

Analysis of MC simulations

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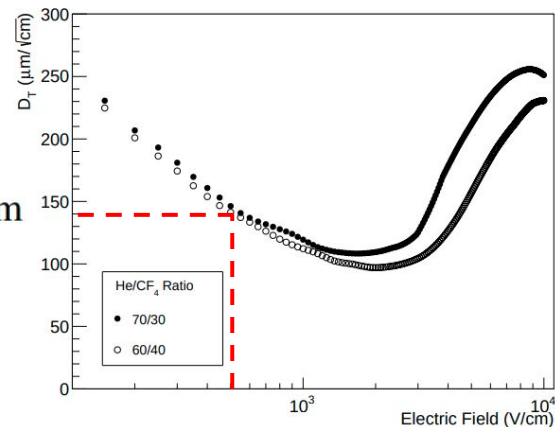
CYGNO simulation meeting 7/12/20

Digitization parameters (LIME)

- Transverse diffusion from <https://arxiv.org/abs/2007.00608> for an electric field of 0.5 kV/cm

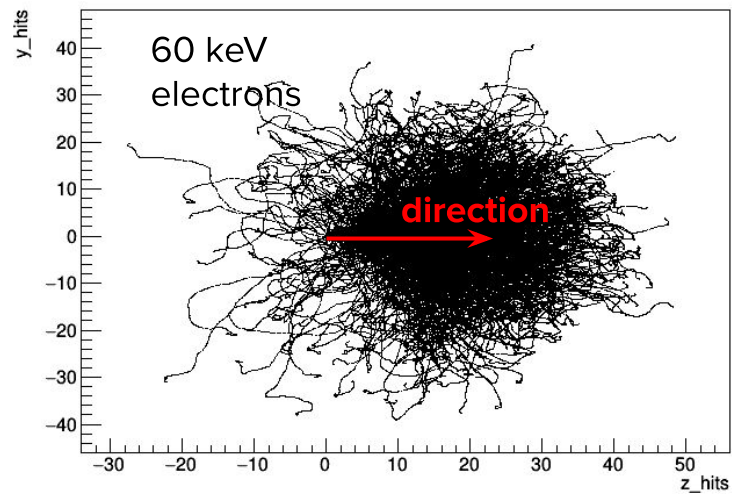
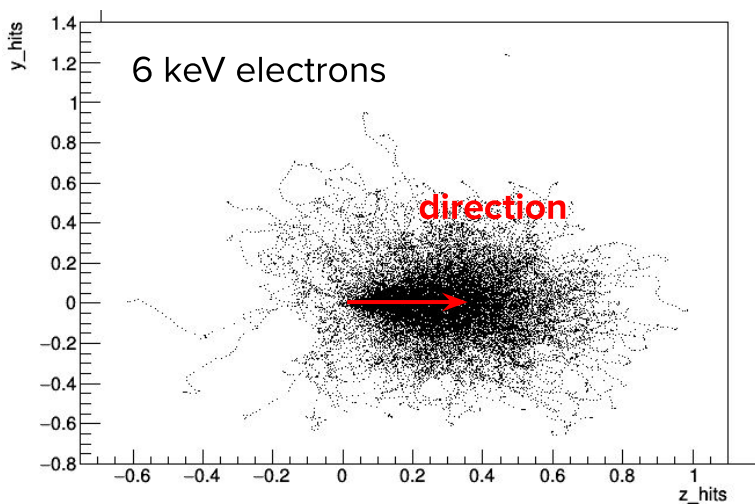
$$\sigma_T = \sqrt{\sigma_{T0}^2 \oplus D_T^2 \cdot z} \quad D_T^{60/40} = 140 \frac{\mu\text{m}}{\sqrt{\text{cm}}} \quad \sigma_{T0}^{60/40} = (280 \pm 60) \mu\text{m}$$

- Active area: 35 cm x 35 cm
- ORCA Fusion:
 - 2304 x 2304 pixels
 - Camera aperture 0.95
 - Sensor size 13.3 mm
- Ionization potential: 46.2 keV
- Single GEM gain: 123
- light yield: 0.07 photons/electrons
- Distance from the GEM: 0, 10, 20, 30, 40, 50 cm

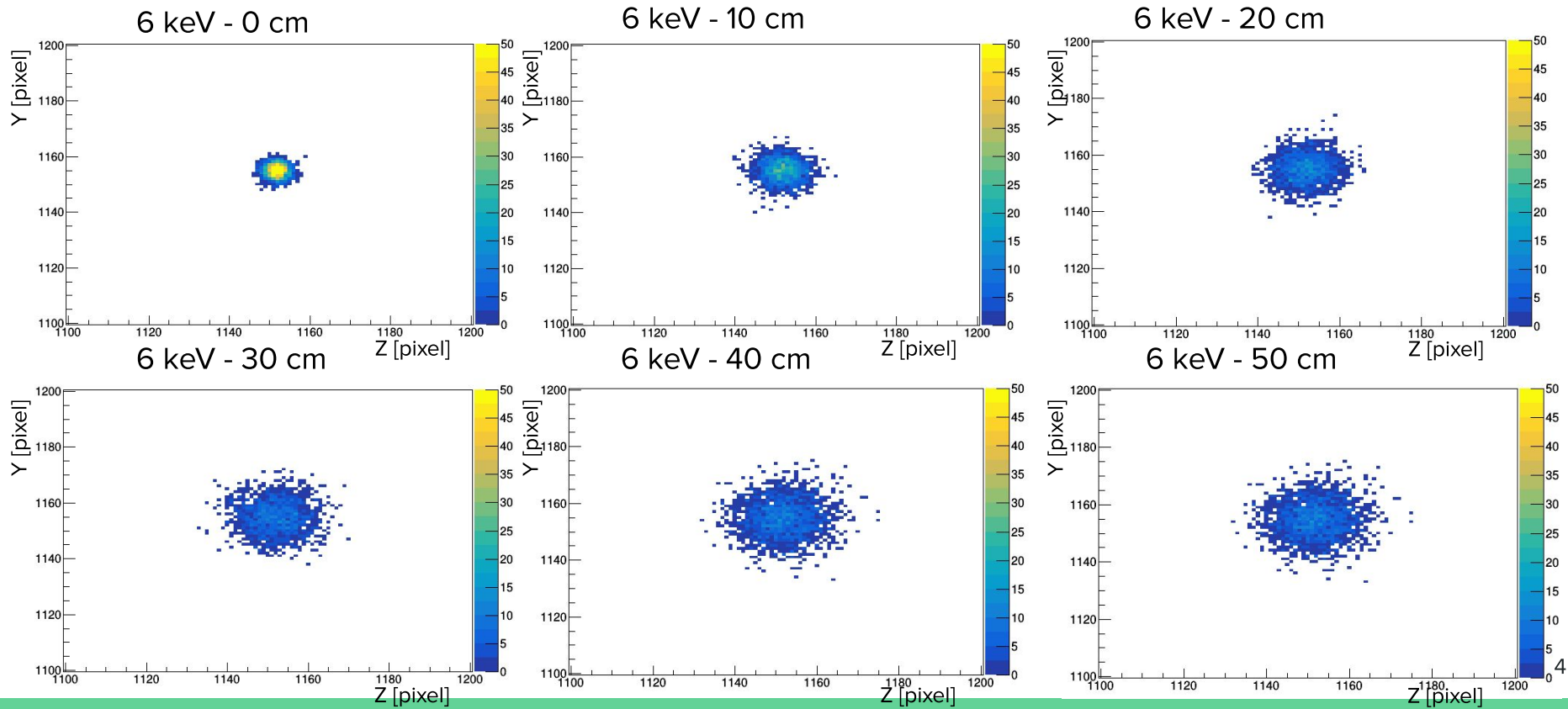


Electron recoil simulation example

- 500 events starting from the center
- Energies 1, 3, 6, 10, 30, 60, 100 keV
- Initial direction (0,0,01)
- GEM plane Z-Y, drift axis X

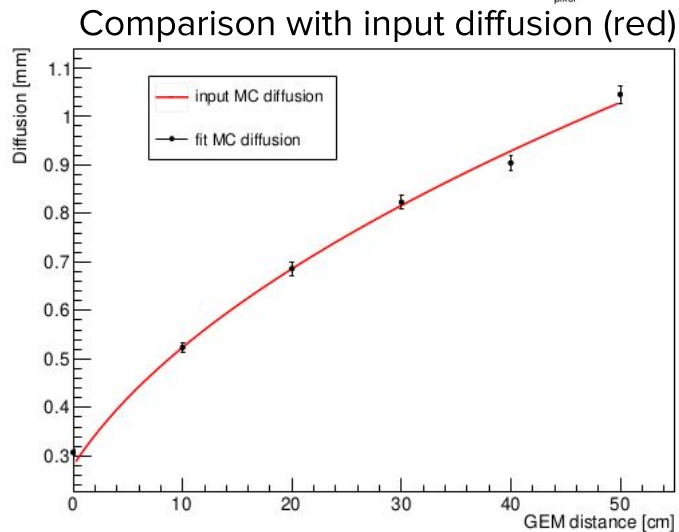
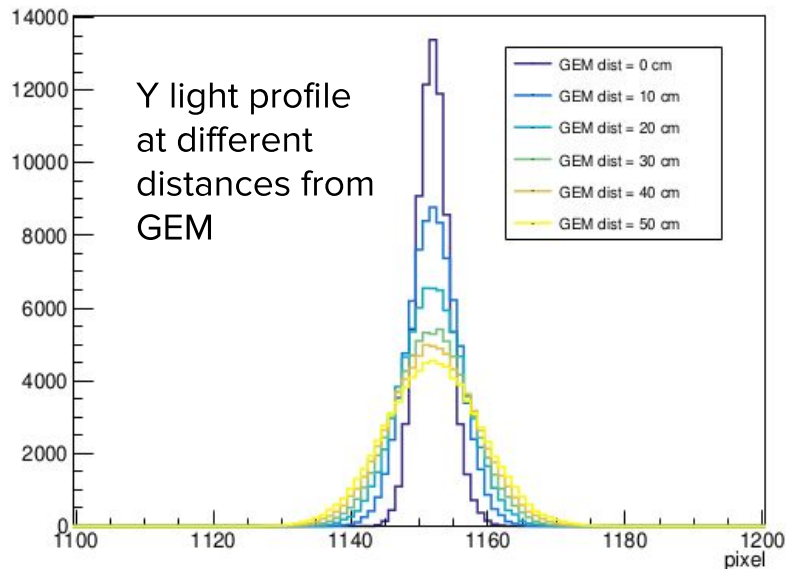
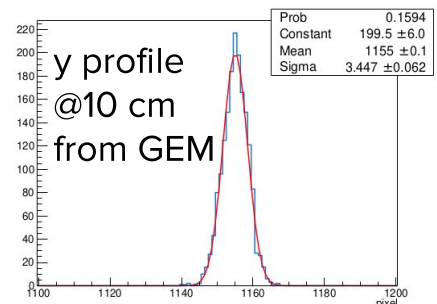


Digitization ER of 6 keV (no camera noise)



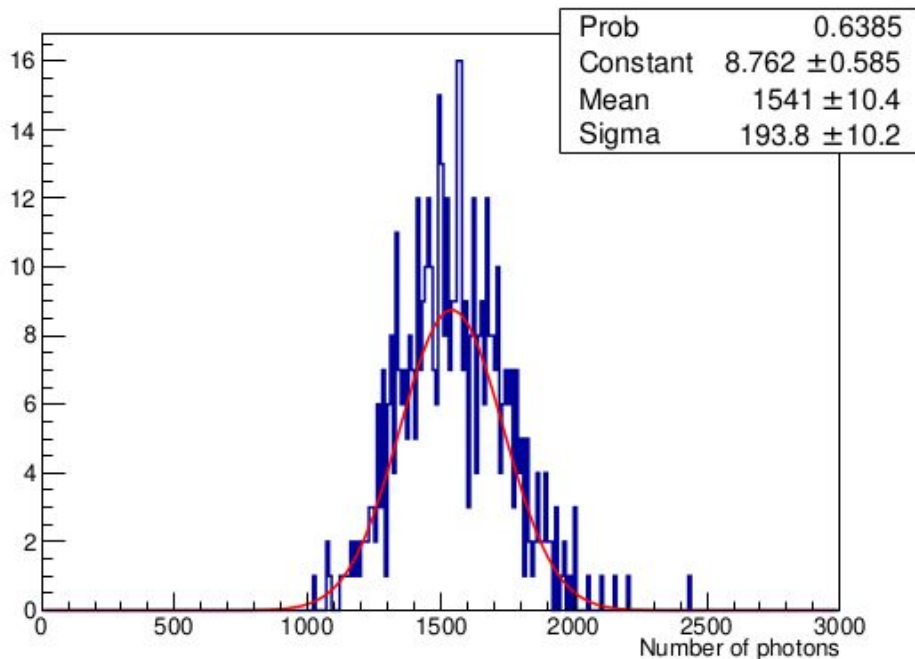
Closure test diffusion (no background)

- 6 keV ER at different distance from the GEM
- Start from the center, direction (0,0,1)
- GEM plane Z-Y, drift axis X

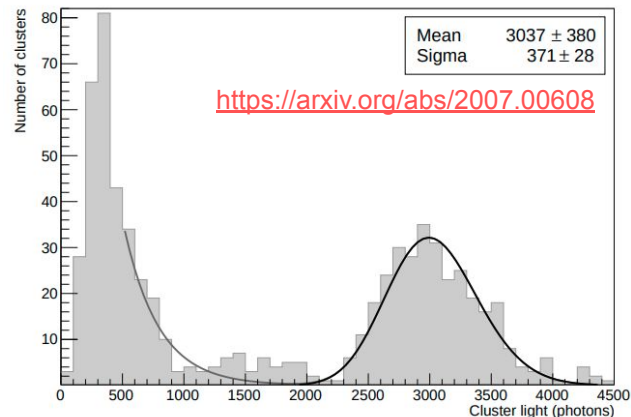


Energy resolution (no background)

Number of photons is proportional to energy

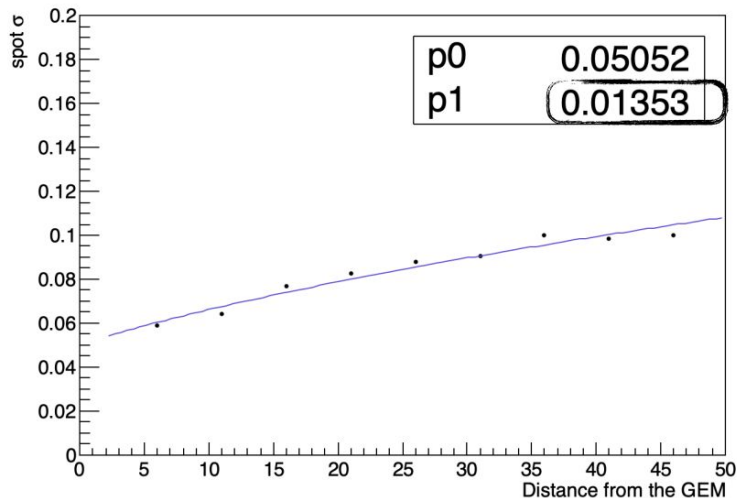


- Using 6 keV ER at 0 cm from the GEM
- No background
- mean 1541 photons
(~ 0.5 of LEMON light yield on data)
- $\sigma_{N/N} = 0.125$
→ energy resolution 12.5%



Digitized MC with noise

- Use diffusion parameters for 930 V drift field
→ same of LIME dataset
- noise data from run 3944 (10 ms exposure)
(3797 pedestal run probably had some external light)

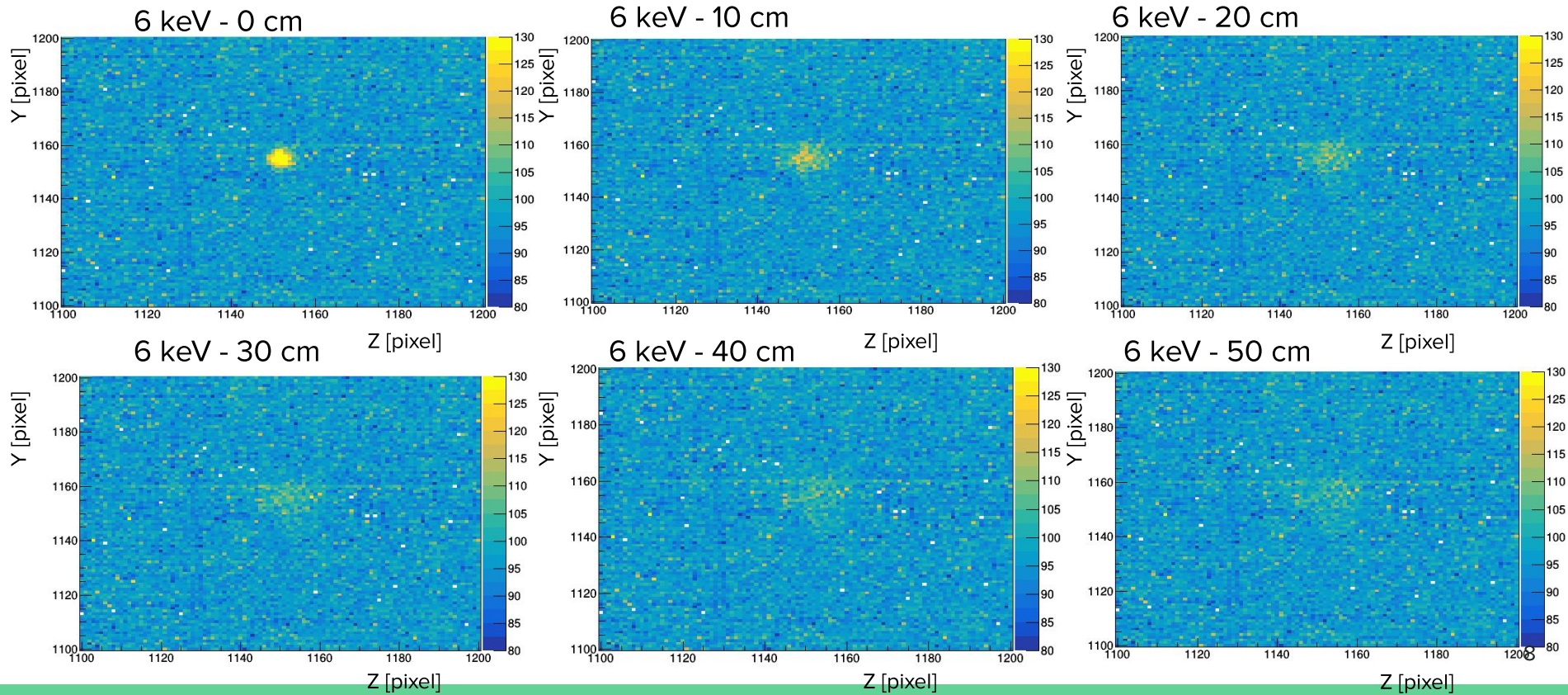


From recent analysis of ^{55}Fe data with LIME (Davide's presentation at the last analysis meeting)

https://agenda.infn.it/event/24936/contributions/126154/attachments/77455/99852/55_Fe_Lime.pdf

Digitized ER 6 keV with camera noise

Use background images from run 3944



Reconstruction test

Version of the reconstruction code used:

Commits on Dec 3, 2020

Merge pull request #133 from emanueledimarco/lime_2020



emanueledimarco committed 3 days ago

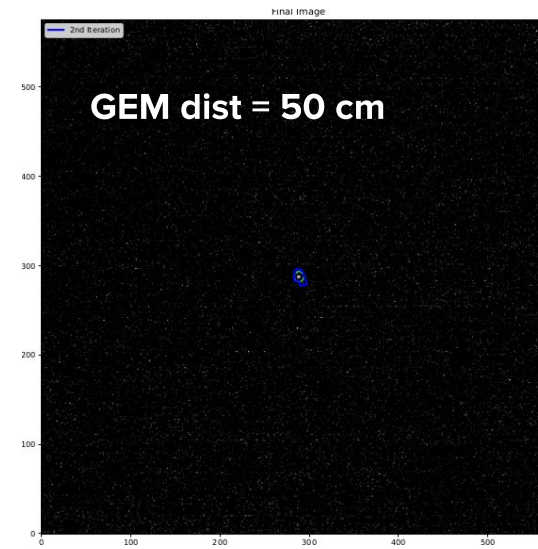
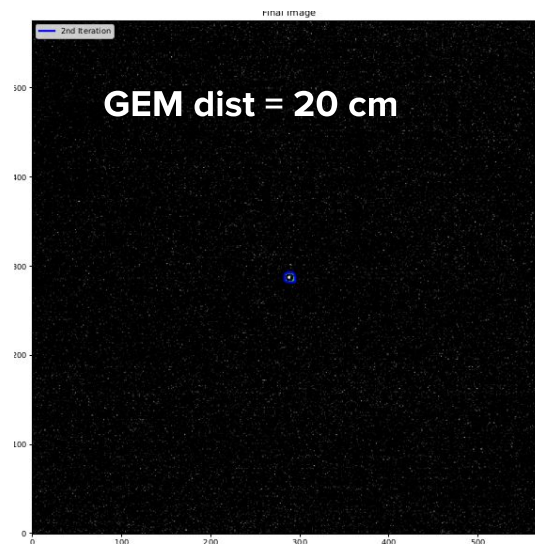
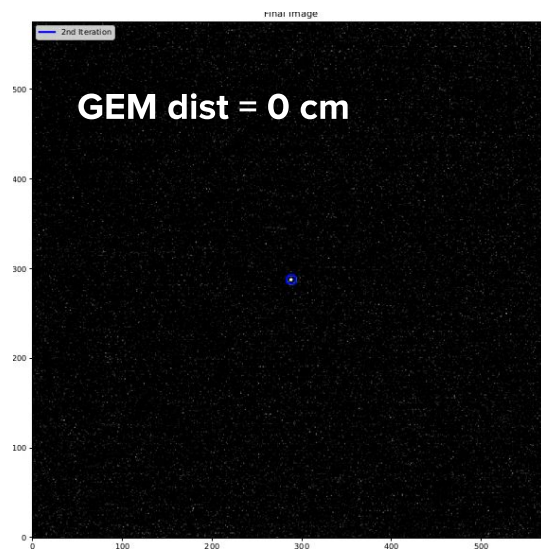
Verified



934dc7c



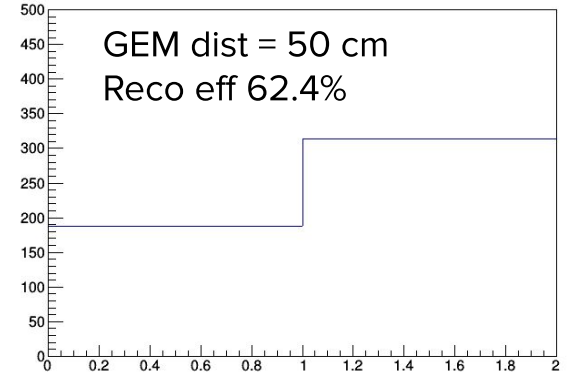
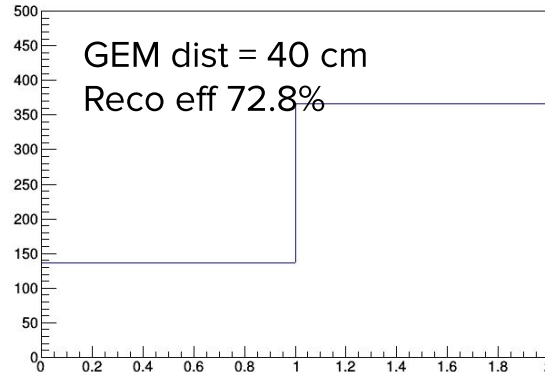
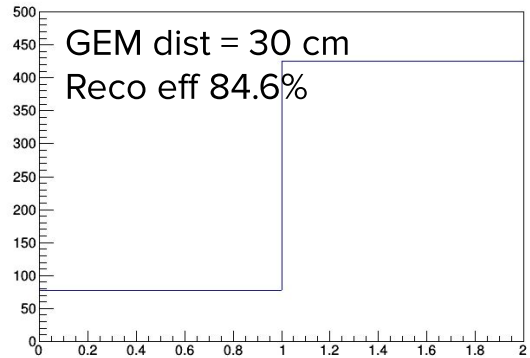
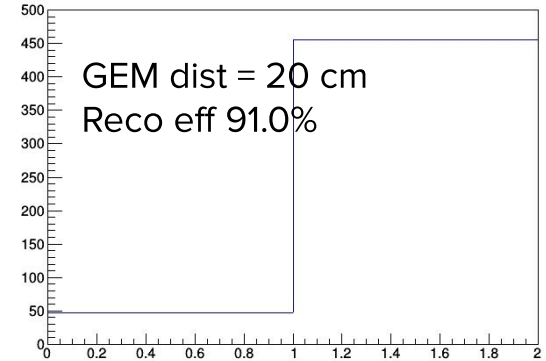
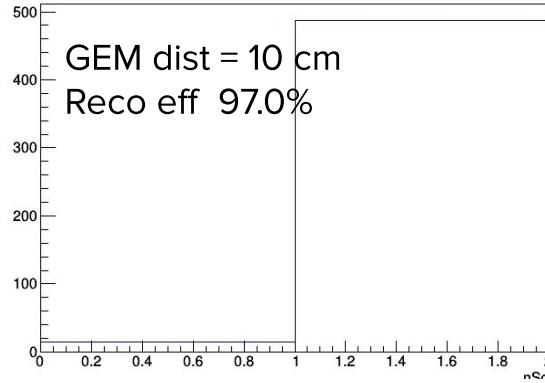
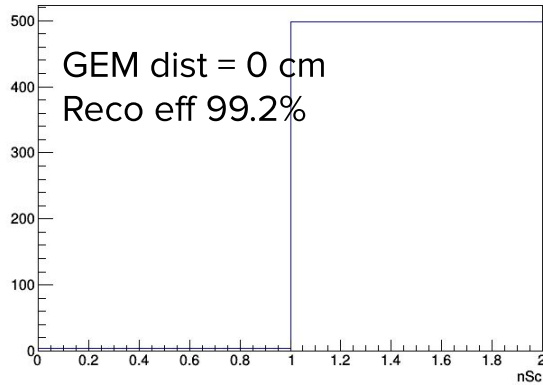
Example clusters



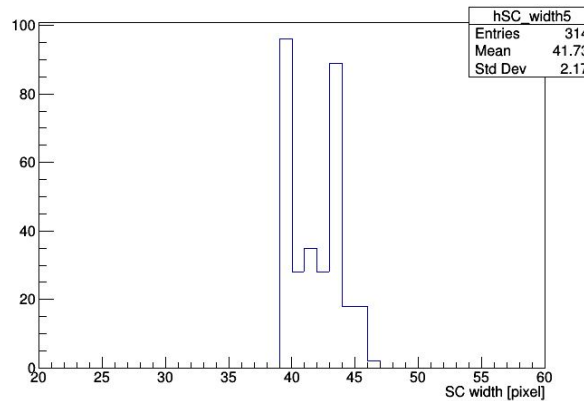
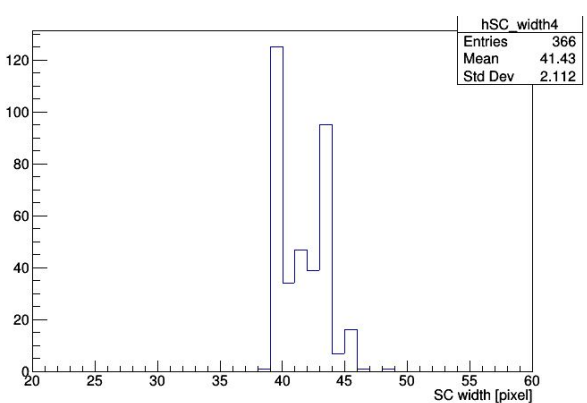
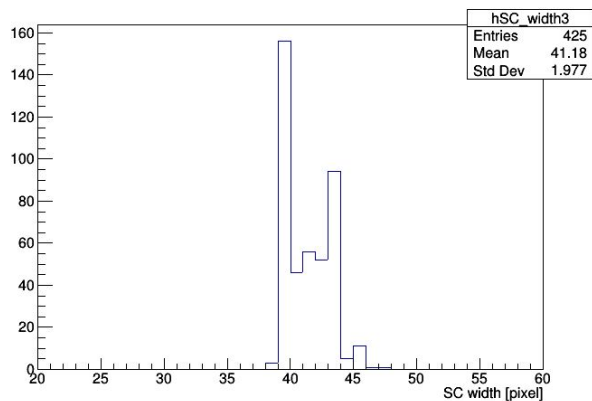
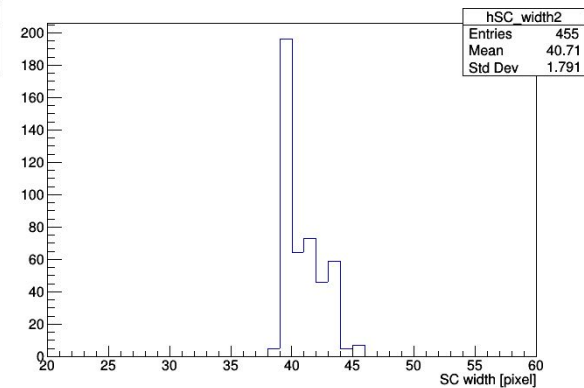
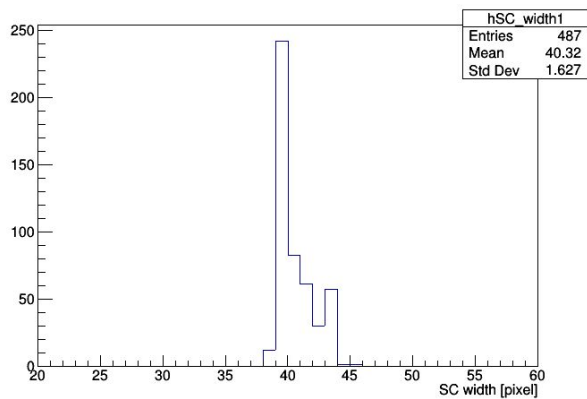
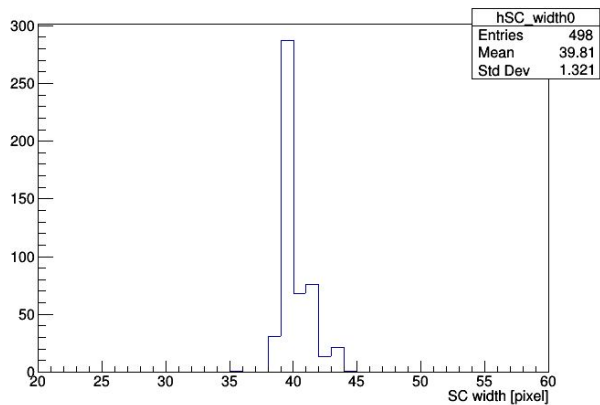
Reconstructed superclusters

1 ER per image → expected 1 reconstructed supercluster

Never reconstructed >1 supercluster, sometimes 0 sc found



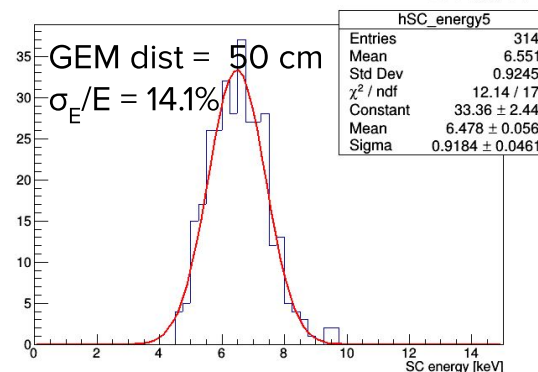
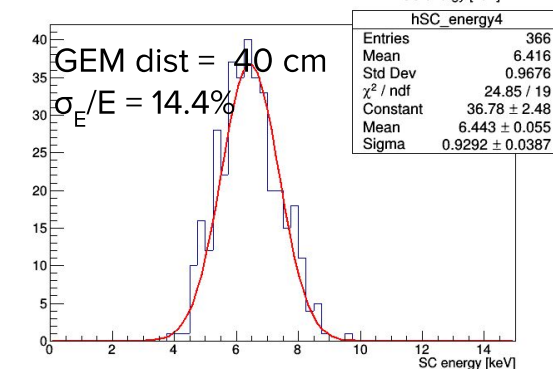
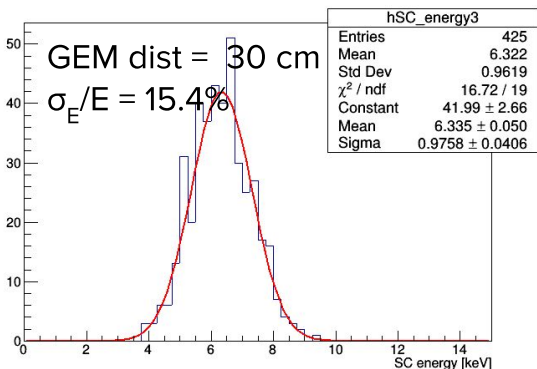
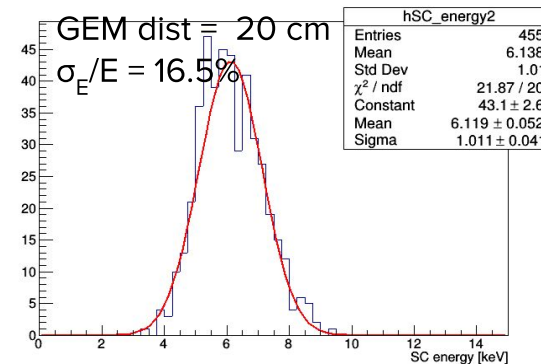
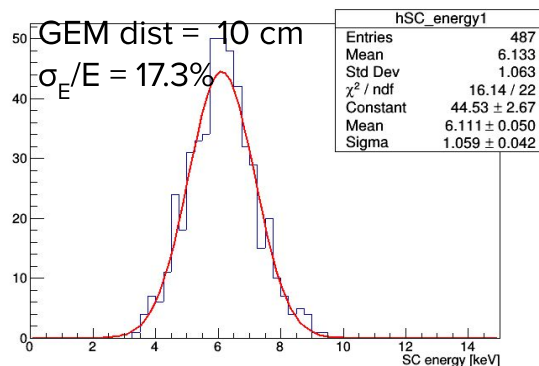
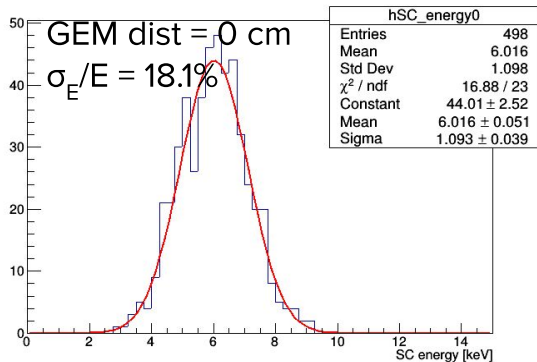
Reconstructed spot width



Reconstructed SC energy

“Manual” calibration: 1544 photons \rightarrow 6 keV

Calibration implemented in the code reconstructs an energy of 2.2 keV (to be checked)



Summary and conclusions

- Preliminary analysis gives results similar to data
- Extensive comparison still to be done
- Clusterization efficiency is 99 for spots near the GEM, goes down to 62% for spots at 50 cm from the GEM
- Energy resolution at 6 keV from MC \sim 14-18%
- Reconstructed width \sim 40 pixel \rightarrow 6 mm (seems too much..?)

To do:

- Cross check the analysis of MC with ^{55}Fe data analysis in LIME
- Prepare MC samples of ER and NR for the Data Analysis Olimpiad

<https://idao.world/>