LIME-55Fe

Z-Scan

- First of all, we took run at 440V for different positions of source of 55Fe, that is for different z
- We analyzed 200 images for each run and we counted the number of clusters in every image with a clustering software
- To select the clusters for the analysis we used an other software and we did several cuts
- The first cut we did to analyze the clusters was to pick out those ones with an almost circular shape
- For this reason we selected clusters with a slimness between 0.6 and 1
- Then, we have chosen a limited region in which to consider clusters and a range of size values

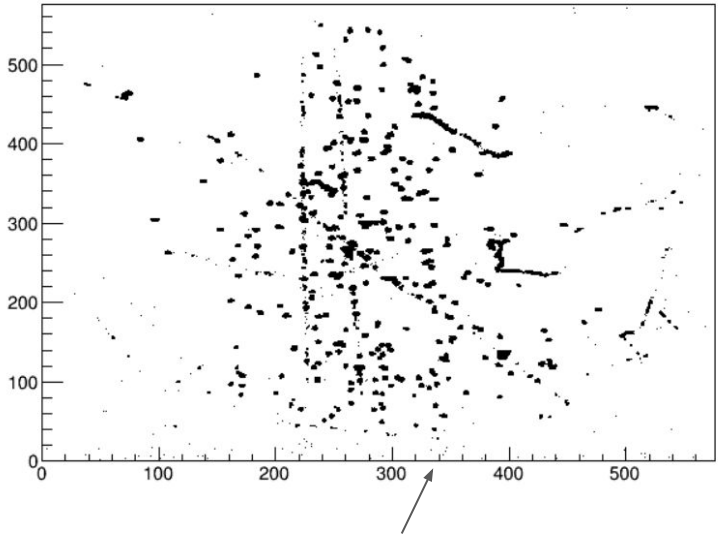
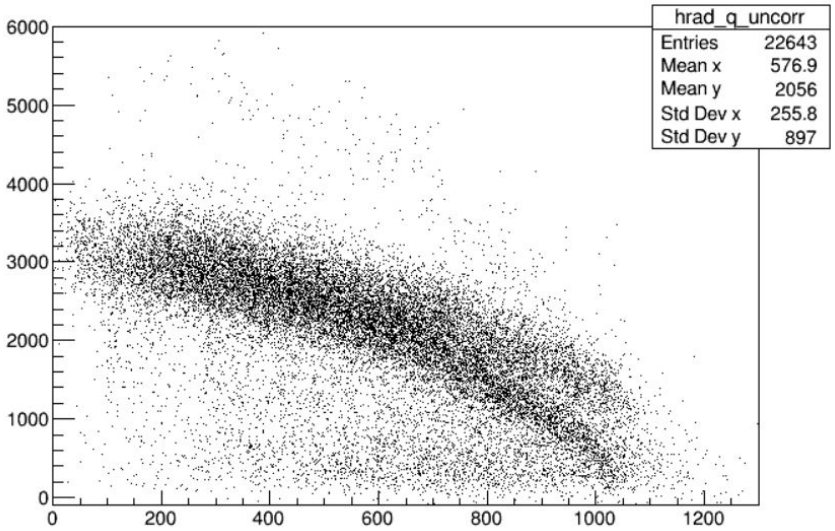
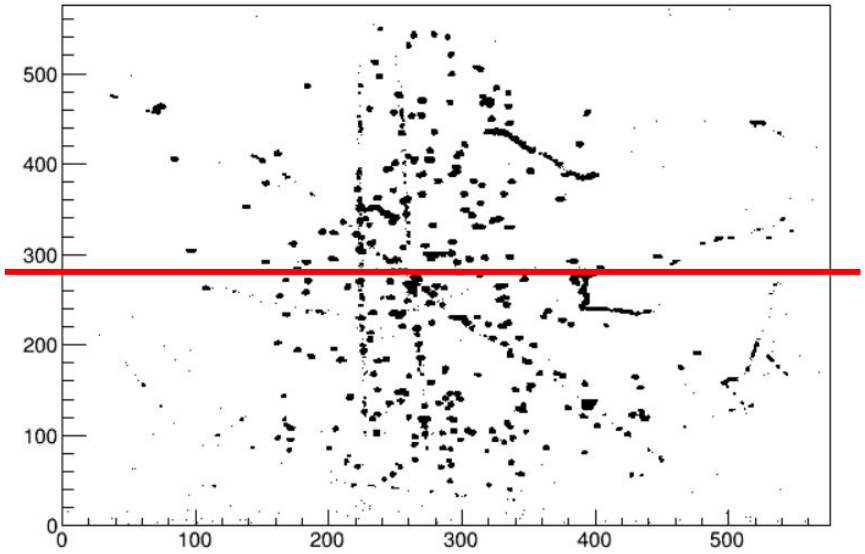


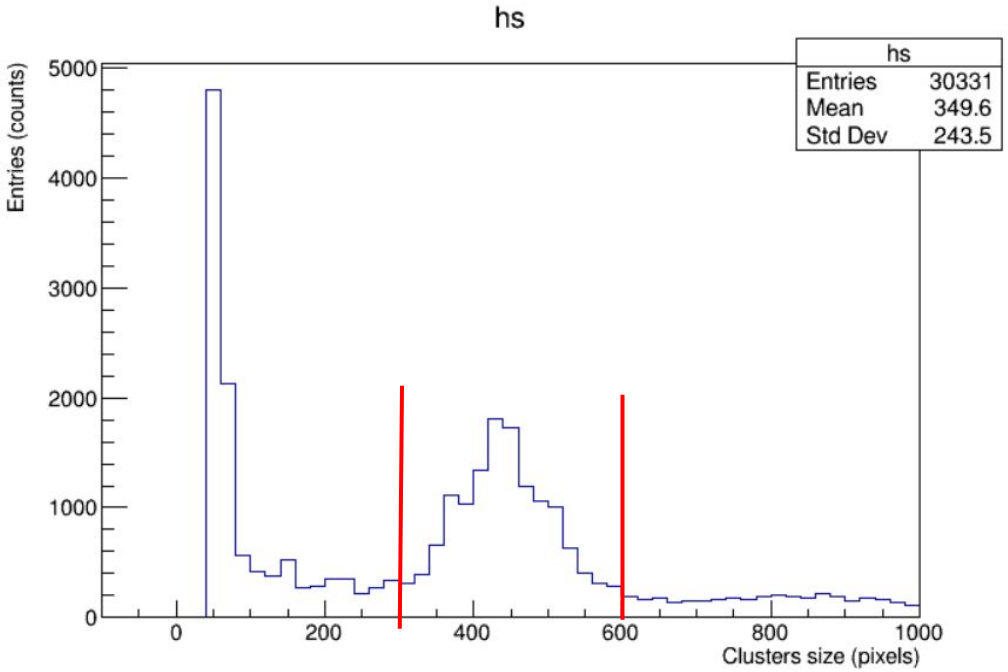
Image of clusters @ 21 cm

- The plot on the bottom shows the clusters light as a function of distance from centre
- As the distance increases clusters light takes on a double trend that is not simple to analyze
- This proves that it’s not only vignetting



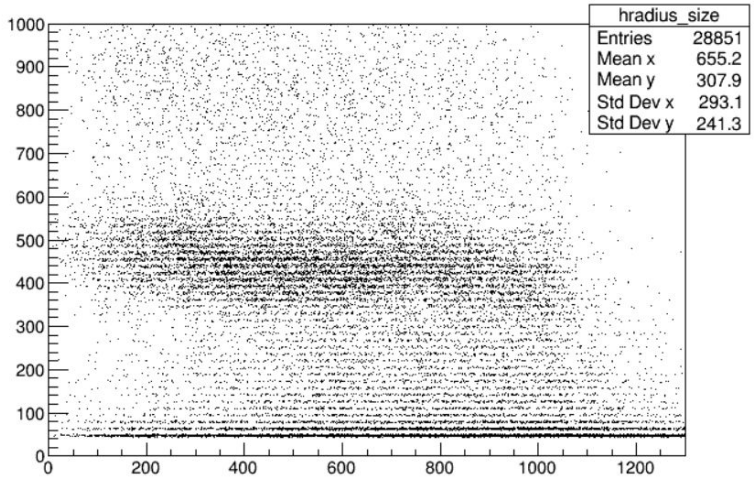


- To obtain a simpler light behavior, we selected only the clusters that occur in the upper region of the clusters image
- The upper region of the image is the region at the top of the red line in the plot on the right

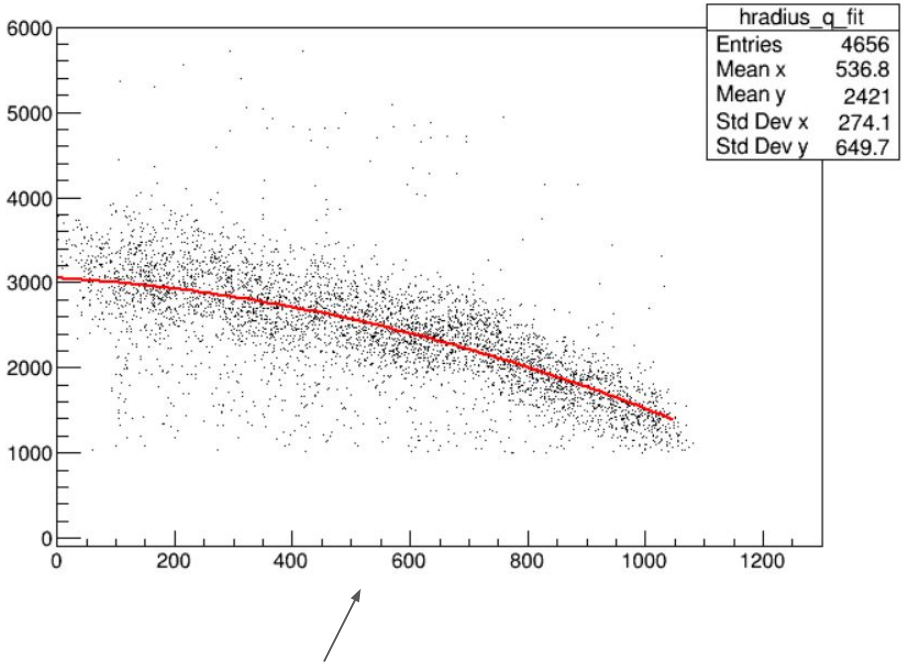


- The plot on the right shows size as a function of distance from centre
- We have to analyze accurately clusters size
- For now we use size distribution as cut on the clusters analysis

- The next step was to study the size distribution of the clusters
- For each run we selected clusters with a size in the range around the peak of the distribution
- The range of size values chosen is (300,600) for the distribution on the left
- The range changes according to the run studied



- We analyzed the clusters light as a function of the distance from centre and we fitted it with a quadratic function



- Source at 21 cm from GEMs
  - y>1152
  - light>1000
  - 300<size<600 (around the peak of size distribution)

- To get a better fit, we only selected clusters with light value > 1000 and size value in the range around the peak of size distribution of each run

- We also considered clusters in a certain region as shown in the picture on the bottom

- Limits on x coordinates allowed us to reduce the noise clusters

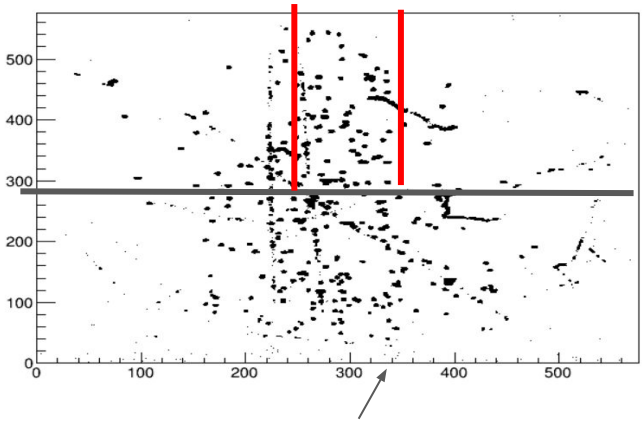
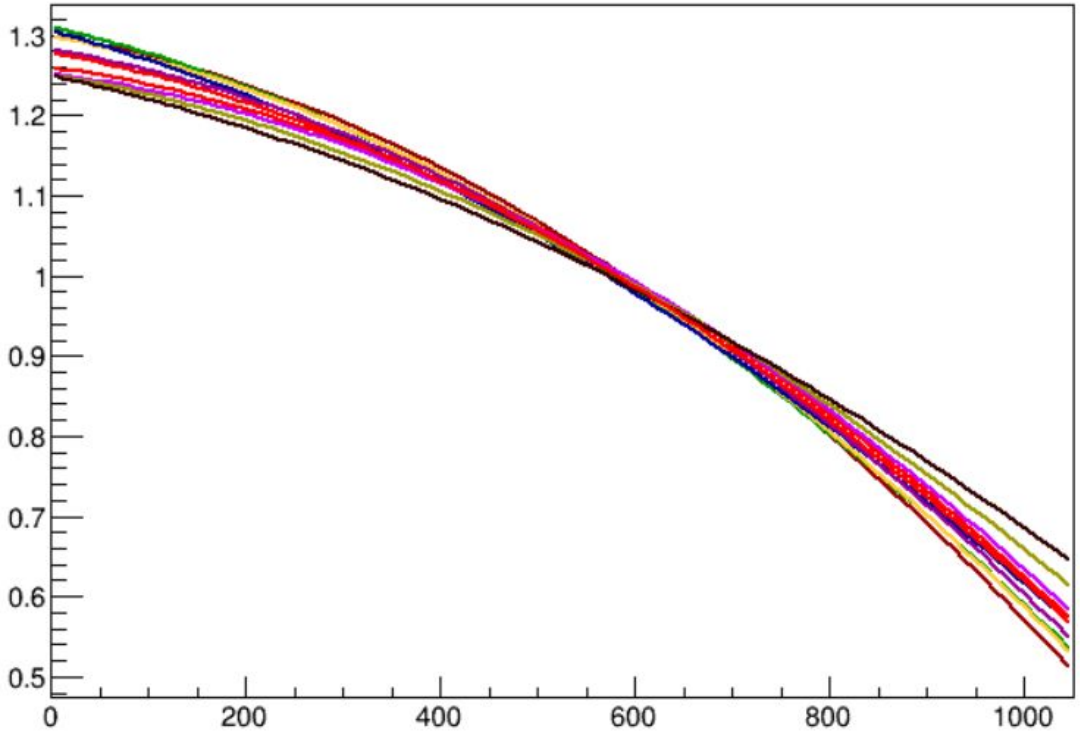


Image of clusters @ 21 cm



- By fitting the plot of clusters light vs distance from centre we got a quadratic function for each z position
- We estimated the mean value for each fit function obtained
- The three parameters of function were divided by the mean value previously estimated
- Then, we obtained the mean function that is the red function shown by the plot on the left

❖ Mean value of function:

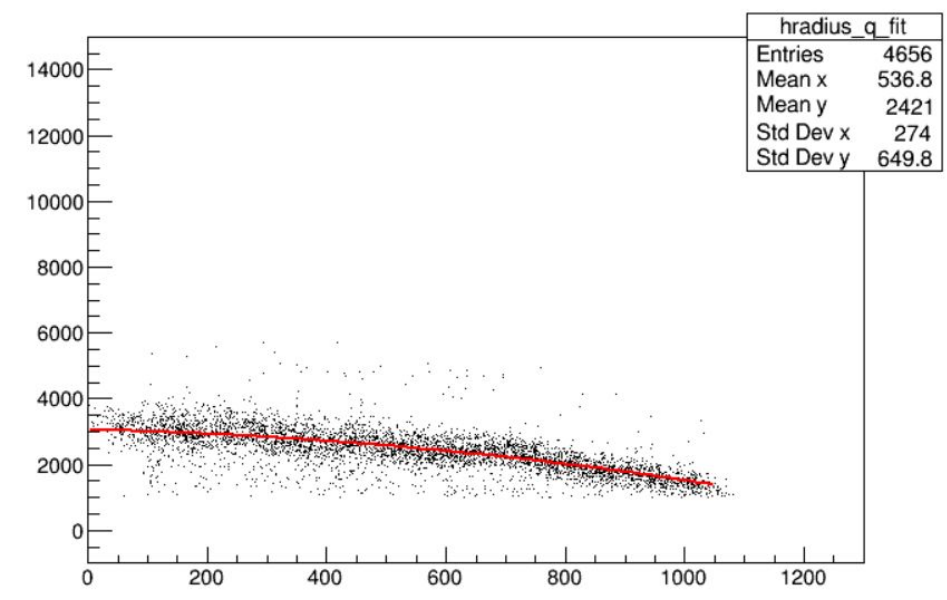
$$f_m = \frac{1}{\Delta r}\int_{r_1}^{r_2} f(x)dx$$

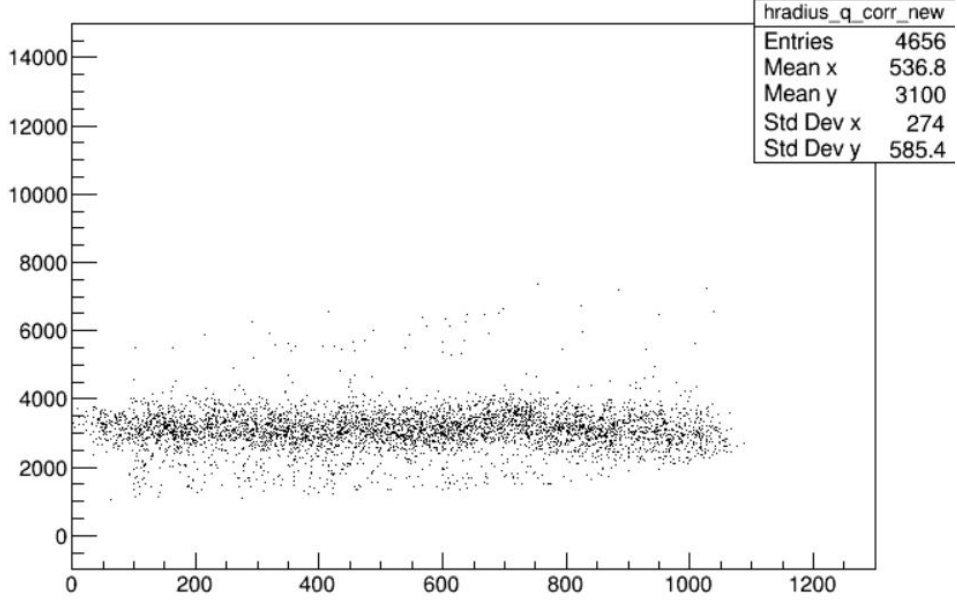
Range of integration
$\Delta r = (r_2 - r_1)$

- LIST OF NORMALIZED FIT VALUES FOR EVERY RUN

➢ f_m is the mean value and it is different for each run

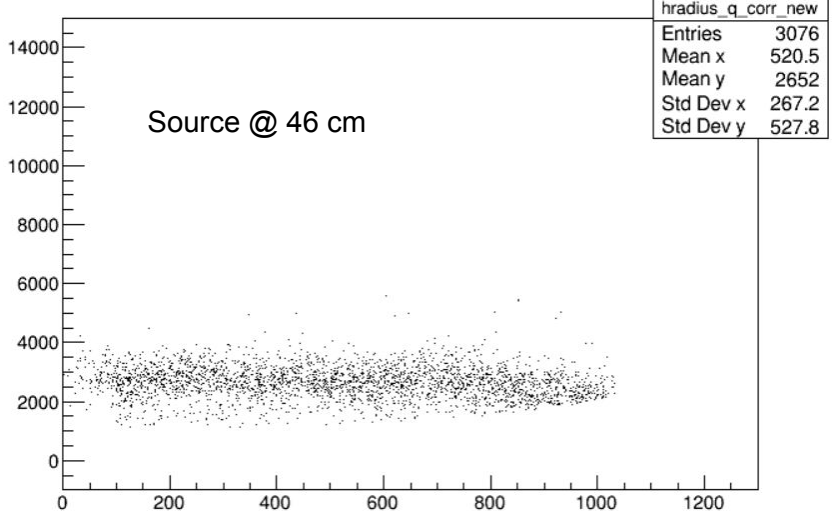
z (cm)	run	p0/f_m	p1/f_m	p2/f_m
46	4120	-5,31E-07	-1,98E-04	1,30E+00
41	4128	-4,33E-07	-2,88E-04	1,31E+00
36	4136	-4,77E-07	-2,36E-04	1,30E+00
31	4144	-3,59E-07	-3,30E-04	1,31E+00
26	4152	-4,74E-07	-2,04E-04	1,28E+00
21	4160	-4,69E-07	-1,66E-04	1,26E+00
16	4168	-4,60E-07	-1,57E-04	1,25E+00
11	4176	-3,81E-07	-2,11E-04	1,25E+00
6	4184	-2,99E-07	-2,66E-04	1,25E+00

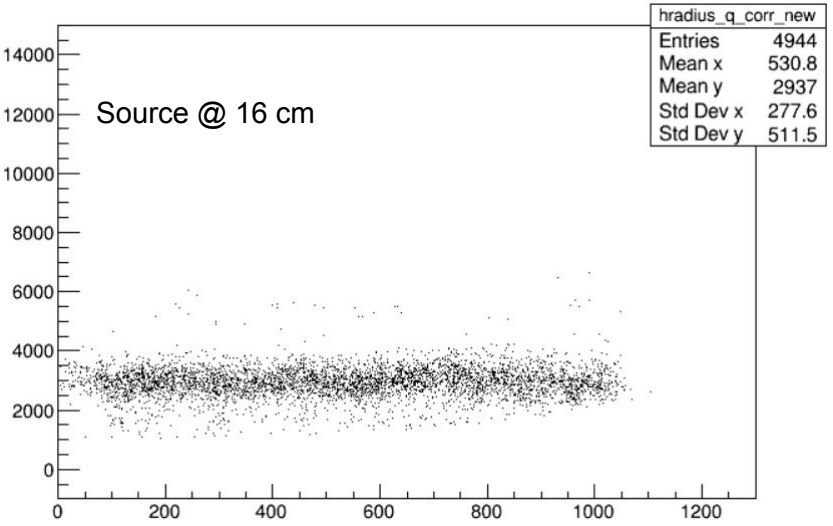


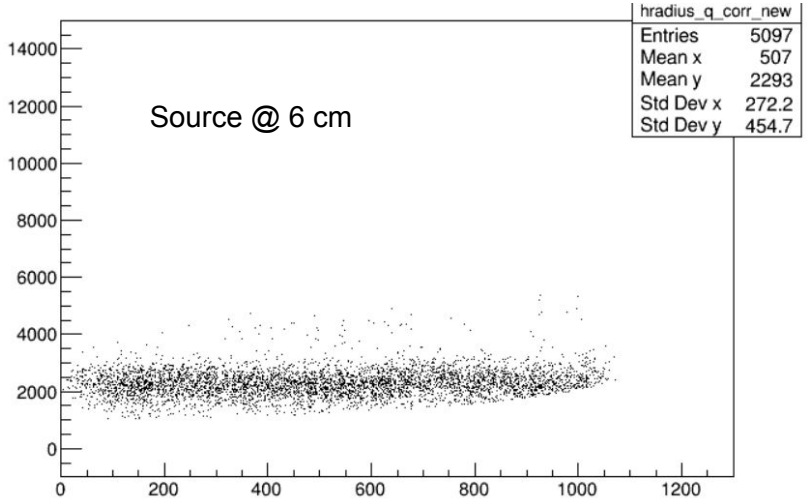


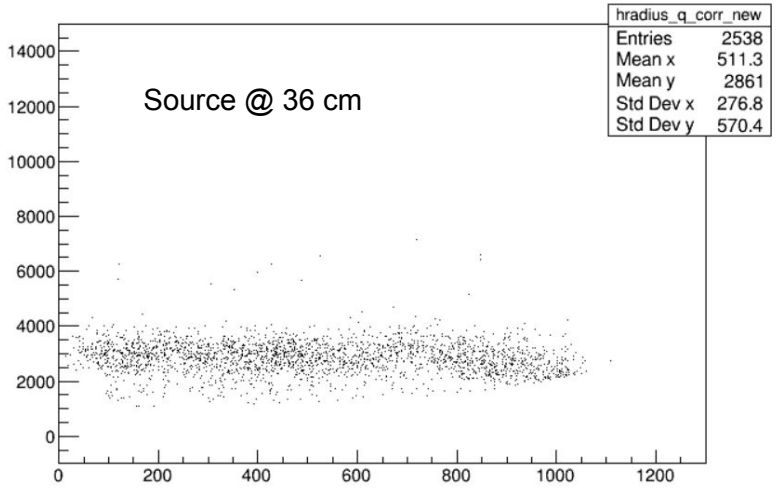
- Then, for every run we normalized the light values by the estimated mean function and we studied the obtained light values as function of distance from centre
- Two plots on the top show light behavior before and after the correction

- To correct the light trend we used one only function for all z positions
- So, the distortion does not depend upon the drift field

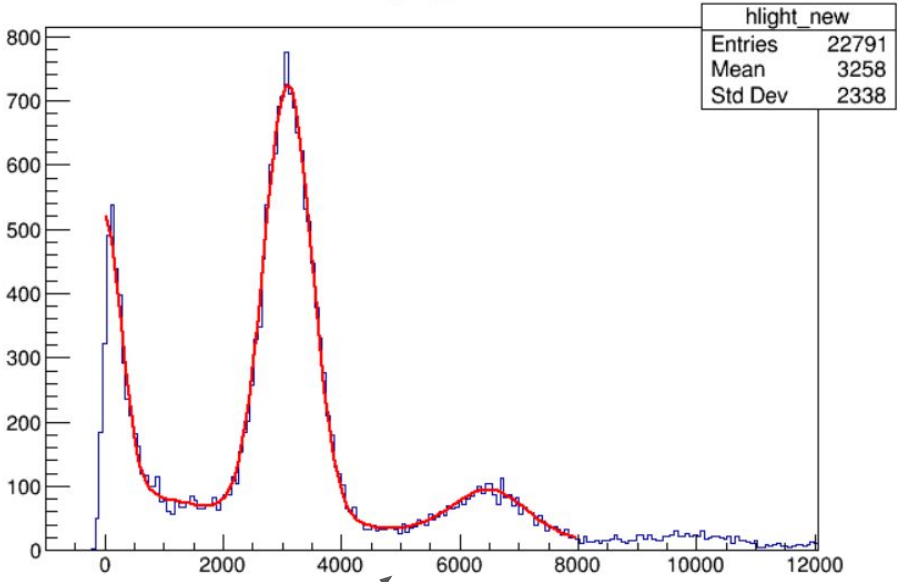

hradius_q_corr_new
Entries 3076
Mean x 520.5
Mean y 2652
Std Dev x 267.2
Std Dev y 527.8
Source @ 46 cm


hradius_q_corr_new
Entries 4944
Mean x 530.8
Mean y 2937
Std Dev x 277.6
Std Dev y 511.5
Source @ 16 cm

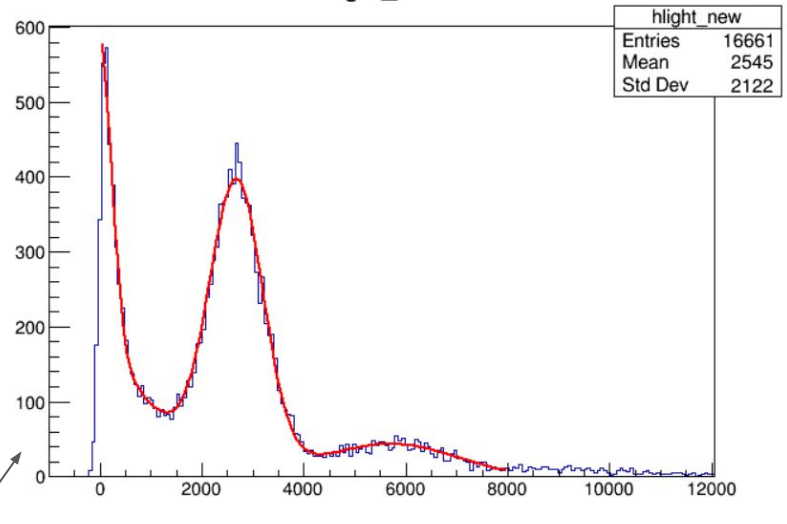

hradius_q_corr_new
Entries 5097
Mean x 507
Mean y 2293
Std Dev x 272.2
Std Dev y 454.7
Source @ 6 cm


hradius_q_corr_new
Entries 2538
Mean x 511.3
Mean y 2861
Std Dev x 276.8
Std Dev y 570.4
Source @ 36 cm

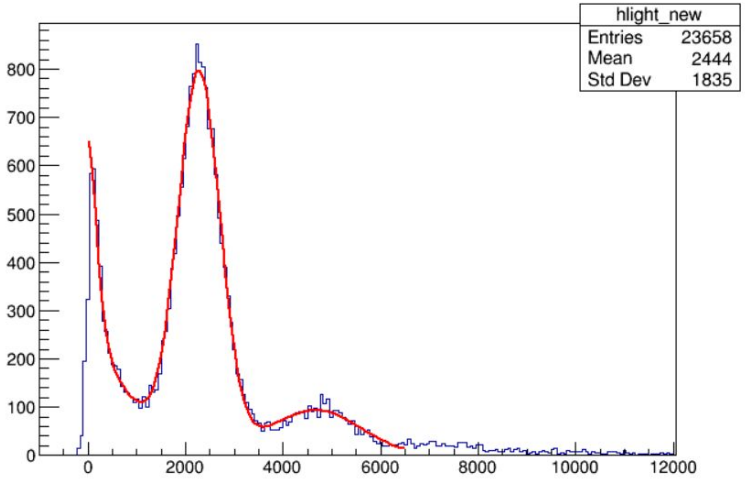
- We studied light distribution at different positions of source
- Plots show the presence of two peaks: the first peak corresponds to a single spot, while the second one corresponds to double spots



Source @ 21 cm

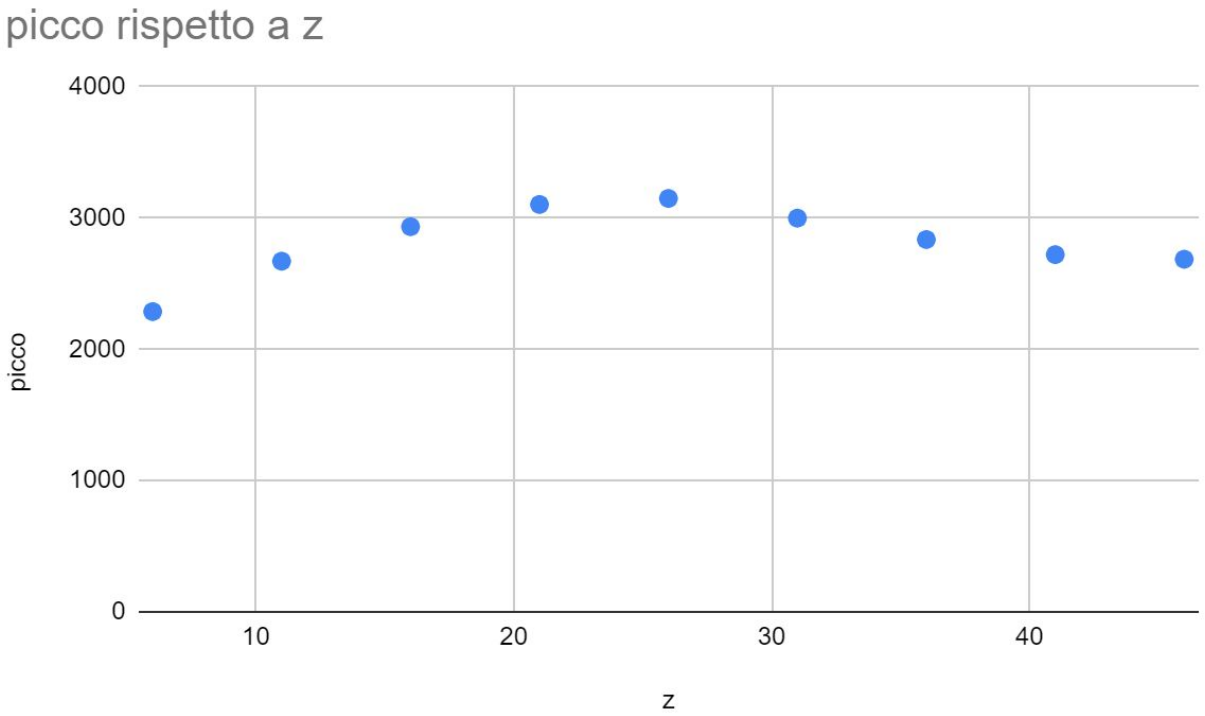


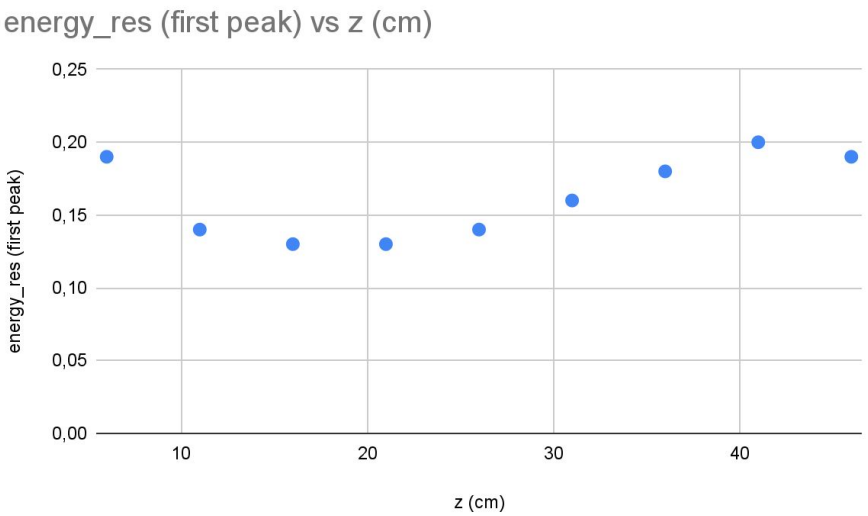
Source @ 6 cm

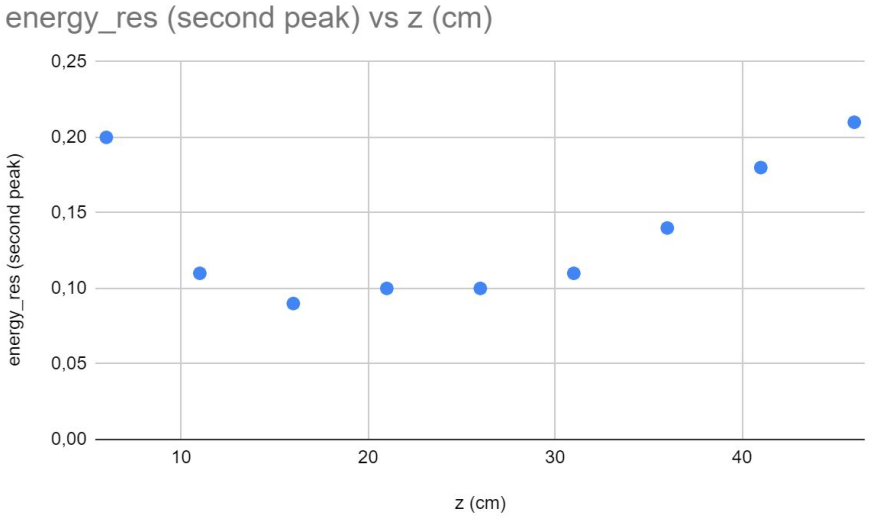


Source @ 46 cm

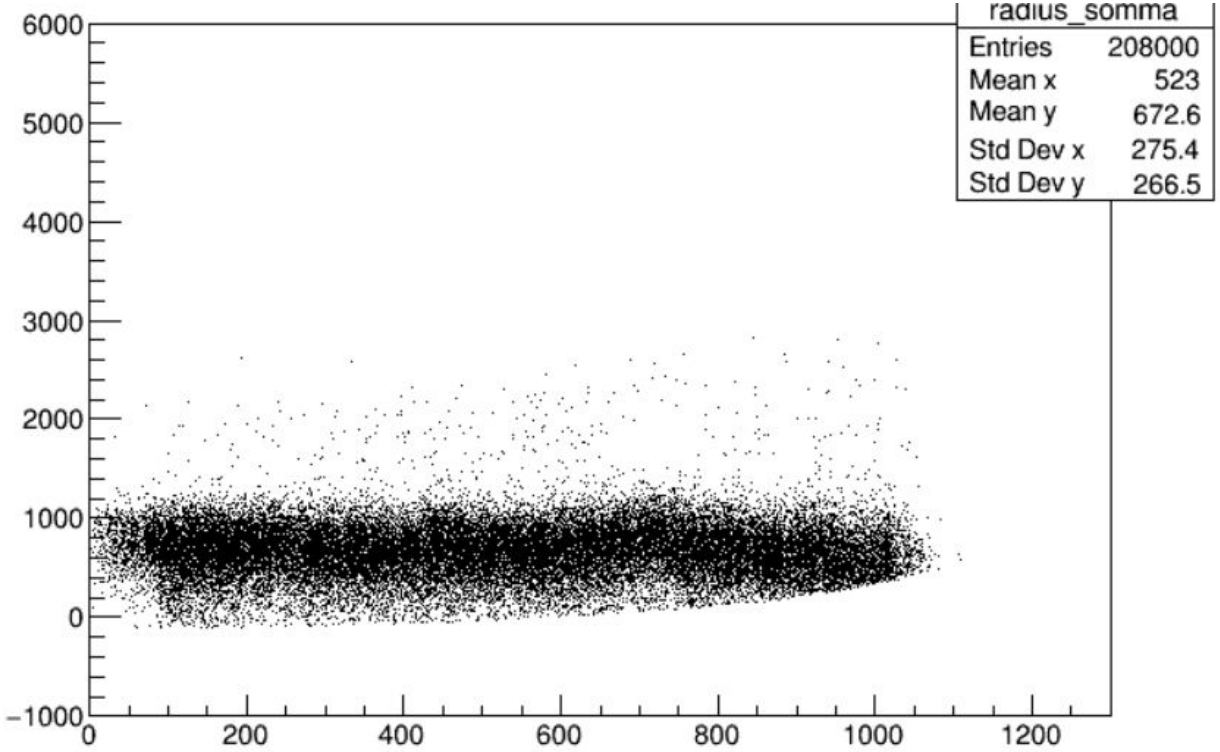
- The plot shows the trend of the peak of first gaussian as a function of position of source from GEMs



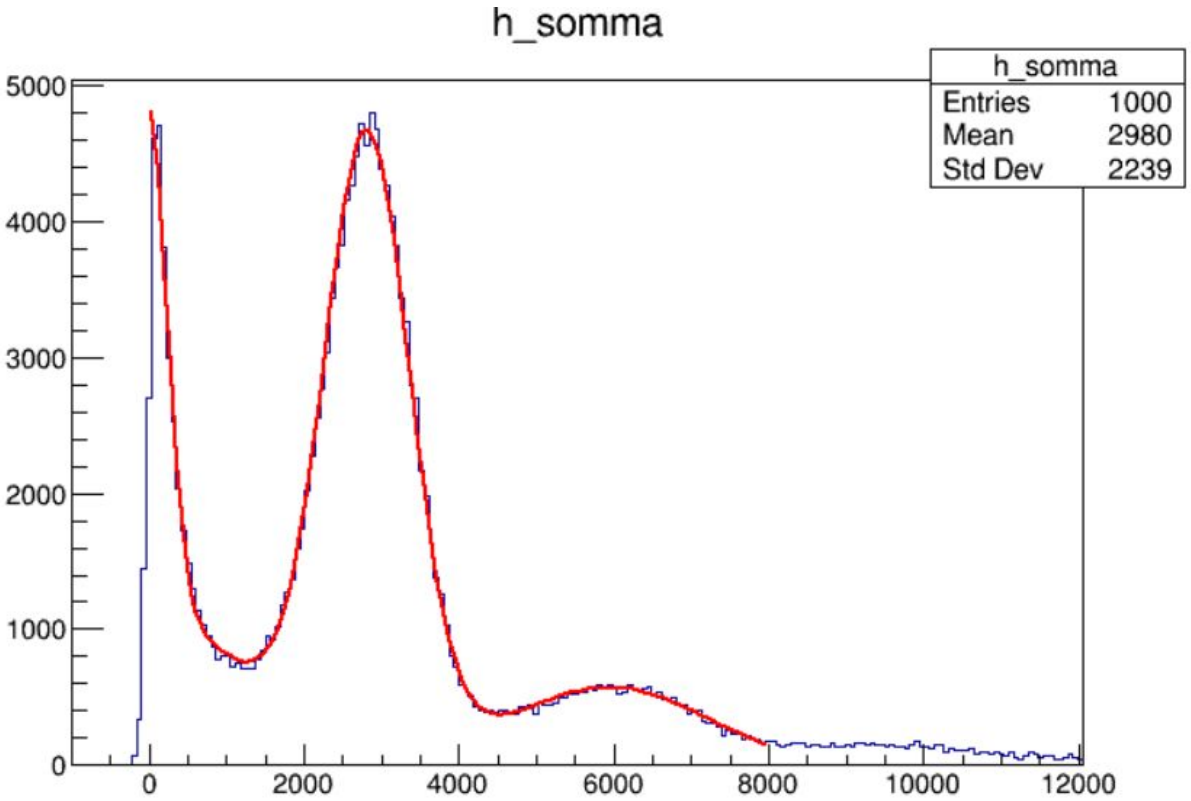




- The two plots on the top show the behavior of energy resolution as a function of source position
- The picture on the left shows the energy resolution of the first peak while that one on the right indicates the energy resolution of the second peak



- Overlapping entries of each plot of light behavior in a single plot we obtain the image on the left



- We did the same thing with light distribution by obtaining the distribution on the left

Fit parameters of first peak:

- 2823±547

Fit parameters of second peak:

- 6023±1188

- So, if we do not correct for z position and saturation we obtain an energy resolution of ~19% for the first peak and ~20% for the second one