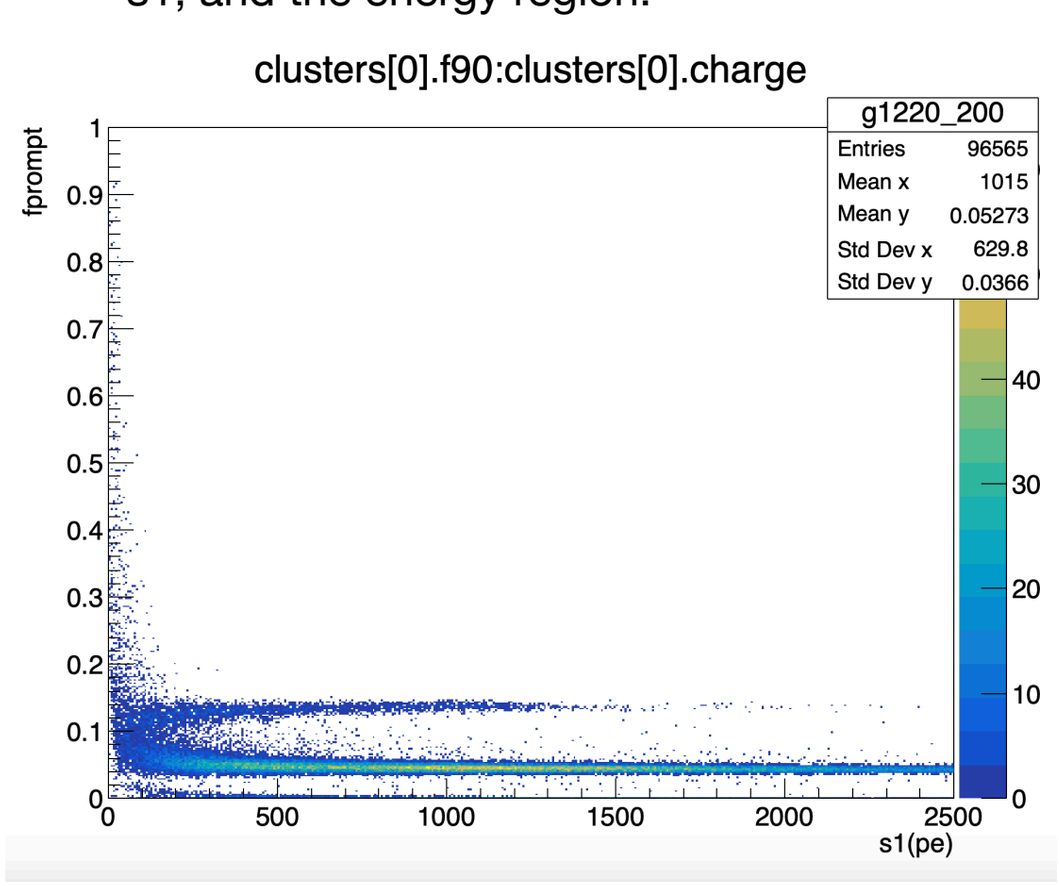
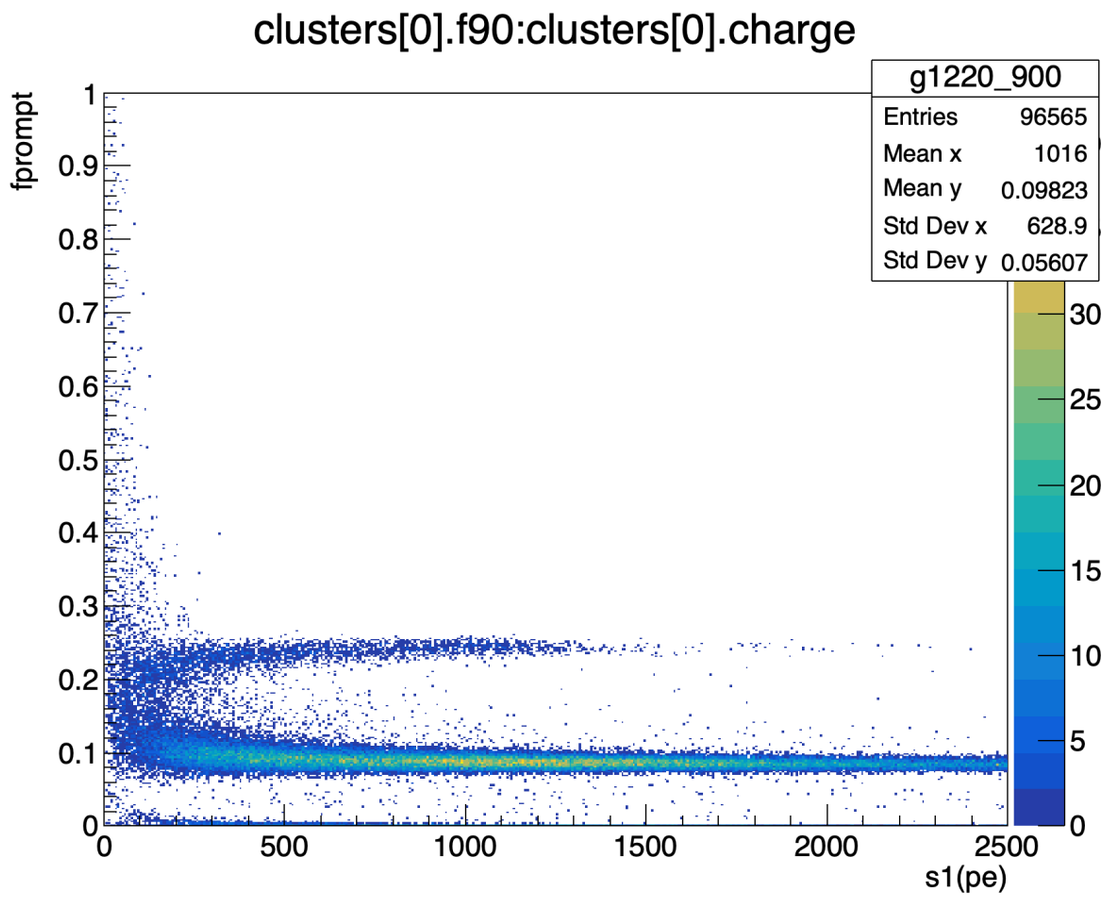
Study pf the PSD capability of the ReD TPC, while varying energy regions and integration time (t_prompt).

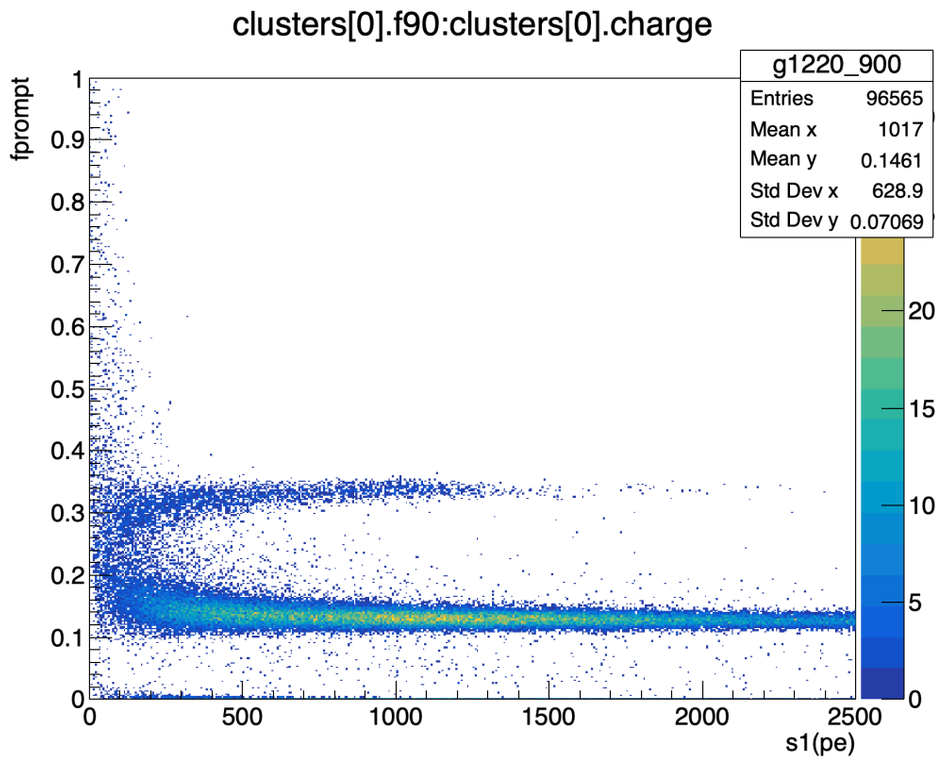
Study of PSD in low energy regions: 0-200 and 200-500 ns
for charge integration times between 200ns and 900ns

(default in ReD runs is 700ns)

Scan in fprompt, varying t_prompt from 200ns to 900ns.
- objective is to notice the difference in the ReD TPC PSD capability, while varying the charge integration time on s1, and the energy region.



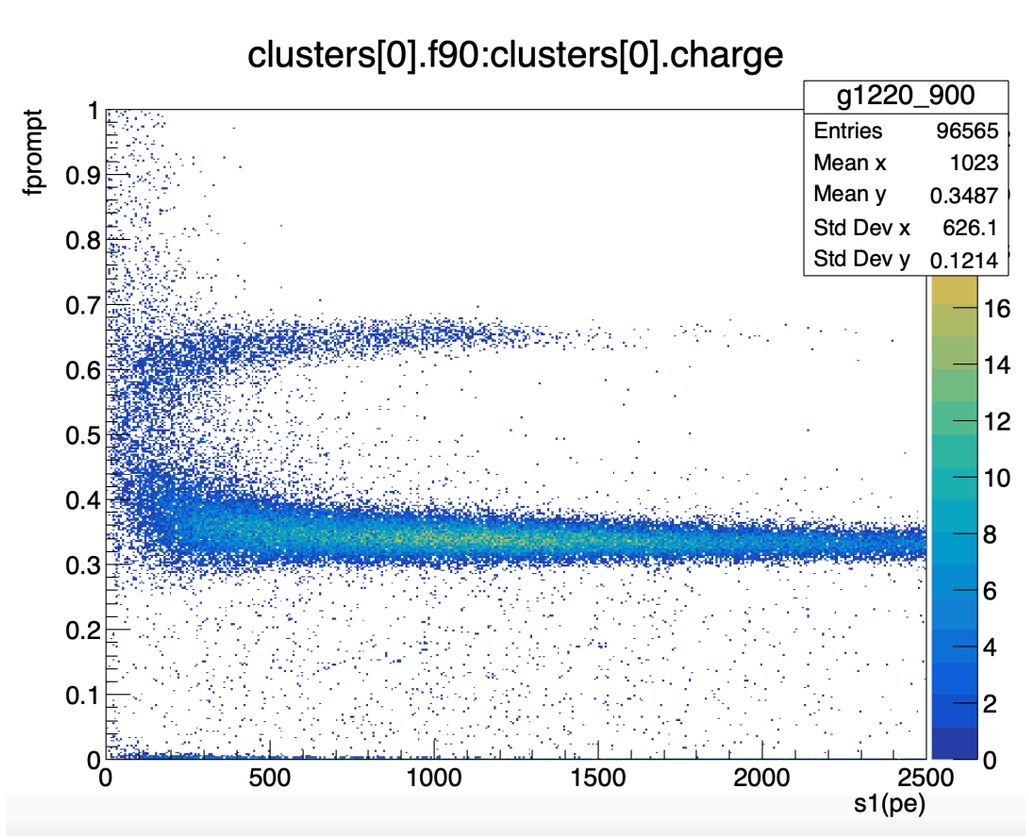


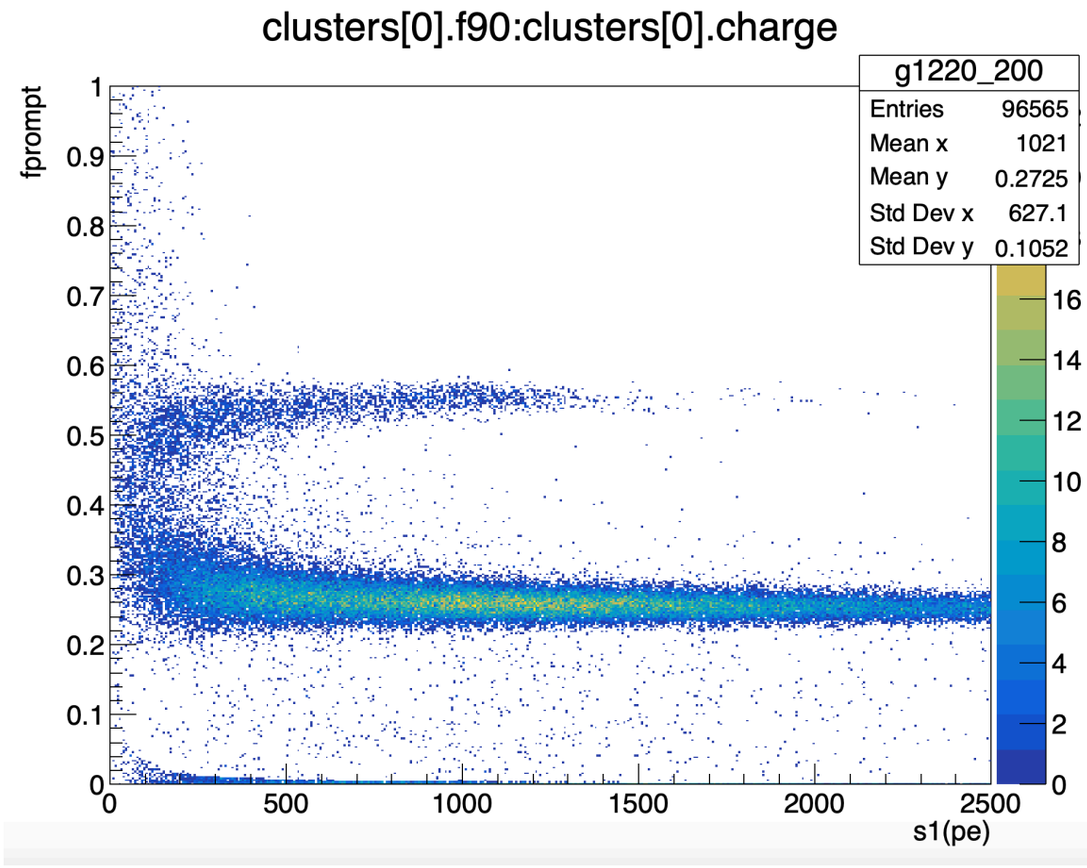


top left, 200ns integration time, top right 300ns, bottom left 400ns.

Different behaviours can be noticed if we consider different energy intervals, or “slices”.
Here, the slices 0-200 and 200-500 pe in s1 were studied.

On the left, scatterplot of fprompt vs s1, for t_prompt=900ns.
On the right, scatterplot of fprompt vs s1, for t_prompt=700ns.





The separation between ER and NR dominated regions is measured by means of a Figure of Merit, previously defined as:

FoM= (mu_2 - mu_1)/sqrt(sigma_R1^2 + sigma_L2^2),

Delta_fom/fom = (Delta_mu1+Delta_mu2)/(mu2-mu1) + (Delta_sigmaR1*sigmaR1 + Delta_sigmaL2*sigma_L2)/(sigmaR1^2 + sigmaL2^2)

where mu_1 is the mean value of the ER dominated peak, mu_2 is the mean value of the NR dominated peak, sigma_L2 is the standard deviation of the NR dominated peak taken from the left side, and sigma_R1 is the standard deviation of the ER dominated peak, taken from the right side, considering fits of fprompt with 2 asymmetric gaussians and an exponential function. Such, in fact, are the sigmas involved in the separation of the 2 peaks. The prefix “Delta” indicates the error on such quantity. Errors were taken from fits and propagated.

FoMs were calculated for run 1220 scanned in t_prompt:

fom run 1220 (<200 pe)

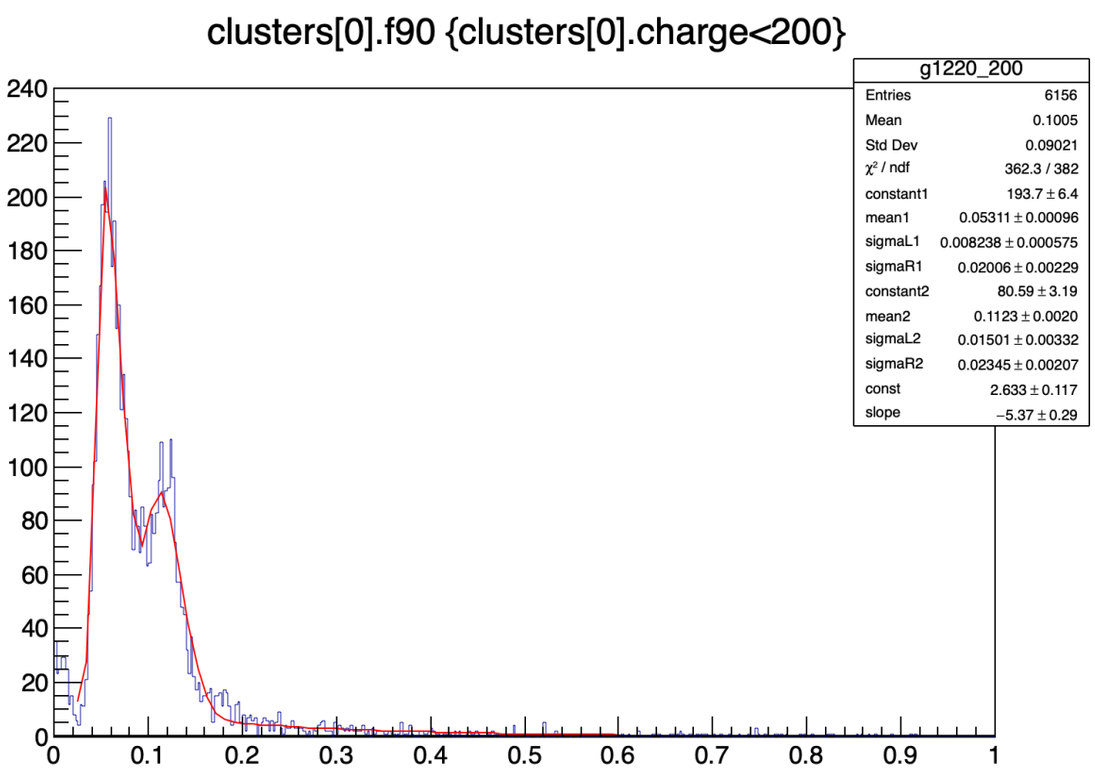
t_prompt, FoM			
200	2.36	±	0.47
250	2.43	±	0.44
300	2.44	±	0.40
350	2.45	±	0.27
400	2.44	±	0.43
450	2.47	±	0.44
500	2.49	±	0.41
550	2.57	±	0.45
600	2.53	±	0.48
650	2.	±	1.
700	2.45	±	0.27
750	2.46	±	0.07
800	2.47	±	0.07
850	2.37	±	0.88
900	2.36	±	0.88

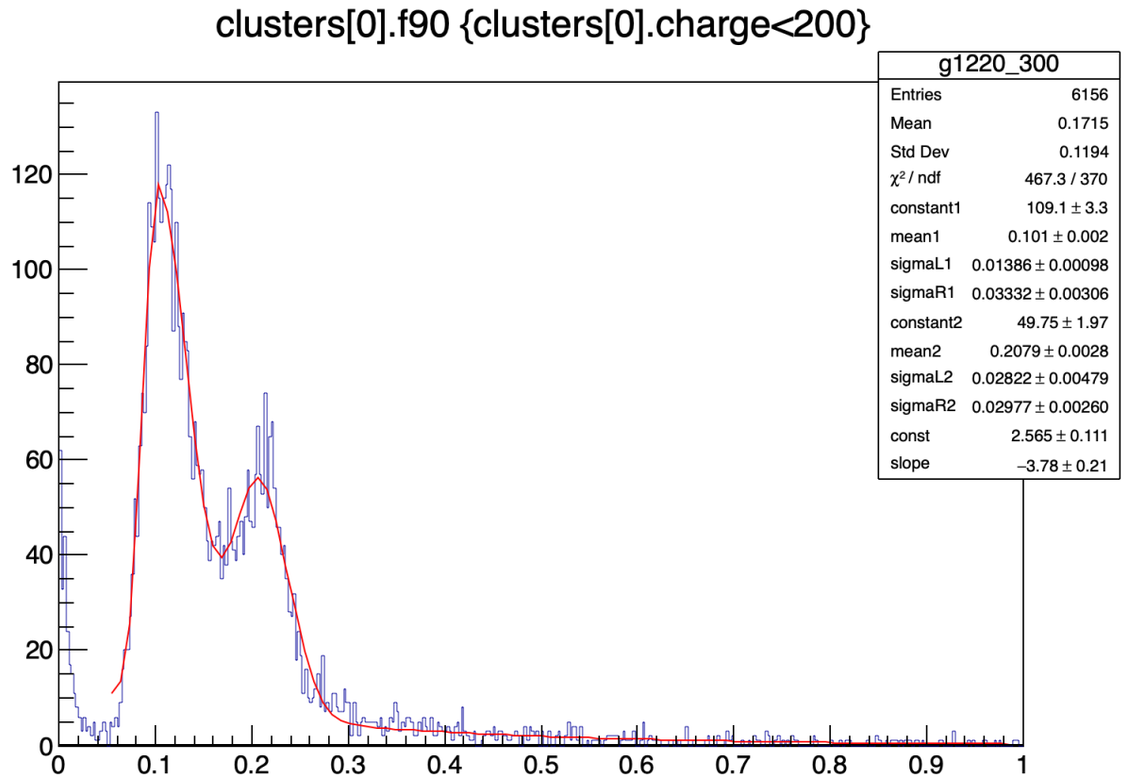
fom run 1220 (200-500 pe)

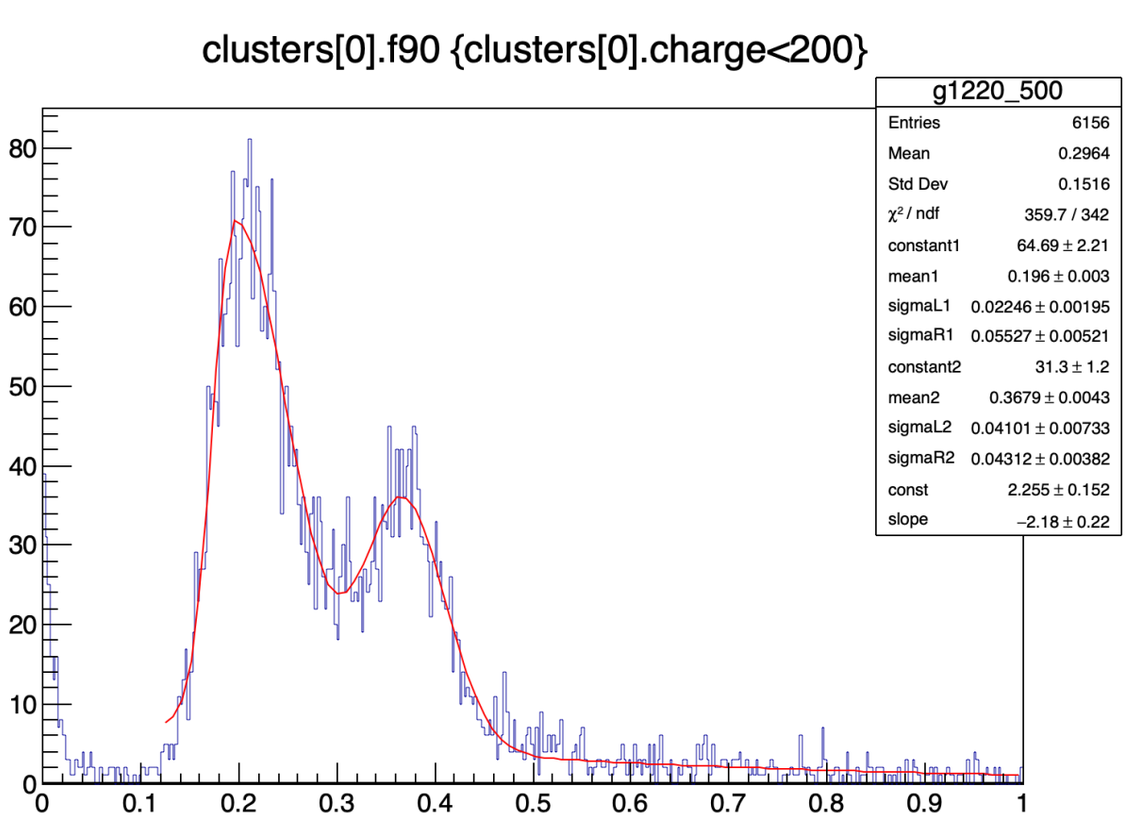
t_prompt, FoM	
200	3.67 ± 0.15
250	5.90 ± 0.22
300	5.92 ± 0.28
350	5.95 ± 0.29
400	5.96 ± 0.27
450	5.18 ± 0.30
500	5.97 ± 0.28
550	5.20 ± 0.28
600	5.23 ± 0.28
650	5.22 ± 0.28
700	5.12 ± 0.28
750	5.09 ± 0.28
800	3.96 ± 0.08
850	4.03 ± 0.06
900	3.99 ± 0.06

Mean values and sigmas are obtained from fits of fprompt by means of a function: gaus+gaus+exp. FoM was studied in 2 energy “slices”, 0-200 pe and 200-500 pe.

Fits of fprompt in the energy slice 0-200 pe: top left, t_prompt = 200ns, top right, t_prompt = 300ns, bottom left, t_prompt = 500ns

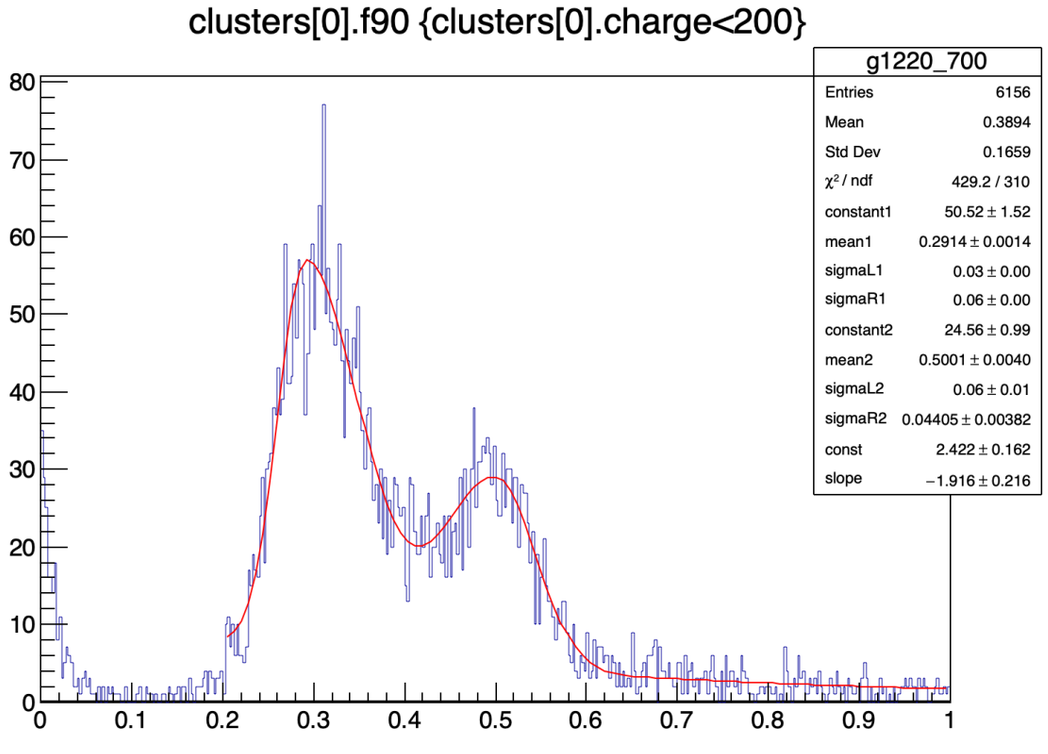


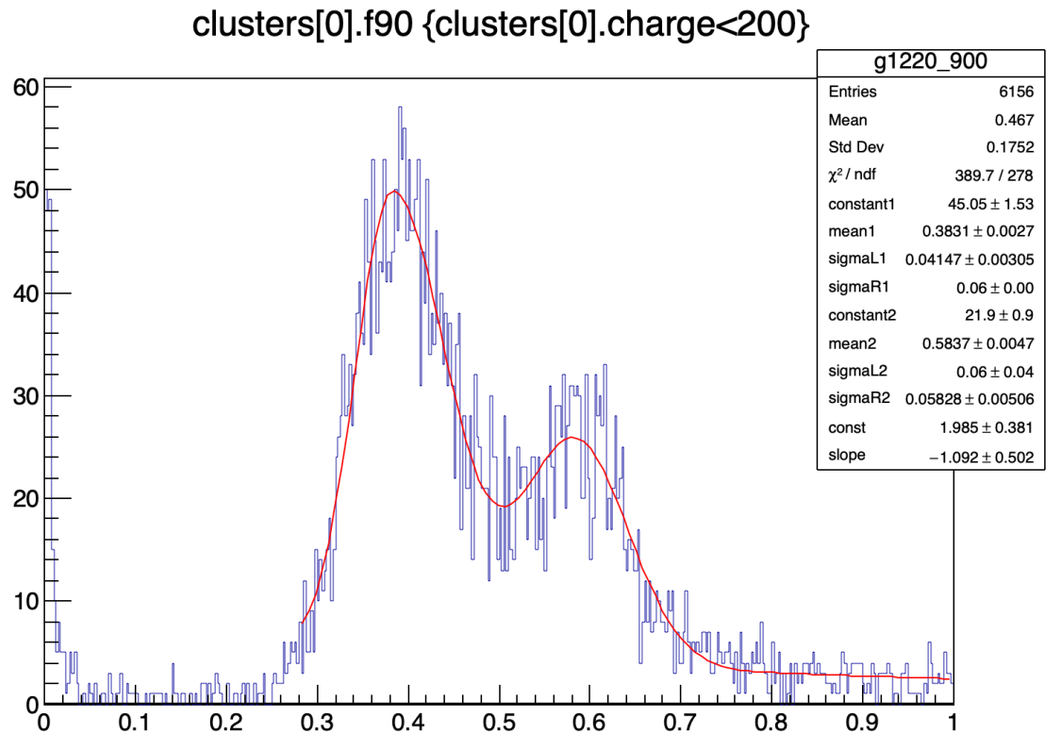




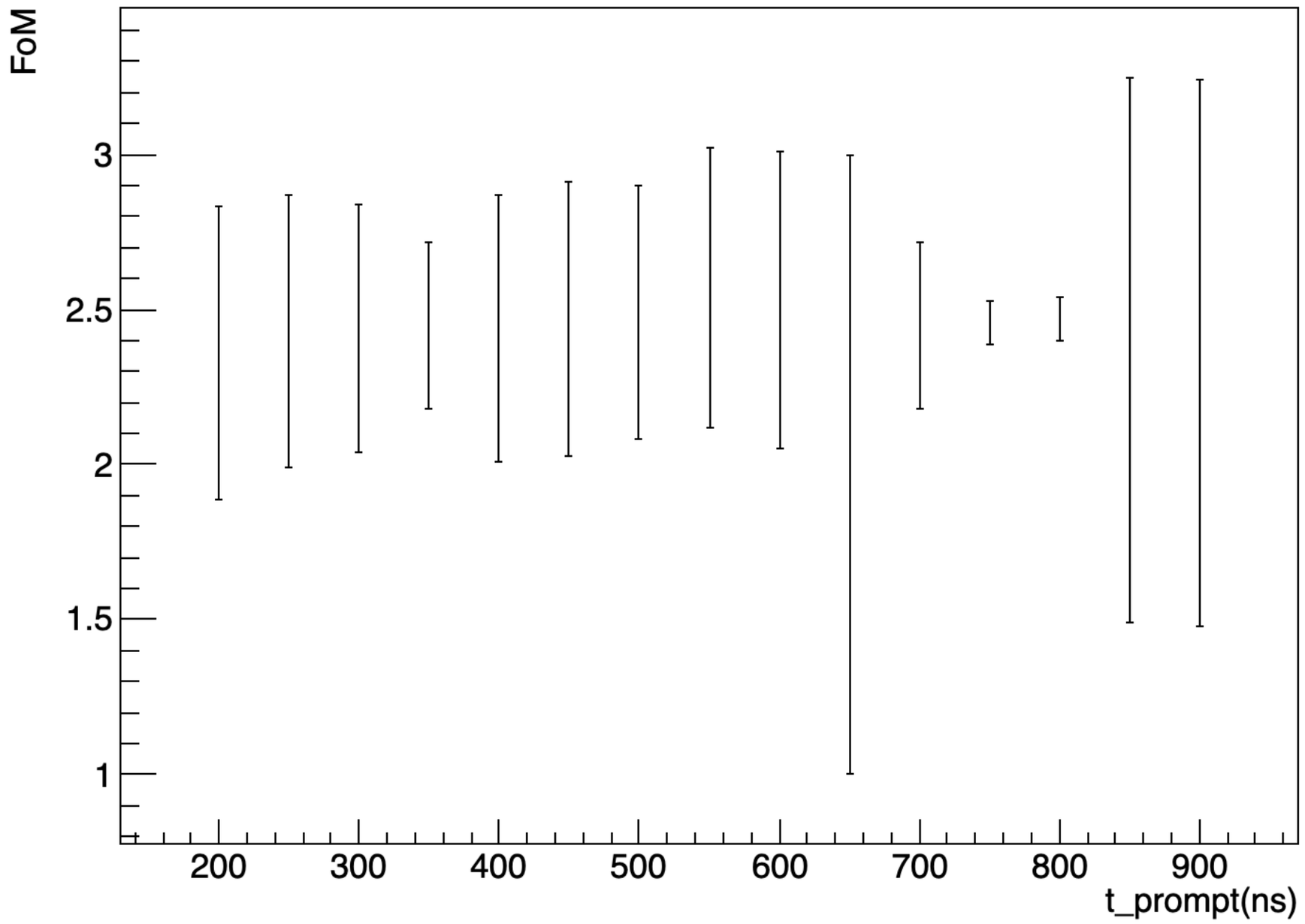
by increasing the integration time, peaks get larger and shift in fprompt. In this energy slice, separation between the 2 regions remains roughly constant: as peaks get larger, the distance that separates them also gets larger, -> FoM ˜constant

integration times of 700 ns (left) and 900 ns (right)

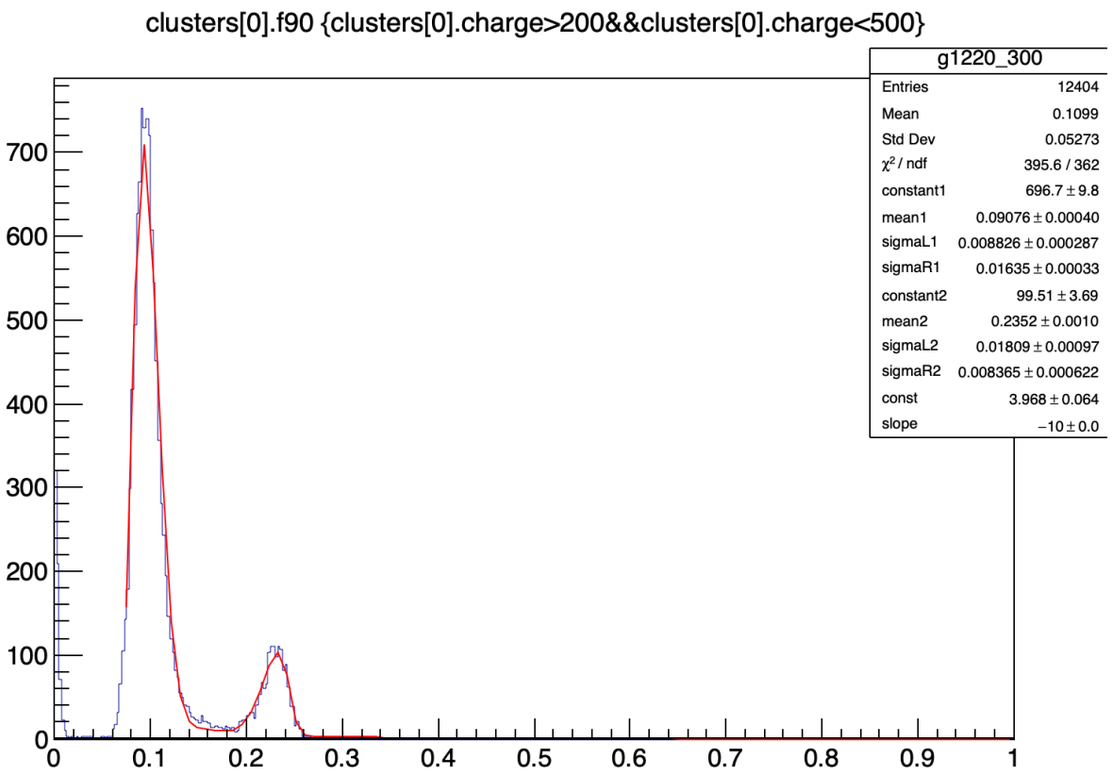


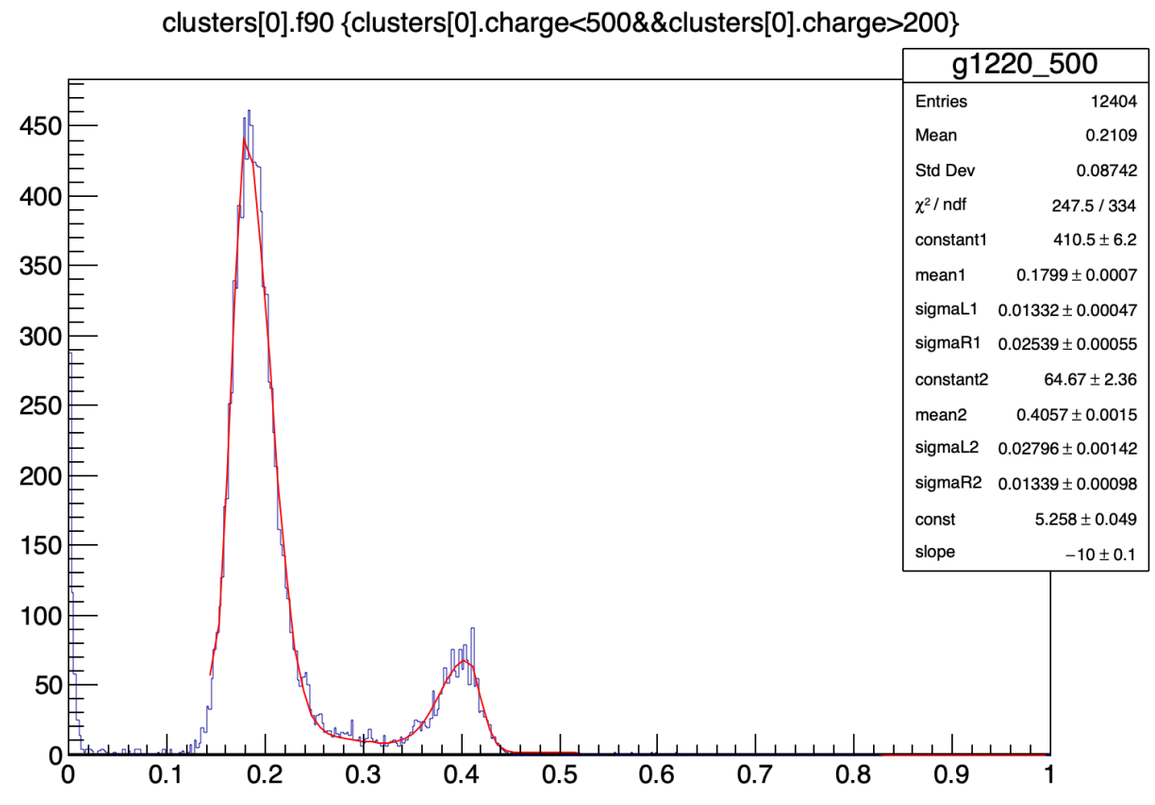


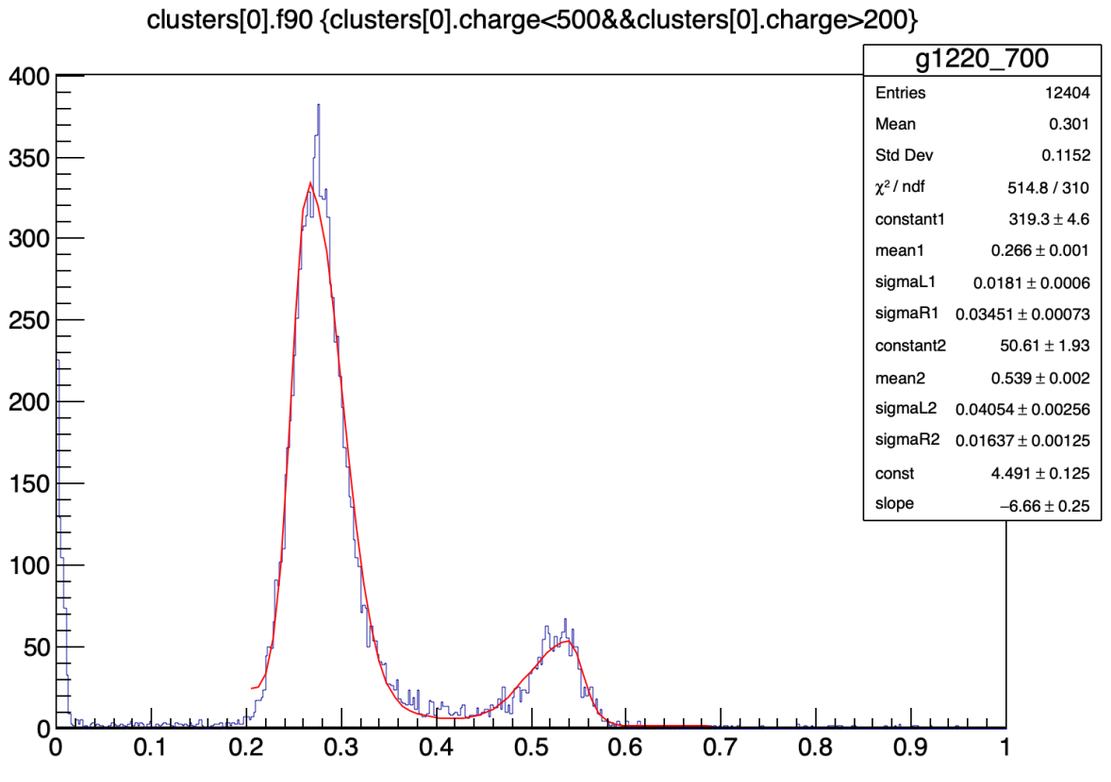
Scan in t_prompt for FoM in the energy slice 0-200 pe.

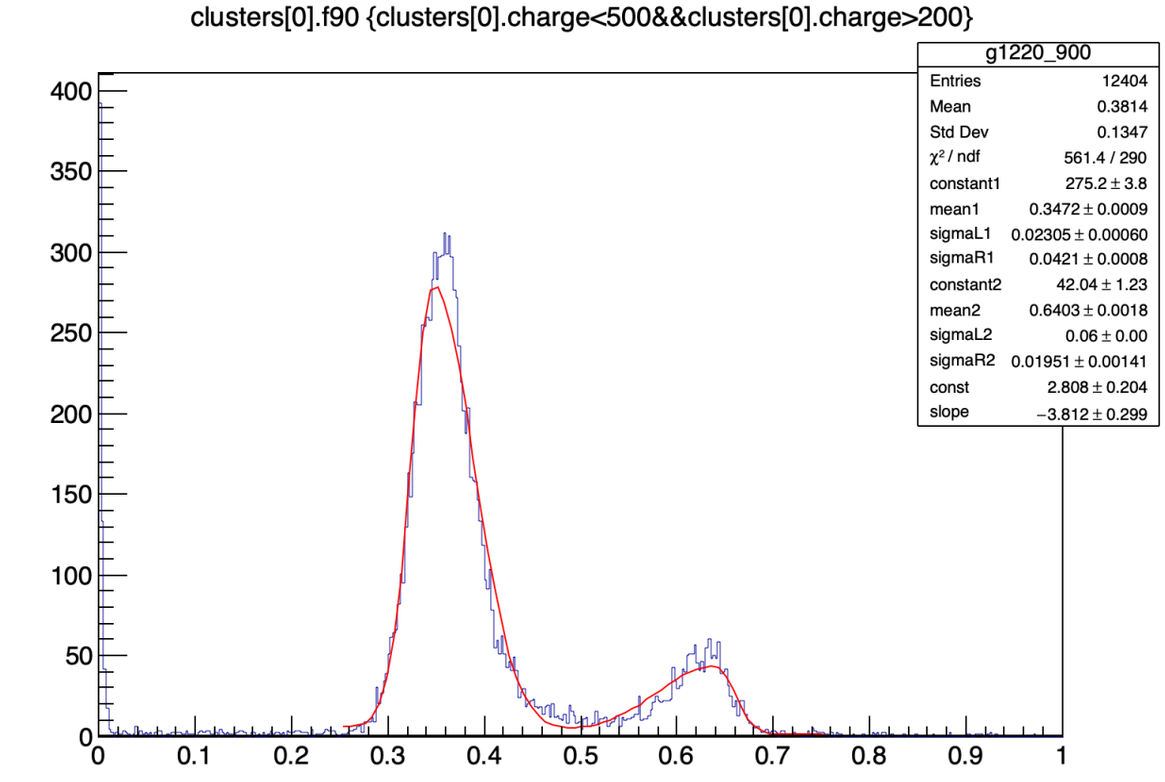


Fits for the energy slice 200-500 pe, according to different integration times: top left 300 ns, top right 500 ns, bottom left 700 ns, bottom right 900 ns.









In this energy slice, decreasing integration time the FoM gets slightly better: the separation between the mean values of the ER and NR region increases more than the sigmas of the gaussian distributions.