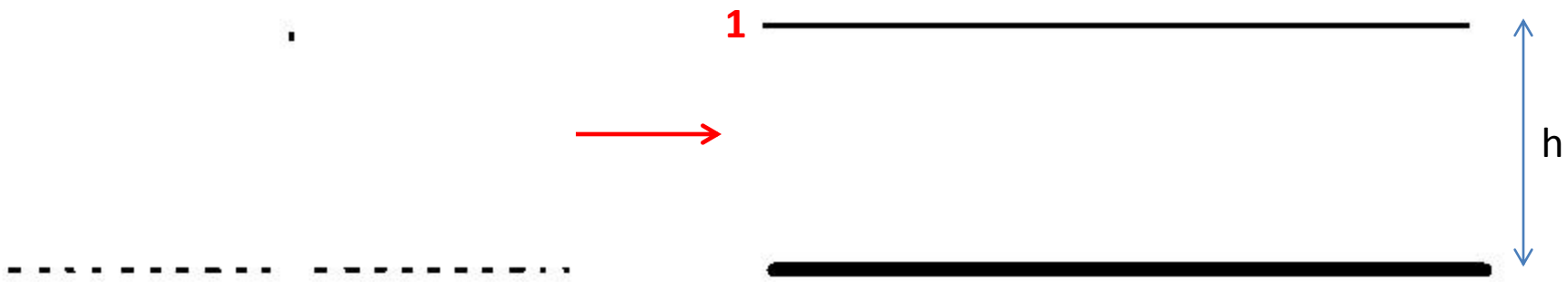
Test of Averaging & Decimation

Test # 01: A Visual Approach

The Algorithm:

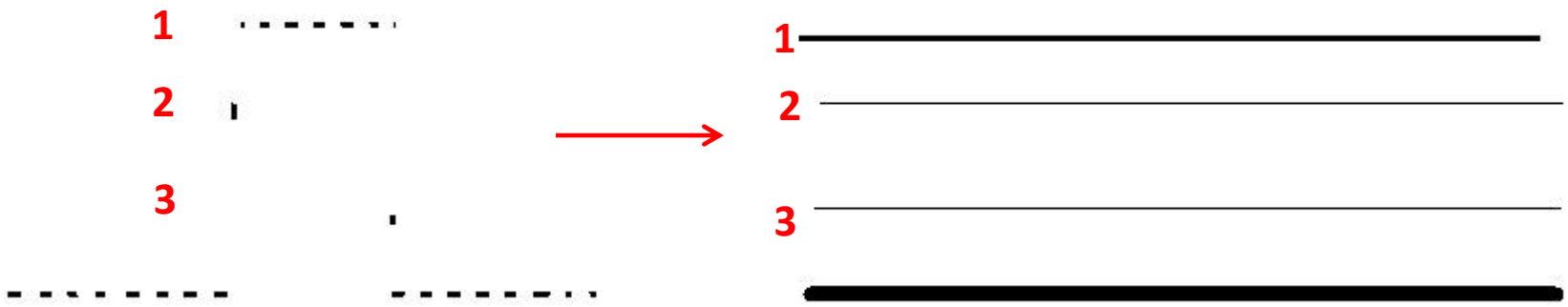
❑Suppose we have a pulse/signal like the following
Where all entries are effectively(close to) zero except one entry/point.



Where the first diagram(on left) is just one pulse. And Second diagram(on right) is what you see if you take data for certain time(in Resync mode) and plot using ROOT i.e. it will squeeze so many pulses in small a range that it will appear as just two lines , where lower one much thicker(as it contains most of the entries) than the upper.

❑Now what we are interested in is just the height of the upper line. Because, if you find the height without any averaging to be ‘h’ , then if you merge ‘x’ entries, the height of the Upper line will be shifted to ‘h/x’ .

❑Again consider that we have a pulse like the following:



Just like the previous one, the left diagram is one pulse and right one is many similar pulses (taken is Resync mode) congested in small space.
(The top of left diagram contains much more points than shown in the diagram)

❑ Now if we repeat the same procedure as before (take data with and without merging) , then in this case we would expect that no matter how many points we merge (of course it has to be very very less than the number of points on top of the pulse), height of line 1(or its center) will not be shifted but height of line 2 and 3 will be shifting depending on how many points we are merging.

❑Now the situation explained in the last two slides are the ideal situation. But in practice for any sharp signal there will be reflection. However we still can reproduce the essential features that we are interested in.

❑Run Configuration: The DAQ is running at 50KHz, hi resolution mode, Resynchronized mode, Triggered on rising edge and configured to take 700 entries per event.

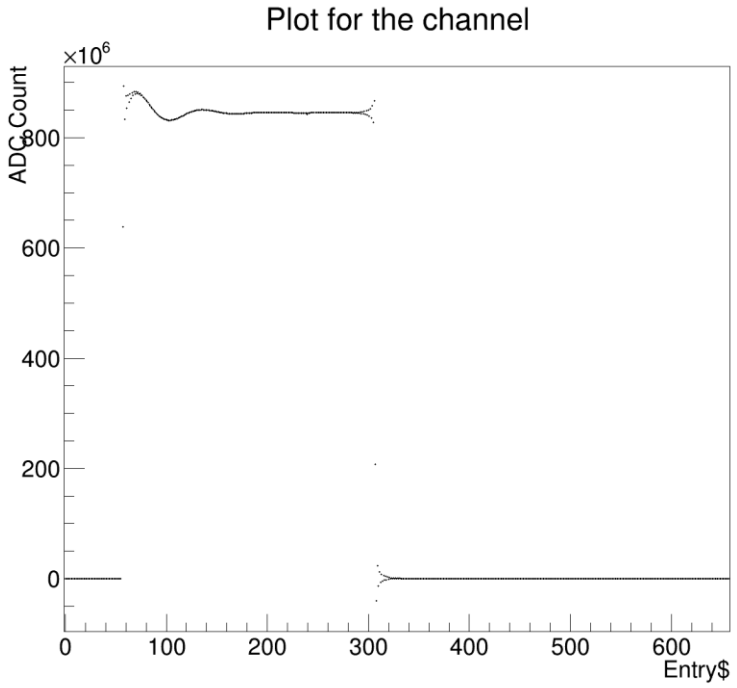
❑Input Signal: Pulse of height 4 V (i.e. upper limit=4V, lower limit=0 V) and sharp slope. I just adjust the width to 5mili sec (to produce second situation) and then to 10 micro sec(to produce first situation).

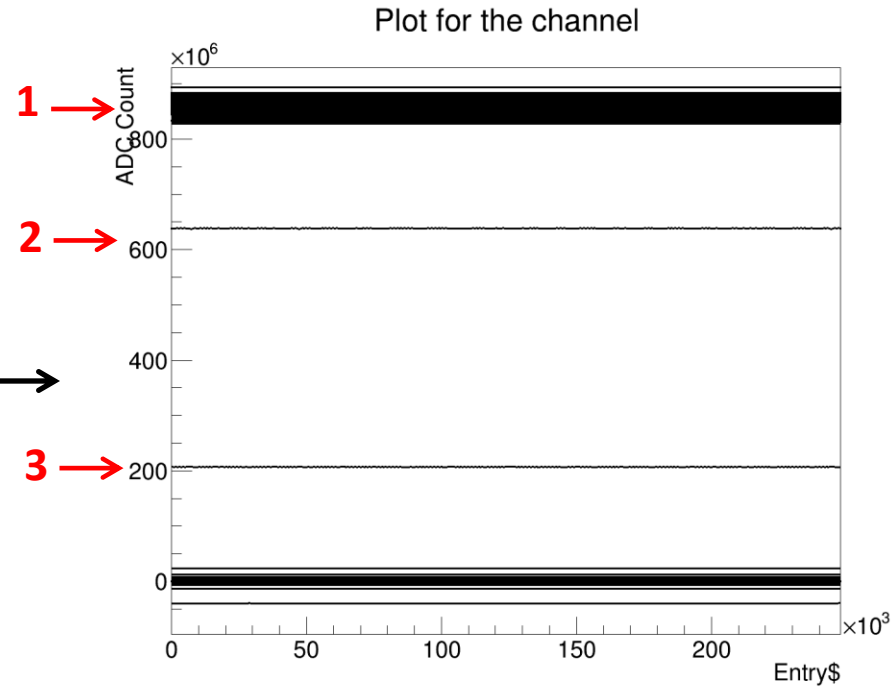
❑Notation: The parameter to be tune for merging is: nacc=n,d . Where n = number of points To be merged, d= the number by which the ADC value to be divided to adjust the amplitude. 'd' needs to be power of 2. Through out the test I take n=d=1,2,4,8,16,32,64

❑Result: I present the result for second situation (Line 1 does not shift but 2 and 3 will be shifting), then I present the result for first situation (Line 1 will be shifting where we want it to be shifted by merging points).

nacc=1,1 , Signal width=5milli sec

Signal height= Line 1 height = 4 V = ~ 850 x 10^6 ADC count



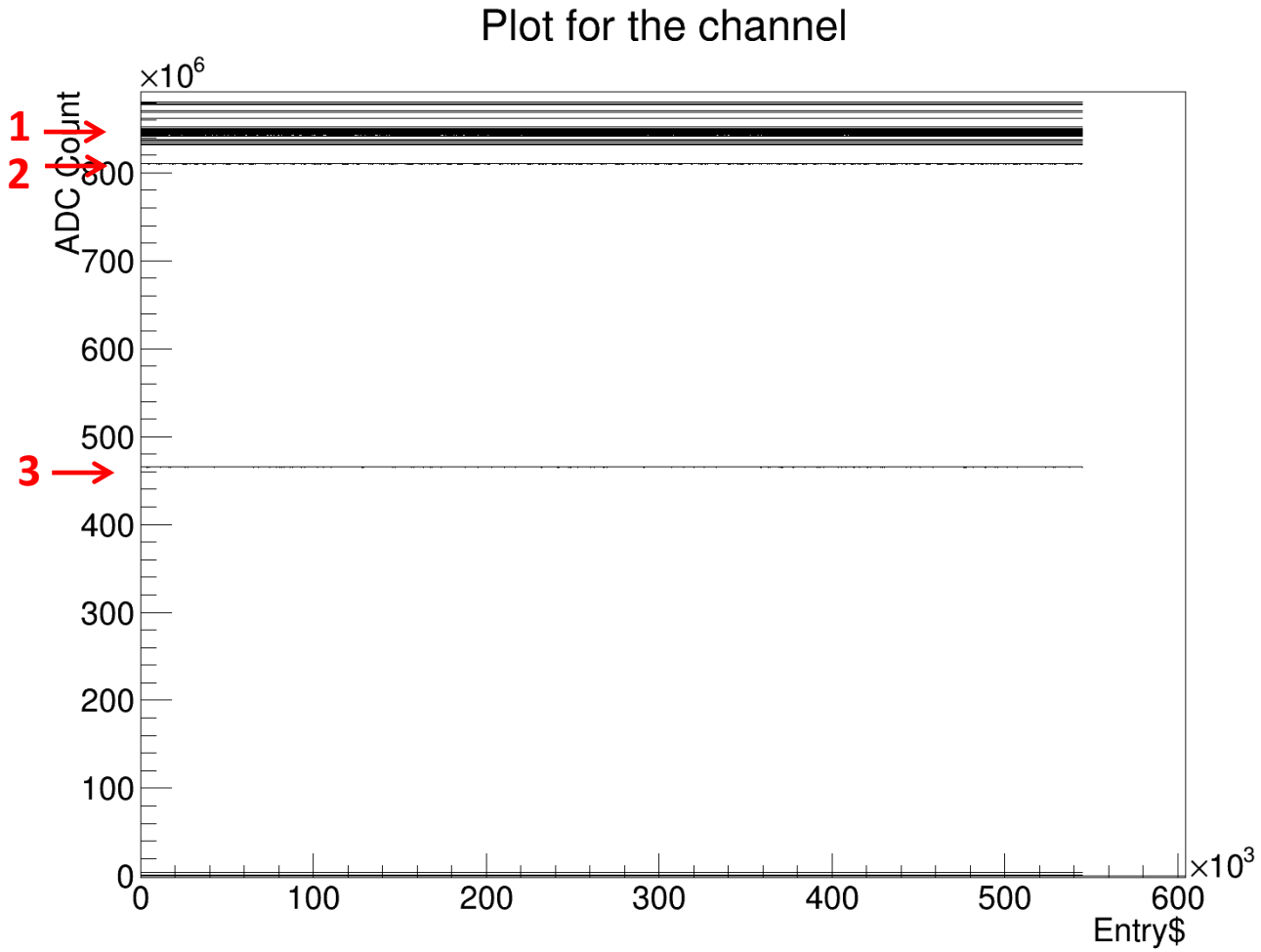


Note: The pulse on the left has one entry each on rising and falling edge

Notice the height of line 1, 2 and 3

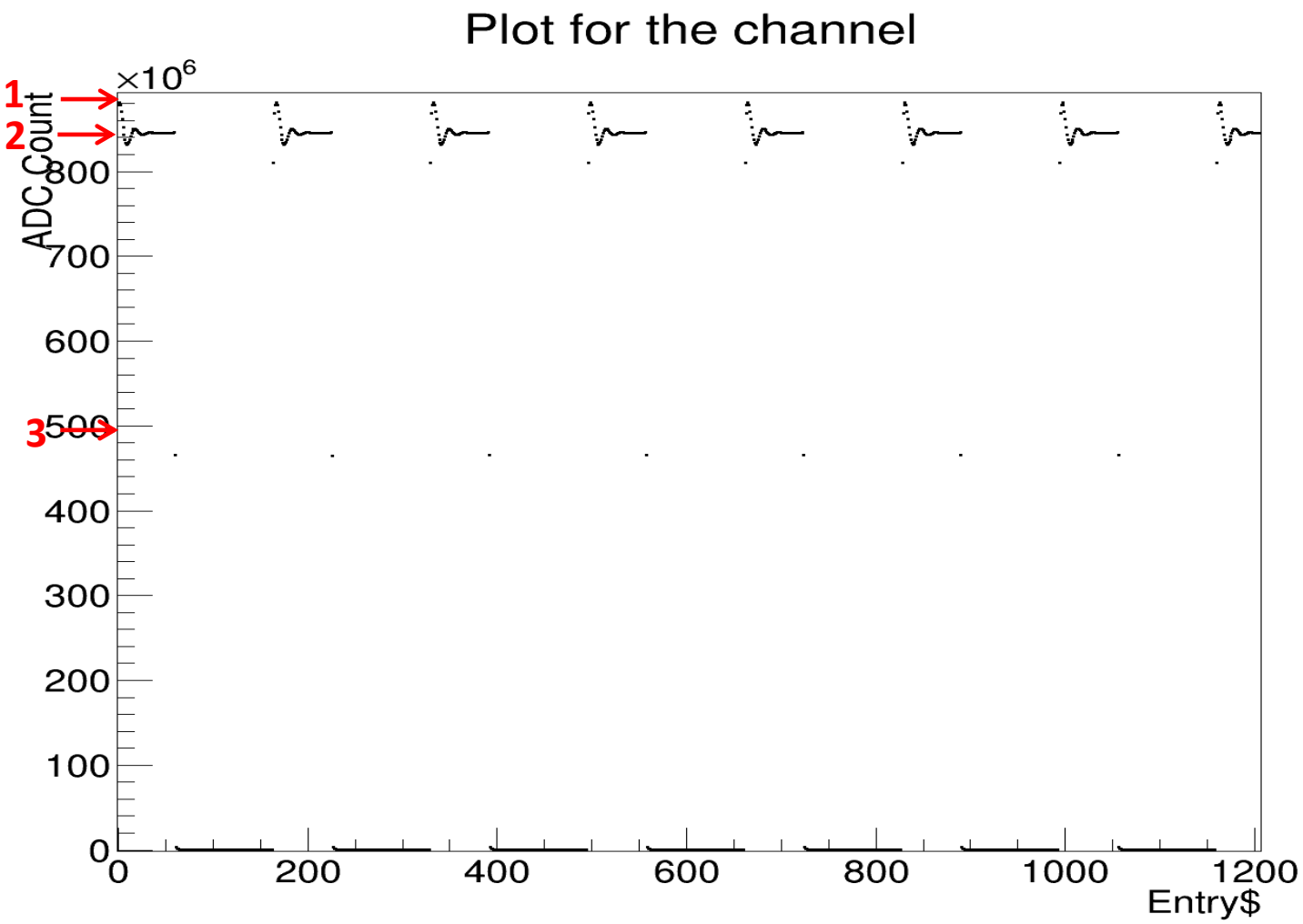
nacc=4,4 , Signal width=5 milli sec

Signal height= Line 1 height = 4 V = ~ 850 x 10^6 ADC count



Note that height of line 1(i.e. its center) is same but that of line 2 and 3 are shifted, Line 2 in the upward and line 3 in downward direction as expected (most likely case) from last slide.

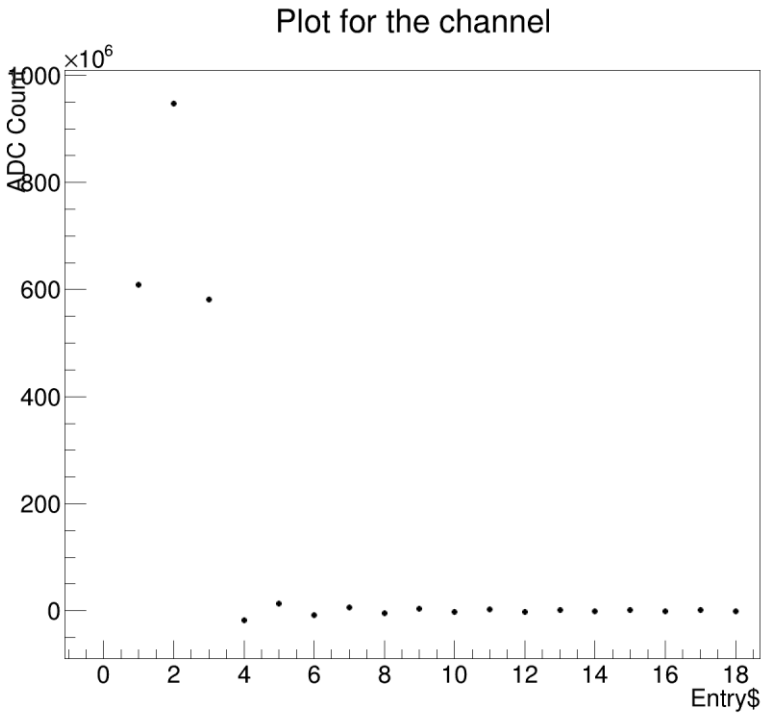
nacc=4,4 , Signal width=5 milli sec
Signal height= Line 1 height = 4 V = ~ 850 x 10^6 ADC count

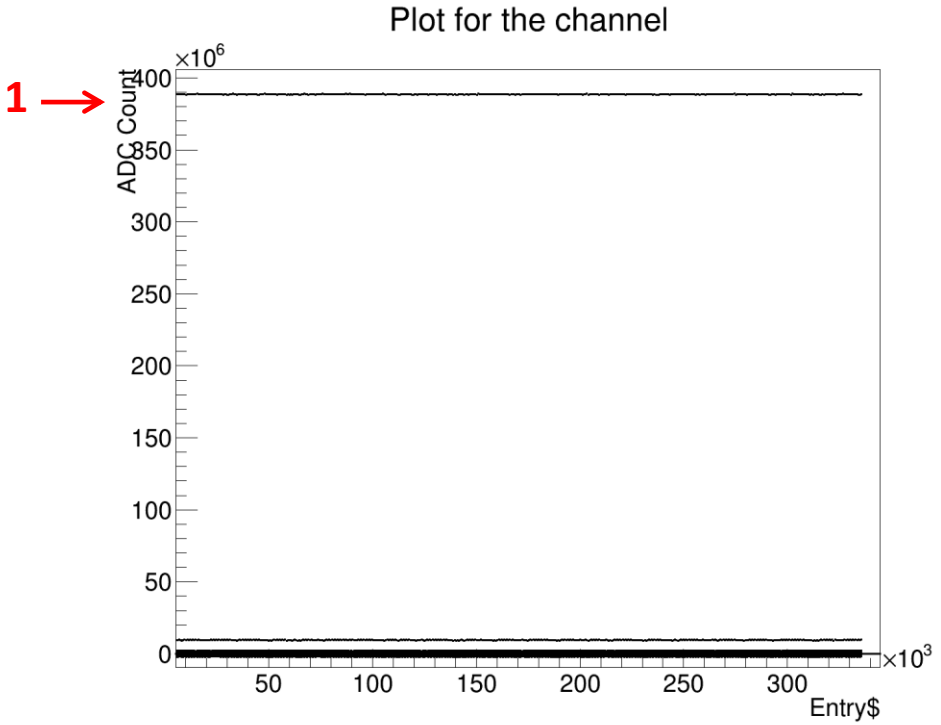


This is Zoomed version of last slide

Now We consider the first case (one entry in the pulse with very high ADC value above zero) which is more specific than second case.

nacc=1,1 , Signal width= 10 µsec on right
Signal height= Line 1 height =~ 400 x 10^6 ADC count



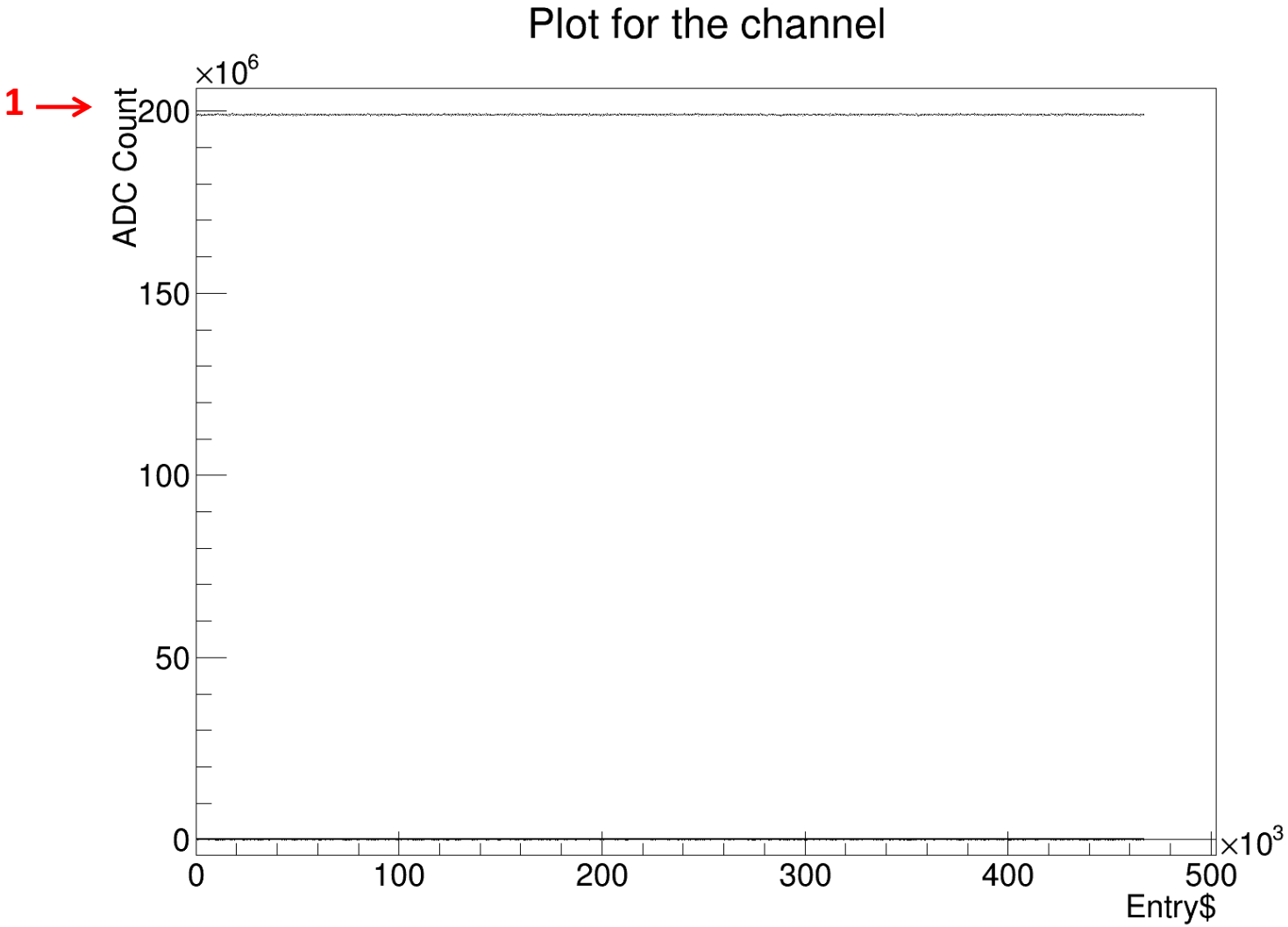


One pulse with 50 µsec width,
has three entries above zero

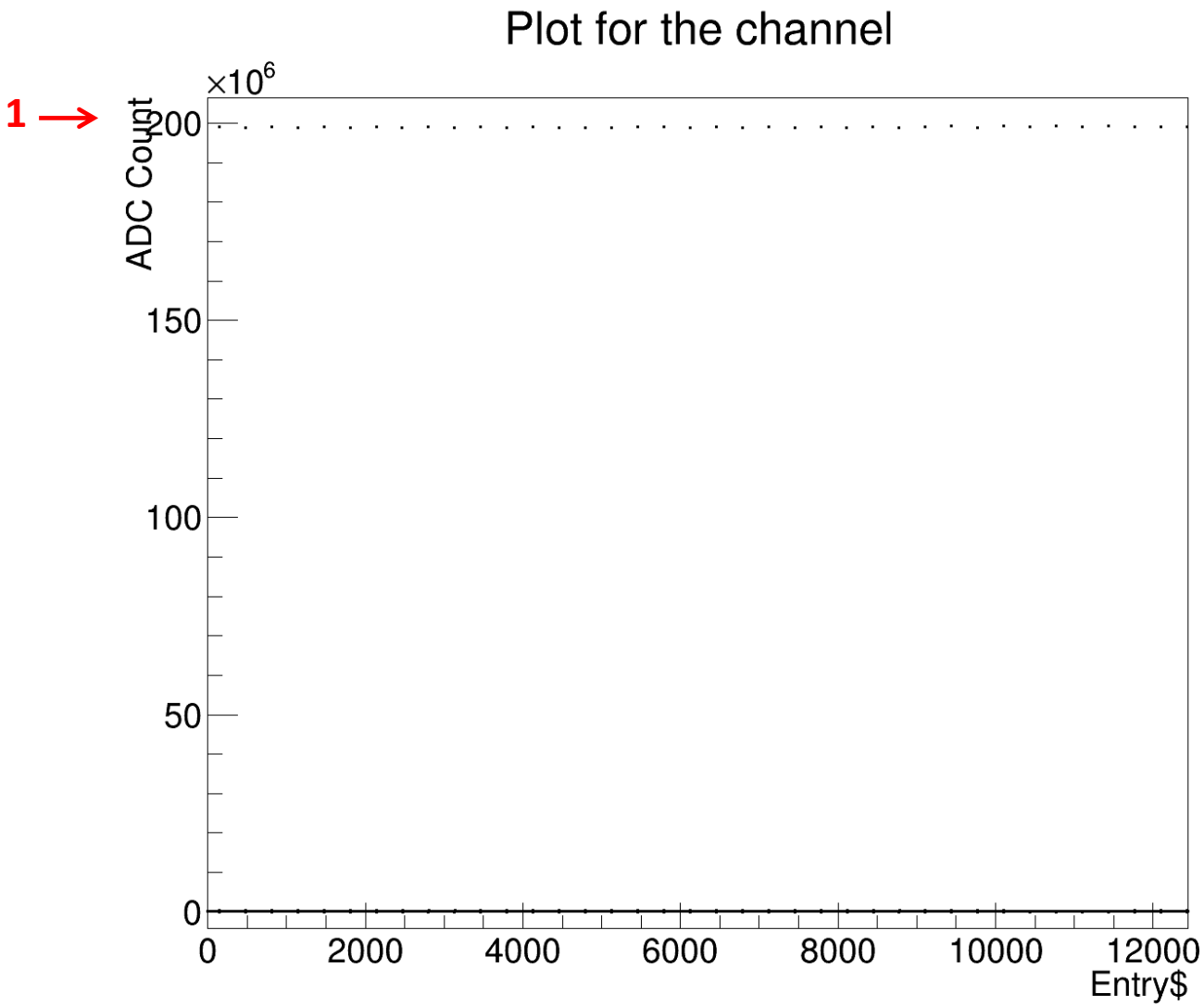
Many pulses with 10 µsec width,
Has only one entry above zero

Notice the height of line 1

nacc=2,2 Signal width= 10 µsec
Signal height= Line 1 height =~ 200 x 10^6 ADC count



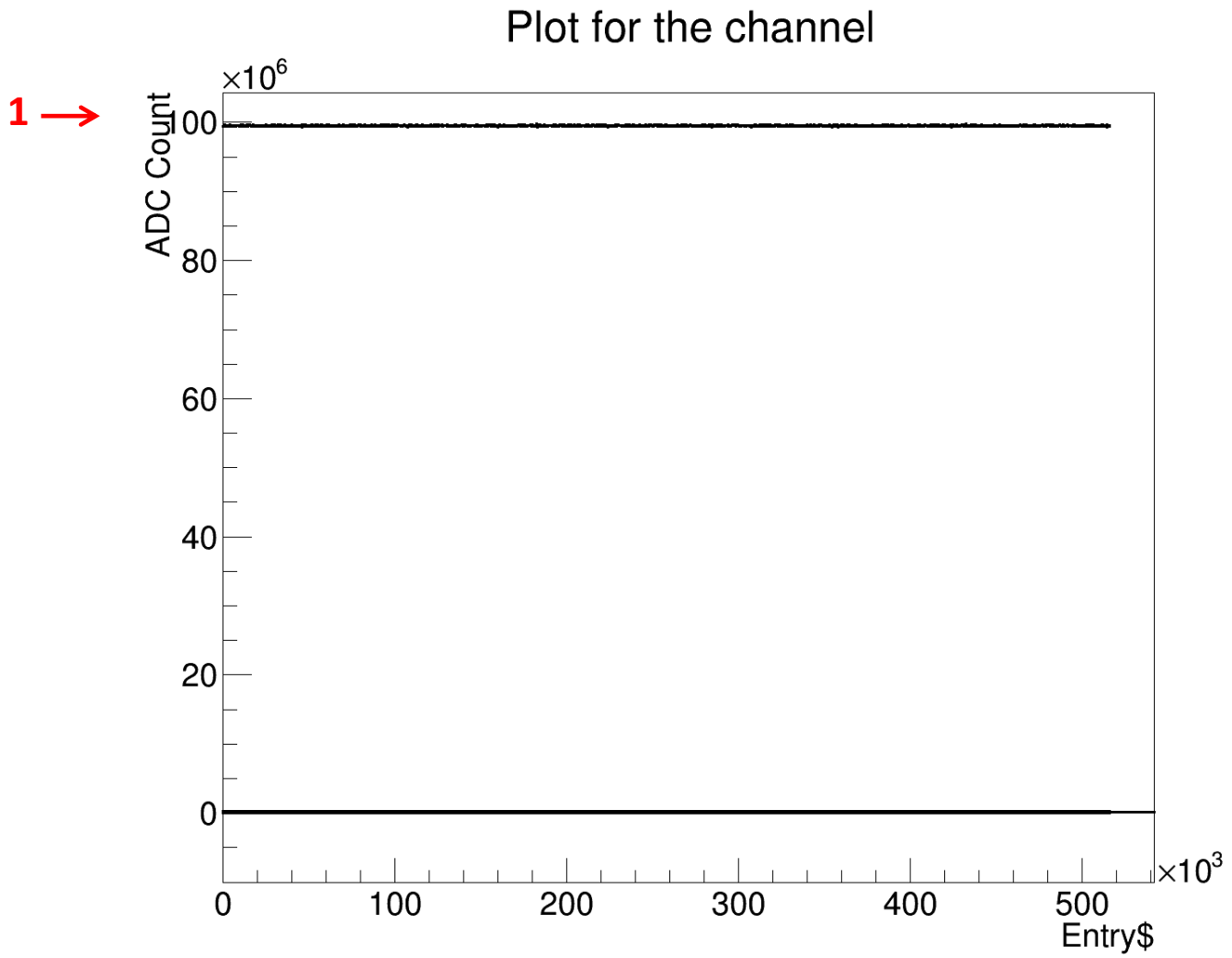
With nacc=2,2 the height becomes half of the height with nacc=1,1



Zoomed version of previous plot

nacc=4,4 Signal width= 10 µsec

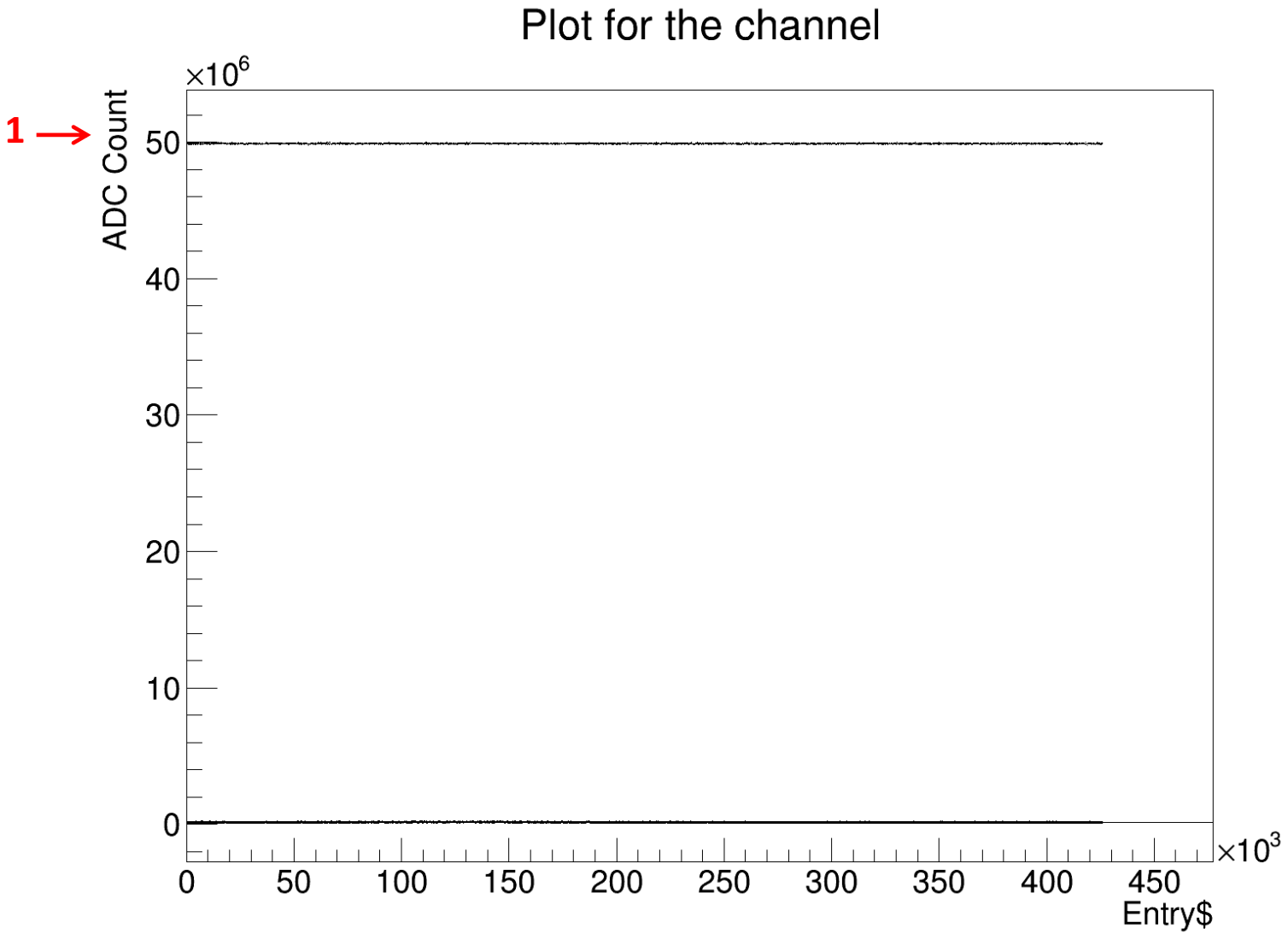
Signal height= Line 1 height =~ 100 x 10^6 ADC count



With nacc=4,4 the height becomes half of the height with nacc=2,2

nacc=8,8 , Signal width= 10 µsec

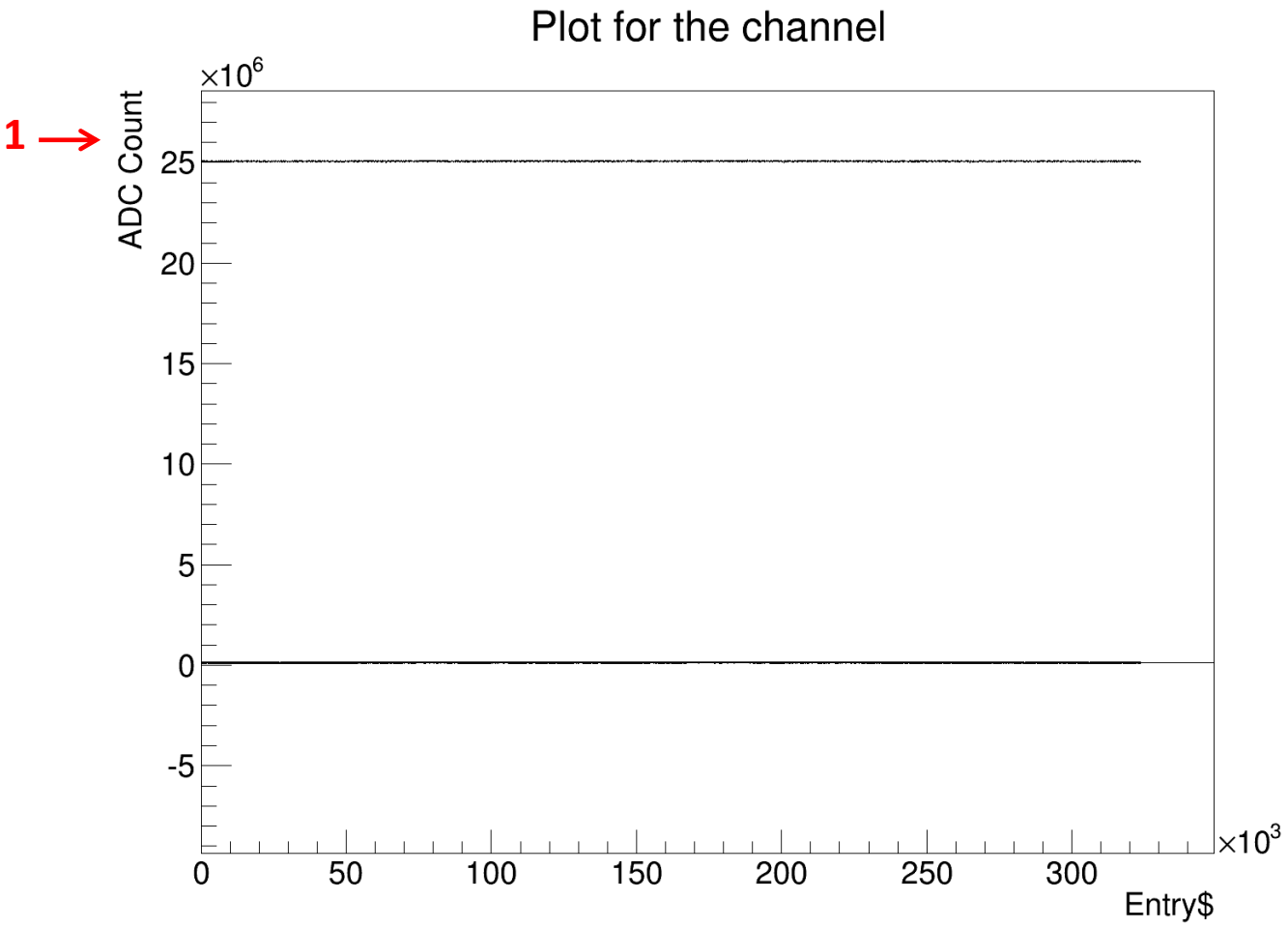
Signal height= Line 1 height =~ 50 x 10^6 ADC count



With nacc=8,8 the height becomes half of the height with nacc=4,4

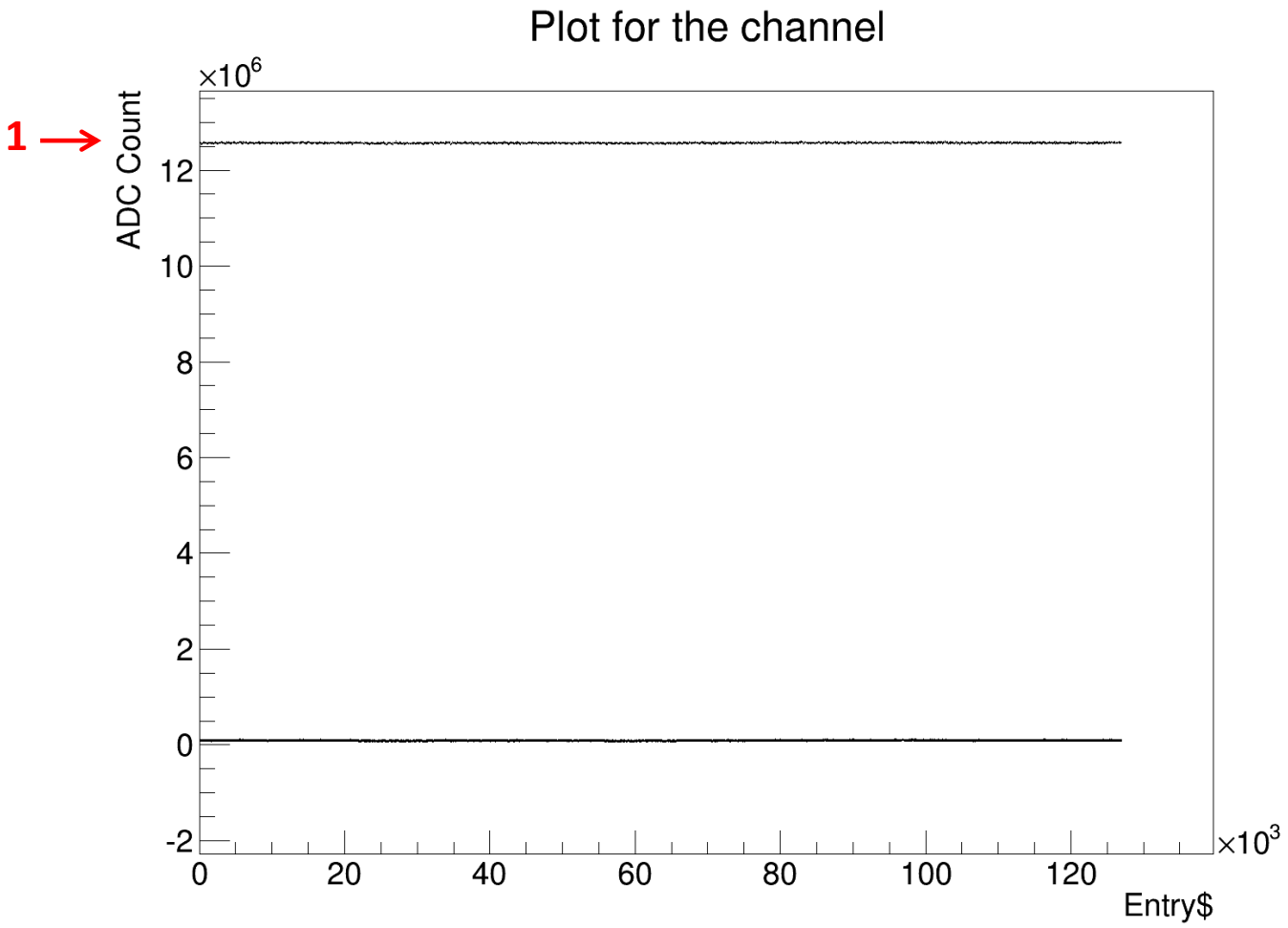
nacc=16,16 Signal width= 10 µsec

Signal height= Line 1 height =~ 25 x 10^6 ADC count



With nacc=16,16 the height becomes half of the height with nacc=8,8

nacc=32,32 , Signal width= 10 µsec
Signal height= Line 1 height =~ 12.5 x 10^6 ADC count



With nacc=32,32 the height becomes half of the height with nacc=16,16