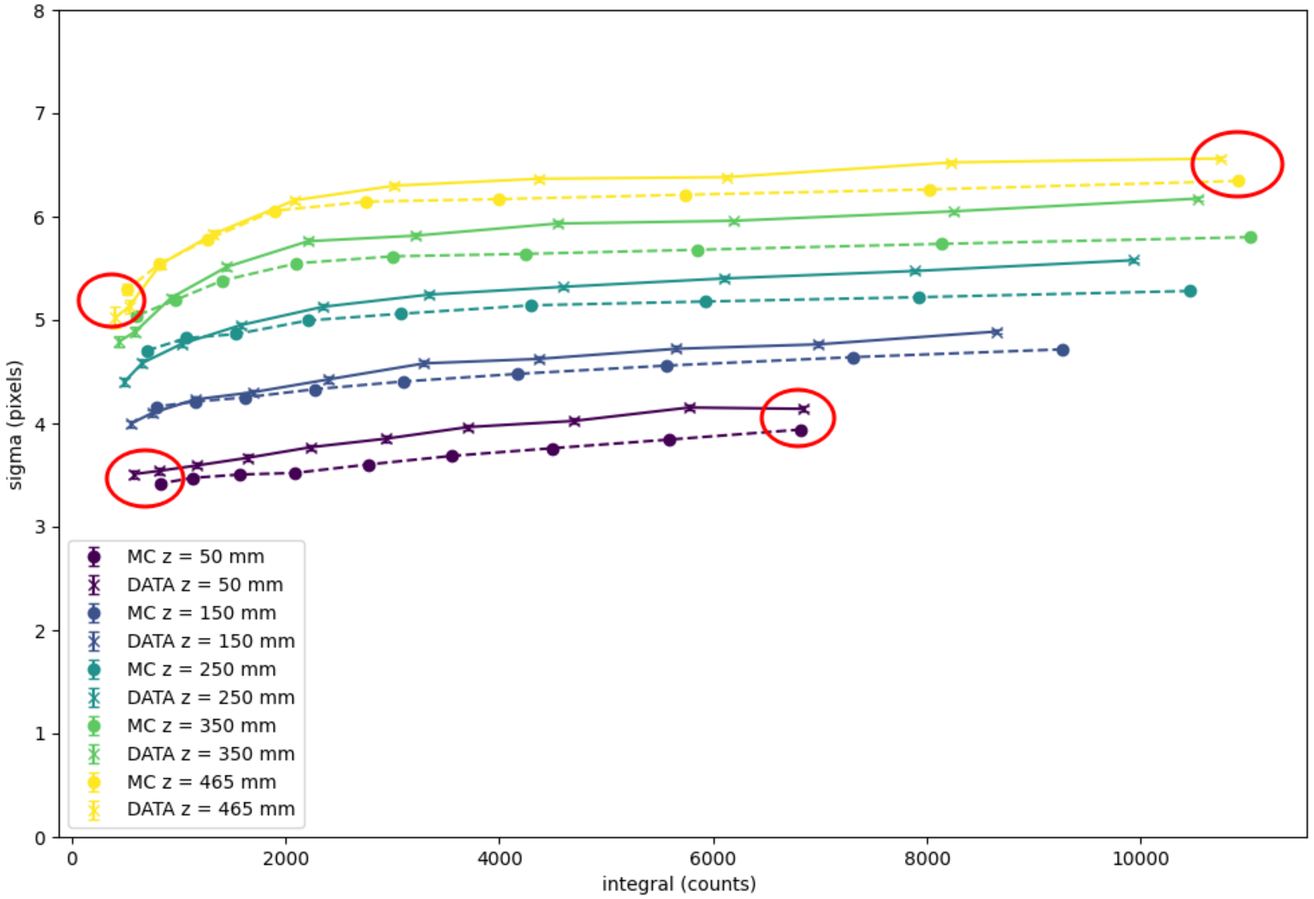
Let's assume that the σ of the light profile (e.g. tgausssigma) is a good indicator of the spot size

In the VGEM#1 and z scan (solid lines are experimental data) it is possible to see that:

- At a fixed z (i.e. with an electron cloud occupying a fixed region on GEM#1), the σ values show a dependence on Isc;

- For the high z values, after a steep increase, the data tend to plateau;

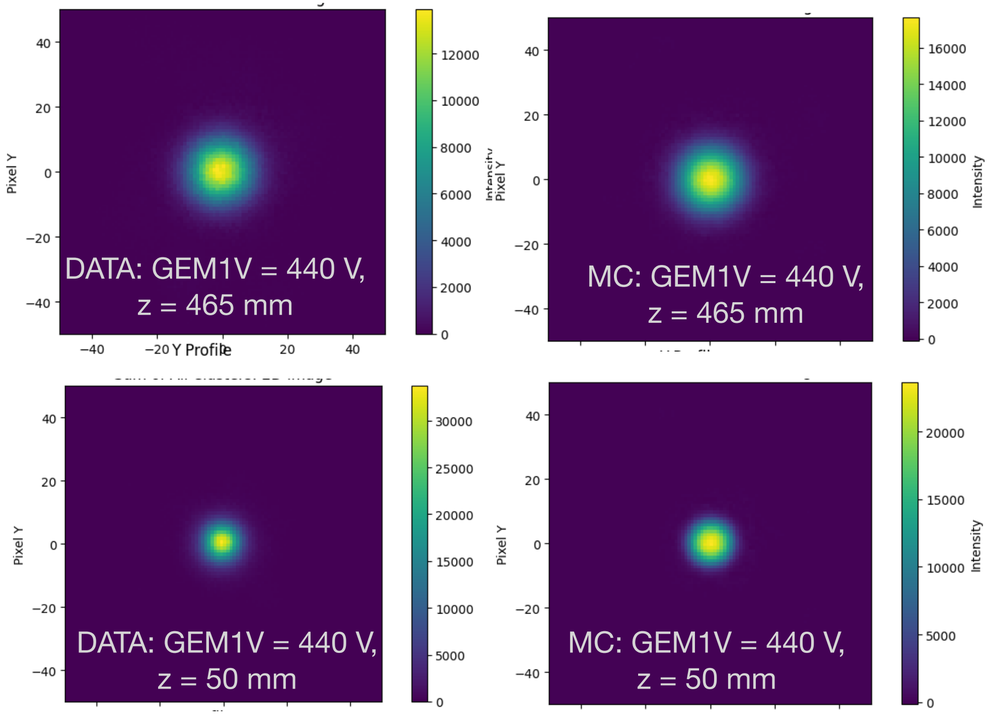
- I do not think this behaviour can be explained with effects B and C;

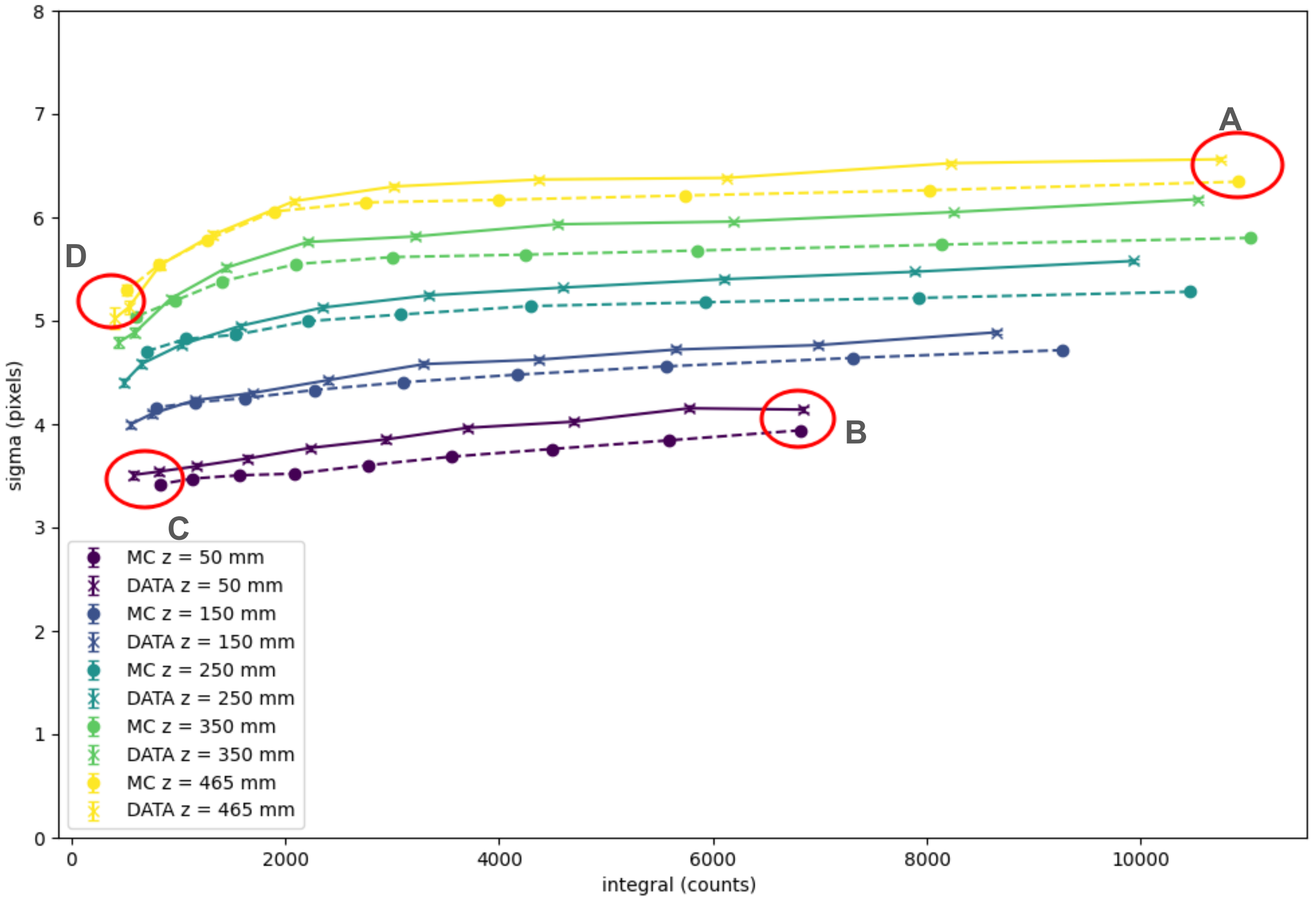


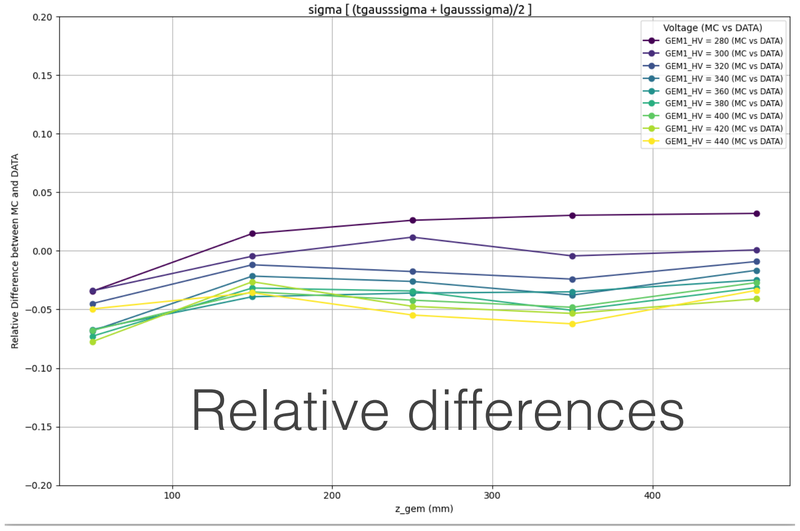
- For the low z values, a linear behaviour is visible: anyway, even in the steepest case (z=5 cm) an increase of the total charge of a factor 10, produces an increase in the total cloud volume (σ^3) of 60%;

Moreover, effects B and C are not included in digitization, that seems to be able to well reproduce (within 5%) the behaviour of the measured σ;

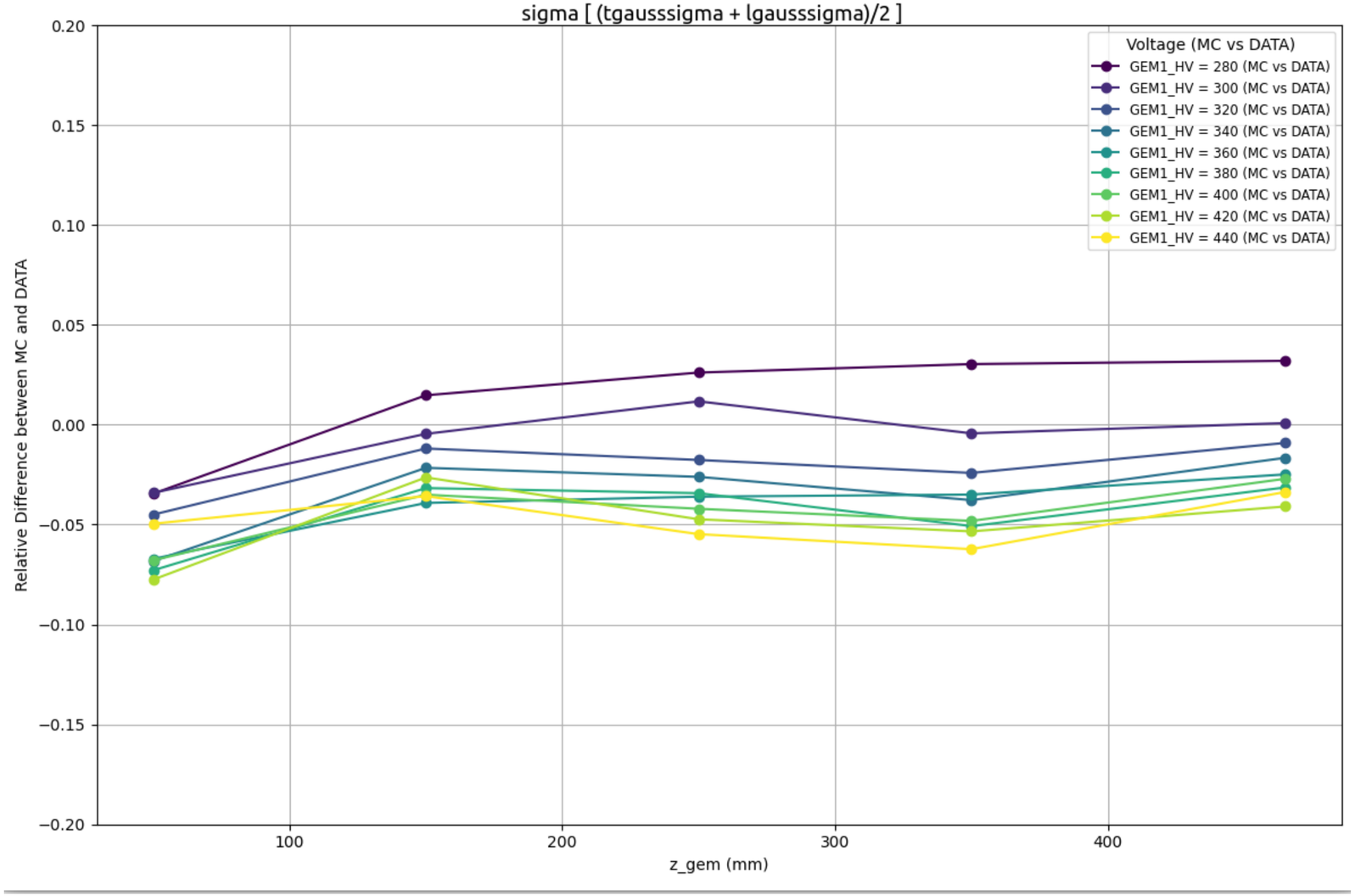
Pietro made a comparison between experimental and simulated spot shapes, to cross check the quality of the digitisations



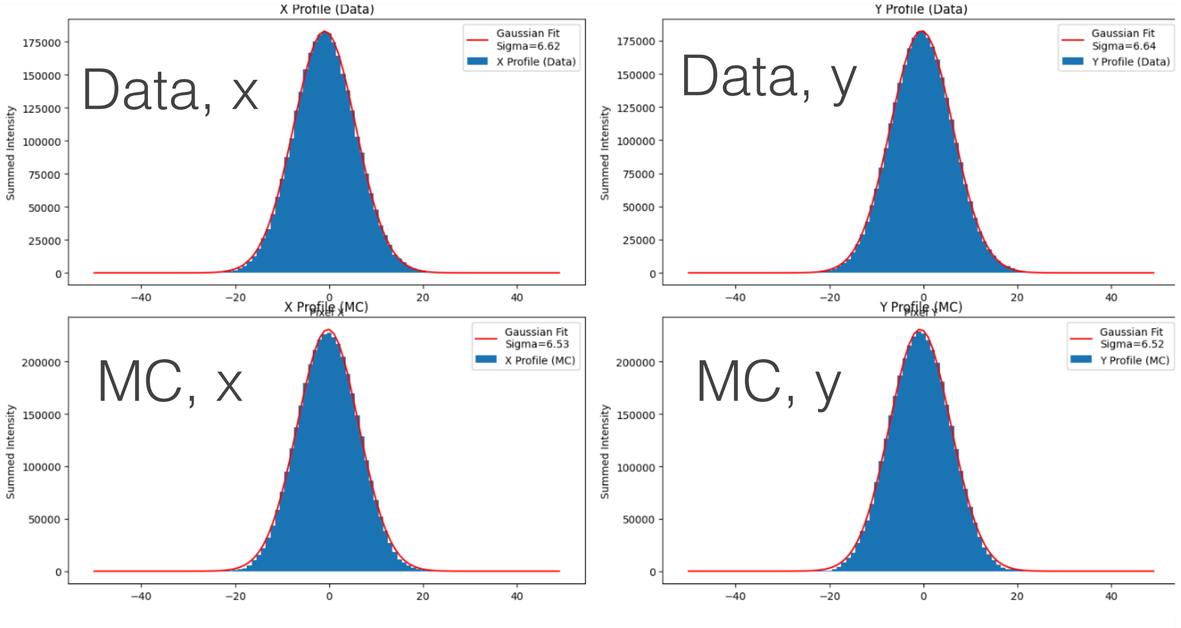


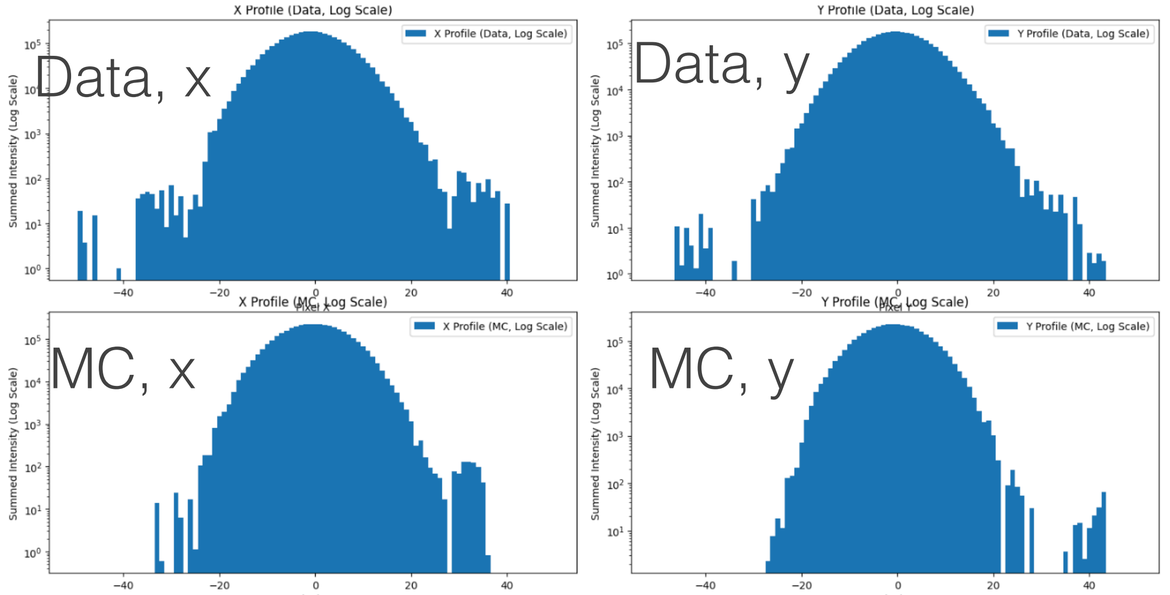


Relative difference between Data and Monte Carlo about σ

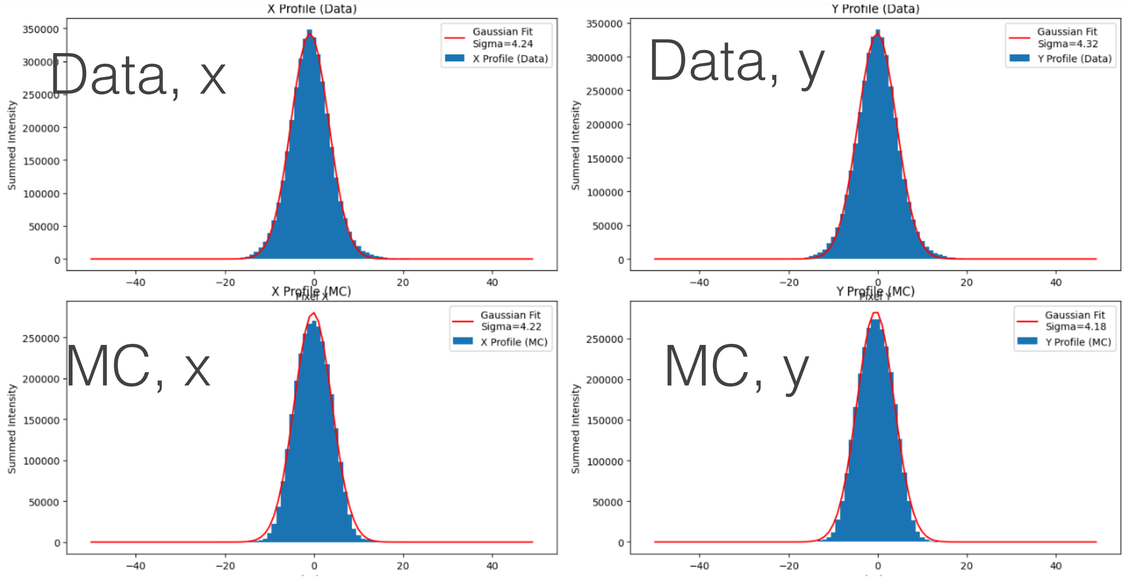


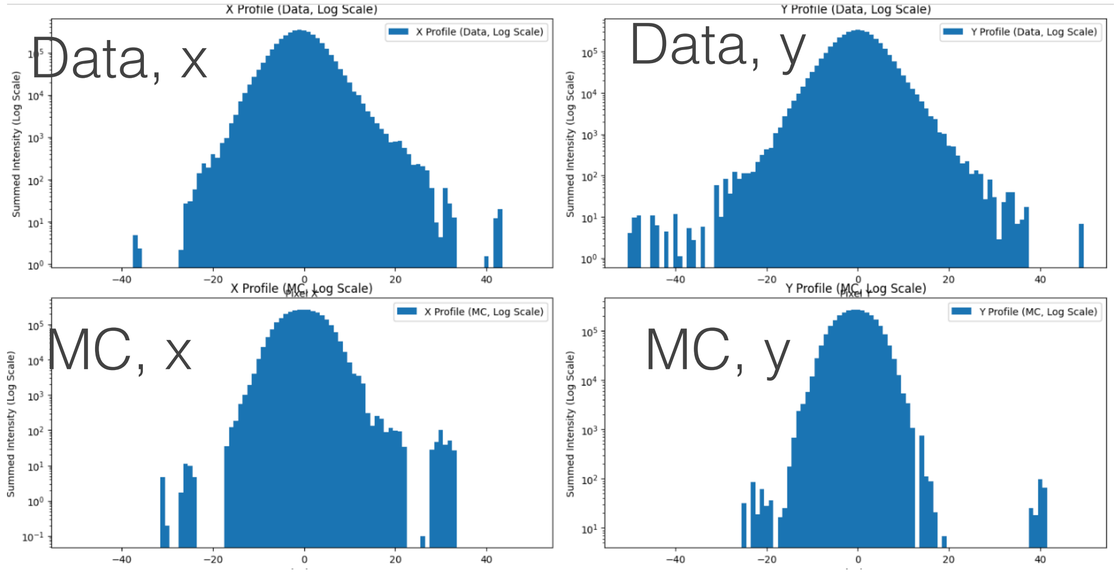
Configuration A: GEM1V = 440 V, z = 465 mm



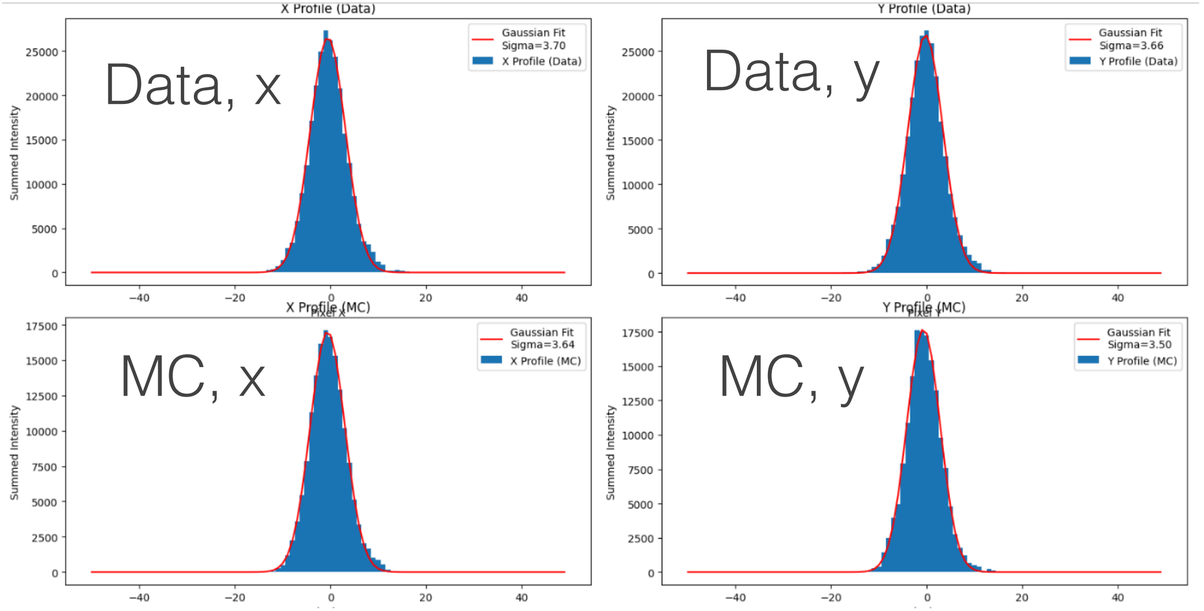


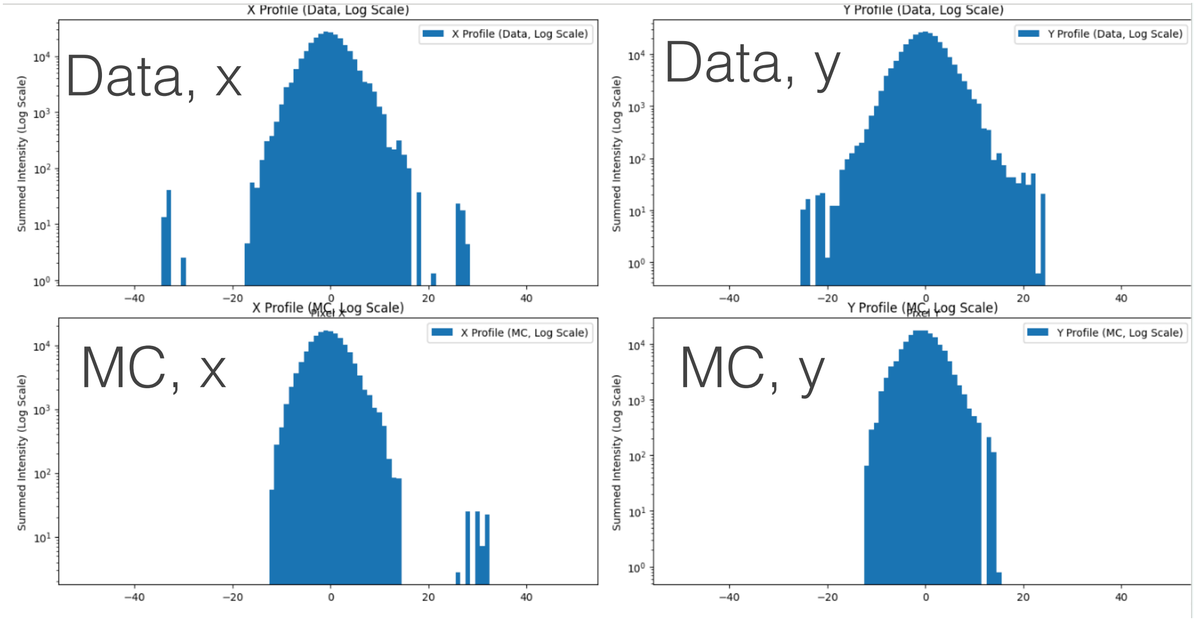
Configuration B: GEM1V = 440 V, z = 50 mm



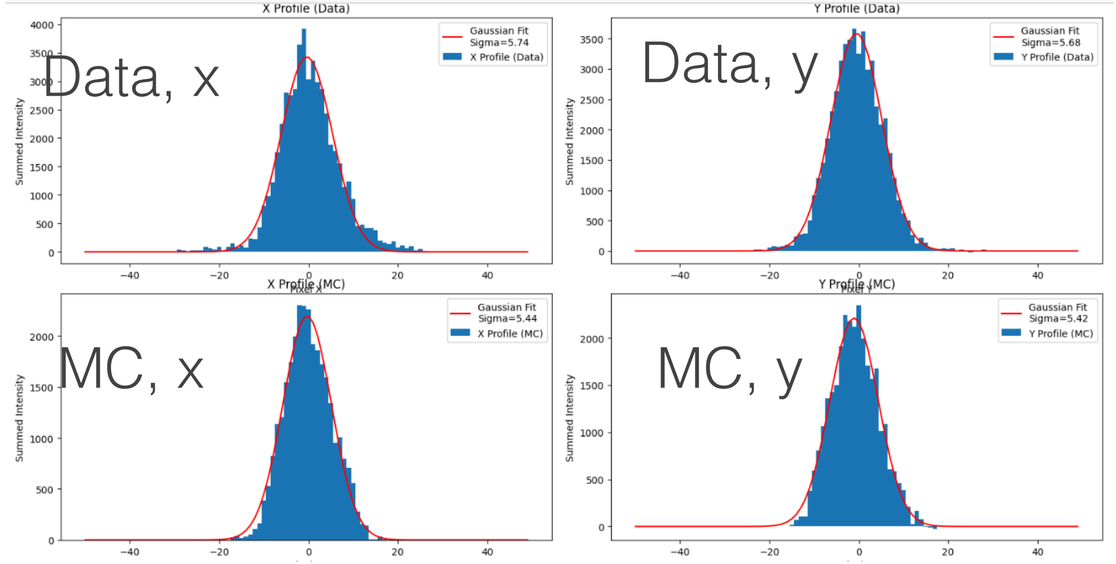


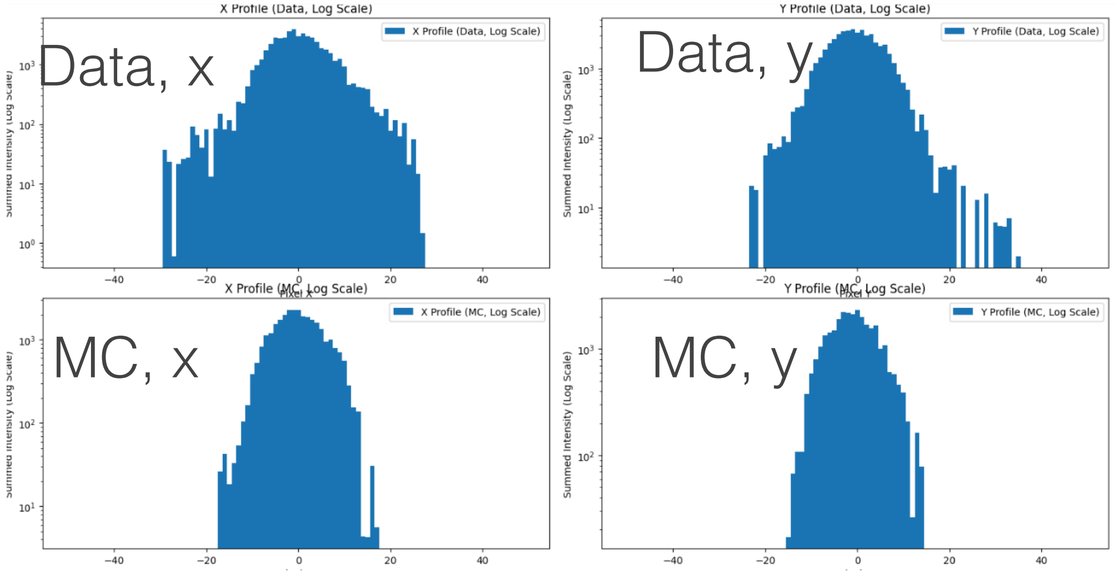
Configuration C: GEM1V = 280 V, z = 50 mm





Configuration D: GEM1V = 280 V, z = 350 mm





Conclusion on the ^{55}Fe spot size

- Except for the tails at very low gain, the digitization is able to well reproduce the spot shapes and sizes;
- In particular, the behaviour of σ in data and simulation are compatible within a 5% without any need of increasing the “physical” σ;
- Experimental data behaviour itself do not indicate a clear dependence of σ on the total amount of charge
- The increase of σ as a function of Isc for the ^{55}Fe spots can (almost completely) be explained as an “reconstruction effect” (inefficient on the spot tails when the light is too small) or distortion of light profiles because of the saturation;
- For highly ionising particles other effects can have a larger contribution;