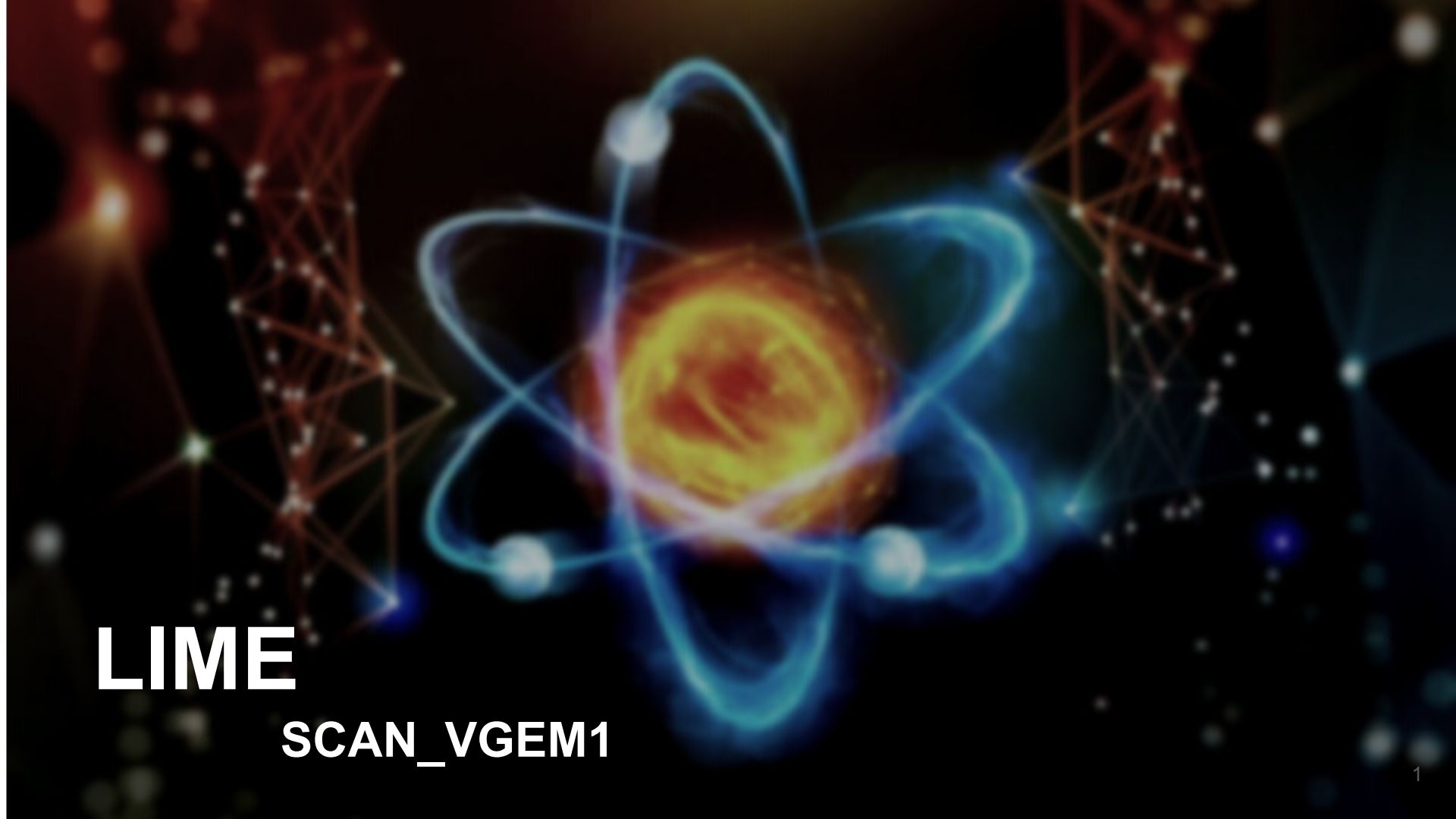


LIME

SCAN_VGEM1

- The goal of this analysis is to study how LIME can detect particles with energies lower than the energy of photons emitted by source 55Fe

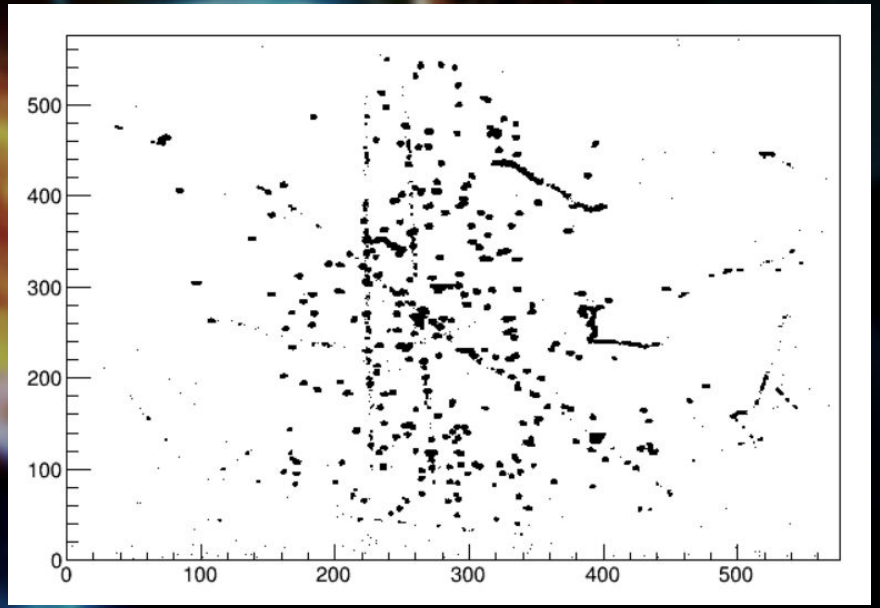
- We took data putting the source 55Fe at a given distance from GEM
- We chose a range from 6.5 cm to 46 cm with a step of 5 cm
- Then, we did a scan of voltage applied to the GEM1 for each z of source
- The different voltages applied were: 440V, 431V, 406V, 386V, 350V, 320V
- From the following relation $G = 0.0303\ e^{(0.0189*V)}$ we estimated the gain for every voltage and we associated with each gain an energy that is a fraction of 6 keV (photons energy)

- We have analyzed following runs with the source at a distance of 21 cm:

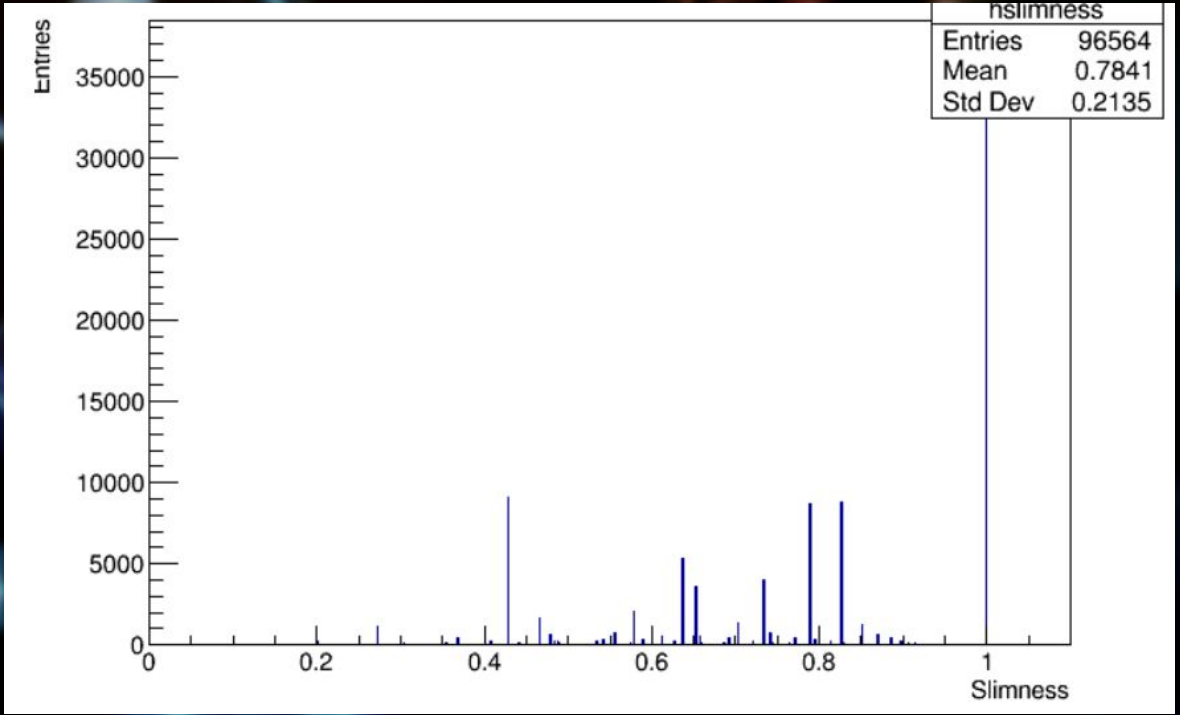
  - run 4160 → Vgem1 = 440V→ G/G_440 = 1
  - run 4161 → Vgem1 = 431V→ G/G_440 = 0.844
  - run 4162 → Vgem1 = 420V→ G/G_440 = 0.685
  - run 4163 → Vgem1 = 406V→ G/G_440 = 0.526
  - run 4164 → Vgem1 = 386V→ G/G_440 = 0.360
  - run 4165 → Vgem1 = 350V→ G/G_440 = 0.103

- For run 4166 with Vgem1 = 320V we are developing a dedicated analysis due to the very low gain

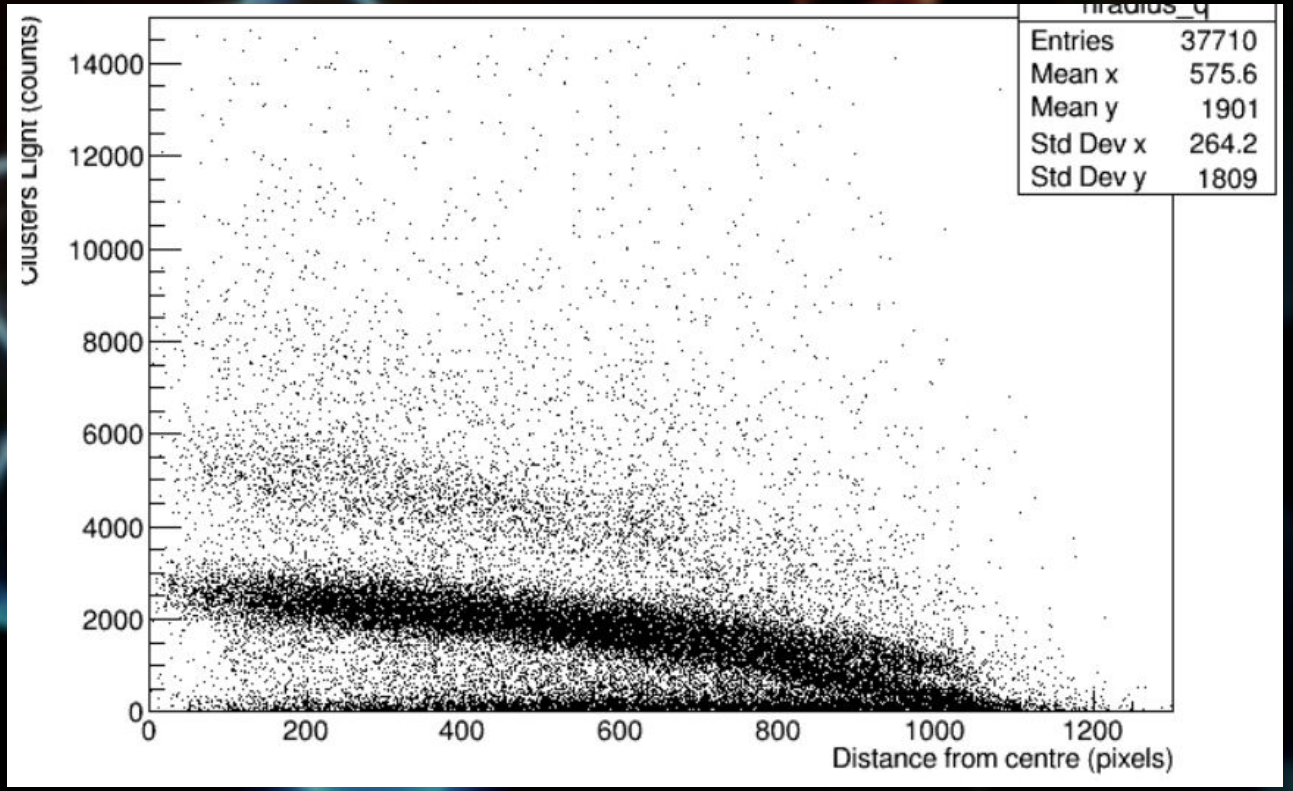
- We acquired 200 images for each run
- First, we counted the number of clusters for each image with a clustering software
- To estimate the number of clusters for each image we chose a threshold of counts
- We couldn't analyze the last run because of threshold we chose
- Then, we used an other software to select clusters for the analysis
- The first cut we did to analyze clusters was to pick out those ones with an almost circular shape



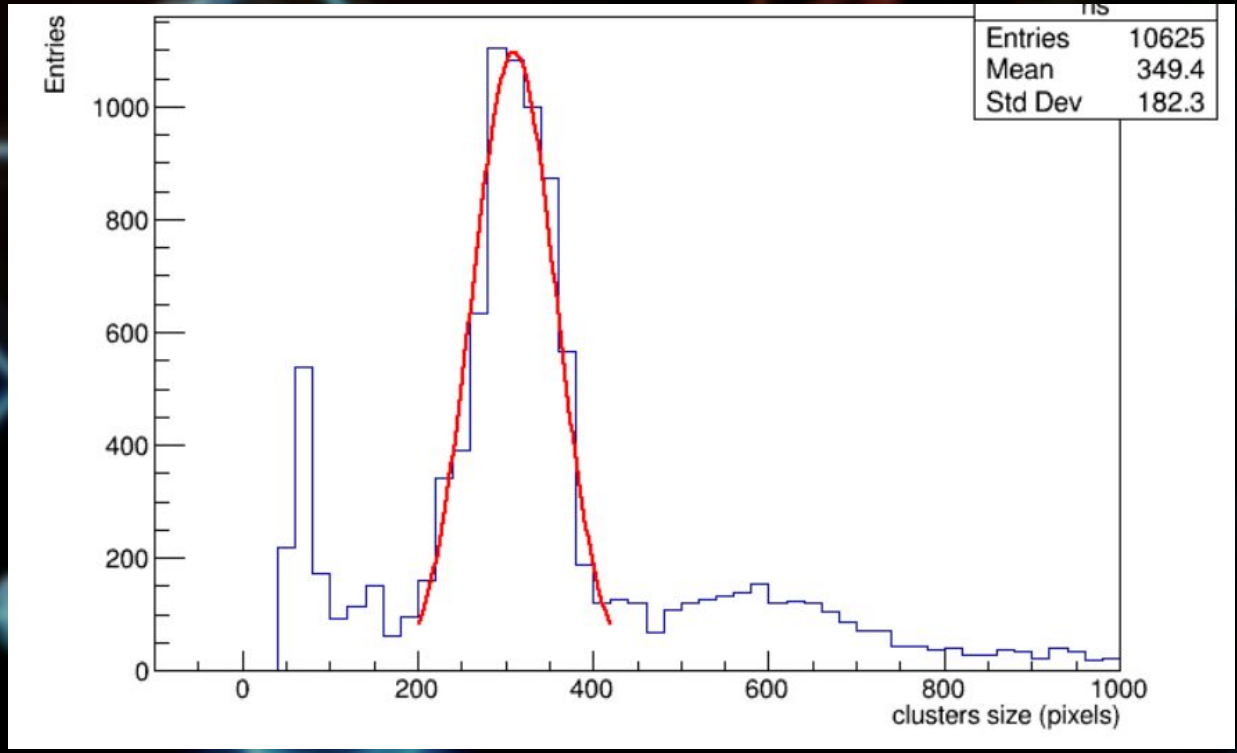
- To select clusters with a given shape we studied the distribution of clusters slimness
- The slimness is ΔX/ΔY
- The clusters with a slimness between 0.6 and 1 are selected



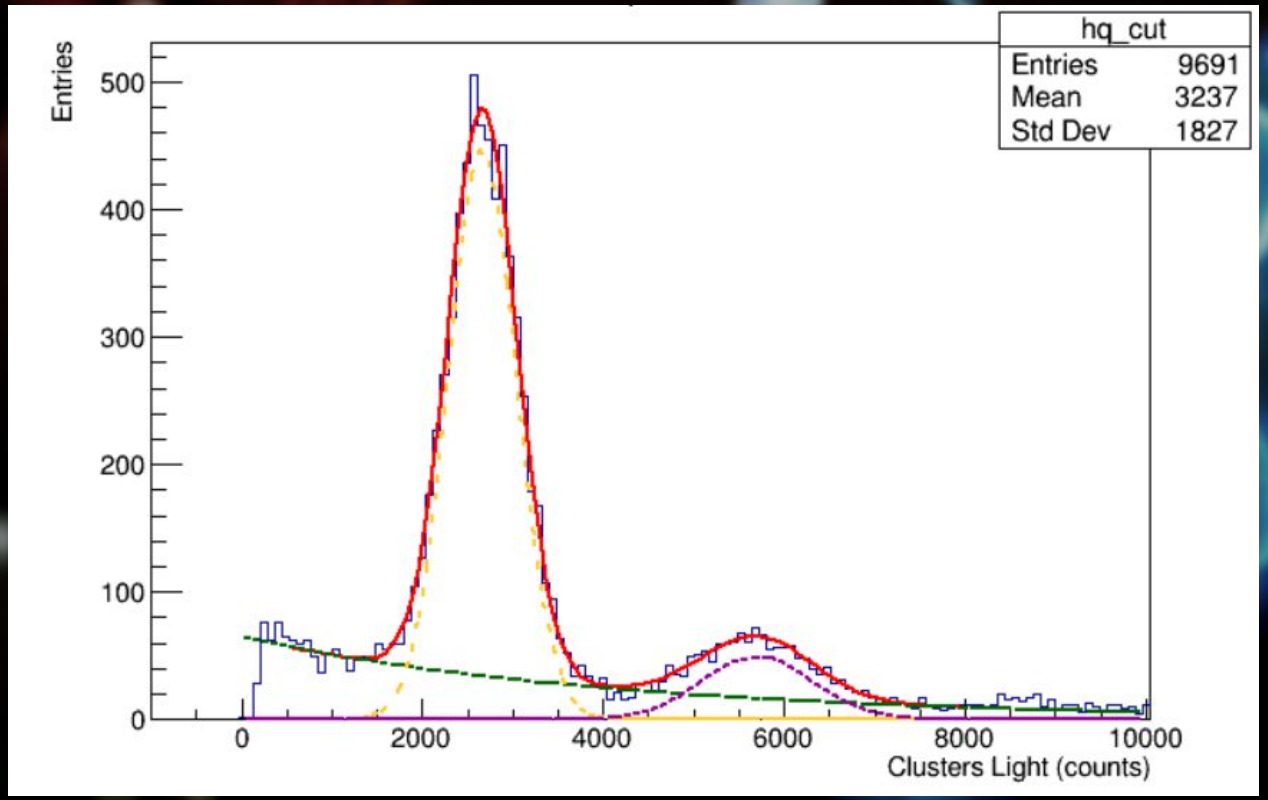
- Then, we studied the behavior of clusters light as a function of the distance from centre
- By looking at the plot, we cut where the trend of light was constant
- Clusters with a radius less than 400 pixels are considered



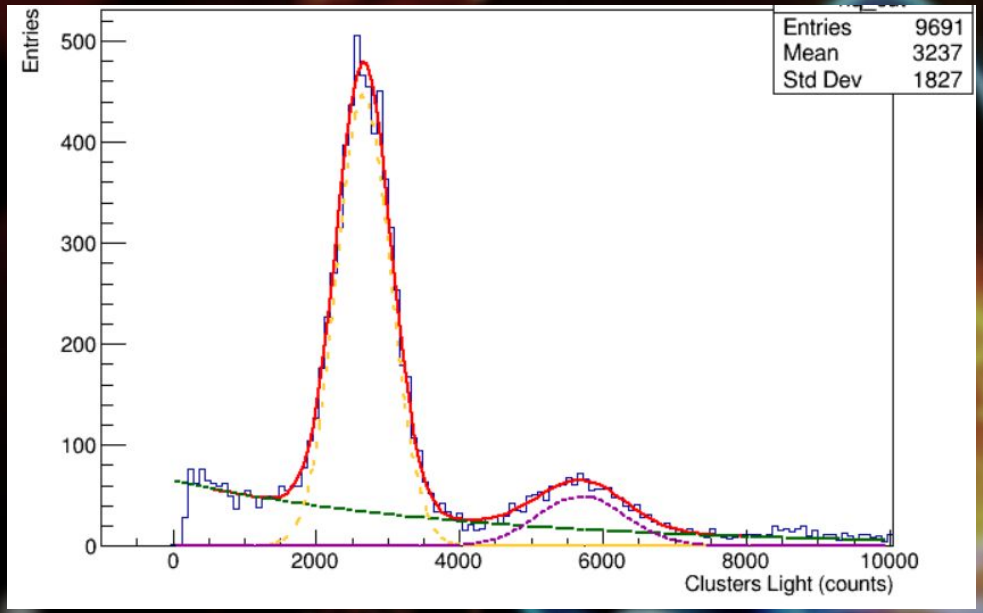
- Finally, we studied the distribution of clusters size
- Clusters size is the number of pixels in the clusters
- Clusters with a size bigger than 100 pixels are analyzed



- **Clusters light distribution**



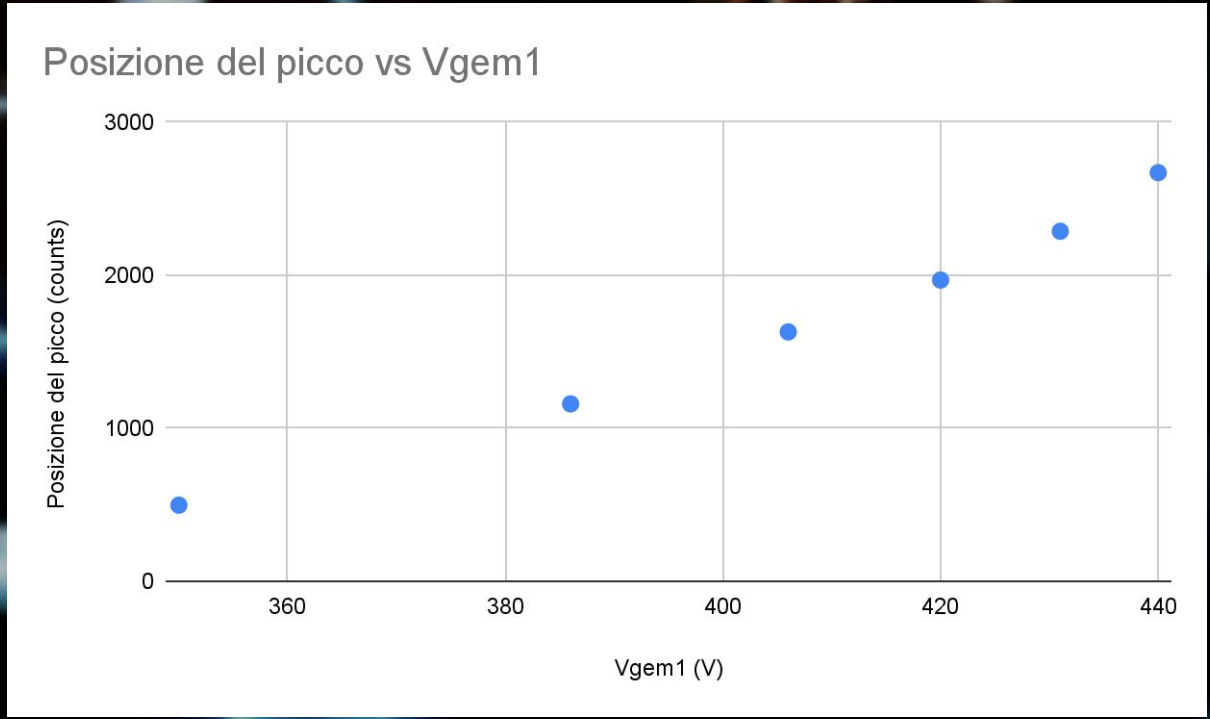
- **The plot on the left shows two peaks: the first peak on the left corresponds to a single spot, while the second one corresponds to two spots not well separated**



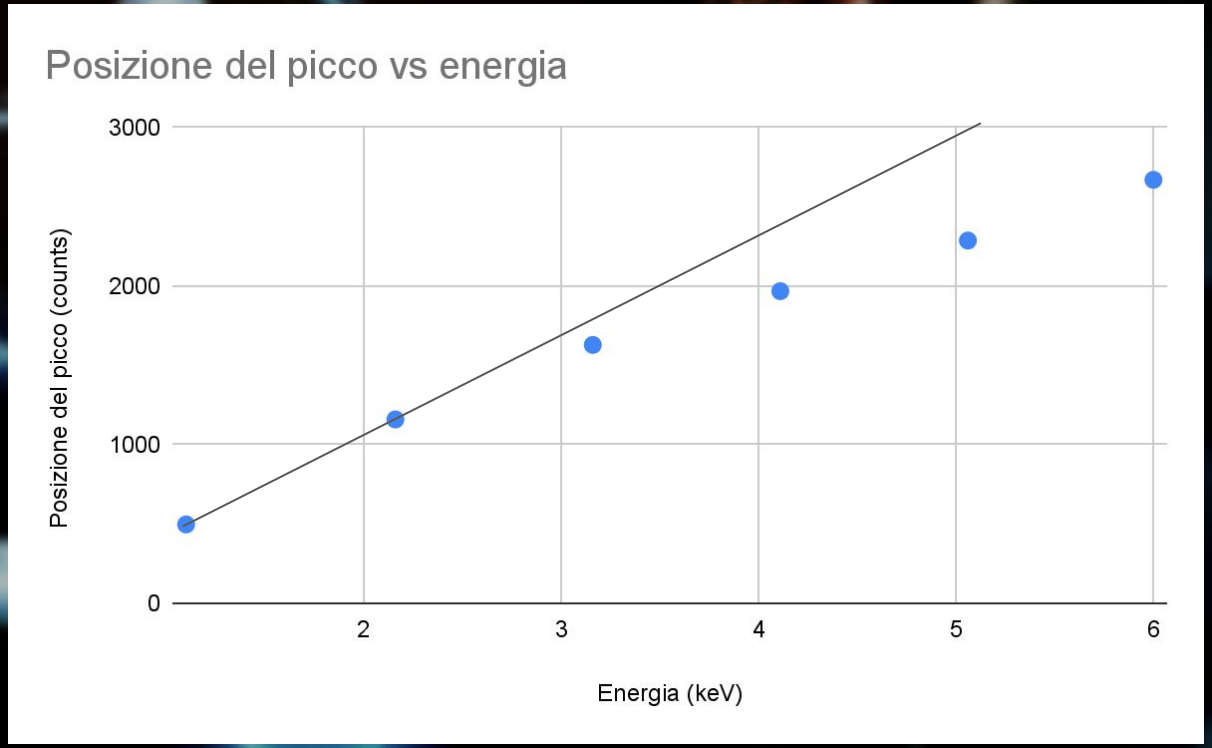
- We used a fit to study clusters light distribution
- The fit is the sum of three functions: an exponential function and two gaussian functions
- At first, we set the mean of second gaussian function equal to twice the mean of first gaussian function, but we got a positive offset
- Then, we set parameters of two gaussian functions independent each others and we fix offset at 0

- After studying light distribution, we saw the behavior of size, number of spots, number of photons, and energy resolution as a function of voltage applied to GEM1

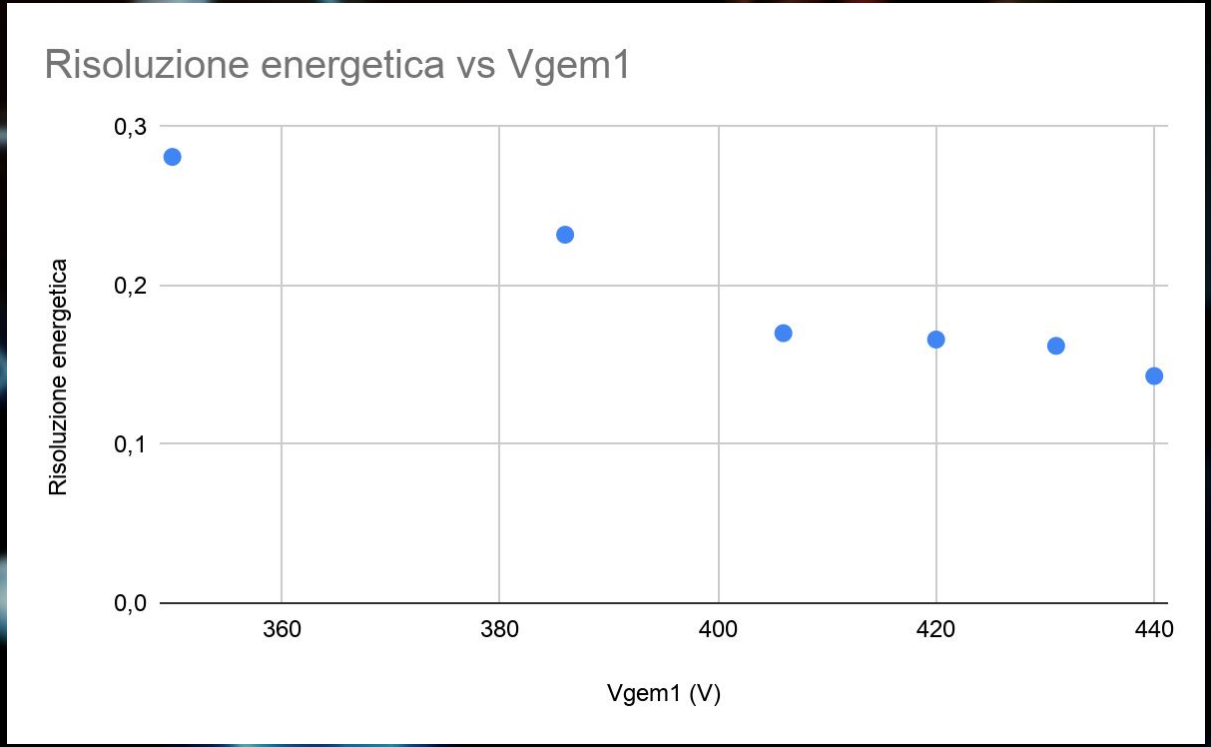
- **As the voltage increases, the number of photons increases**



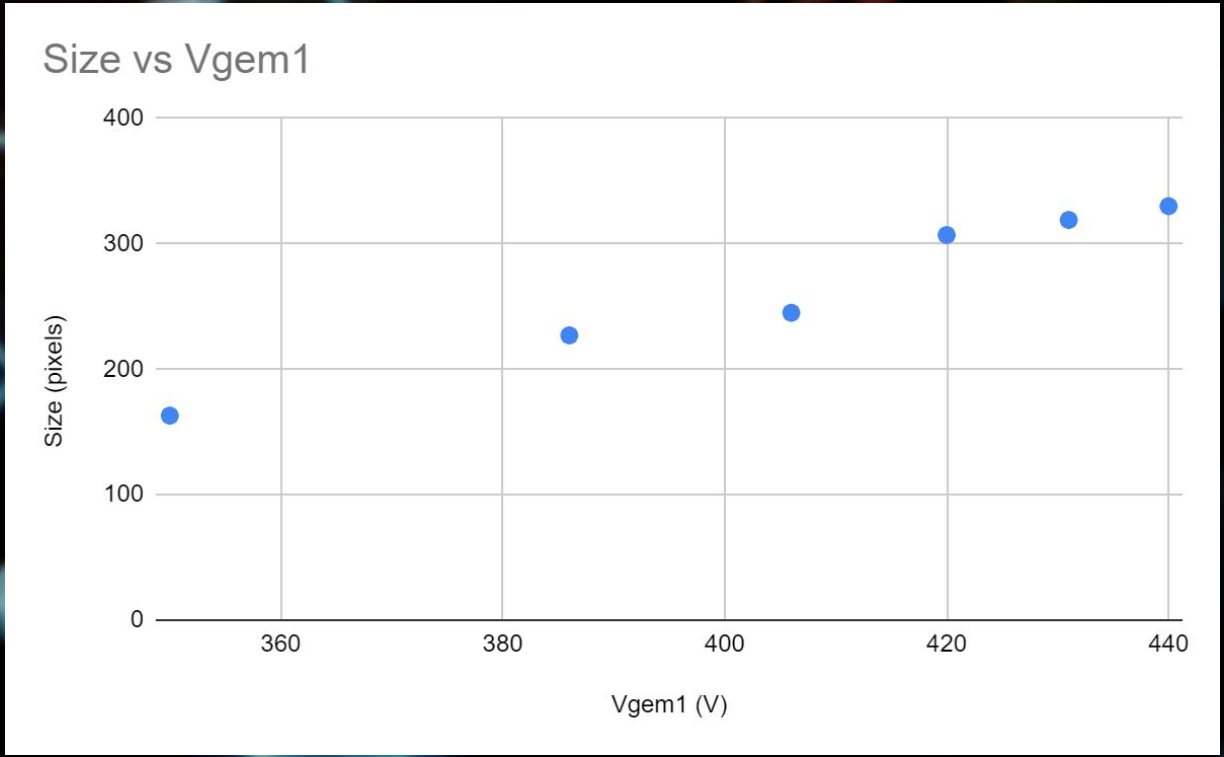
- **Looking the plot we can see the behavior of the number of photons as a function of the energy associated with each voltage**



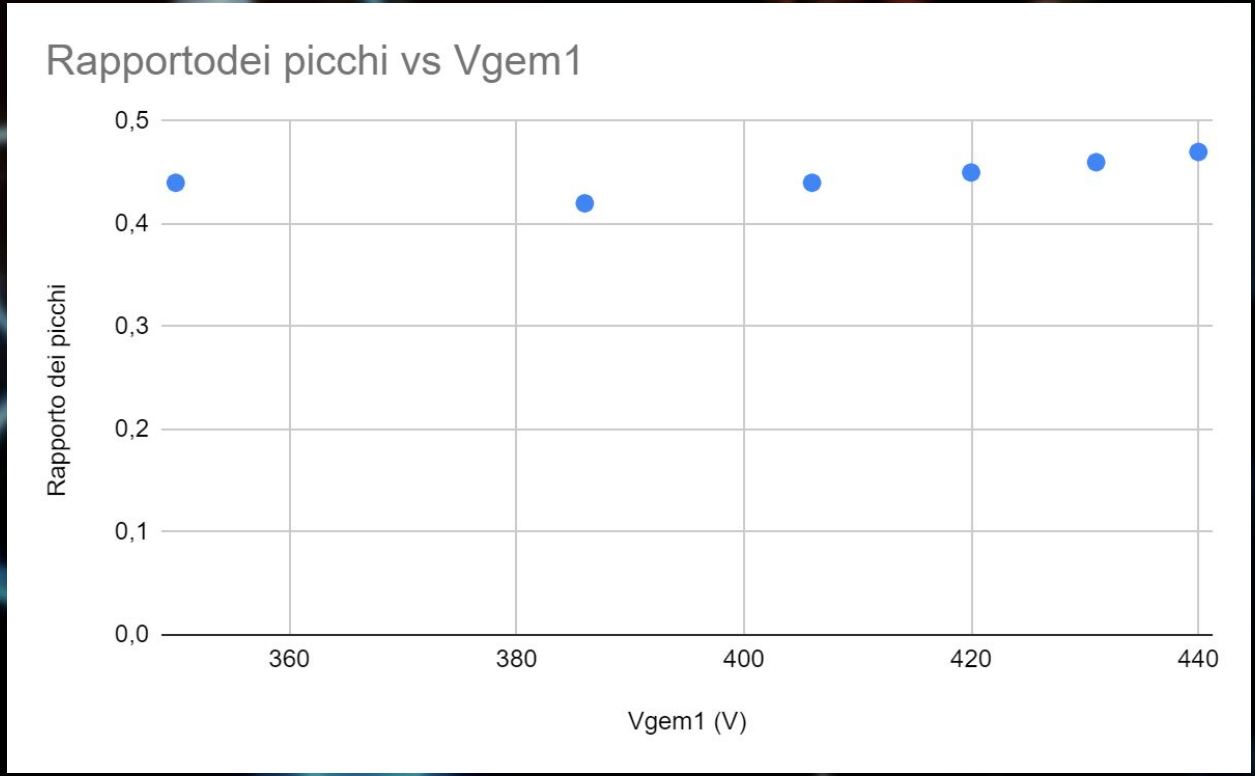
- We estimated the energy resolution as the ratio between the sigma of first peak and the mean of first peak
- We can see that the energy resolution decreases with Vgem1



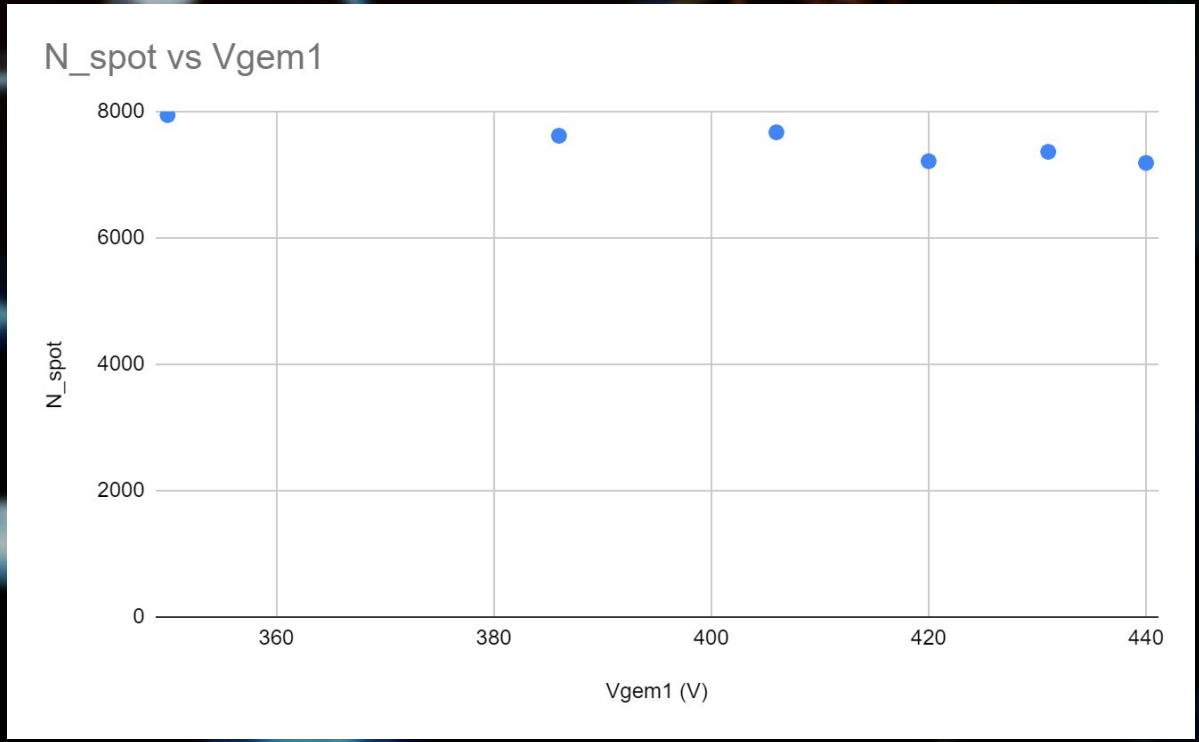
- The plot on the right shows the clusters size trend as a function of Vgem1
- At high voltage the number of pixels in the clusters increases



- **If we estimate the ratio of two peaks, we can see that this amount is almost constant with Vgem1**

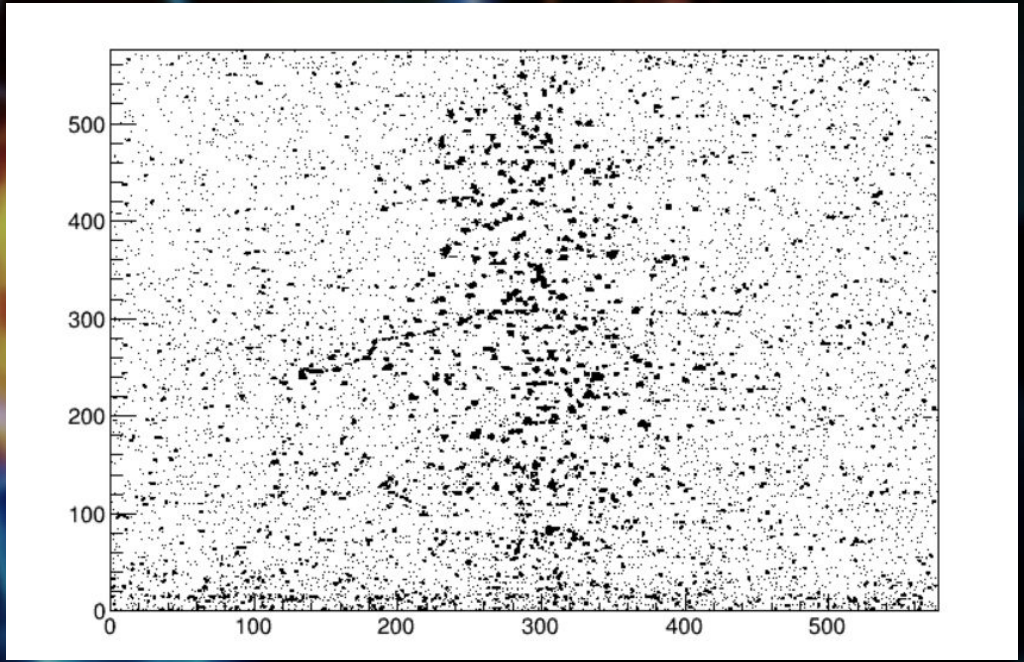


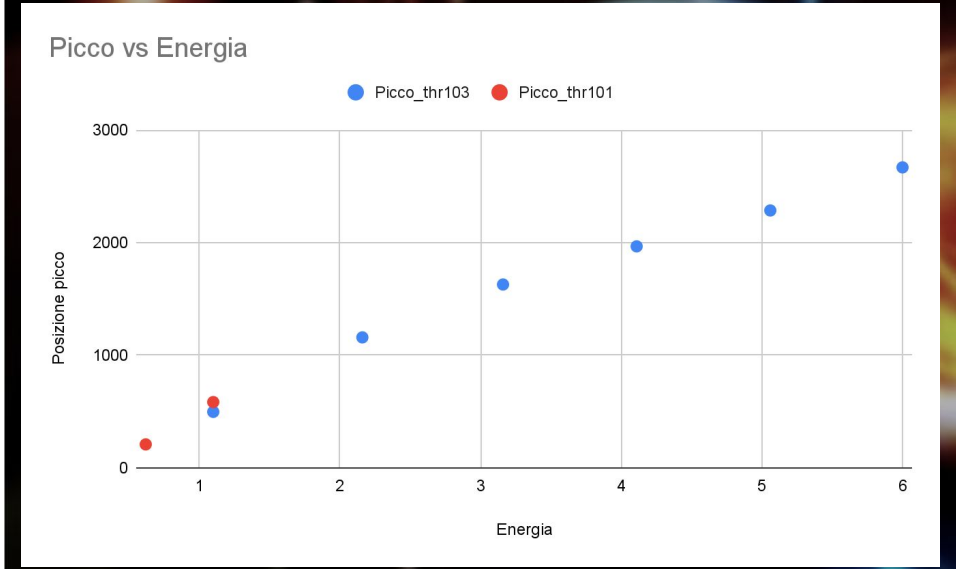
- Finally, we can see the behavior of the number of spots as a function of Vgem1
- The number of spots is estimated by doing integral of two peaks

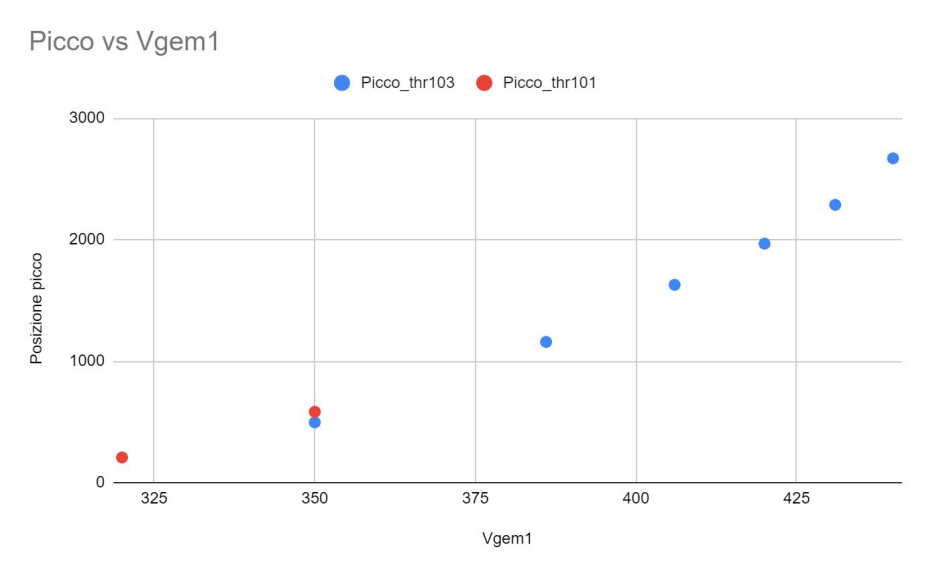


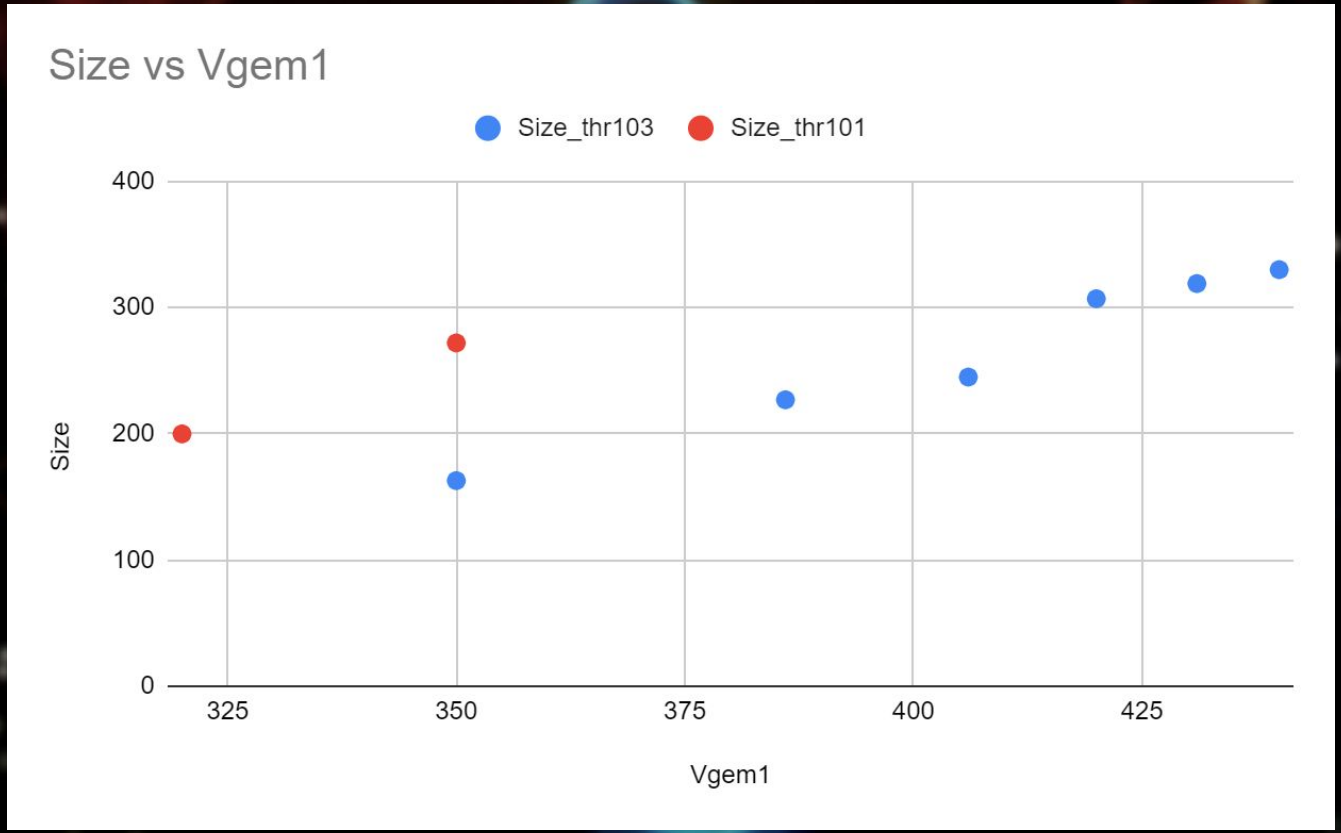
- We chose a lower threshold to analyze run at 320V

- This new threshold value lets us to increase the statistics, but at the same time the probability to find ghost clusters increases too

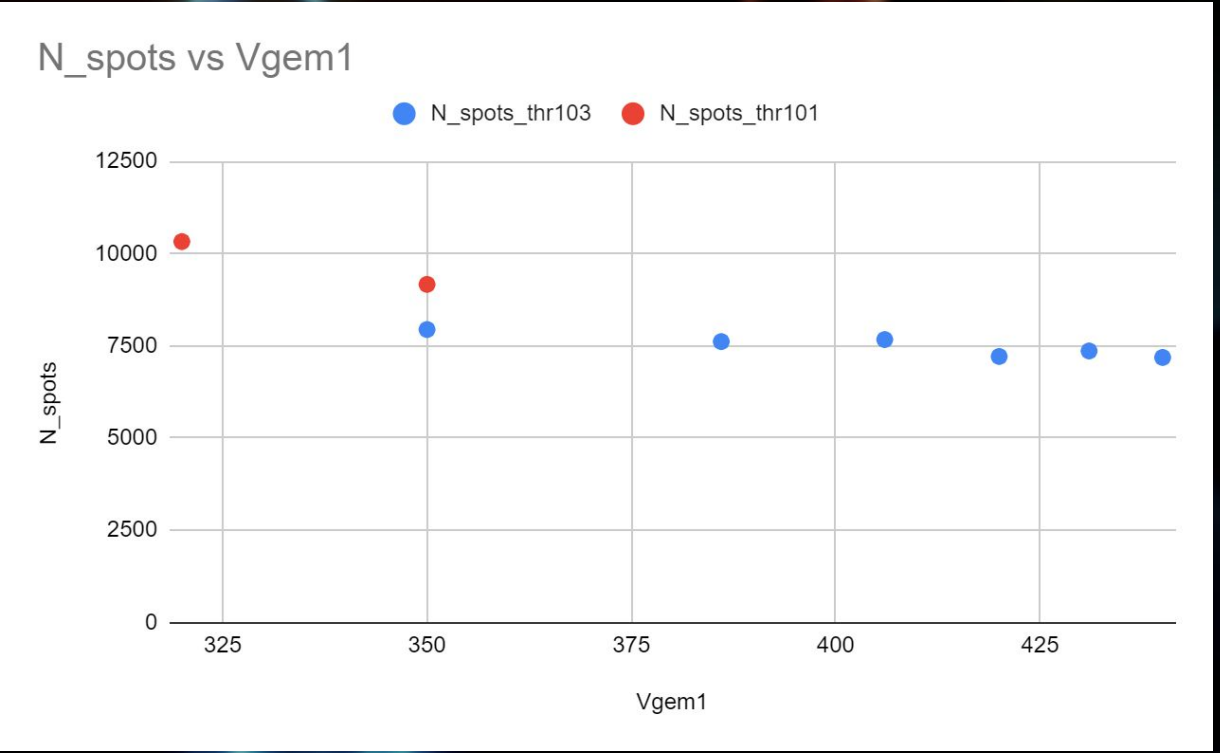



Picco vs Energia
Picco_thr103
Picco_thr101
3000
2000
1000
0
Posizione picco
1
2
3
4
5
6
Energia


Picco vs Vgem1
Picco_thr103
Picco_thr101
3000
2000
1000
0
Posizione picco
325
350
375
400
425
Vgem1


Size vs Vgem1
Size_thr103
Size_thr101
400
300
200
100
0
Size
325
350
375
400
425
Vgem1

- As we can see the number of spots increases for the run with a lower threshold
- We think that this is because of we are counting the noise
- To study and properly subtract this noise we are counting, we are going to compare signal and background



- Because of we didn’t take a run without source, the background is given by studying light distribution in the edges of the image
- For this reason, we are going to correct the vignetting by studying the clusters light as a function of the distance from centre
- Then, we are fitting it and we are going to be able to compare signal and background


THANKS FOR YOUR ATTENTION

- We studied the distribution of the fake light density to estimate the offset
- The fake light density is defined as the ratio of fake light and the number of pixels in the clusters
- The fake light is estimated by counting pixels in random points in the image