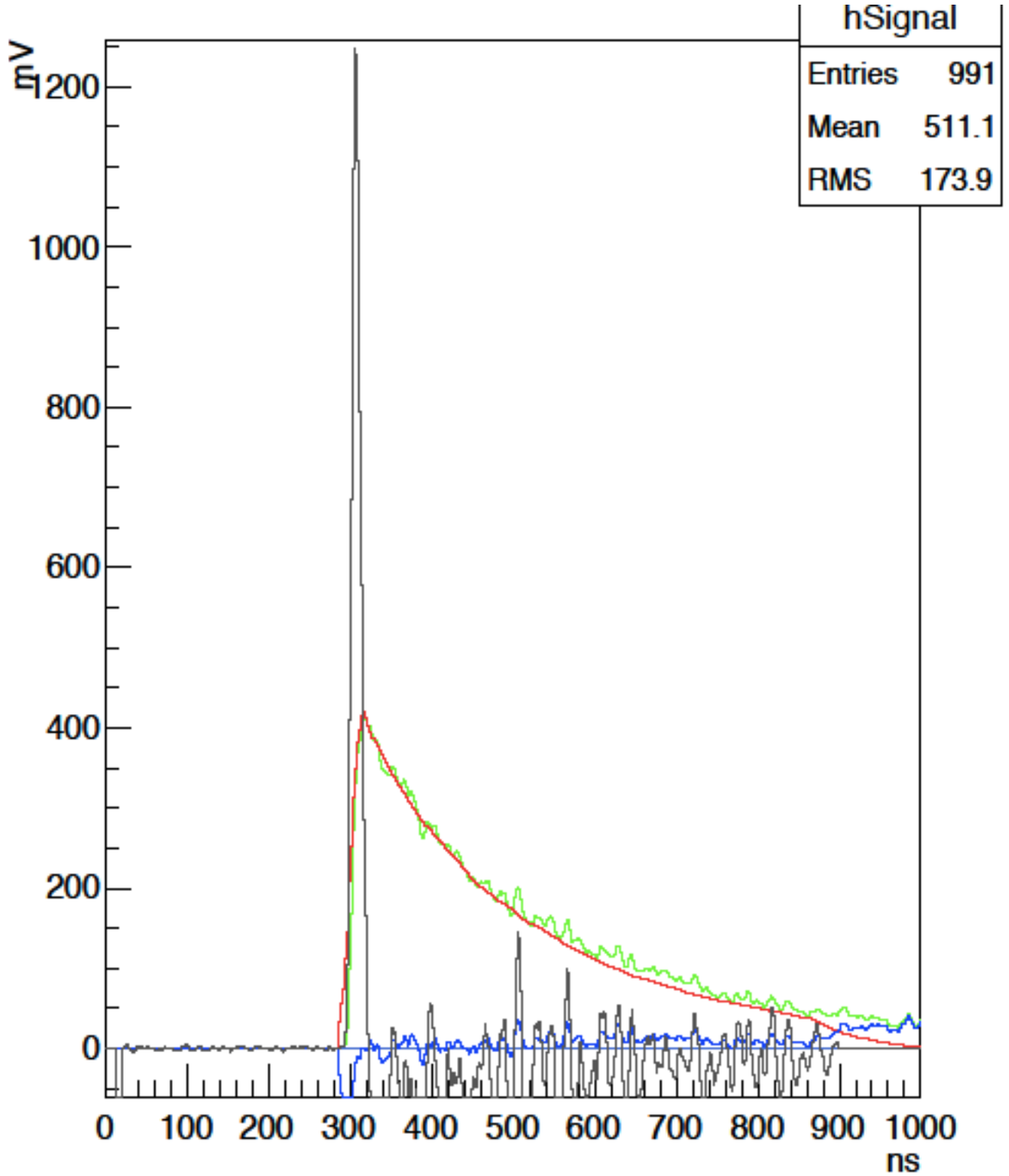
CORRECTION ON SATURATED HIT

I.Oceano & Lecce group

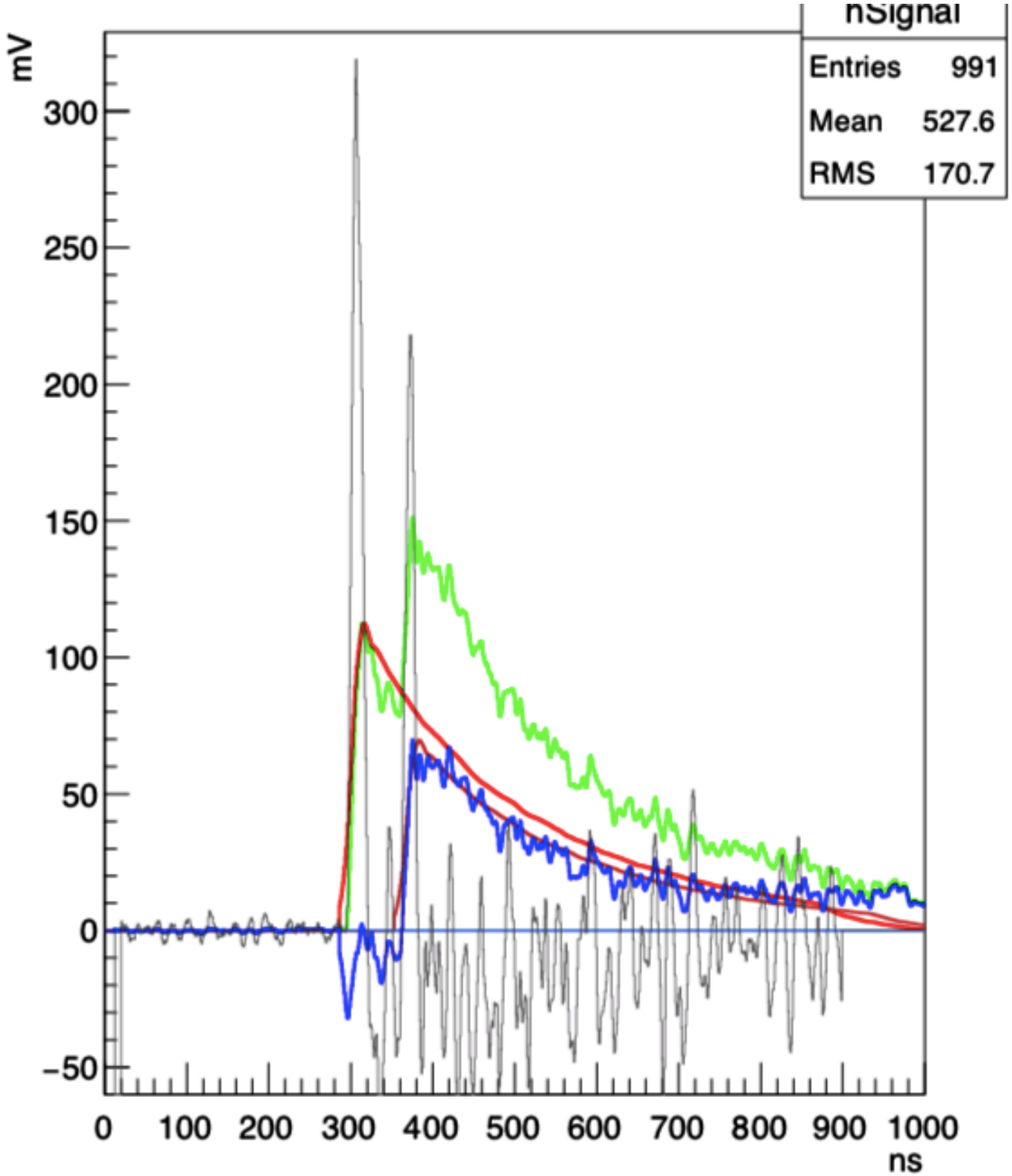
MY SIMPLE ALGORITHM

- Take the waveform, make the derivative and save the maximum of the derivative as time of the hit t_{hit_1};
- Adapt my template on the waveform
- Make the difference between the waveform and the template



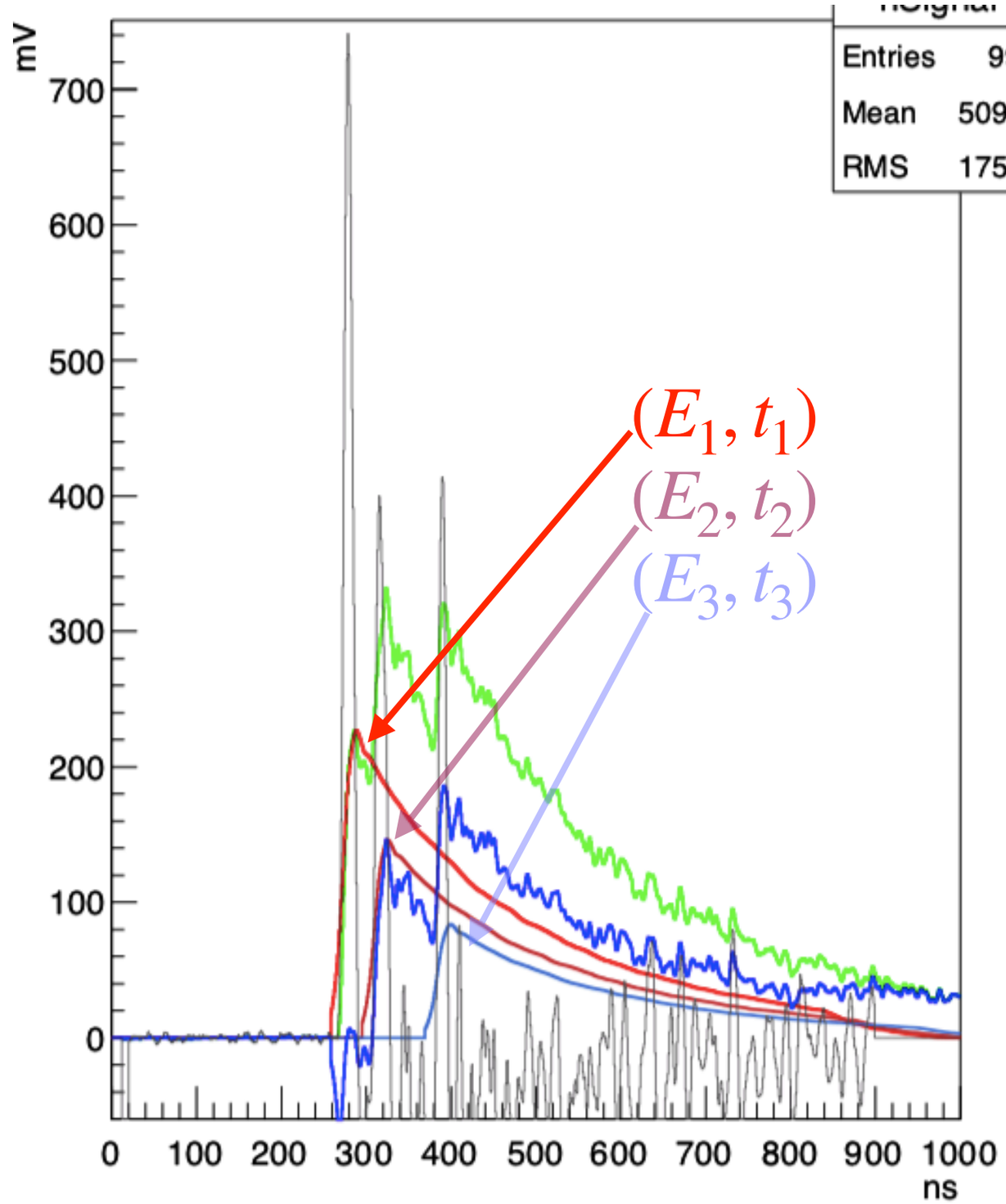
My simple algorithm

- Make the derivative on the difference and save the time of maximum derivative t'_{max}
- Adapt a second template if
  - the value of the difference at t'_{max} is tiger than 30 mV
  - $|t_{hit_1} - t'_{max}| > 25$ ns
- Made the same procedure to find a third hit.



My simple algorithm

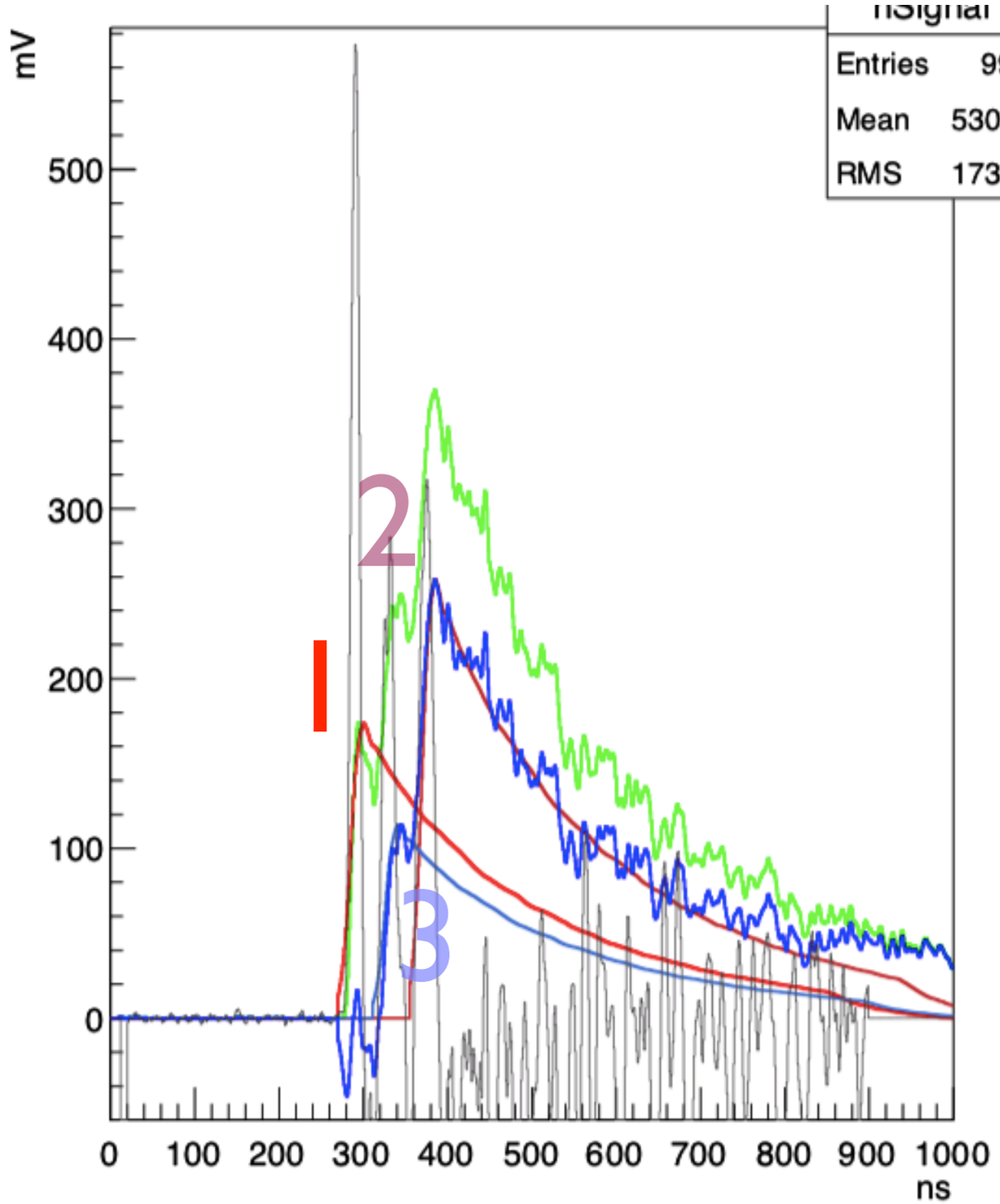
- To estimate the energy I integrate the template
- The time of the second (or third) hit is the time of maximum derivative of the difference
- I have at most three times and energies $(E_1, t_1), (E_2, t_2), (E_3, t_3)$
- If $t_1 < t_2 < t_3$ and the energy of second and third hit is higher than 5.MeV I save all the hits.



MULTIHIT RECONSTRUCTION

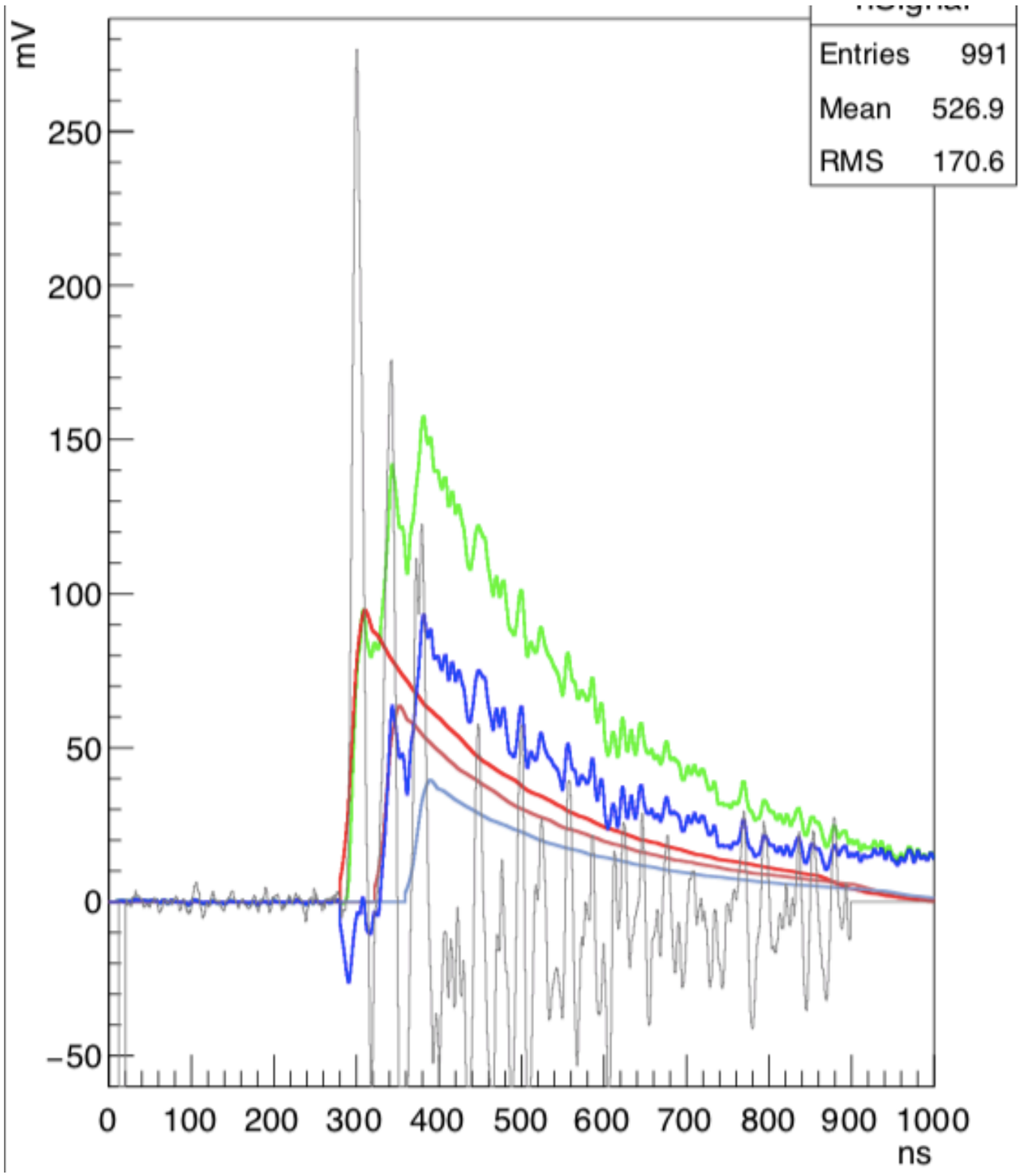
- If $t_{1(2)} > t_{2(3)}$ I correct the energy of hit 1(2) for the fraction due to the tail of the second/third hit

- If the corrected energy is higher than 5.MeV I save the hit.



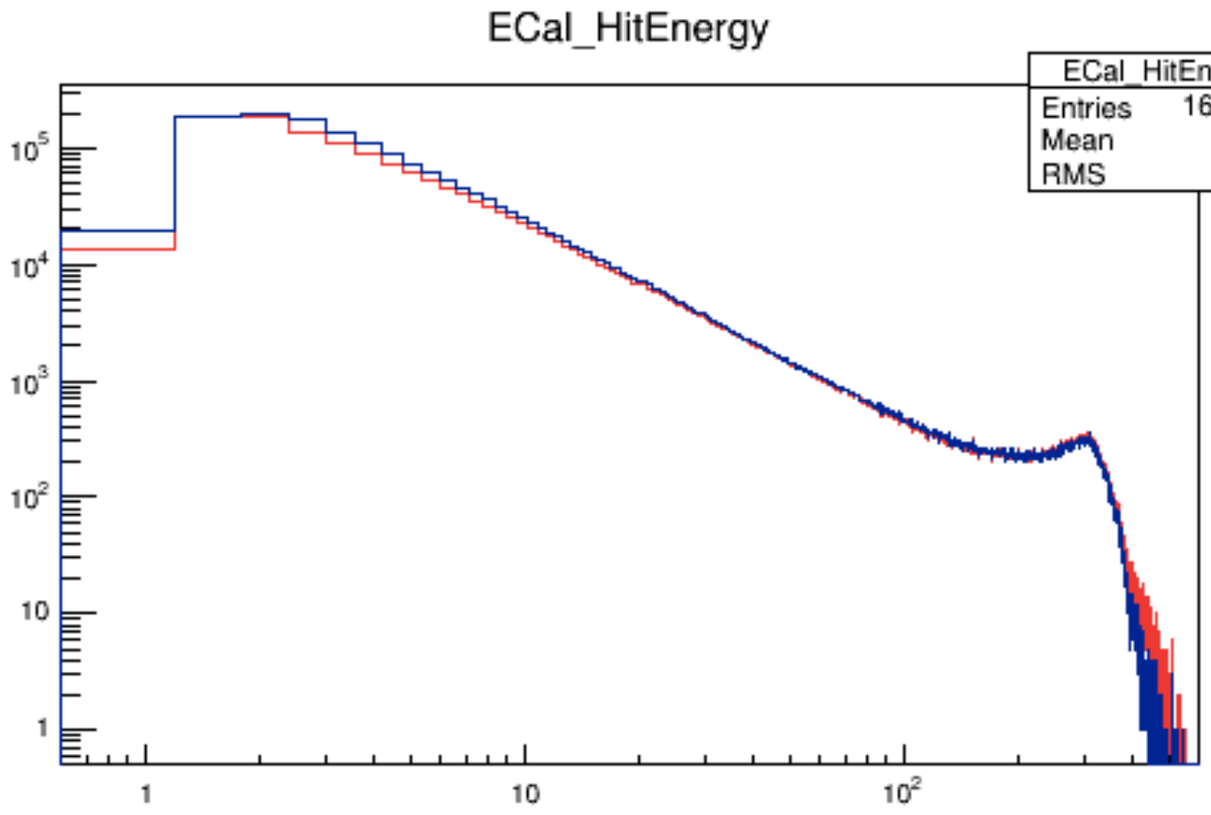
RECONSTRUCTION OF SINGLE POSITRON RUN

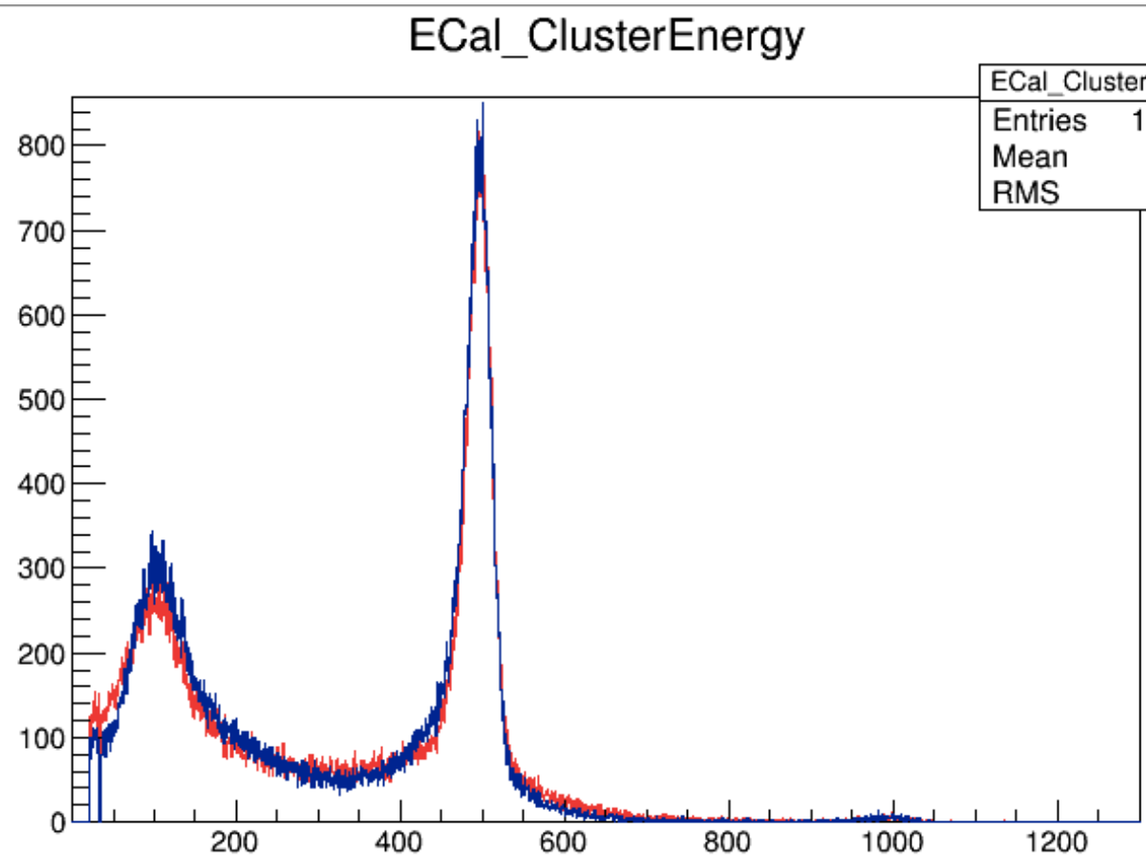
- To understand the efficiency of my algorithm I studied the run of single positron run w/o the saturated waveform
- Through this samples I performed the digitisation changing
  - Threshold on the waveform amplitude (included the differences between the initial waveform and my template) at the time of maximum derivative
    - The better performance is with $A_{wave(t_{maxDerivative})} > 5$ mA (~1.2 MeV)
  - Threshold to save the hit reconstructed
    - The better performance is with $E_{wave} > 2$ MeV



ENERGY DISTRIBUTION

Single hit
Multi hit





- Reconstruction of single positron run w/o saturated waveform

Single Hit

$\mu = 495.5 \pm 0.1$

$\sigma = 15.84 \pm 0.11$

Multi Hit

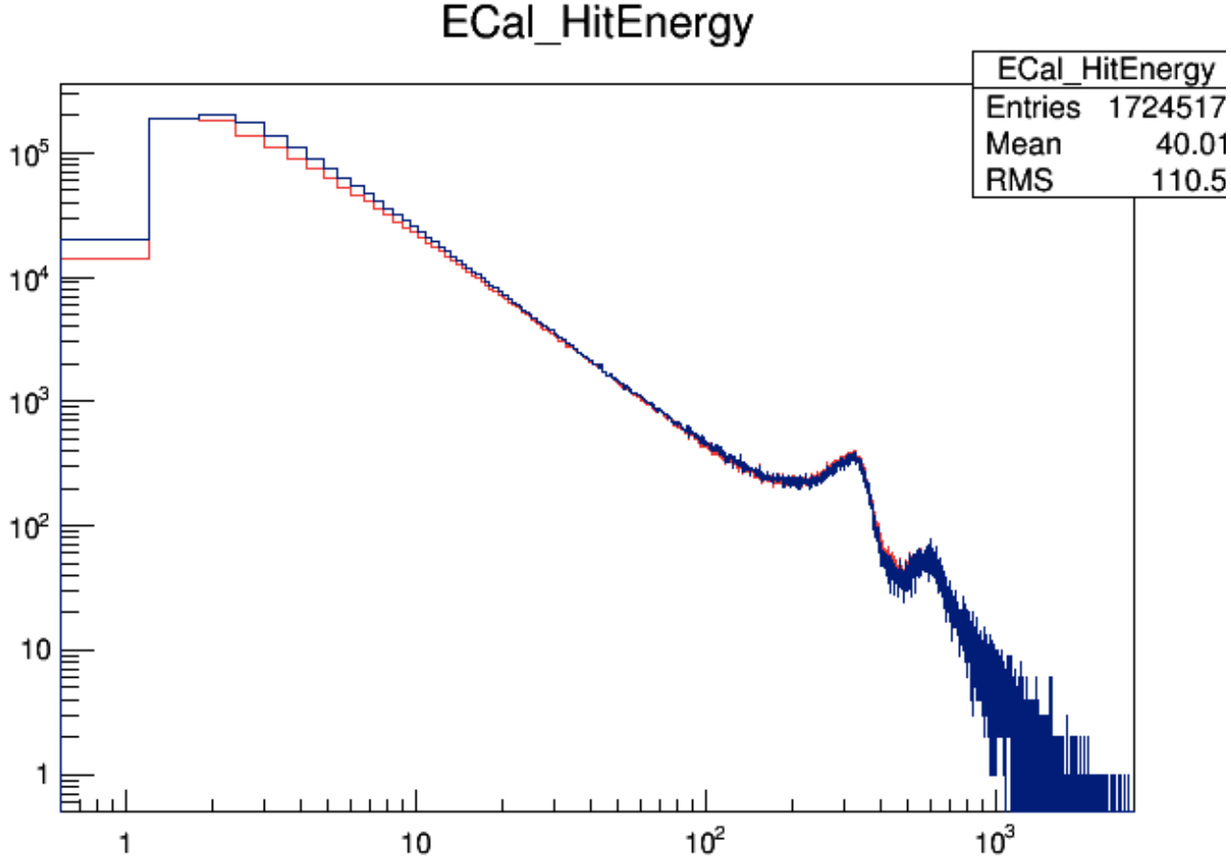
$\mu = 495.5 \pm 0.1$

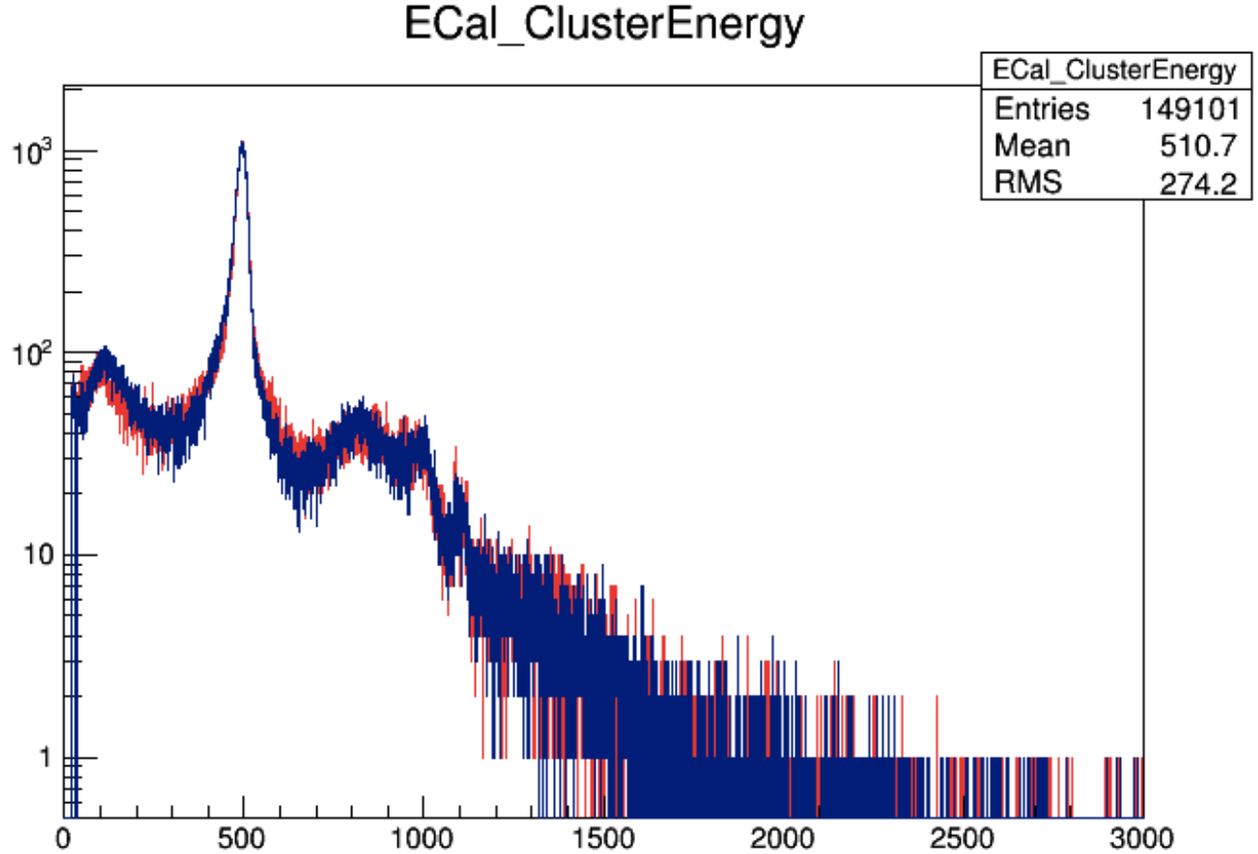
$\sigma = 15.07 \pm 0.15$

PROBLEMS OF SINGLE POSITRON RUN

Single hit
Multi hit

- When two positrons hit a single channel I observe a saturated waveform
  - I reconstruct this waveform as a single hit
  - The hit energy distribution has a second peak
  - No relevant differences between the single and multi hit reconstruction





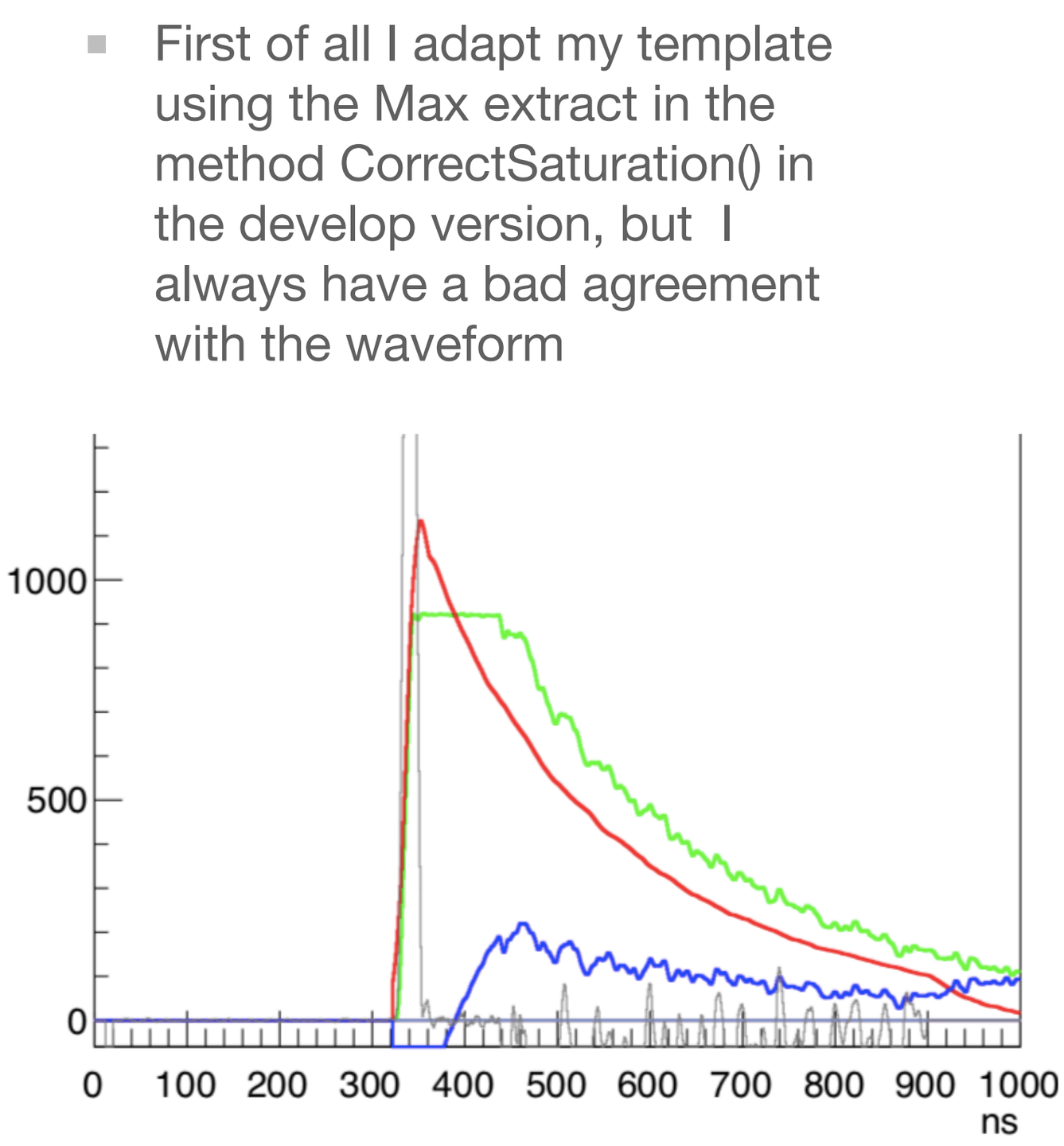
START TO WORK ON SATURATED WAVEFORM

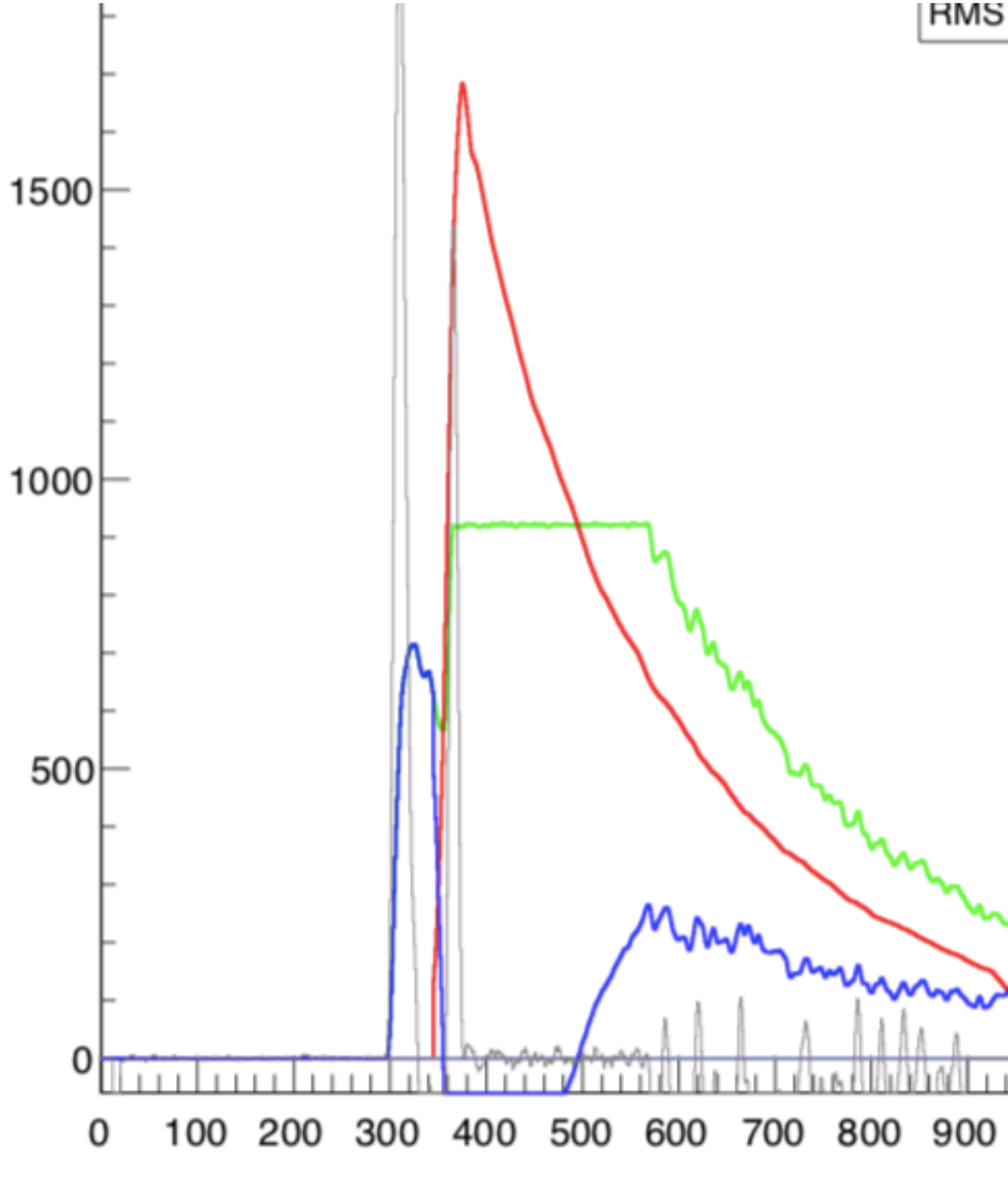
SATURATED WAVEFORM MH

- In saturated waveform I don’t have the maximum of the voltage->I’m not able to adapt my template
  - For this reason in my MH the saturated waveform is considerate a single hit
  - But:
    - I have a saturated waveform when there is al least two hit with high energy!
      - It is useful to fix this problem!

DEVELOP VERSION OF NSAT

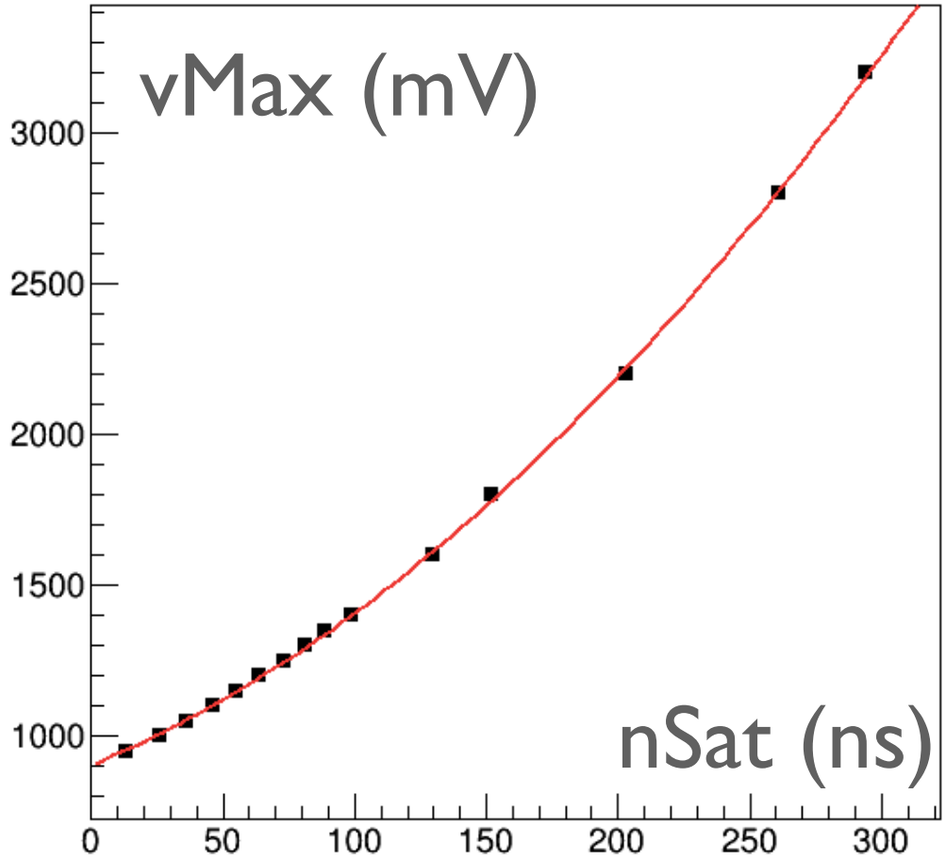
- First of all I adapt my template using the Max extract in the method CorrectSaturation() in the develop version, but I always have a bad agreement with the waveform





ESTIMATION OF VMAX

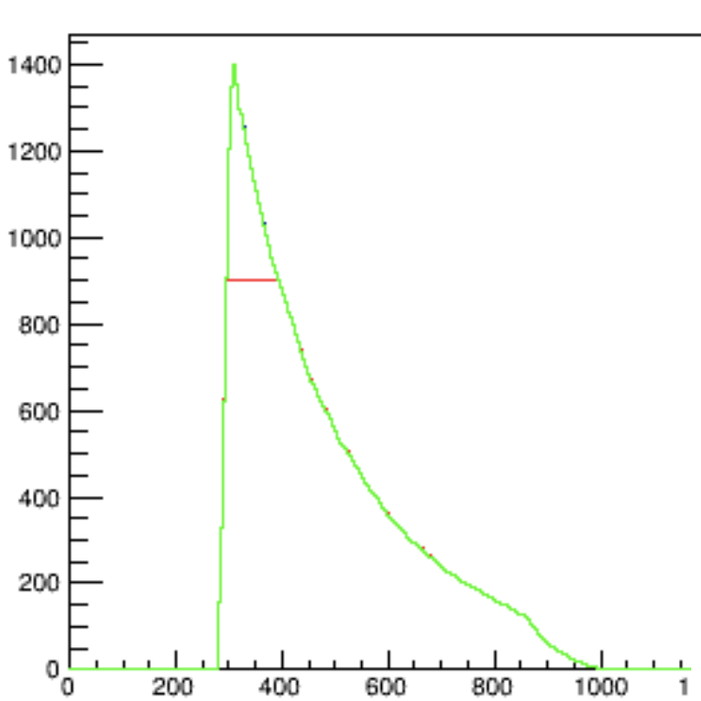
- In order to extract a value on Vmax, I used the correlation between Max and N Δsat
- I take my template and normalised it for different value of vMax;
- I saturated this waveform at 900 mV (like data)
- I save the real vMax and the nSatBin, so I studied the correlation

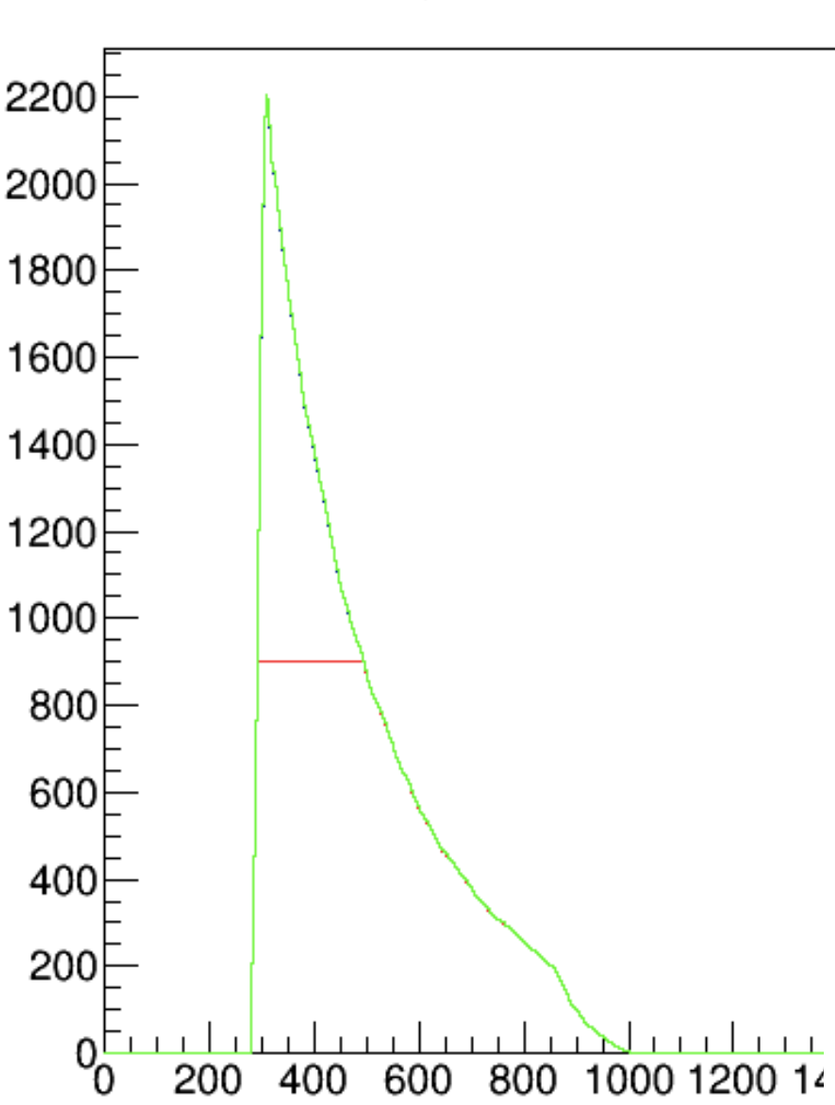


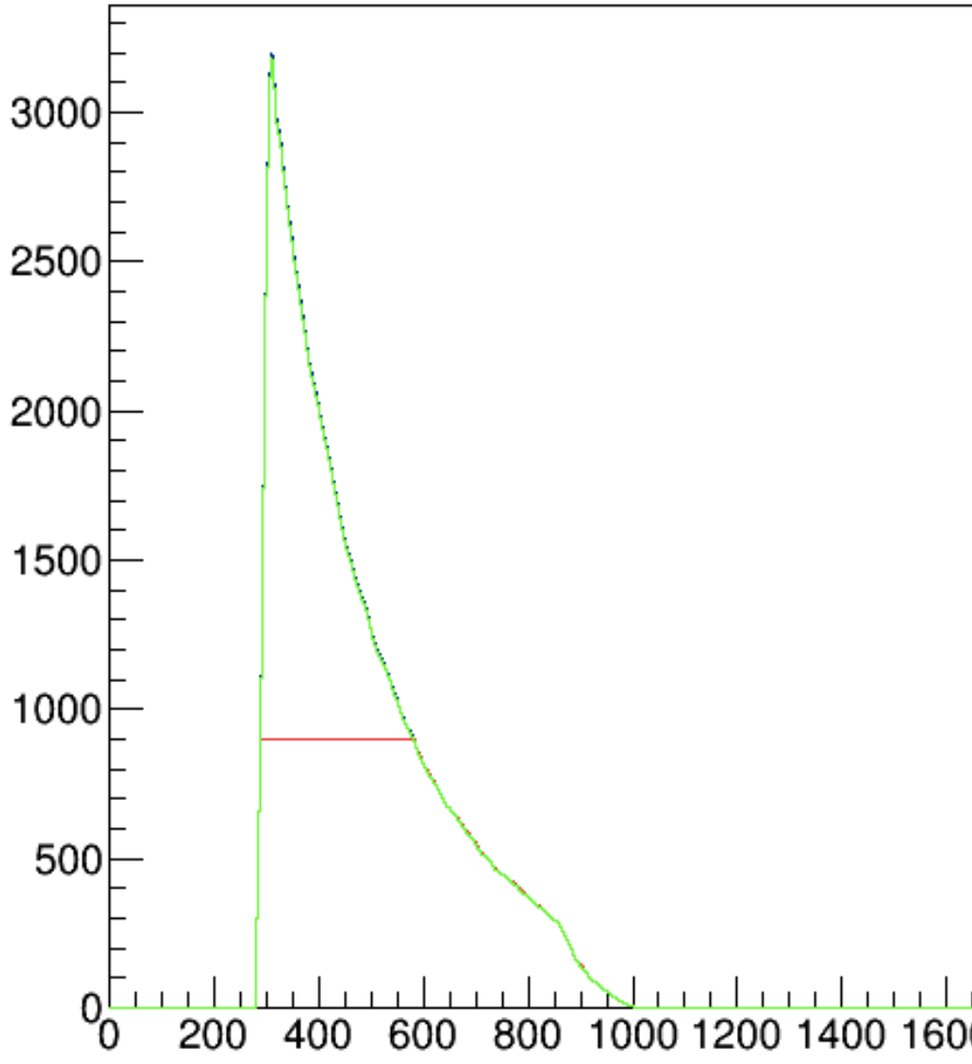
There are different value of saturation, for this reason I studied this correlation for V

$$V_{sat}^{max} = 750,\ 800,\ 850,\ 900\ \text{mV}$$

CORRELATION BETWEEN VMAX AND NSAT



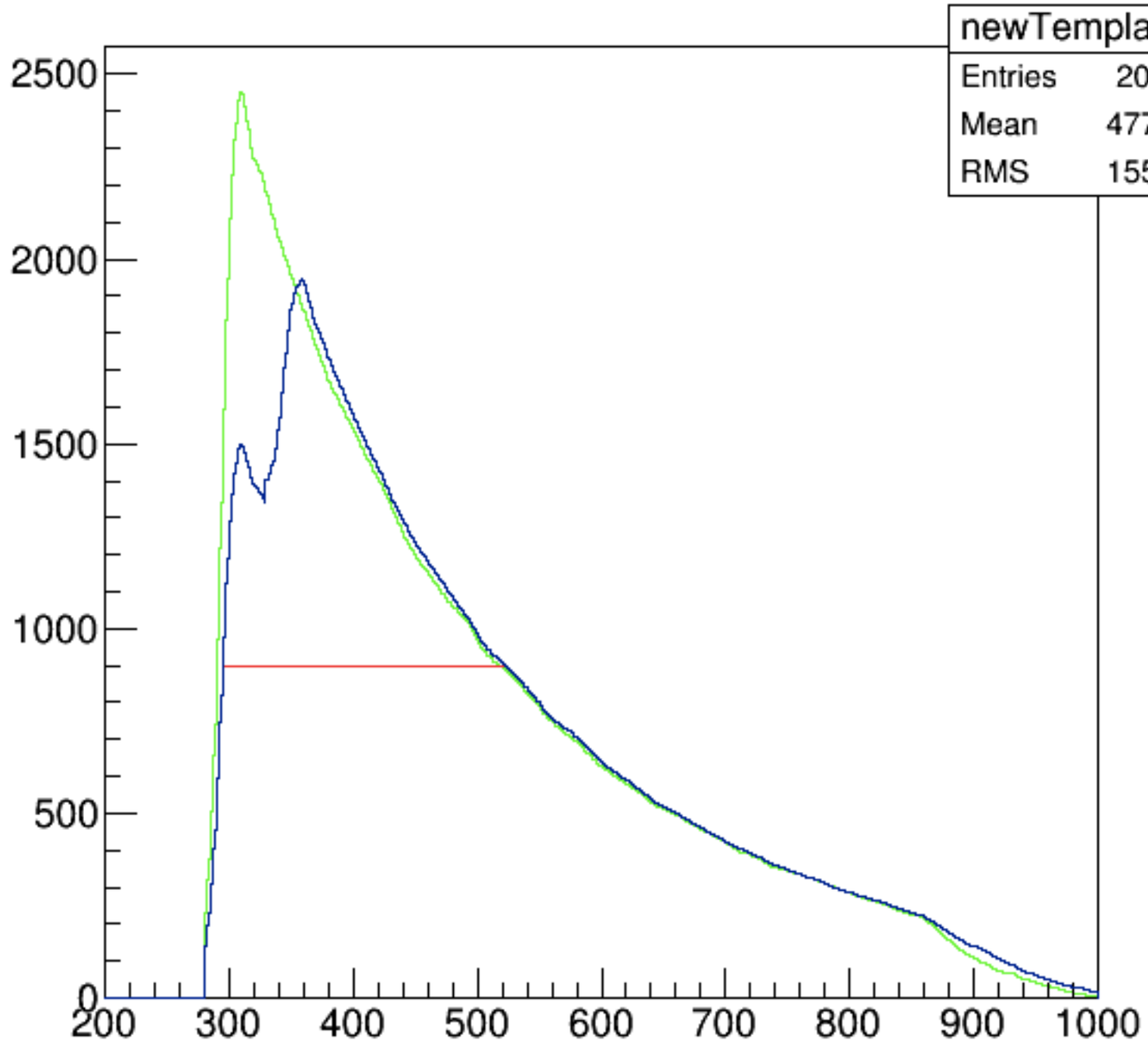




Template
saturatedTemplate
CorrectedTemplate

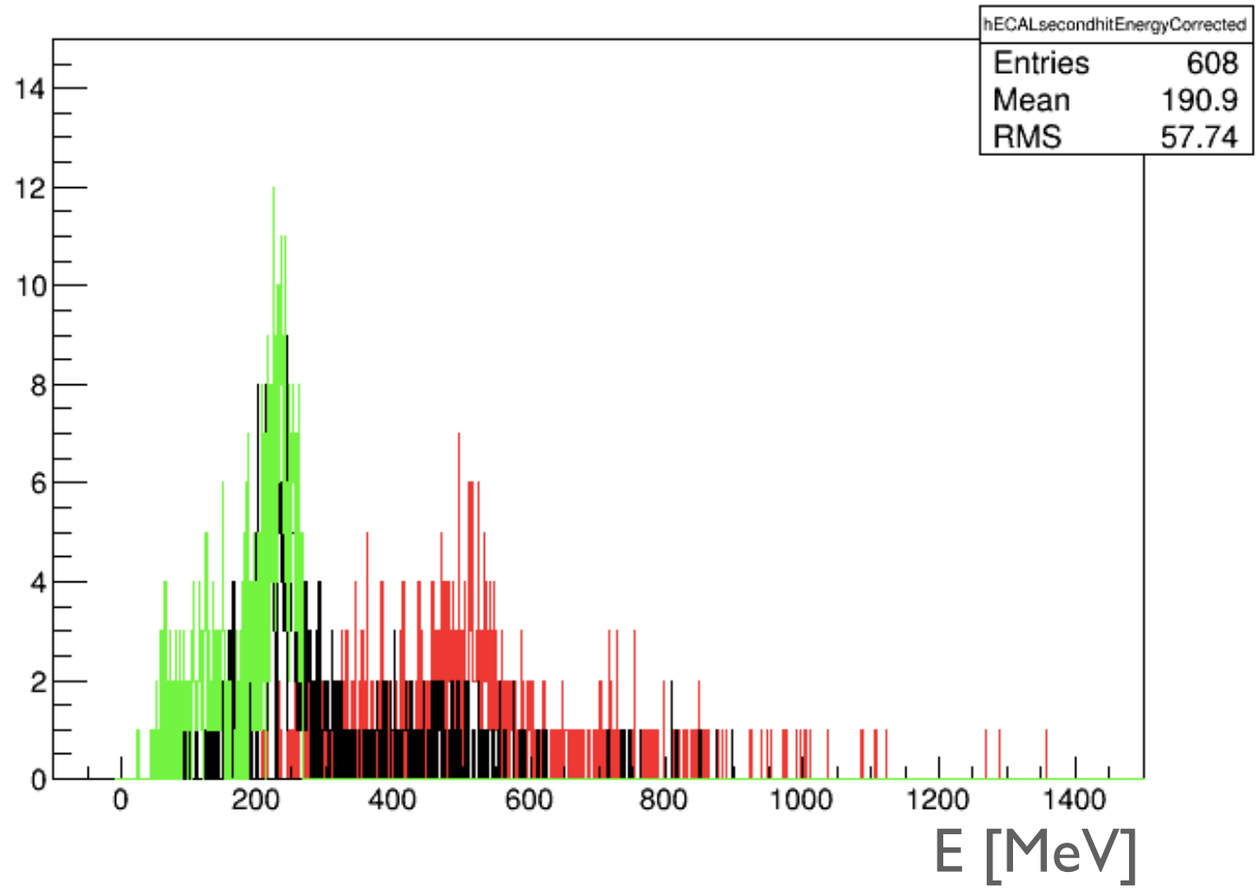
PROBLEMS

- It is impossible to understand when I have a second saturated hit over the V_{max}^{sat}



MH RESULTS

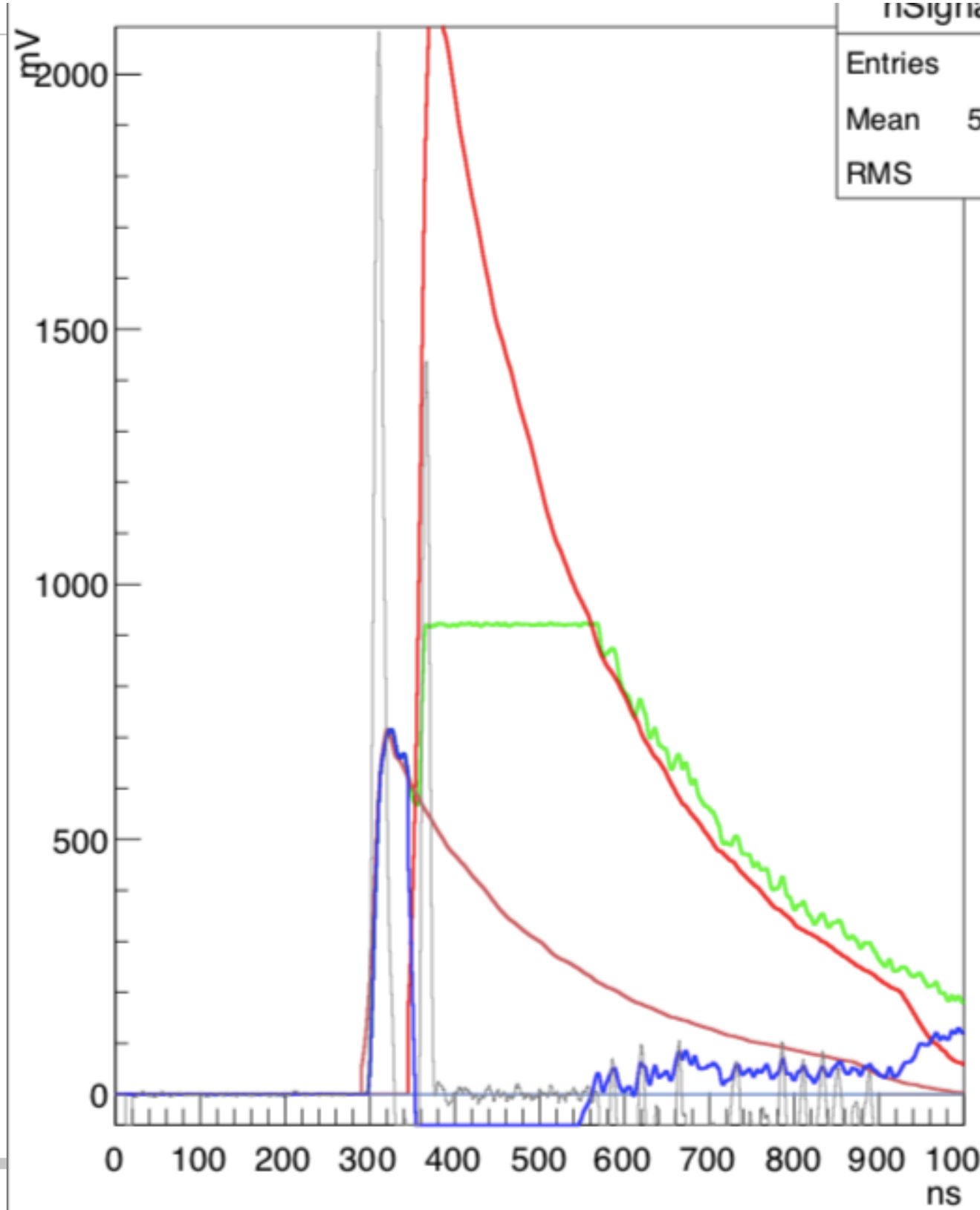
5k ev reconstructed



SH estimation

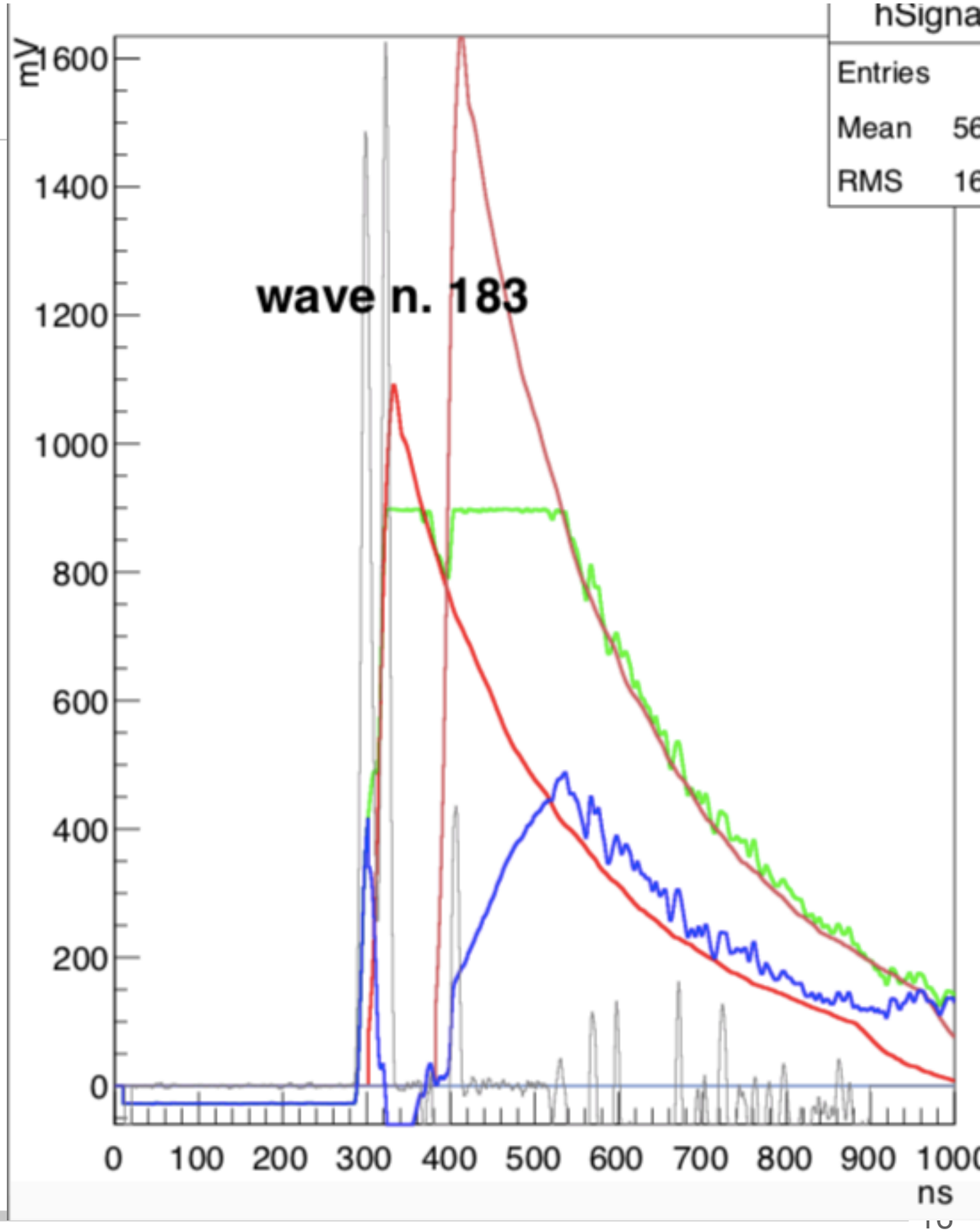
First hit energy (MH)

Second hit energy (MH)

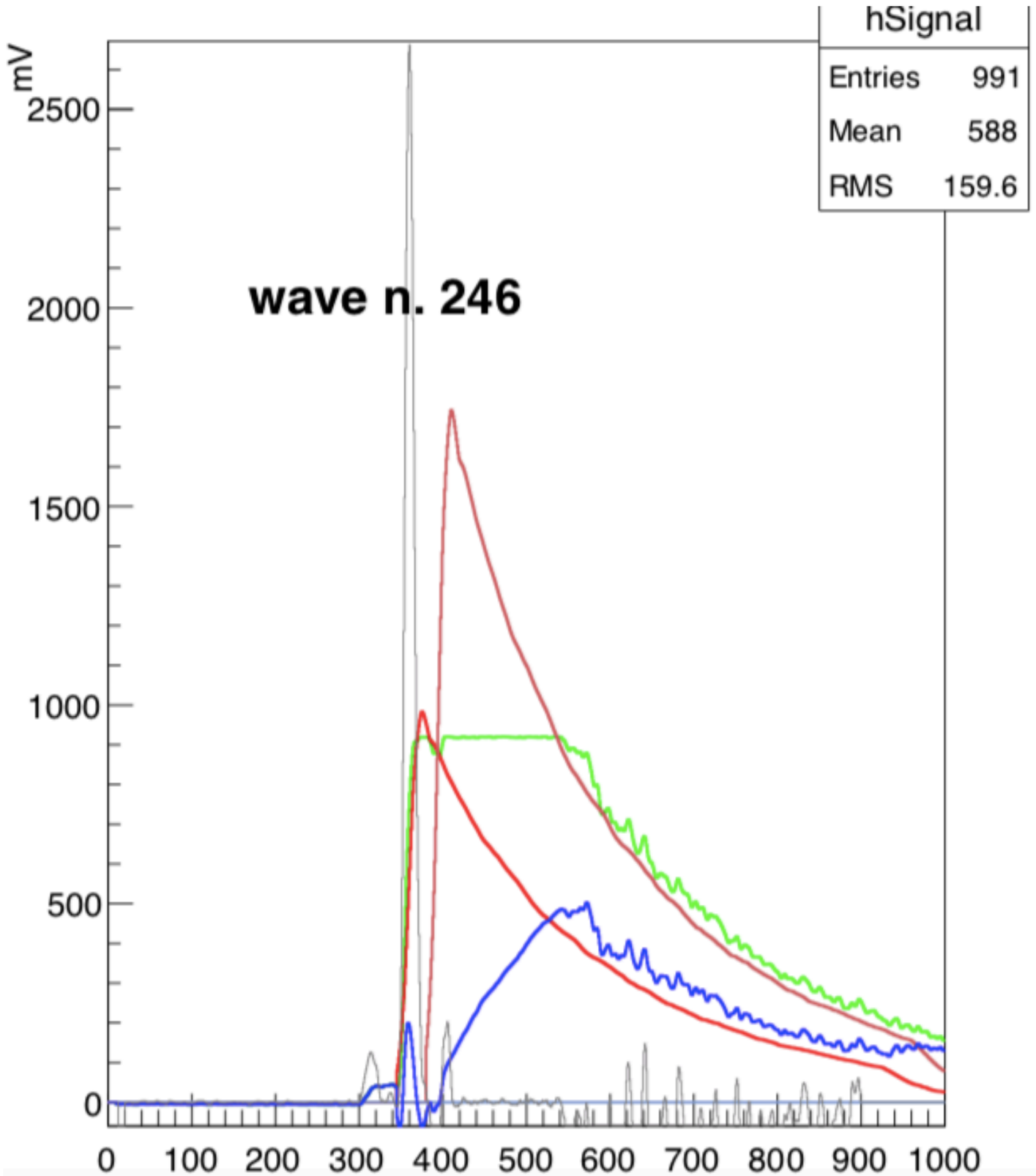


DOUBLE SATURATED

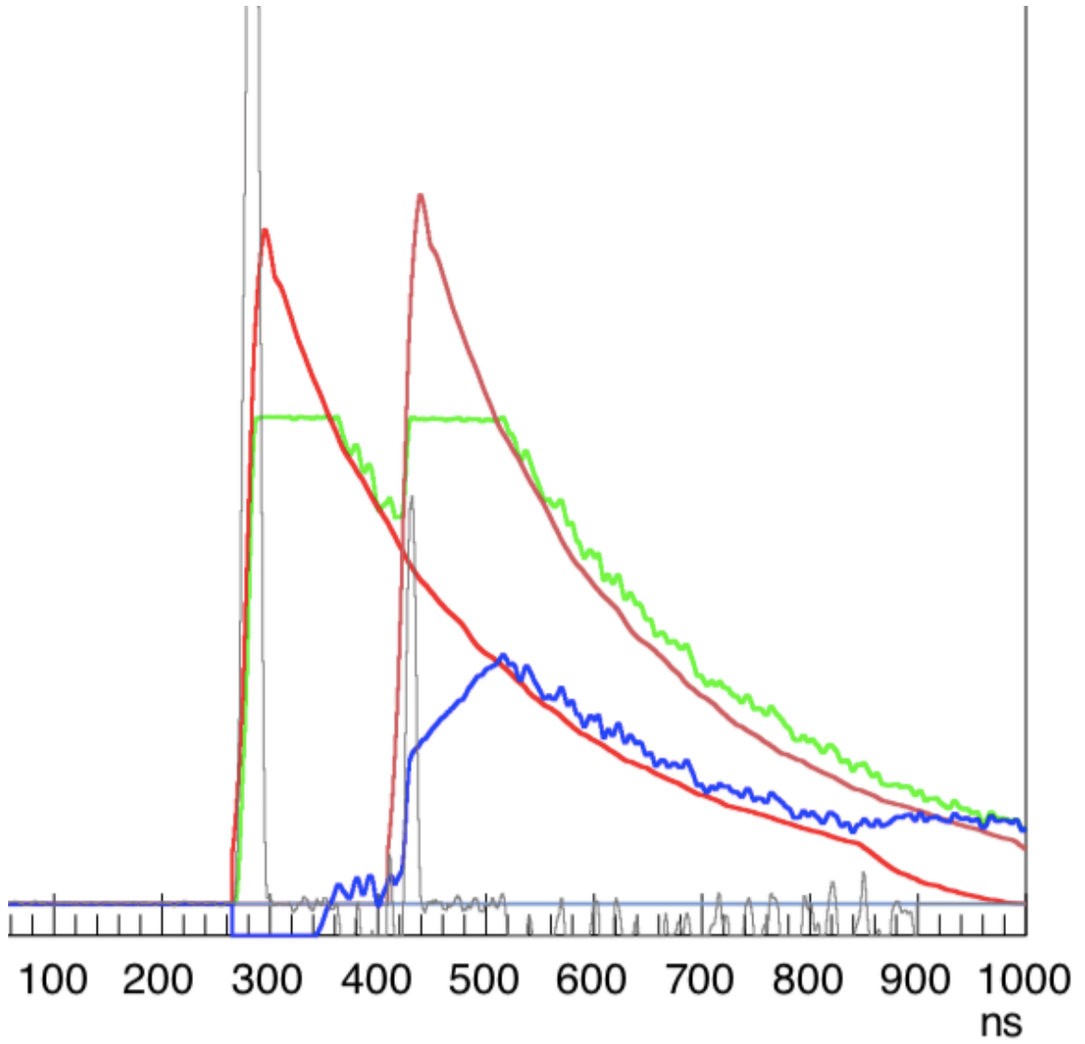
- In single positron run there are more waveform that shows a double hit saturation
  - I adapt two templated on this waveform studying the starting time of each saturation and the Δsat
- The energy is extract using the template for both the signals
  - The second energy is corrected subtracting the tail of the first signal.



EXAMPLES OF DOUBLE SATURATION

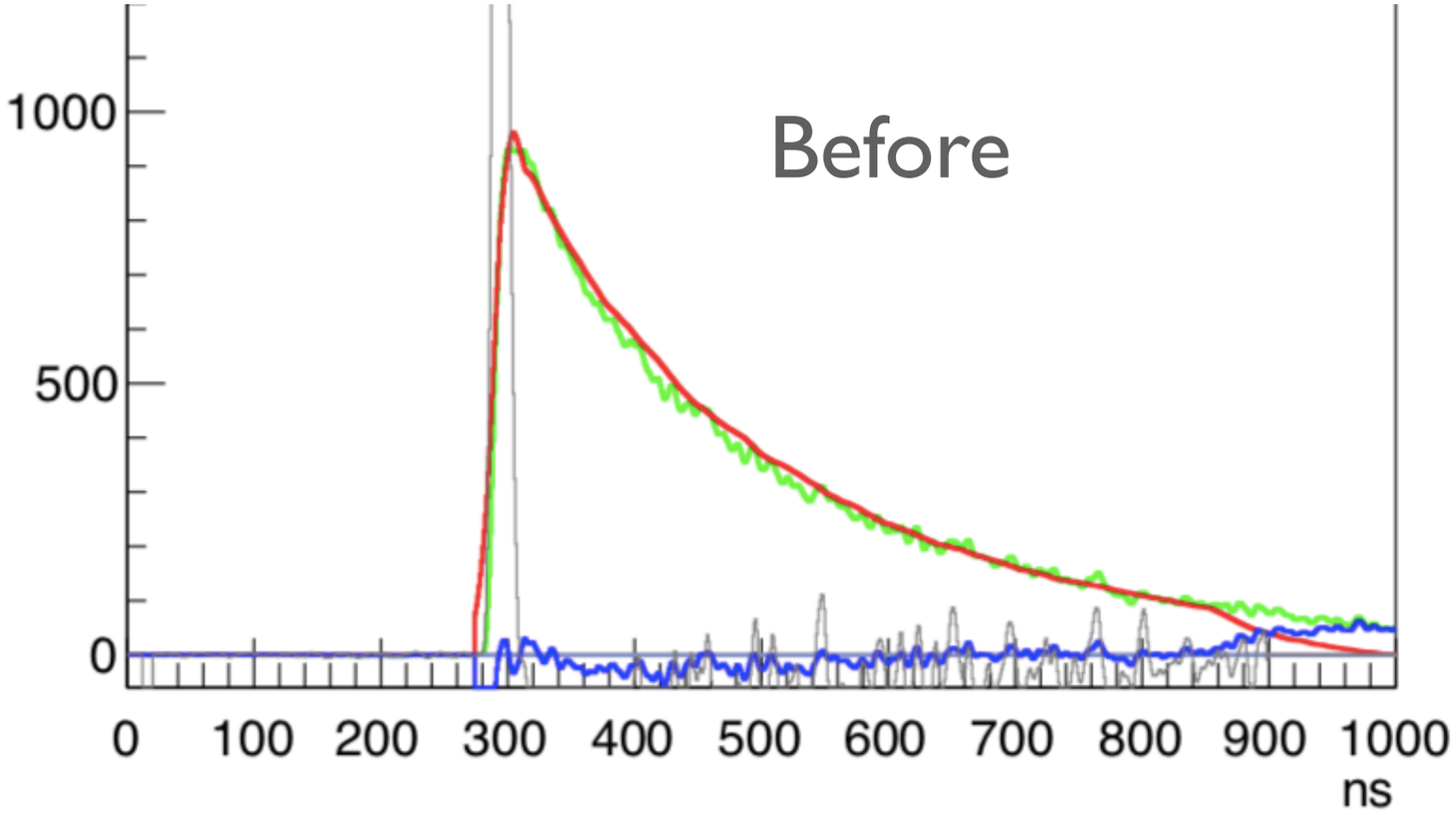


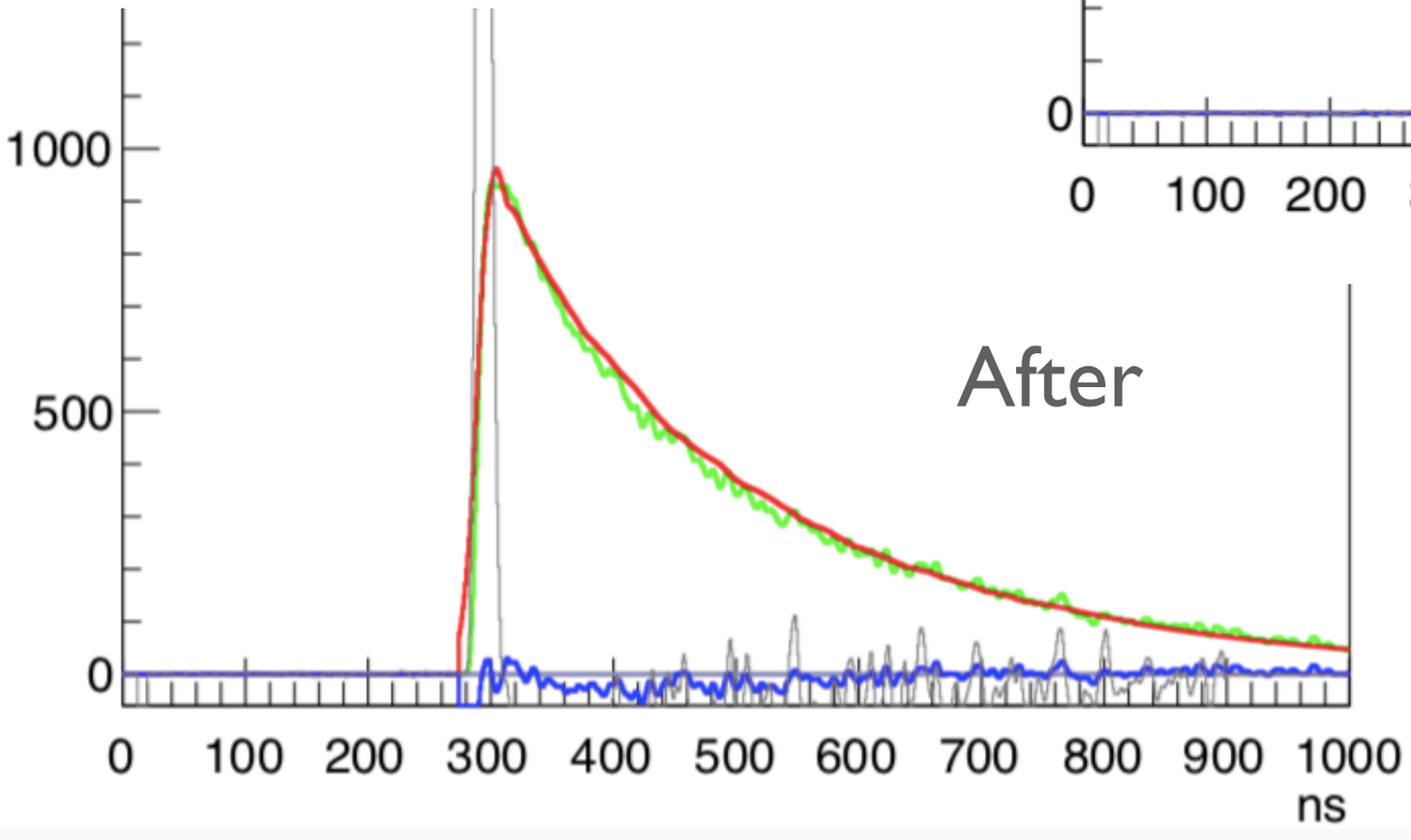
The difference with the template in this case in not used



OTHER IMPROVEMENTS

- I corrected the tail of the template (due to the end of the DAQ window) using an exponential





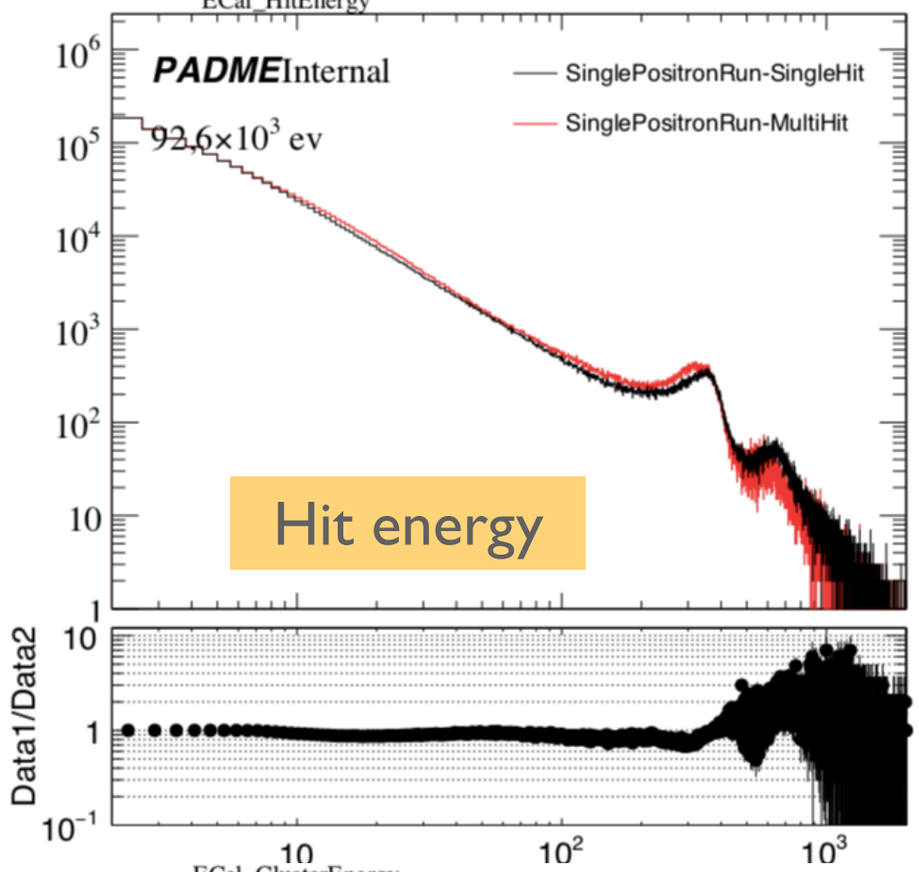
DATA

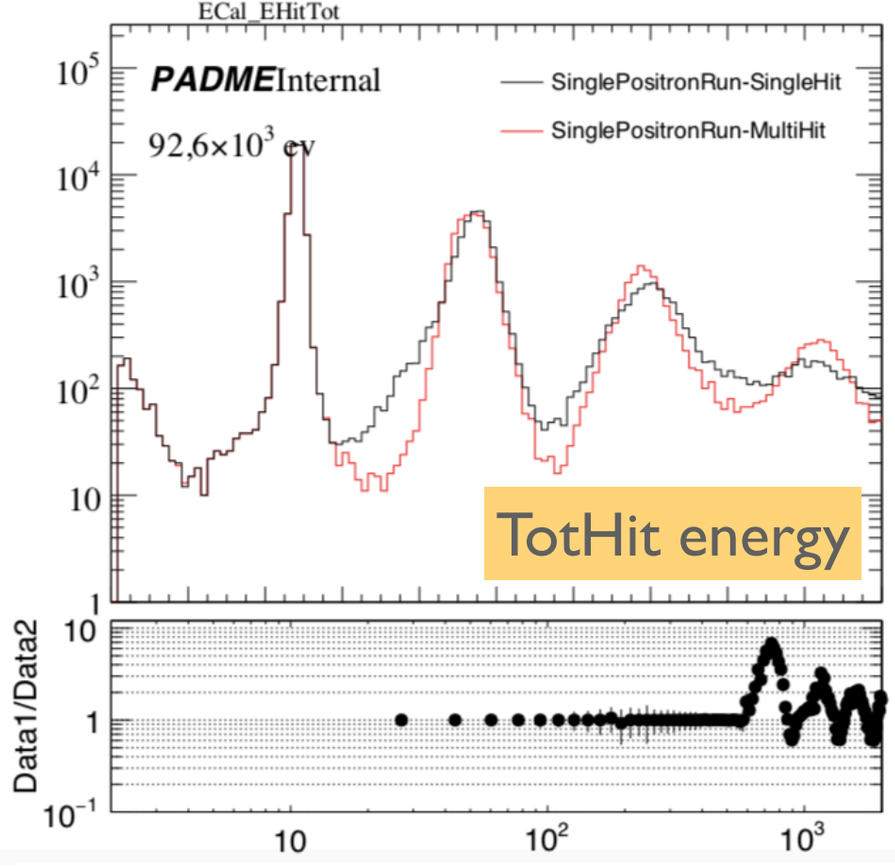
RESULTS

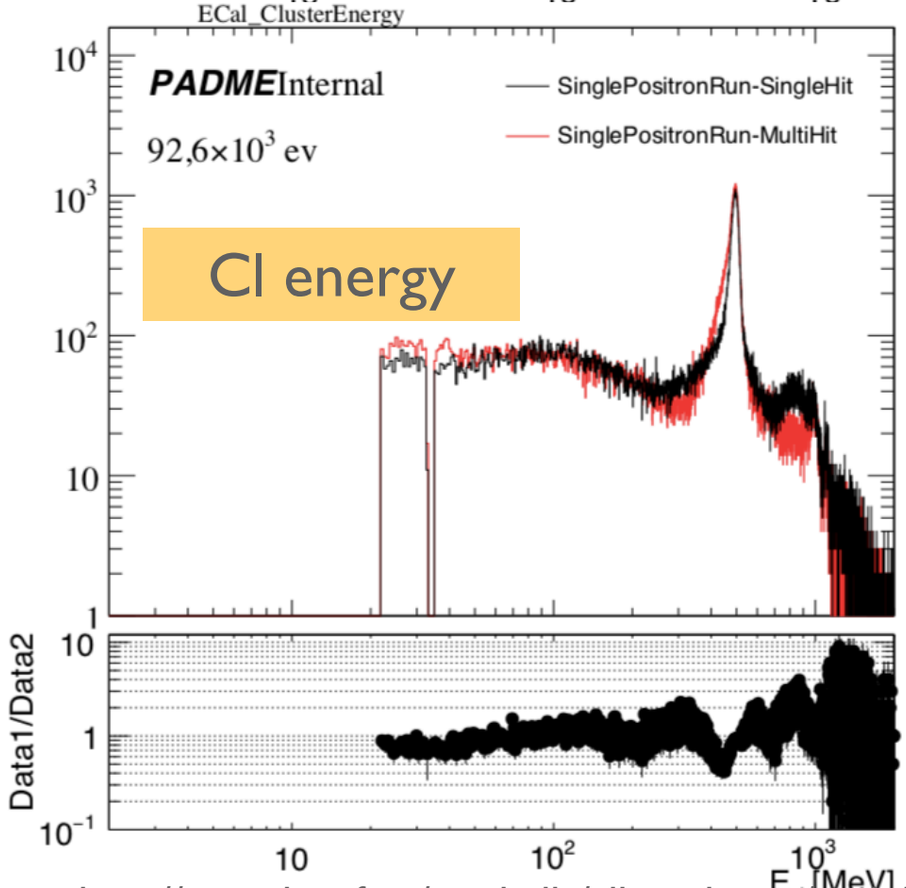
recoMH

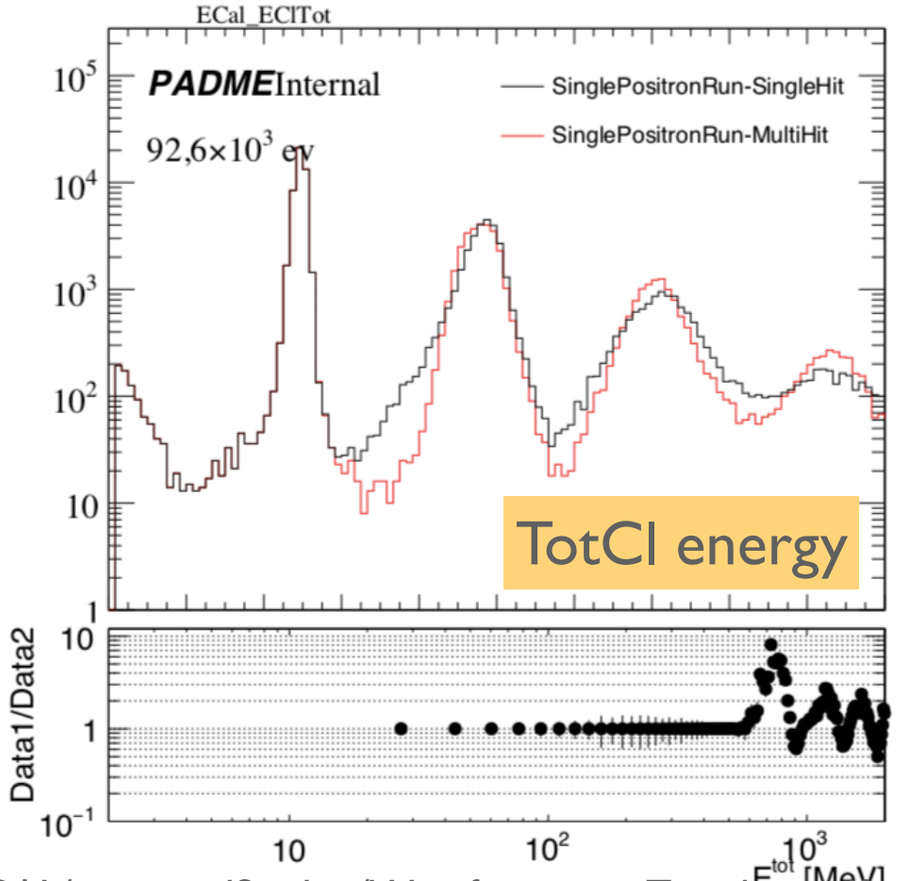
Reco SH

- Worst second peak resolution…. maybe due to the bad agreement between my template and the saturated waveform on the tail ?!
- But how to correct it? The top of waveform seems is in good agreements..!









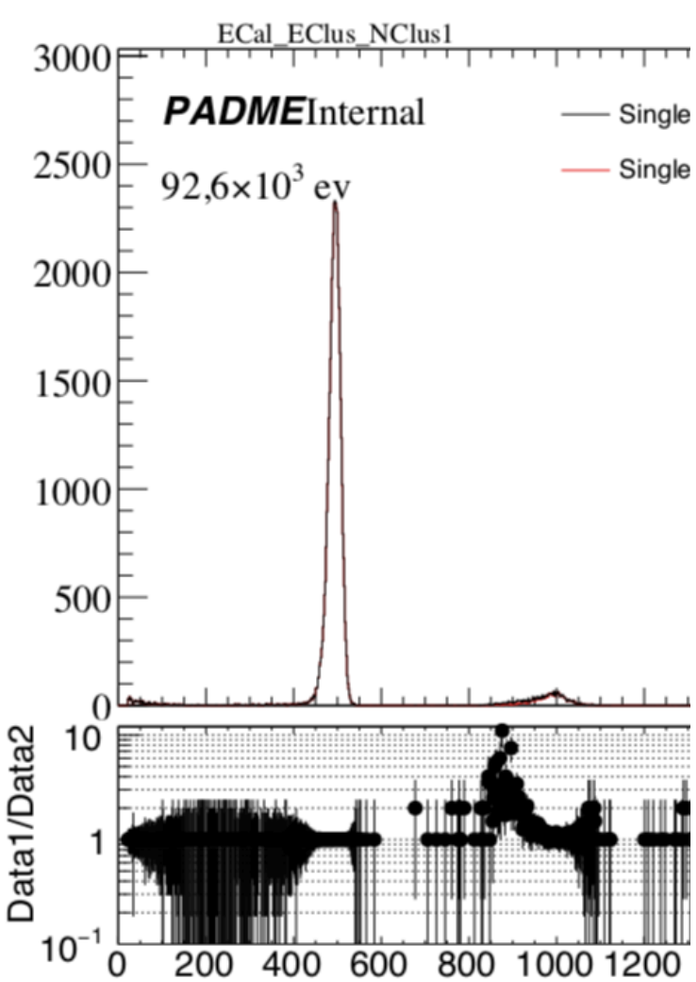
http://www.le.infn.it/~isabella/allow_listing/multihitECAL/saturatedStudies/Waveform_newTemplate.pdf

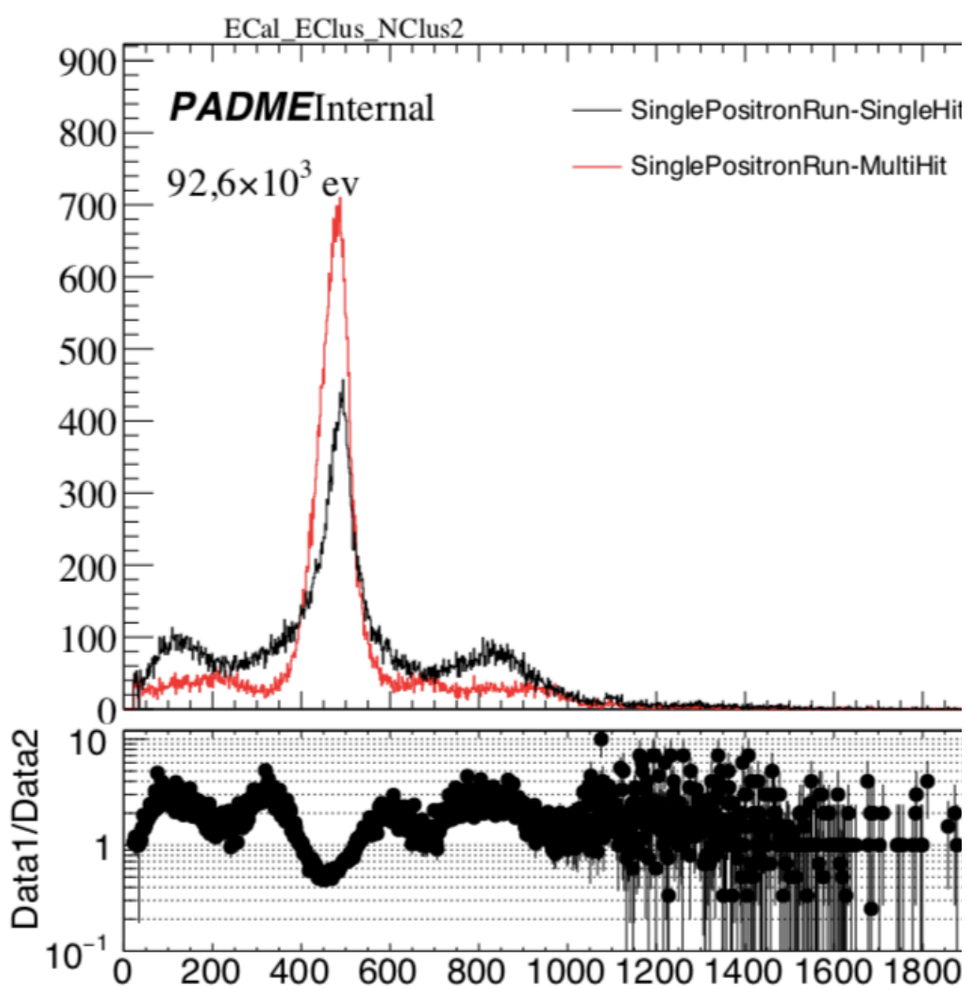
http://www.le.infn.it/~isabella/allow_listing/multihitECAL/AnalysisHisto_MCSinglePositron_SingleHitMultiHitAllEvents.pdf

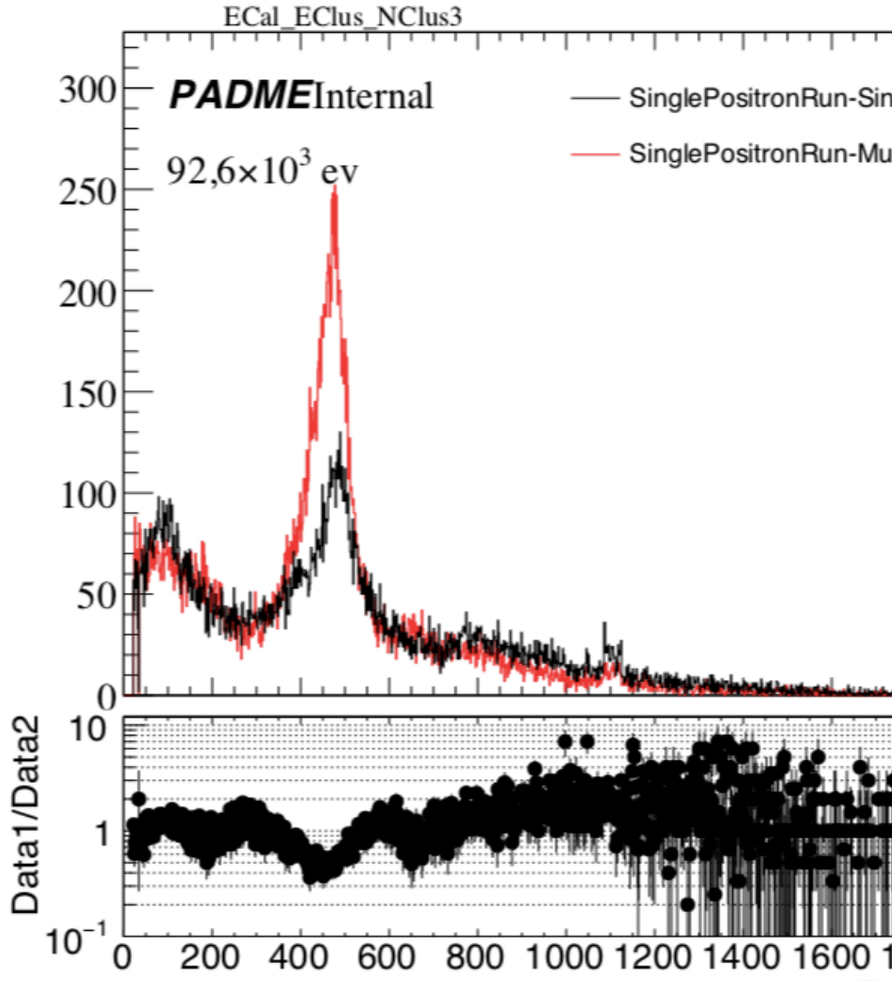
COMPARISON ON DATA BETWEEN SINGLE AND MULTI HIT RECONSTRUCTION

recoMH
Reco SH

- Distribution of cluster energy when I have 1 (2 and 3) cluster / bunch



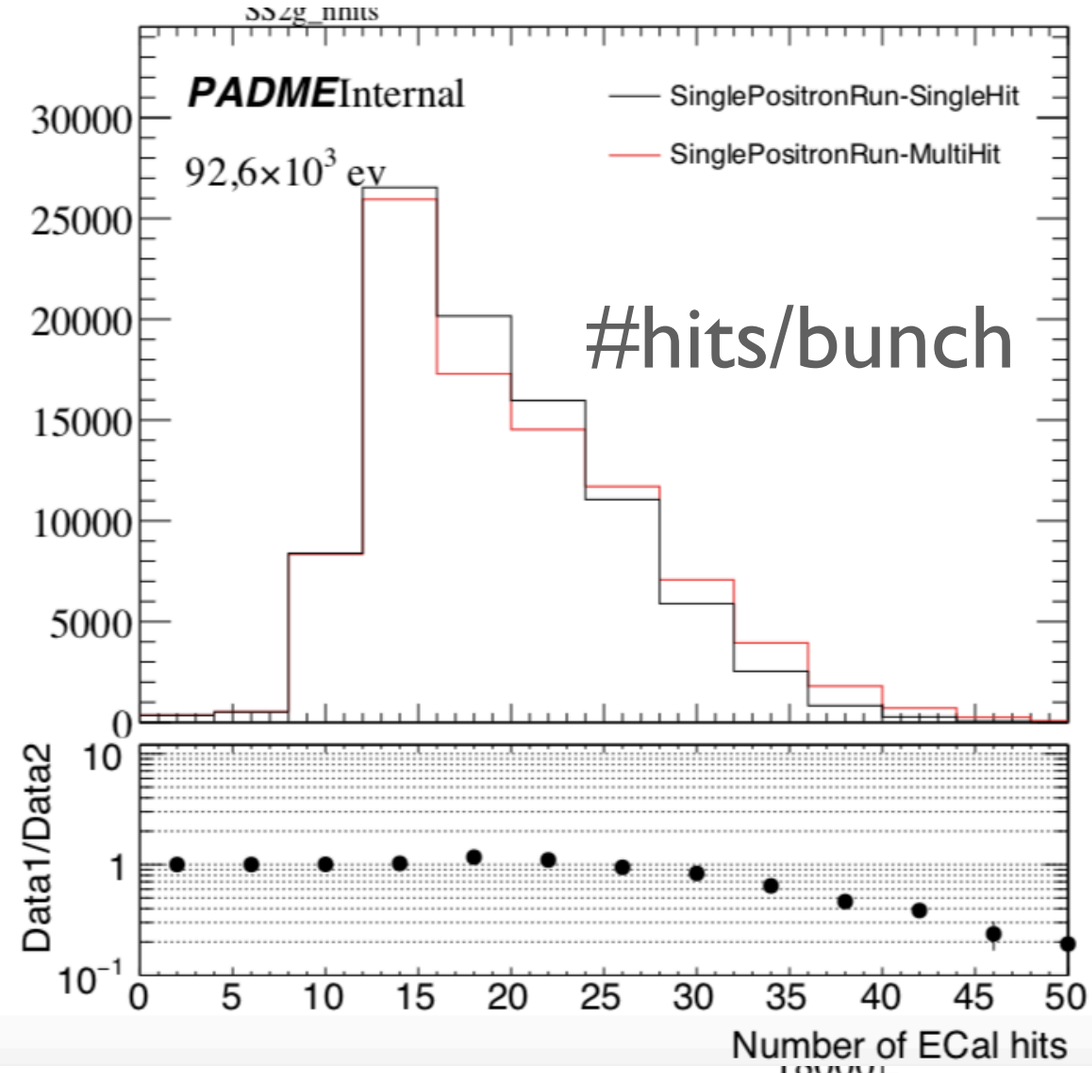


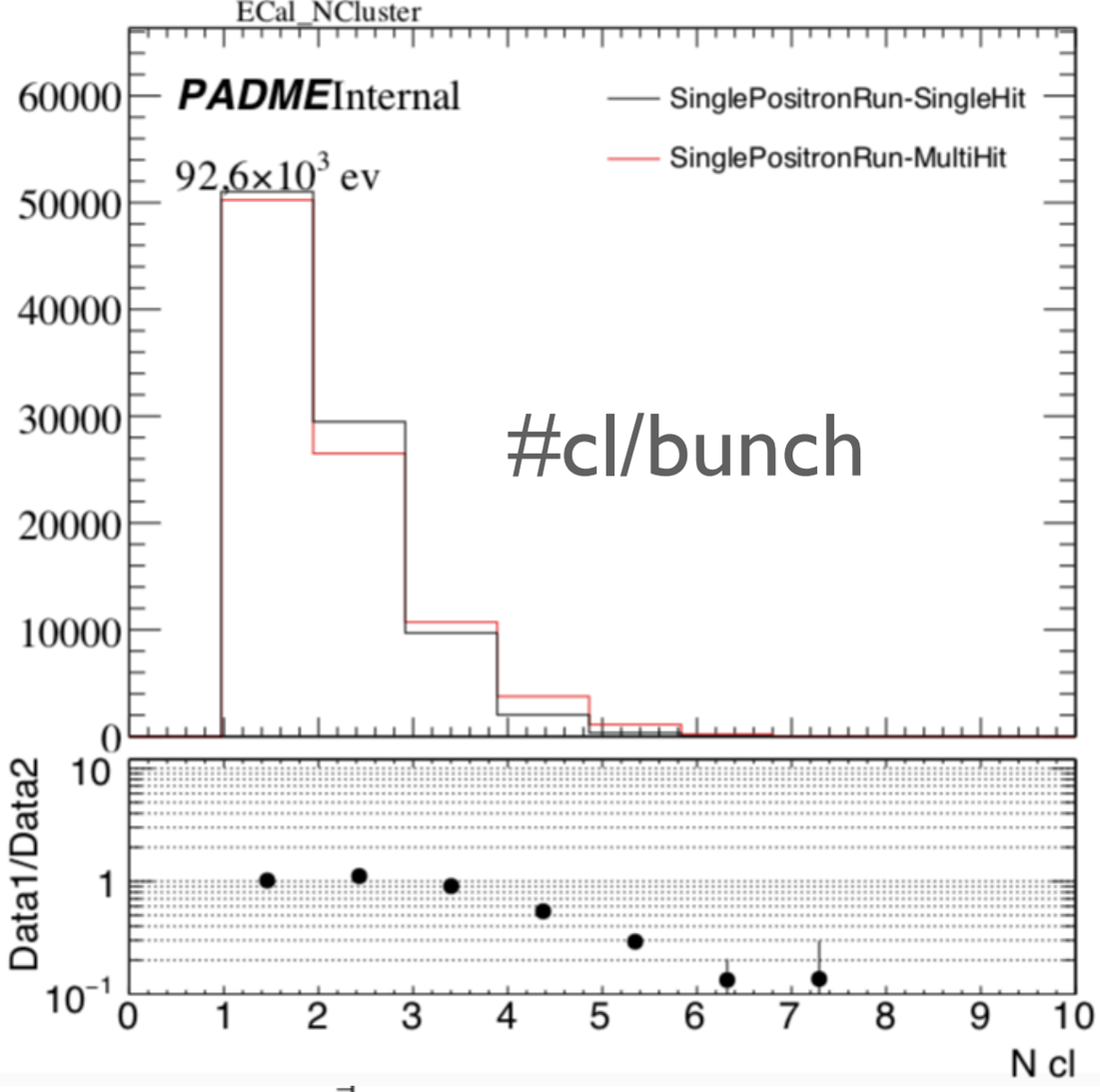


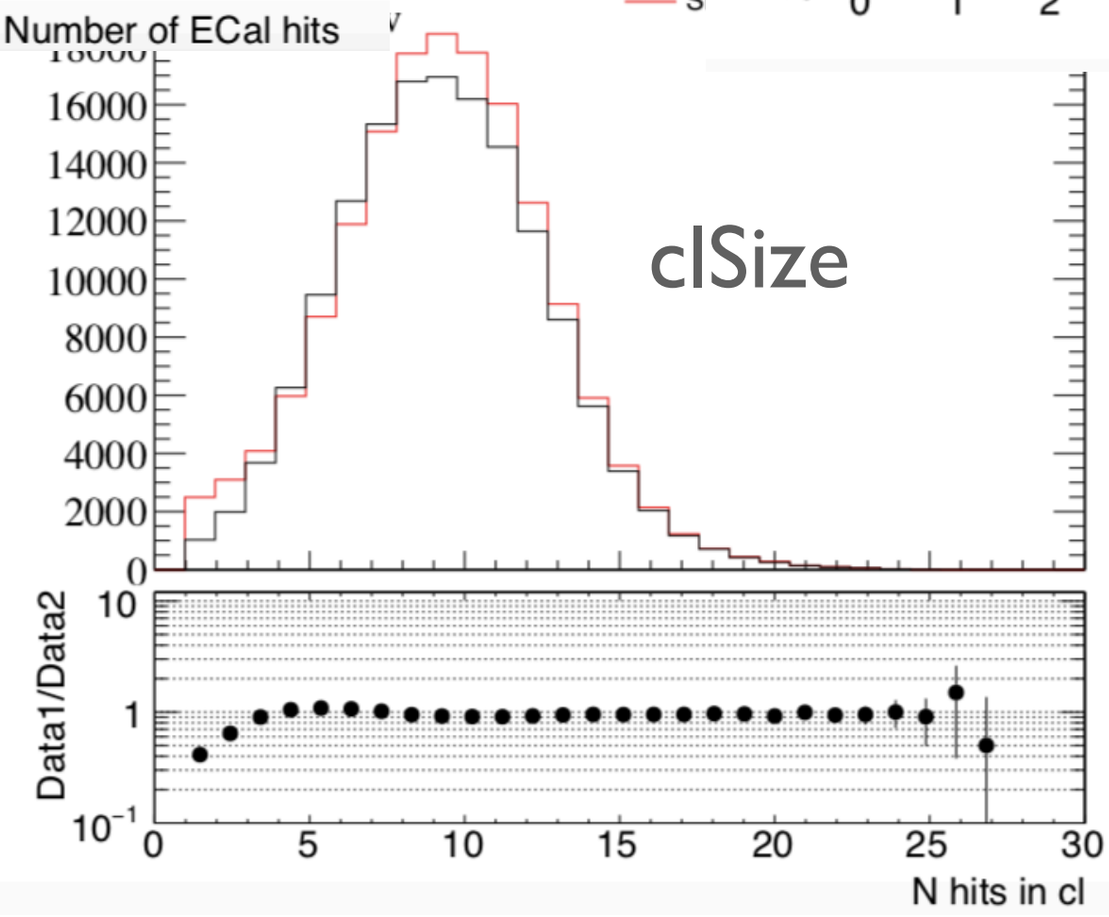
1 cl in ECAL

2 cl in ECAL

3 cl in ECAL







recoMH
Reco SH

DATA

Let's have a look on MC single positron in ECAL

MC SAMPLES

- Production of single positron in ecal (#e+ Poisson(1));
  - Beam before the target position;
    - I’ve several problems with the production of the beam at the Bew..with few e+/bunch I don’t see anything the the ecal
      - True for different value of padme B -also in SAC-
  - No spread;
    - 300k events.

- Reconstruction:
  - Single hit no energy/time spread ;
  - Single hit +energy/time spread ;
  - Ideal multi hit (time window digitiser 5. ns);
  - Ideal multi hit (time window digitiser 5. ns) + ZSup;
  - Ideal multi hit (time window digitiser 25. ns) + ZSup;

DATA SAMPLES

- Run single positron of March
  - 92608 events.

Comparison between Single Hit reconstruction data/MC

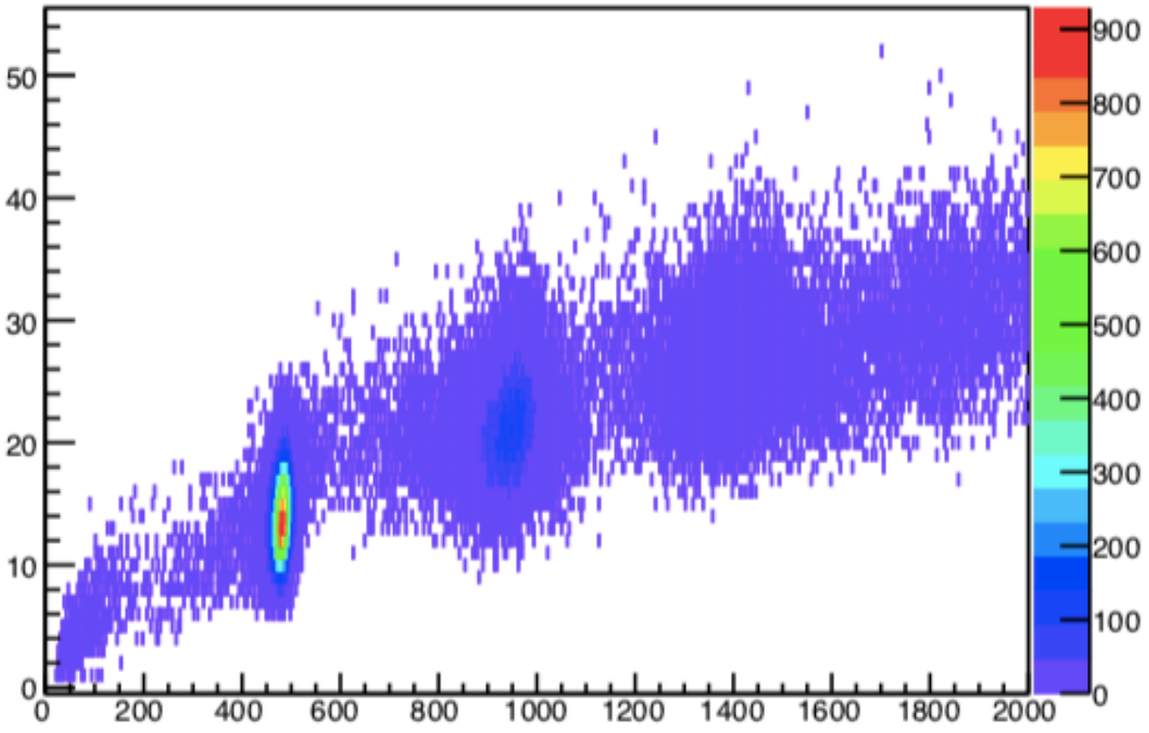
- w/o spread: http://www.le.infn.it/~isabella/allow_listing/multihitECAL/AnalysisHisto_singlePositronInEcal_singleHitRecodataMCWithSpread.pdf
- With energy and time spread: http://www.le.infn.it/~isabella/allow_listing/multihitECAL/AnalysisHisto_singlePositronInEcal_singleHitRecodataMCWithSpread.pdf

SINGLE HIT RECONSTRUCTION

- Study the sample MC with energy and time spread
  - MC w/o spreads has the same feature
- Develop single hit reconstruction for data

Data

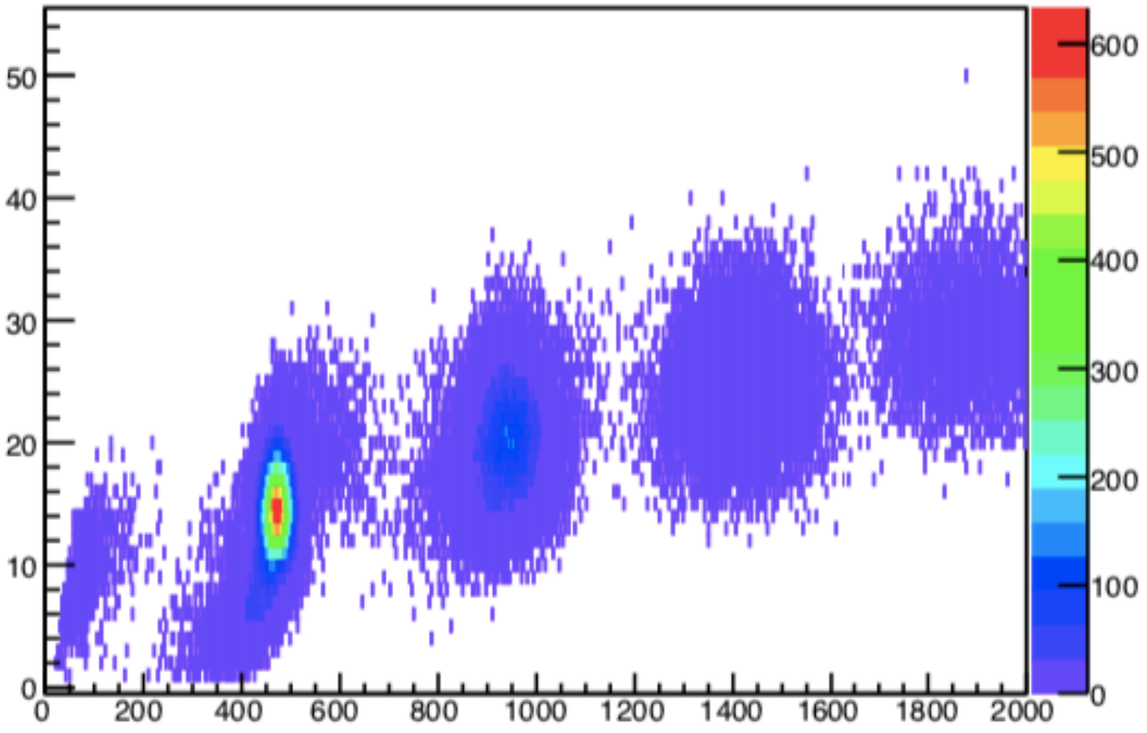
#hits/bunch



E_{hit}^{tot} [MeV]

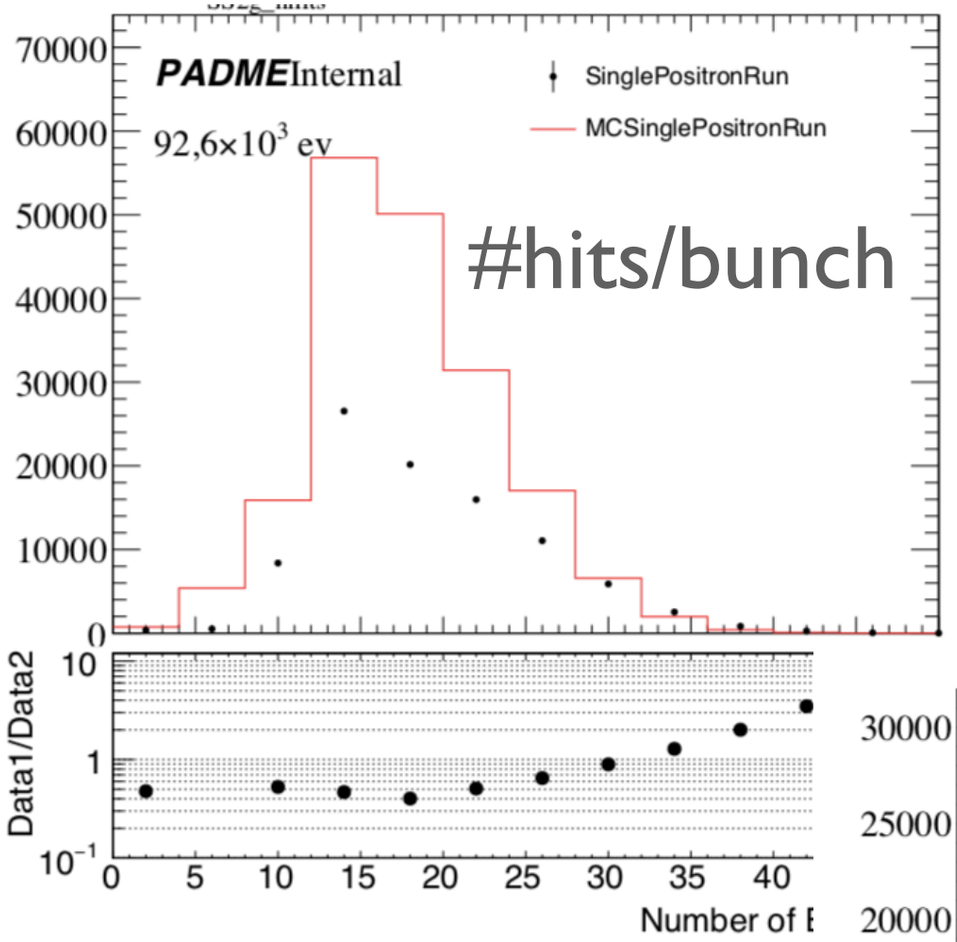
MC

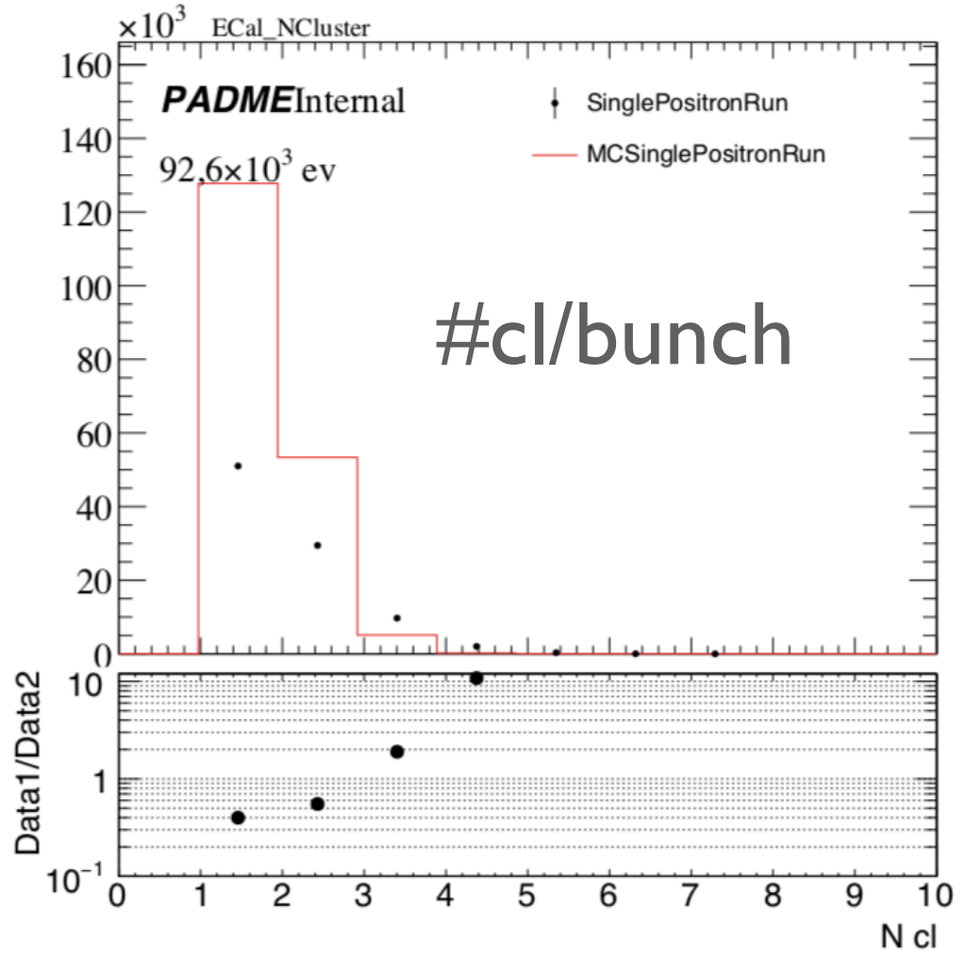
#hits/bunch

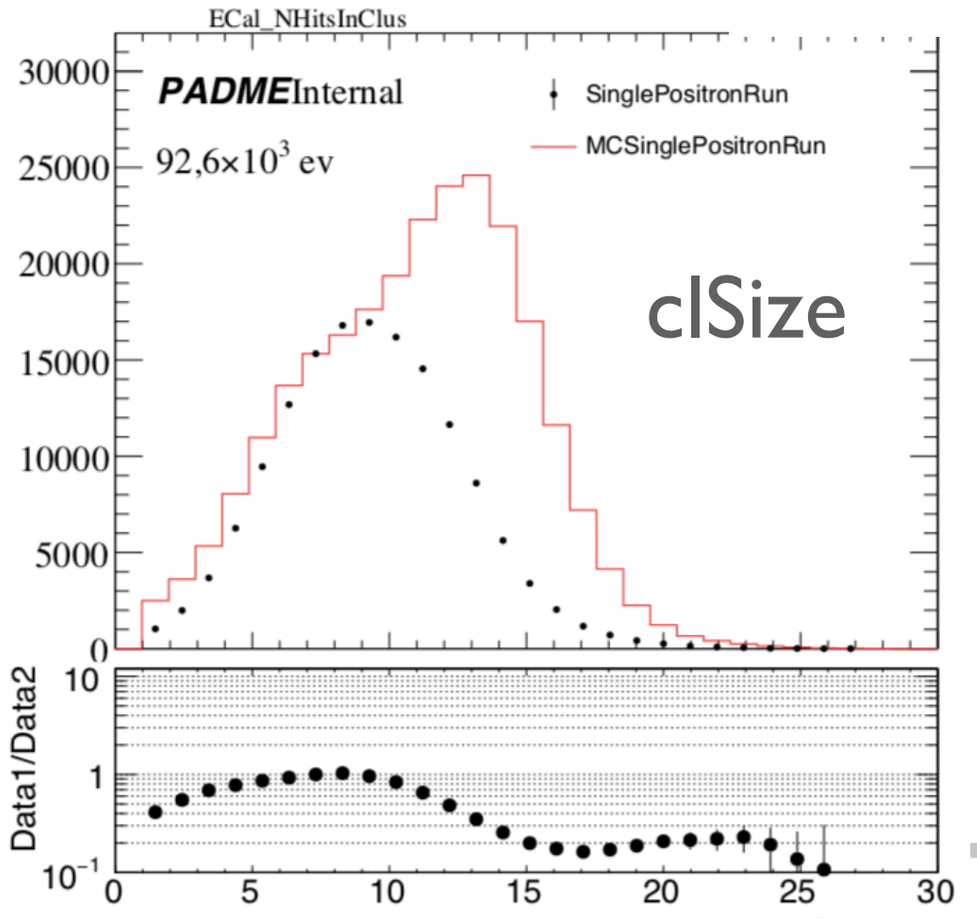


E_{hit}^{tot} [MeV]

#HITS, #CLUSTER & CLSIZE

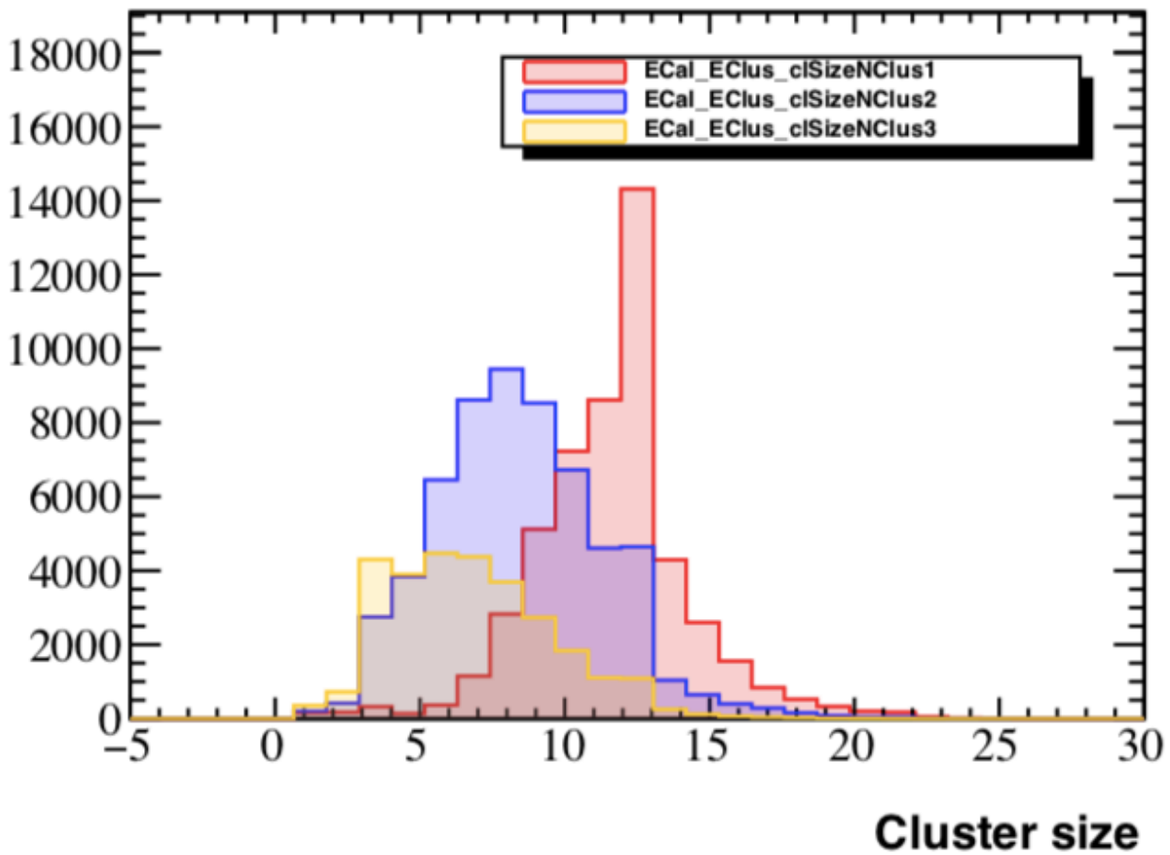




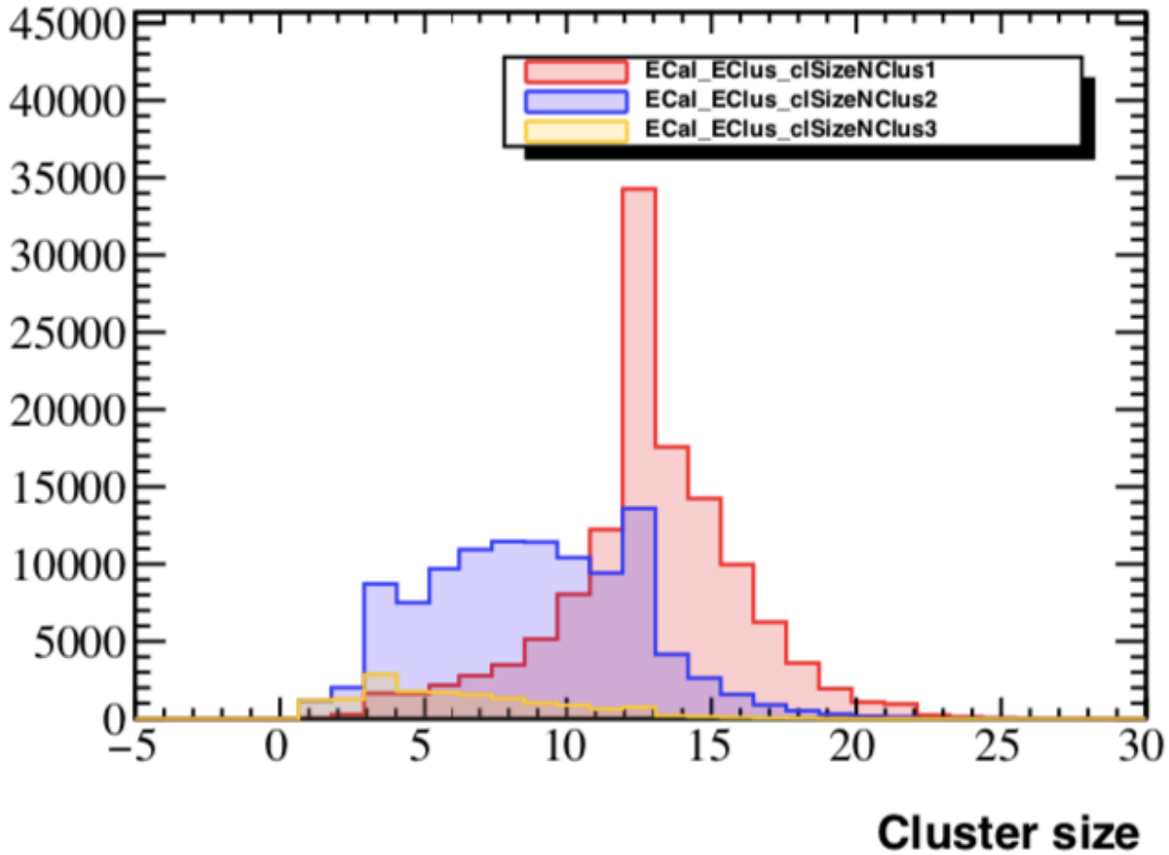


CLUSTER SIZE FOR NCL=1(2,3)/BUNCH

Data

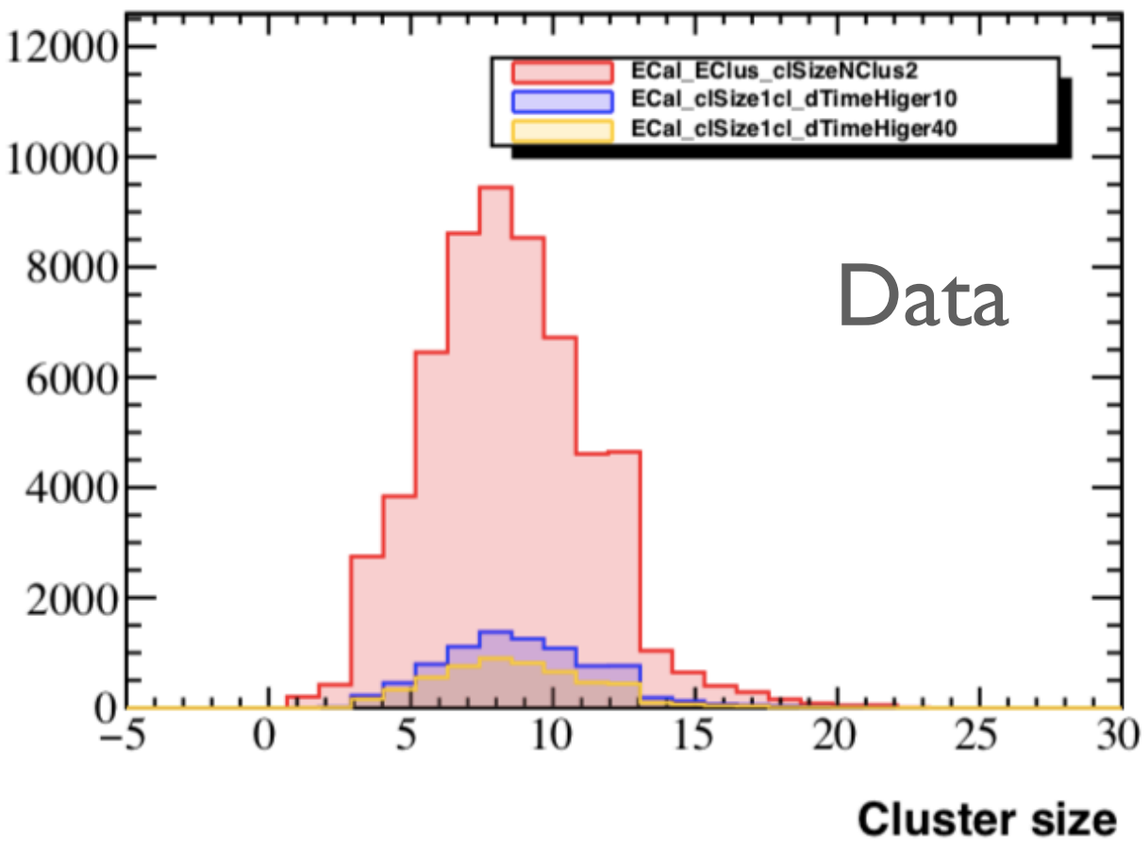


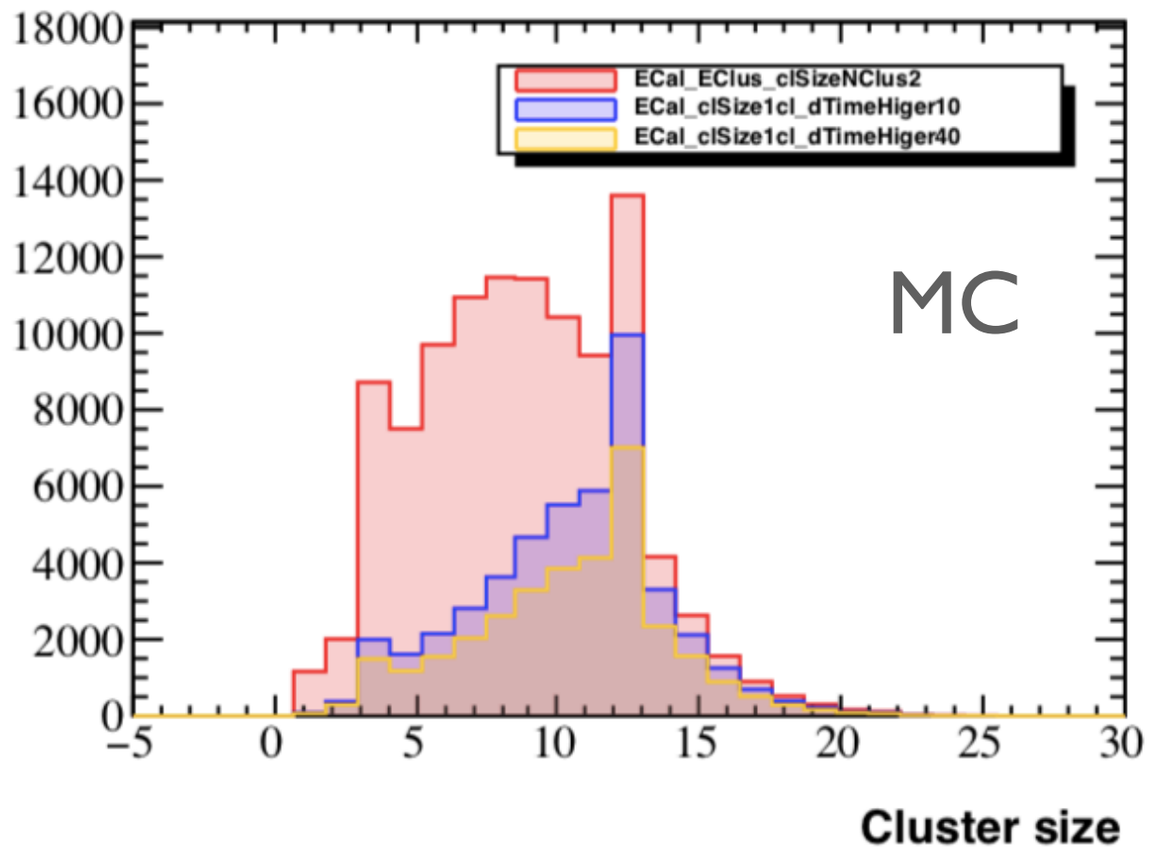
MC



CL SIZE DISTRIBUTION

- Cl size if NCl=2/event;
- Cl size if NCl=2/event & $|\Delta t| = |t_{cl1} - t_{cl2}| < 10$ ns
- Cl size if NCl=2/event & $|\Delta t| = |t_{cl1} - t_{cl2}| < 40$ ns

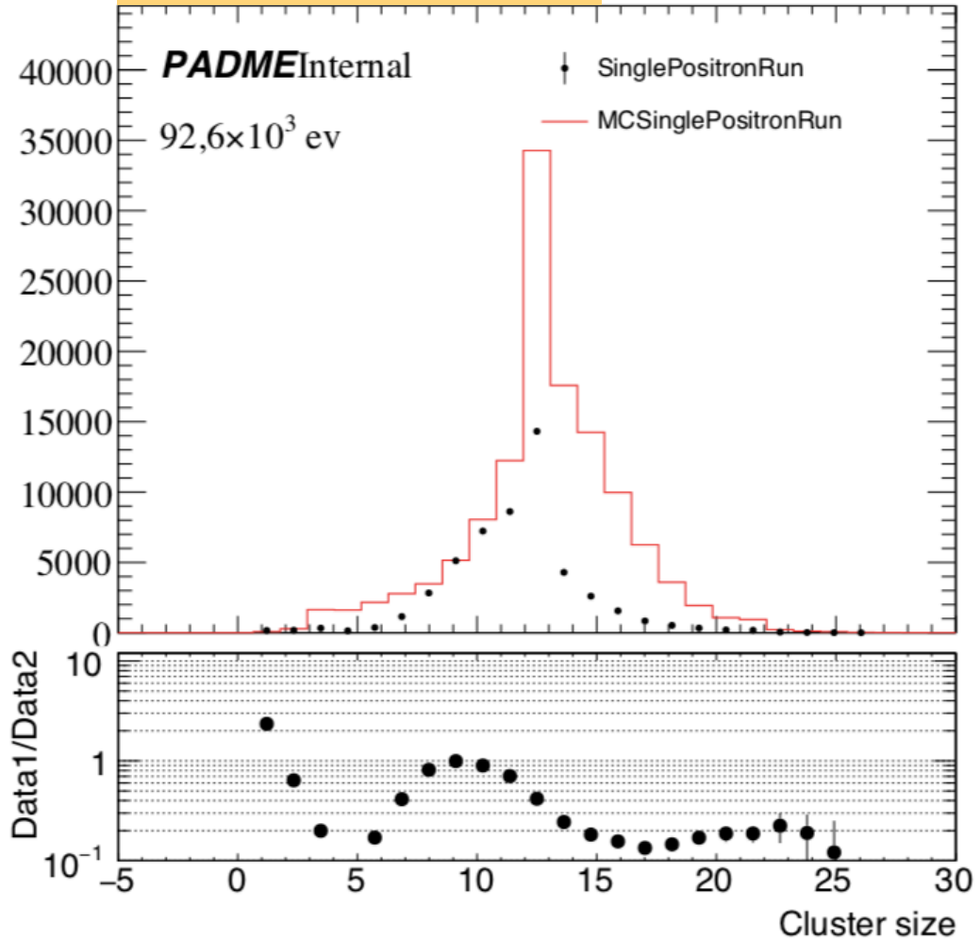




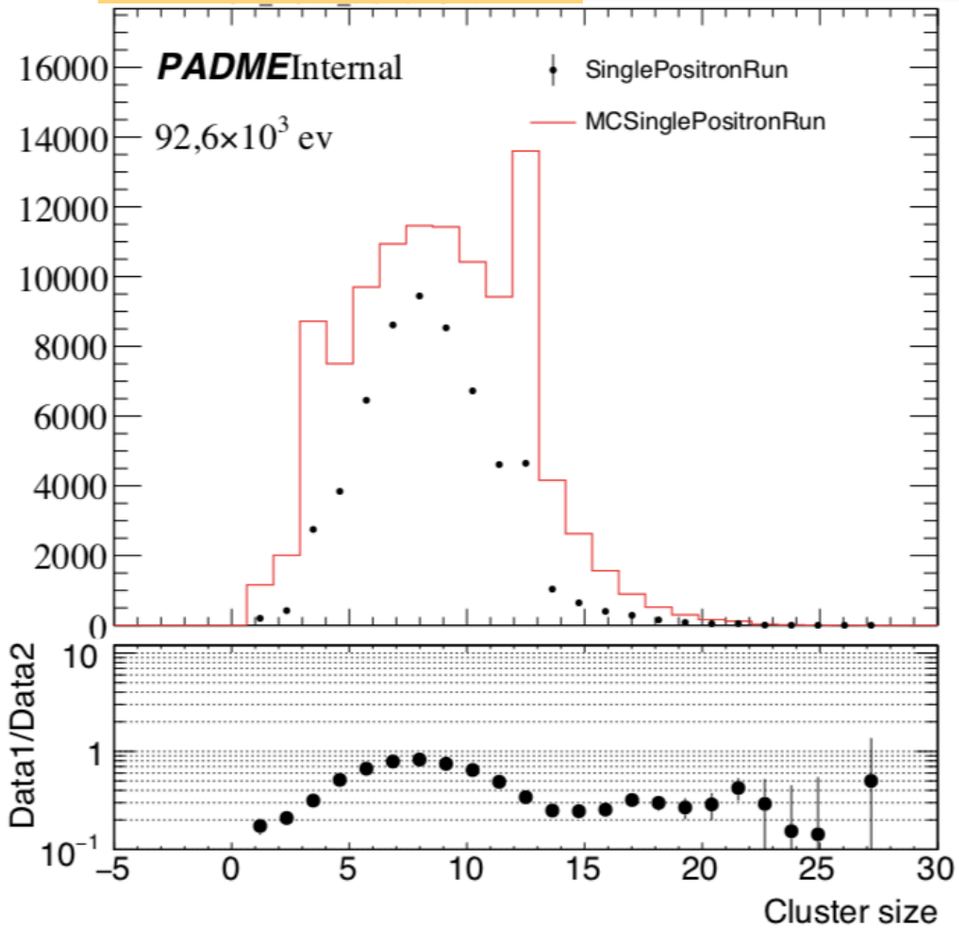
The mean doesn't change when the cluster are separately in time!

CLUSTER SIZE

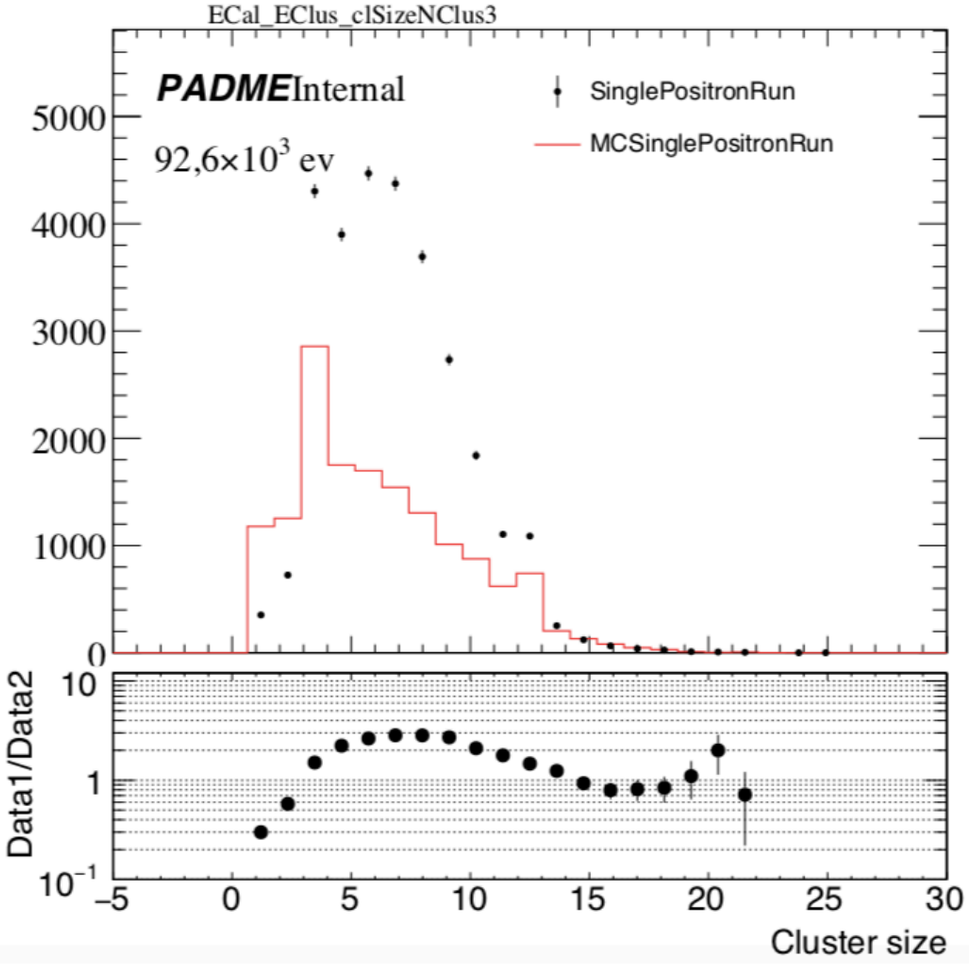
1 cl in ECAL



2 cl in ECAL



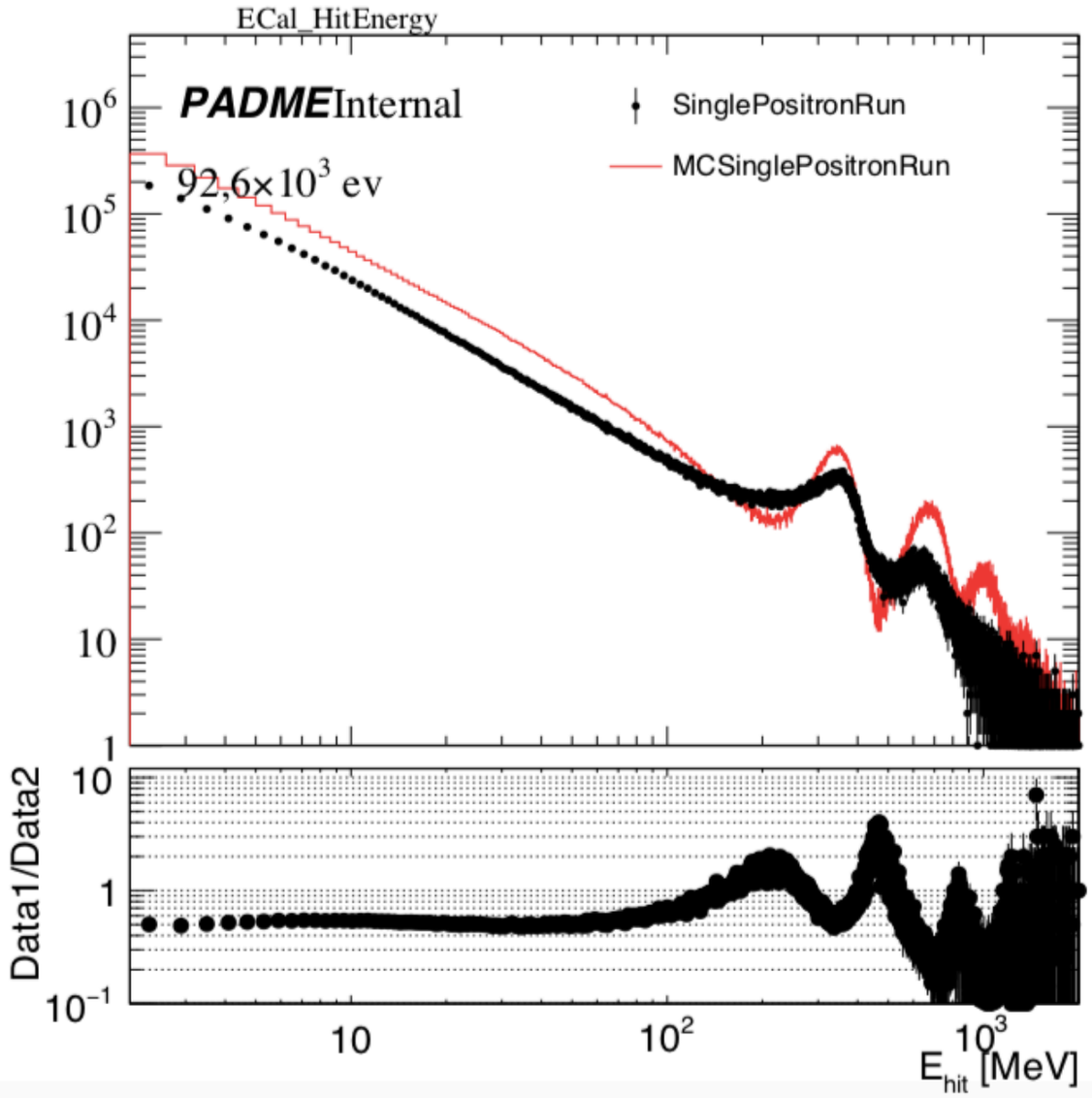
3 cl in ECAL



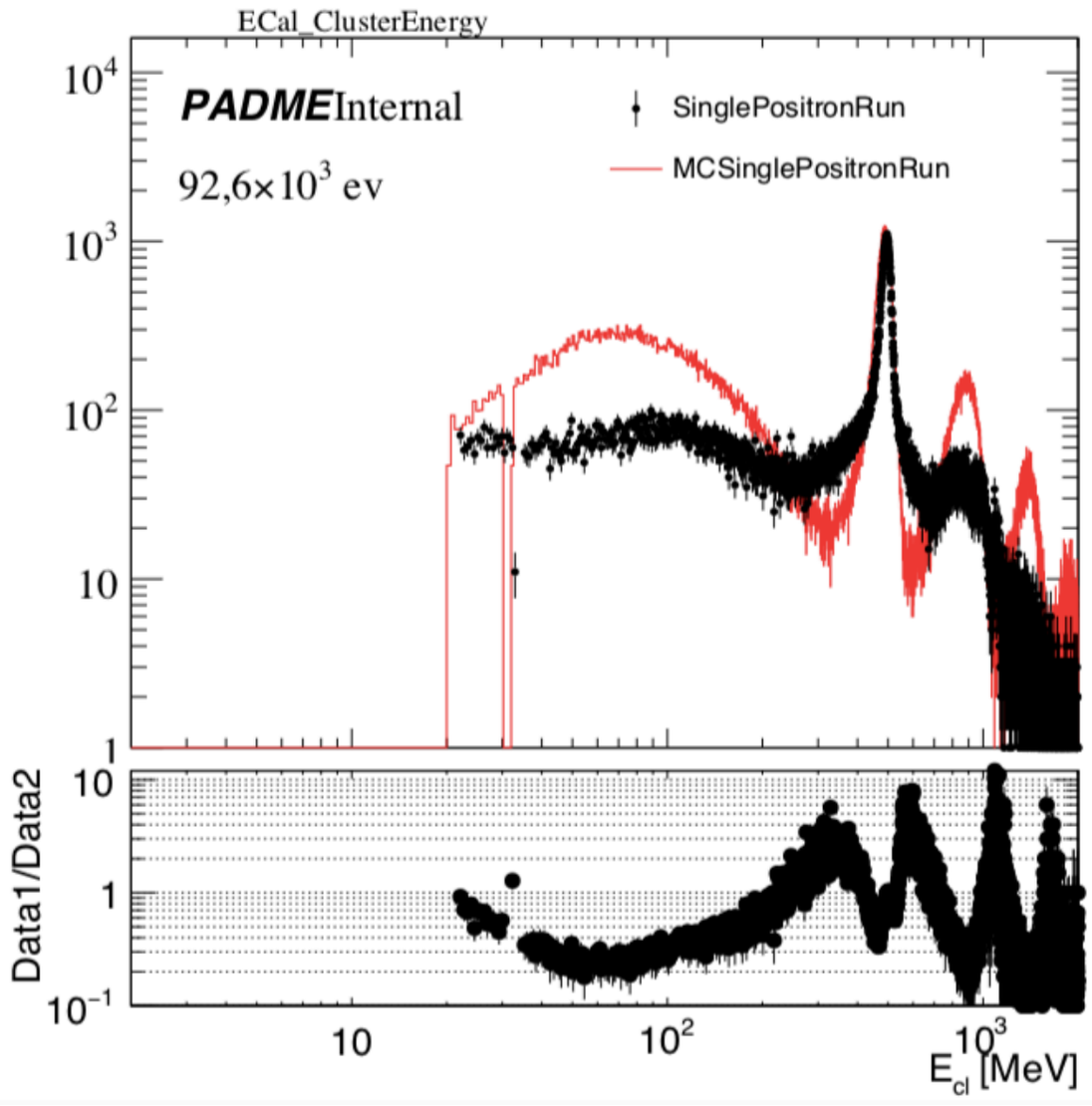
- Distribution of the cluster size when I have 1 (2 or 3) cluster / event

HIT AND CLUSTER ENERGY

Hit energy

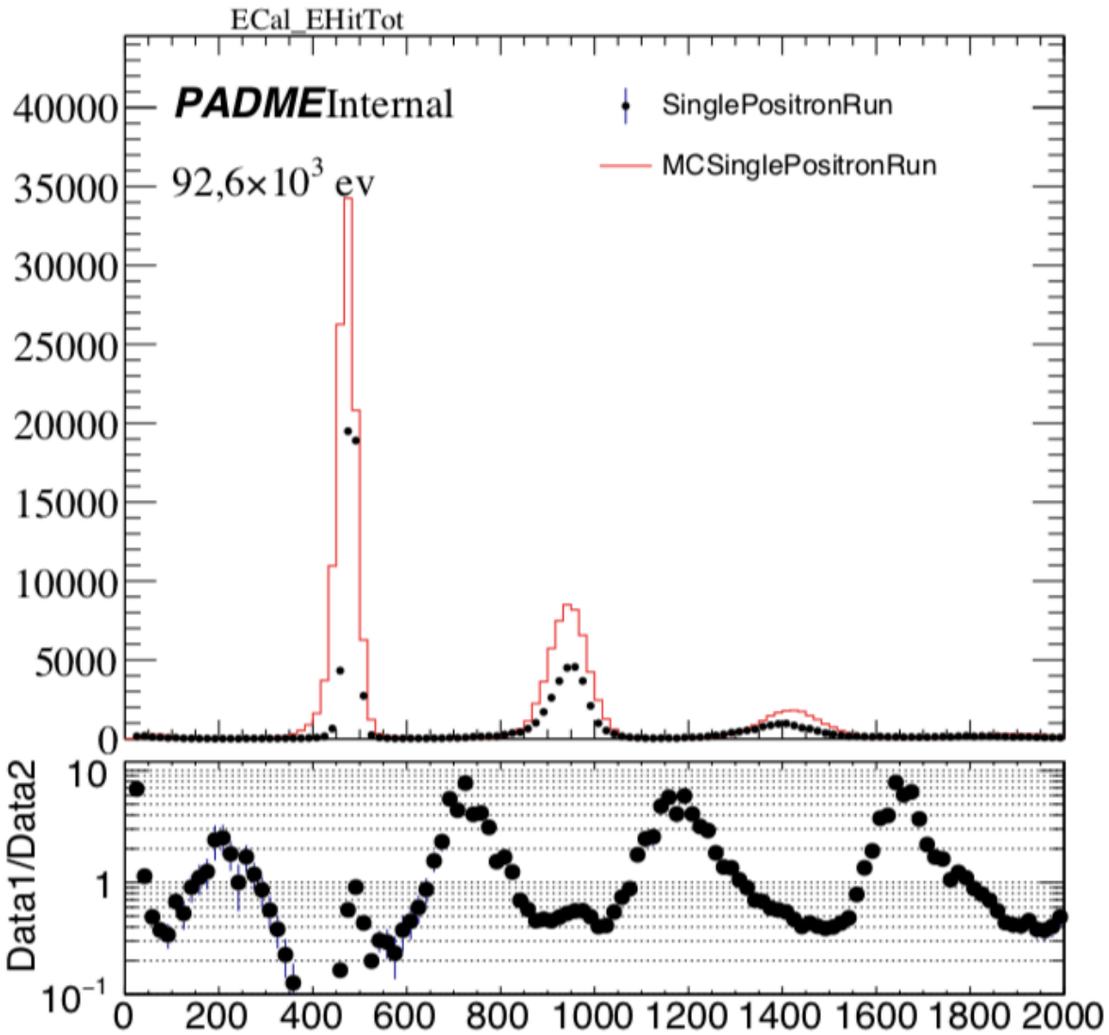


Cluster energy

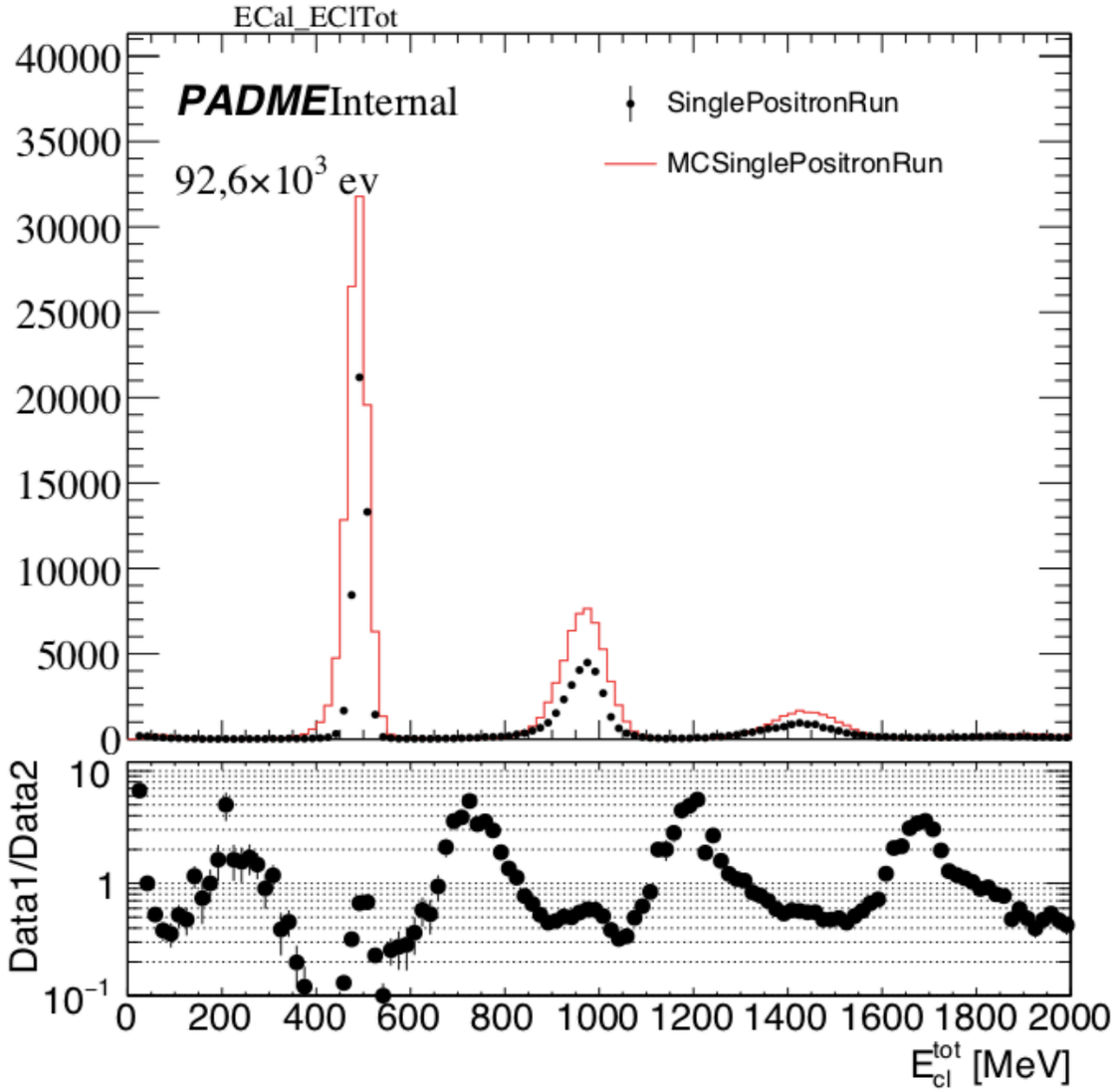


TOTAL ENERGY DISTRIBUTION

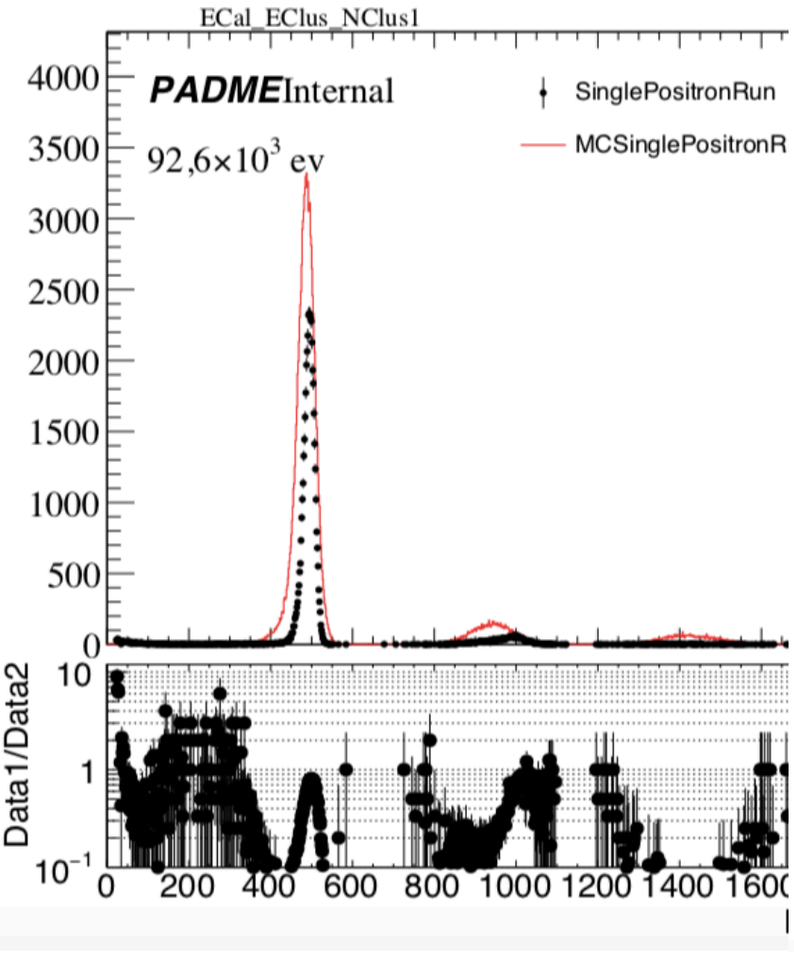
TotHit energy

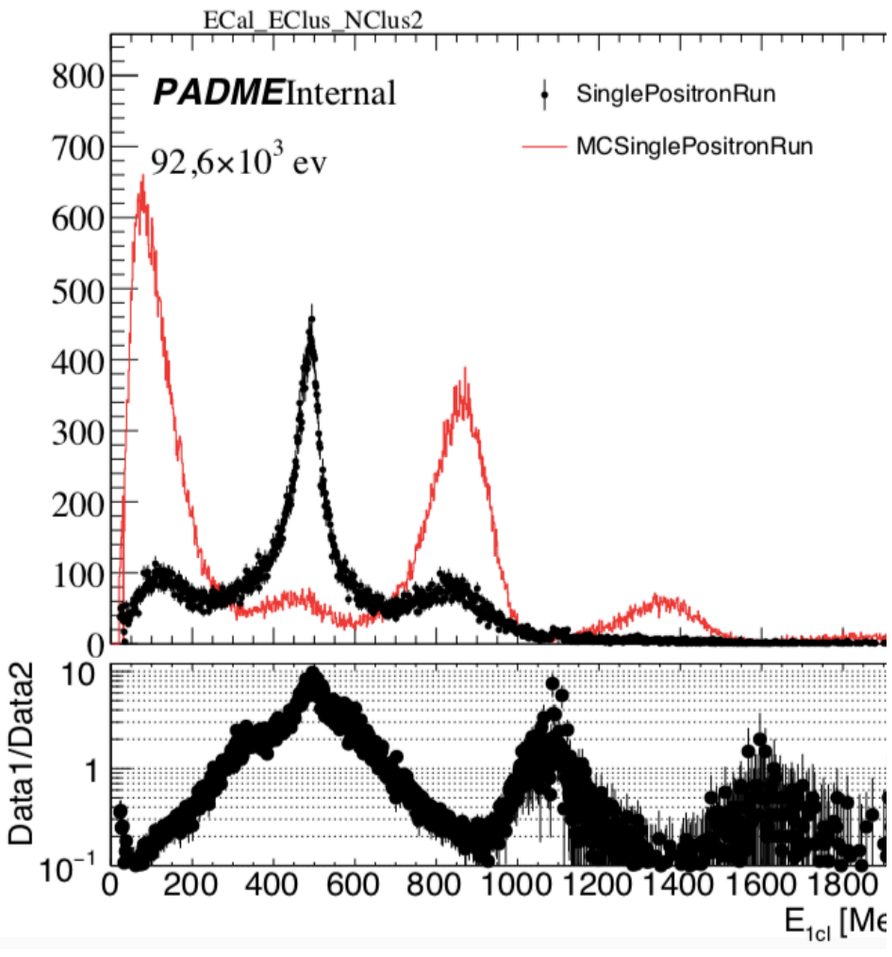


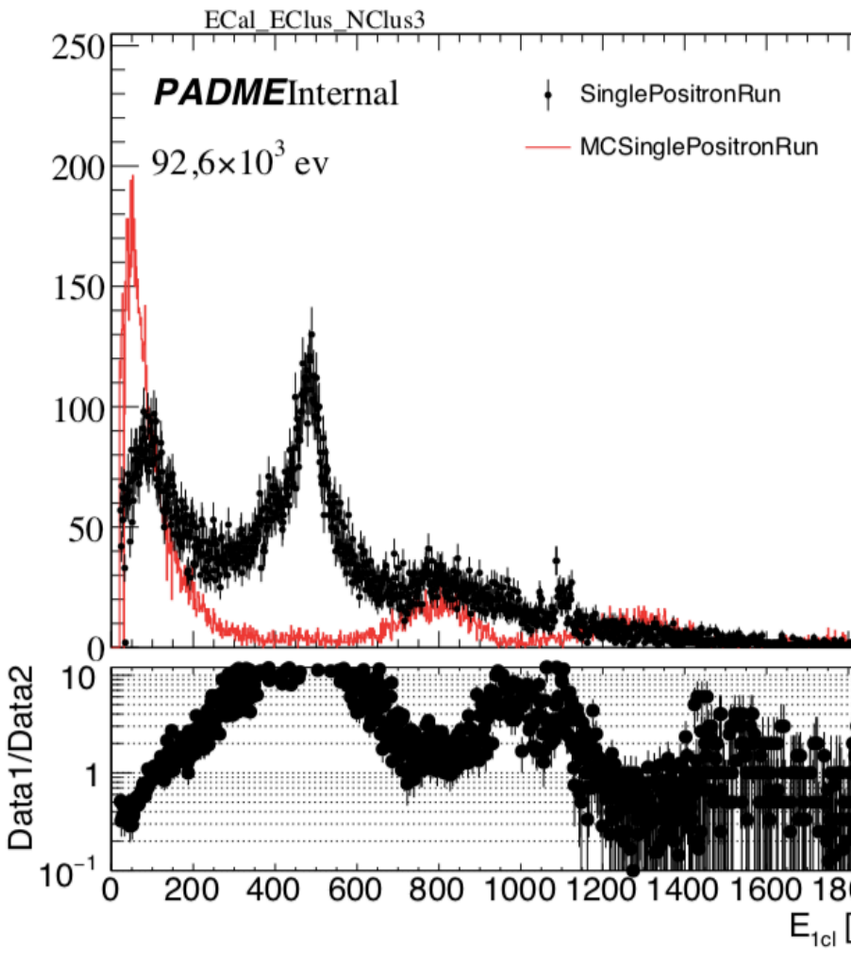
TotCluster energy



- Distribution of cluster energy when I have 1 (2 and 3) cluster / bunch







1 cl in ECAL

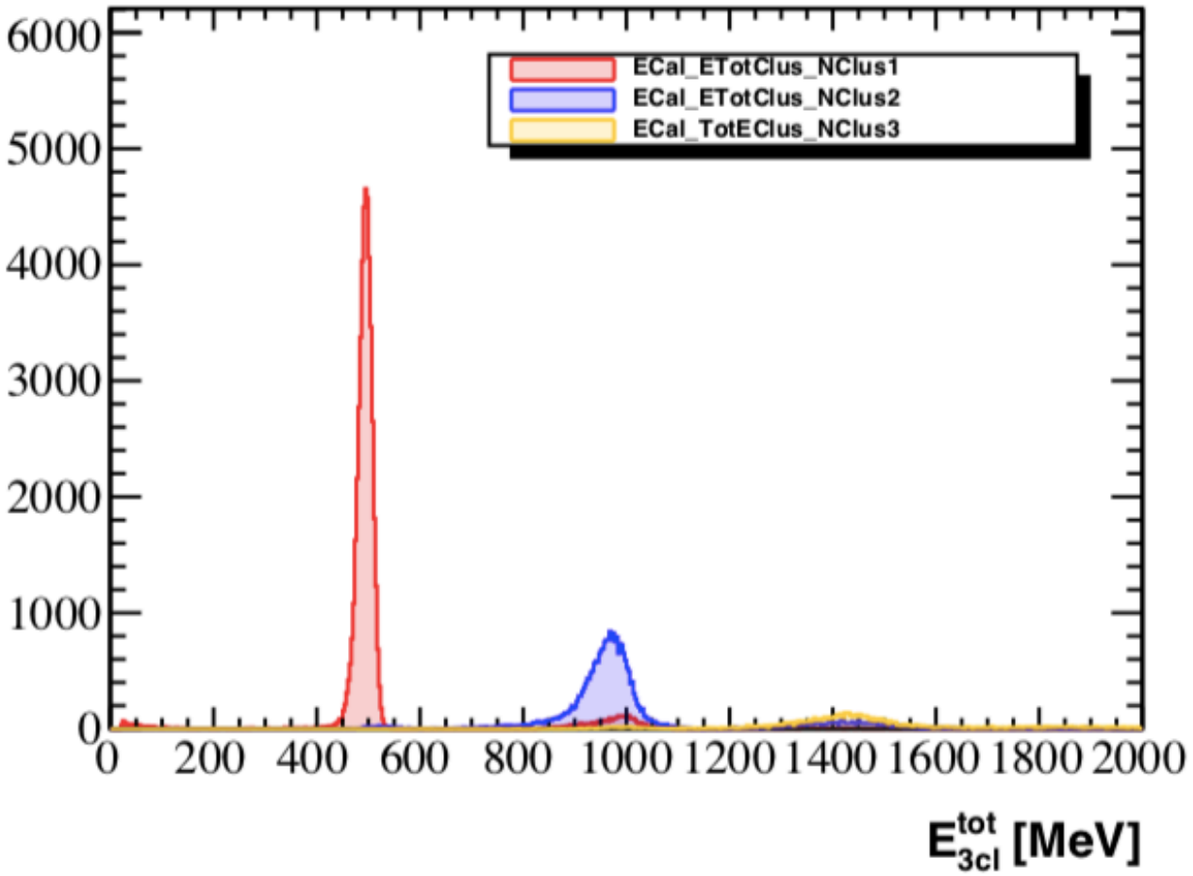
2 cl in ECAL

3 cl in ECAL

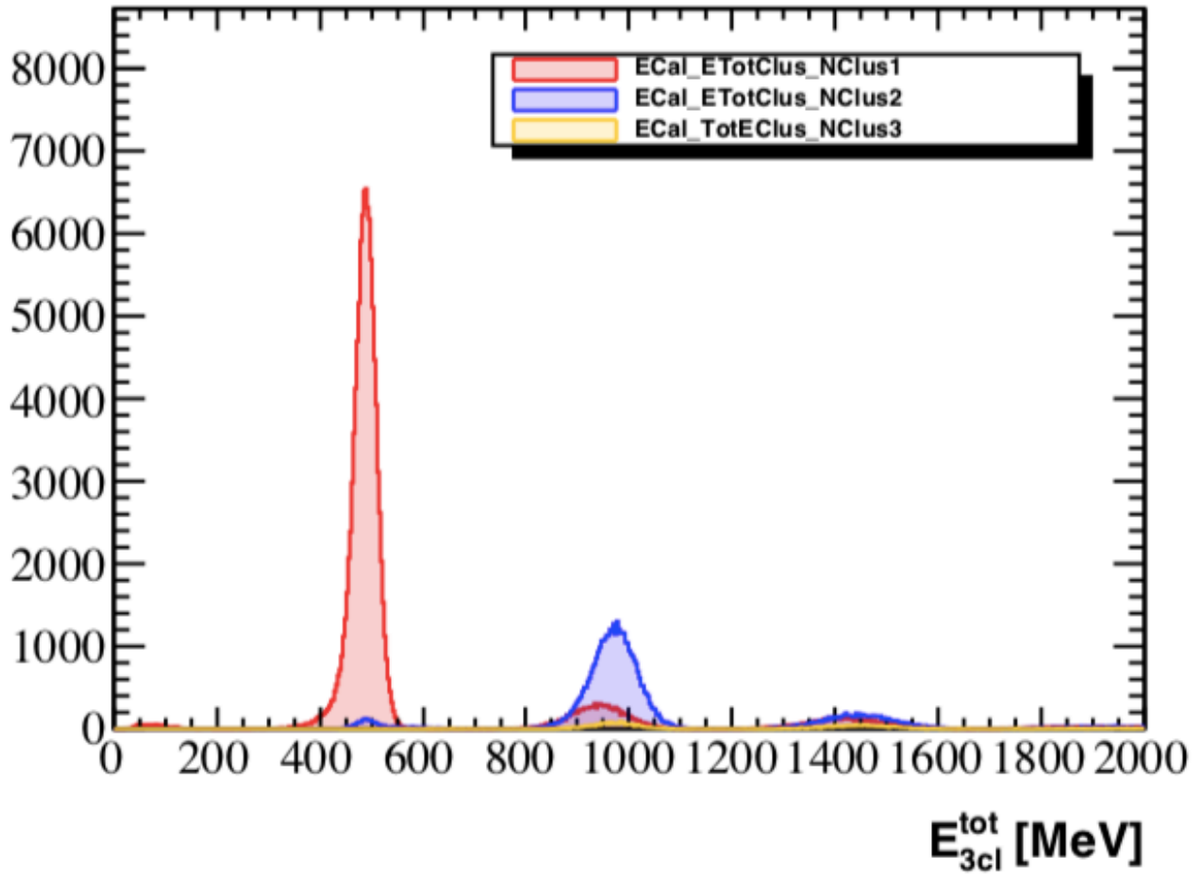
TOTAL CLUSTER ENERGY

- Total cluster energy / bunch when I have 1 (2 or 3) cluster/event

Data

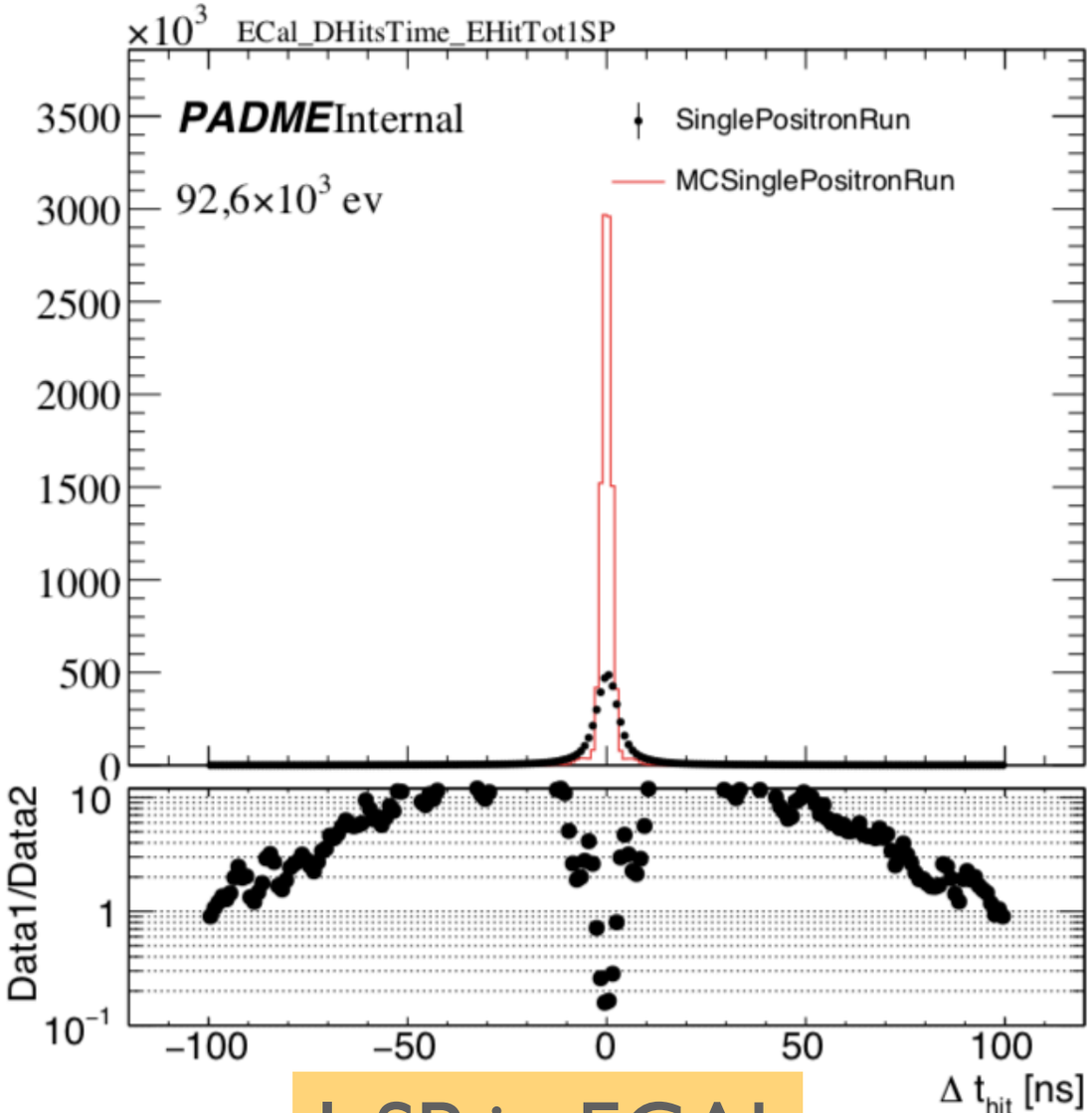


MC

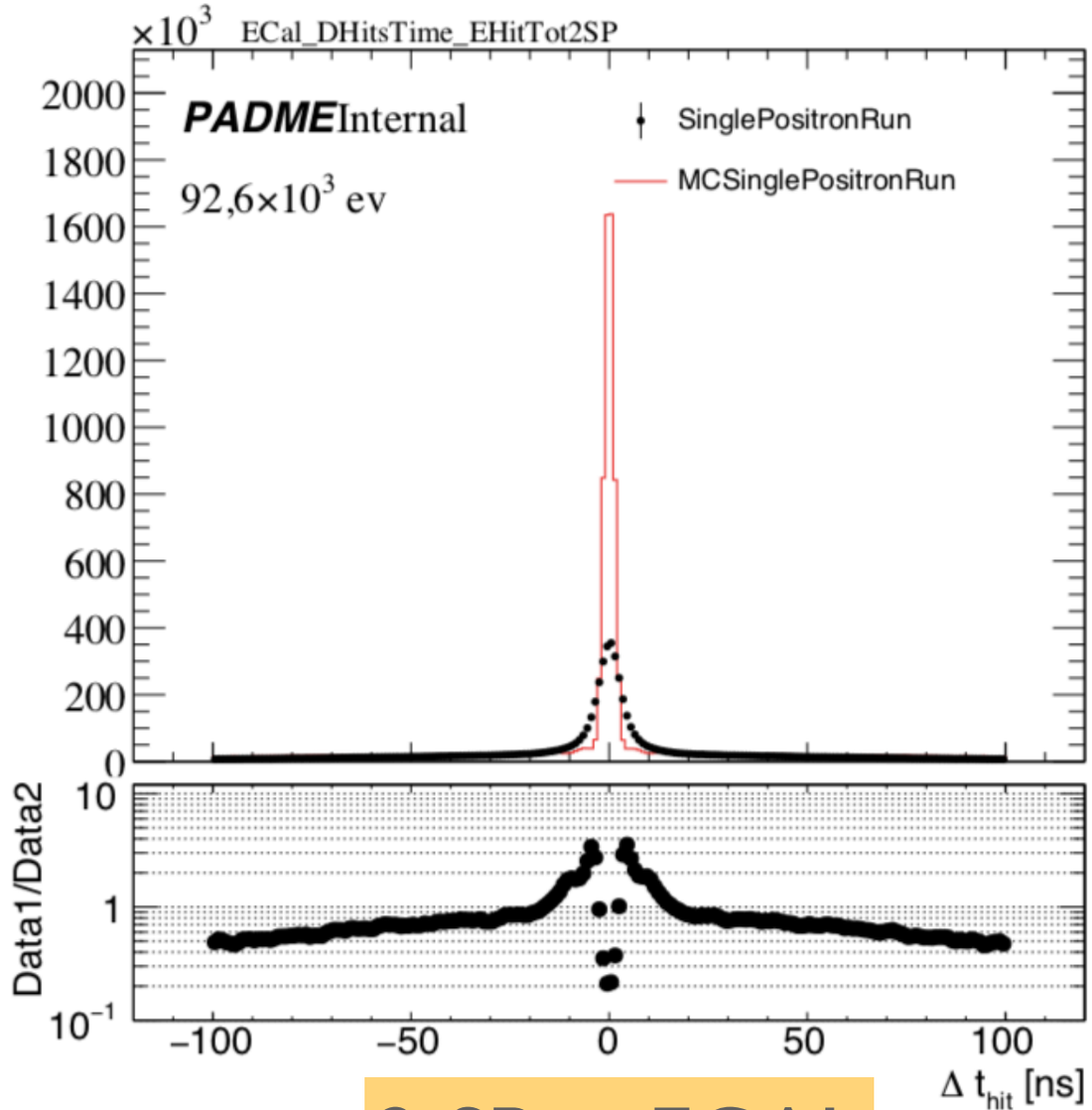


DELTA HITS TIME

- Time difference between hit i and hit j when the EHitTot/bunch is compatible with 1 single positron (left) or 2 positron (right) on bunch.



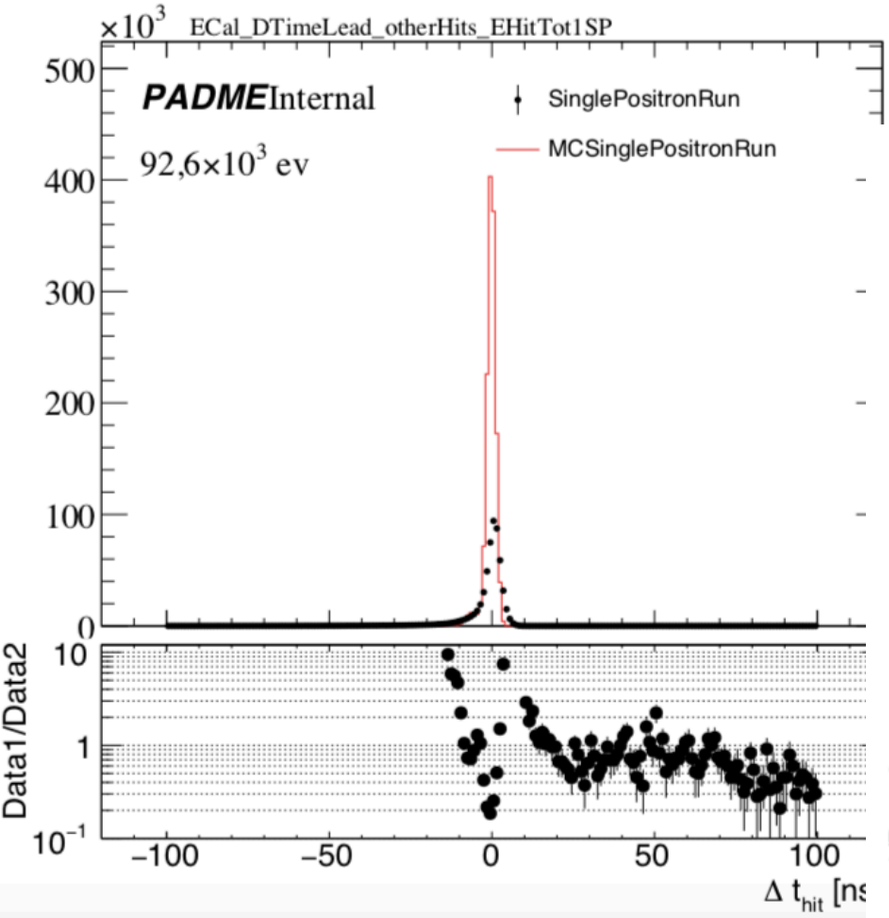
1 SP in ECAL



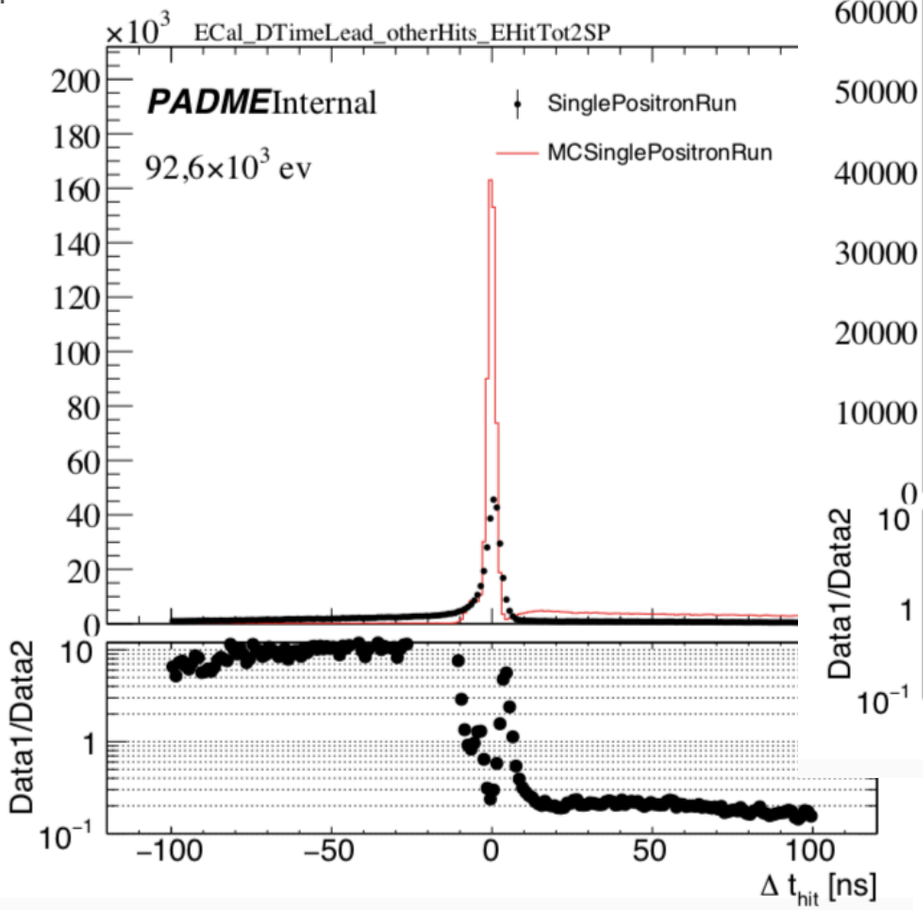
2 SP in ECAL

DELTA LEADING-HITS TIME

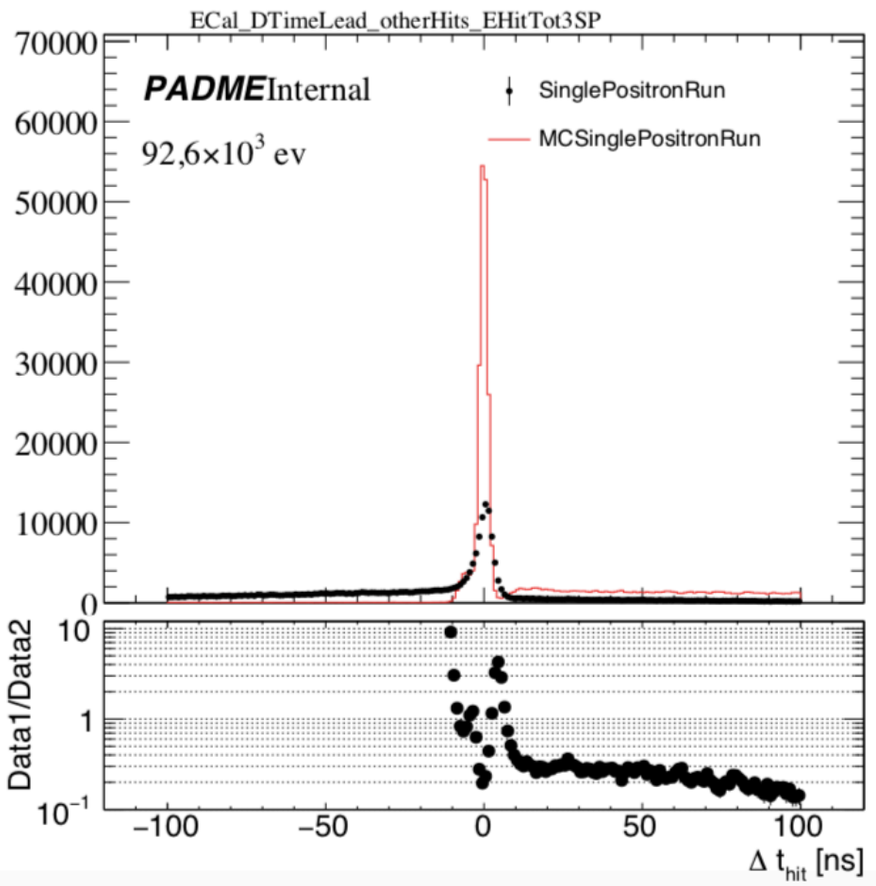
- Time difference between leading hit and hit i when the EHitTot/bunch is compatible with 1 single positron (left), 2 or 3 positron (right) on bunch.



1 SP in ECAL



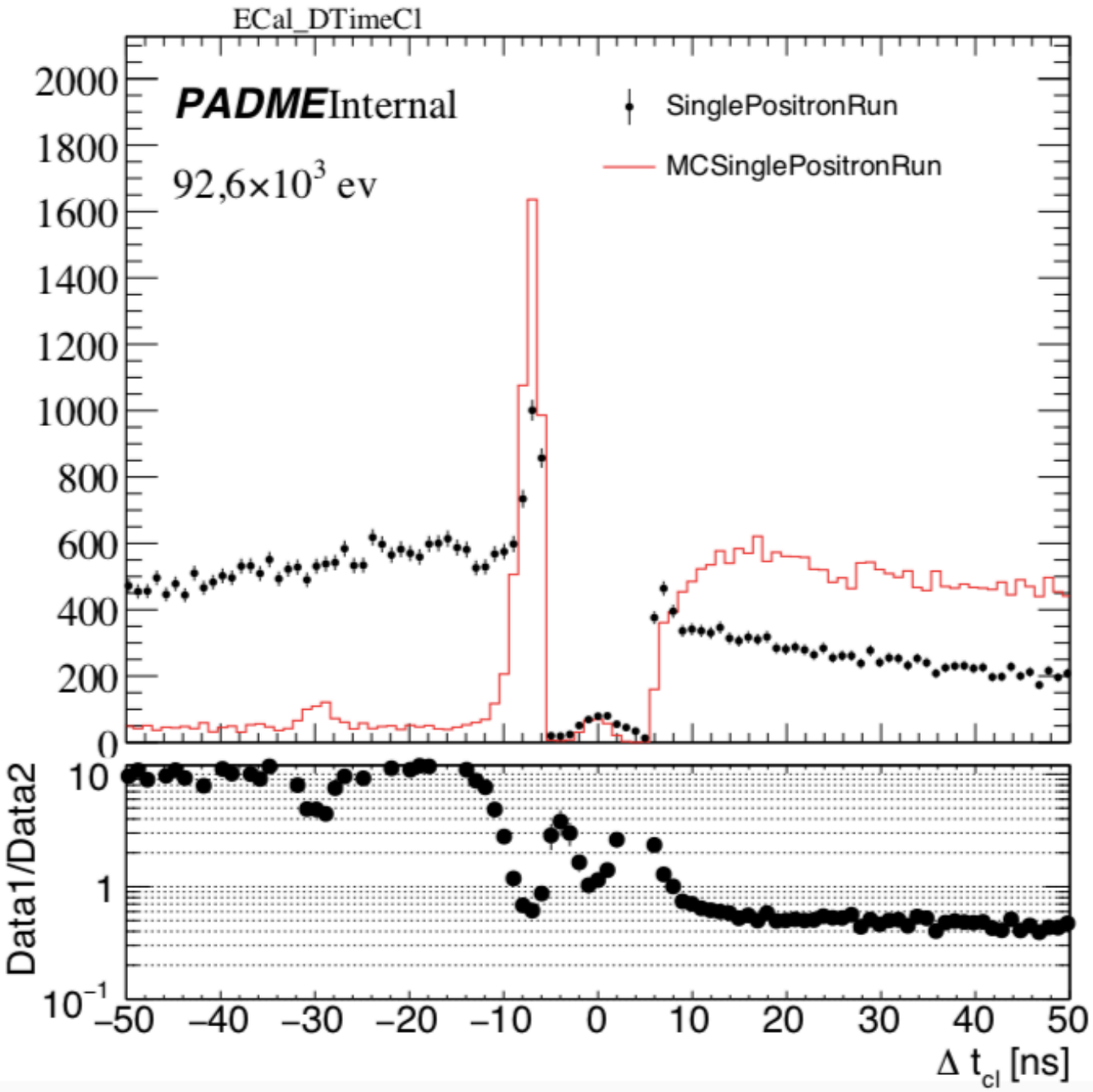
2 SP in ECAL



3 SP in ECAL

DELTA CLUSTER TIME

- Difference between the time of cluster i and cluster j

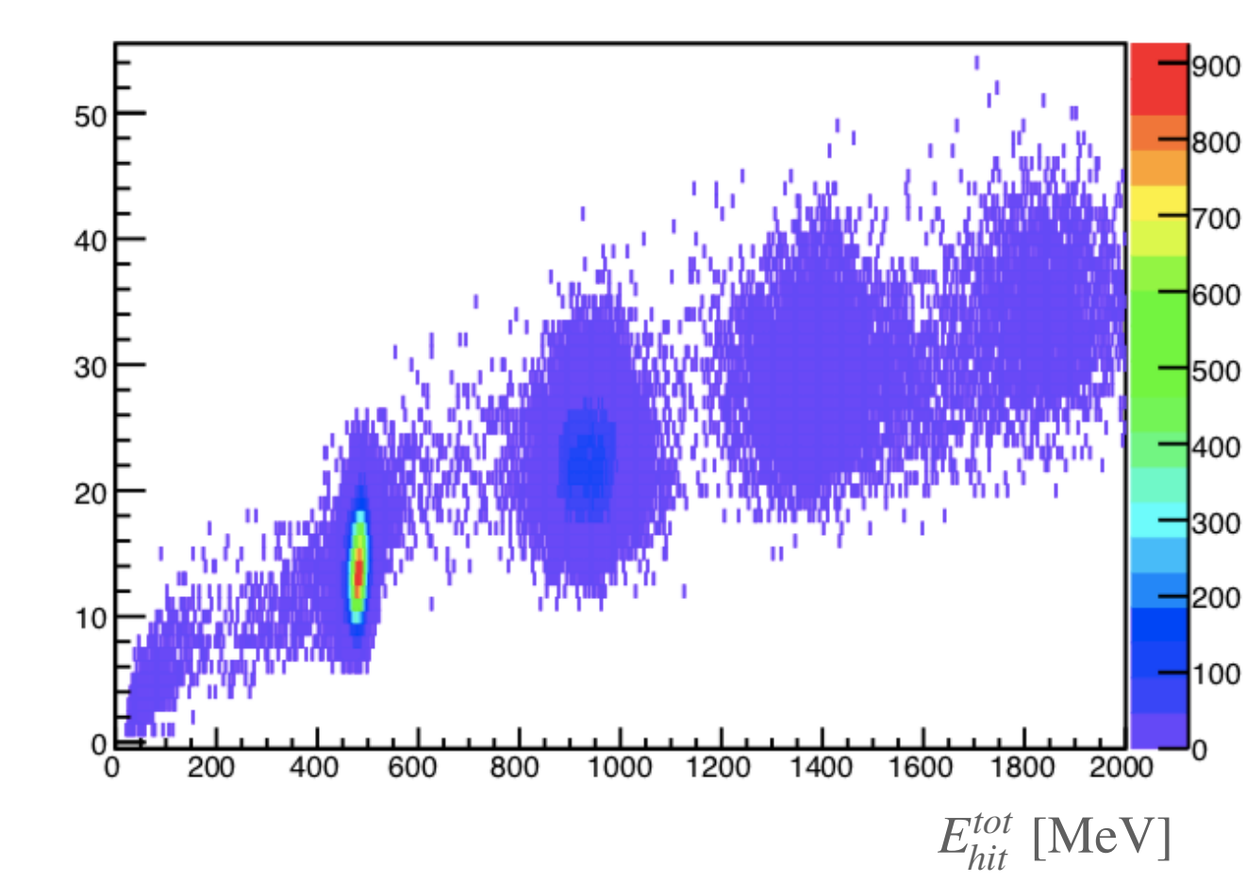


Not same asymmetry

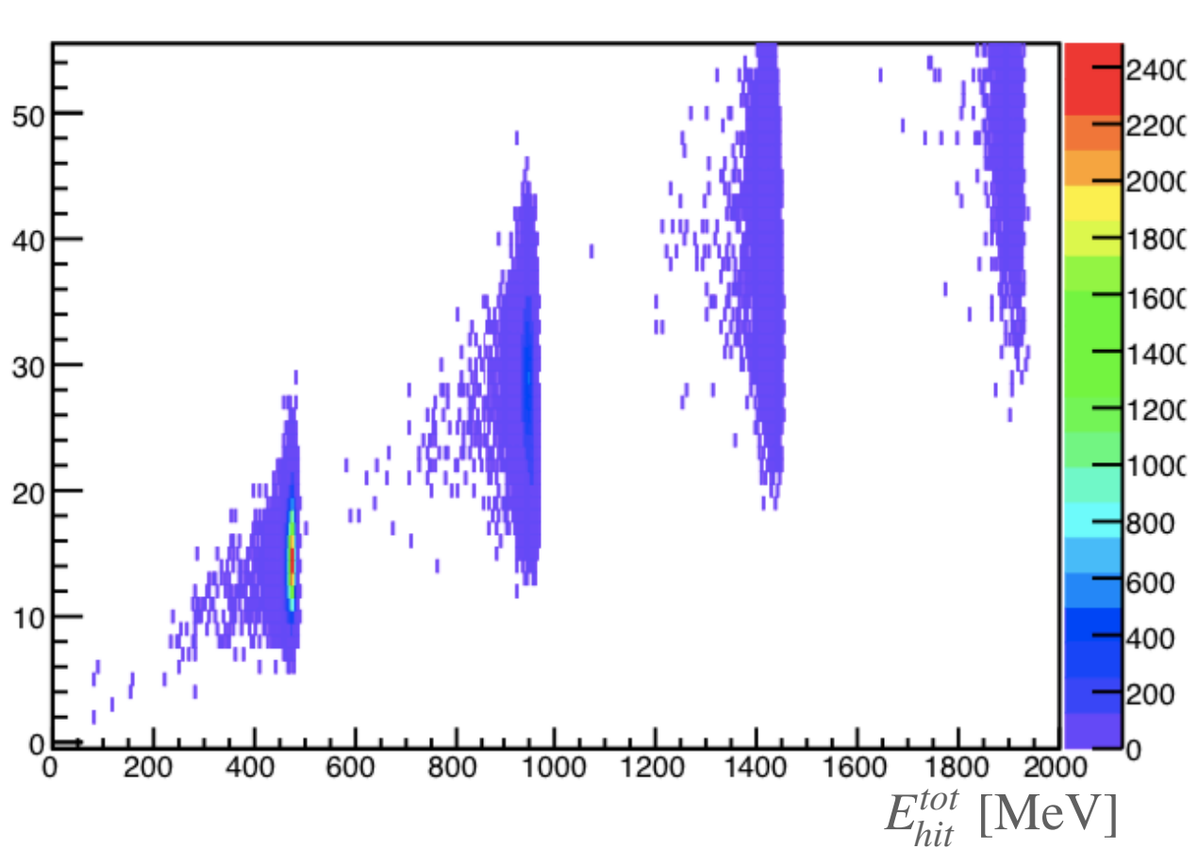
MULTI HIT RECONSTRUCTION

- Study the sample MC Multi Hit with digs time window of 25ns
  - No energy/time spread
- Data reconstructed with my latest version of multi hit (new template & saturation correction)

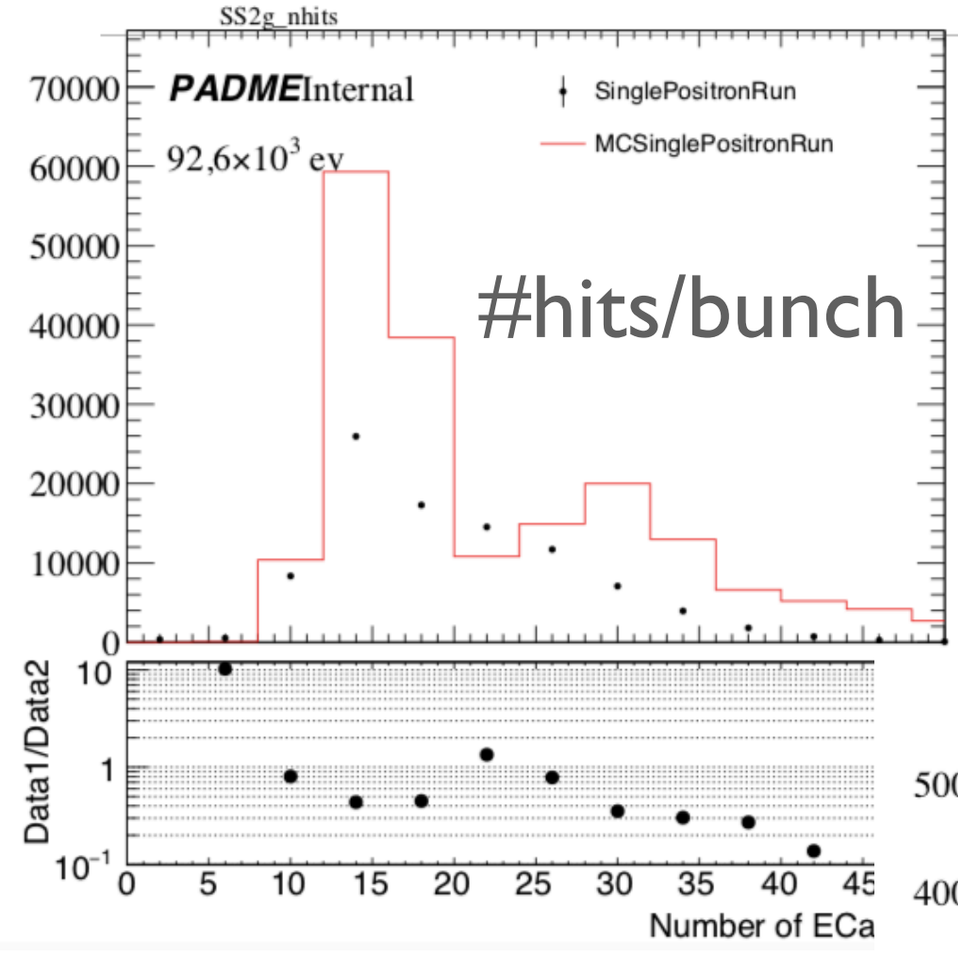
Data

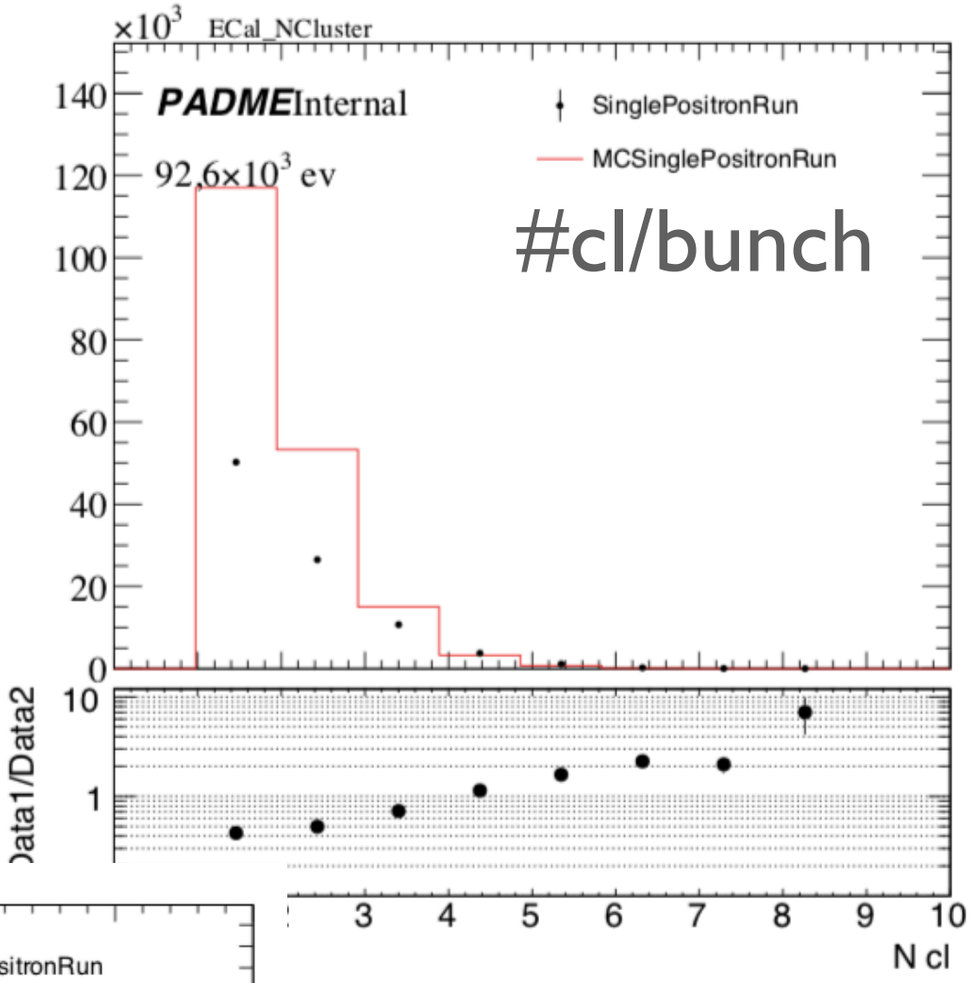


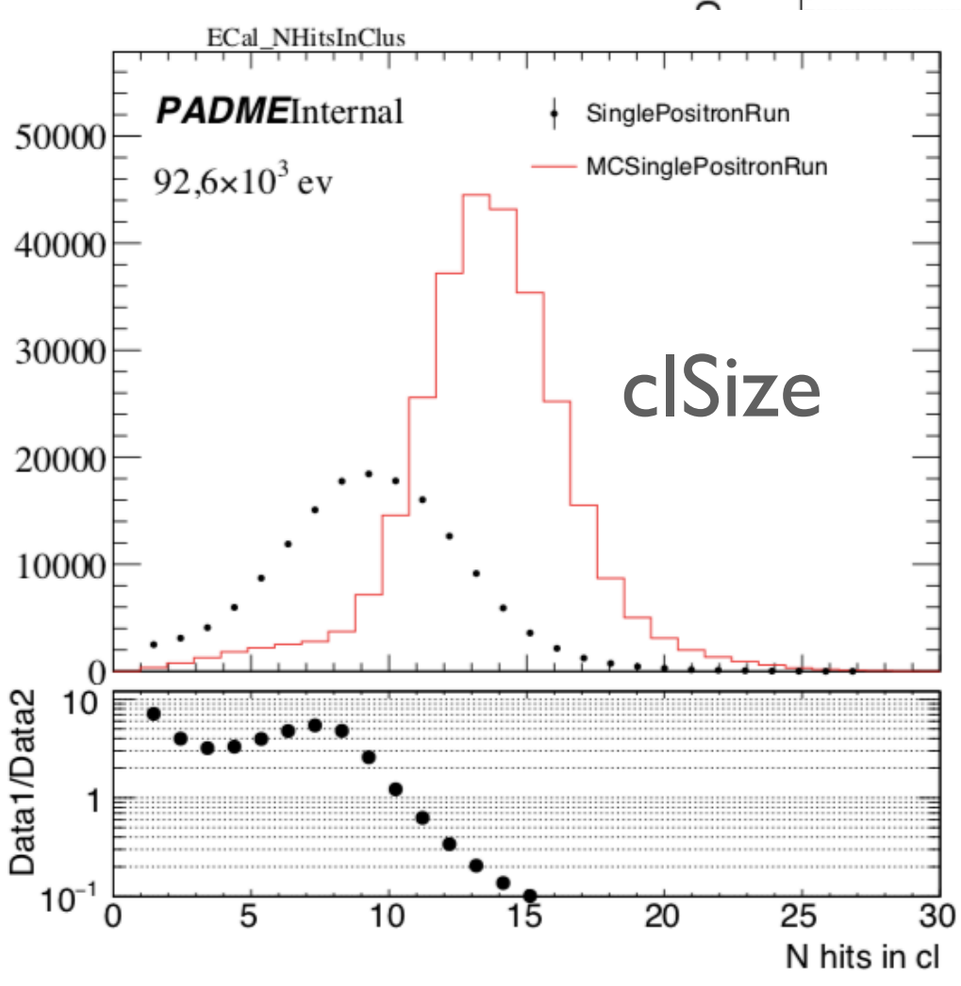
MC



#HITS, #CLUSTER & CLSIZE

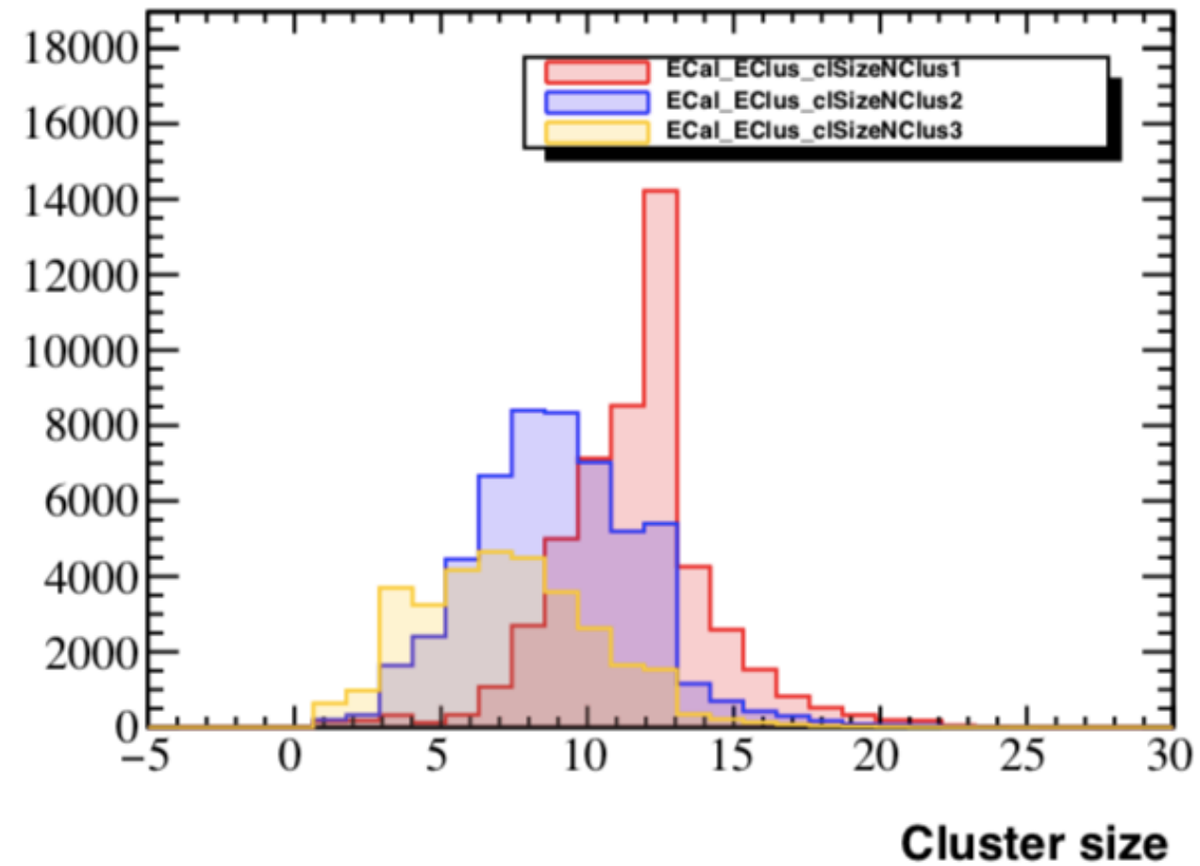




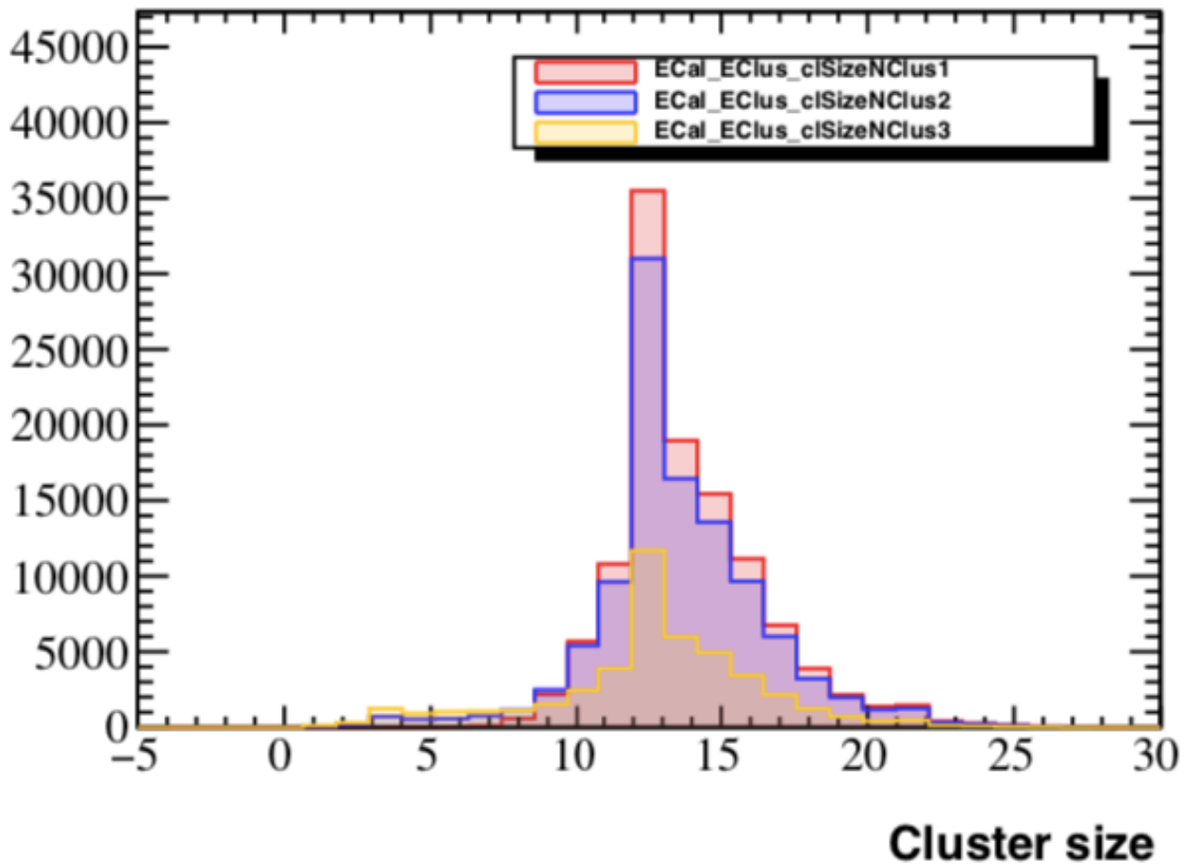


CLUSTER SIZE FOR NCL=1(2,3)/BUNCH

Data

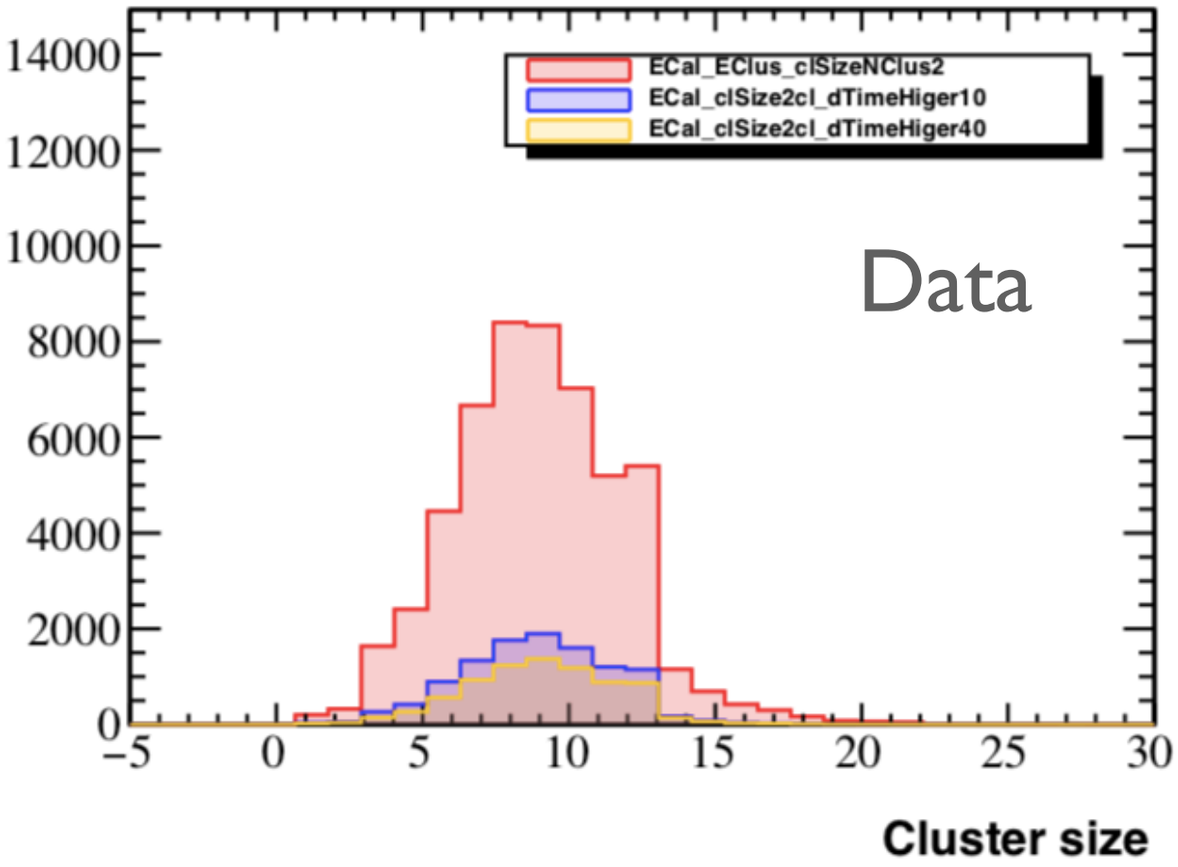


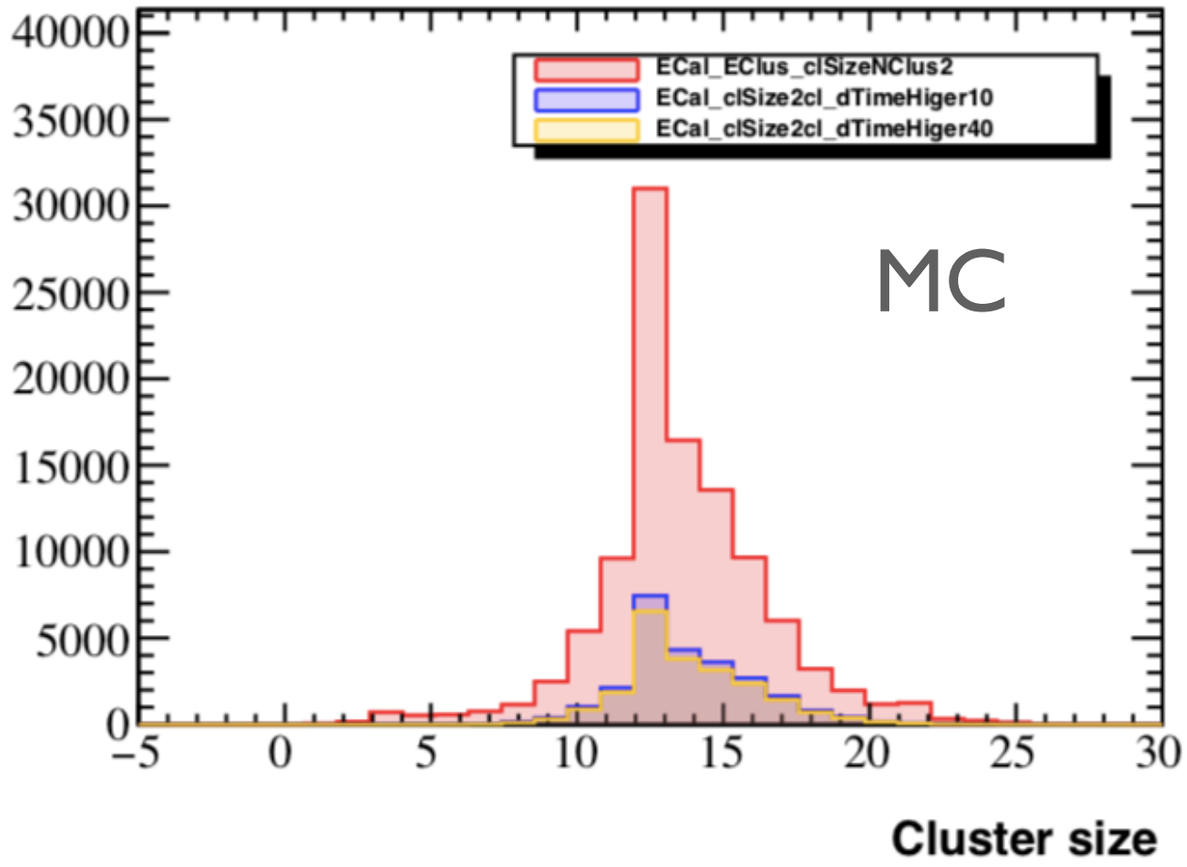
MC



CL SIZE DISTRIBUTION

- Cl size if NCl=2/event;
- Cl size if NCl=2/event & $|\Delta t| = |t_{cl1} - t_{cl2}| < 10$ ns
- Cl size if NCl=2/event & $|\Delta t| = |t_{cl1} - t_{cl2}| < 40$ ns

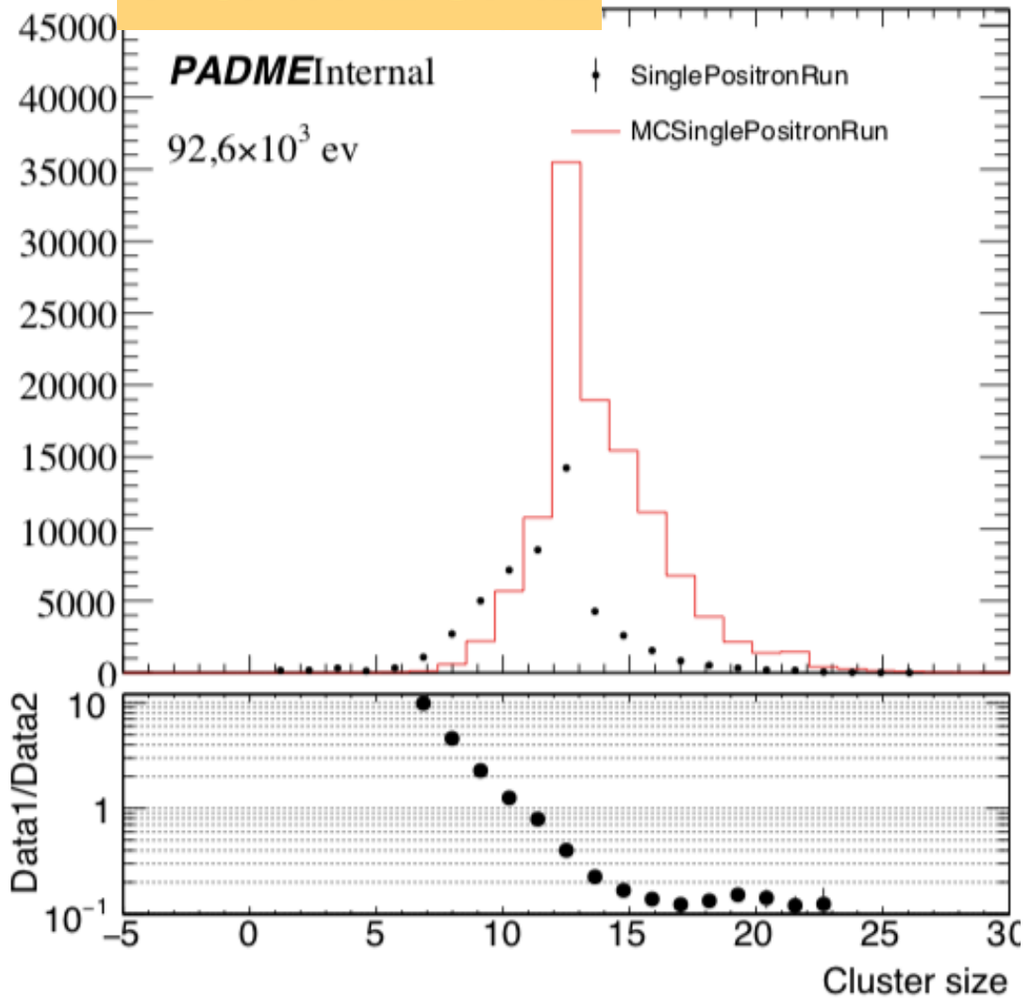




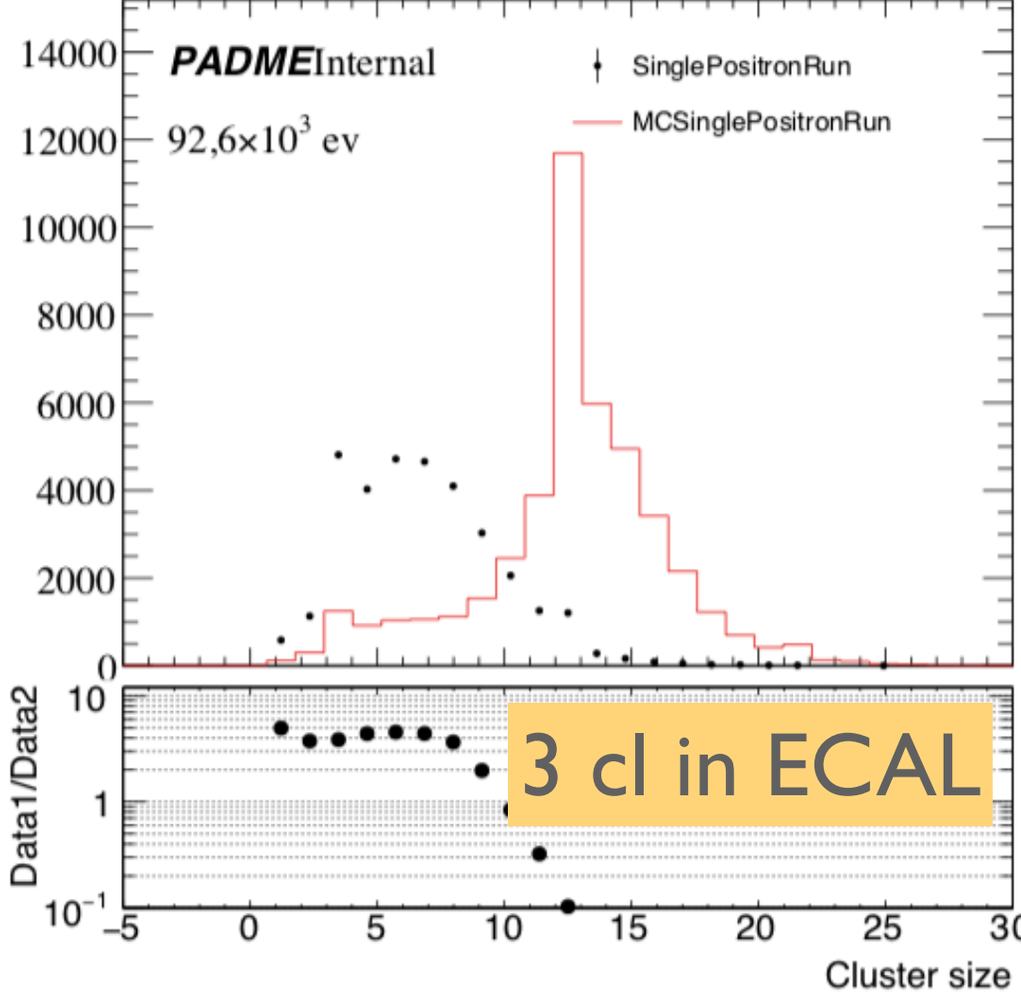
The mean doesn't change when the cluster are separately in time!

CLUSTER SIZE

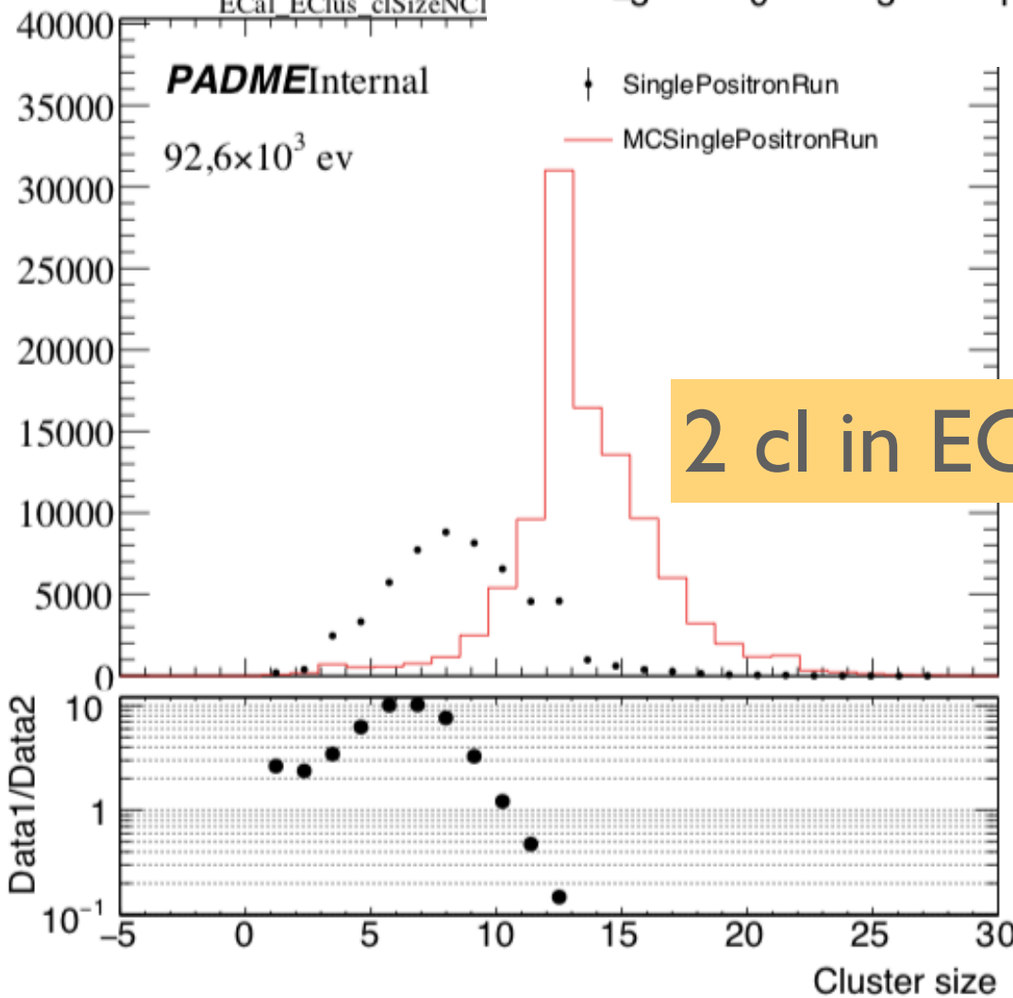
1 cl in ECAL



3 cl in ECAL



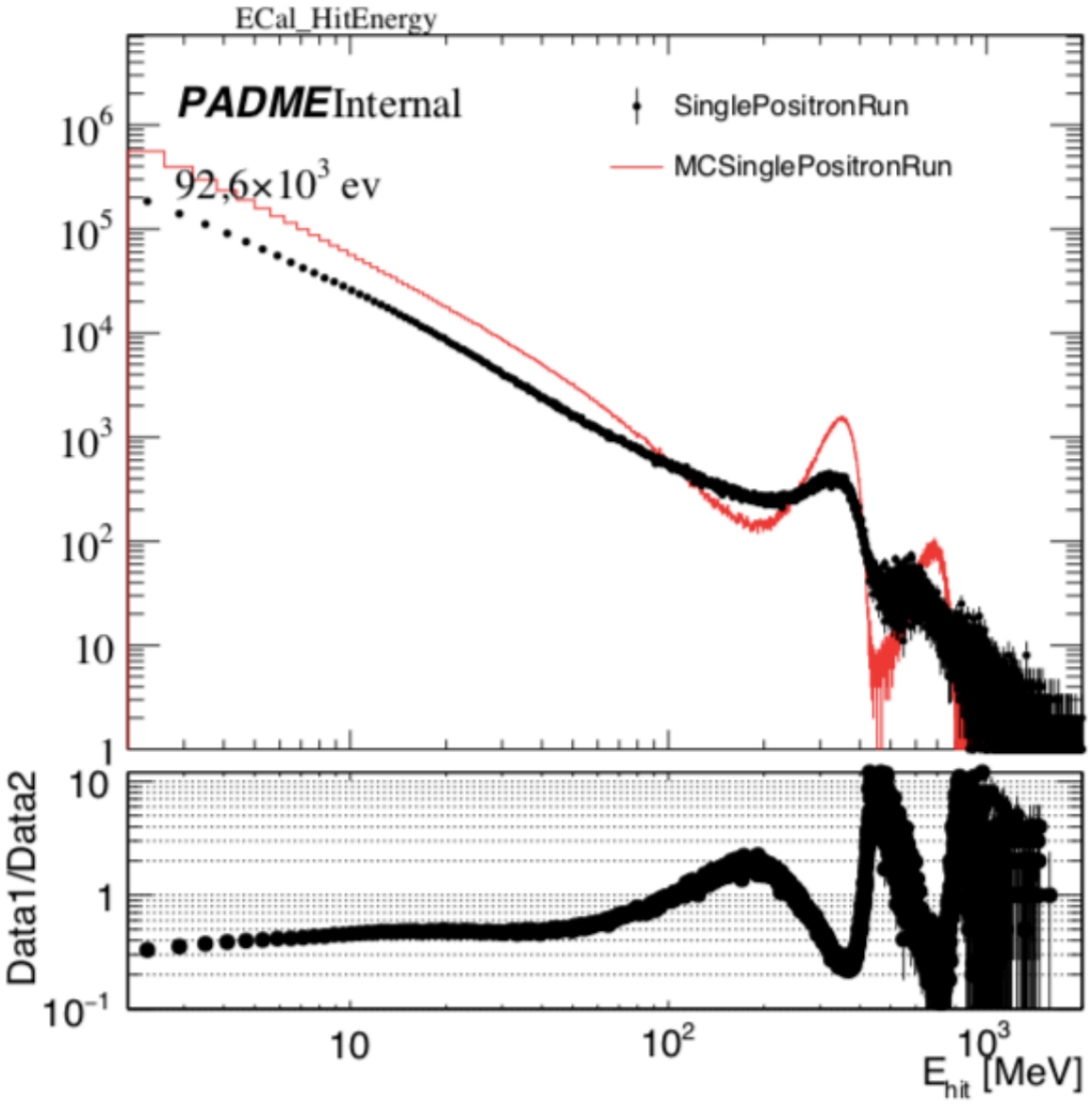
2 cl in ECAL



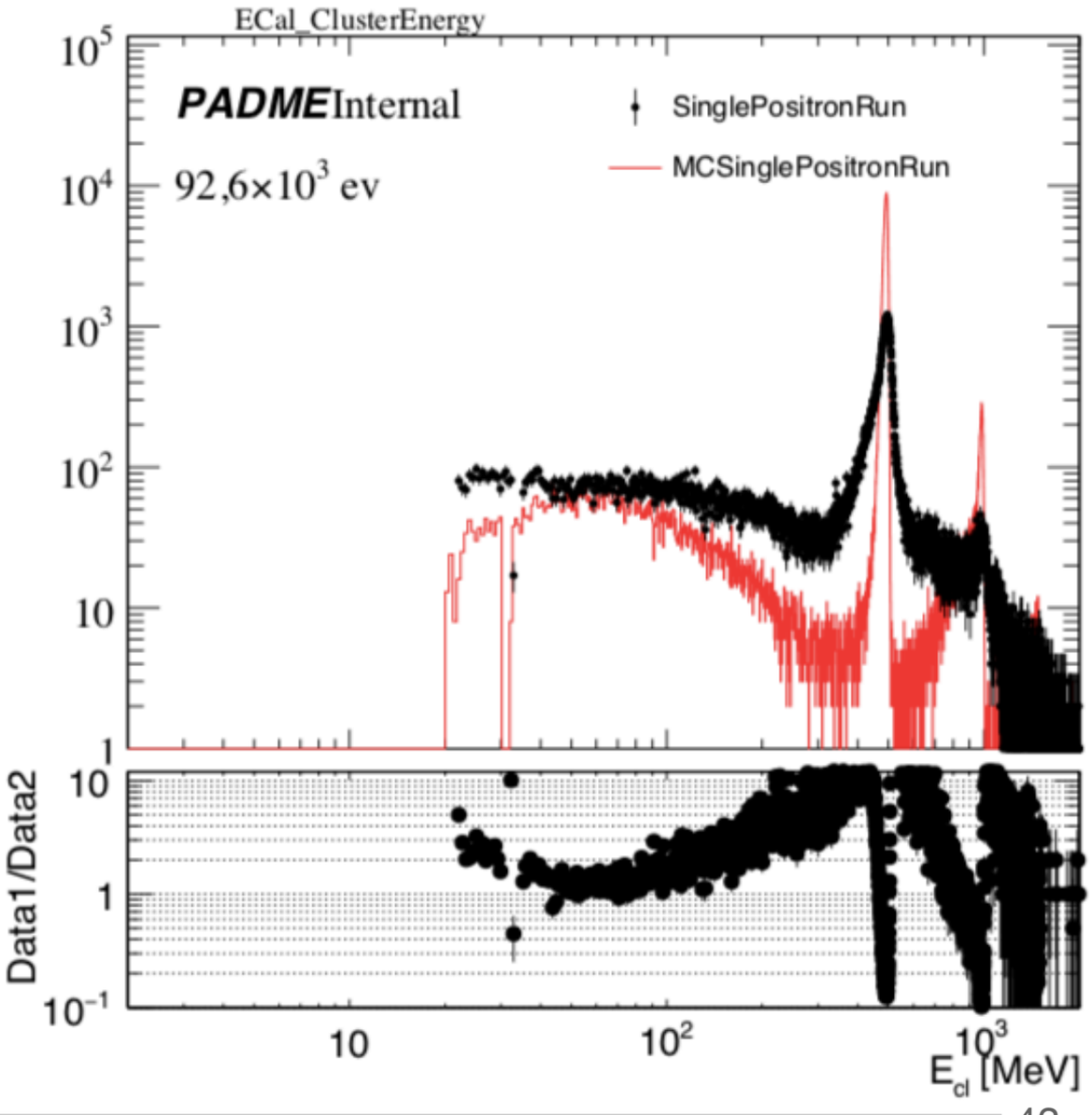
- Distribution of the cluster size when I have 1 (2 or 3) cluster / event

HIT AND CLUSTER ENERGY

Hit energy

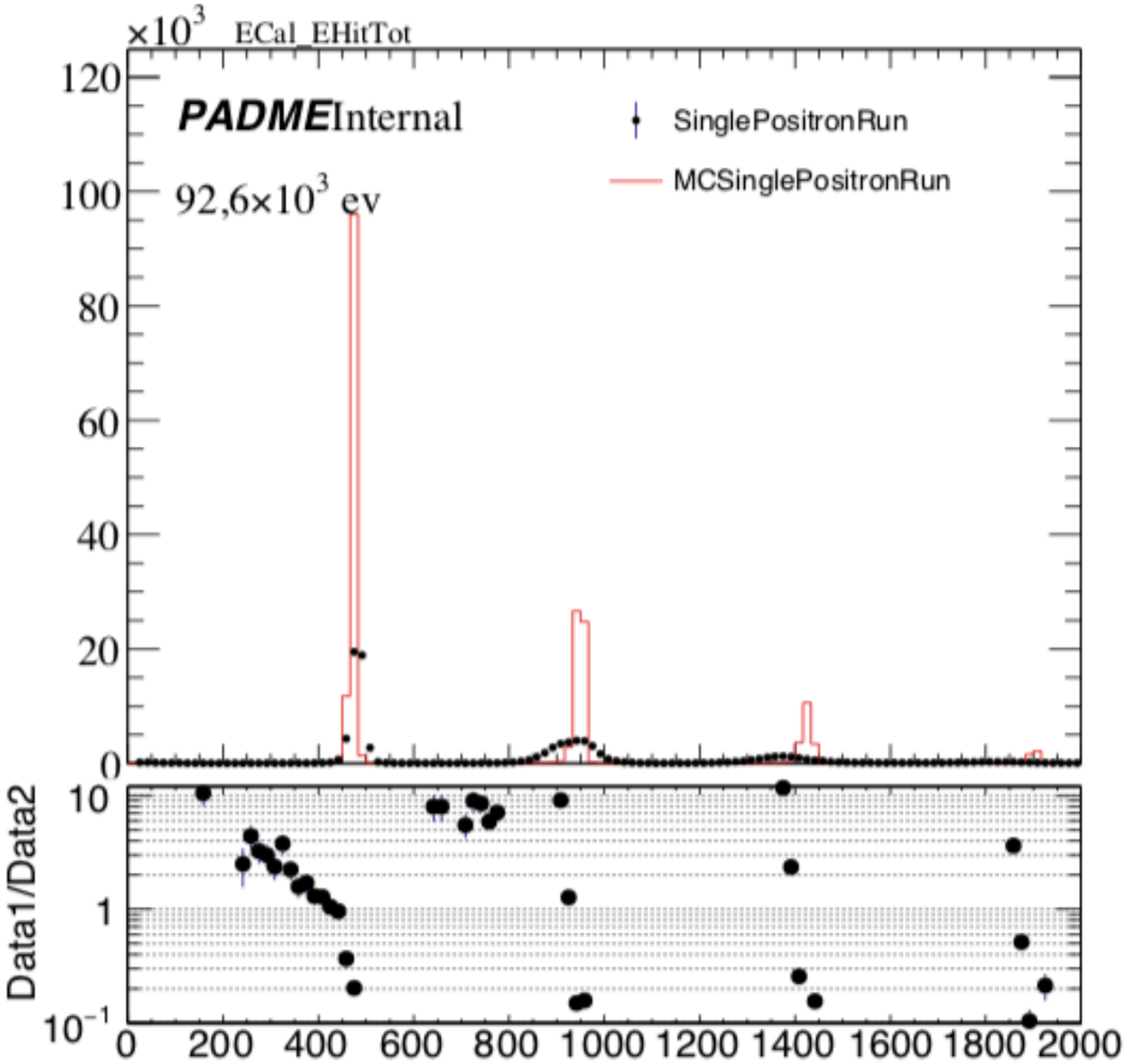


Cluster energy

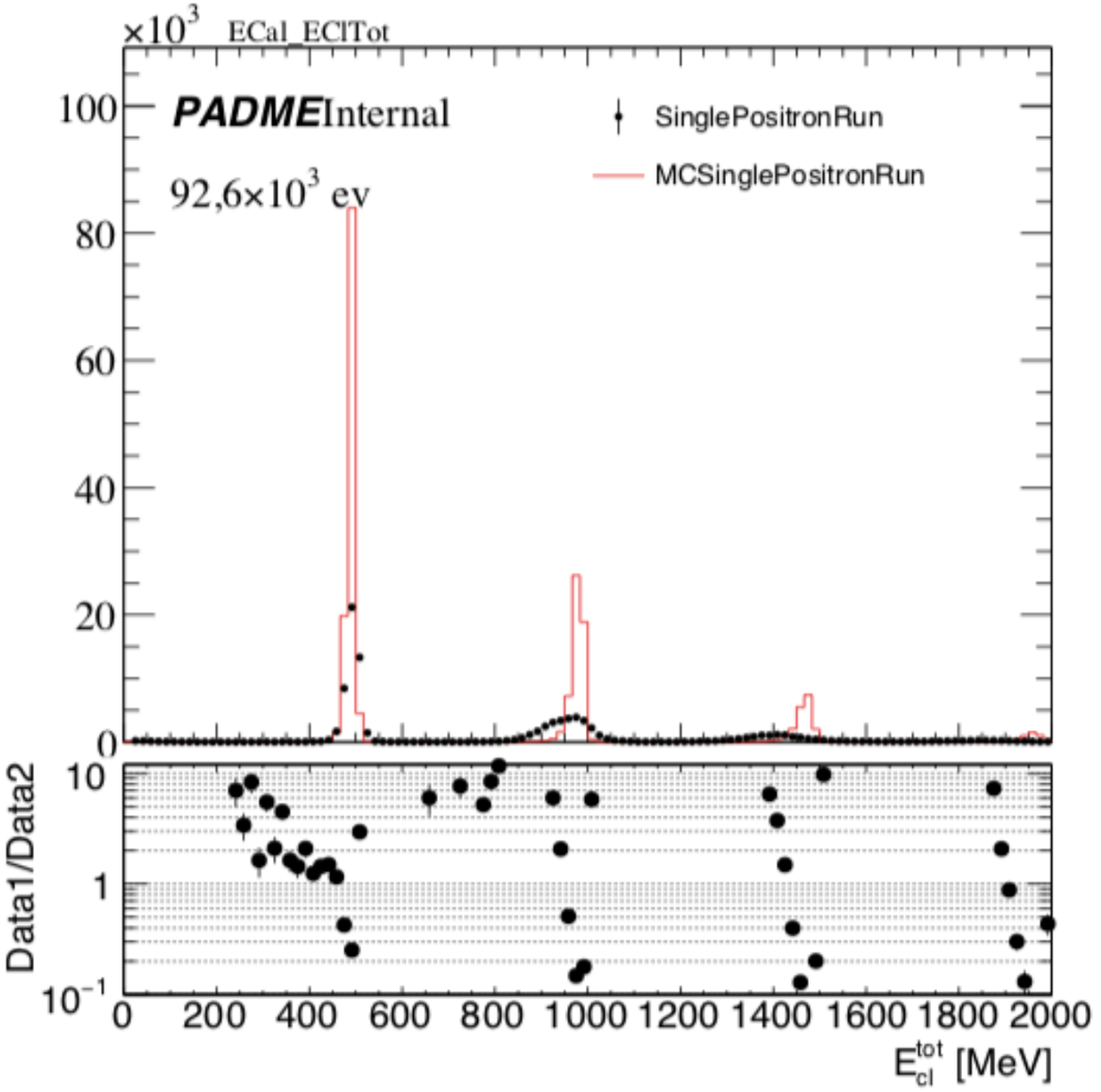


TOTAL ENERGY DISTRIBUTION

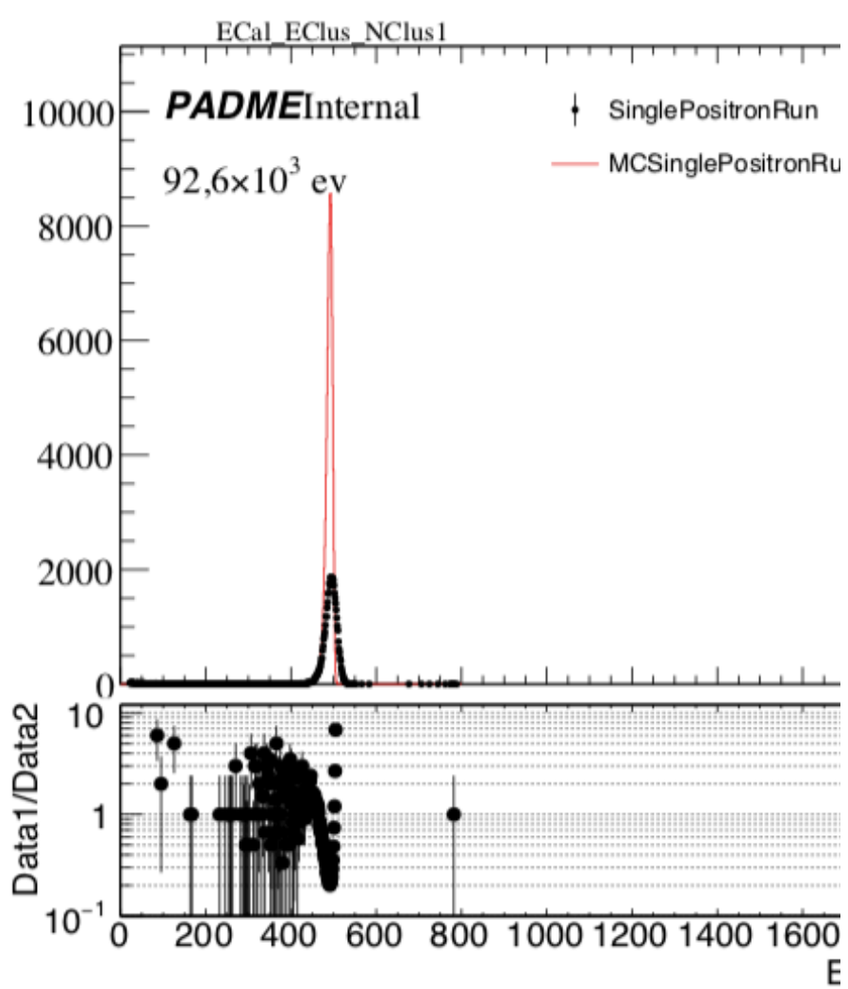
TotHit energy



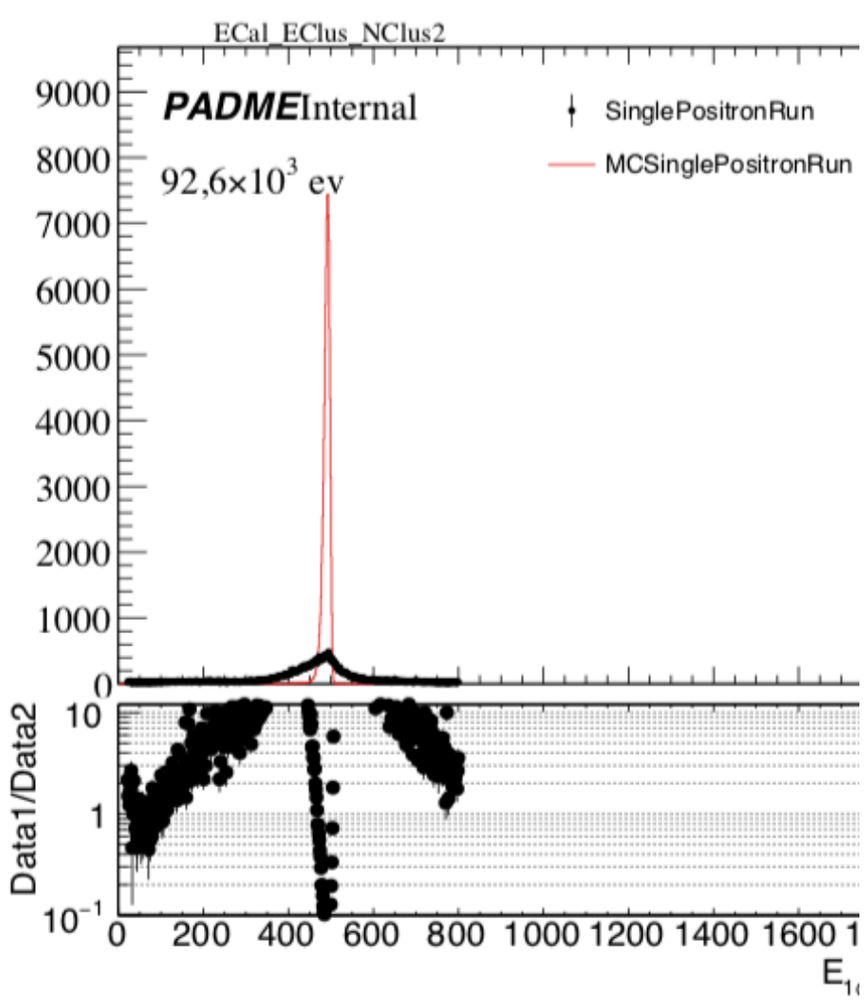
TotCluster energy



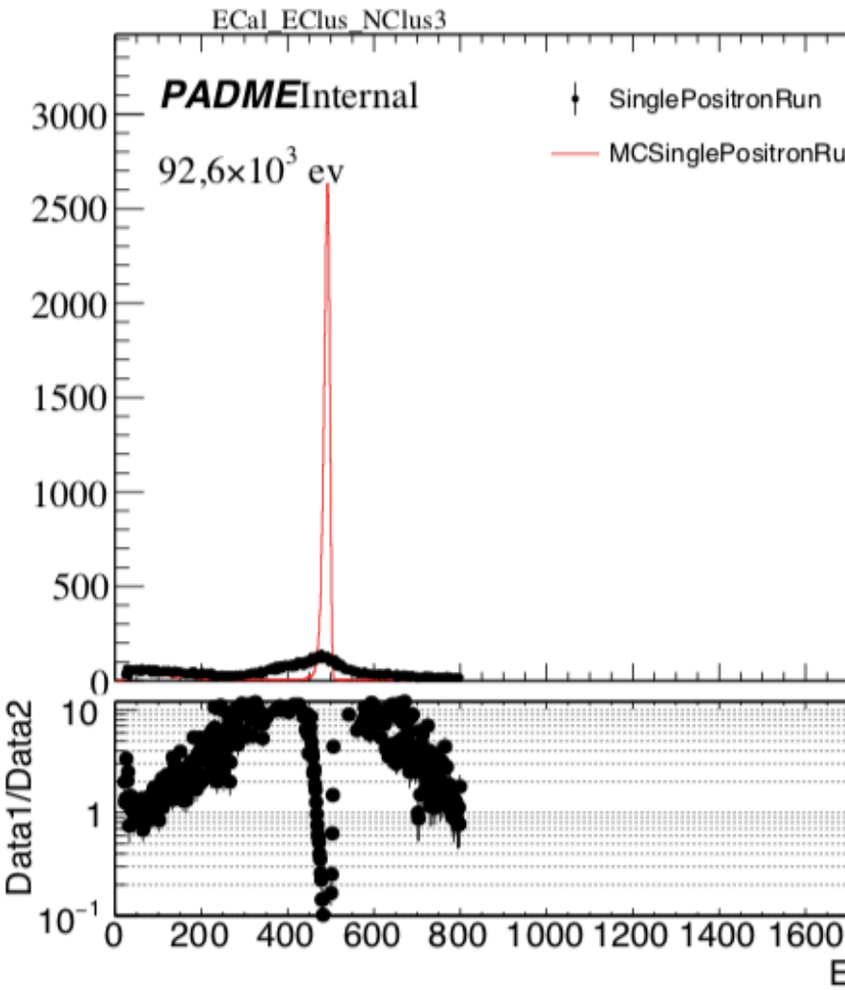
- Distribution of cluster energy when I have 1 (2 and 3) cluster / bunch



1 cl in ECAL



2 cl in ECAL

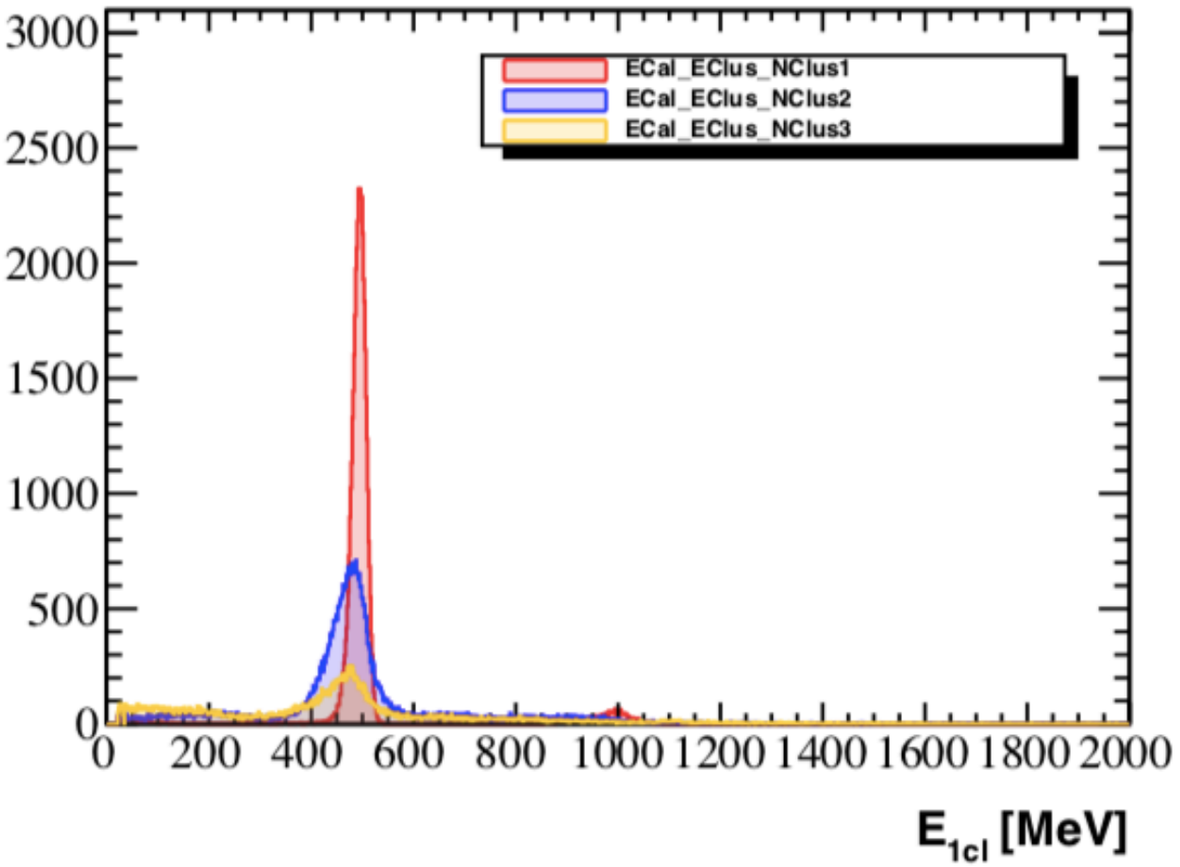


3 cl in ECAL

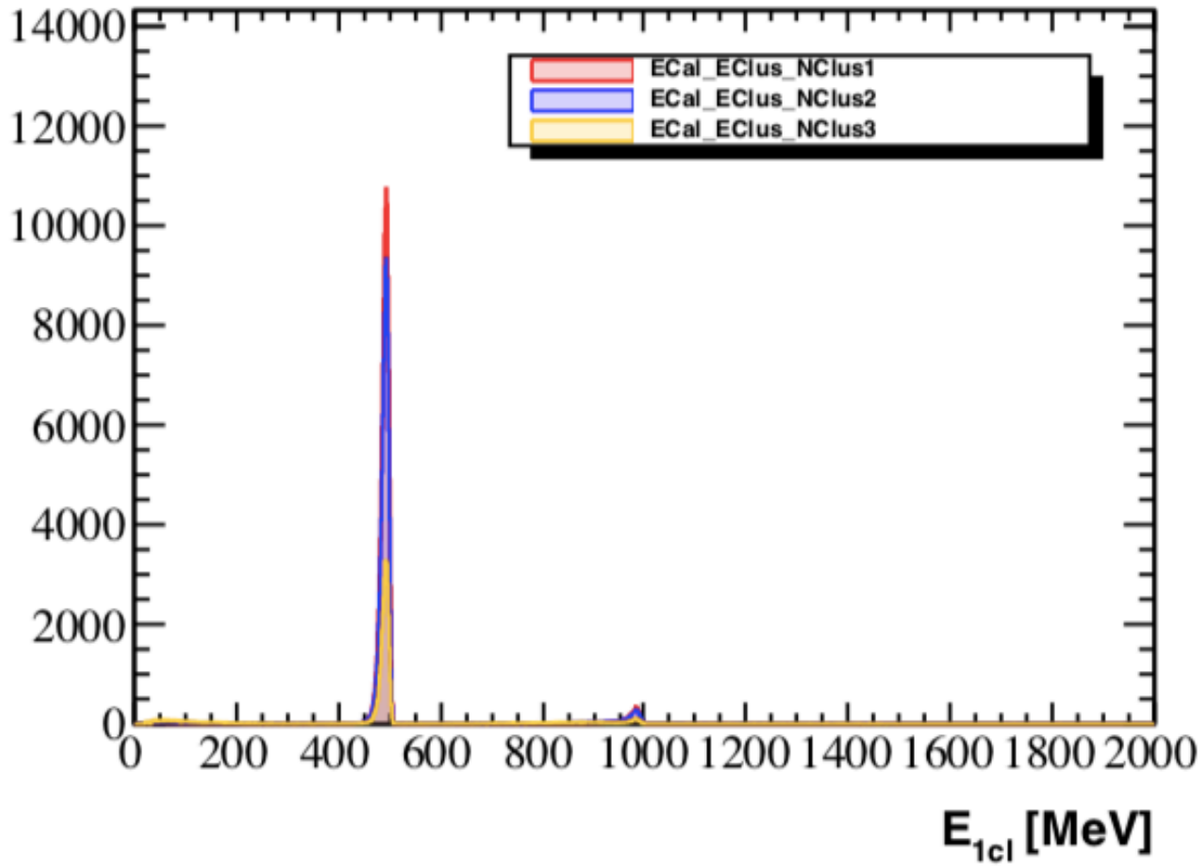
TOTAL CLUSTER ENERGY

- Total cluster energy / bunch when I have 1 (2 or 3) cluster/event

Data



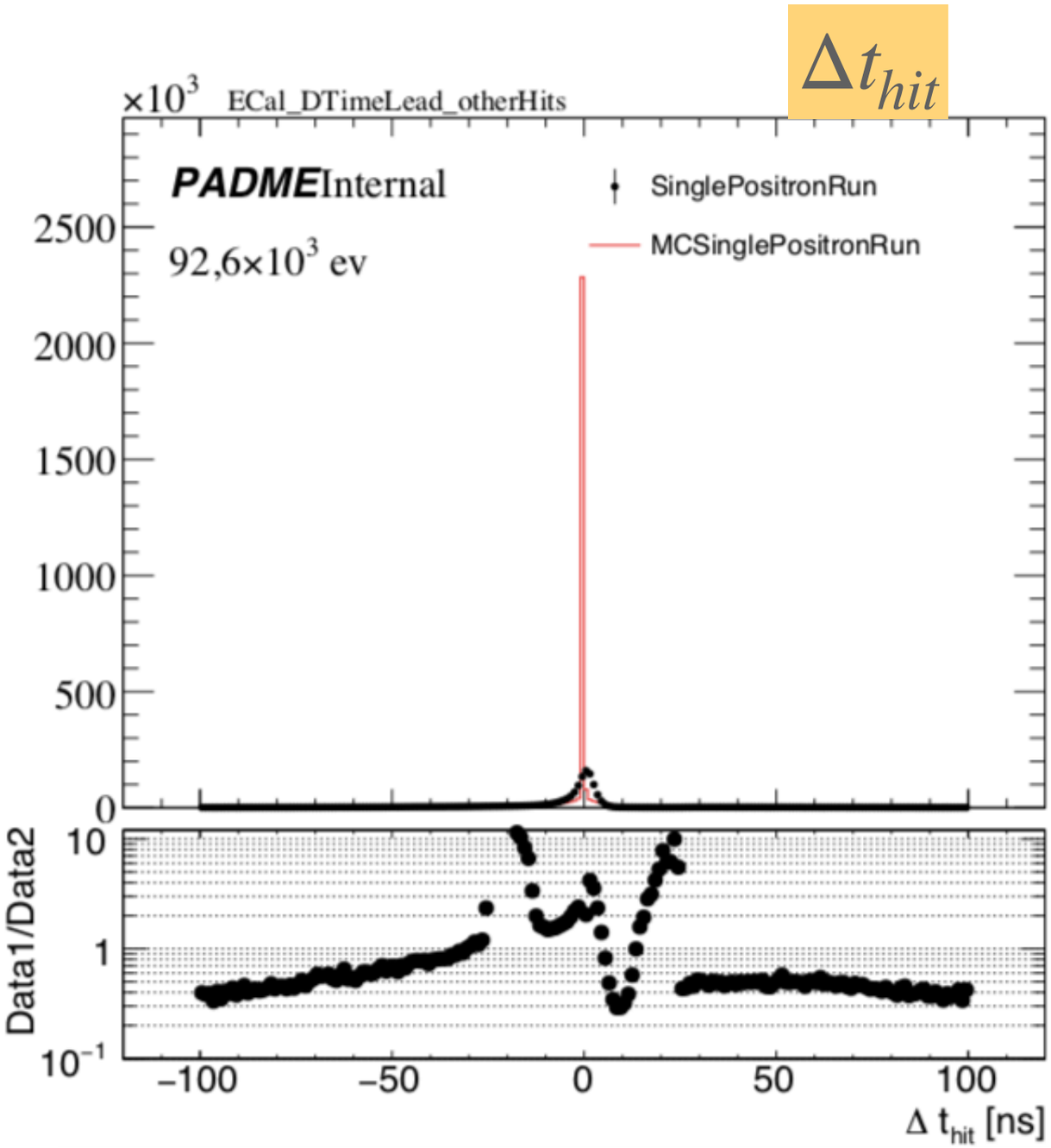
MC



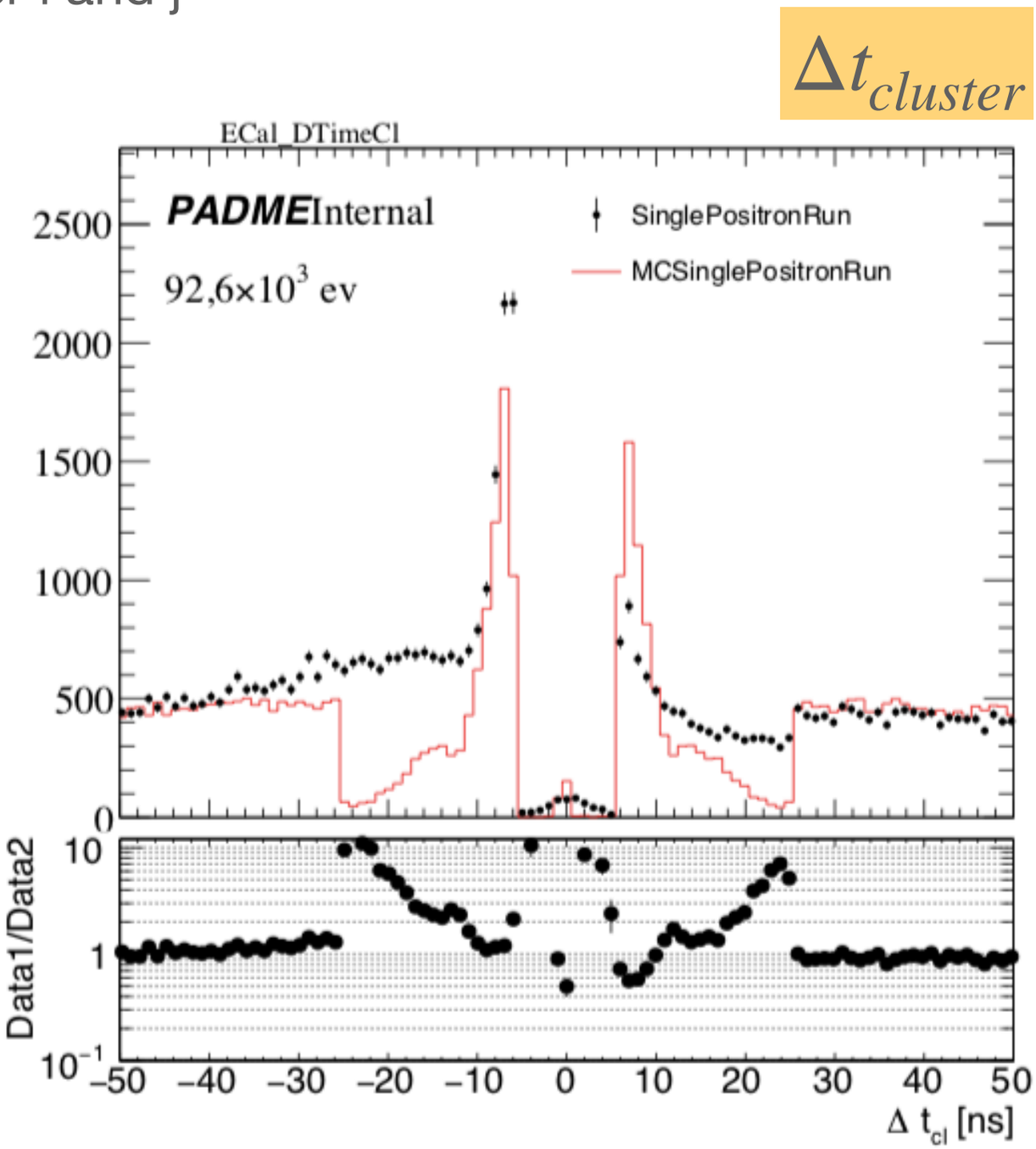
DELTA HIT & CLUSTER TIME

- Difference between the time of hit/cluster i and j

Δt_{hit}



$\Delta t_{cluster}$

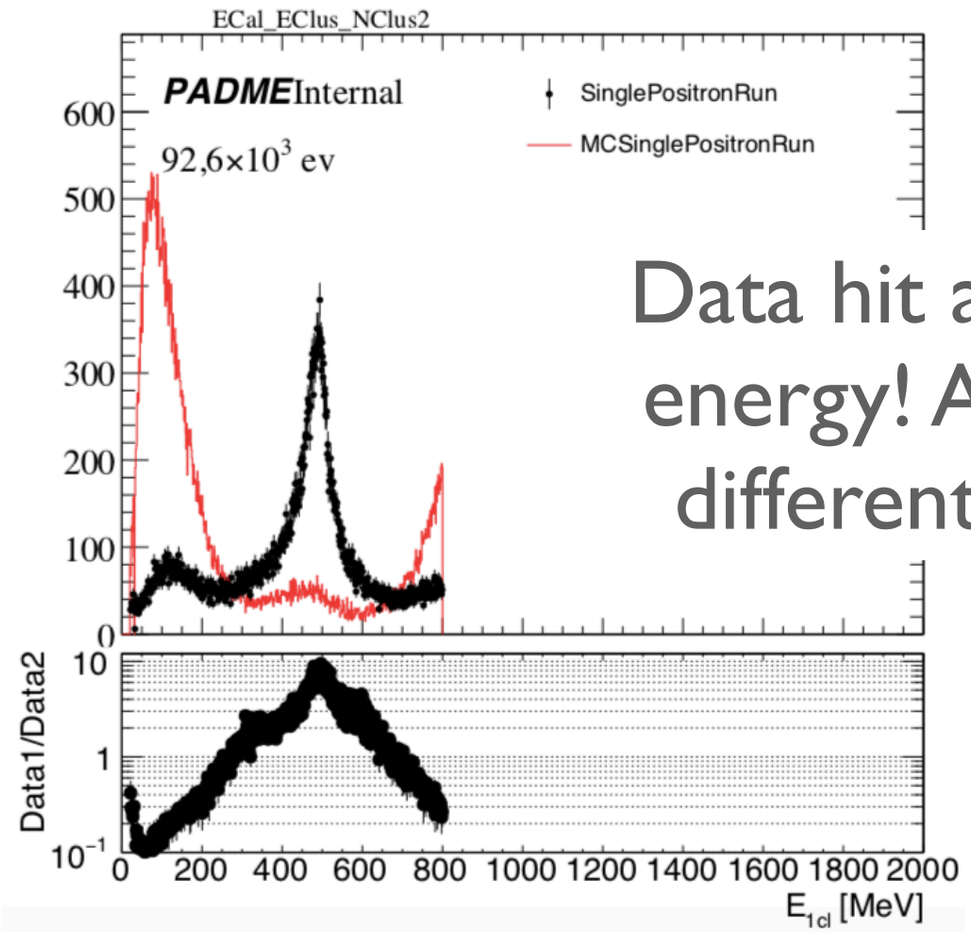


CONSIDERATION

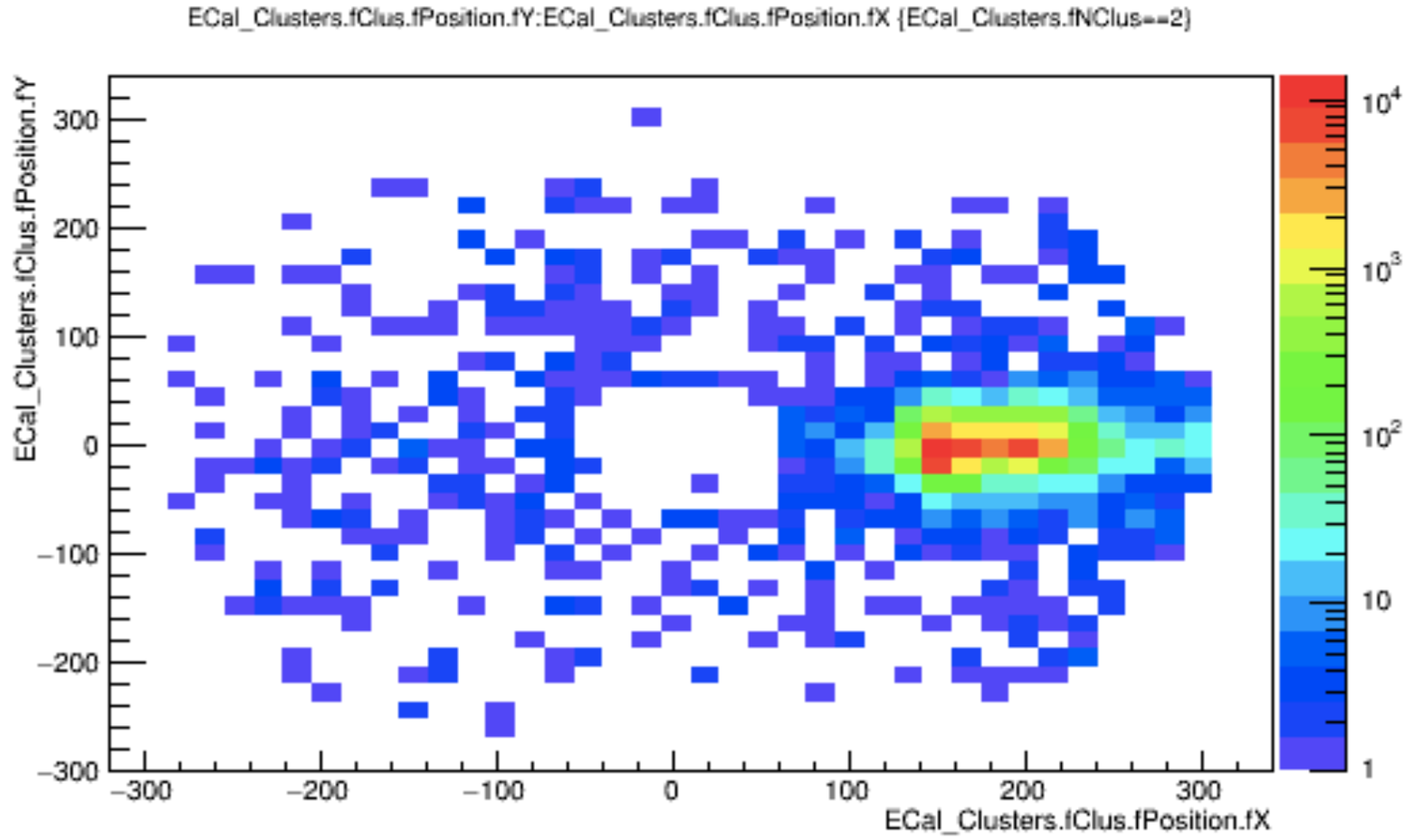
- Single hit reconstruction with energy & time spread shows the same problem that the single hit w/o spread has.
- Multi hit reconstruction has the same features for all the samples.

SINGLE POSITRON IN ECAL - SINGLE HIT RECONSTRUCTION

- Studies useful to understand the distribution of the positron in ECAL on data
  - Why the number of hit doesn't change with MH?
  - The positrons on data are separately in space? This can allow me to see the distribution below

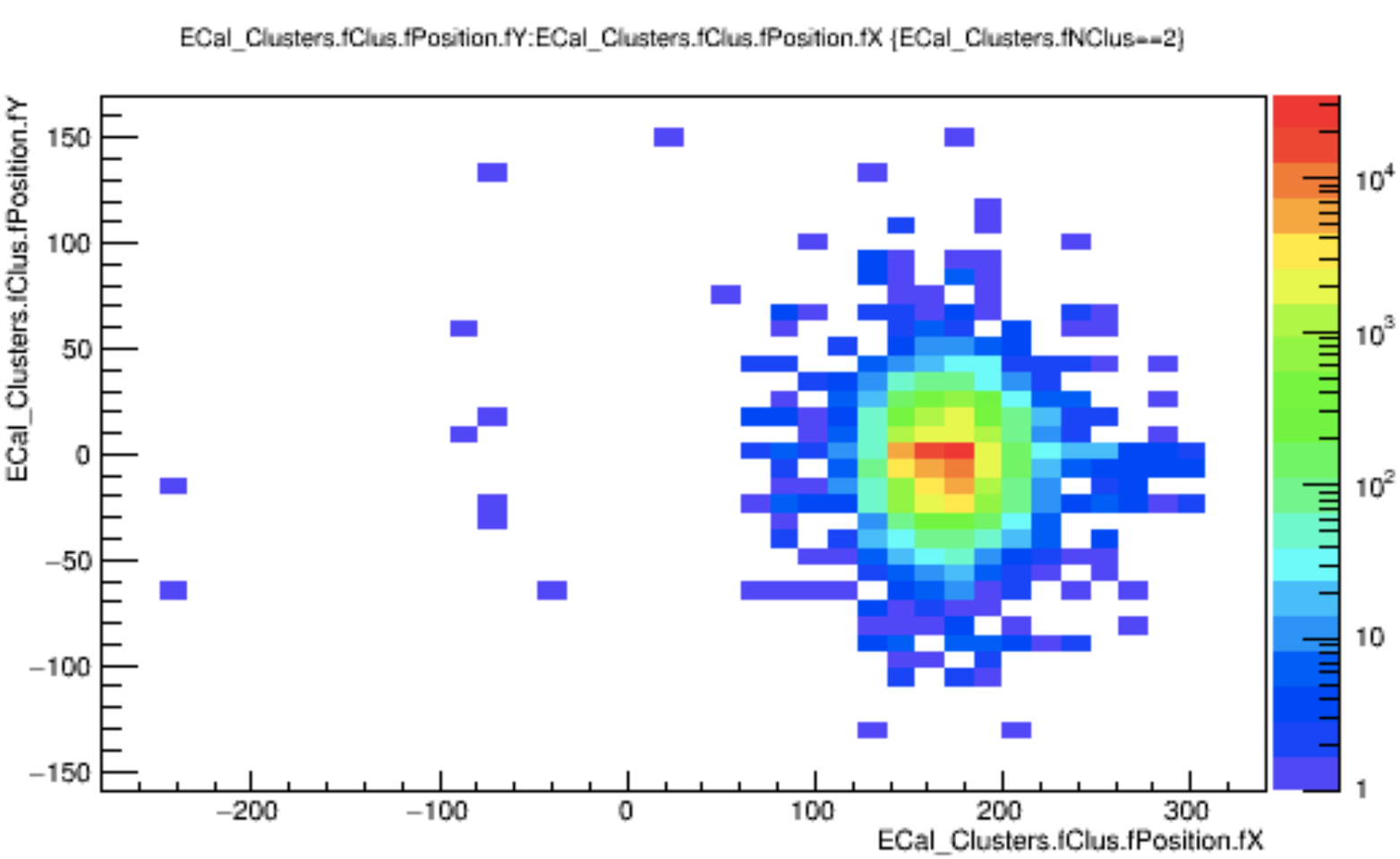


Data hit at the right energy! Are they at different channel?



- Ecal cluster map when nCl/bunch=2

Data

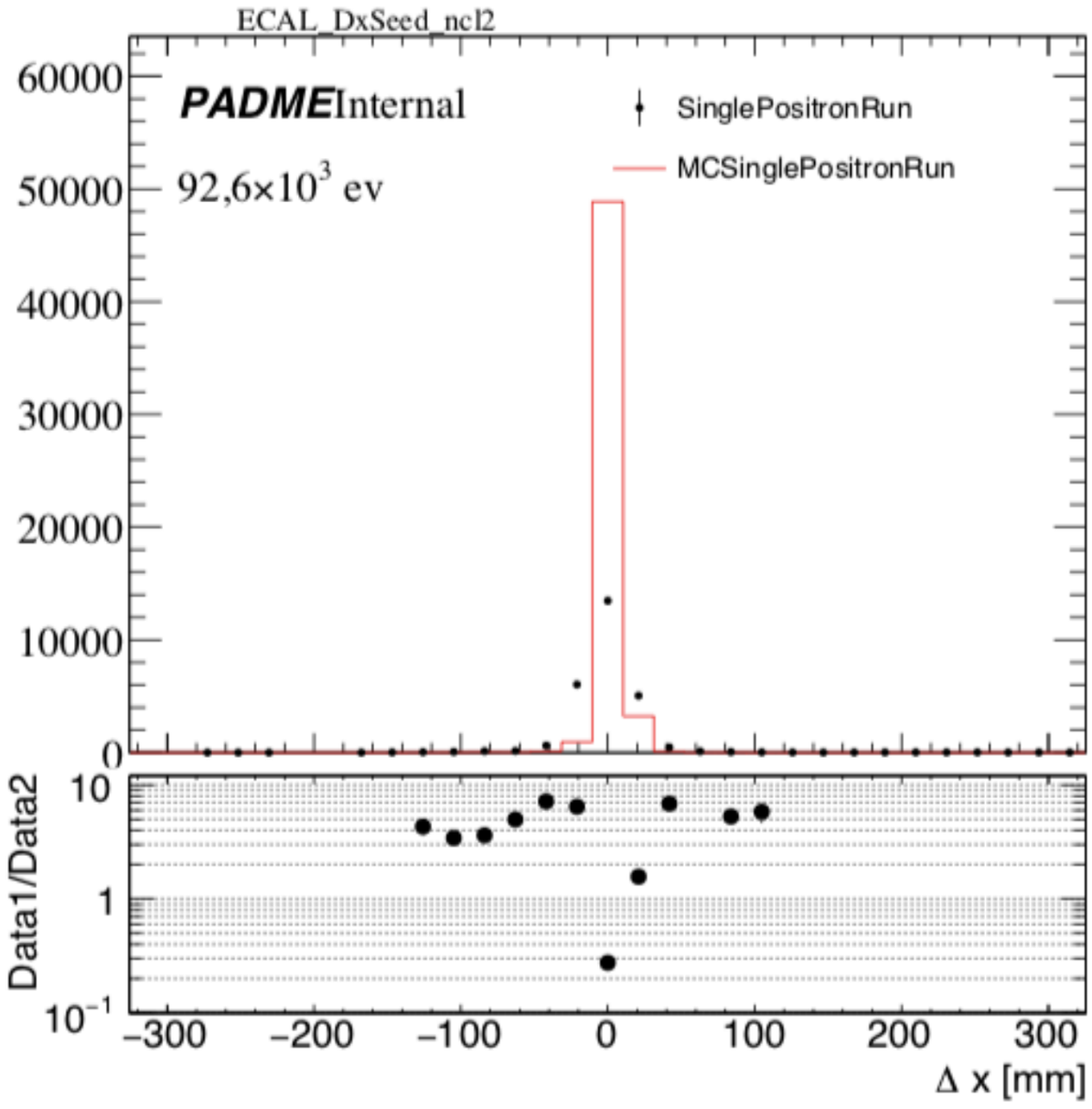


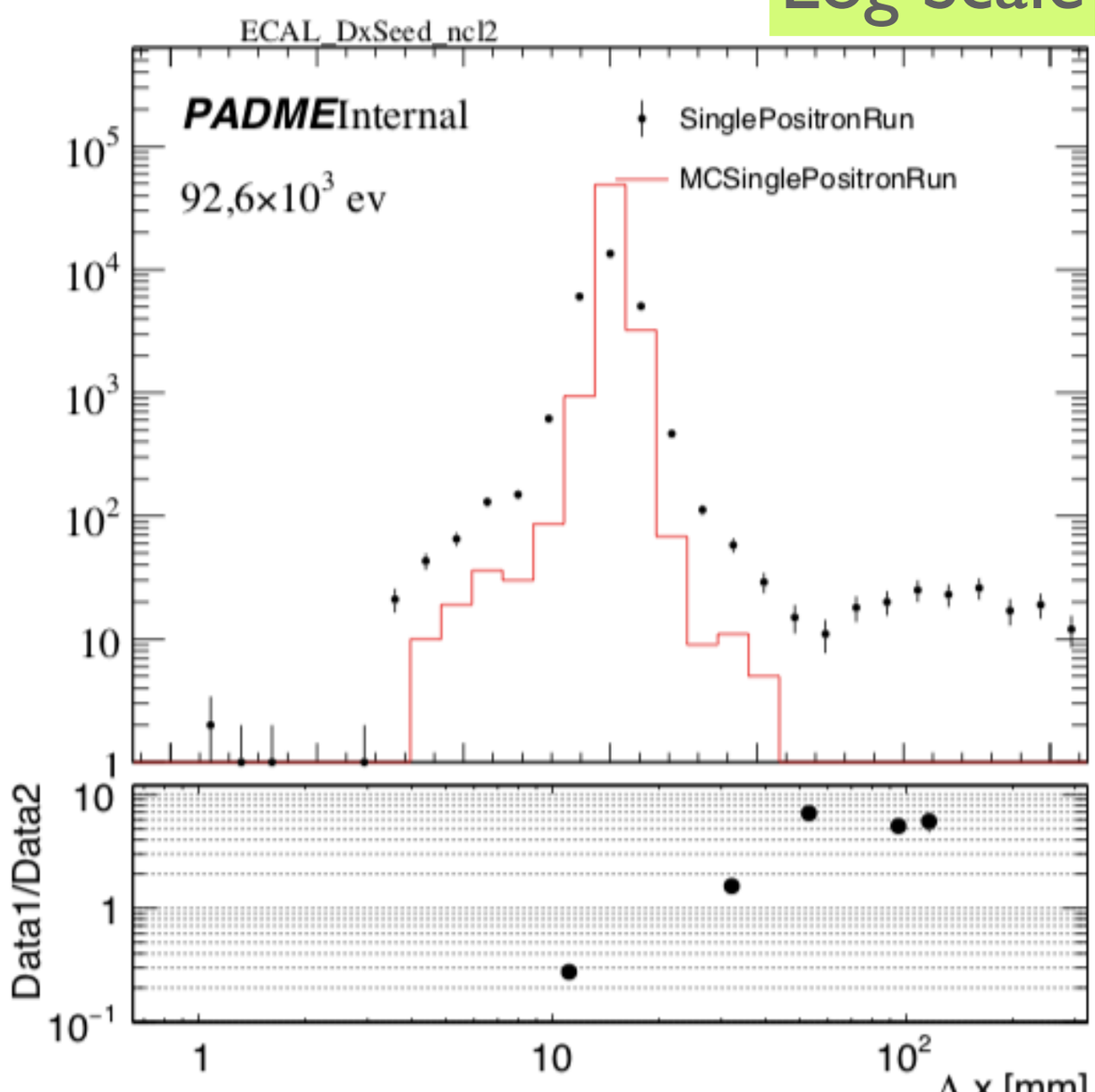
MC

Dx

- X Difference between the seed of the two clusters when I have NCl=2/bunch

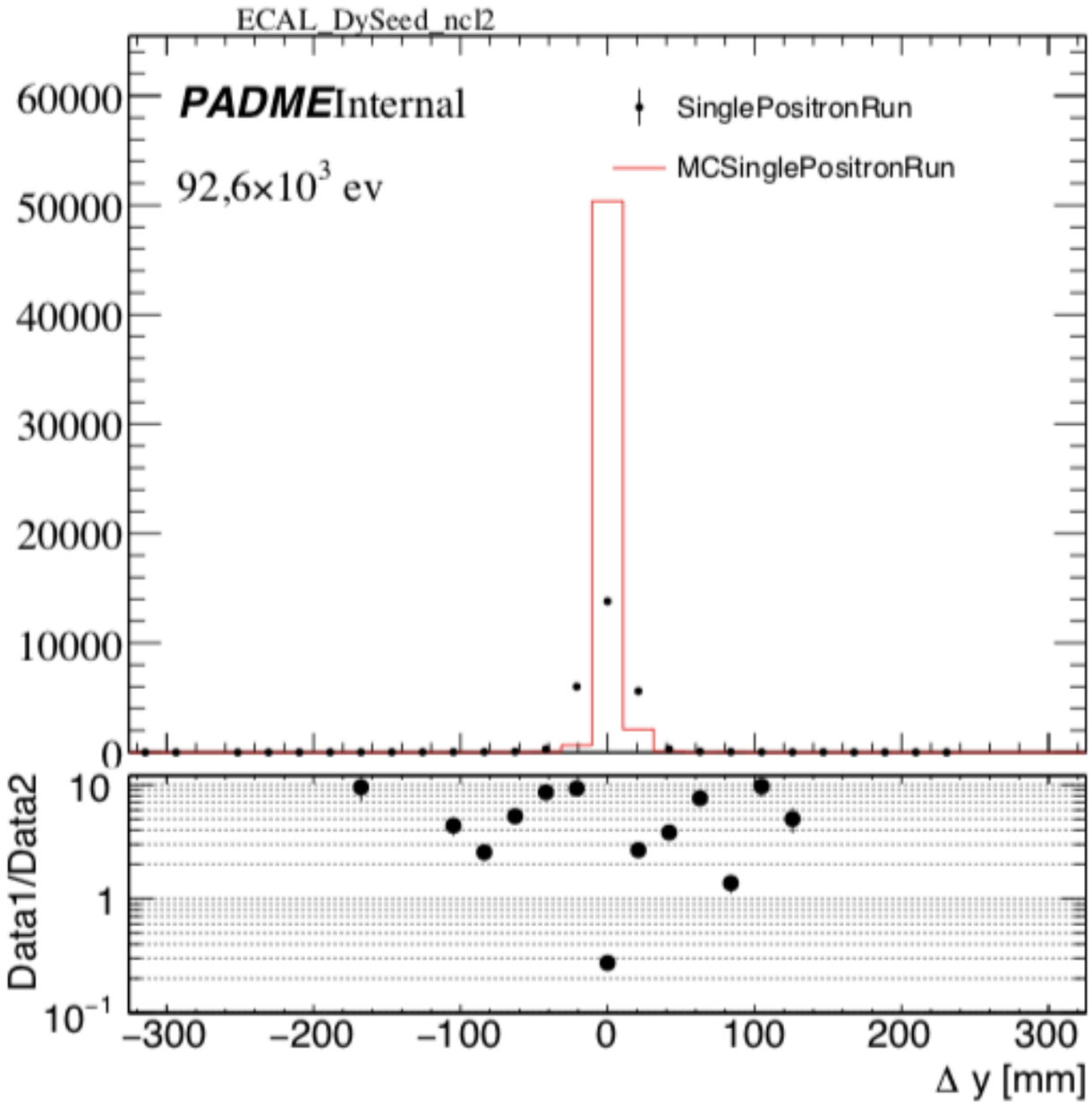
Log Scale



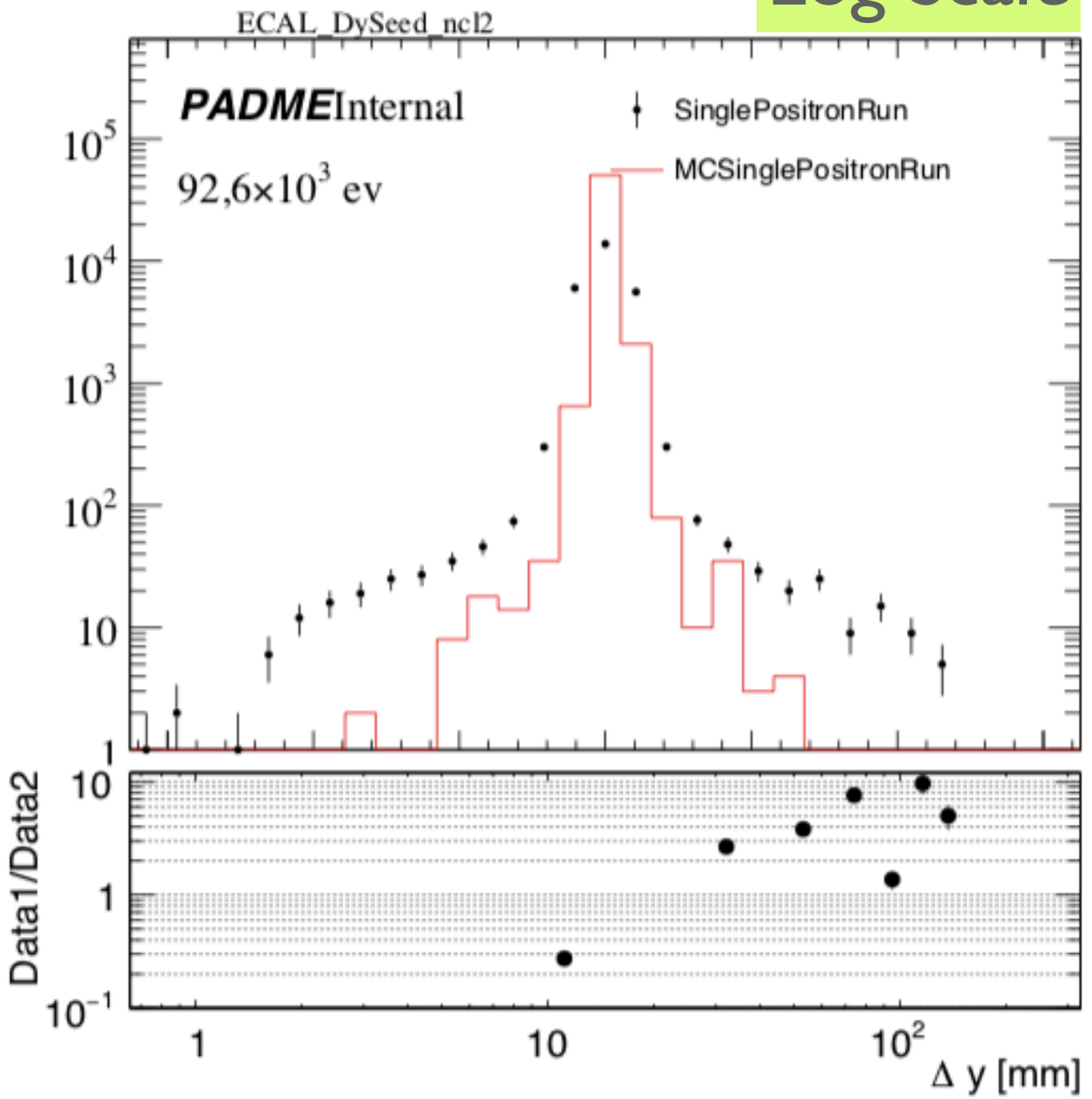


Dy

- Y Difference between the seed of the two clusters when I have NCl=2/bunch

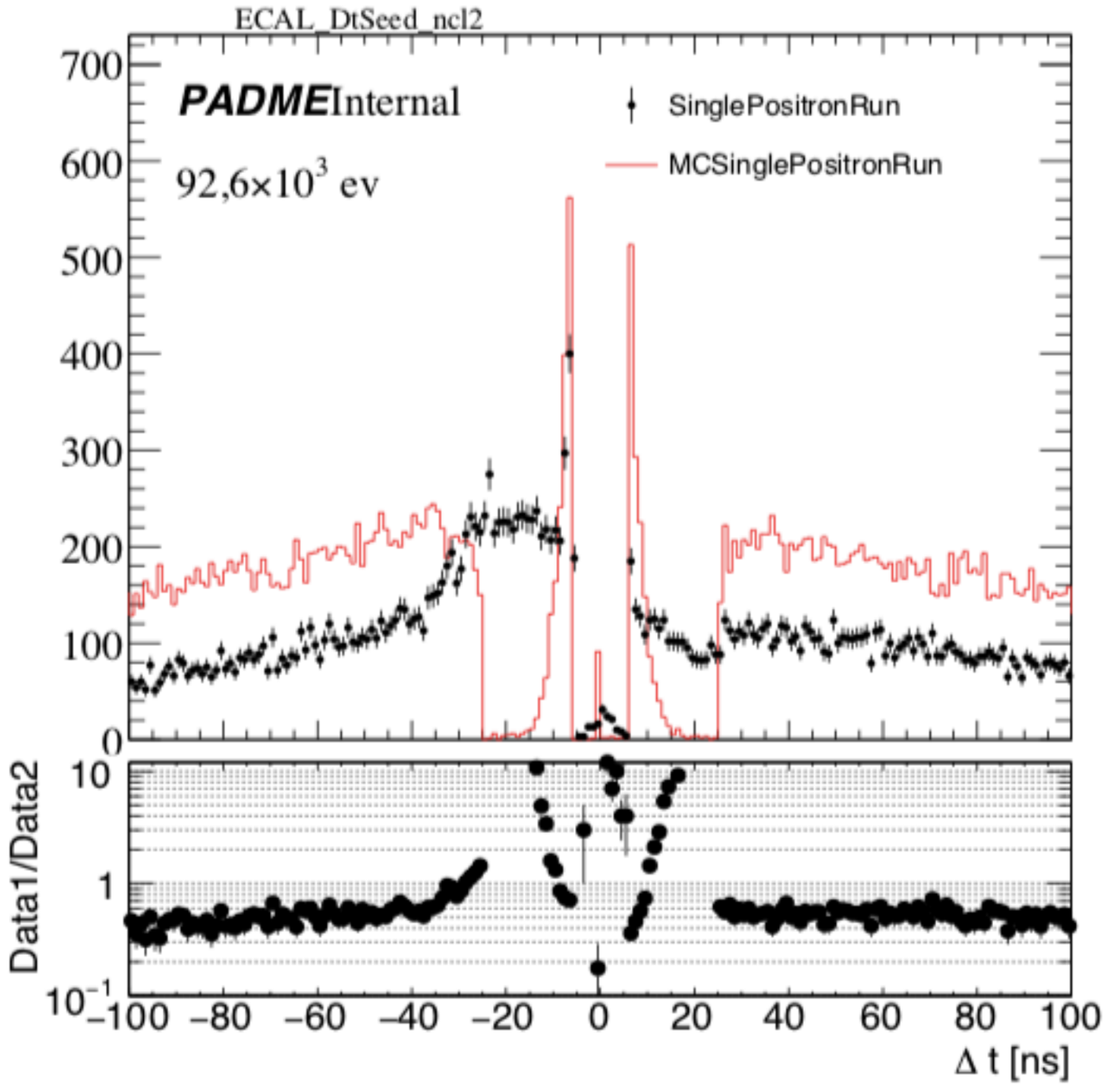


Log Scale



DTIME

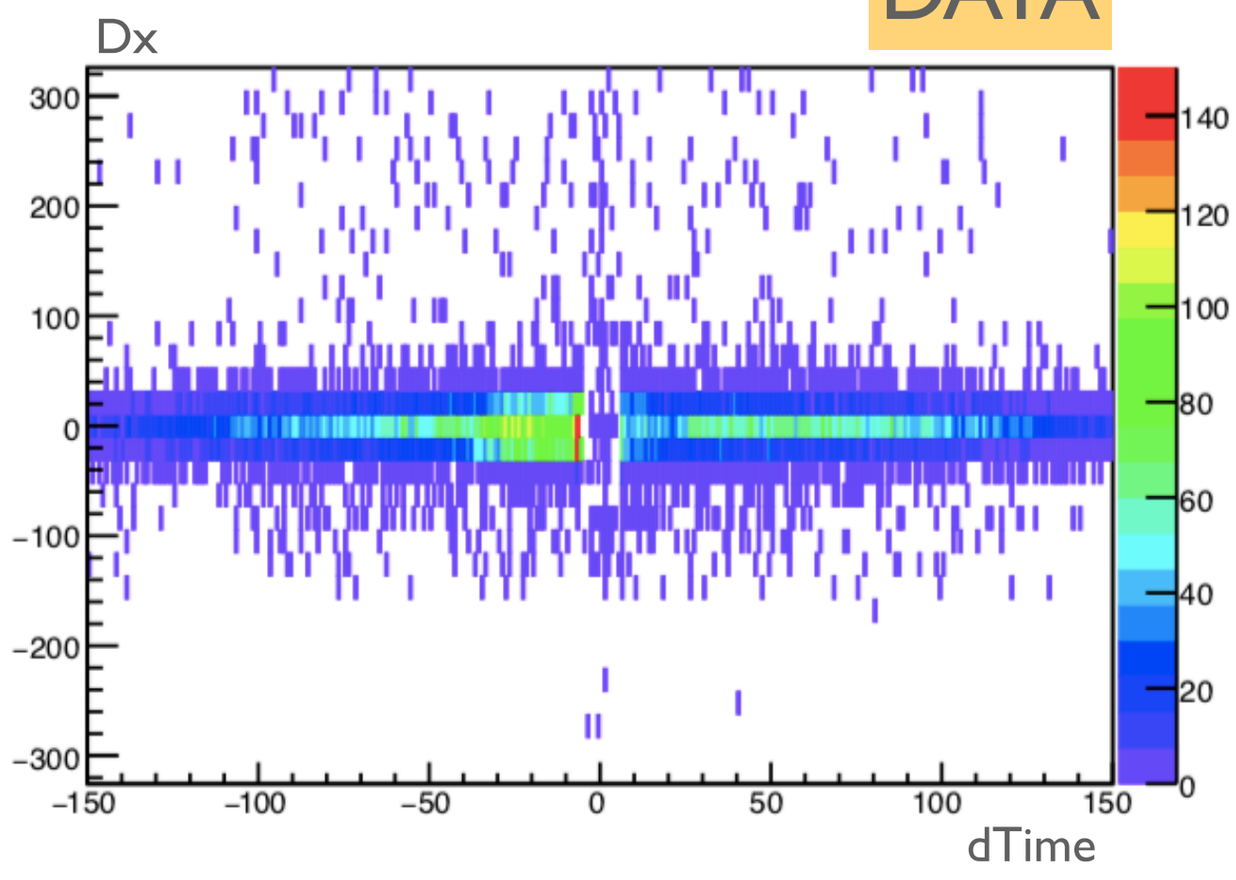
- Difference in time between the time of the clusters seed when I have NCl=2/bunch



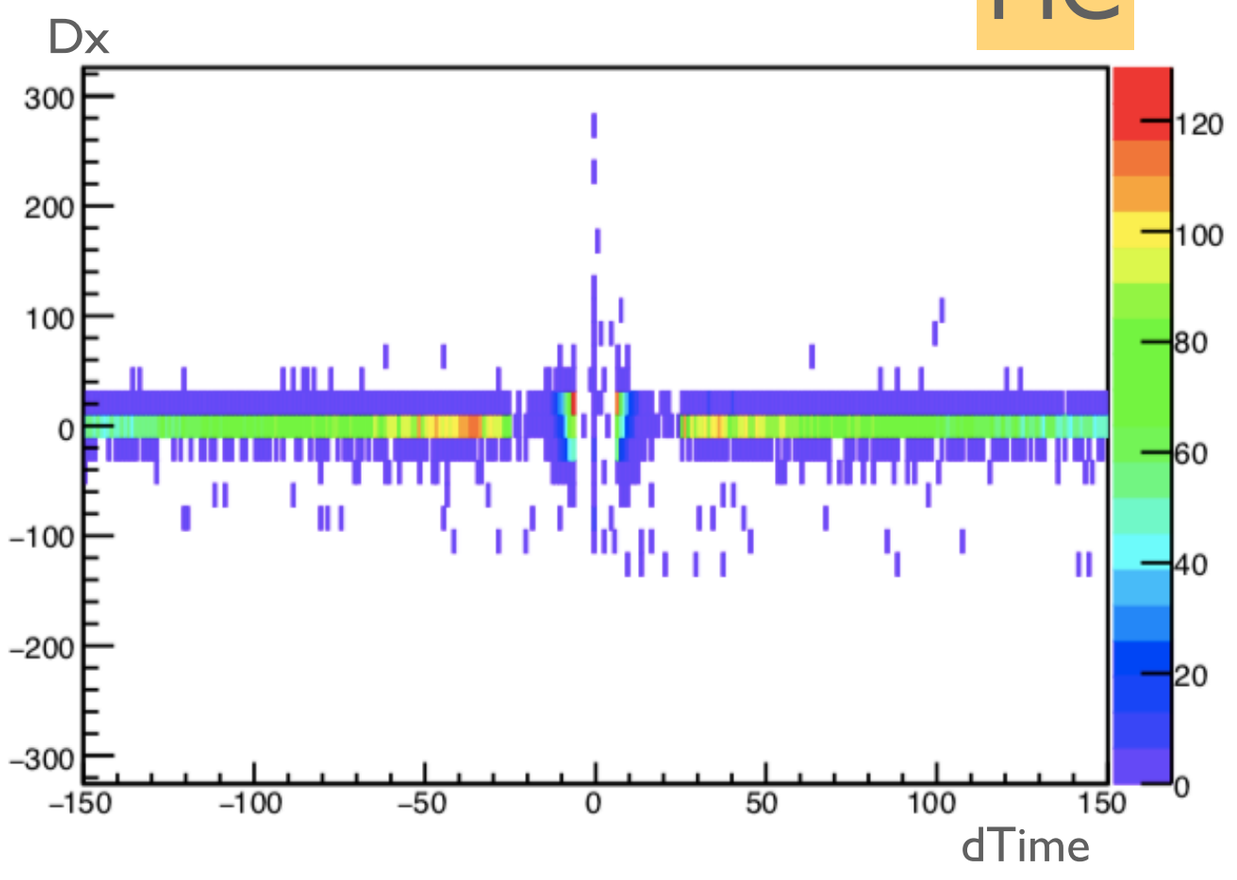
Dx vs dT

- Difference of the x position of two clusters as a function of the difference of the time when I have NCl=2/bunch

DATA

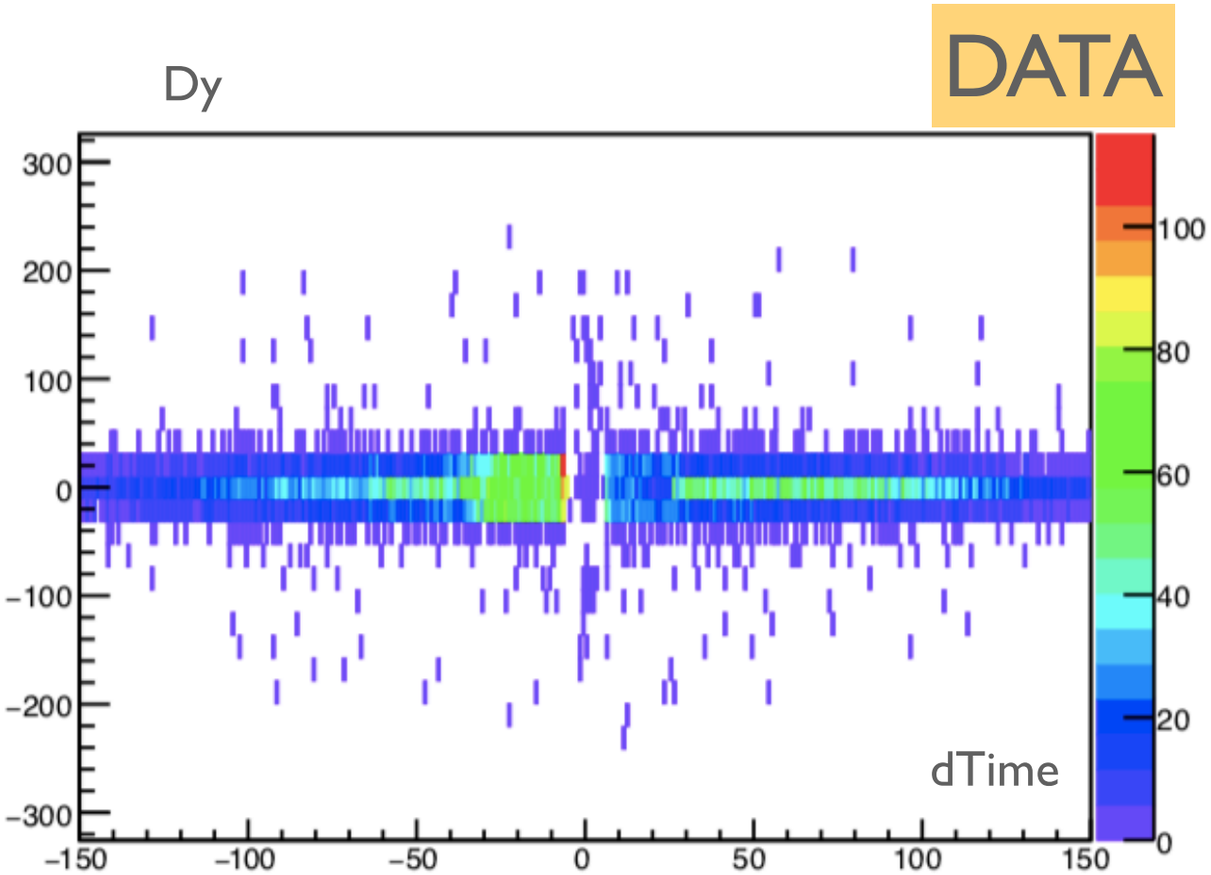


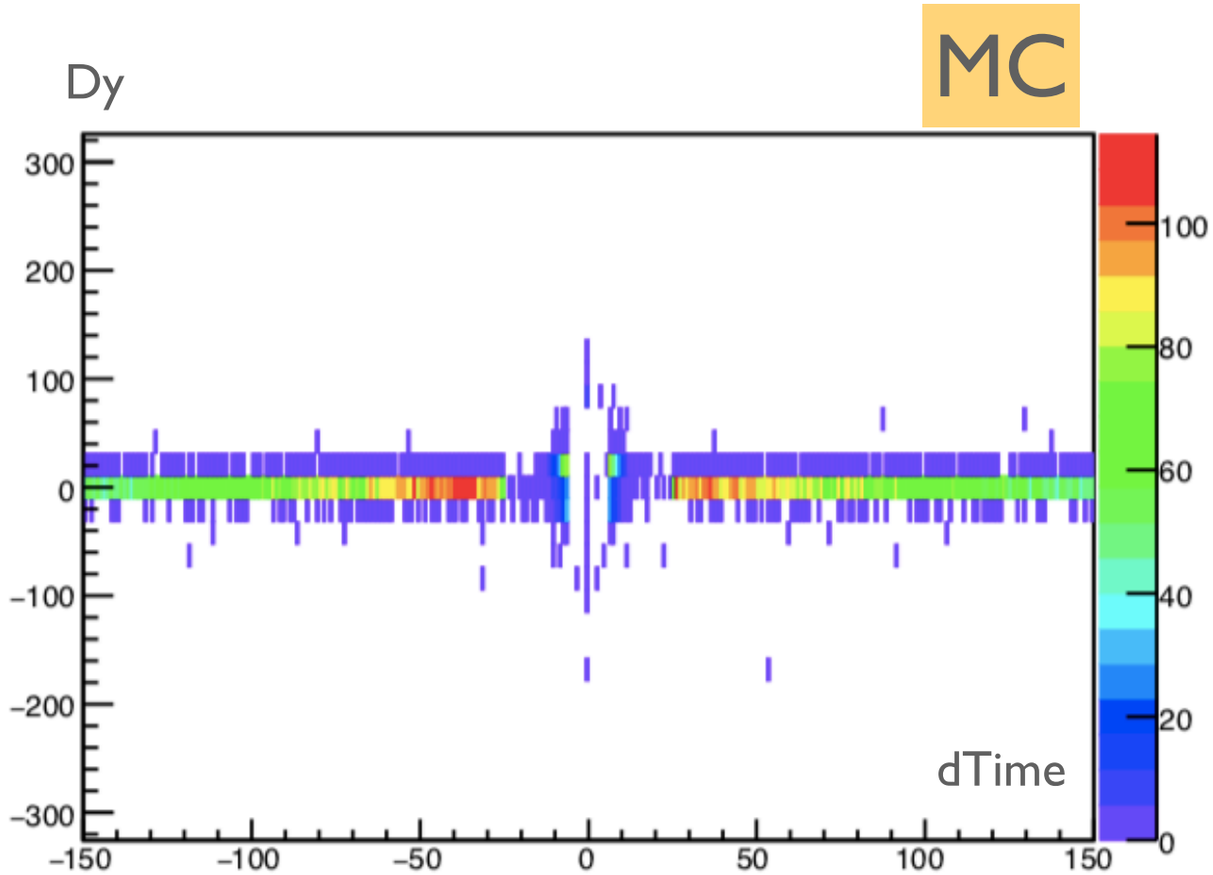
MC



Dy vs Dt

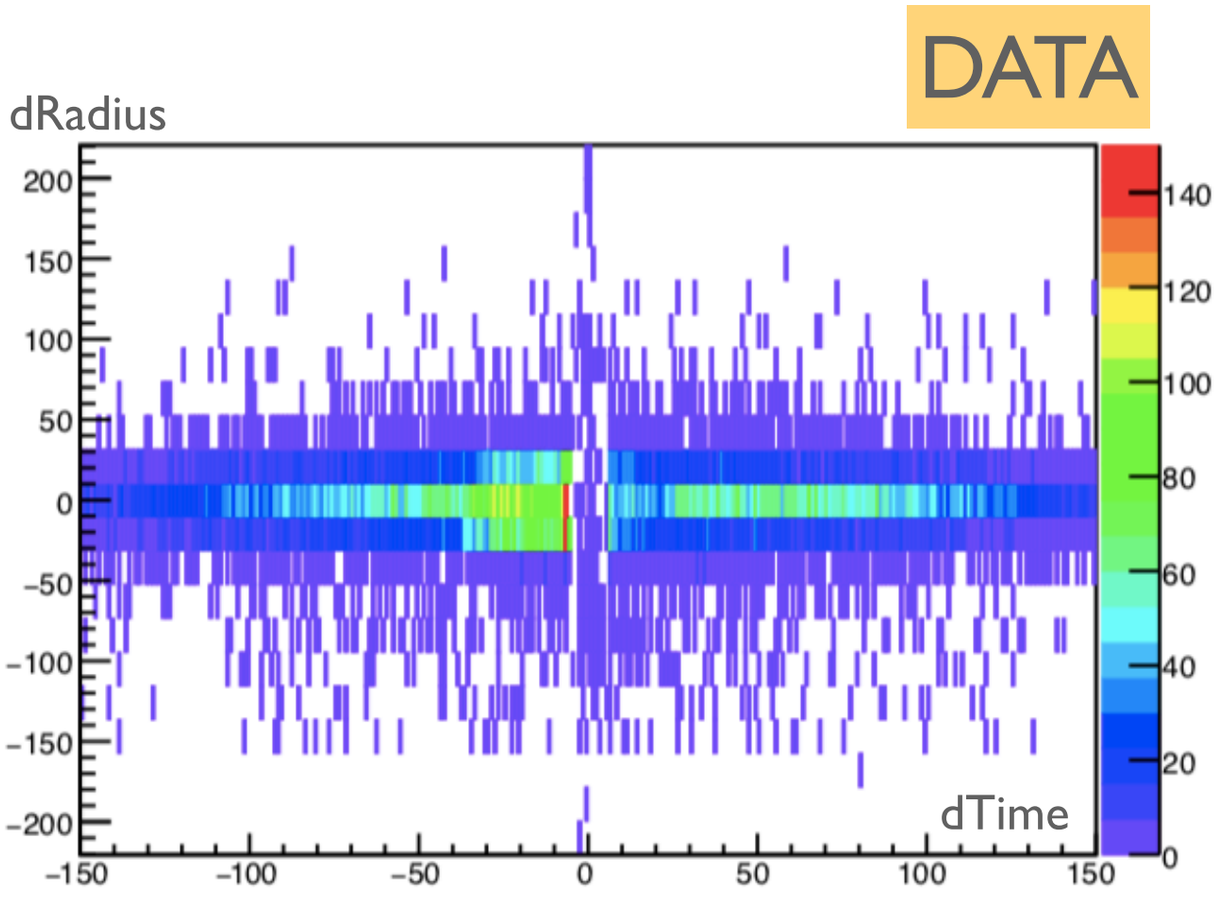
- Difference of the y position of two clusters as a function of the difference of the time when I have NCl=2/bunch && when I have the difference of the position x < 2.1 (two clusters are in the same x position- same column)

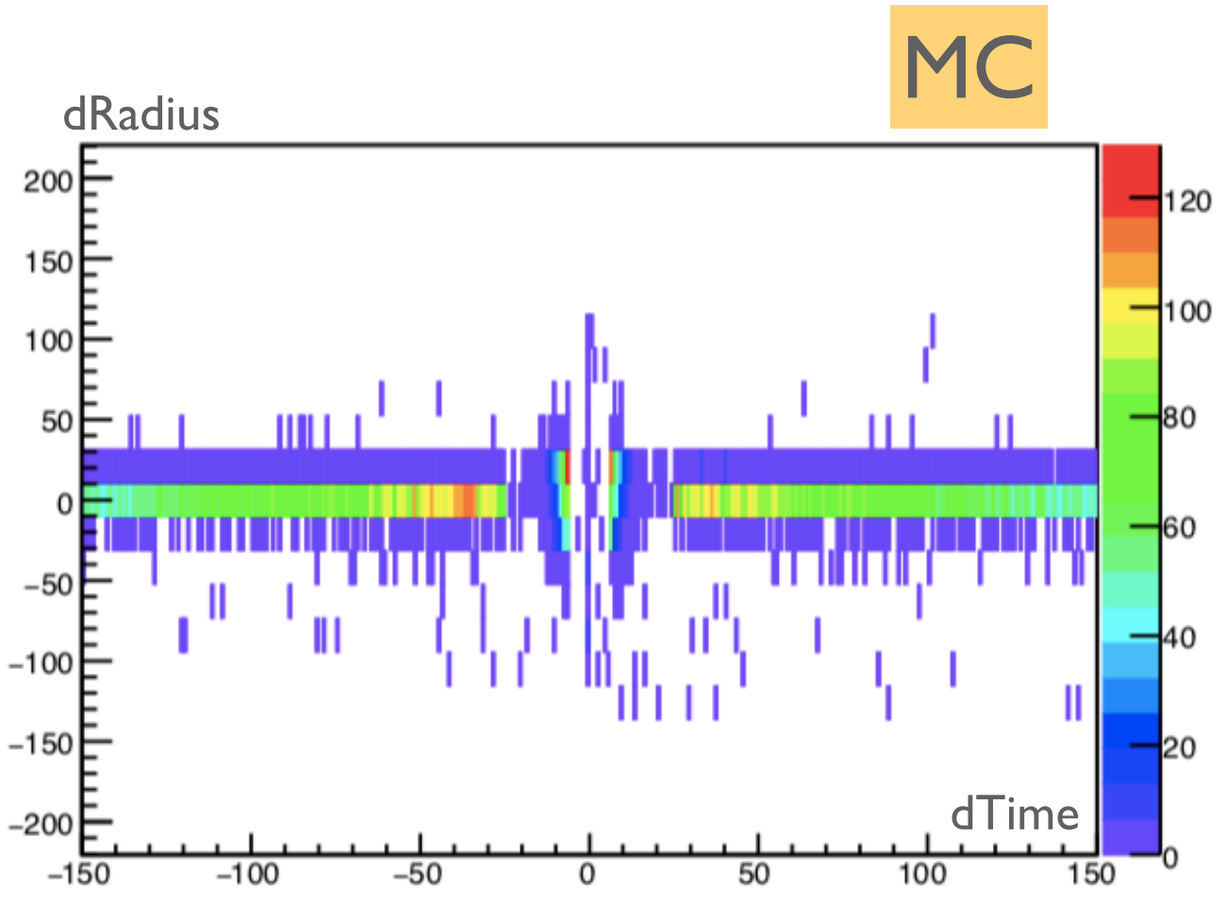




dR vs dT

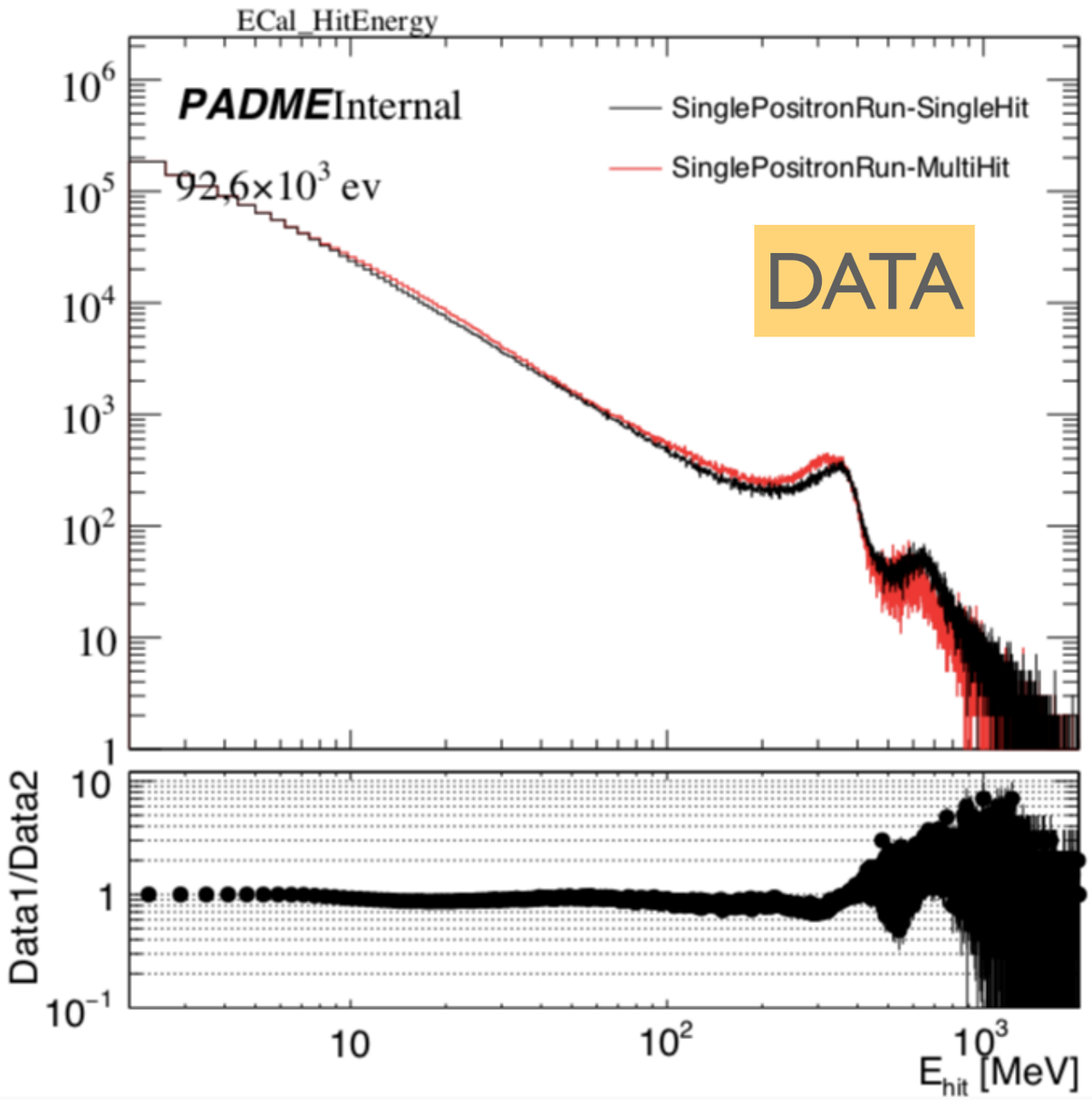
- Difference of the radius of two clusters as a function of the difference of the time when NCl=2/bunch

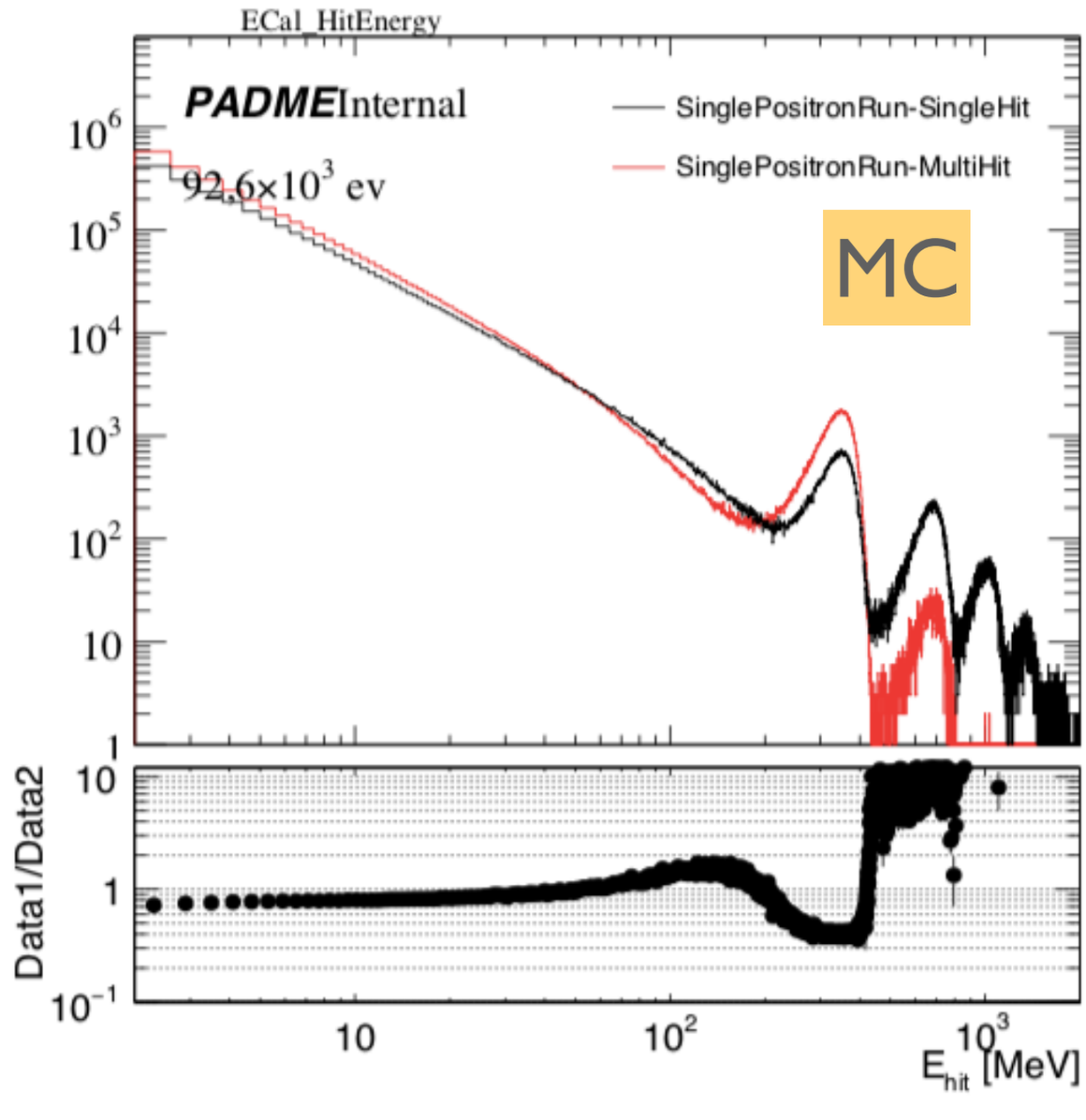




HIT ENERGY DISTRIBUTION

- Hit energy distribution for data and MC : comparison between single hit e multi hit reconstruction

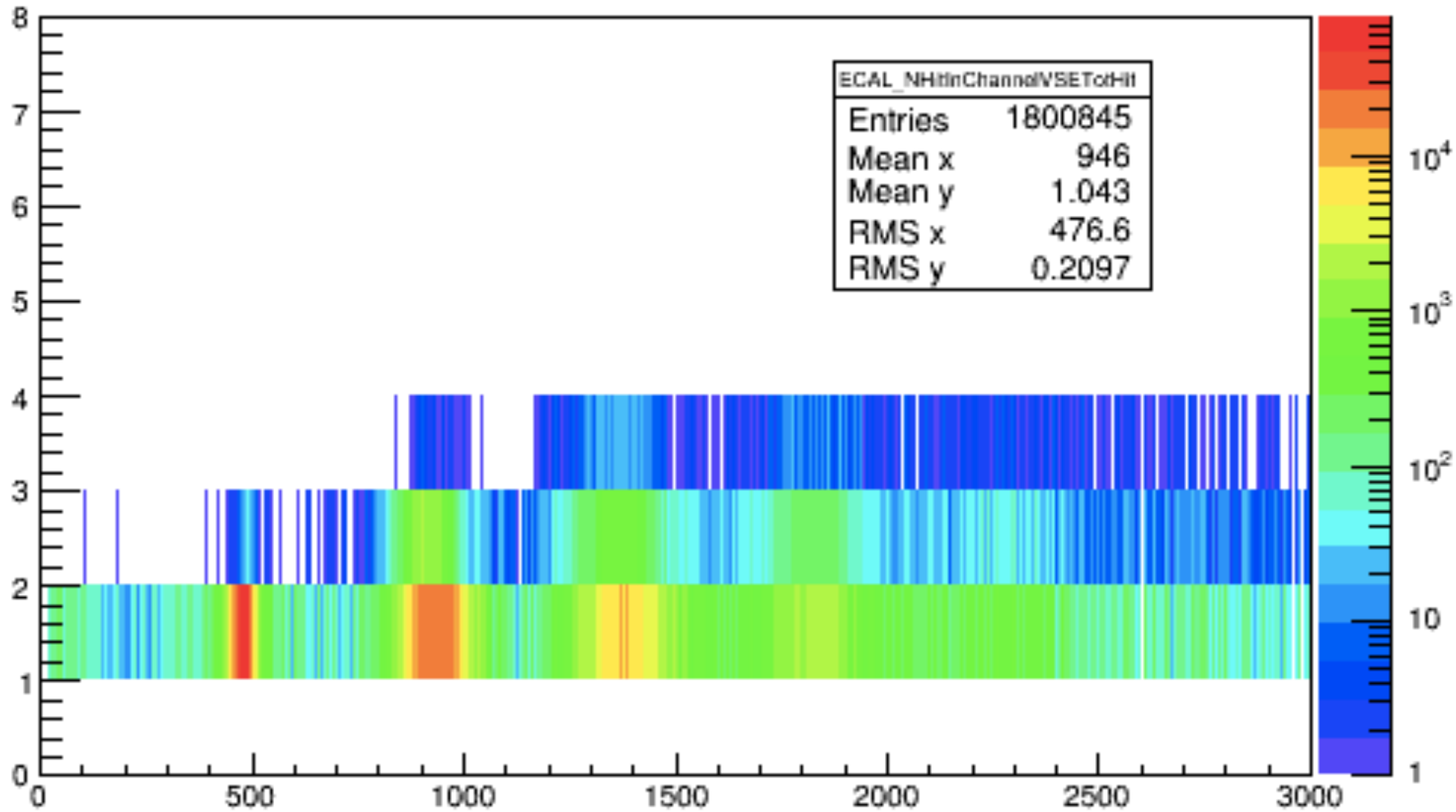




PROBLEMS IN DATA..?

- Number of hits/channel as a function of the total energy of the hits on events for MULTI hit reconstruction..!

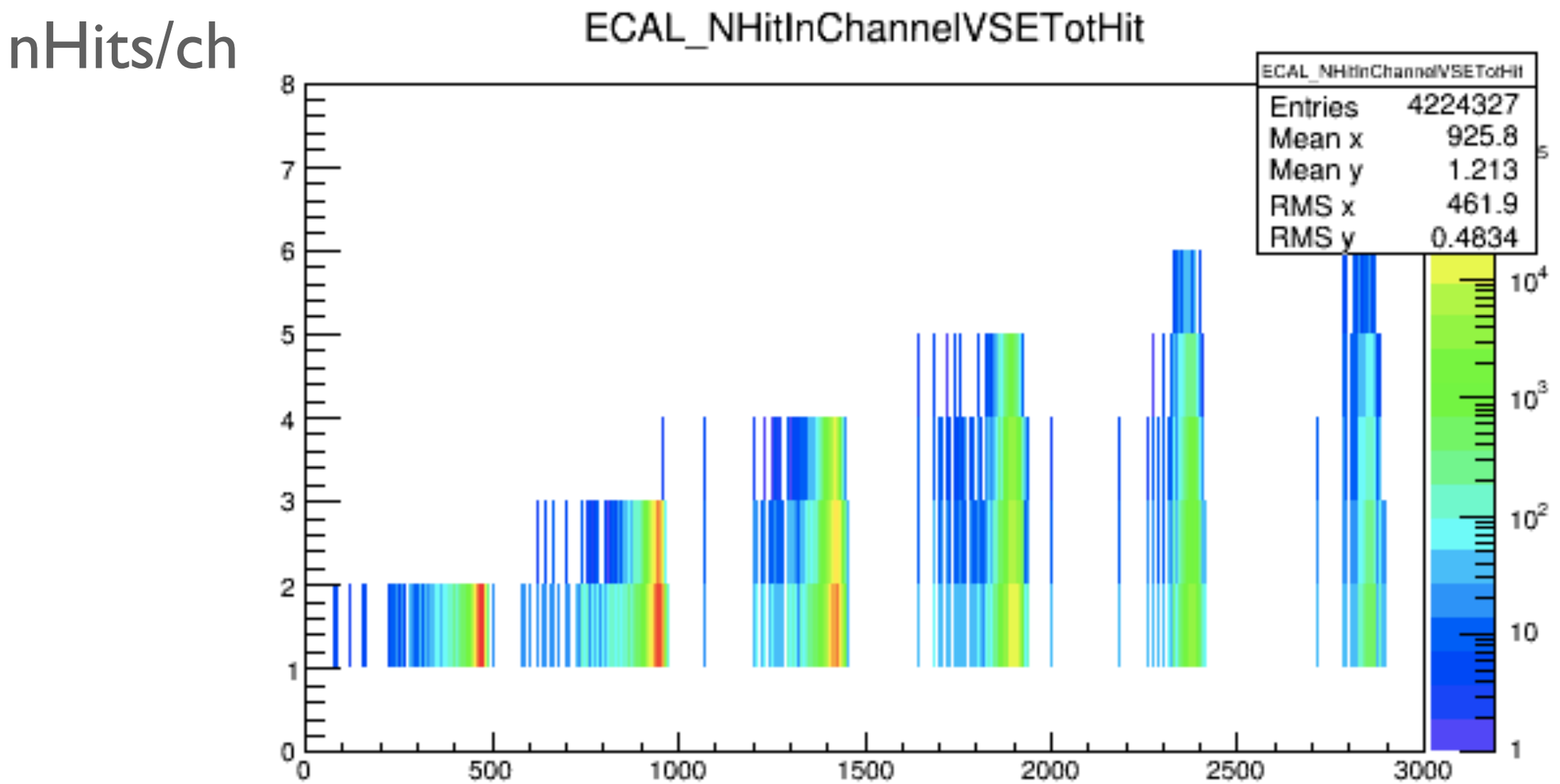
nHits/ch



ETotHit/bunch

SAME DISTRIBUTION FOR MC -MH RECO

- Number of hits/channel as a function of the total energy of the hits on events for MULTI hit reconstruction

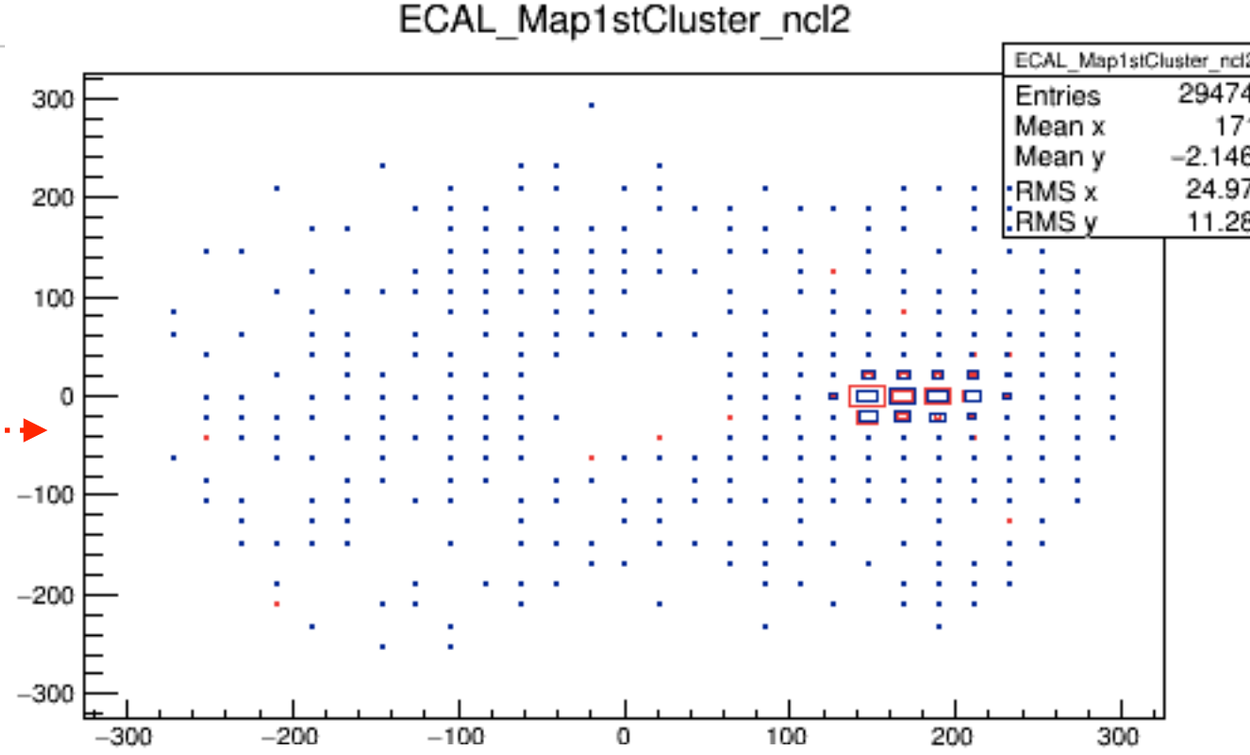


DATA ON SINGLE HIT RECONSTRUCTION

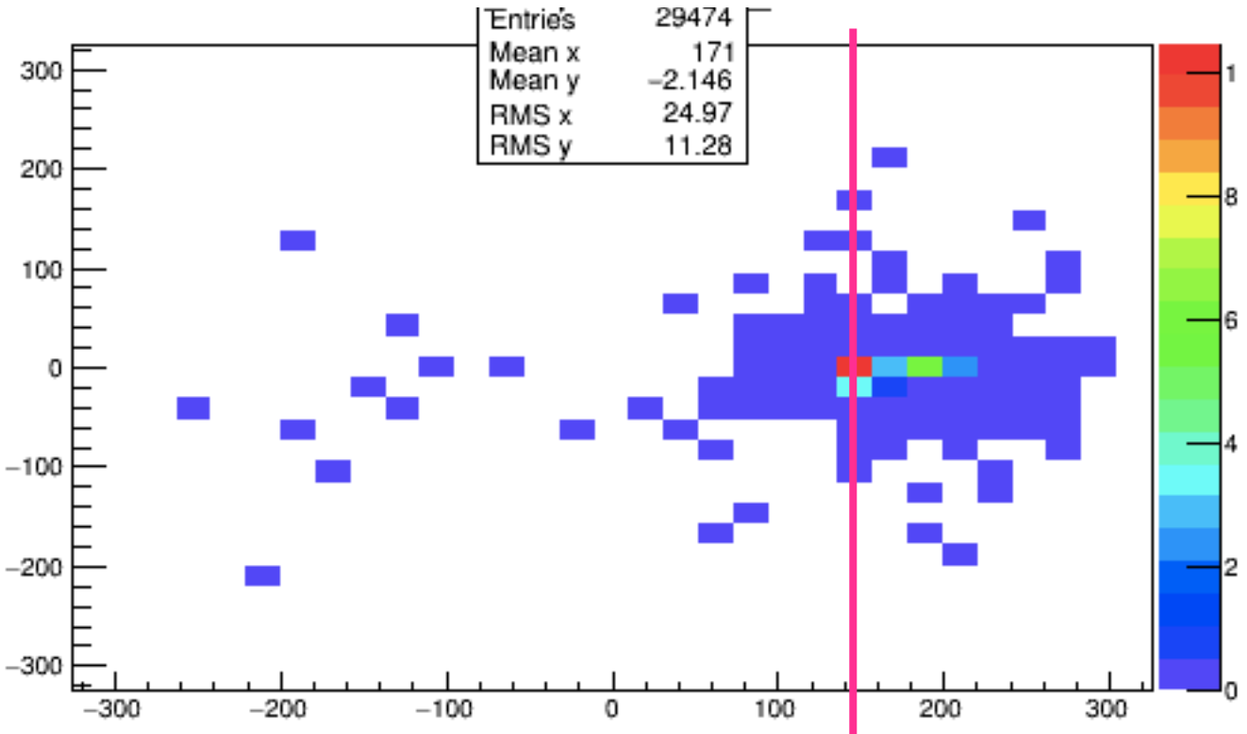
- Single hit reco data…nCl=2/event

Map 1st cluster

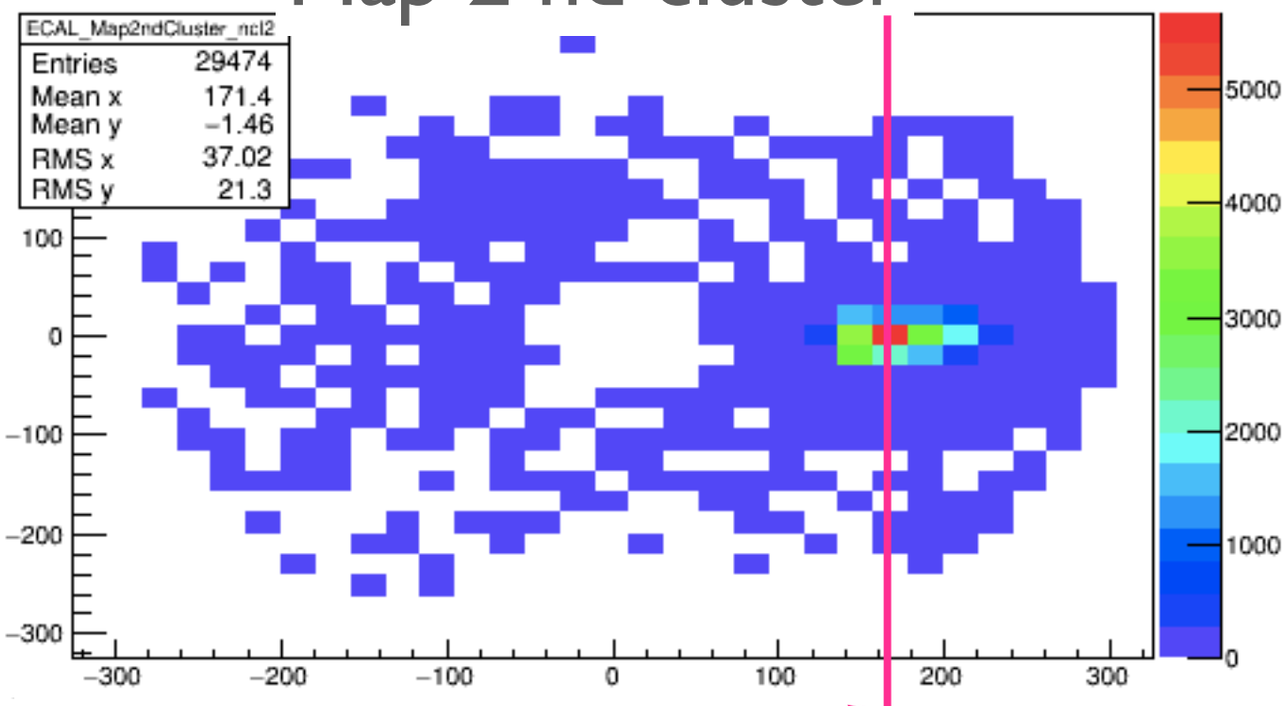
Map 2 nd cluster



Map 1st cluster



Map 2 nd cluster



Different crystals

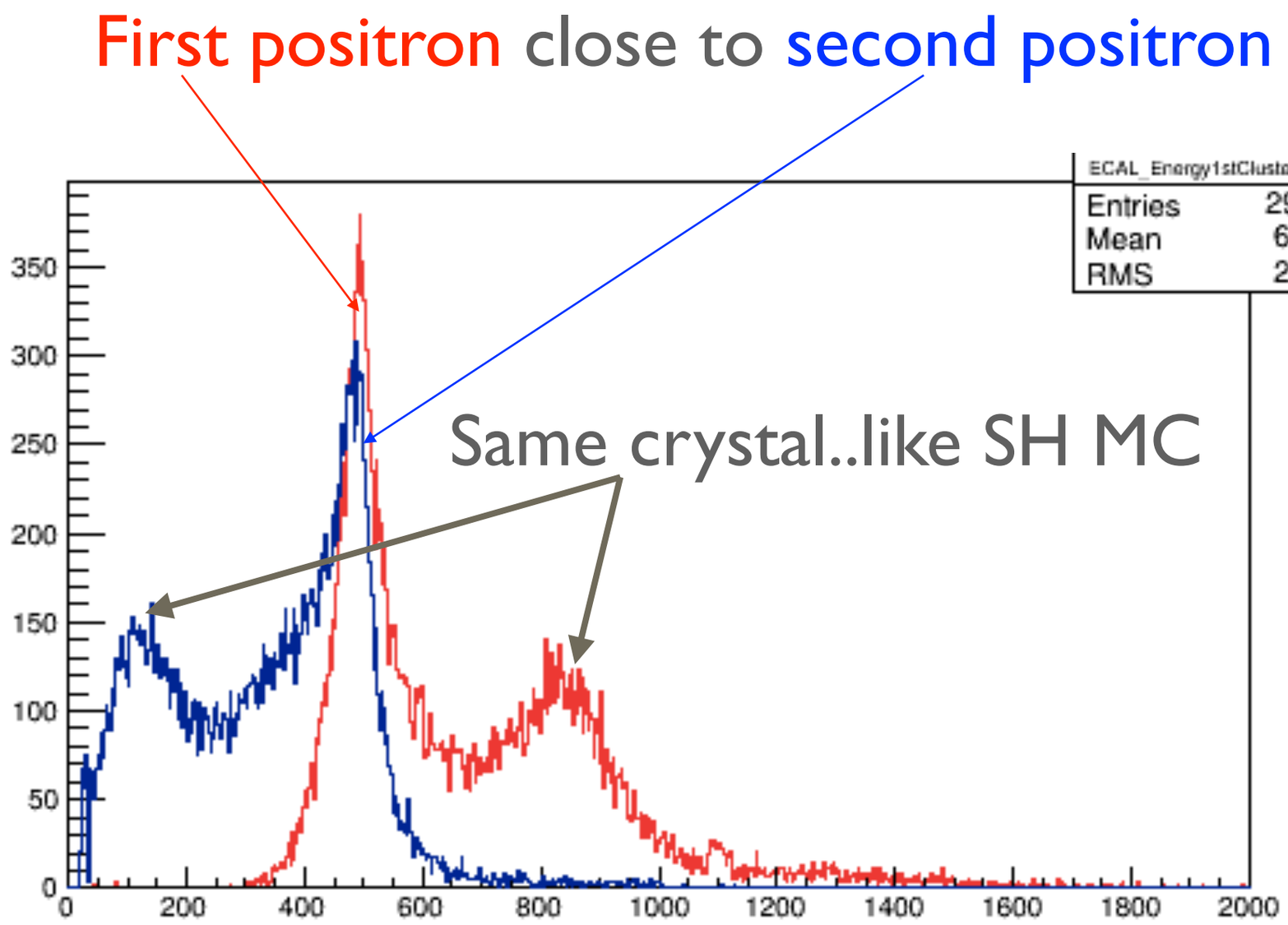
DATA ON SINGLE HIT RECONSTRUCTION

- Single hit reco data…nCl=2/event

Energy 1st cluster

Energy 2 nd cluster

Energy of the second positron is less than the first one. This is due to the fact that I merged more hits in the first positron (high right tale). The second cluster has less hits to merge-> left tale

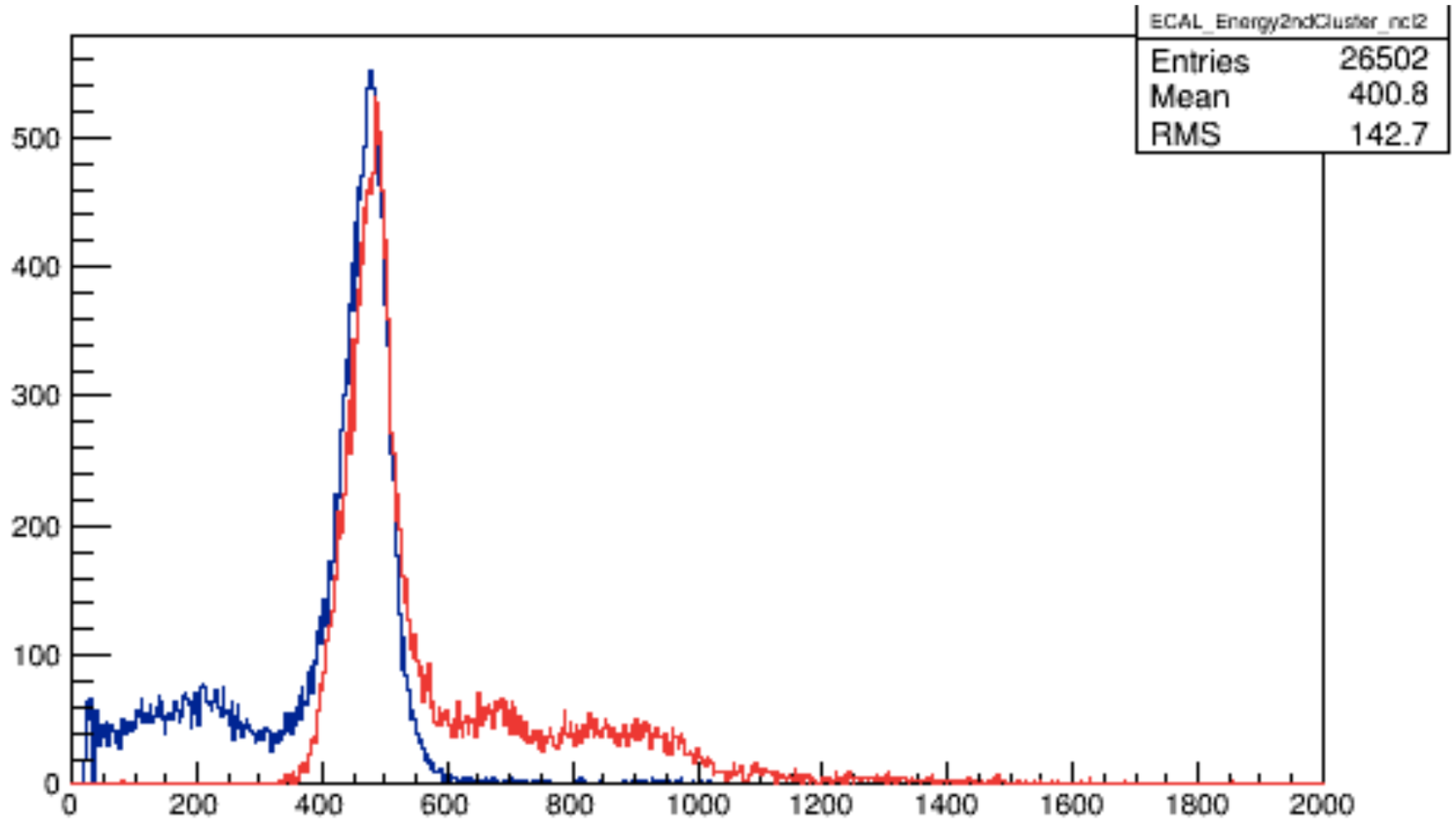


MH DATA

- Same plot of before but with multi hit reconstruction on data

Energy 1st cluster

Energy 2 nd cluster

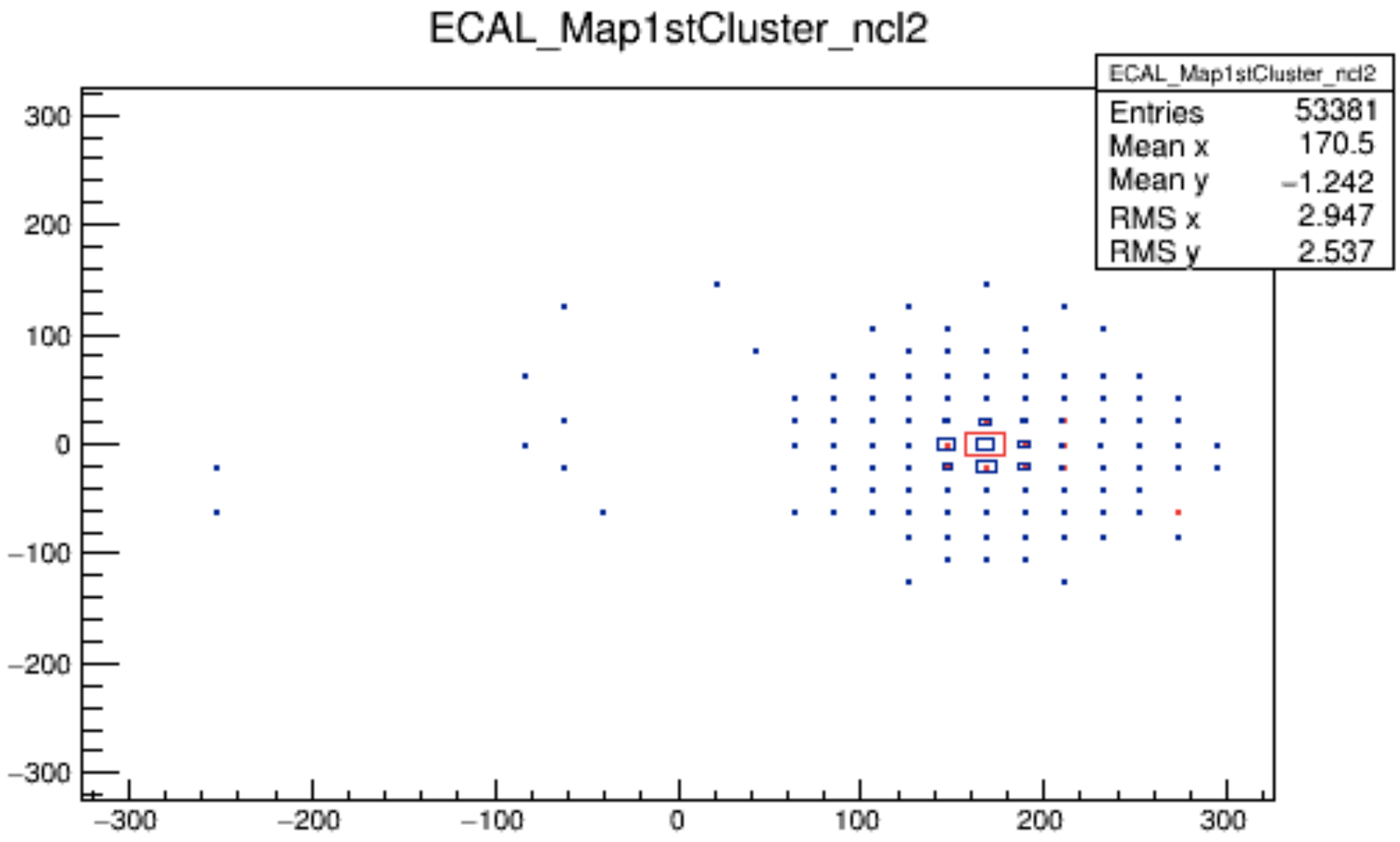


MC ON SINGLE HIT RECONSTRUCTION

- Single hit reco MC…nCl=2/event

Map 1st cluster

Map 2 nd cluster

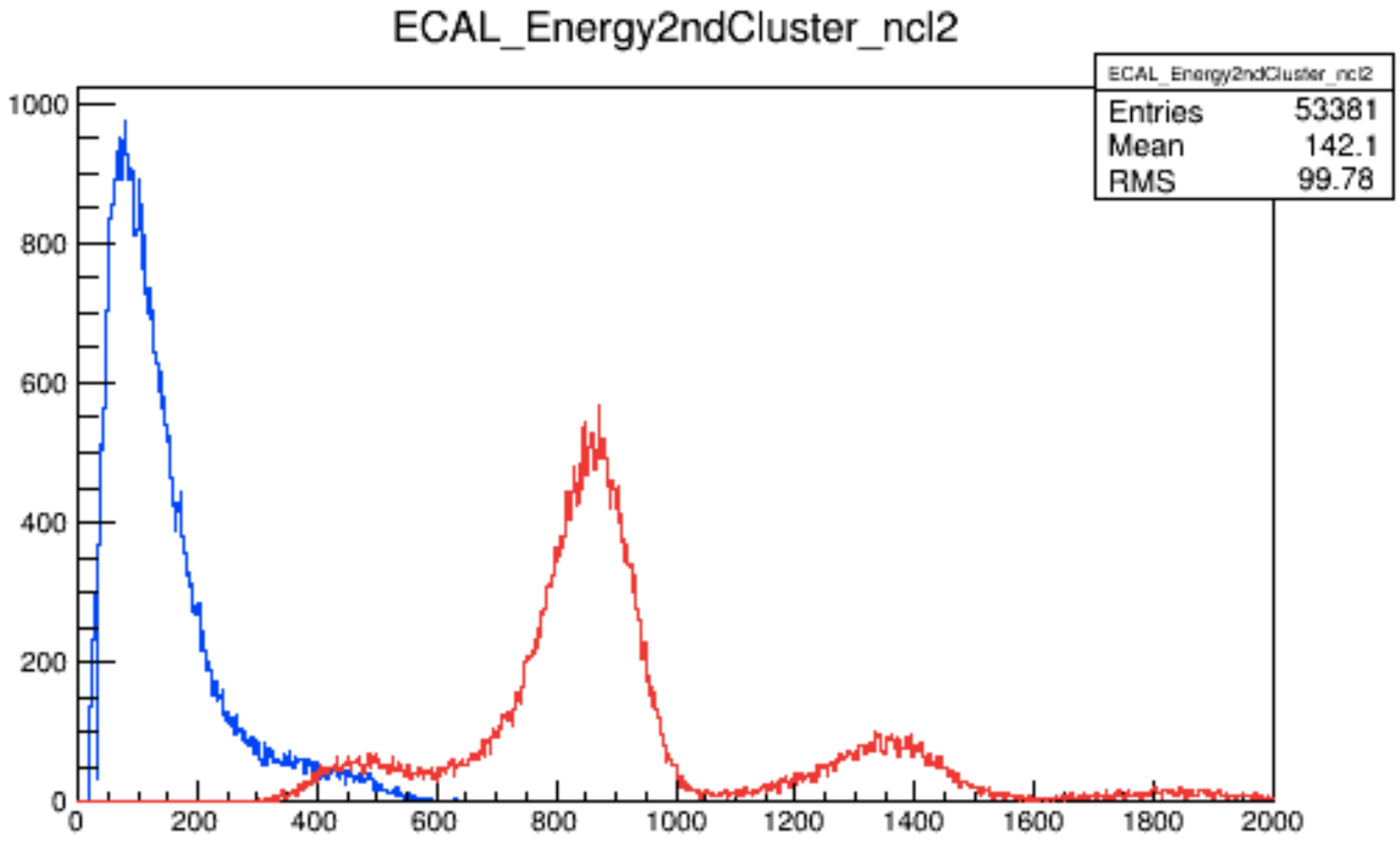


MC ON SINGLE HIT RECONSTRUCTION

- Single hit reco MC…nCl=2/event

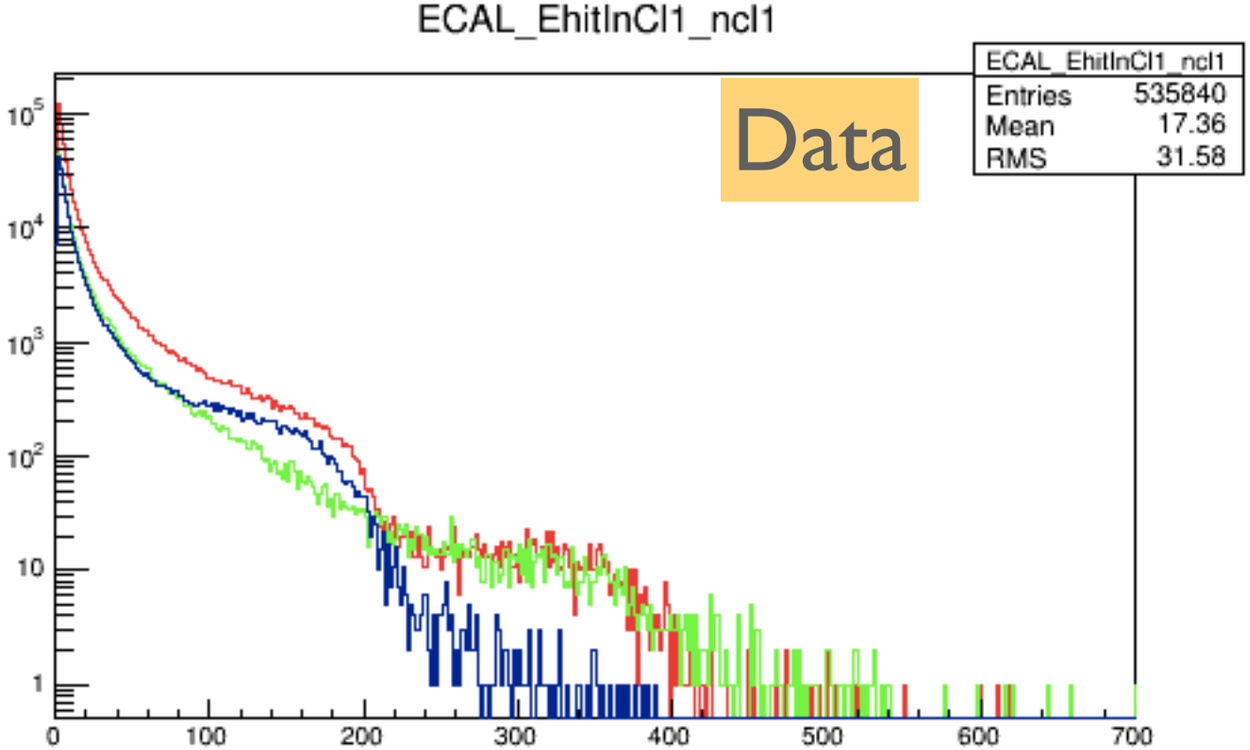
Energy 1st cluster

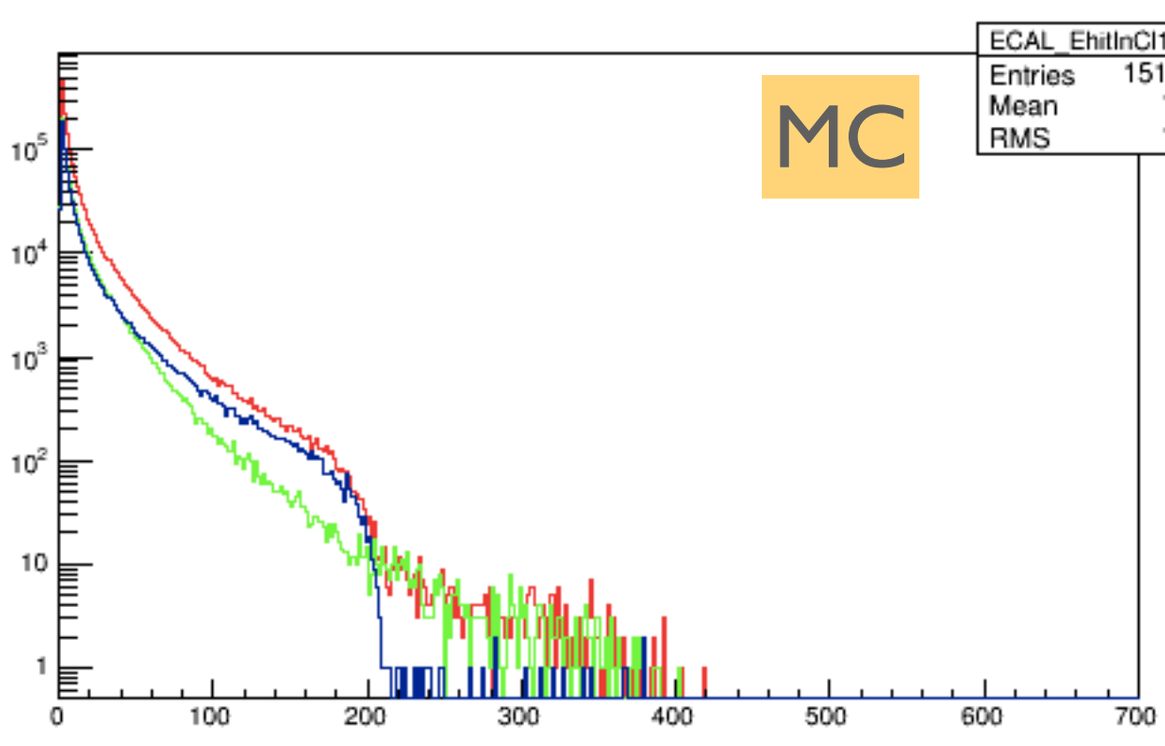
Energy 2 nd cluster



MH DATA AND MC

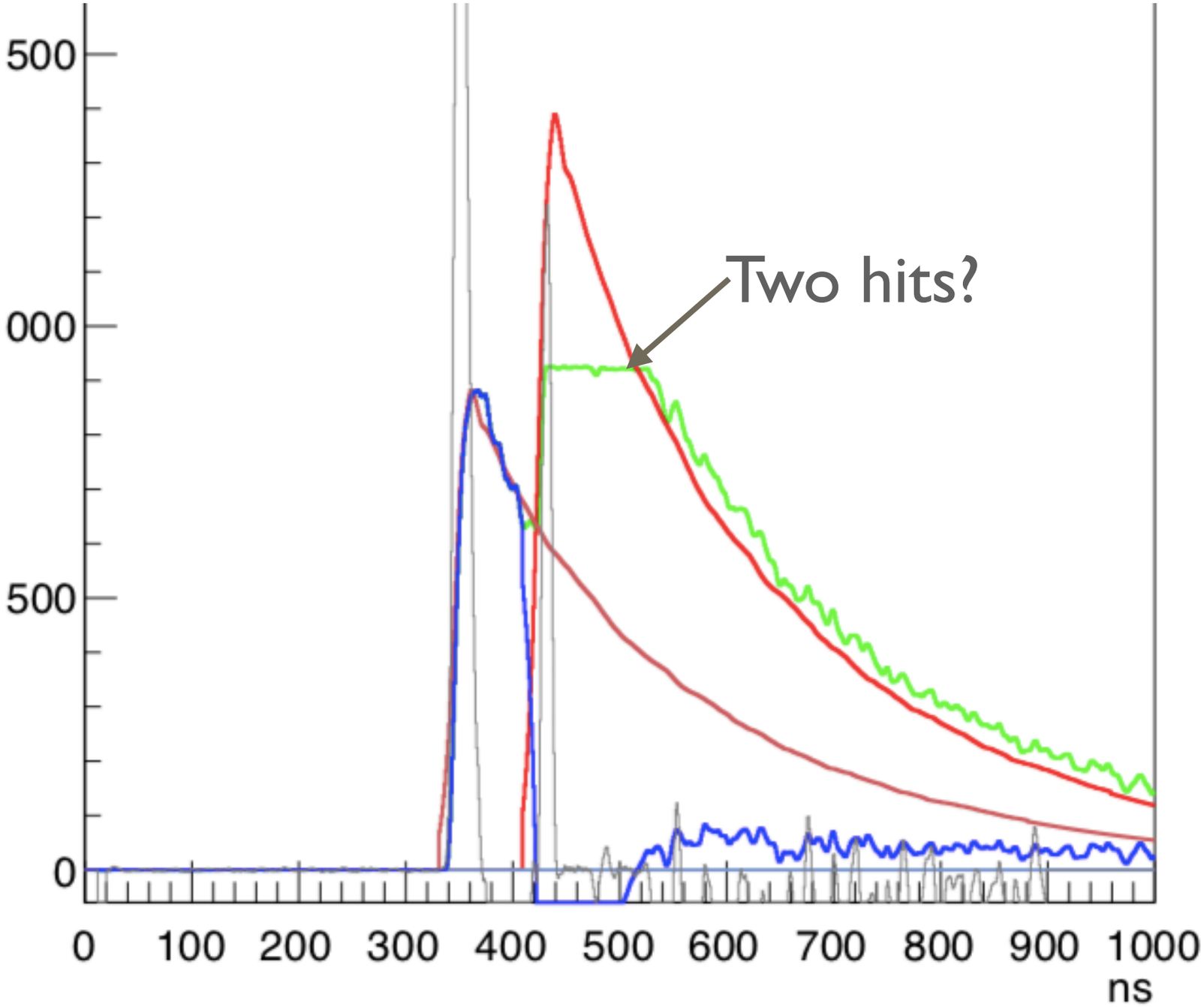
- E_{hit} in clus (w/o leading) for nCl=1
- E_{hit} in first clus (w/o leading) for nCl=2
- E_{hit} in second clus (w/o leading) for nCl=2





Upgrades on multi hit discrimination on saturated waveform

SOME EXAMPLE OF THE FAIL OF PREVIOUS ALGORITHM



SOME TESTS

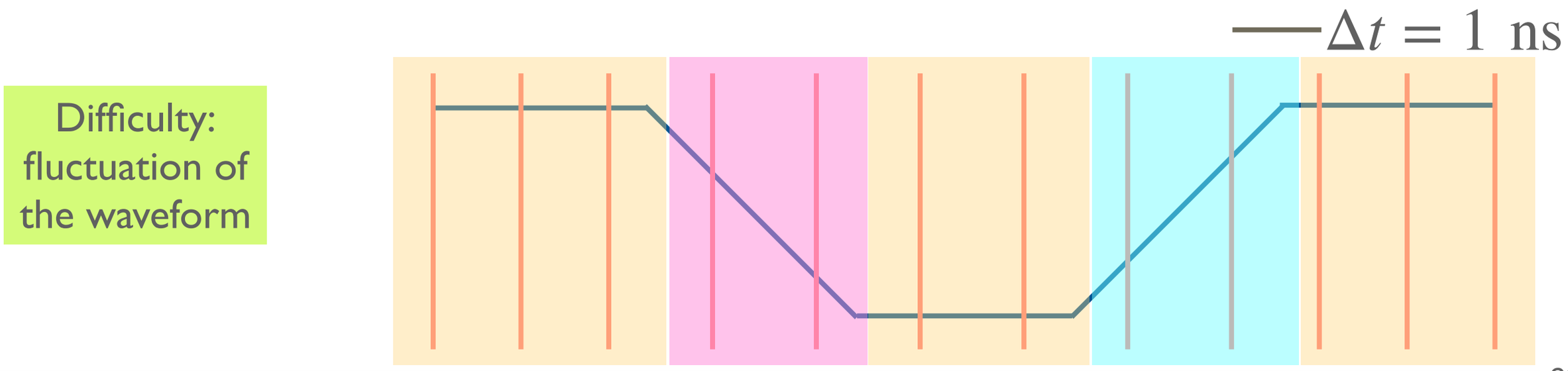
- To discriminate the two hits when I have saturation and a small separation:
  - I used the derivative $(\Delta t = 5\ \mathrm{ns})$ ->high fluctuation-> more errors in the definition of the double hits
  - I used the same procedure to recognised the double saturated hit used in the latest version but I used a smallest range to recognised the first and second saturated hit-> high fluctuation-> fail
    - http://www.le.infn.it/~isabella/allow_listing/multihitECAL/saturatedStudies/Waveform_secondSmallSaturatedhitExtractUsingSmallDiffAndMeanWithMaxWave.pdf
  - I perform a method based on the angular coefficient (derivative with $\Delta t = 1\ \mathrm{ns}$)

PHILOSOPHY

- In the figure there is the zoom of the with in the region of the small hole that separate two hits
- The angular coefficient should has three different values:
  - m=-1
  - m=0
  - m=1

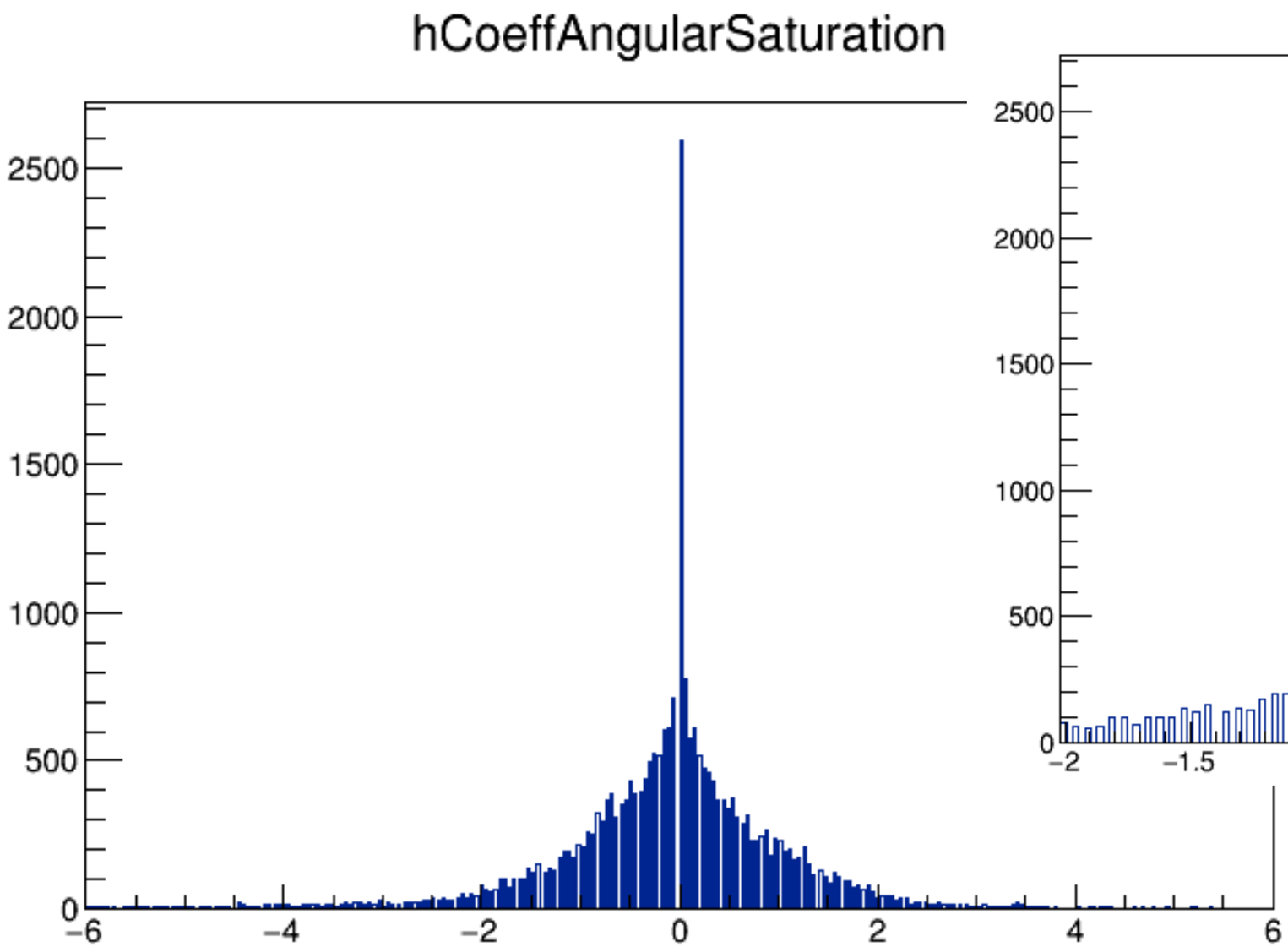
$$m = \frac{wave(t_1 + \Delta t) - wave(t_1)}{\Delta t}$$

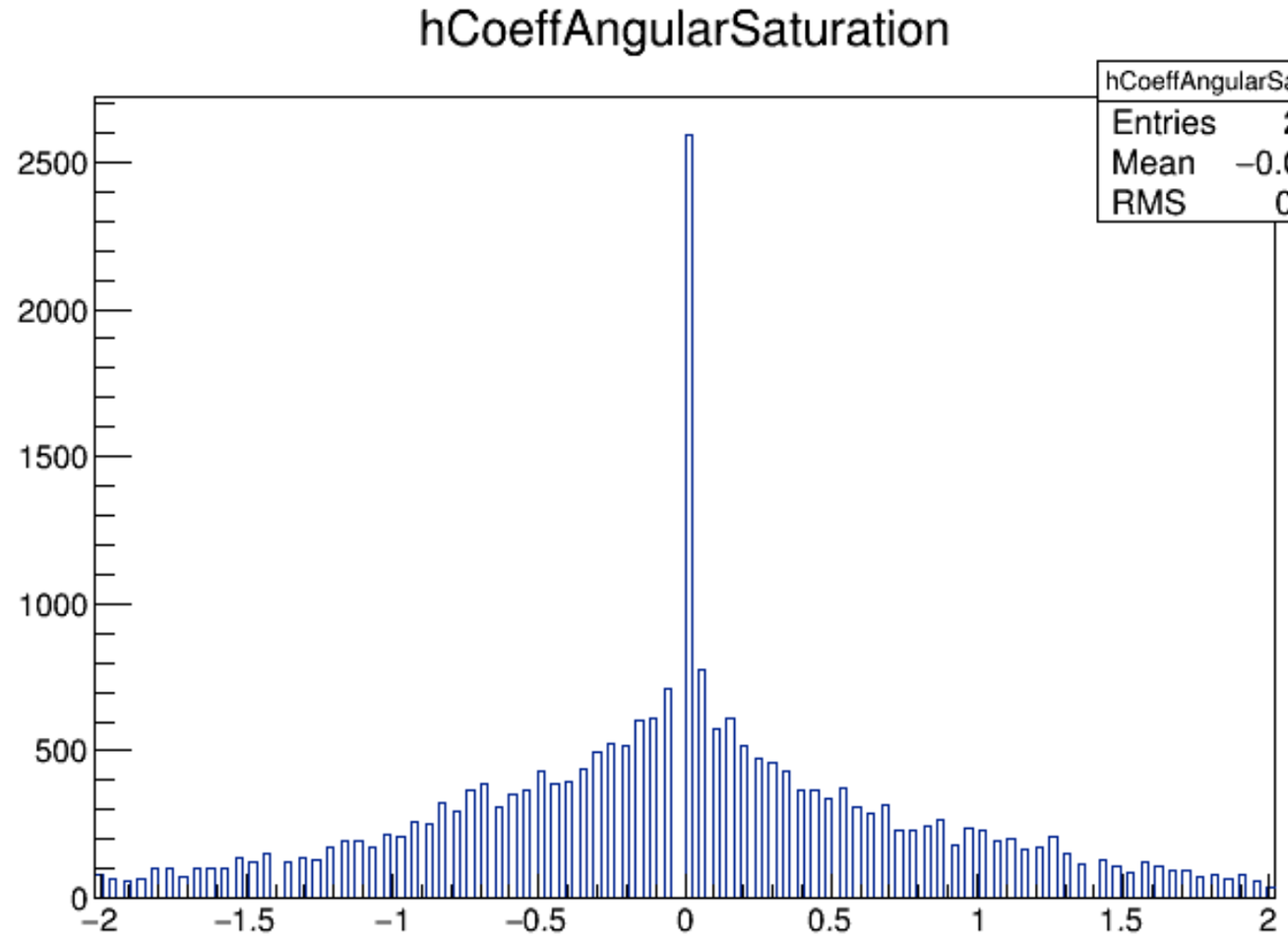
- Using the changing of m I estimate the presence or not of a double hit saturated



COEFFICIENT ANGULAR DISTRIBUTION

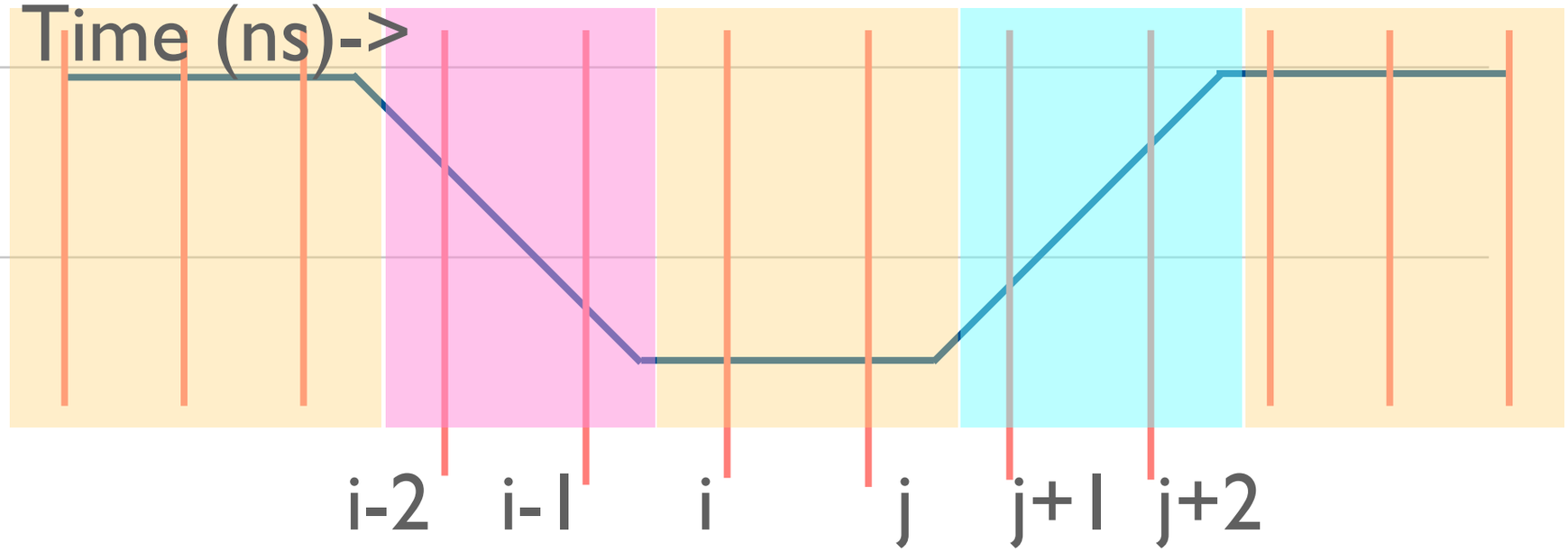
- Close to the saturation the angular distribution has a mean at 0 and a RMS of 0.79 . I used these parameters to define the “zero”. All the points of waveform with an amplitude out 3σ is a possible candidate of a new hit.





Zoom [-2,2] for RMS

My algorithm

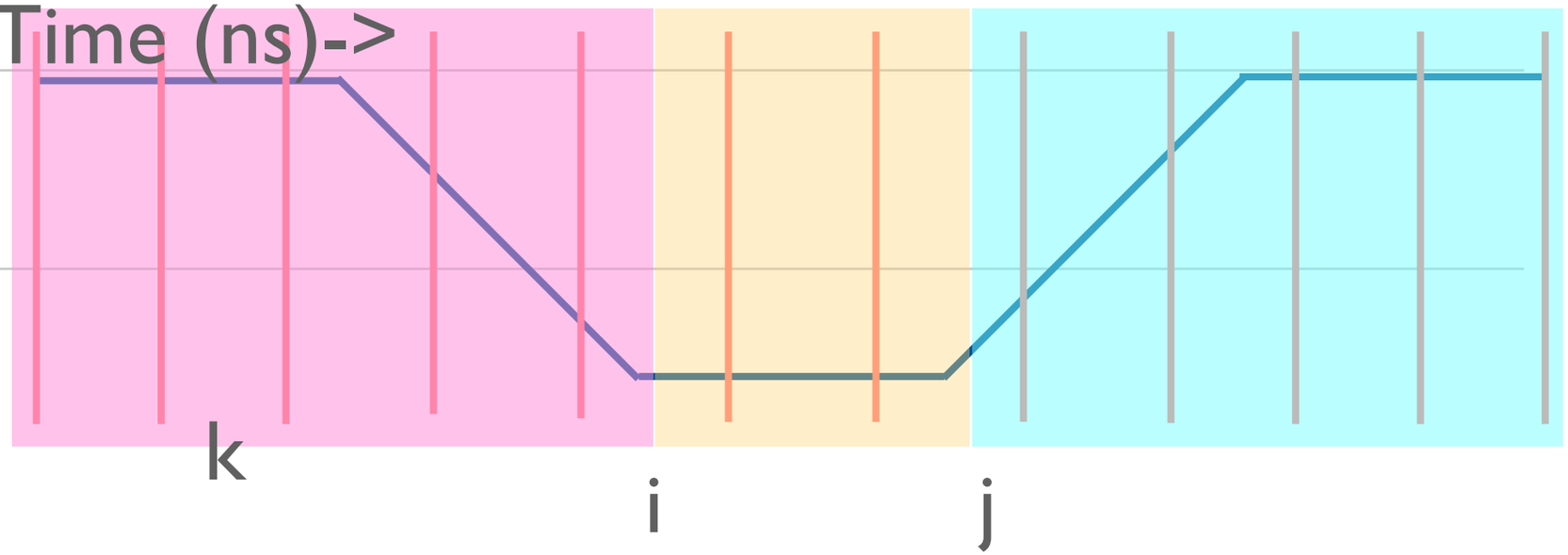


- In saturated range I extract all the angular coefficient : $m = \frac{wave(t_1 + \Delta t) - wave(t_1)}{\Delta t}$

  where $\Delta t = 1$ ns
- I'm interested in the event that
  - $m(i) \cdot m(j) < 0$
- My additional request to eliminate the fluctuation:
  - $|t(i) - t(j)| < 5$ ns;
  - $t(i) > t_{firstBinSaturated}$
  - $m(i) \cdot m(i-1) > 0$
  - $m(j) \cdot m(j+1) > 0$
  - $|t(i) - t(i-1)| < 3$ ns
  - $|t(j) - t(j+1)| < 3$ ns

If there are more than one points with this features I tagged this saturated waveform as noises and don't fix a second saturated hit

My algorithm



- If the waveform pass that preliminary selection, I apply a second selection based on a differentiation on left and right range.

- For the left range:
  - $t(k) \leq t(i)$;
  - $t(k) > t(i) - 8$;
  - $m(i) \cdot m(k) > 0$
  - $|t(k) - t(k-1)| < 2$ ns
  - $|t(k) - t(k+1)| < 2$ ns
- If is true all of this -> left++;

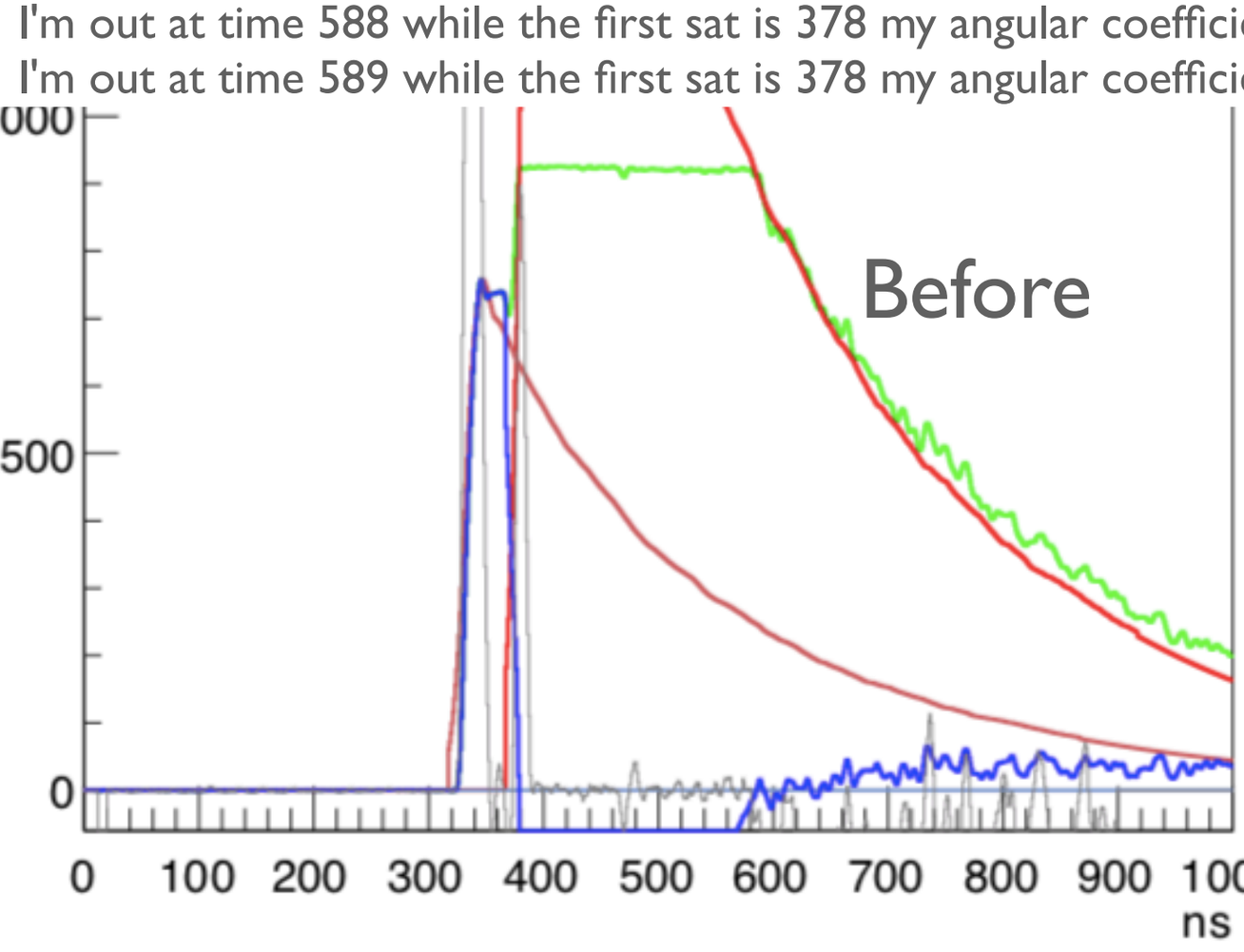
- For the right range:
  - $t(k) \geq t(j)$;
  - $t(k) < t(j) + 8$;
  - $m(j) \cdot m(k) > 0$
  - $|t(k) - t(k-1)| < 2$ ns
  - $|t(k) - t(k+1)| < 2$ ns
- If is true all of this -> right++;

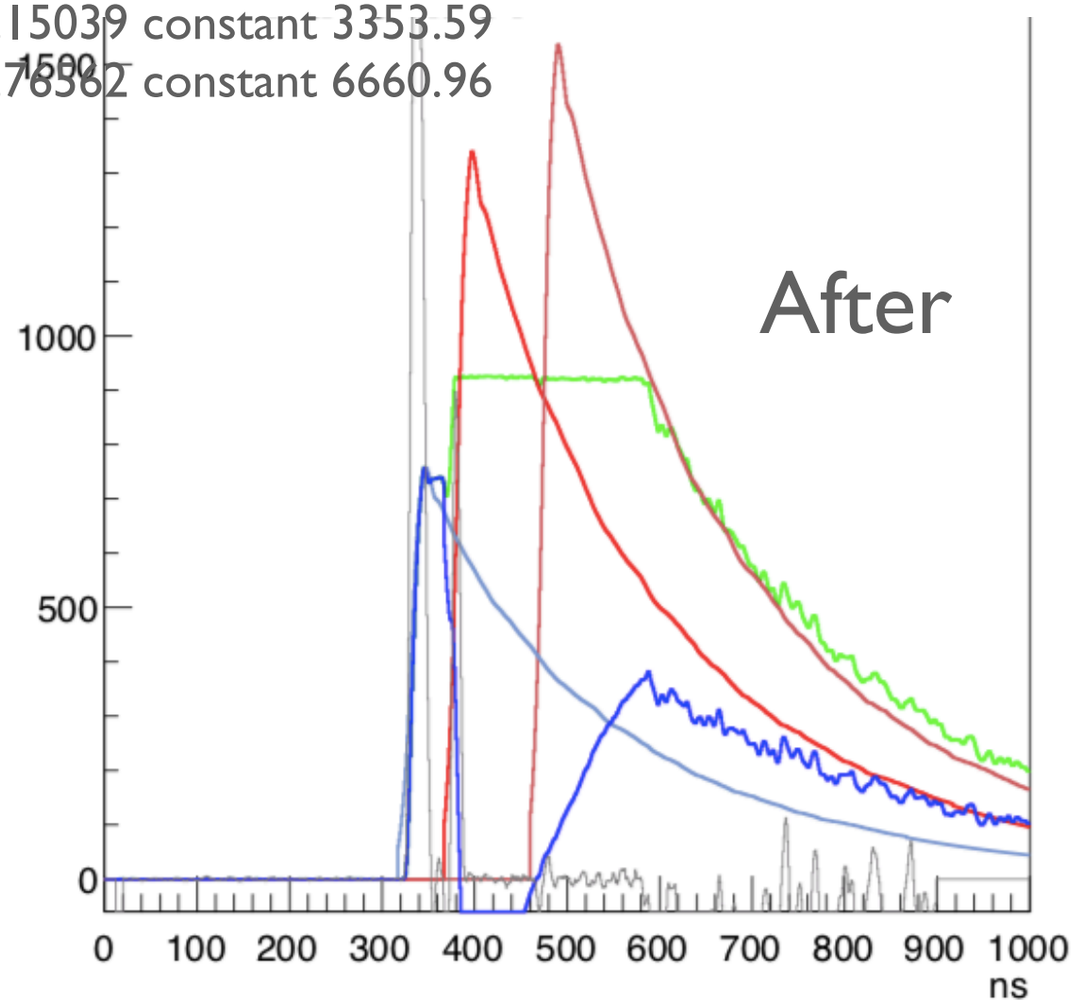
If left+right>3 && the time of this second saturated hit is far 25 ns from the end of the saturation (here the waveform is dominated by the fluctuation)->I find a second saturated hit

AN EXAMPLE

----------ev 30
I'm out at time 379 while the first sat is 378 my angular coefficient is 5.61523 constant -1209.4
I'm out at time 442 while the first sat is 378 my angular coefficient is -2.58789 constant 2068.92
I'm out at time 447 while the first sat is 378 my angular coefficient is 2.58789 constant -234.35
I'm out at time 466 while the first sat is 378 my angular coefficient is -2.97852 constant 2309.79
I'm out at time 467 while the first sat is 378 my angular coefficient is -2.49023 constant 2081.76
I'm out at time 468 while the first sat is 378 my angular coefficient is -3.71094 constant 2653.05
I'm out at time 471 while the first sat is 378 my angular coefficient is 3.41797 constant -699.927
I'm out at time 472 while the first sat is 378 my angular coefficient is 4.15039 constant -1045.63
I'm out at time 473 while the first sat is 378 my angular coefficient is 3.07617 constant -537.524
I'm out at time 582 while the first sat is 378 my angular coefficient is -3.66211 constant 3049.44
I'm out at time 588 while the first sat is 378 my angular coefficient is -4.15039 constant 3353.59
I'm out at time 589 while the first sat is 378 my angular coefficient is -9.76562 constant 6660.96

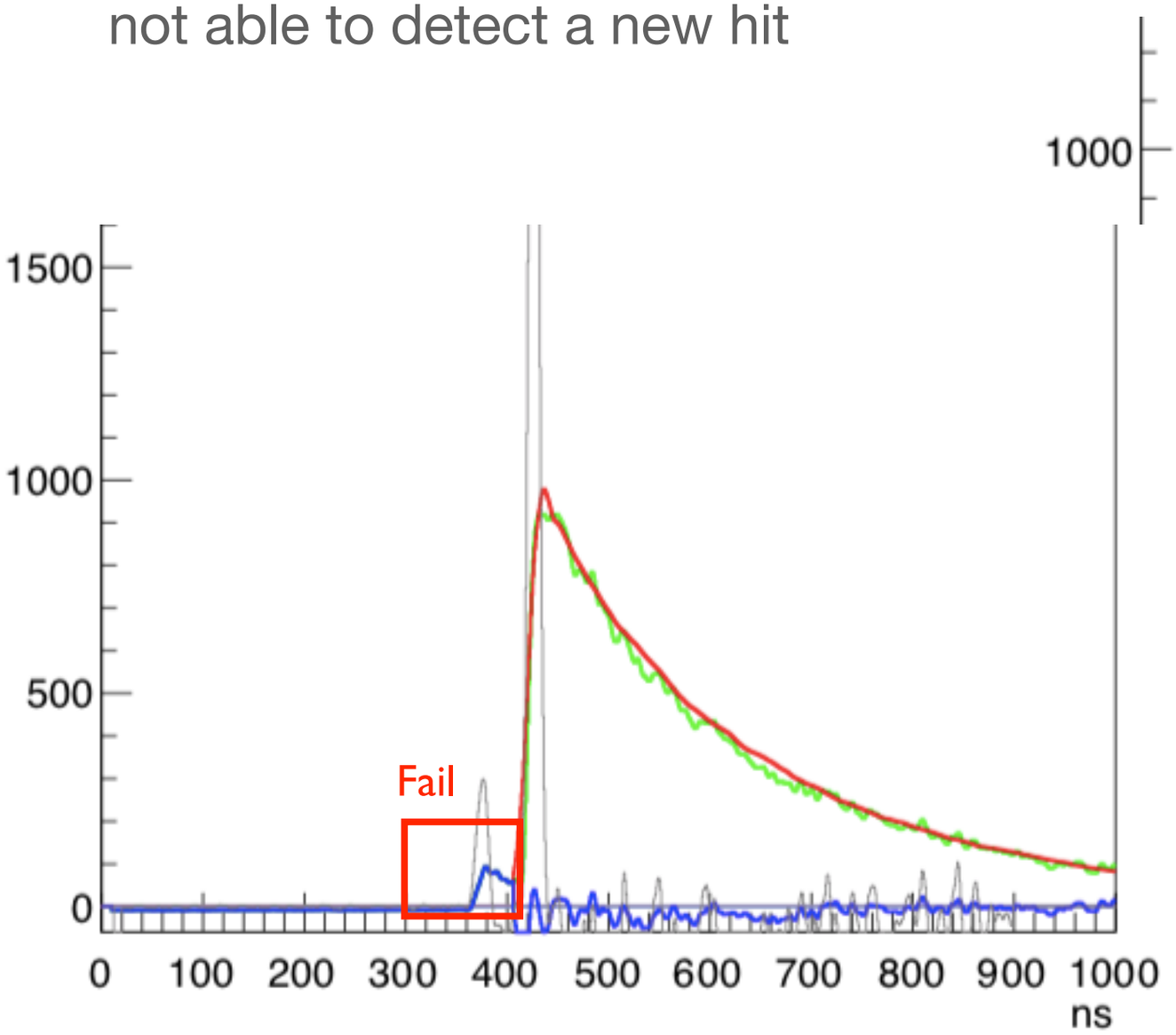
I find a second saturated hit!

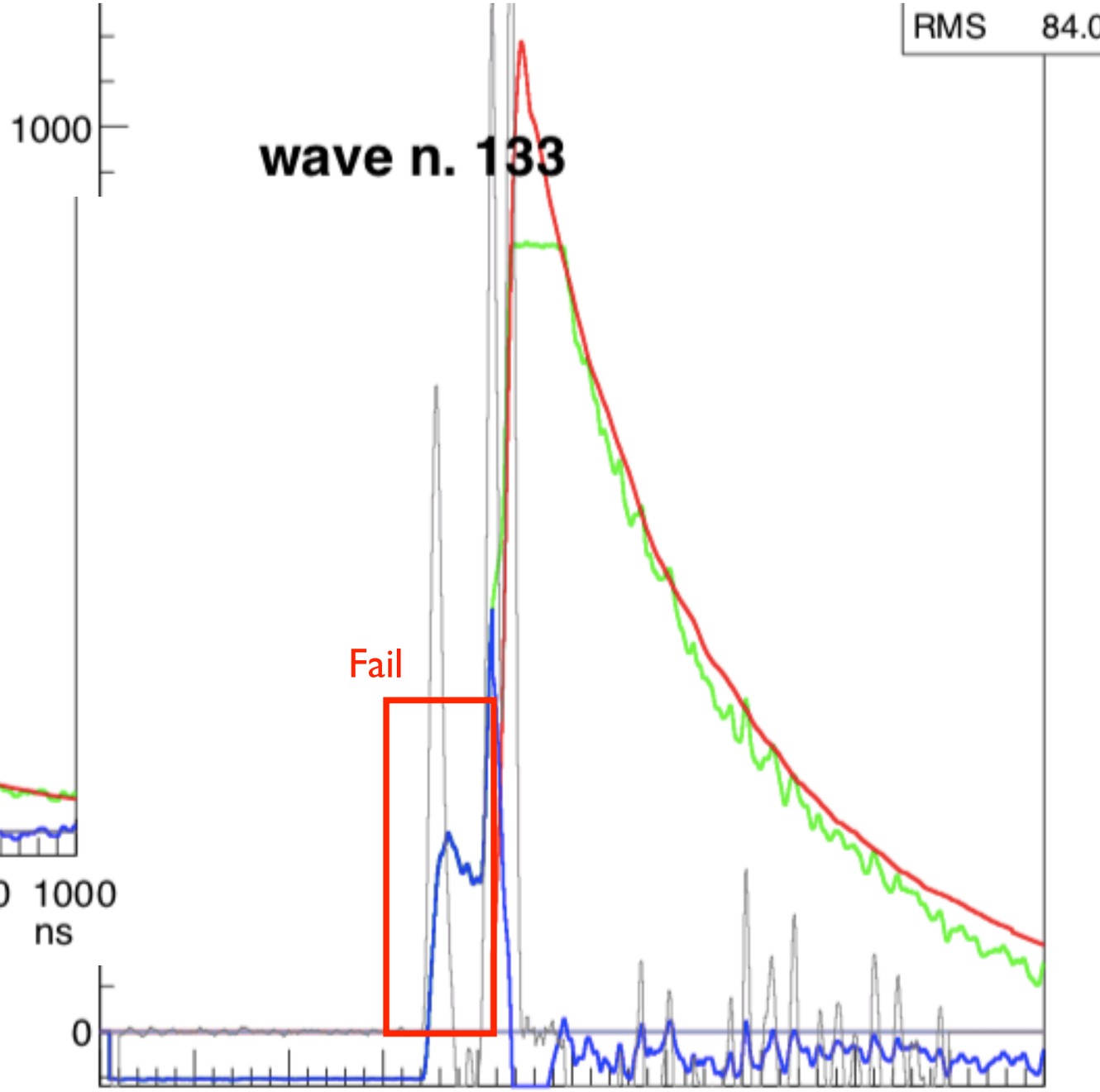




SOME PROBLEMS

- Close to the saturation there is more peak on the derivative, so my algorithm is not able to detect a new hit



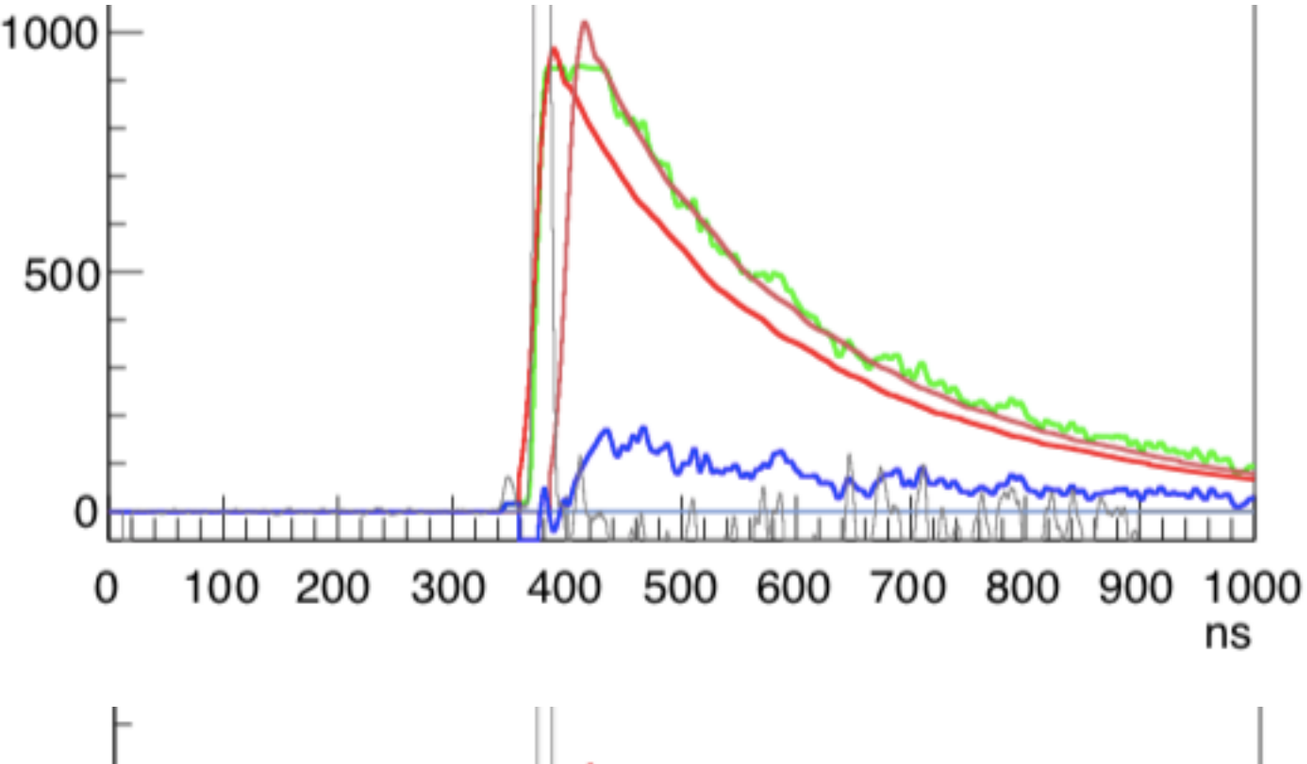


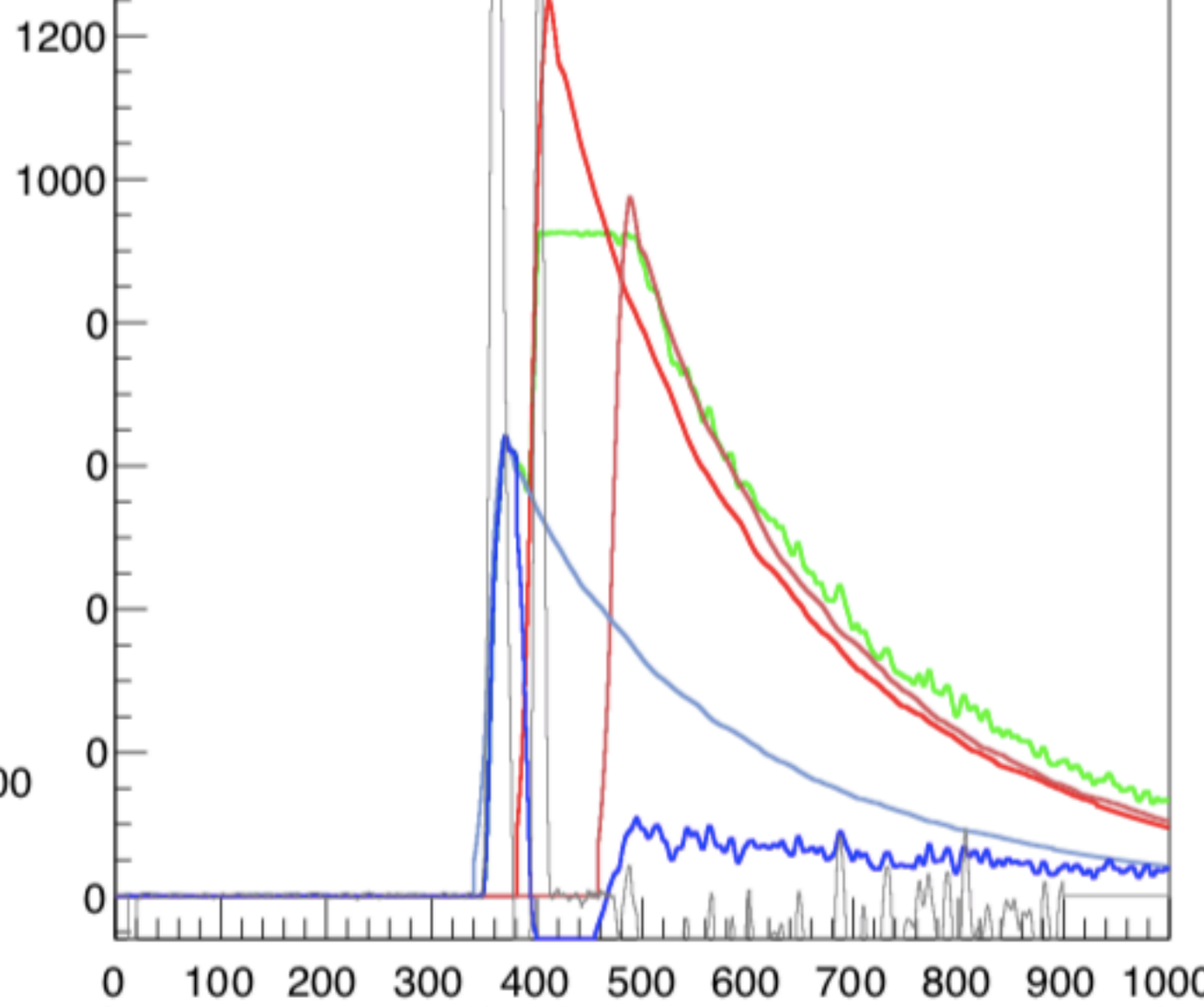
My resolution

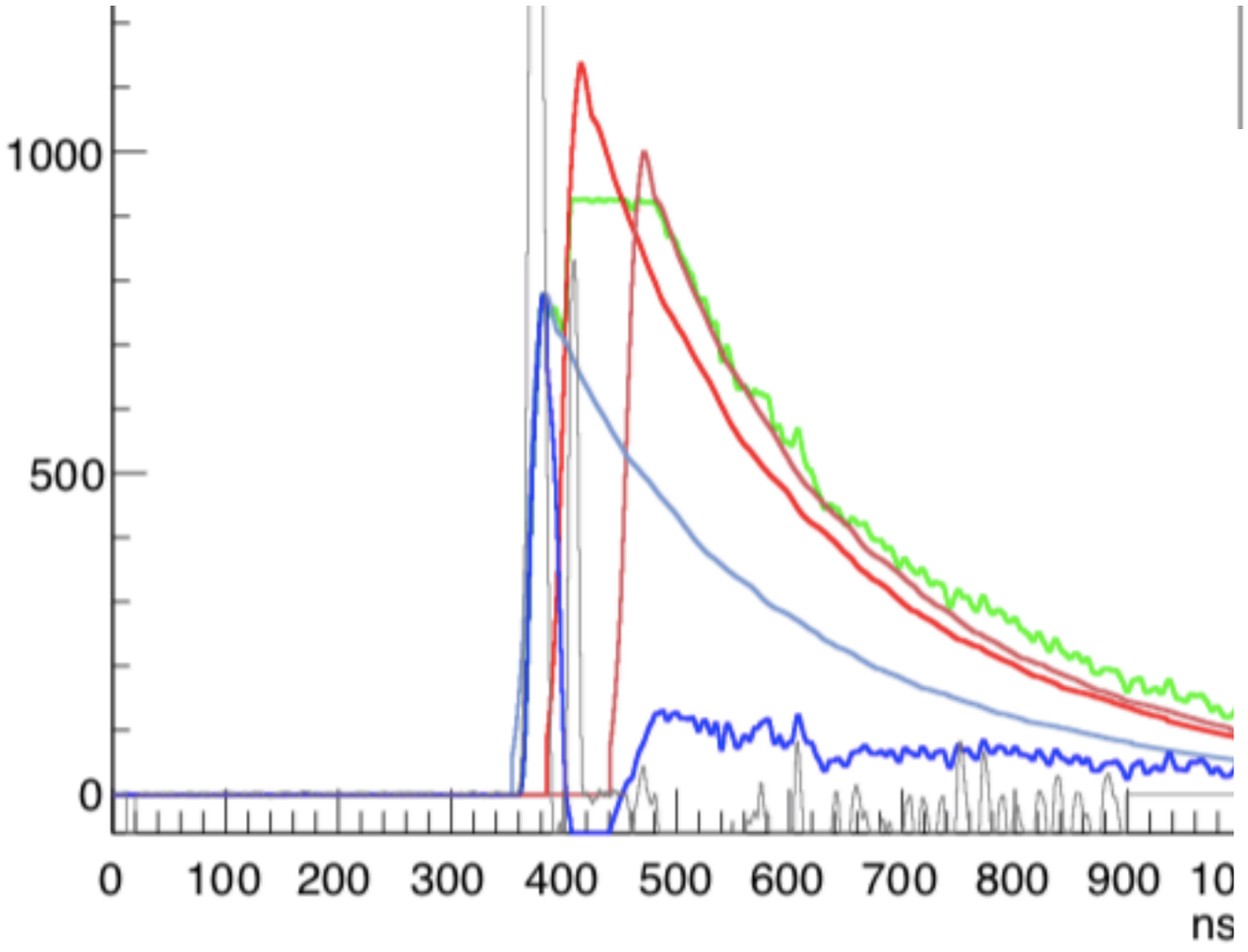
- To allow the reconstruction of other hits, after the first hit reconstruction I put at 0 the waveform in the time range [saturation-25, saturation+Δt_{sat}+25]
- Same problems for the third hit, in this case:
  - If I have only one saturated hit I put at 0 the waveform on the range [saturation-25, saturation+Δt_{sat}+25] and in the range [$t_{secondHit}$-25, $t_{secondHit}$ +25] ns
  - If I have two saturated waveform:
    - I pun on 0 all the waveform on the range [$t_{firstSat}$-25, ∞]
    - This because I have a worst “fitting” of the template at the end of the waveform

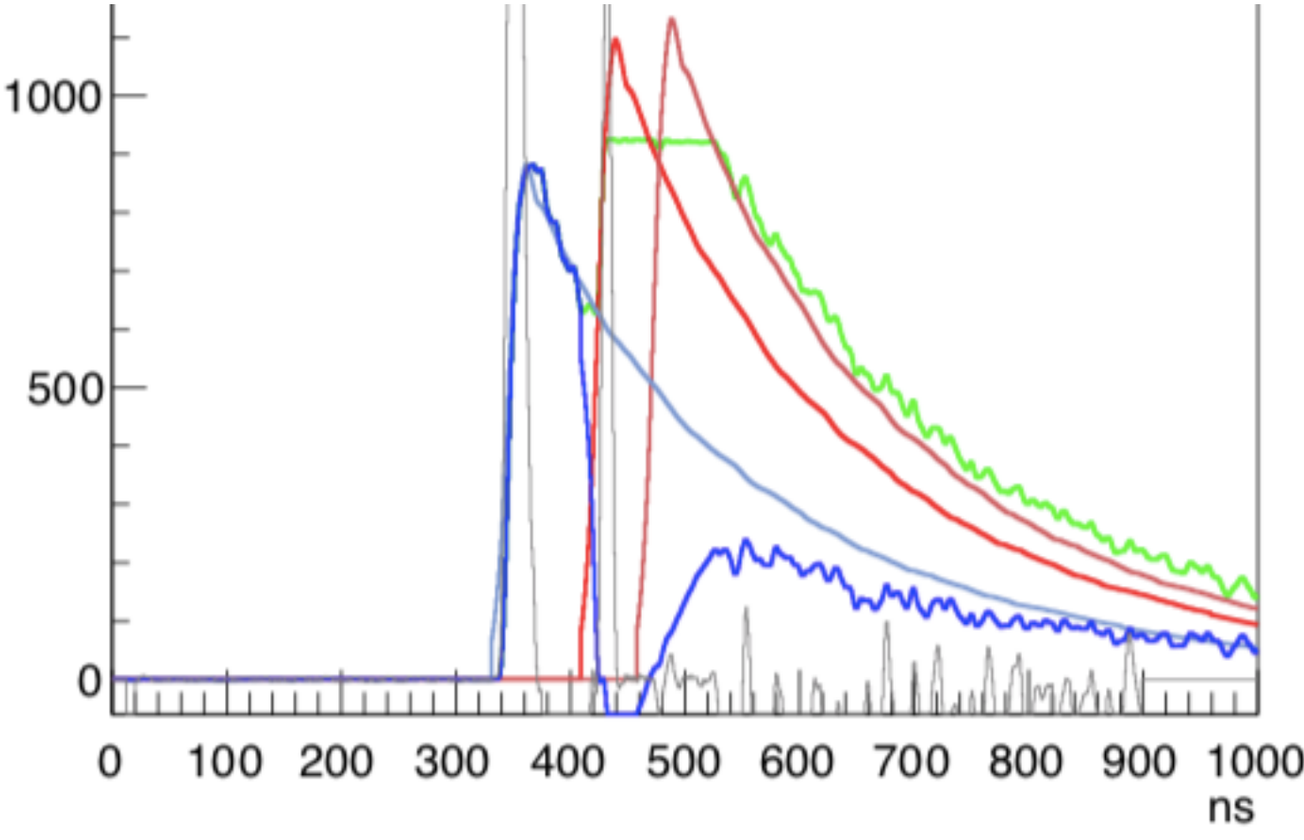
- At: http://www.le.infn.it/~isabella/allow_listing/multihitECAL/saturatedStudies/Waveform_testToBetterEstimateThirdHit.pdf there are more waveform with this final version

SOME EXAMPLES



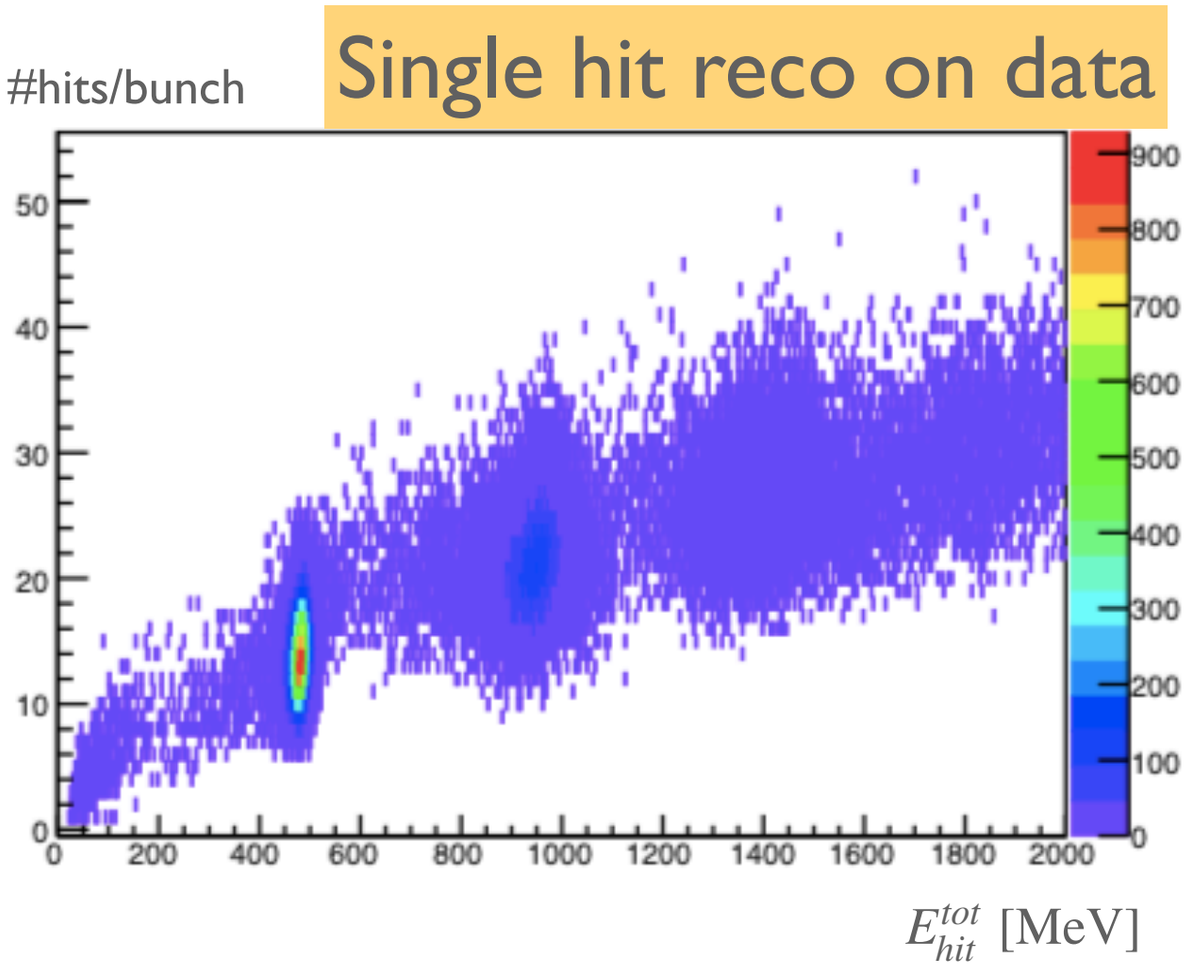


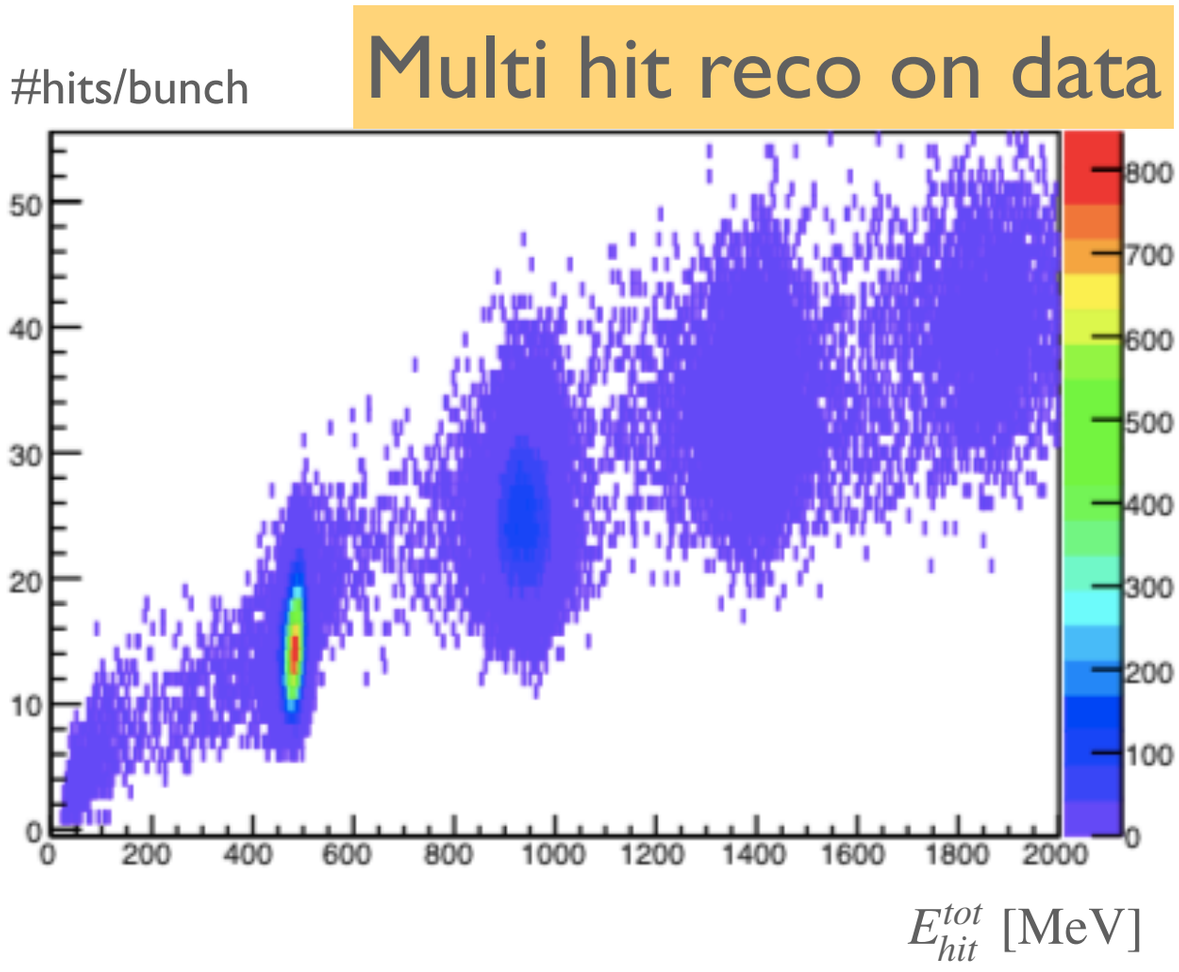




RESULTS

- From the comparison of single and multi hit reconstruction on single positron run

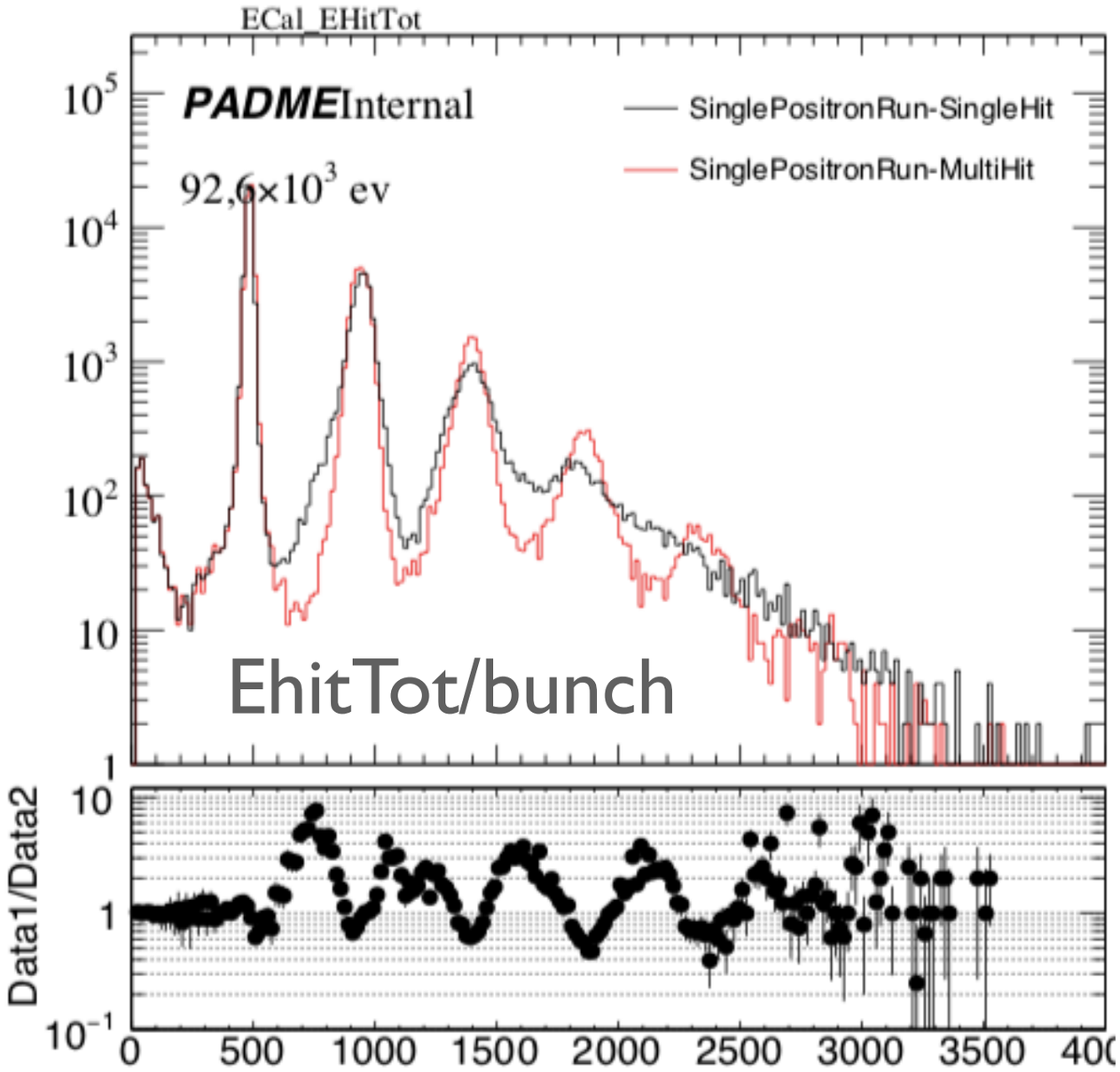


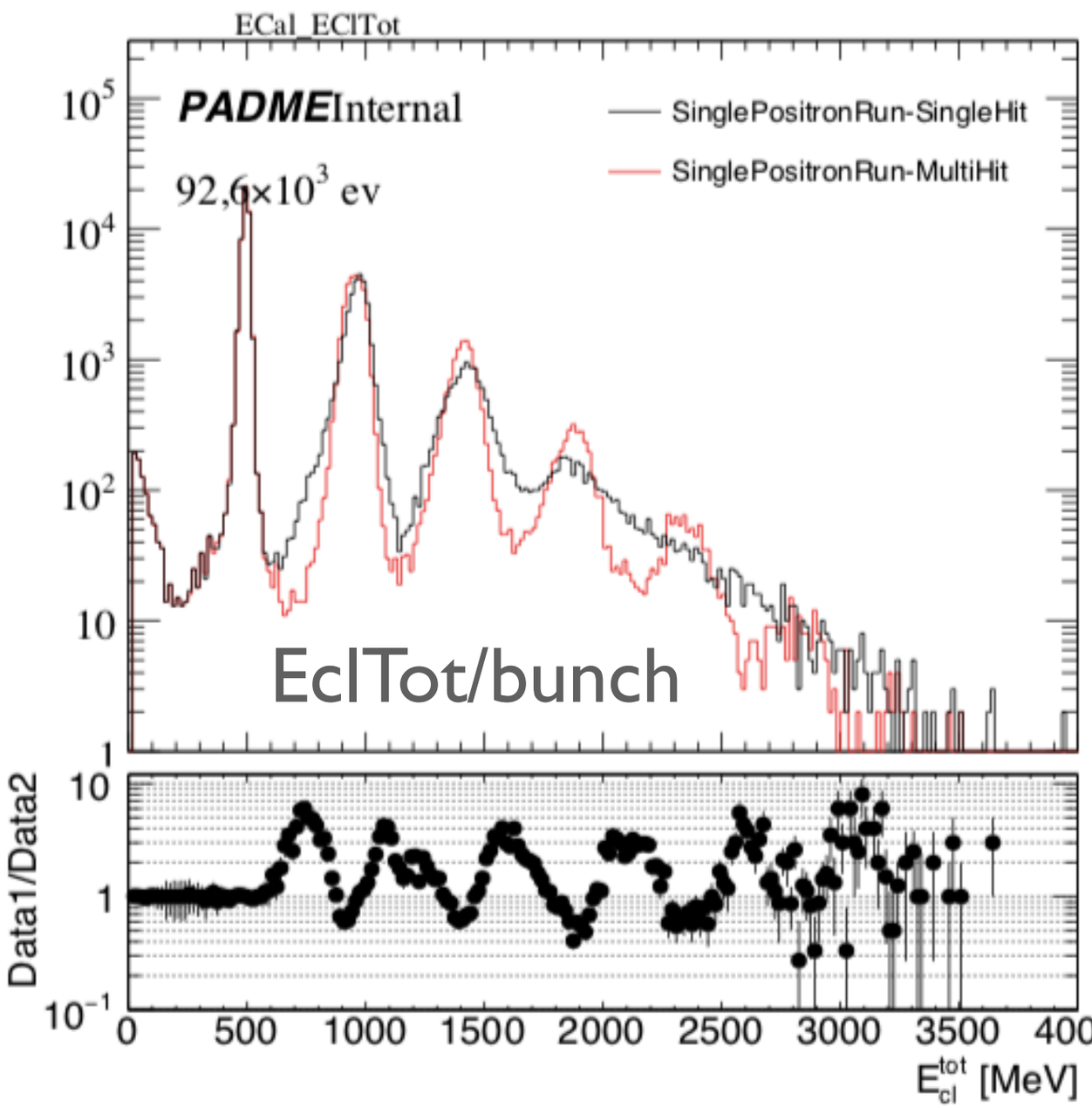


http://www.le.infn.it/~isabella/allow_listing/multihitECAL/AnalysisHisto_singlePositron_comparisonSingleMultiHit_correctionSmallDoubleHit_25May.pdf

TOTAL ENERGY DISTRIBUTION

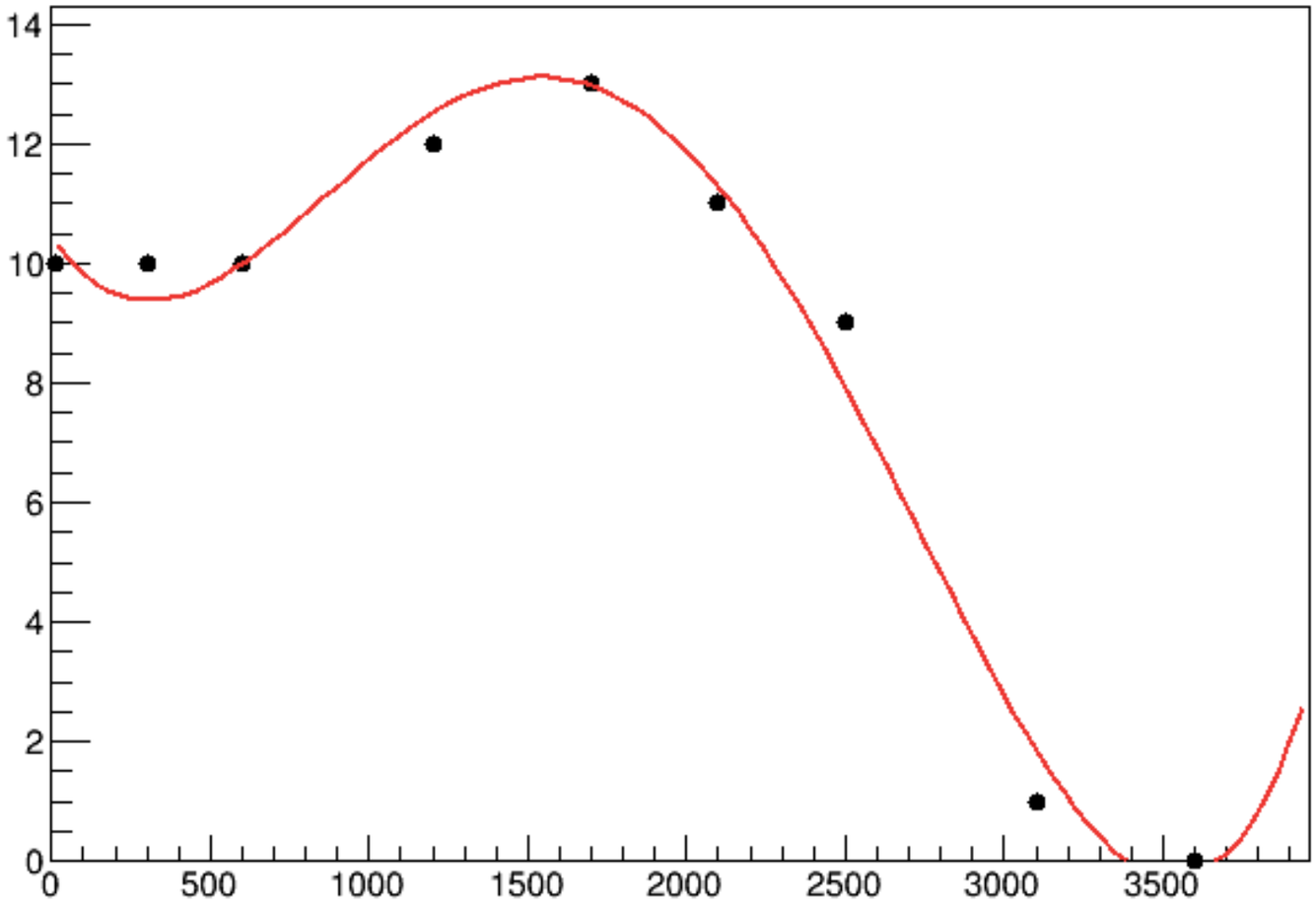
- A better resolution in the definition of the second, third.. peak. I'm now able to discriminate up to 6 peak!





I'M TRYING TO EXTRACT THE BKG FUNCTION

- Double_t e[9]={10,300, 600, 1200, 1700, 2100, 2500, 3100, 3600}
- Double_t count[9]={10,10, 10, 12, 13, 11, 9, 1, 0}



Minimizer is Linear

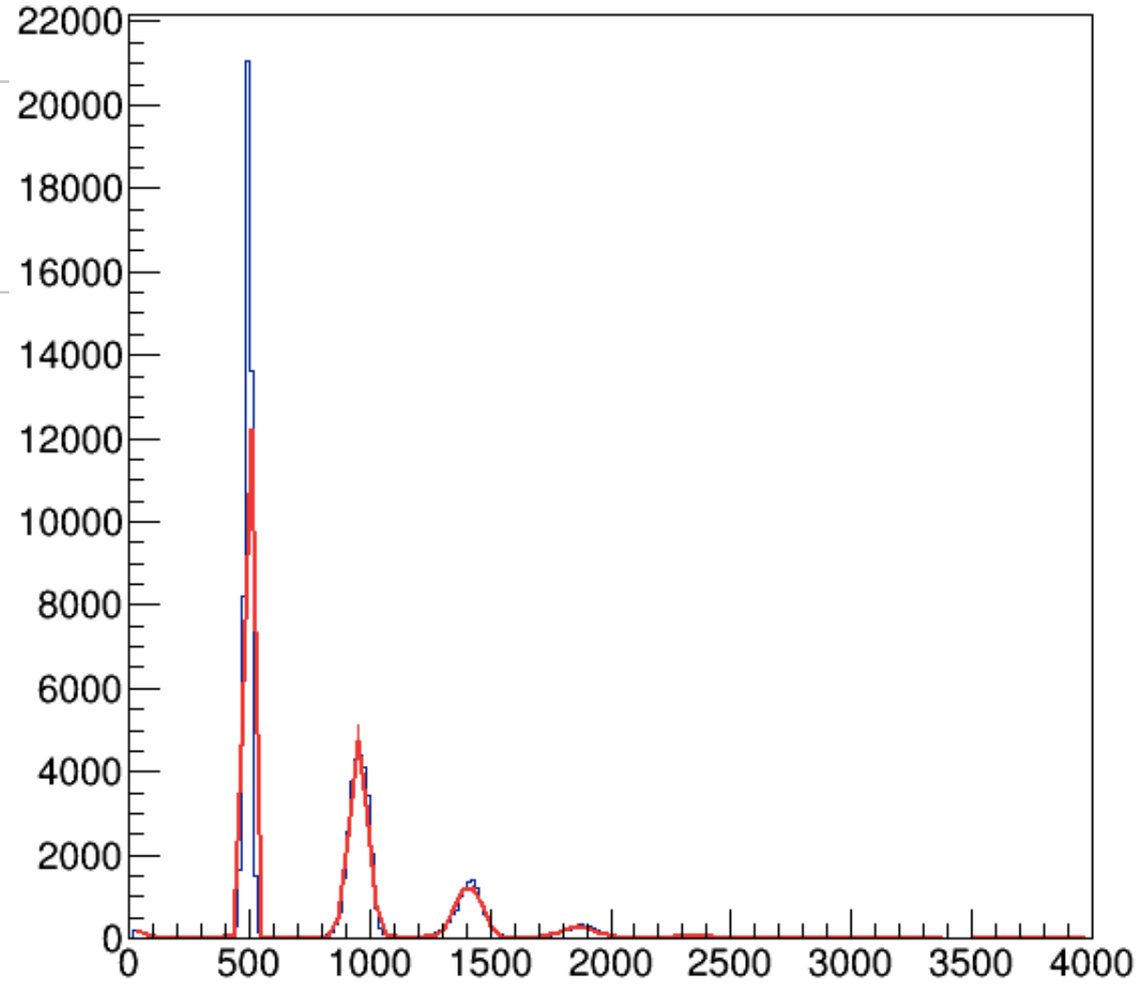
Chi2	=	2.84176	
NDf	=	4	
p0	=	10.4319	+/- 0.82346
p1	=	-0.00758684	+/- 0.0037987
p2	=	1.59233e-05	+/- 4.59021e-06
p3	=	-8.15538e-09	+/- 1.96489e-09
p4	=	1.13568e-12	+/- 2.71513e-13

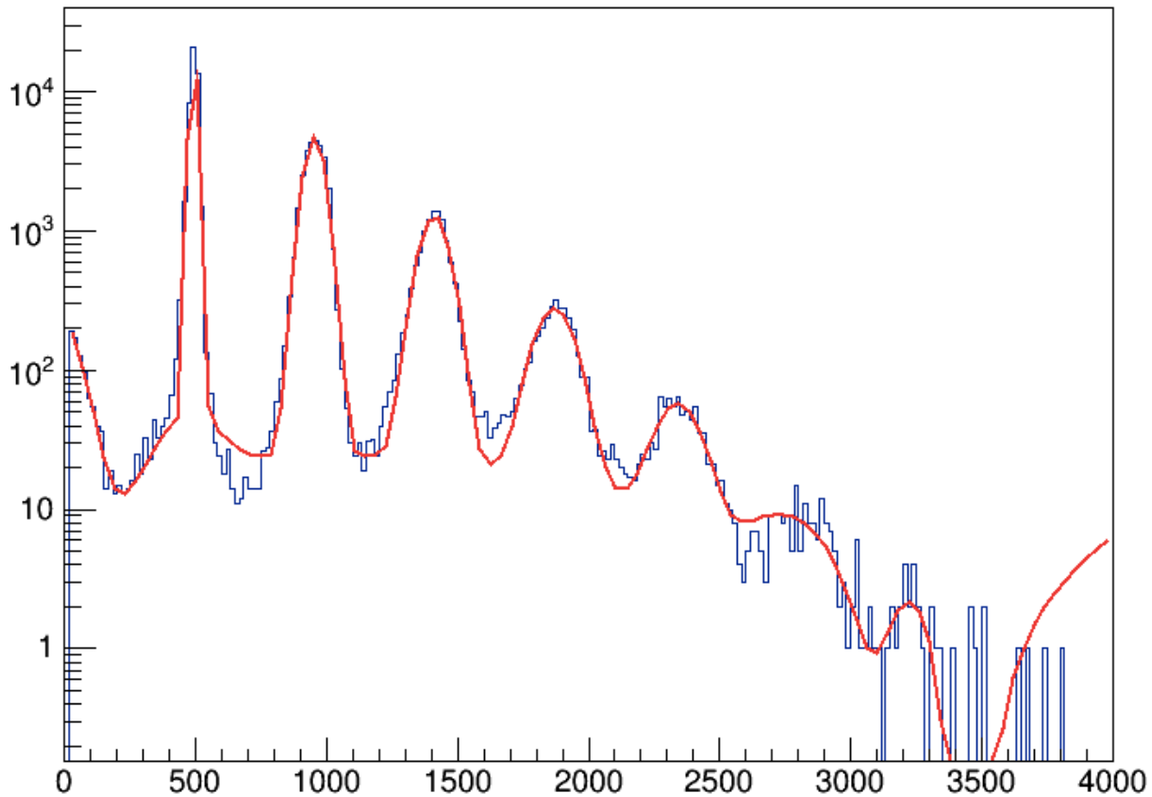
I'M TRYING TO EXTRACT THE SIGNAL PARAMETERS

- 1 Constant 3.00325e+02 1.89016e+02 2.24600e-02 -1.56302e-05
- 2 Mean -8.29096e+01 8.87227e+01 5.33041e-03 -2.87428e-05
- 3 Sigma 1.05522e+02 2.79582e+01 1.80239e-05 1.23167e-03
- 0
- 1 Constant 2.24686e+04 1.36222e+02 4.93416e-01 -1.50988e-06
- 2 Mean 4.84533e+02 6.40548e-02 5.58703e-04 -7.54663e-04
- 3 Sigma 1.35902e+01 5.26955e-02 -1.76639e-06 3.52041e-02
- 1
- 1 Constant 5.32674e+03 3.96407e+01 1.69315e-01 -9.67606e-07
- 2 Mean 9.39477e+02 2.17771e-01 1.15207e-03 -2.67565e-04
- 3 Sigma 3.50188e+01 1.65426e-01 6.83878e-06 -1.35943e-02
- 2
- 1 Constant 1.34761e+03 1.82337e+01 1.08222e-01 -1.00042e-06
- 2 Mean 1.39399e+03 5.17650e-01 4.24286e-03 5.82800e-04
- 3 Sigma 5.23945e+01 5.01886e-01 1.84786e-05 4.85965e-03
- 3
- 1 Constant 2.66177e+02 6.71172e+00 1.96061e-02 -1.60051e-06
- 2 Mean 1.85616e+03 1.57223e+00 6.44331e-03 -1.15074e-05
- 3 Sigma 7.99940e+01 1.69633e+00 2.15058e-05 4.59351e-04
- 4
- 1 Constant 5.17587e+01 2.63780e+00 3.79812e-03 -1.87690e-05
- 2 Mean 2.33049e+03 5.09501e+00 1.02724e-02 -3.70681e-07
- 3 Sigma 1.08876e+02 6.42608e+00 3.24674e-05 9.00209e-04
- 5
- 1 Constant 7.15002e+00 7.12273e-01 1.88717e-03 -2.27015e-04
- 2 Mean 2.71768e+03 4.06319e+01 6.50761e-02 8.51462e-06
- 3 Sigma 1.88292e+02 3.28058e+01 1.37824e-04 3.64142e-03
- 6

On cluster ETot

- 1 p0 3.46839e+02 2.11955e+02 1.43305e-01 -5.50952e-06
- 2 p1 -6.86360e+01 7.07355e+01 -4.59210e-02 -3.23237e-05
- 3 p2 8.84621e+01 2.27048e+01 1.39117e-02 -5.55403e-05
- 4 p3 2.13355e+04 1.29376e+02 1.67390e-02 -1.66101e-07
- 5 p4 4.93730e+02 7.01563e-02 -8.08919e-07 2.60762e-04
- 6 p5 1.41553e+01 5.52606e-02 -4.95929e-06 6.70945e-04
- 7 p6 4.72983e+03 3.49432e+01 3.94490e-03 1.90775e-07
- 8 p7 9.52465e+02 2.44108e-01 -3.68112e-05 1.30333e-04
- 9 p8 3.90064e+01 1.75208e-01 -7.12995e-06 -5.47144e-05
- 10 p9 1.26383e+03 1.68709e+01 -1.94280e-03 1.29399e-06
- 11 p10 1.40986e+03 5.74934e-01 2.38007e-05 -6.35639e-05
- 12 p11 5.46009e+01 5.40827e-01 6.96110e-05 3.57581e-05
- 13 p12 2.62419e+02 7.03859e+00 1.07865e-03 -3.06947e-06
- 14 p13 1.86961e+03 1.65699e+00 1.22021e-04 -2.15902e-05
- 15 p14 7.26026e+01 1.68088e+00 -1.25701e-04 1.54198e-05
- 16 p15 5.00796e+01 2.99474e+00 1.60025e-04 -7.71102e-06
- 17 p16 2.34108e+03 4.38717e+00 -4.60792e-04 1.39086e-05
- 18 p17 8.00119e+01 4.11205e+00 3.04244e-04 -2.15752e-05
- 19 p18 7.00000e+00 fixed
- 20 p19 2.76812e+03 fixed
- 21 p20 1.48517e+02 fixed
- 22 p21 3.00000e+00 fixed
- 23 p22 3.22911e+03 fixed
- 24 p23 8.33684e+01 fixed
- 25 p24 -9.19427e-01 3.59037e+00 -2.02930e-03 9.96349e-05
- 26 p25 5.79897e-02 1.02433e-02 4.67469e-06 -5.50962e-02
- 27 p26 -4.02702e-05 8.71115e-06 -3.55514e-09 -5.92749e+02
- 28 p27 8.38257e-09 2.90930e-09 1.07954e-12 -2.70190e+06
- 29 p28 -4.56116e-13 3.33164e-13 -1.13666e-16 -1.08789e+10
- 30 p29 3.00000e+01 fixed
- 31 p30 4.75000e+02 fixed
- 32 p31 1.00000e+02 fixed
- Chi^2:1587.83, number of DoF: 183 (Probability: 3.44654e-222)



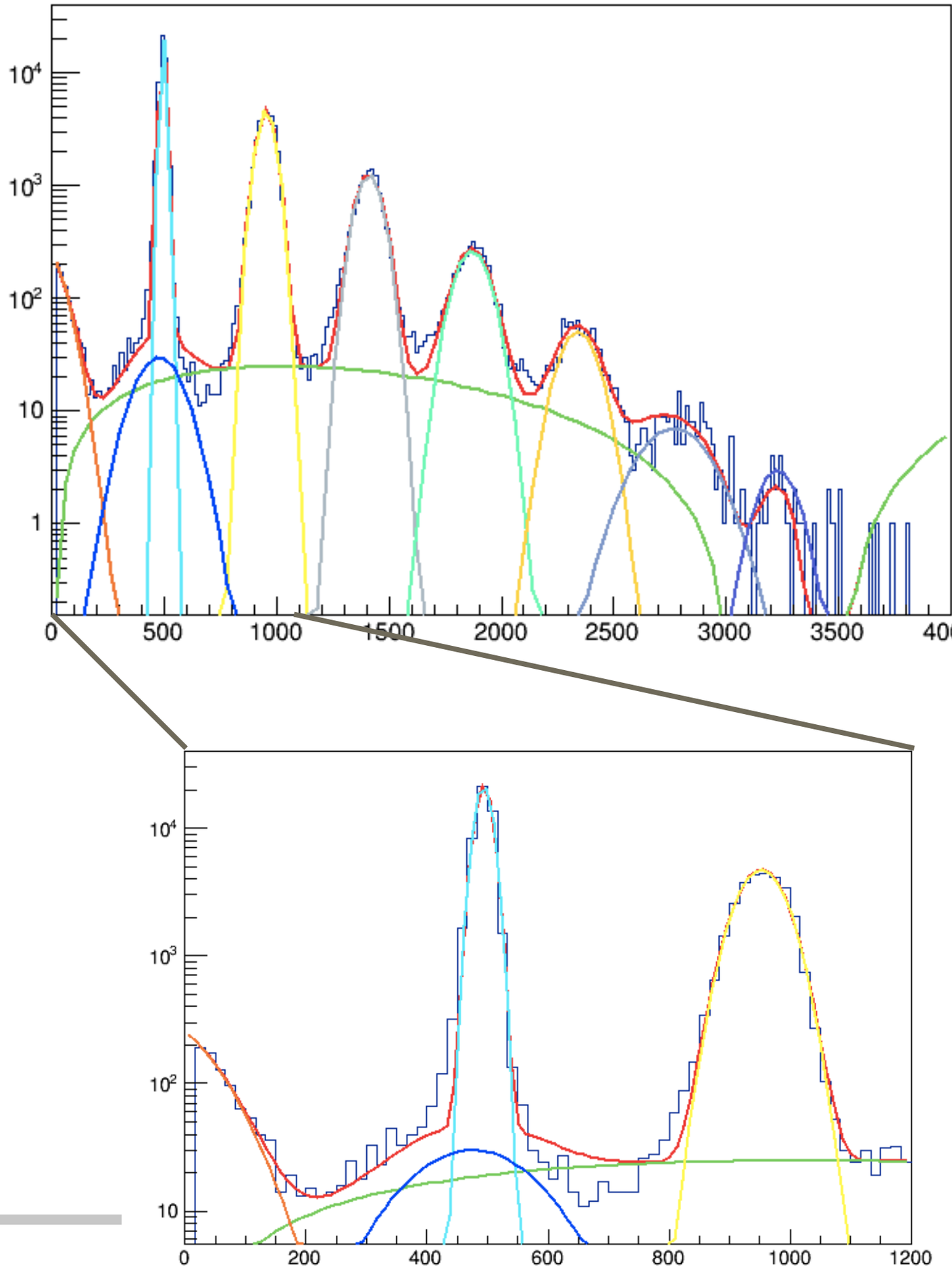


On cluster ETot

1	p0	3.46839e+02	2.11955e+02	1.43305e-01	-5.50952e-06
2	p1	-6.86360e+01	7.07355e+01	-4.59210e-02	-3.23237e-05
3	p2	8.84621e+01	2.27048e+01	1.39117e-02	-5.55403e-05
4	p3	2.13355e+04	1.29376e+02	1.67390e-02	-1.66101e-07
5	p4	4.93730e+02	7.01563e-02	-8.08919e-07	2.60762e-04
6	p5	1.41553e+01	5.52606e-02	-4.95929e-06	6.70945e-04
7	p6	4.72983e+03	3.49432e+01	3.94490e-03	1.90775e-07
8	p7	9.52465e+02	2.44108e-01	-3.68112e-05	1.30333e-04
9	p8	3.90064e+01	1.75208e-01	-7.12995e-06	-5.47144e-05
10	p9	1.26383e+03	1.68709e+01	-1.94280e-03	1.29399e-06
11	p10	1.40986e+03	5.74934e-01	2.38007e-05	-6.35639e-05
12	p11	5.46009e+01	5.40827e-01	6.96110e-05	3.57581e-05
13	p12	2.62419e+02	7.03859e+00	1.07865e-03	-3.06947e-06
14	p13	1.86961e+03	1.65699e+00	1.22021e-04	-2.15902e-05
15	p14	7.26026e+01	1.68088e+00	-1.25701e-04	1.54198e-05
16	p15	5.00796e+01	2.99474e+00	1.60025e-04	-7.71102e-06
17	p16	2.34108e+03	4.38717e+00	-4.60792e-04	1.39086e-05
18	p17	8.00119e+01	4.11205e+00	3.04244e-04	-2.15752e-05
19	p18	7.00000e+00	fixed		
20	p19	2.76812e+03	fixed		
21	p20	1.48517e+02	fixed		
22	p21	3.00000e+00	fixed		
23	p22	3.22911e+03	fixed		
24	p23	8.33684e+01	fixed		
25	p24	-9.19427e-01	3.59037e+00	-2.02930e-03	9.96349e-05
26	p25	5.79897e-02	1.02433e-02	4.67469e-06	-5.50962e-02
27	p26	-4.02702e-05	8.71115e-06	-3.55514e-09	-5.92749e+02
28	p27	8.38257e-09	2.90930e-09	1.07954e-12	-2.70190e+06
29	p28	-4.56116e-13	3.33164e-13	-1.13666e-16	-1.08789e+10
30	p29	3.00000e+01	fixed		
31	p30	4.75000e+02	fixed		
32	p31	1.00000e+02	fixed		

- Chi^2:1587.83, number of DoF: 183 (Probability: 3.44654e-222)

Bkg

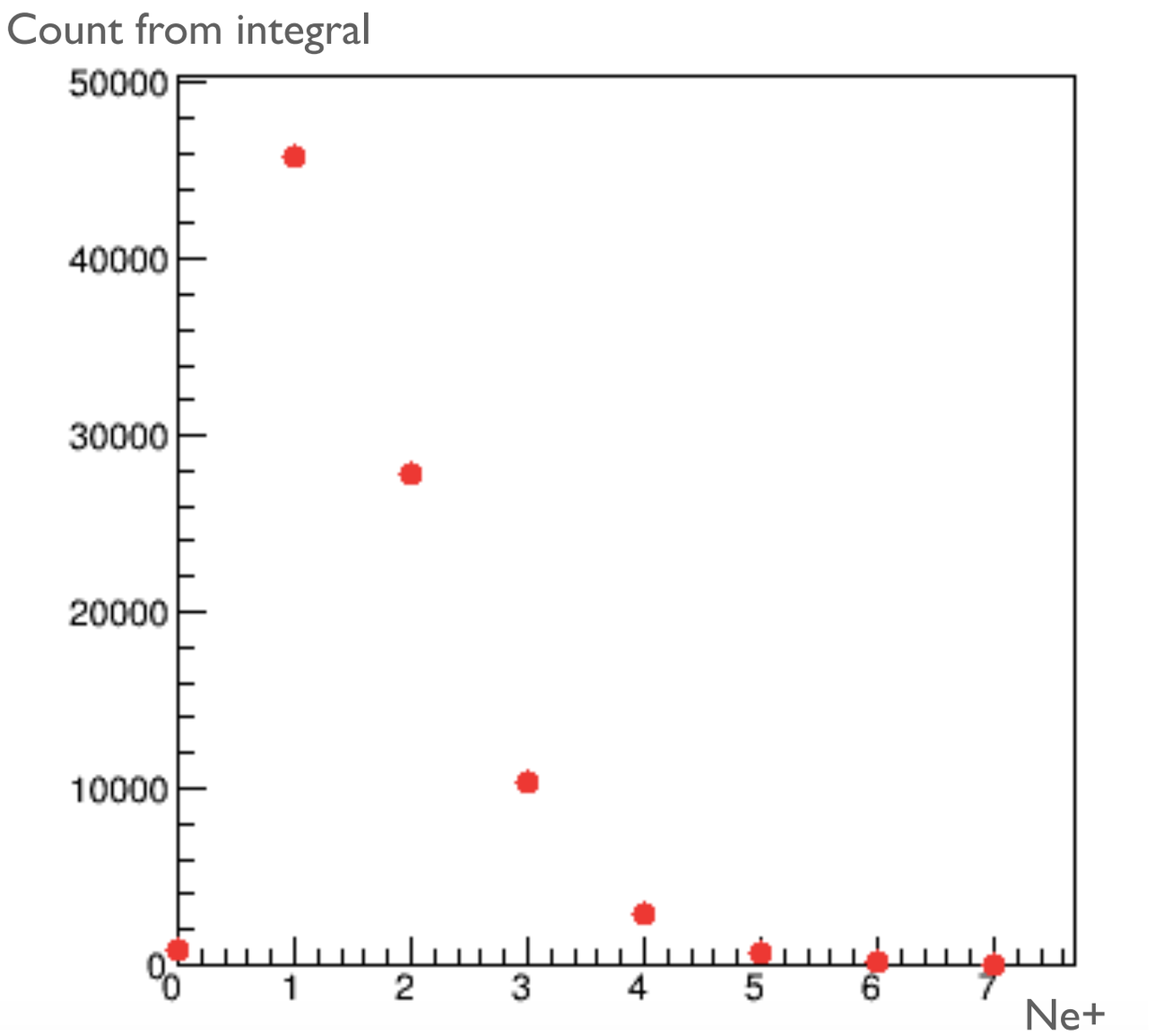


N COUNTS

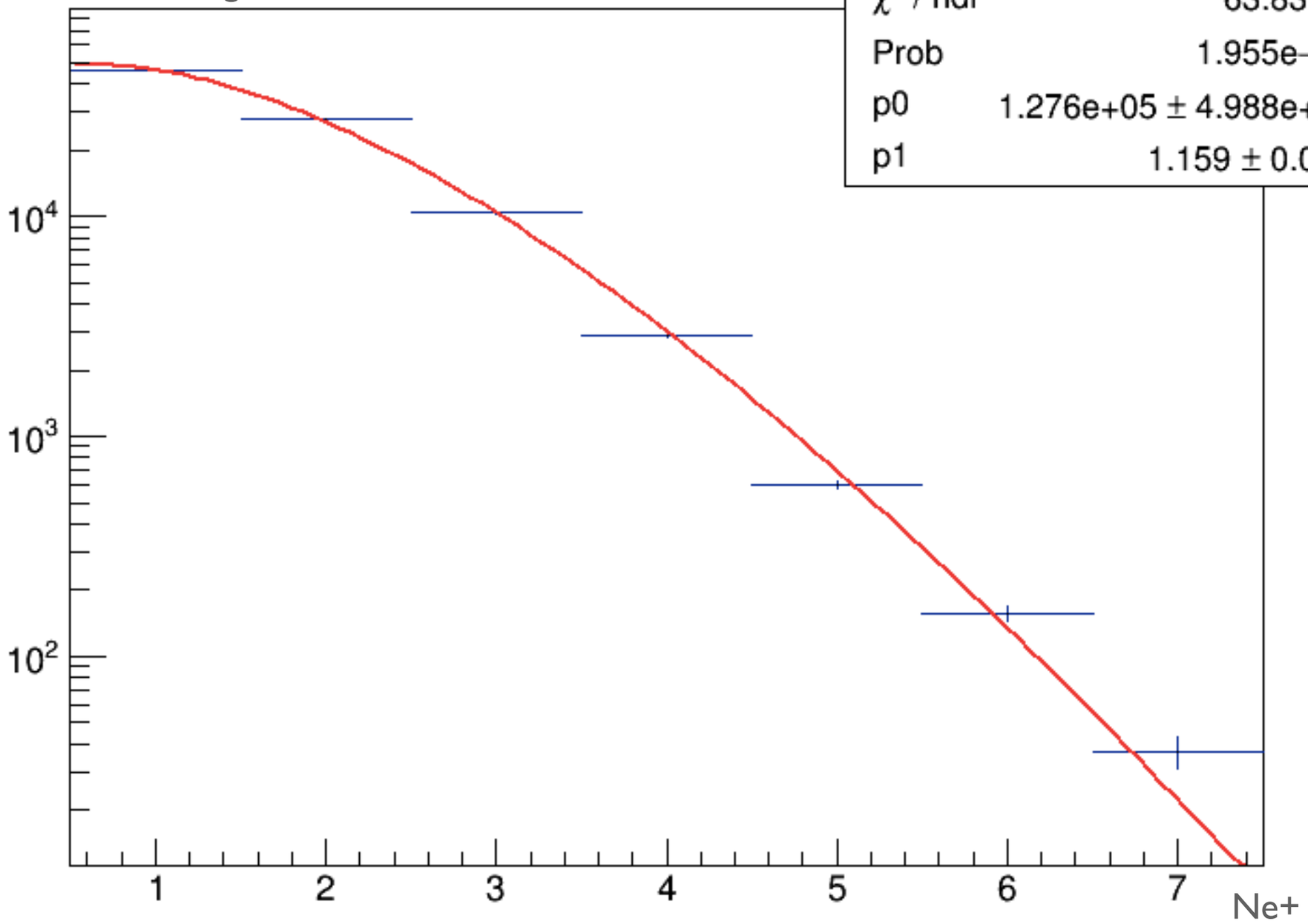
- 0 peak (~0MeV) has 863.018 e+
- 1 peak (~490 MeV) has 45873 e+
- 2 peak has 27747.4 e+
- 3 peak has 10378.3 e+
- 4 peak has 2865.42 e+
- 5 peak has 602.639 e+
- 6 peak has 156.356 e+
- 7 peak has 37.5935 e+

- N e+ second/first peak 0.604875
- N e+ third/second peak 0.374029
- N e+ forth/third peak 0.276096
- N e+ fifth/forth peak 0.210315
- N e+ sixth/fifth peak 0.259453
- N e+ seventh/sixth peak 0.240435
- N e+ eight/seventh peak 0

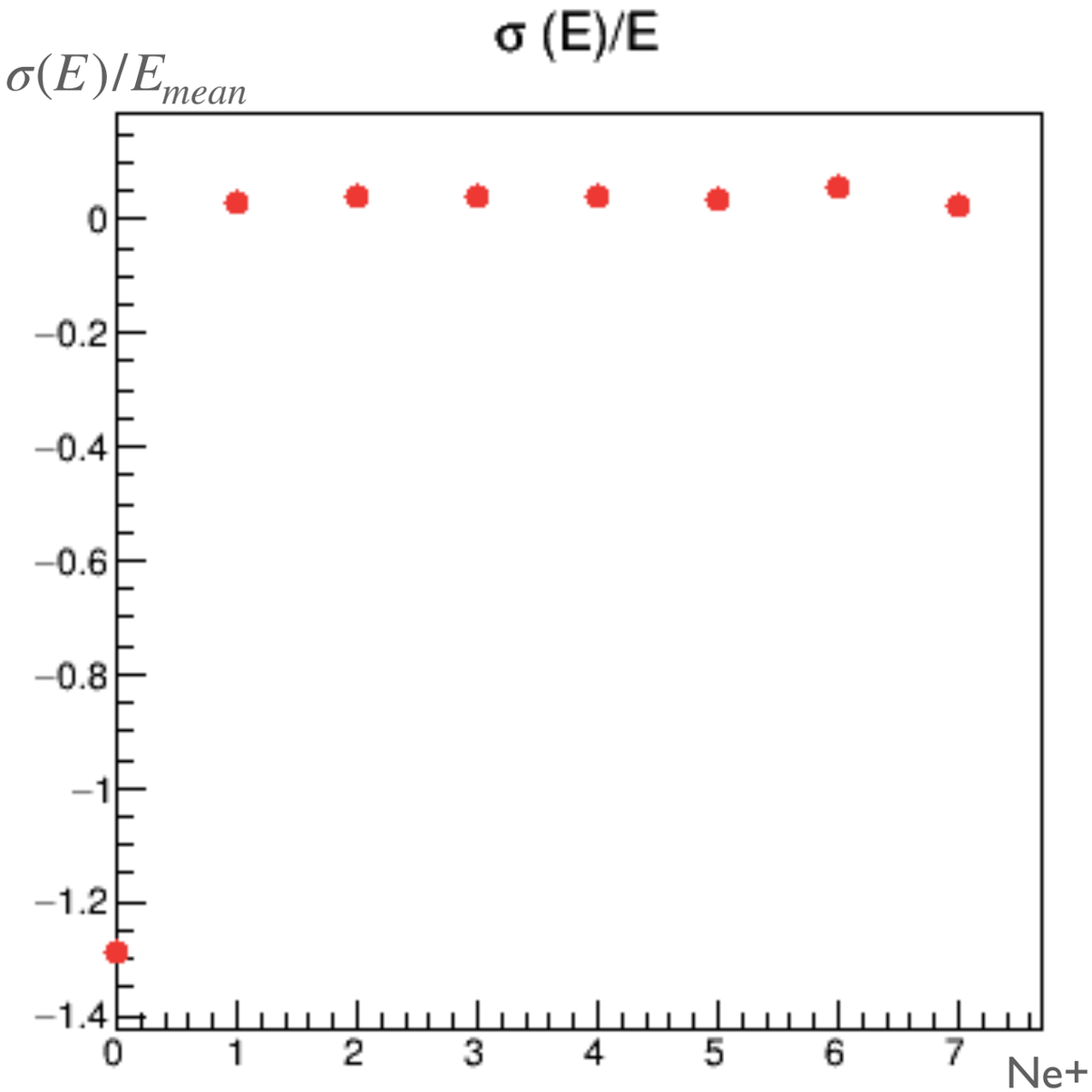
- bkg integral 2580.39 total signal: 88523.8
  - bkg/(total signal) = 2,91%

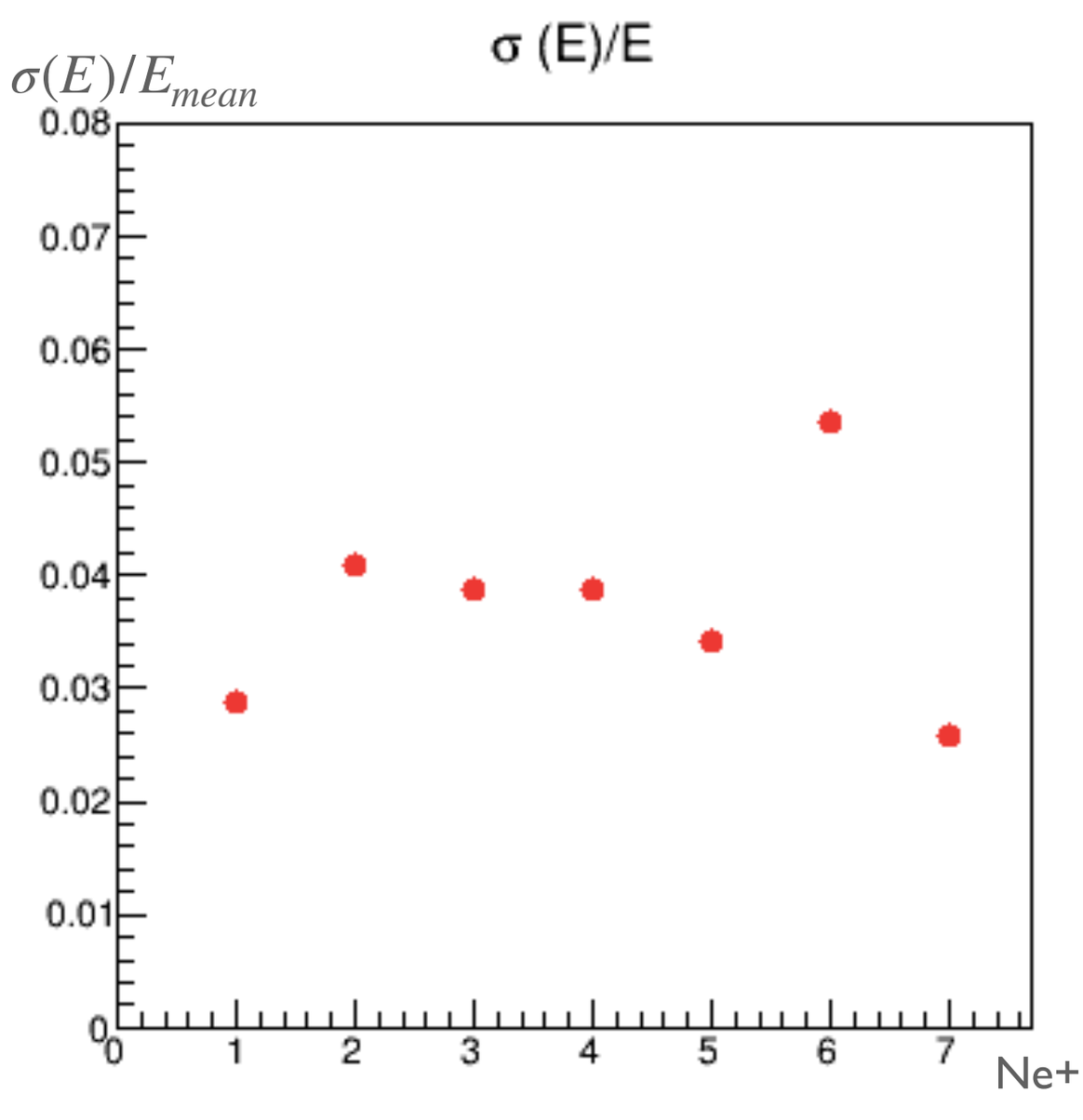


Count from integral

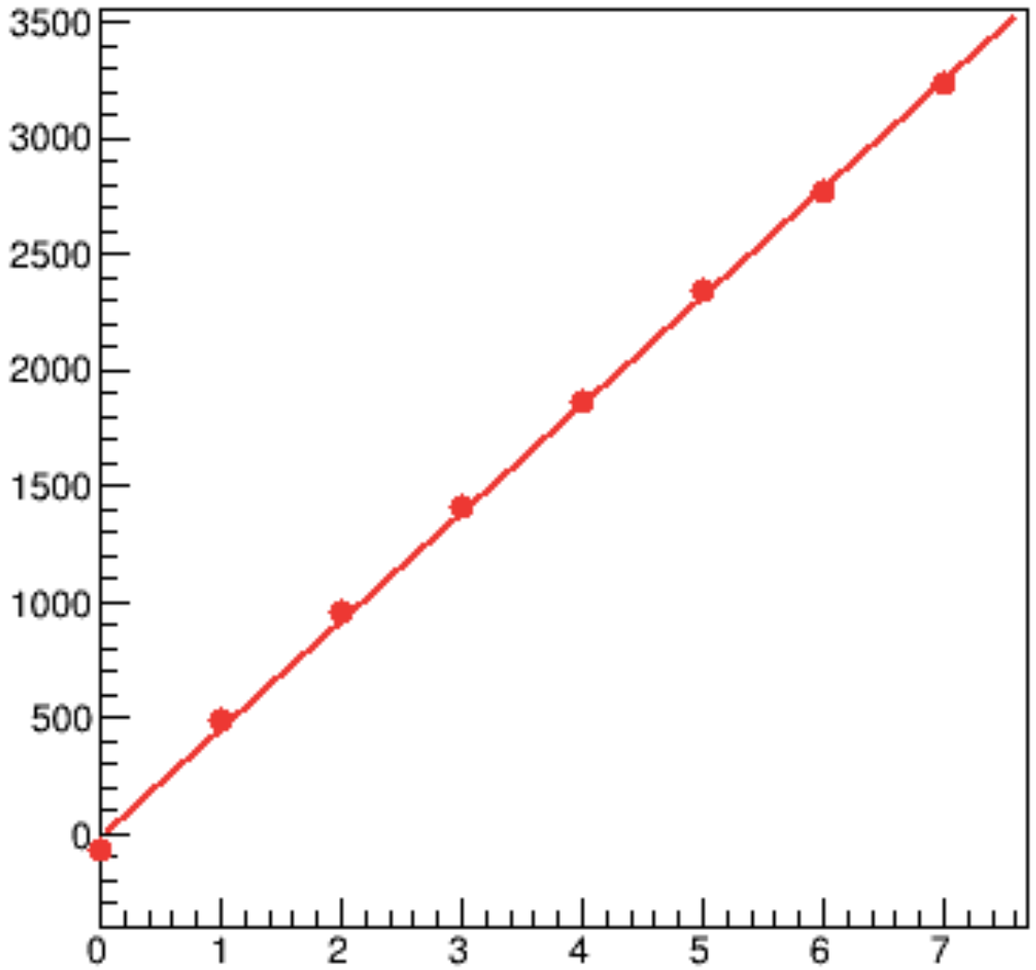


RELATIVE RESOLUTION

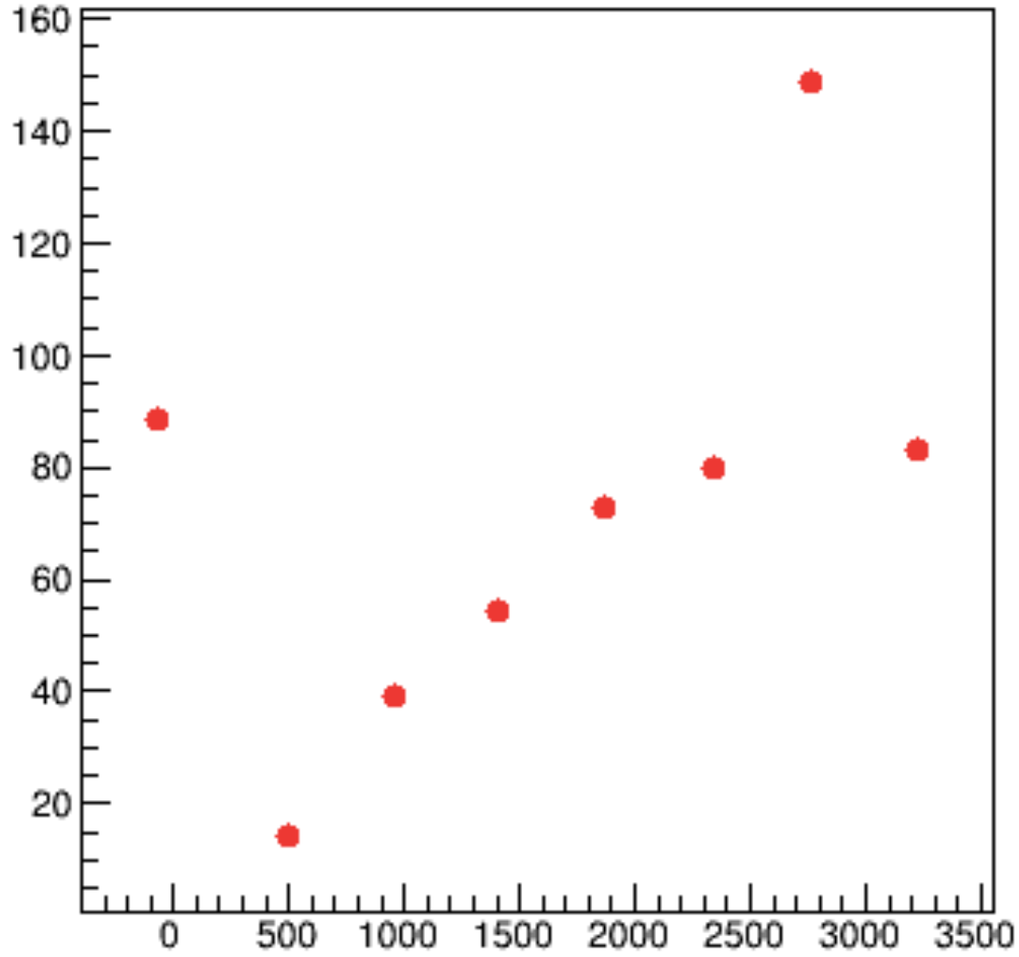




MeanEnergy

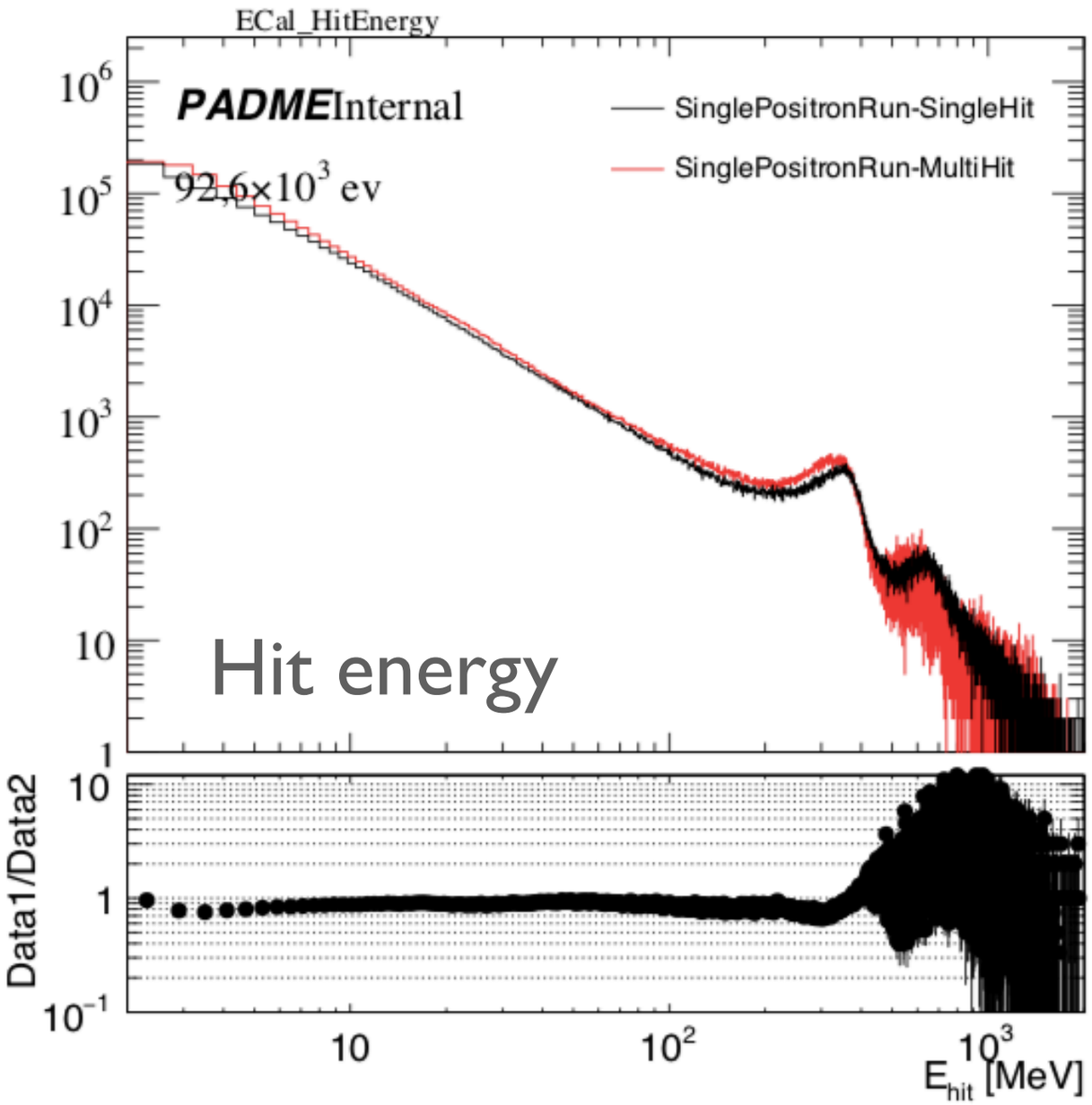


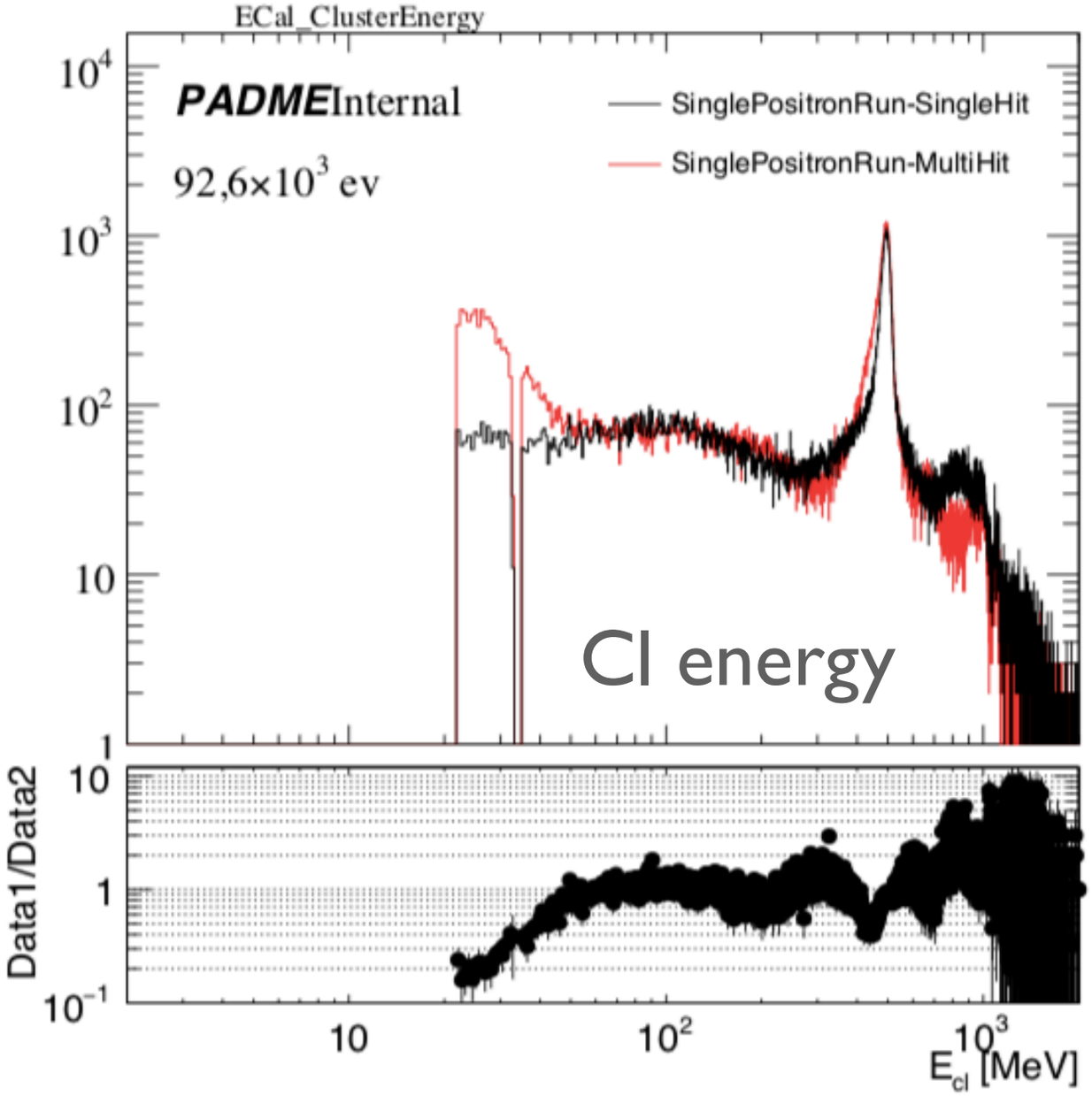
Sigma



- p0 = -3.98917 +/- 23.0985
- p1 = 465.259 +/- 5.5216

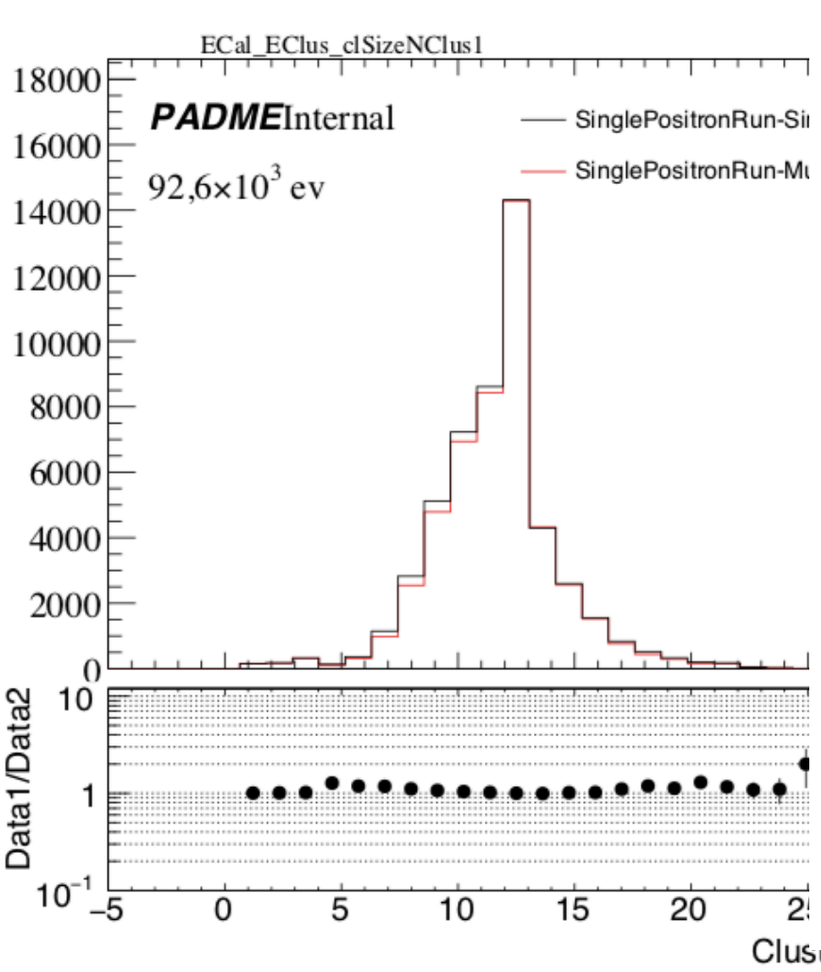
ENERGY DISTRIBUTION



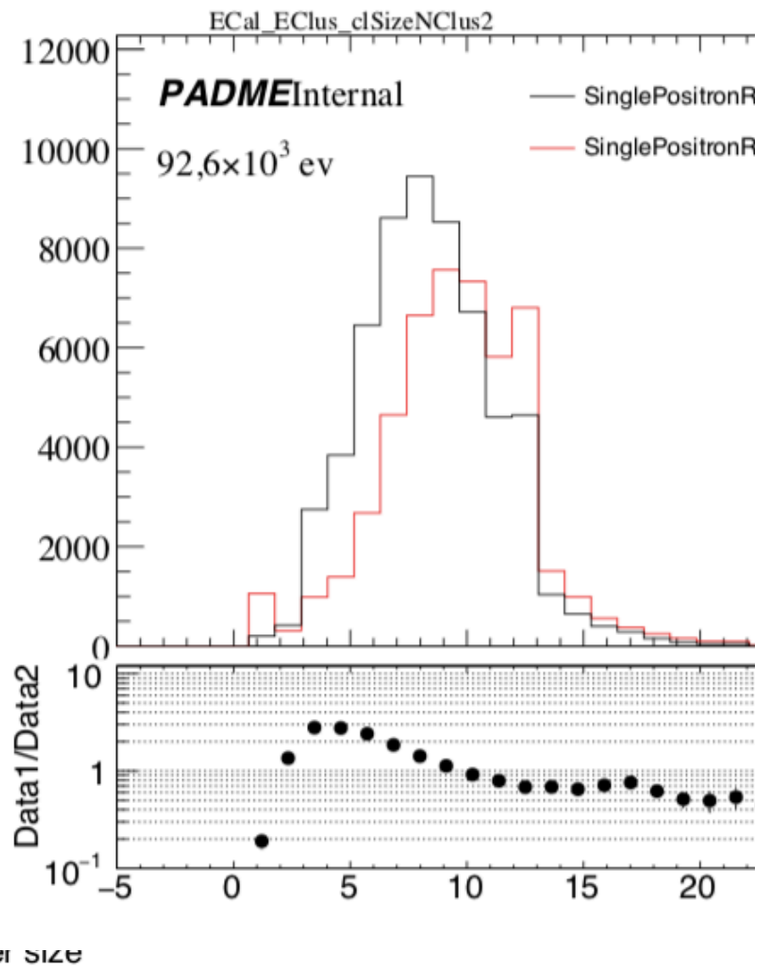


CLUSTER SIZE

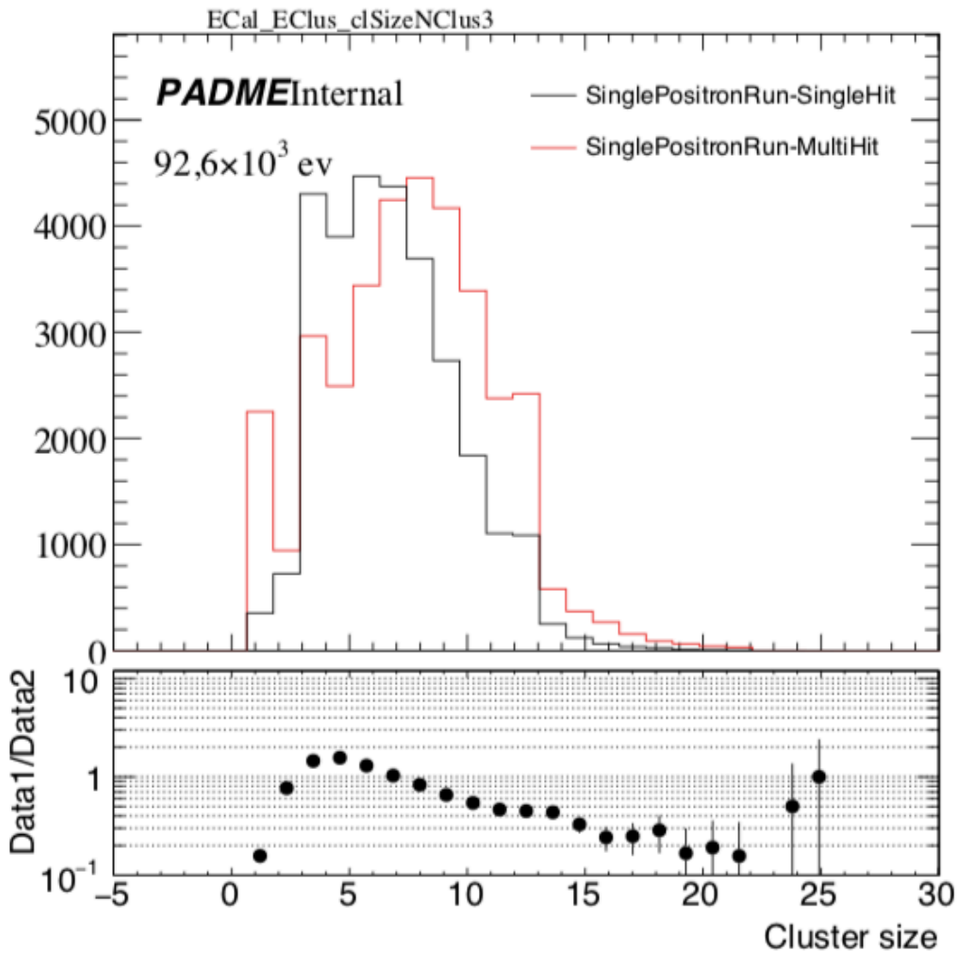
- Cluster size at different condition: 1(2 or 3) cl/bunch



1 cl in ECAL

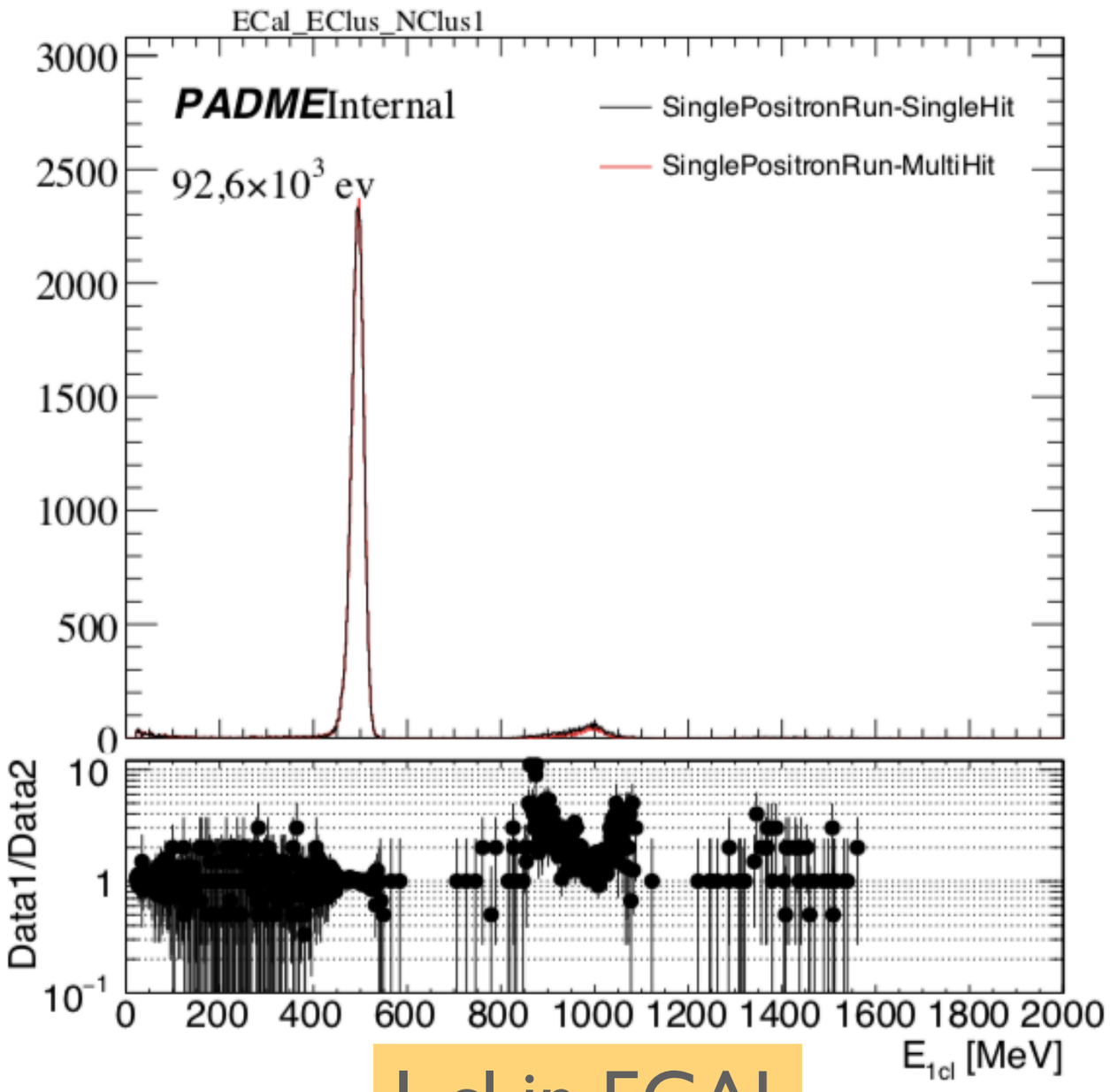


2 cl in ECAL

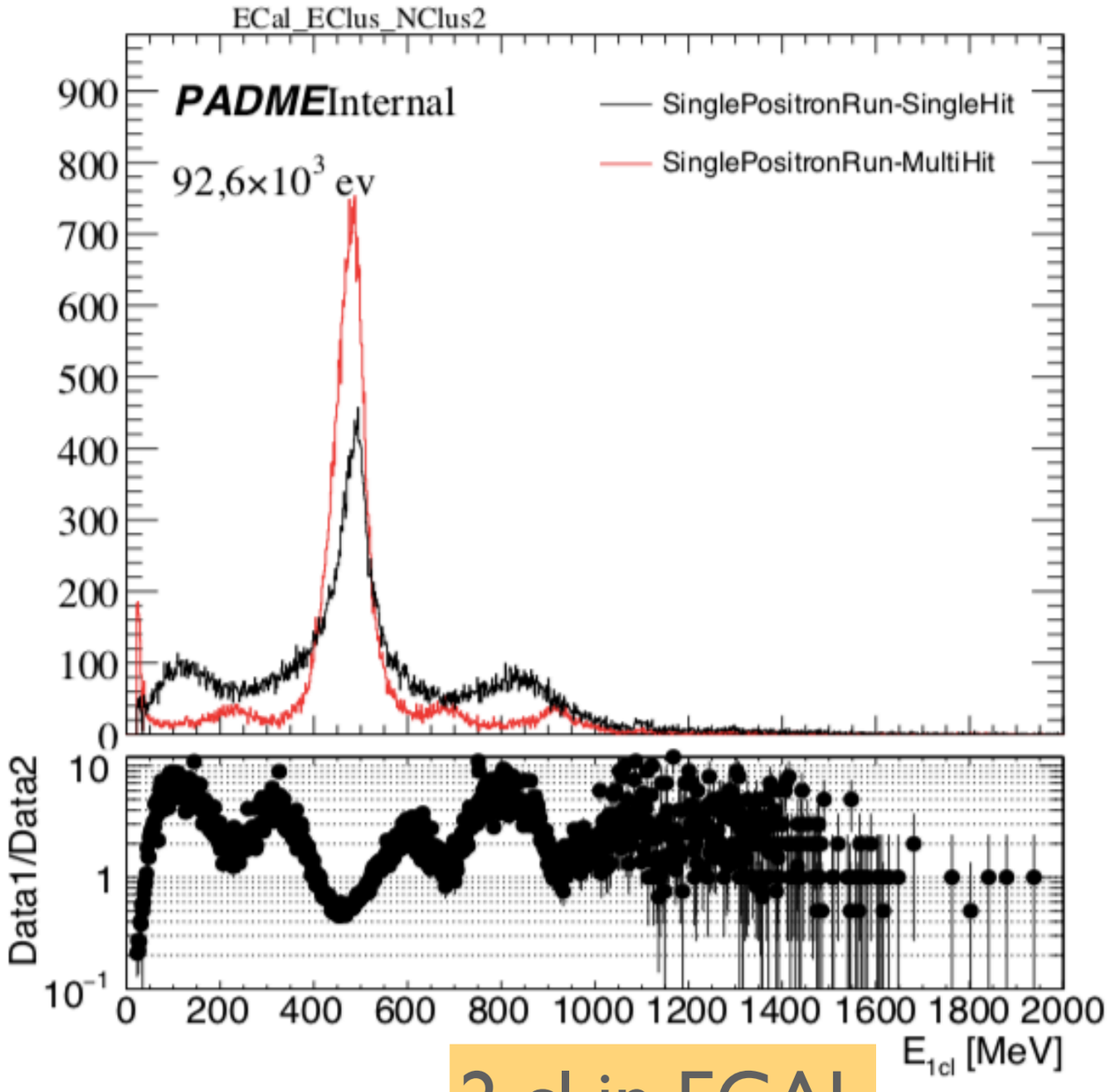


3 cl in ECAL

- Distribution of cluster energy when I have 1 & 2 cluster / bunch

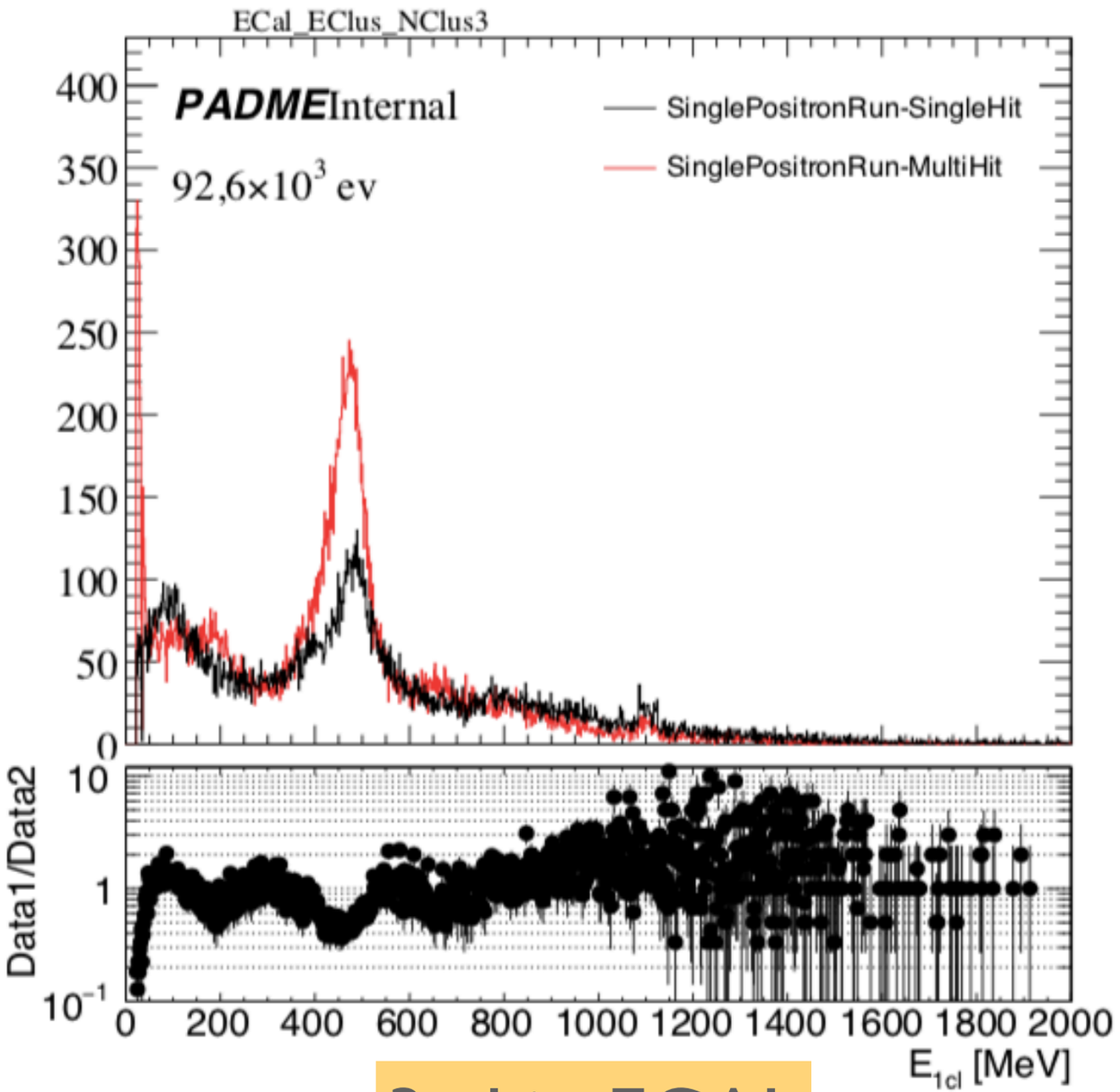


1 cl in ECAL

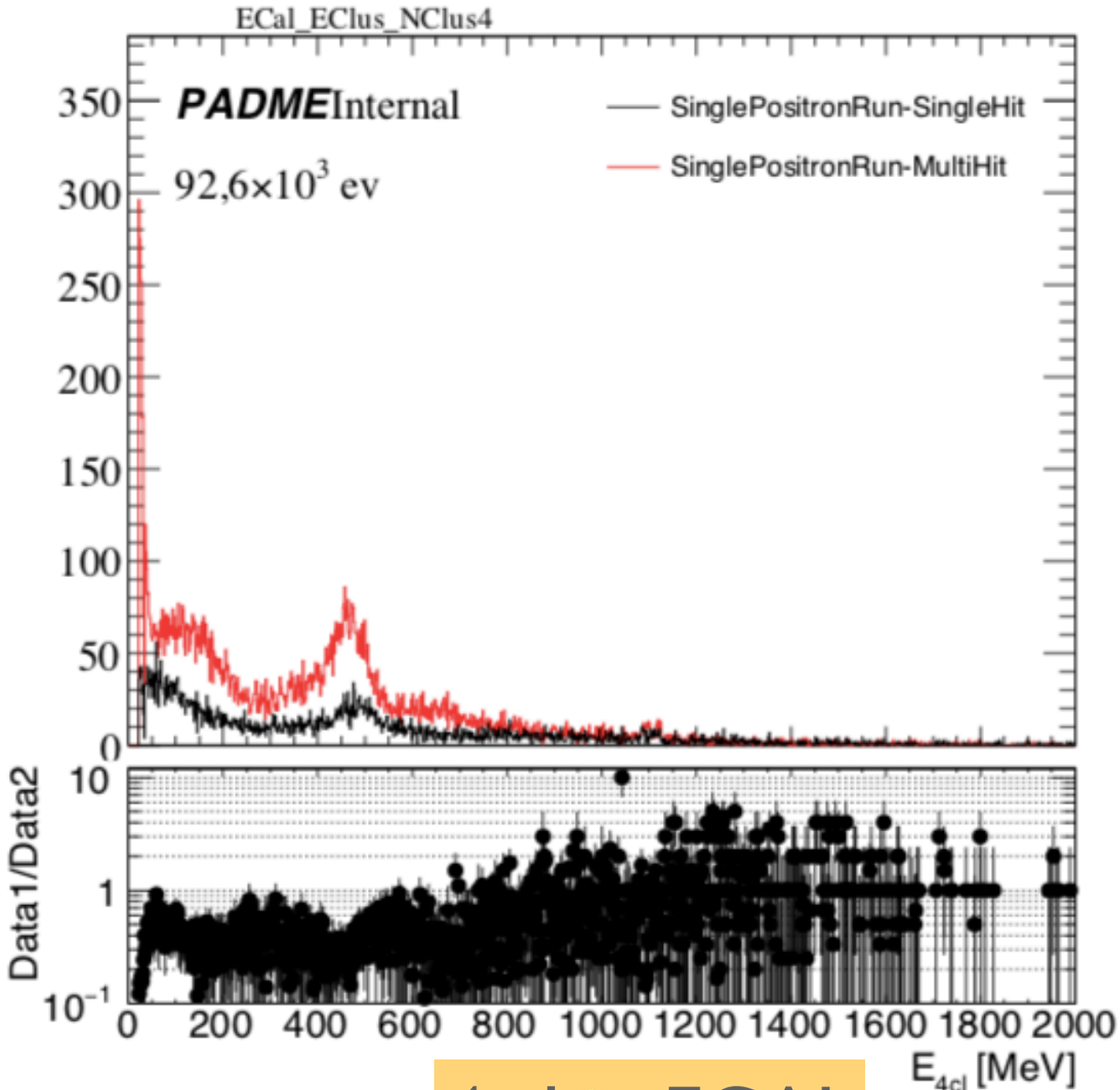


2 cl in ECAL

- Distribution of cluster energy when I have 1 (2 and 3) cluster / bunch

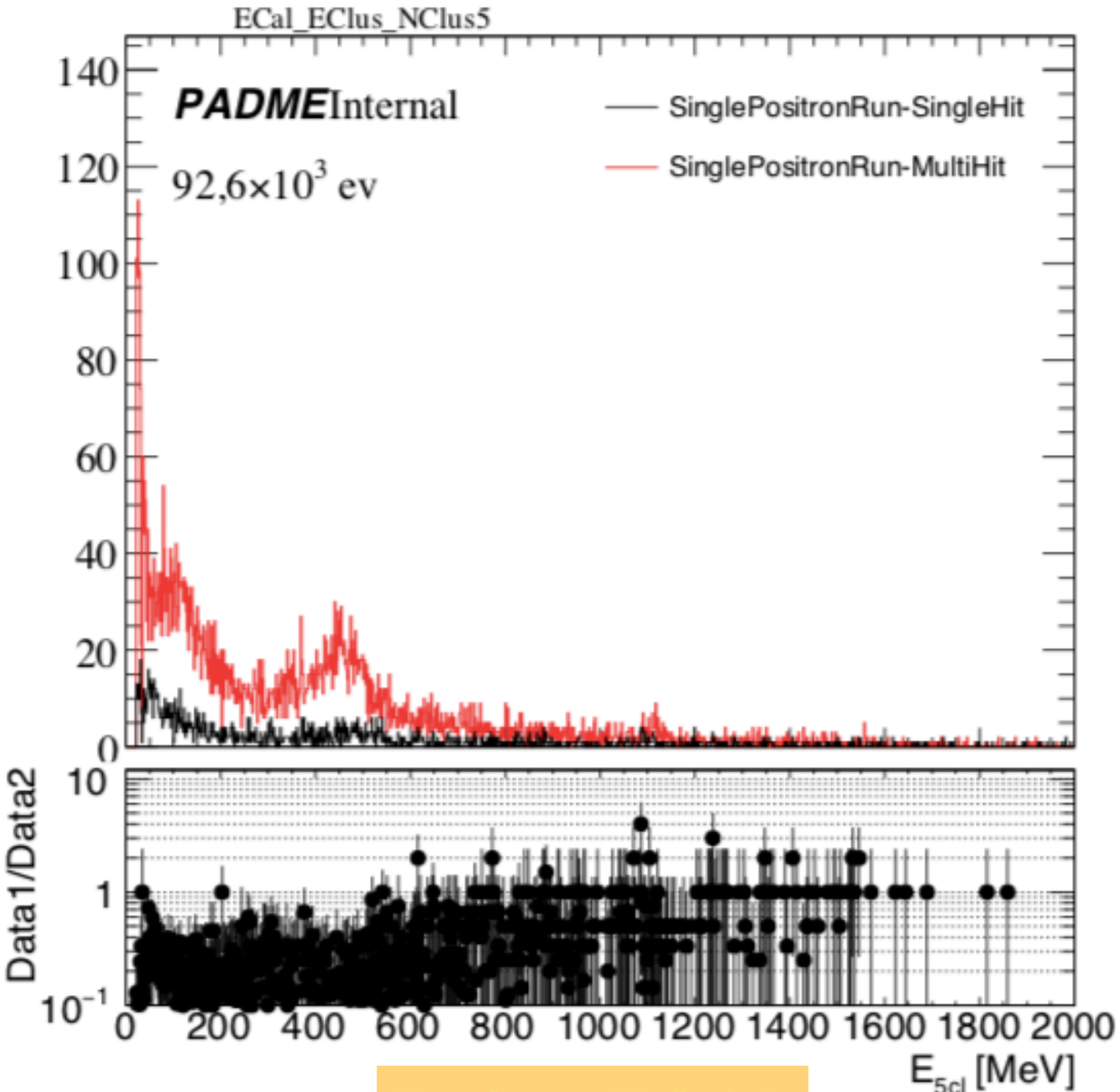


3 cl in ECAL

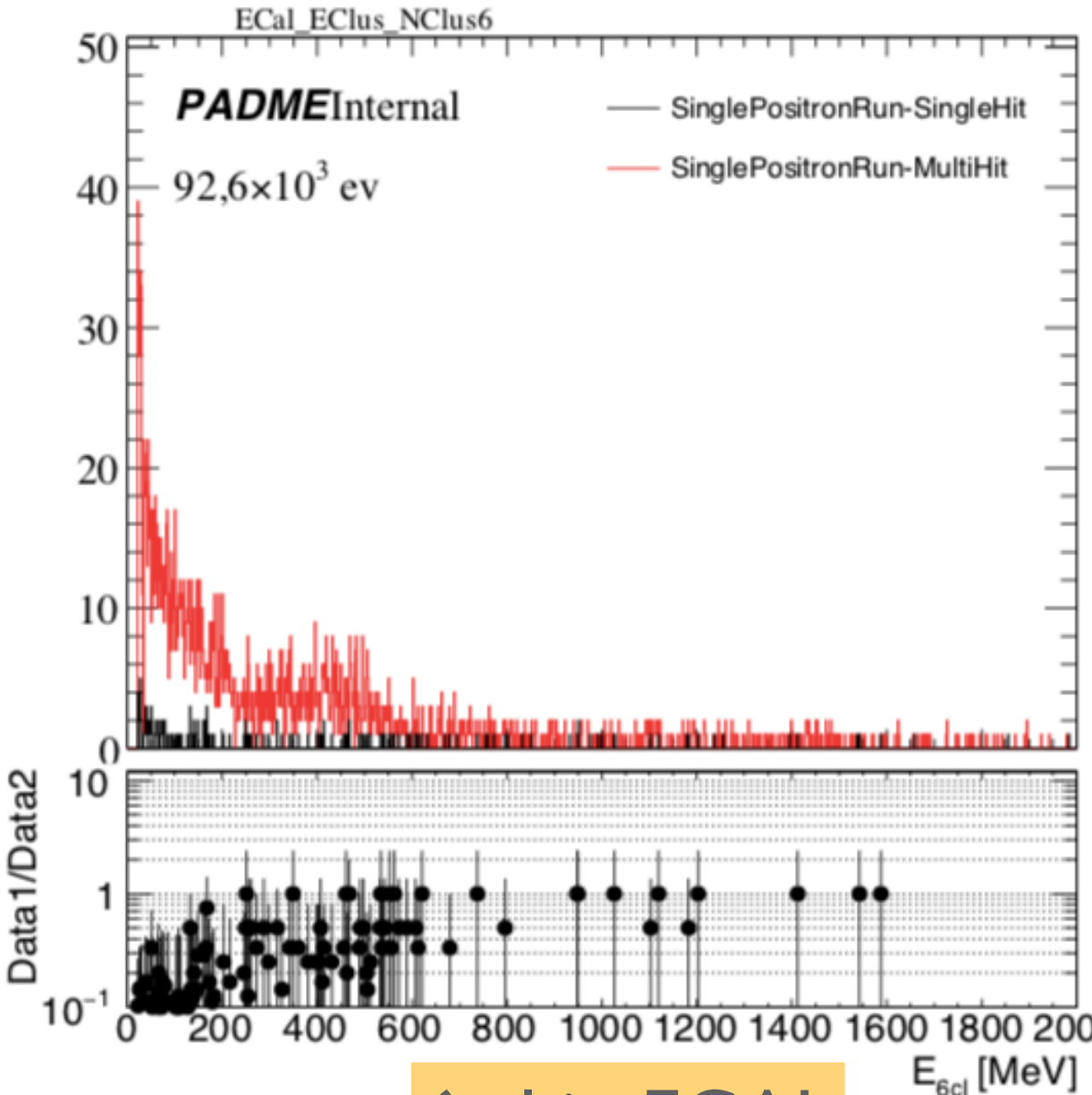


4 cl in ECAL

- Distribution of cluster energy when I have 1 (2 and 3) cluster / bunch

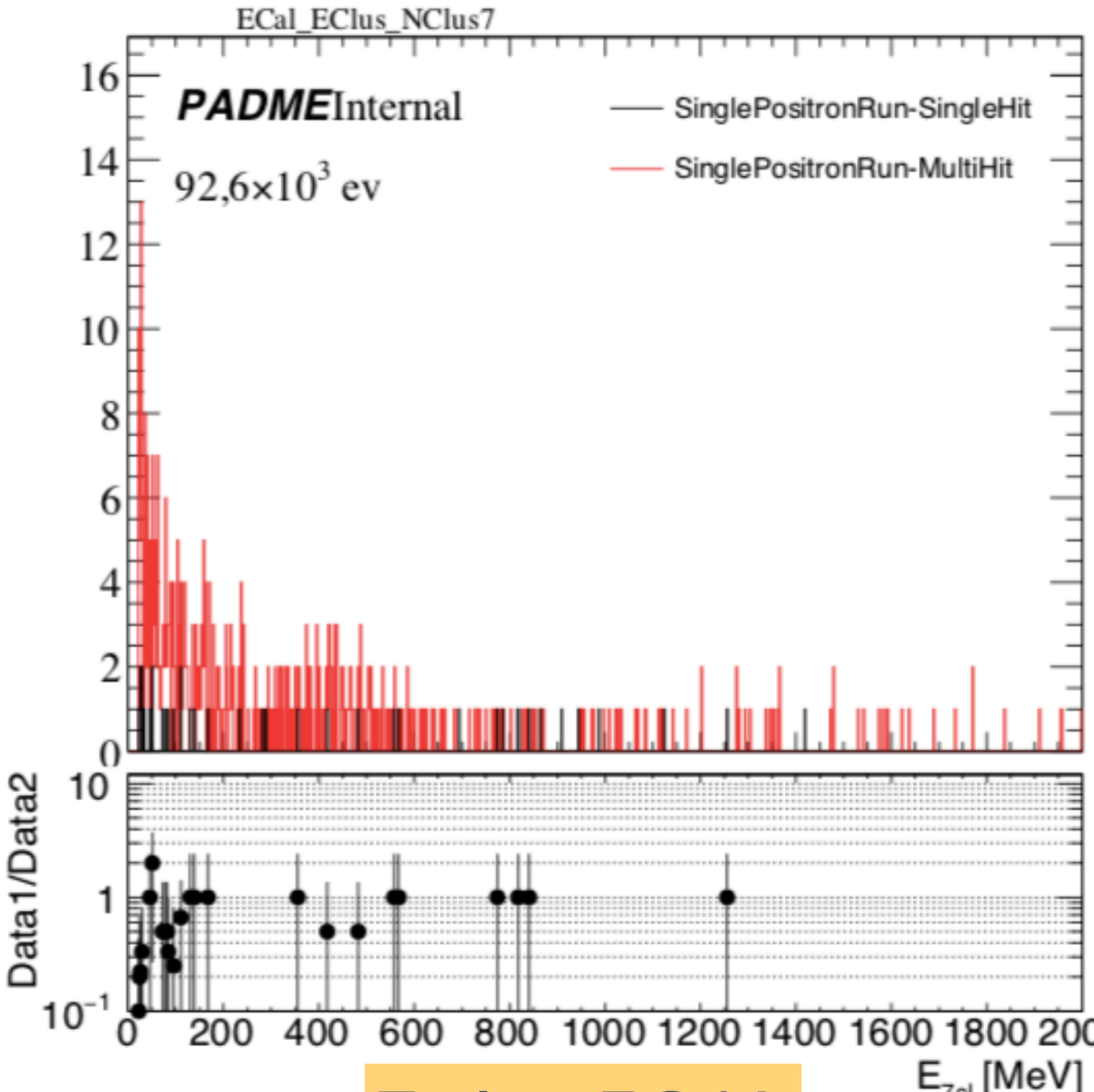


5 cl in ECAL

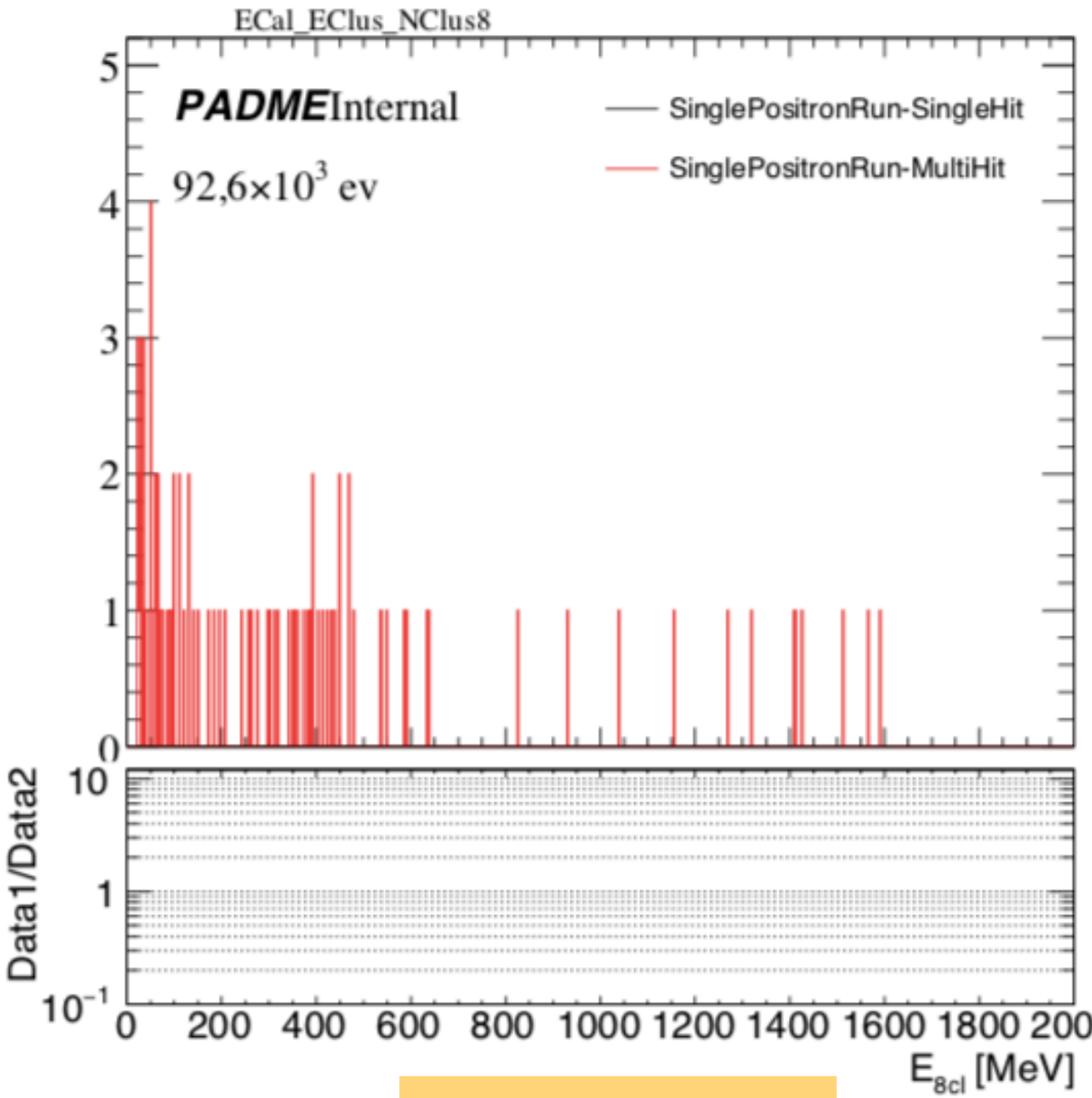


6 cl in ECAL

- Distribution of cluster energy when I have 1 (2 and 3) cluster / bunch



7 cl in ECAL



8 cl in ECAL

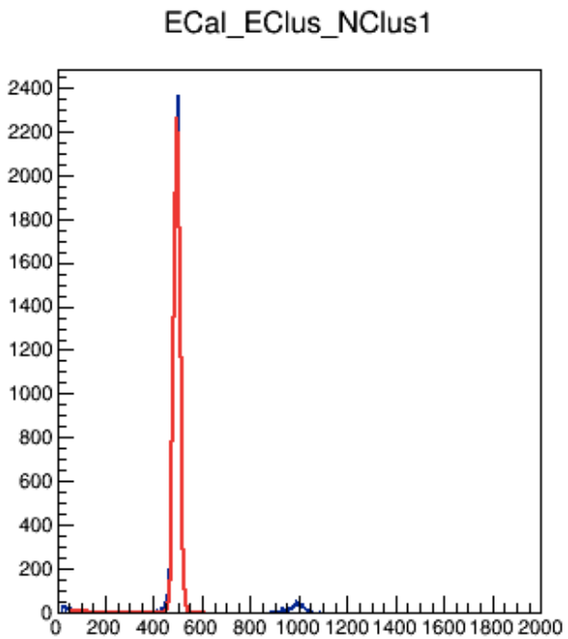
EVENTS UNDER PEAK FOR ECL

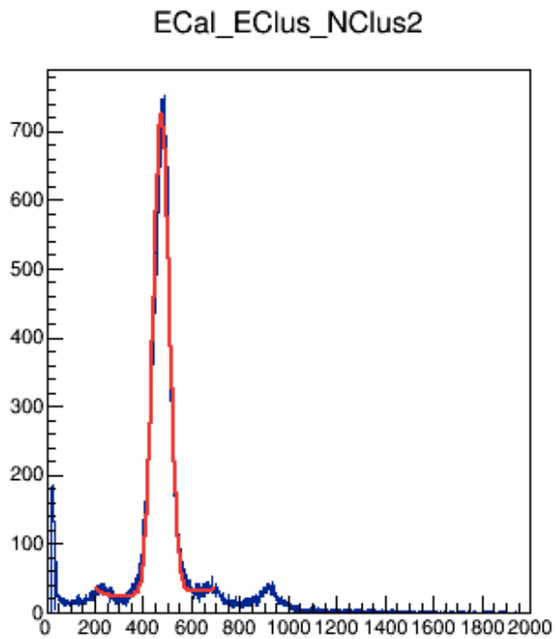
- I fit the distribution of the cluster energy for NCl/bunch = 1, 2 , 3 … 8 with a function
  - Background (expo) + signal (gaus)
- Results:
- nCl/bunch
  - 1 events 44901.7
  - 2 events 34574.6
  - 3 events 10793.2
  - 4 events 3603.53
  - 5 events 2405.5
  - 6 events 749.958
  - 7 events 172.015
  - 8 events 31.8564

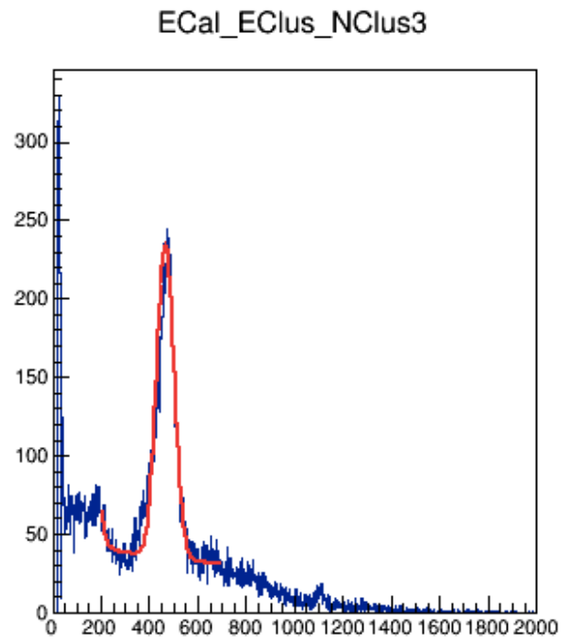
- From total cluster energy / bunch (slide 83):
  - 1 peak (~490 MeV) has 45873 e+
  - 2 peak has 27747.4 e+
  - 3 peak has 10378.3 e+
  - 4 peak has 2865.42 e+
  - 5 peak has 602.639 e+
  - 6 peak has 156.356 e+
  - 7 peak has 37.5935 e+

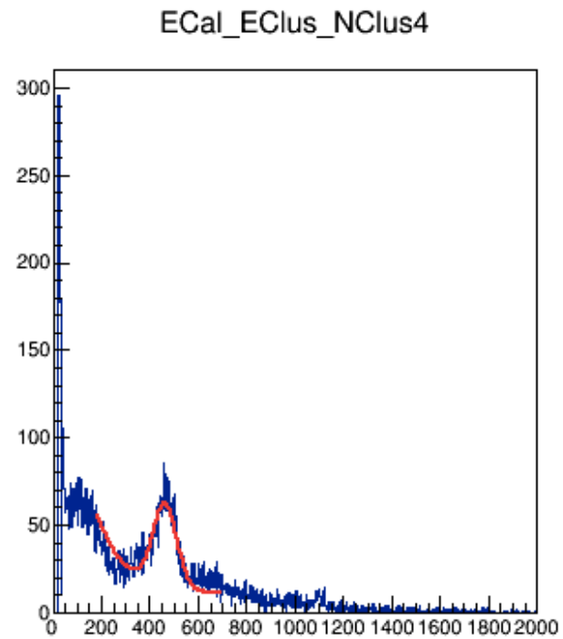
See next slide for fits

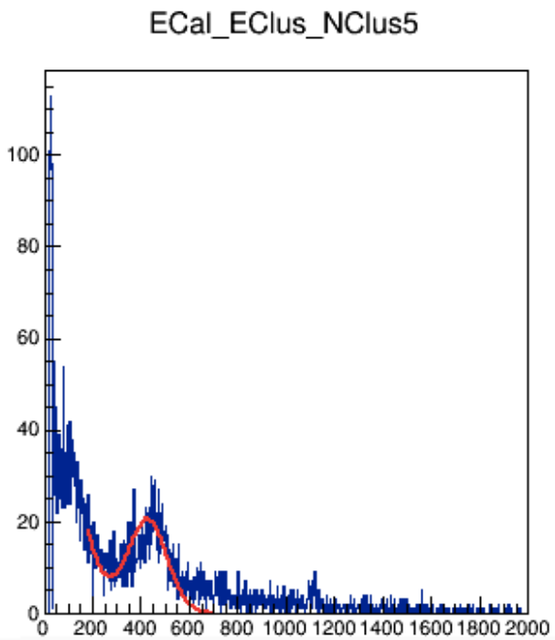
EVENTS UNDER PEAK FOR ECL FIT

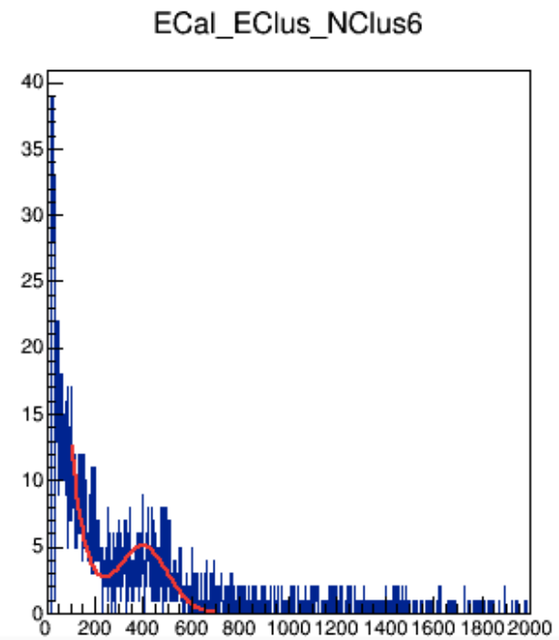


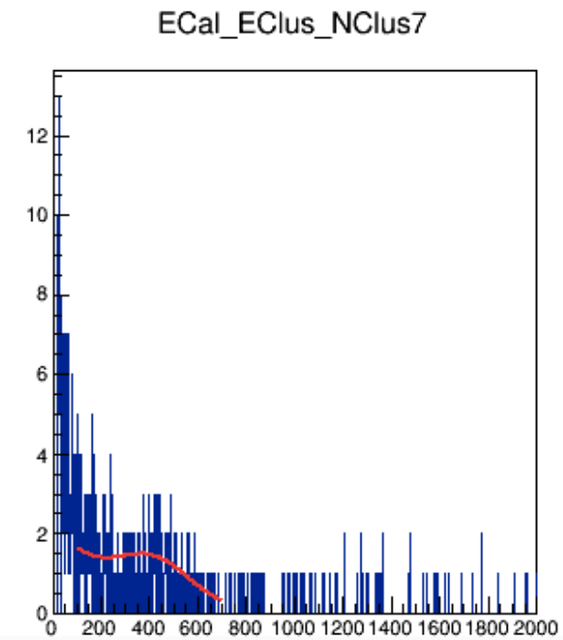


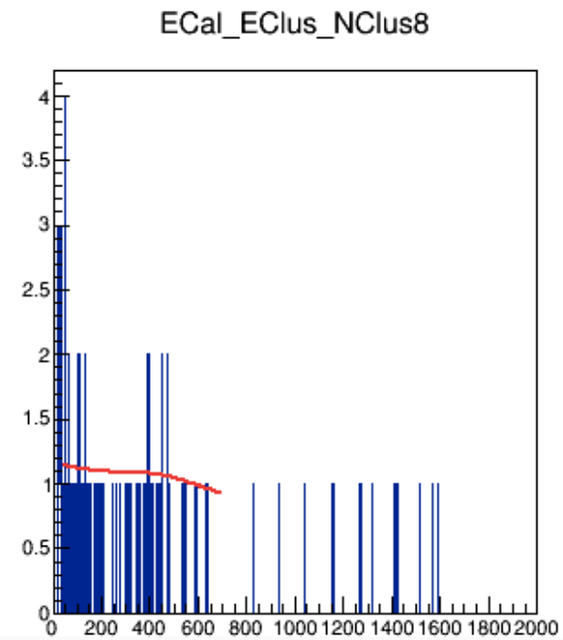




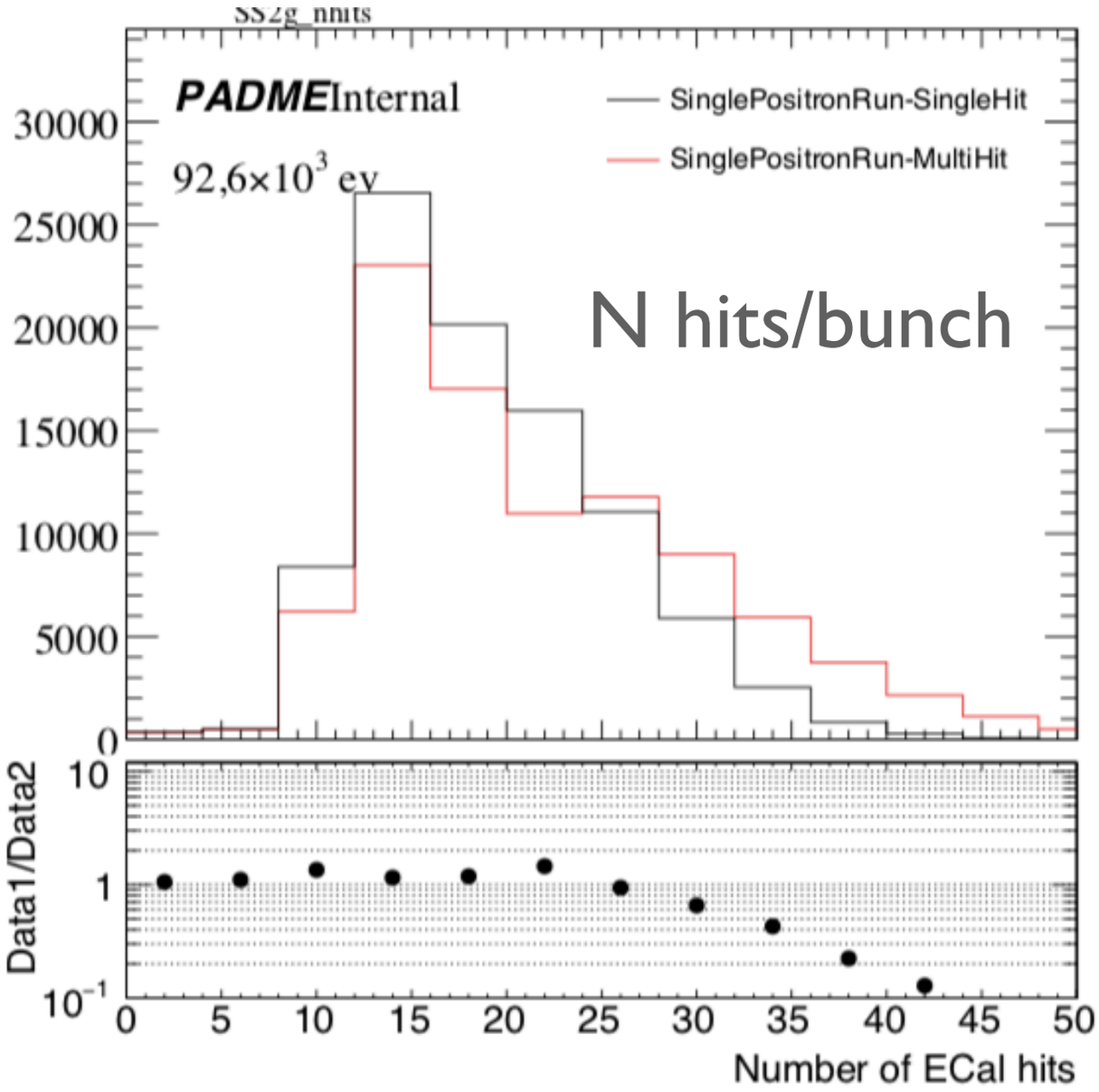


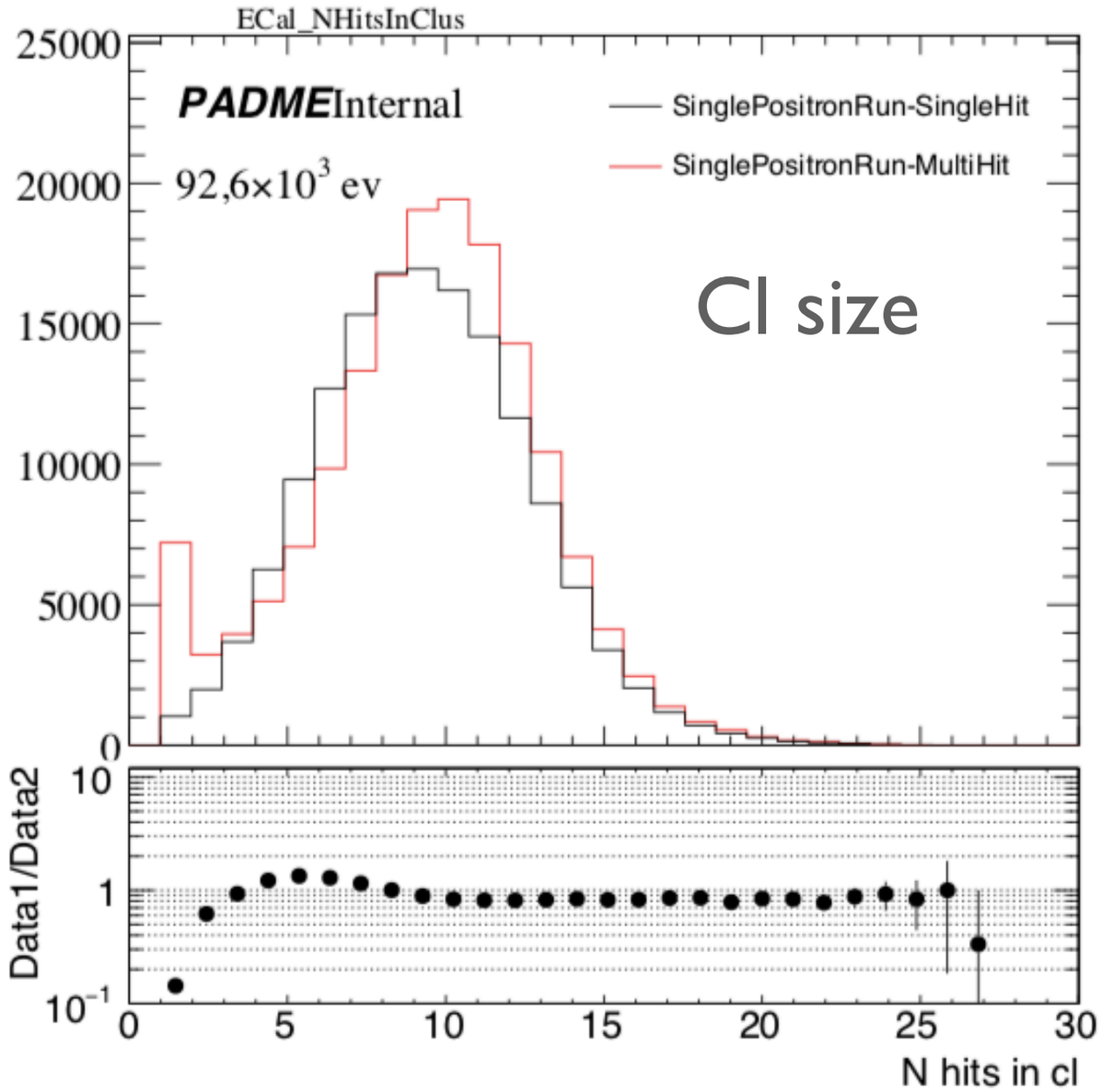






N HITS & HITS IN CLUSTER





CONSIDERATION

- Observing the resolution on EHitTot and EClTot I suppose that this algorithm is better than the single hit, but If I study the cluster energy and the cluster size I suppose that the parameters to make the cluster should be changed
  - Next test: e.g. make the cluster with a $|\Delta t| < 50$ ns

I've tried but 50 is to much! I however have always cluster at low energy and low cluster size

COMPARISON DATA MC MULTI HIT

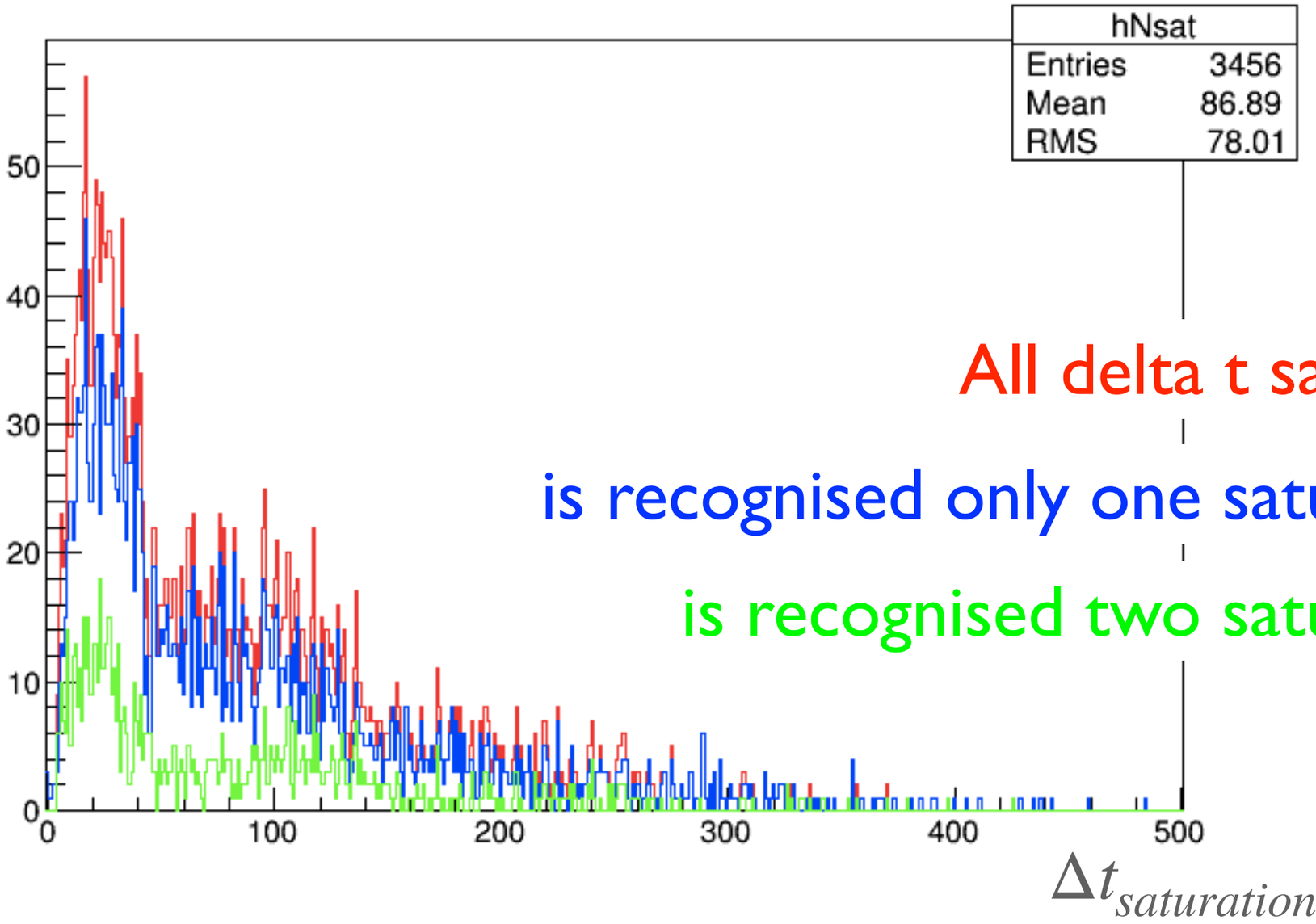
- The plot of the comparison of data and MC for the single positron condition:
  - http://www.le.infn.it/~isabella/allow_listing/multihitECAL/AnalysisHisto_singlePositron_comparisonDataMCMultiHit_correctionSmallDoubleHit_25May.pdf
- However I think that is better to implement the waveform reconstruction also for the MC and then I can compare the two samples. Factors that can make difference:
  - Saturation absence in MC
  - Perfect energy resolution in MC (also for low energy hits)

CONSIDERATION ON DATA SATURATION

Single positron run

10k ev

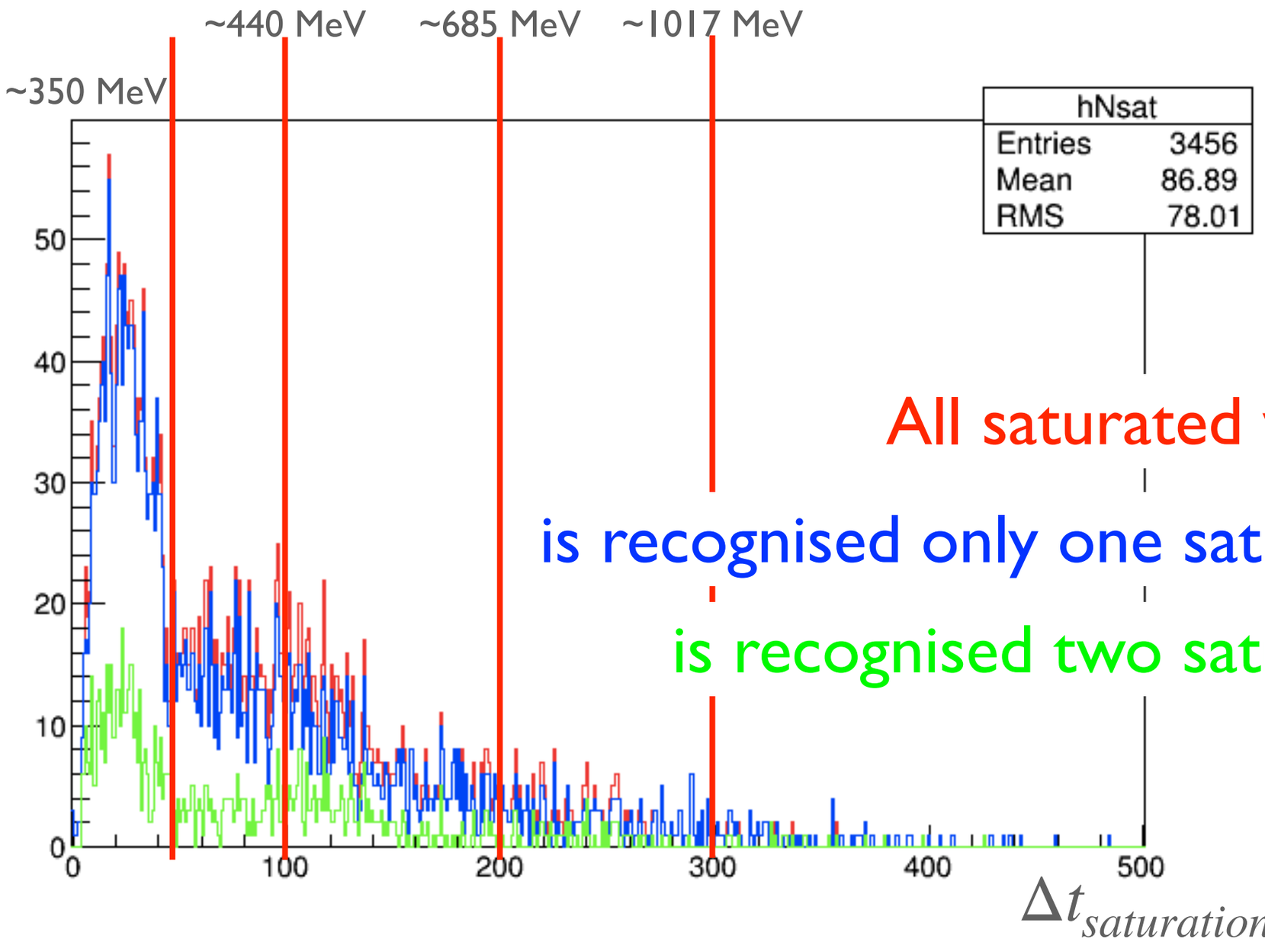
- Let's have a look on the $\Delta t_{saturation}$ (how much the waveform is saturated)



SOME CONSIDERATION

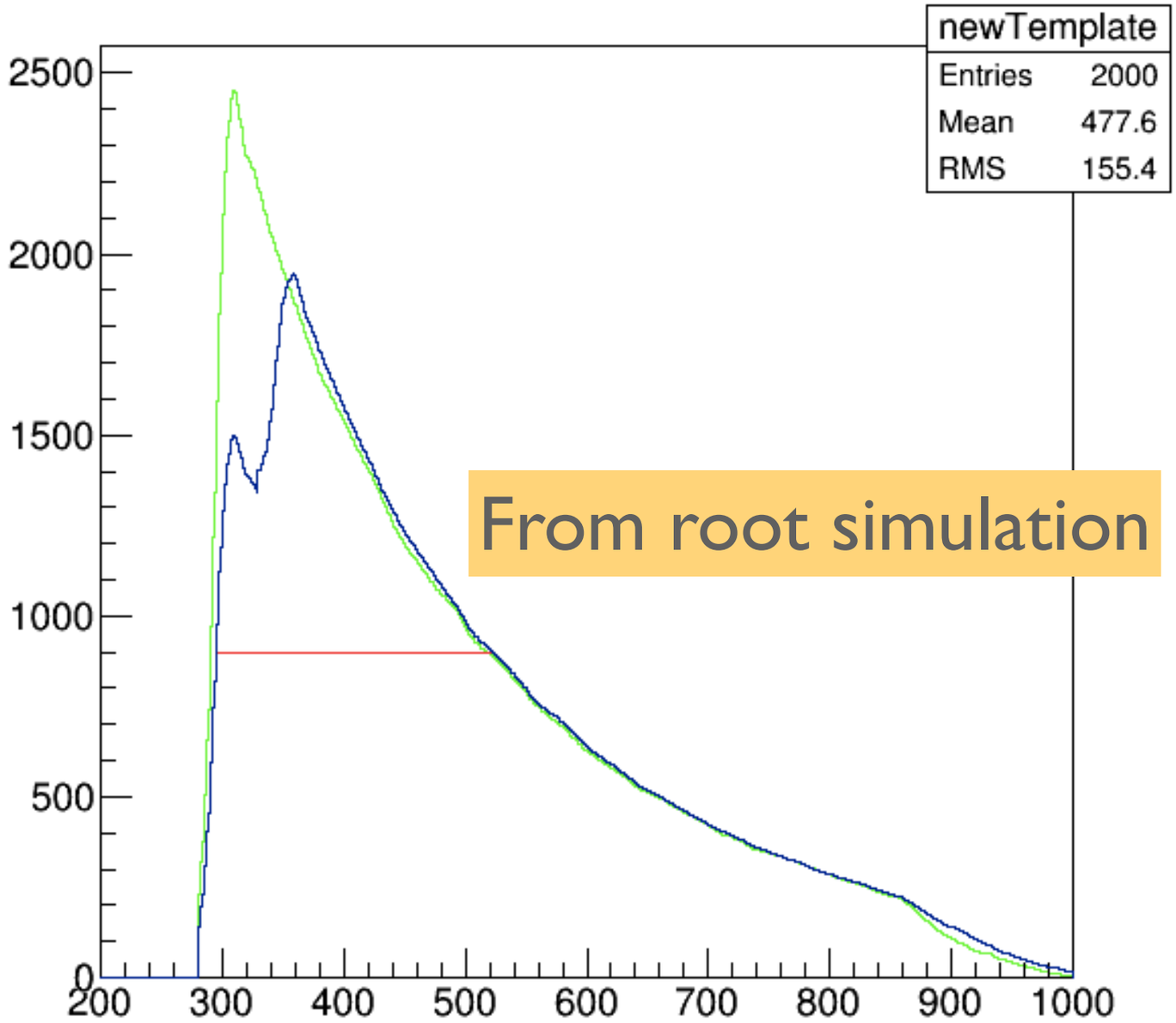
10k ev

- Let's have a look on the $\Delta t_{saturation}$



Correlation between nsat&enegy->TF1 *en = new TF1("en", "((904+ x*3.64+x*x*0.014)-1.097)/3.20", 0, 10000)

CONSIDERATION ON DATA SATURATION

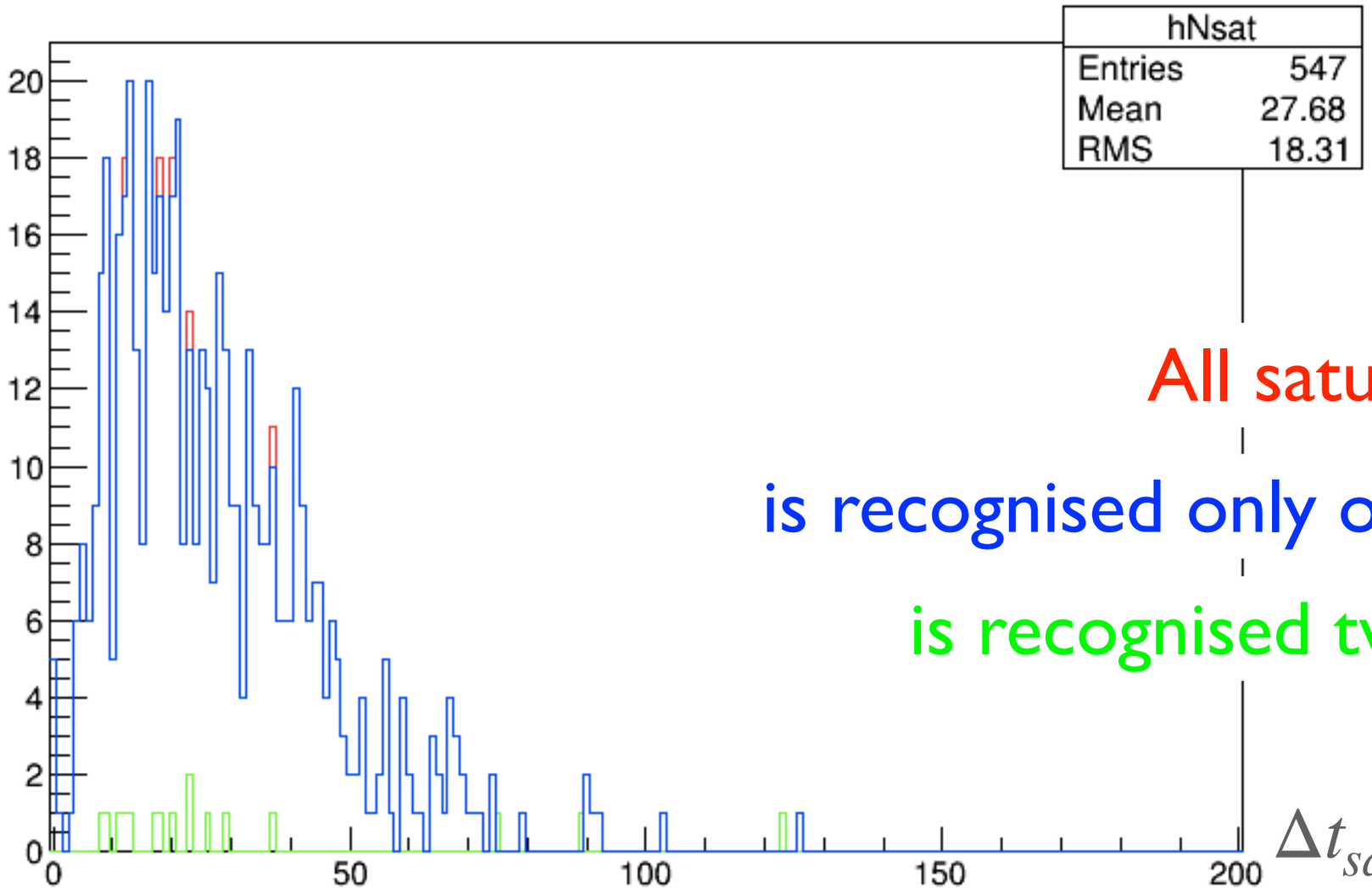


CONSIDERATION ON DATA SATURATION

July run

100k ev

- Let's have a look on the $\Delta t_{saturation}$



All saturated waveform

is recognised only one saturated hit

is recognised two saturated hit

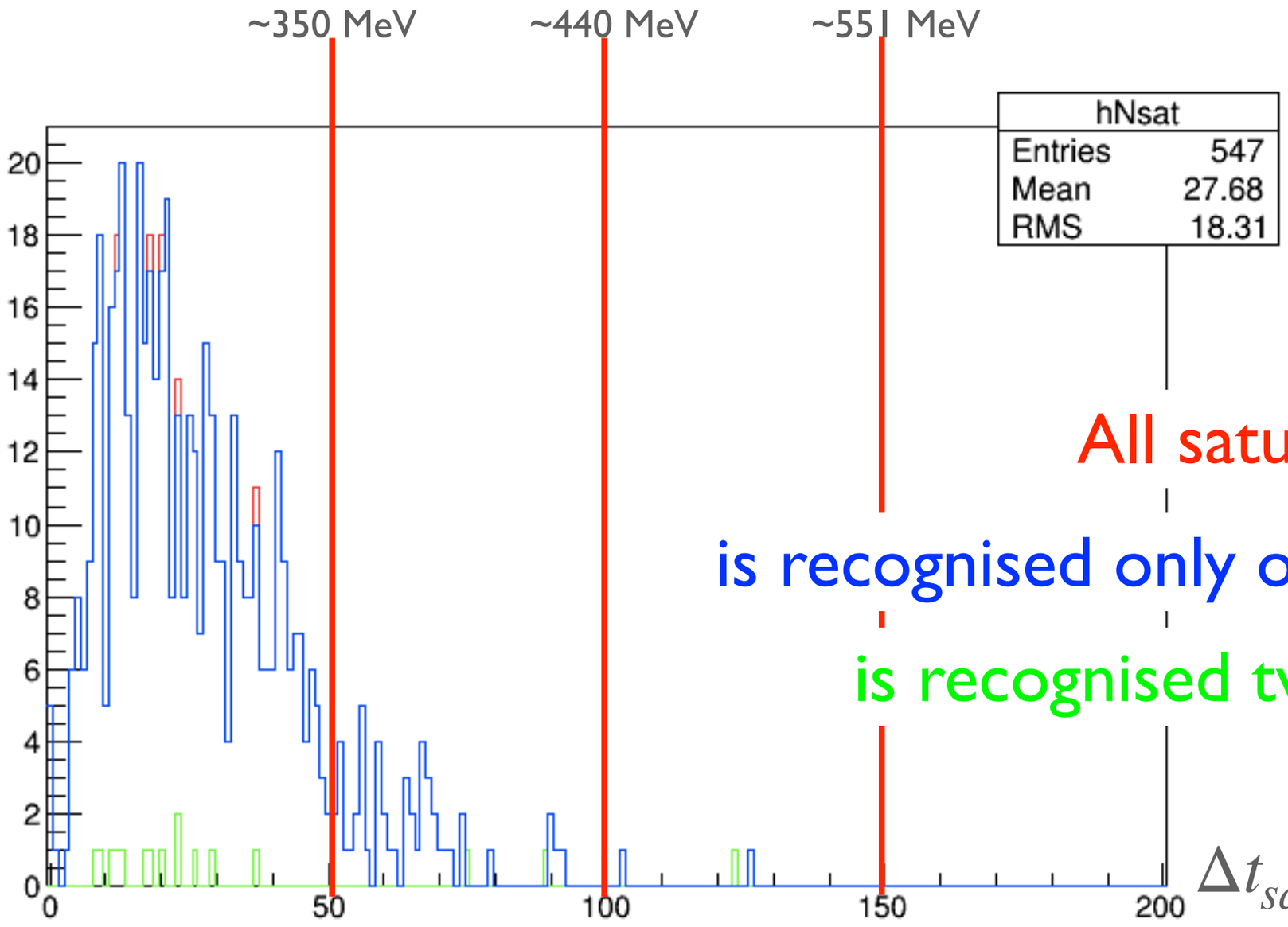
I don't see the problem described before !! (different run)

SOME CONSIDERATION

July run

100k ev

- Let's have a look on the $\Delta t_{saturation}$

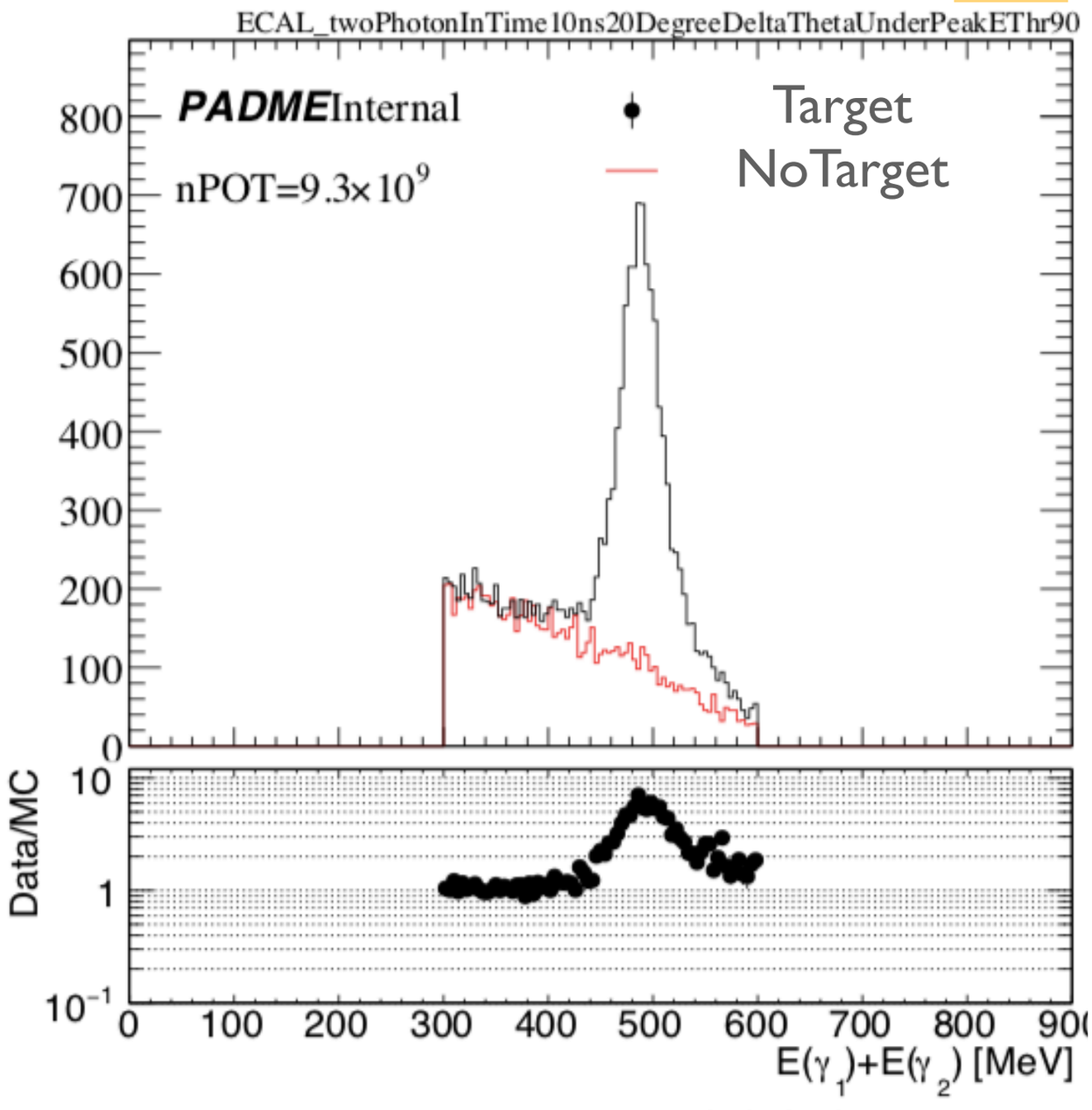


I don't see the problem described before !! (different run)

http://www.le.infn.it/~isabella/allow_listing/ggTargetNoTarget/AnalysisHisto_DataTargetNoTarget_MultiHit25May_2test.pdf

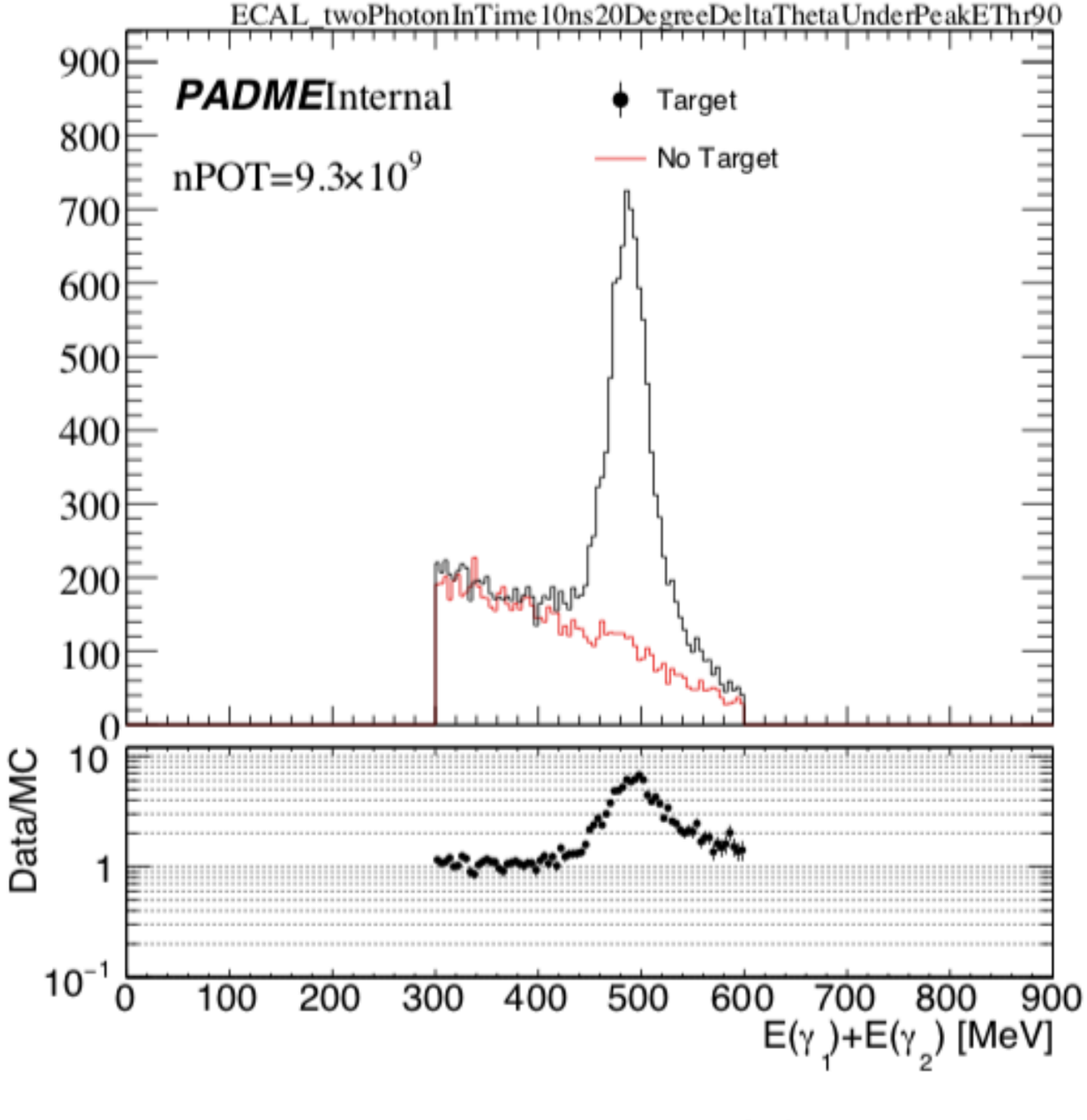
JULY RECONSTRUCTION

SH



Under Peak 8004

MH

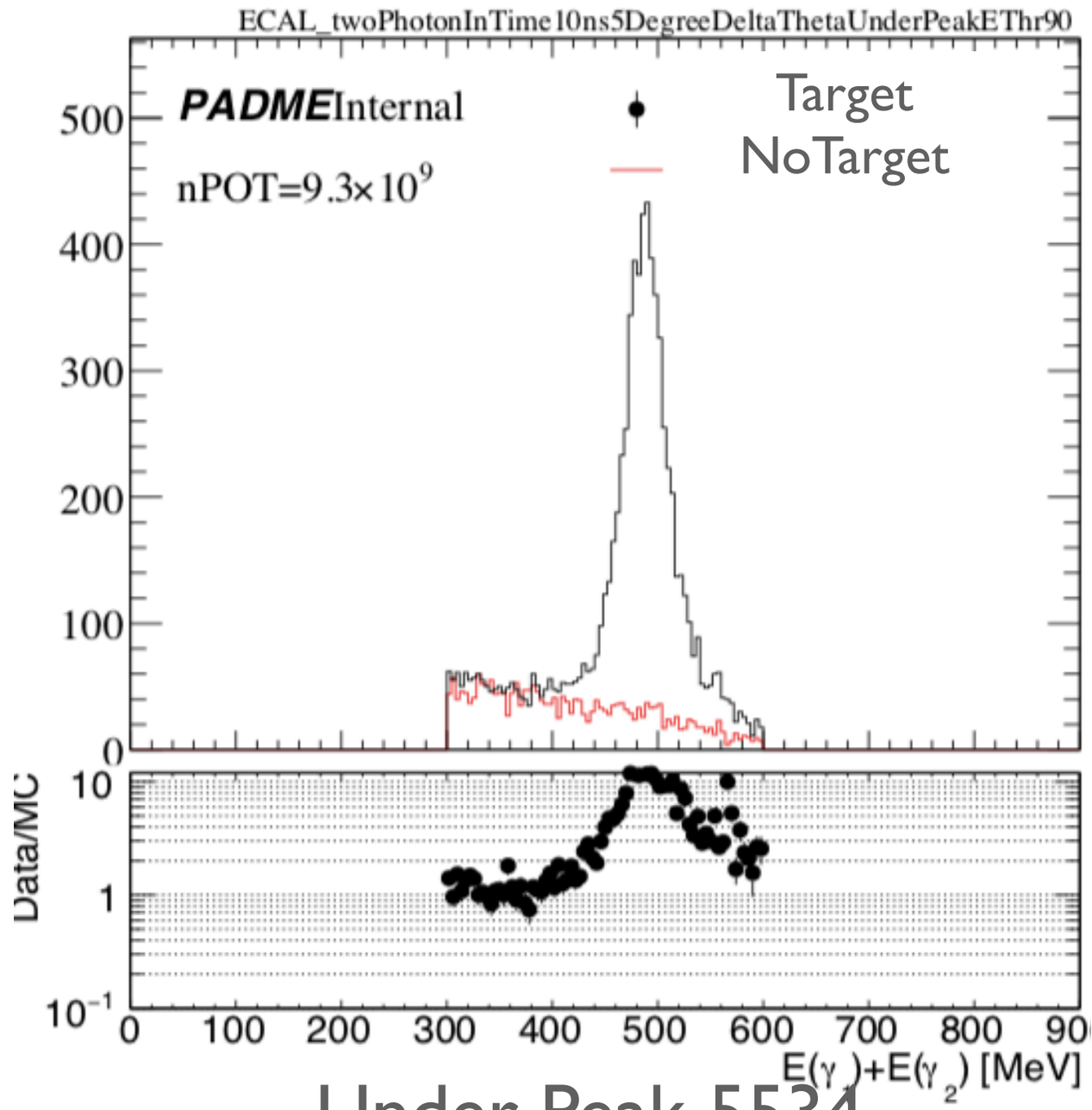


Under Peak 8071

+0.8%

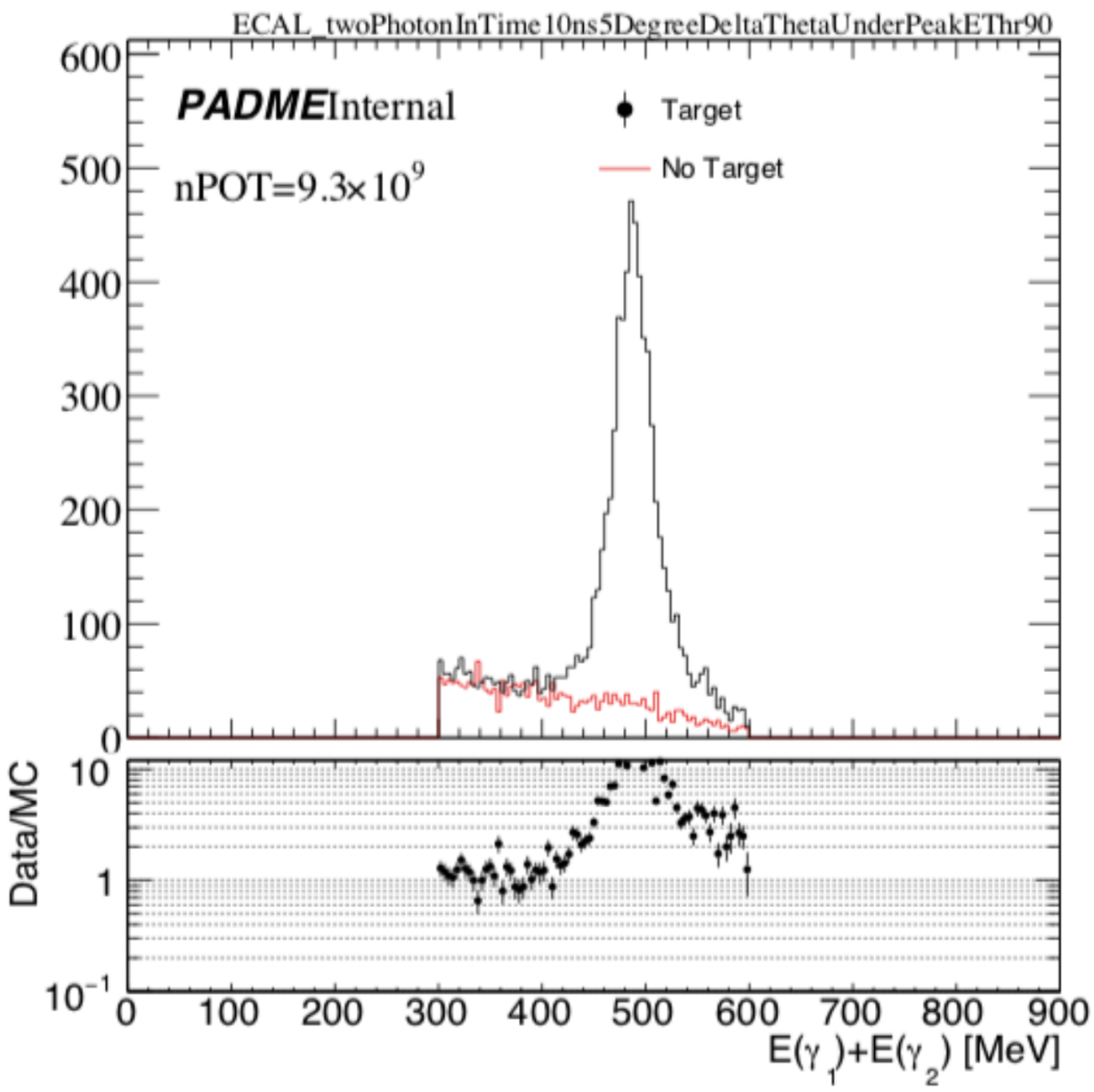
JULY RECONSTRUCTION

SH



Under Peak 5534

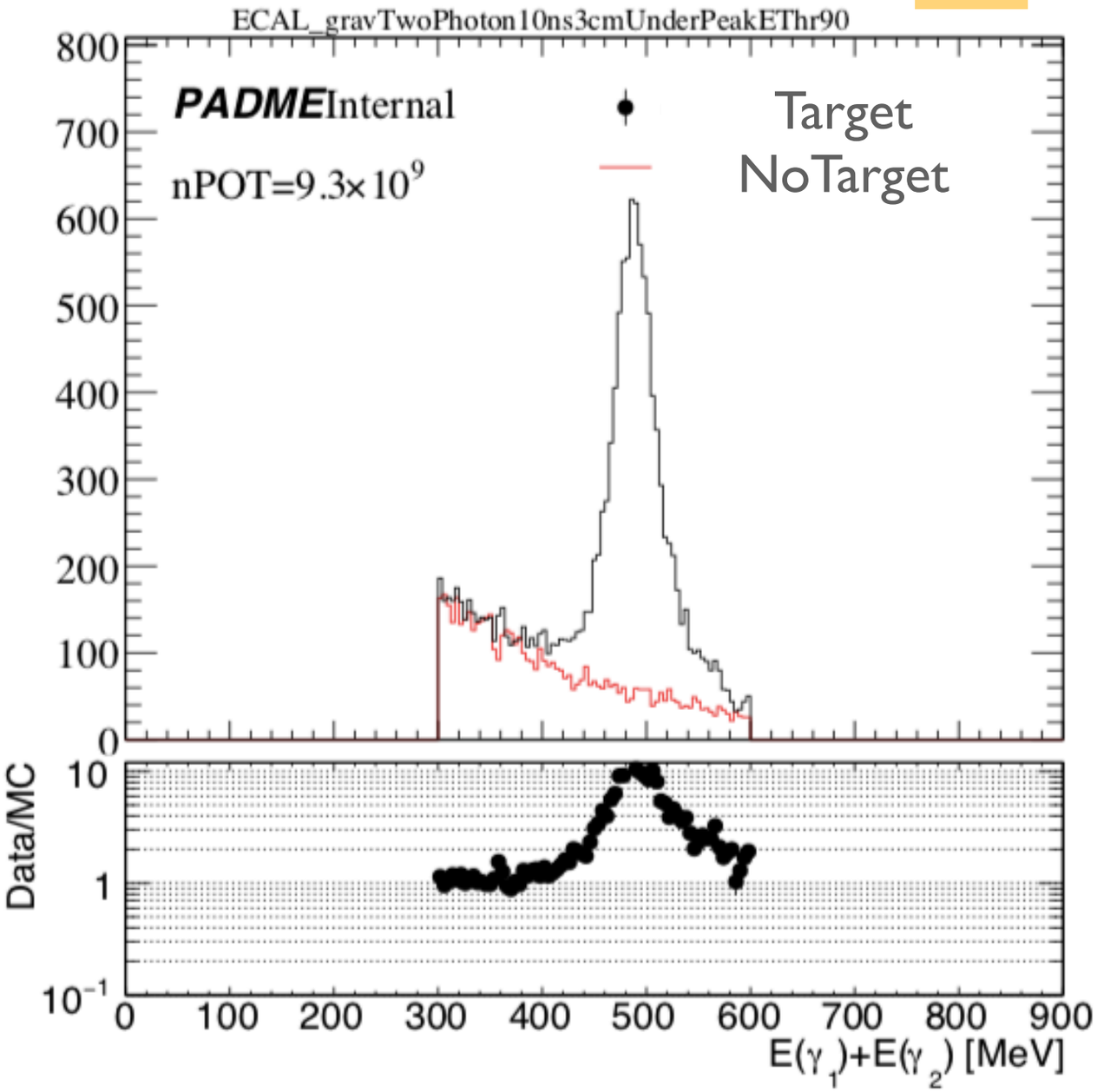
MH



Under Peak 5571

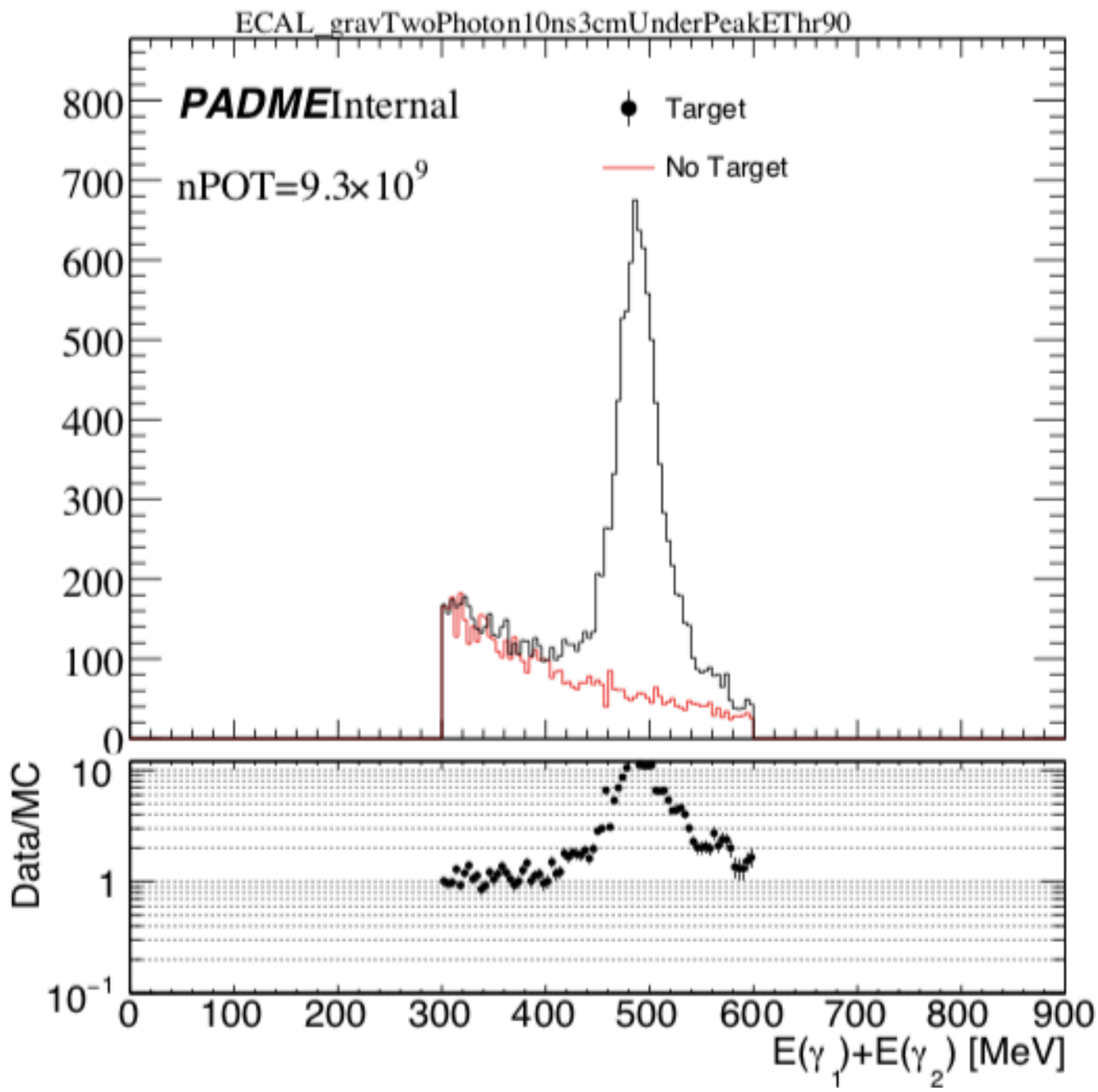
JULY RECONSTRUCTION

SH



Under Peak 8191

MH

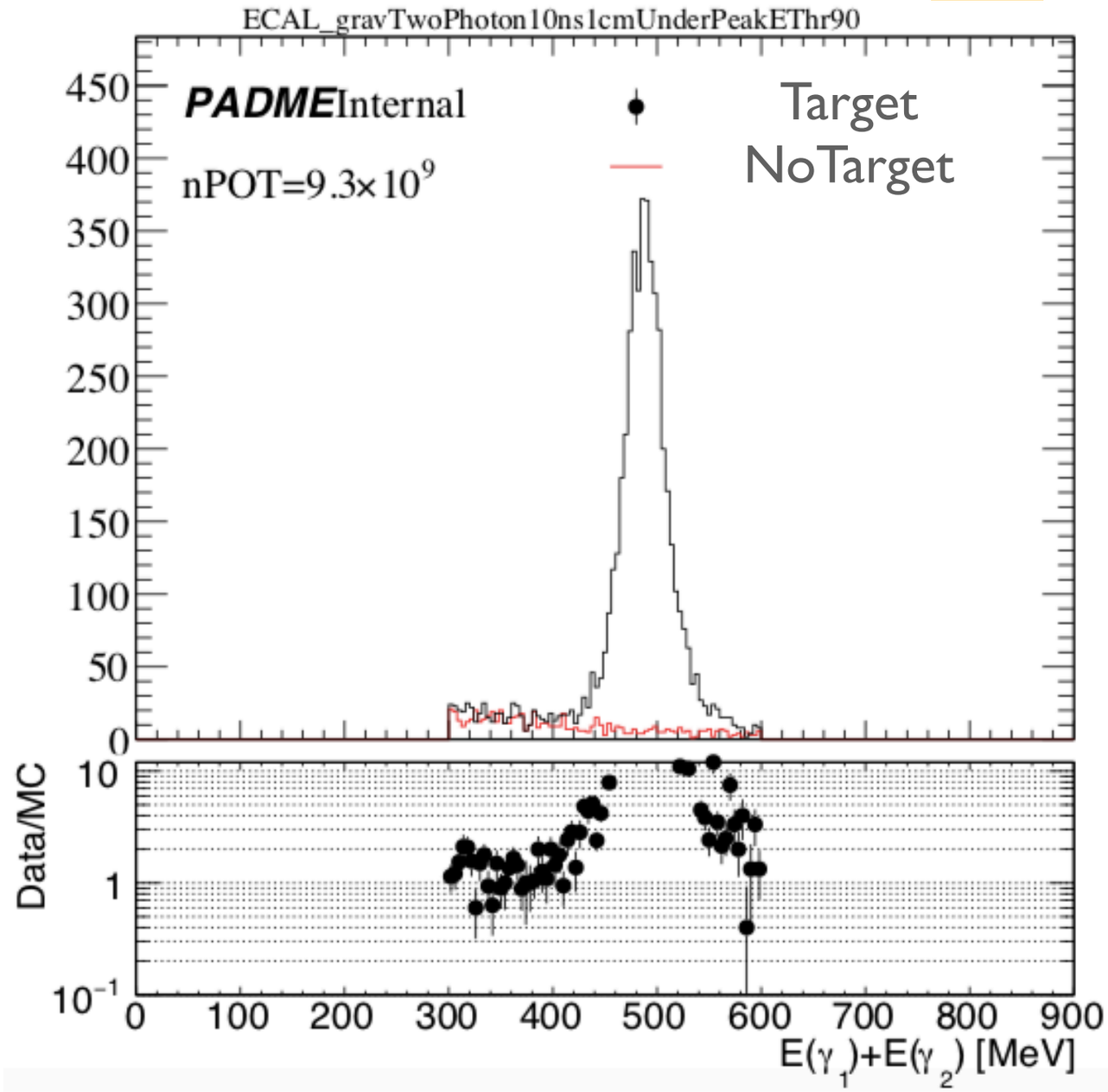


Under Peak 8269

+0.9%

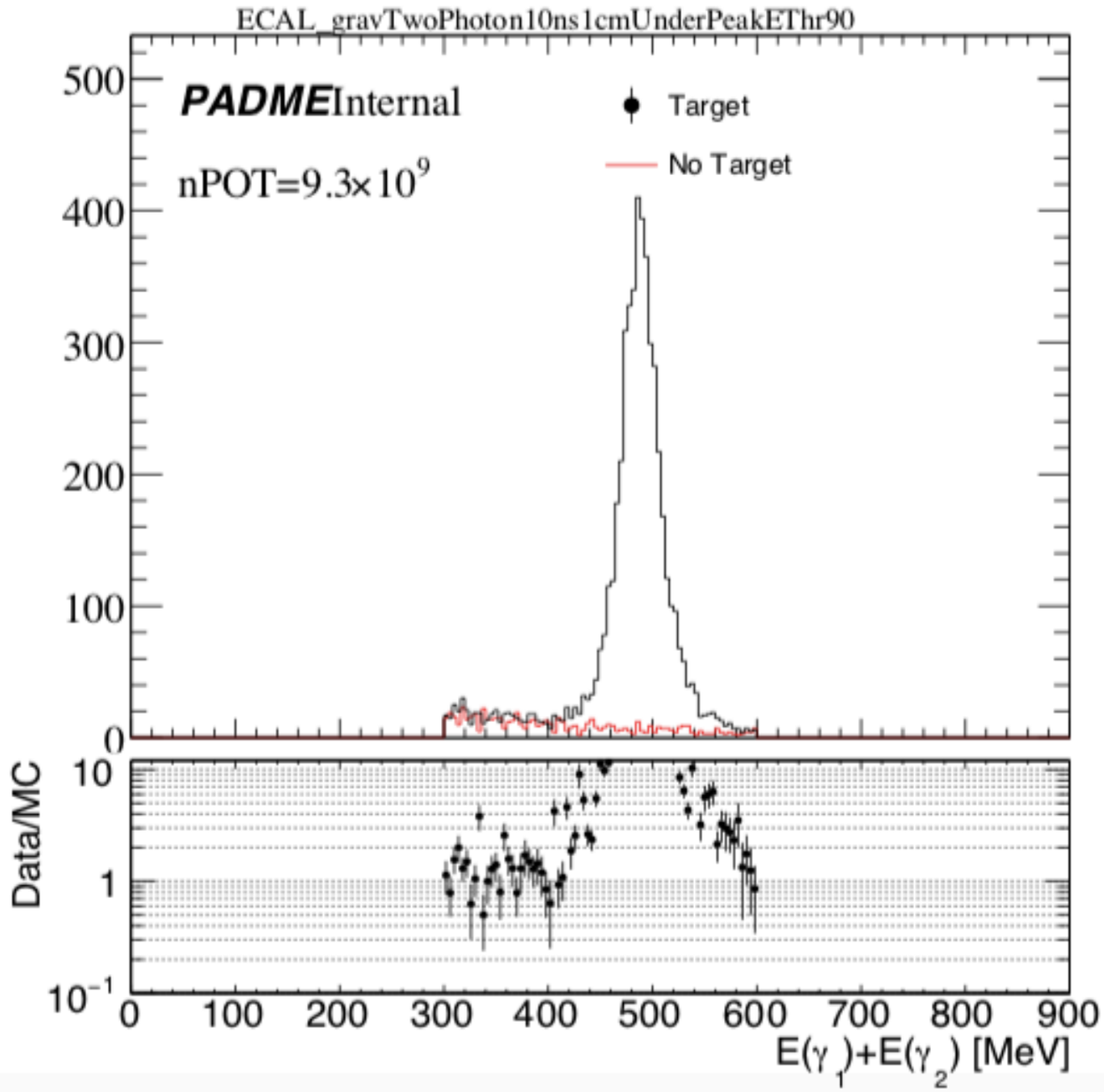
JULY RECONSTRUCTION

SH



Under Peak 4470

MH



Under Peak 4541