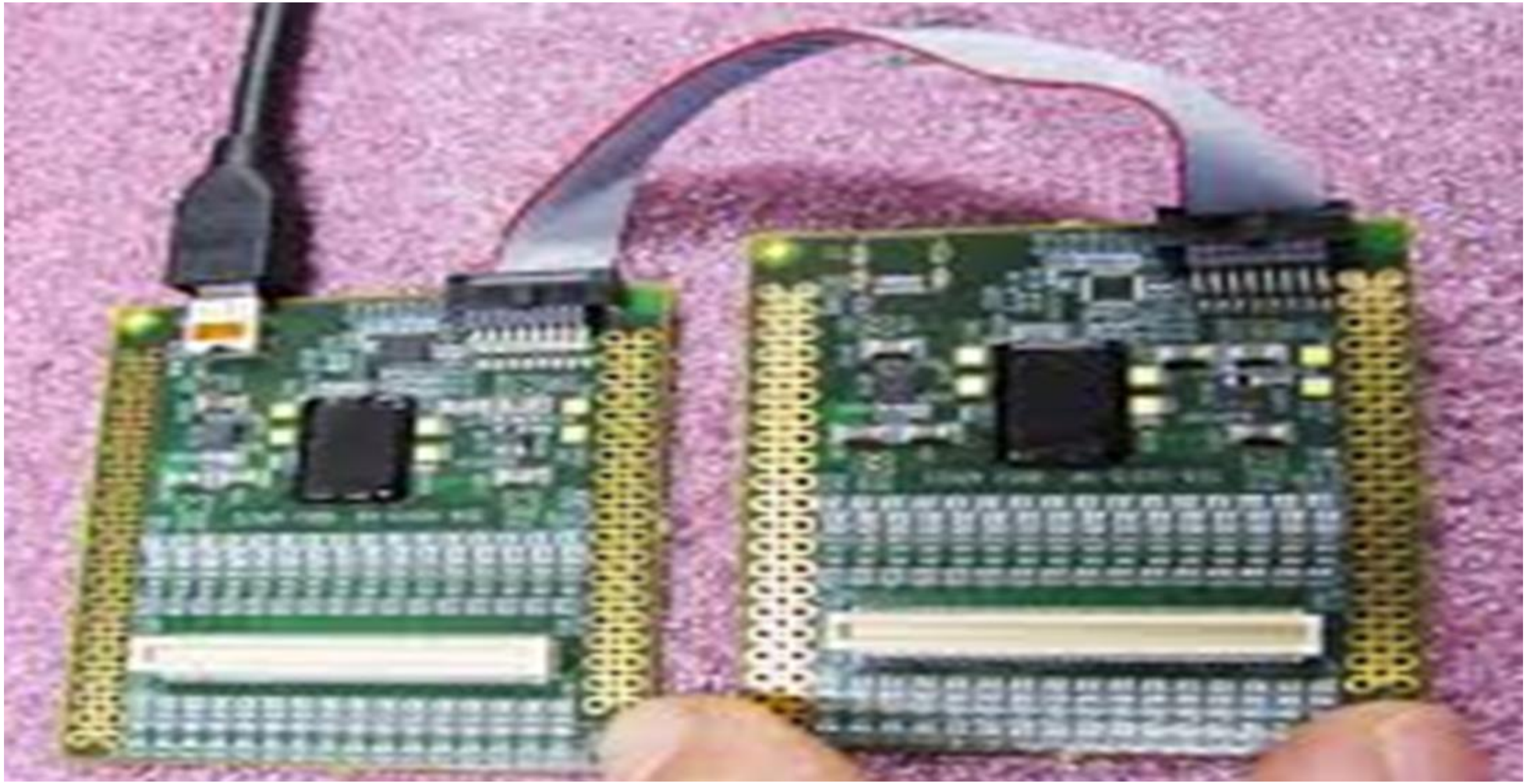
APV test – signal divider.



The goal

- In the system we're working with, there are 128 (0-127) channels conducting the signal. (we call them "main channels")
- Every one of those channels goes thru 2 APVs
- One to read the original signal, we call it "REG".
- And the second one divides the signal, we call it "DIV".

- The first goal is to find the ratio between the two APVs.
- The second goal is to confirm the wave matches the shaping formula.

The system

- The APV is connected to an Oscilloscope with a wave generator, and the signal goes thru 3 voltage dividers (20dB each)

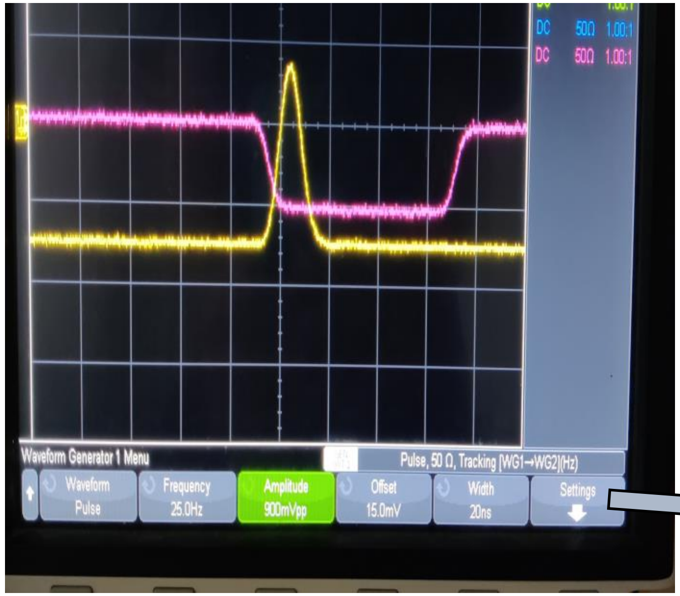
- the APV takes a sample every 25ns for each channel, and all 21 samples are called an event.

- The APV is connected to an SRS which transmits the data to the computer.

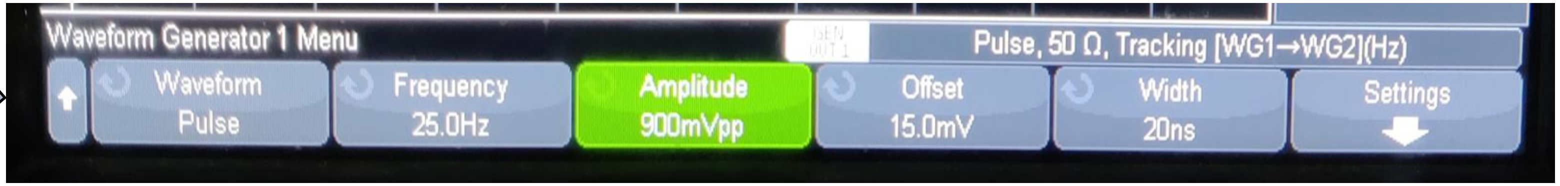
- The data is saved on the computer as ROOT files using the “mmDaq” software.

- The trigger is set to save every event which has at least one sample above a certain threshold.

The system



- The yellow pulse is the signal sent to the APV.
- The pink pulse is the trigger.

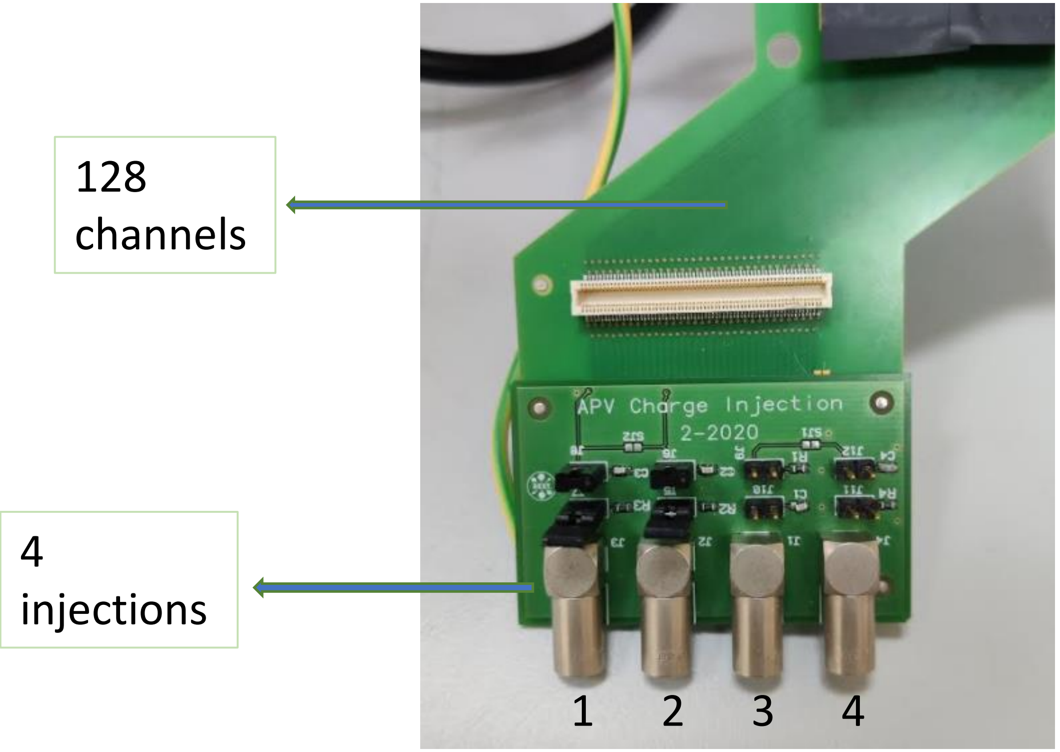


In this test we used the Oscilloscope to simulate the sensor and send the following signal:

- Waveform – pulse.
- Frequency – 25Hz.
- Amplitude – 900mV. (before 60 dB attenuation)
- Width – 20 ns.

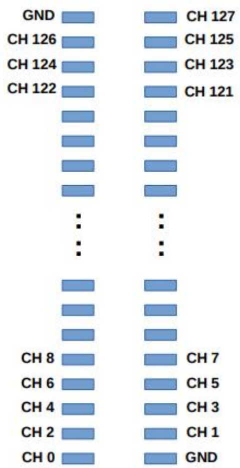
The system

- The dividing card who divdes the signal to 128 (0-127) Main channels has four entries/ injections.
- By testing every injection we could see which channels are activated by each one.
- This are the results:
- In1 – channels 1,5,9 etc
- In2 – channels 3,7,11 etc
- In3 – channels 0,4,8 etc
- In4 – channels 2,6,10 etc

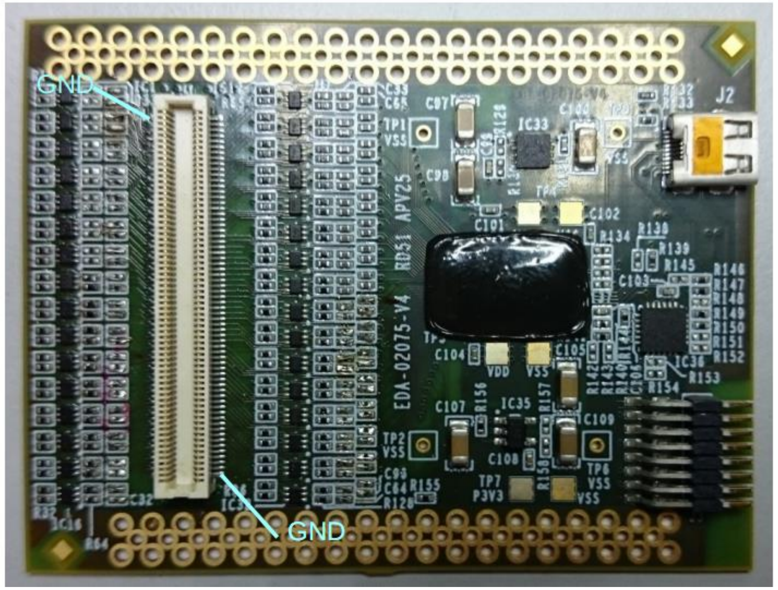


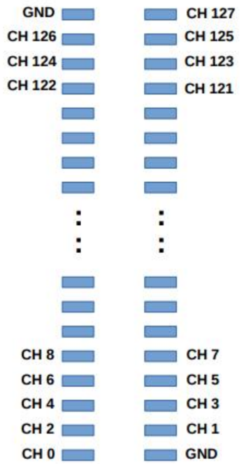
Finding the ratio

- Next we needed to have better understanding about the APV.
- Both APV have 128 channels to read and they are numbered from 0 to 127.
- When everything is connected the APVs are facing each other.
- that means ch 0 on REG is facing ch 127 on DIV, and they both receives signal from the same main channel.

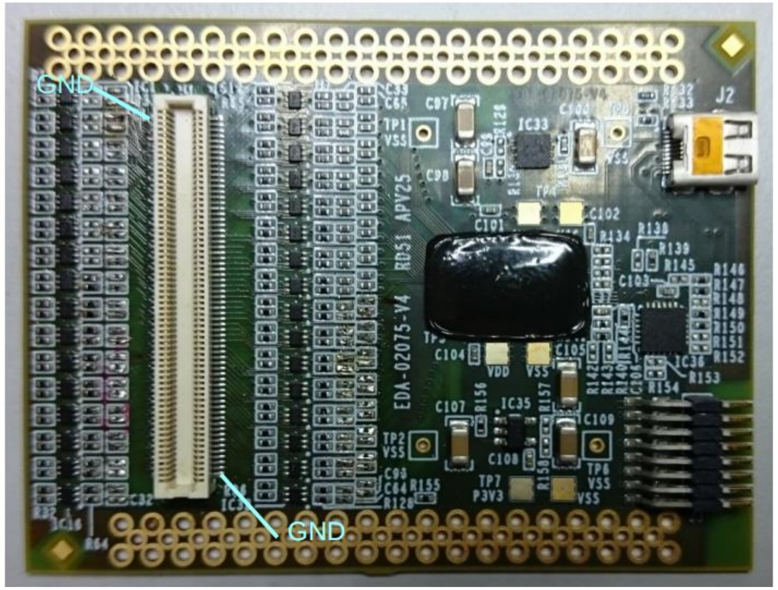


APV1 “REG”



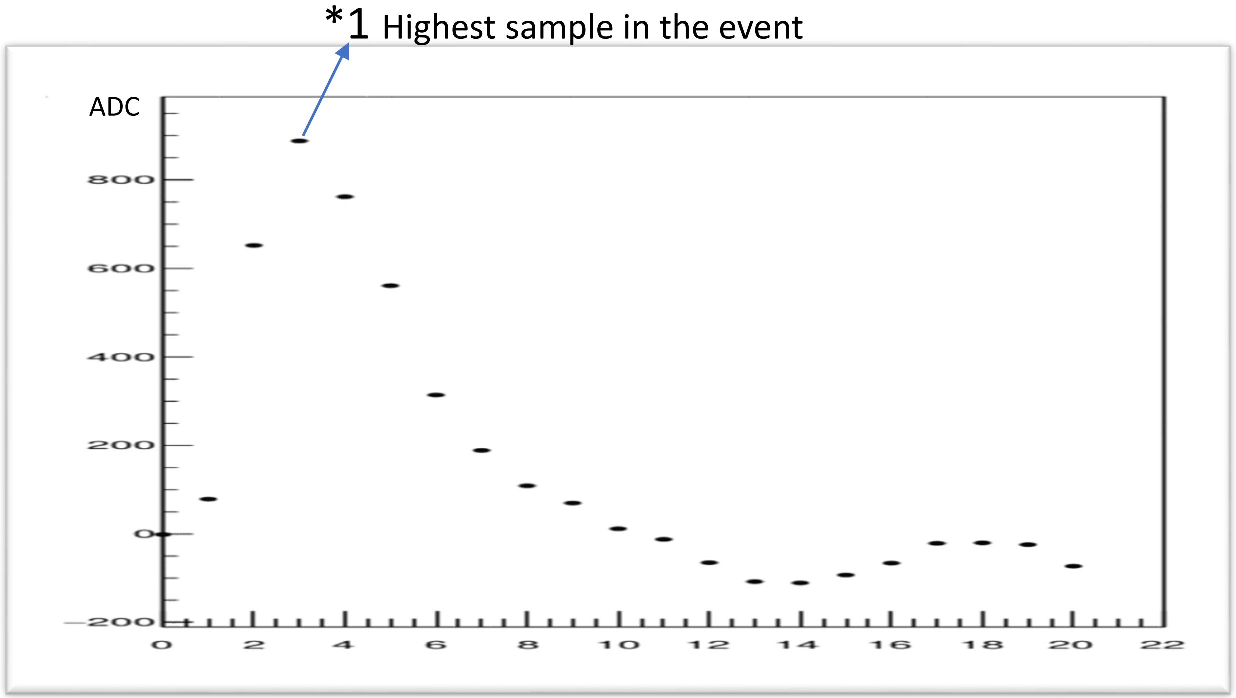


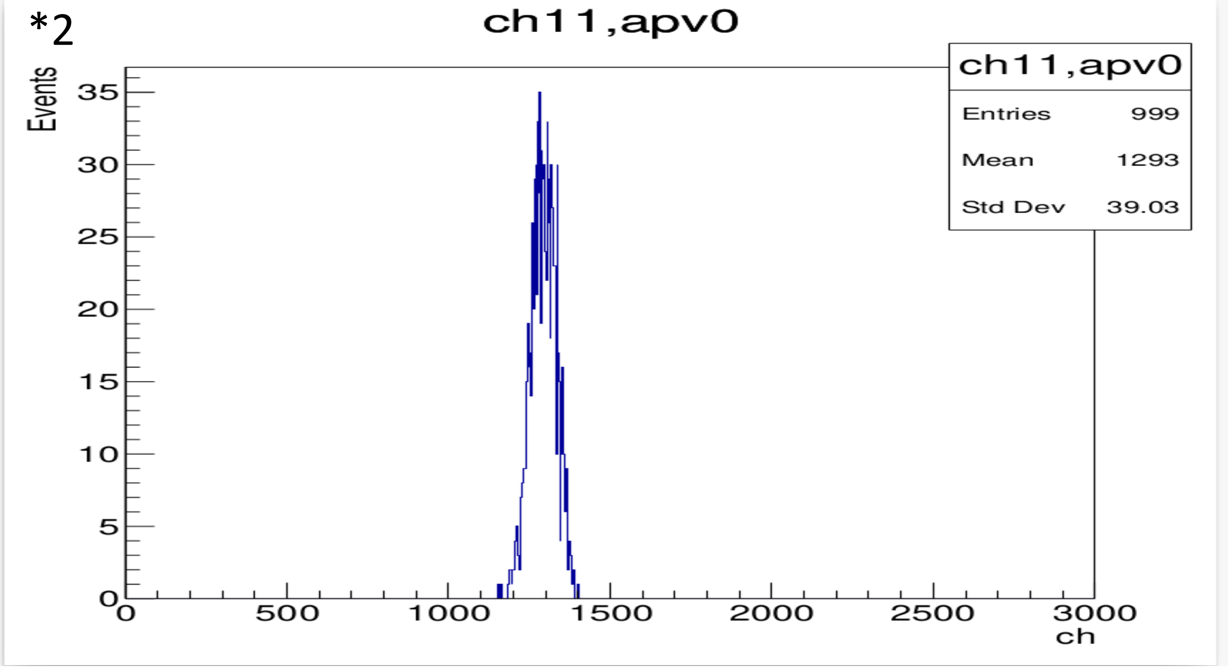
APV2 “DIV”



Finding the ratio

- we wanted to see the signal of every channel.
- We examined 1000 events in each channel and found the value of the highest signal mesured in every event(*1).
- then created histograms show them for every channel(*2).



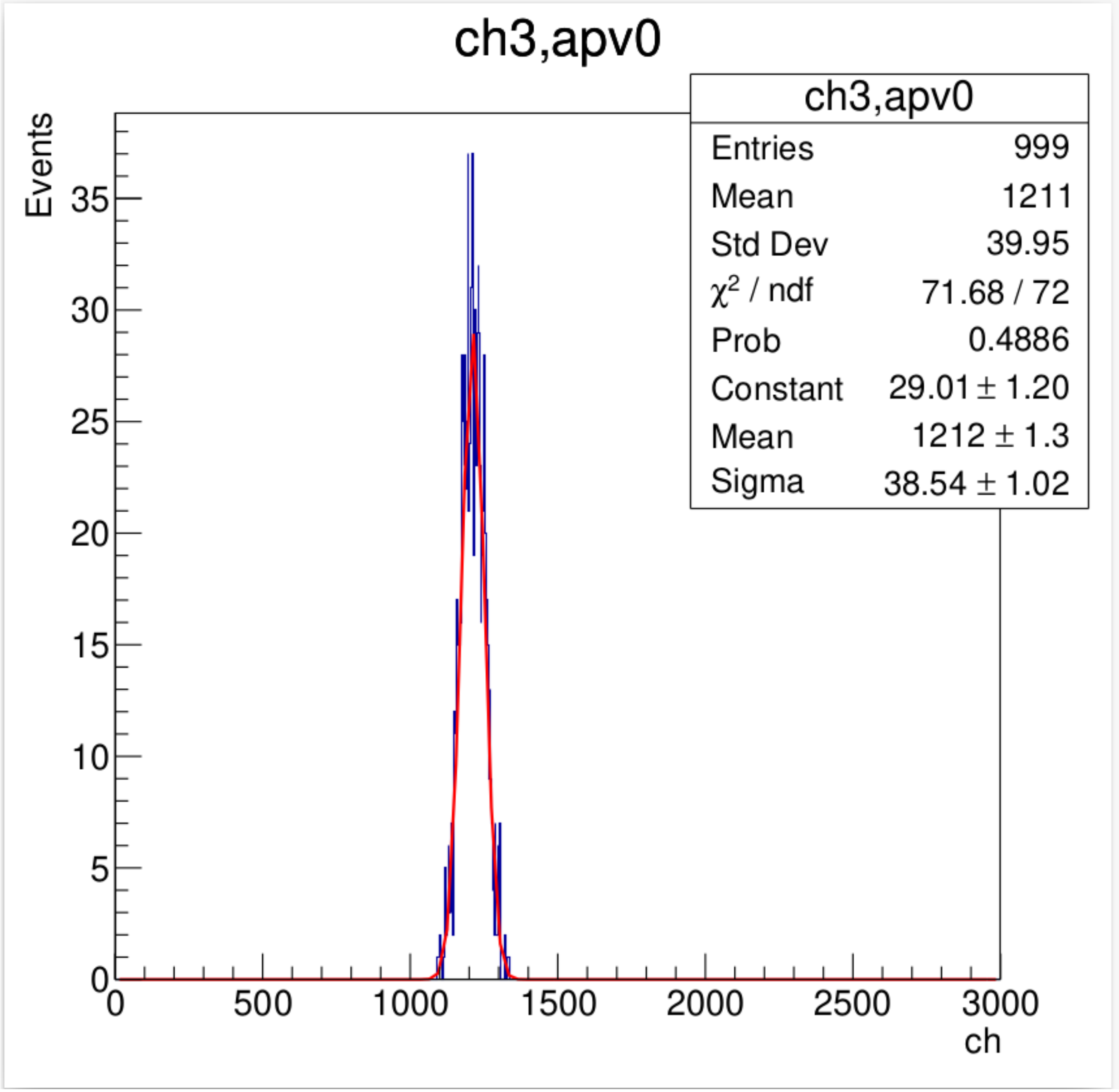


Finding the ratio

- The second step is creating a gaussian fit to the histogram to find an accurate average for the signal results.

- The reason we're not using the histogram mean is to filter out small events caused by noise.

- The gauss fit mean returns the most common results for the peak.

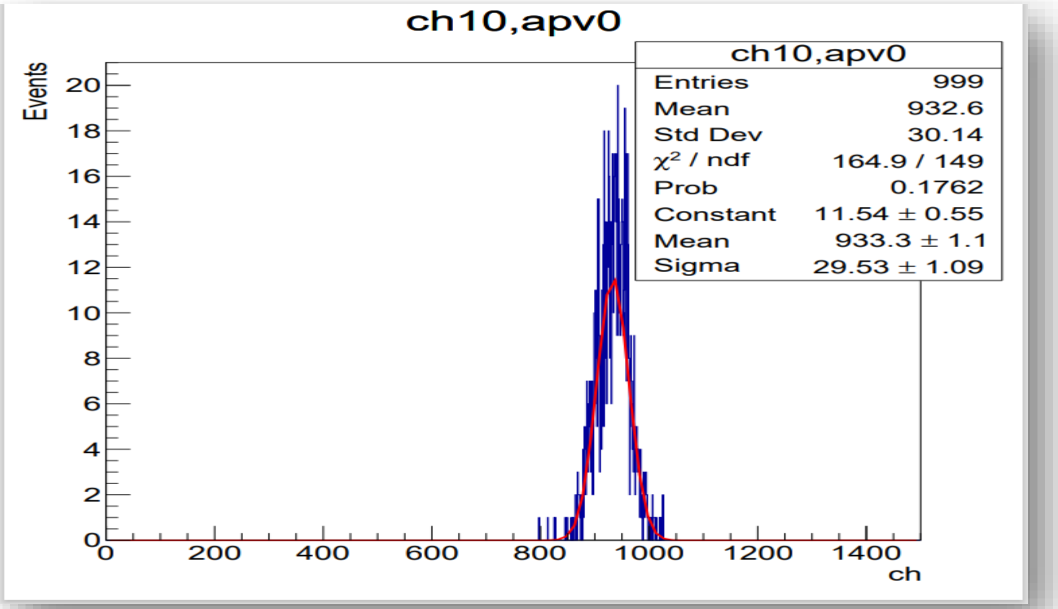


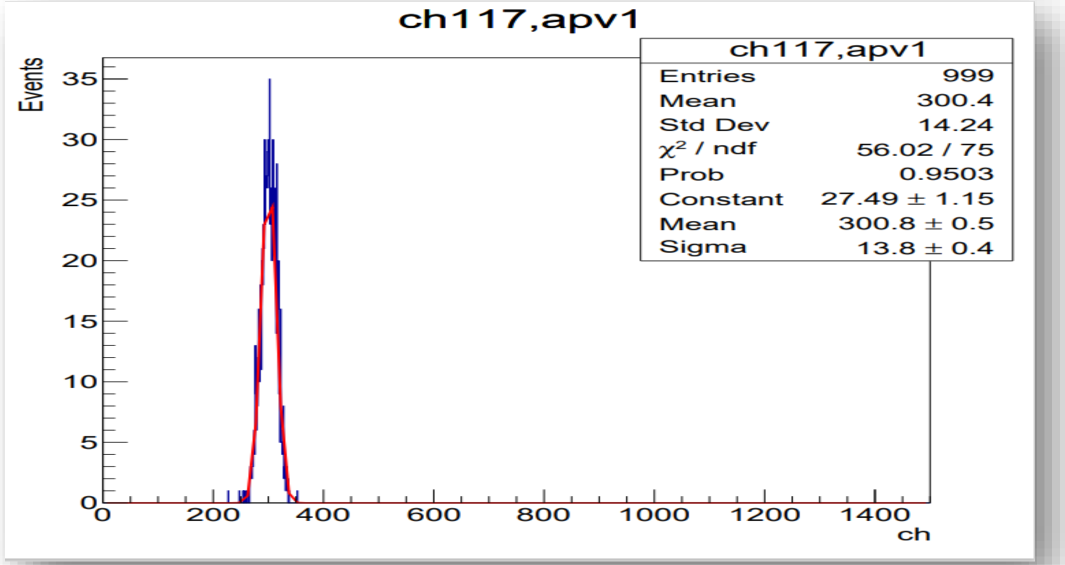
Finding the ratio

- Since we know the APVs are mirrored, we need to pair every ch on REG with 127- ch number on the DIV

- i.e. if we're looking at channel 10 in REG it will face channel

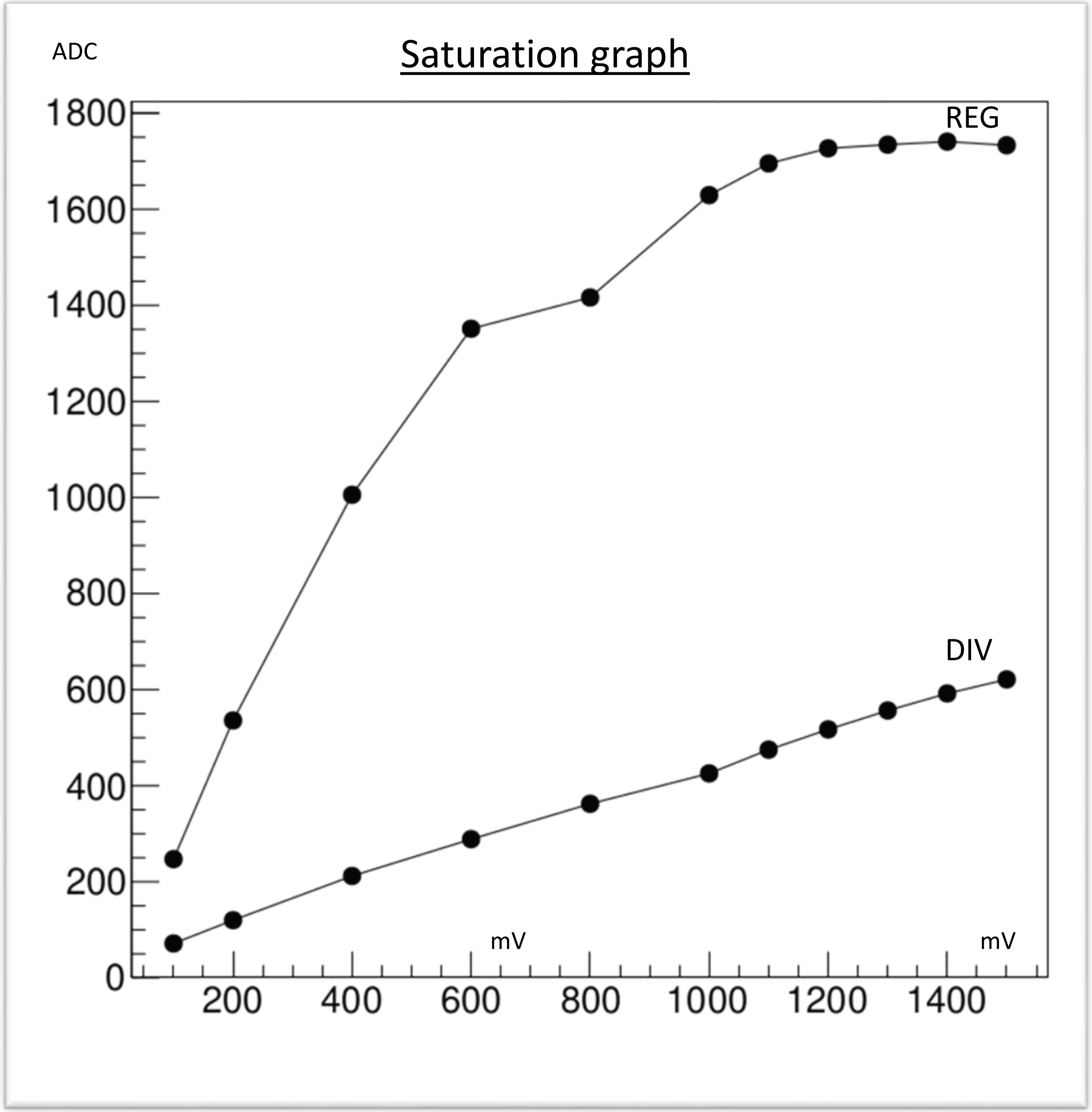
  127-10=117 on DIV.





Finding the ratio

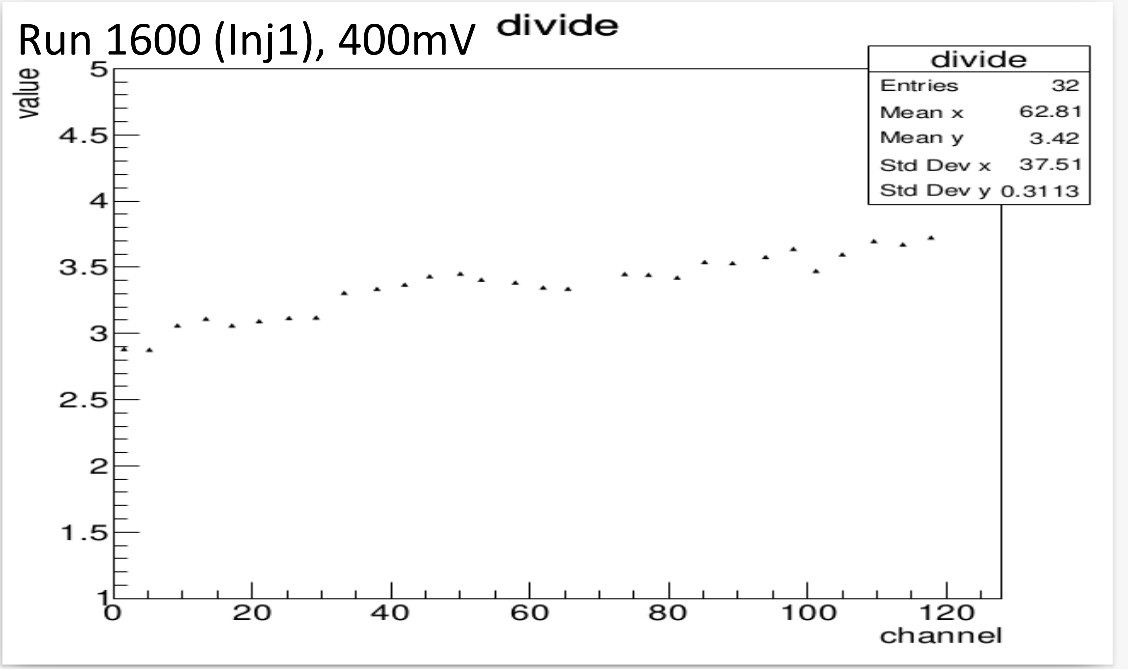
- Also we needed to keep in mind to avoid saturation.
- when APV REG saturates, DIV keeps going up as the signal is increased.
- It starts to saturate at 1500 and reach it’s limit at 2000.
- Therefore to be safe we stayed below 1400.

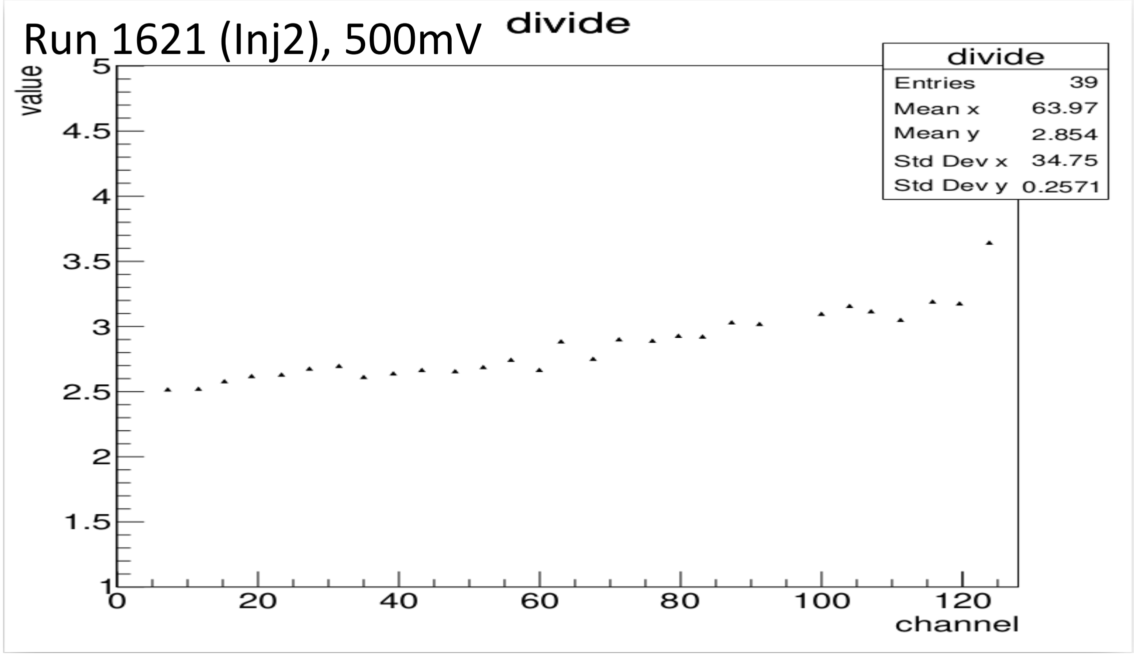


Finding the ratio

- Once we had an average value for all the channels, we divided the matching channels from REG and DIV.

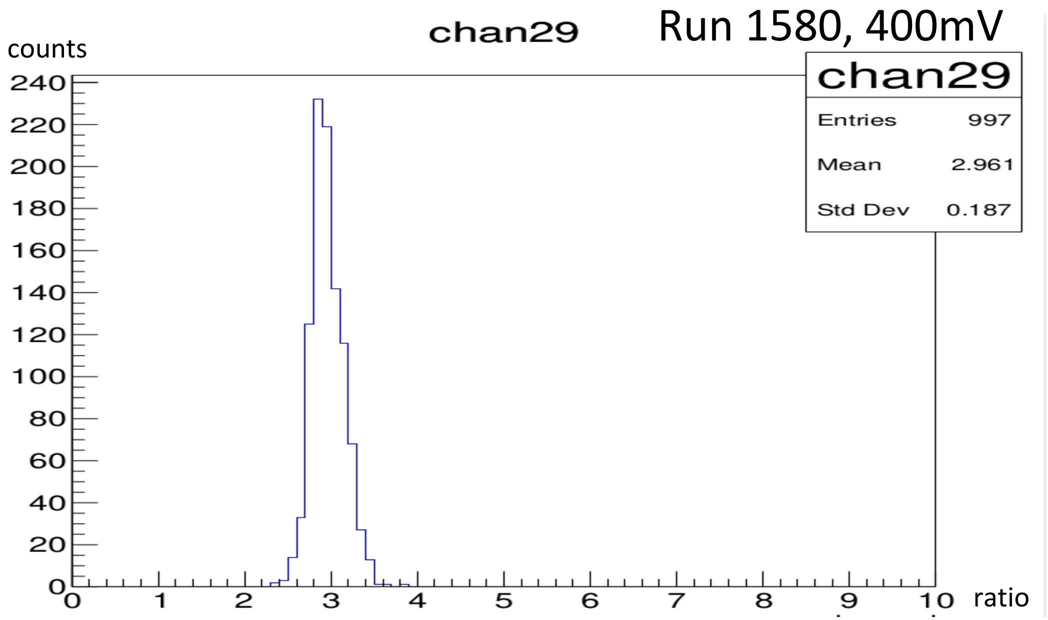
- this are the results for two different Runs, and injections:

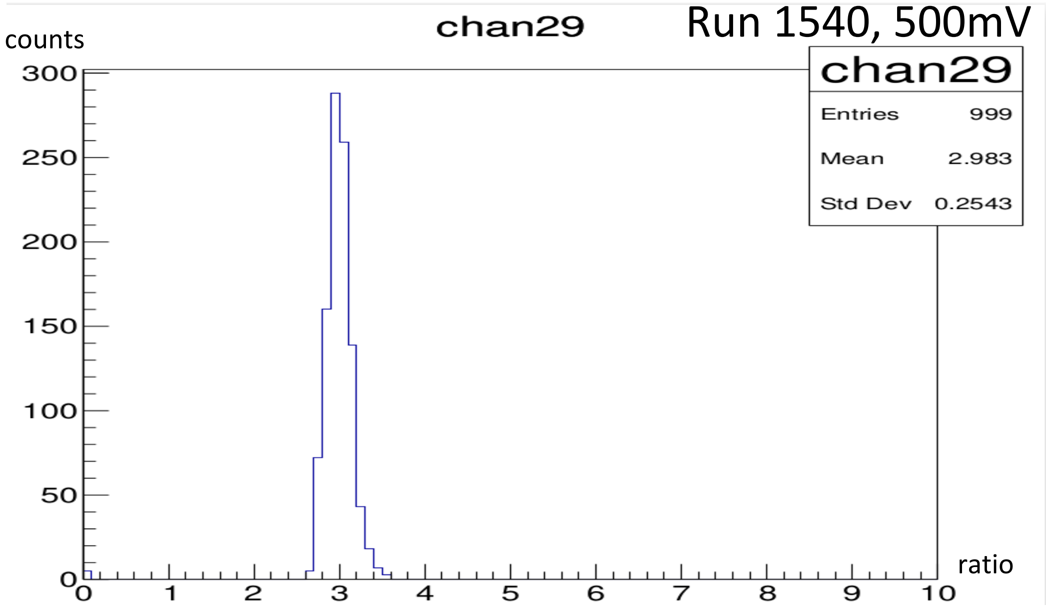




Finding the ratio

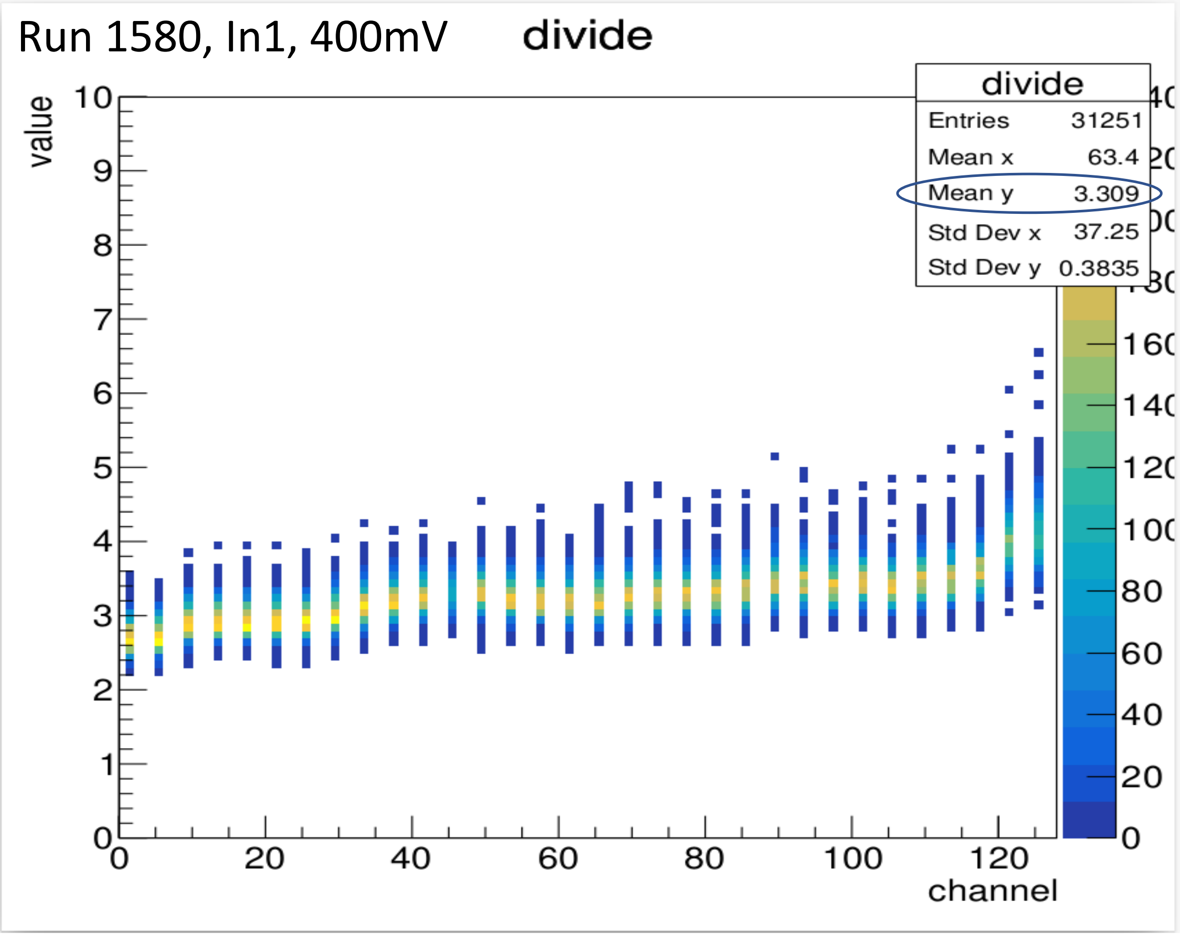
- After this process we got better knowledge on the system and tried a different method.
- For every channel, We took the peaks from every single event and divided the value from REG by the value from DIV.
- That way you can see the same signal from one main channel through both APVs and measure the ratio between them

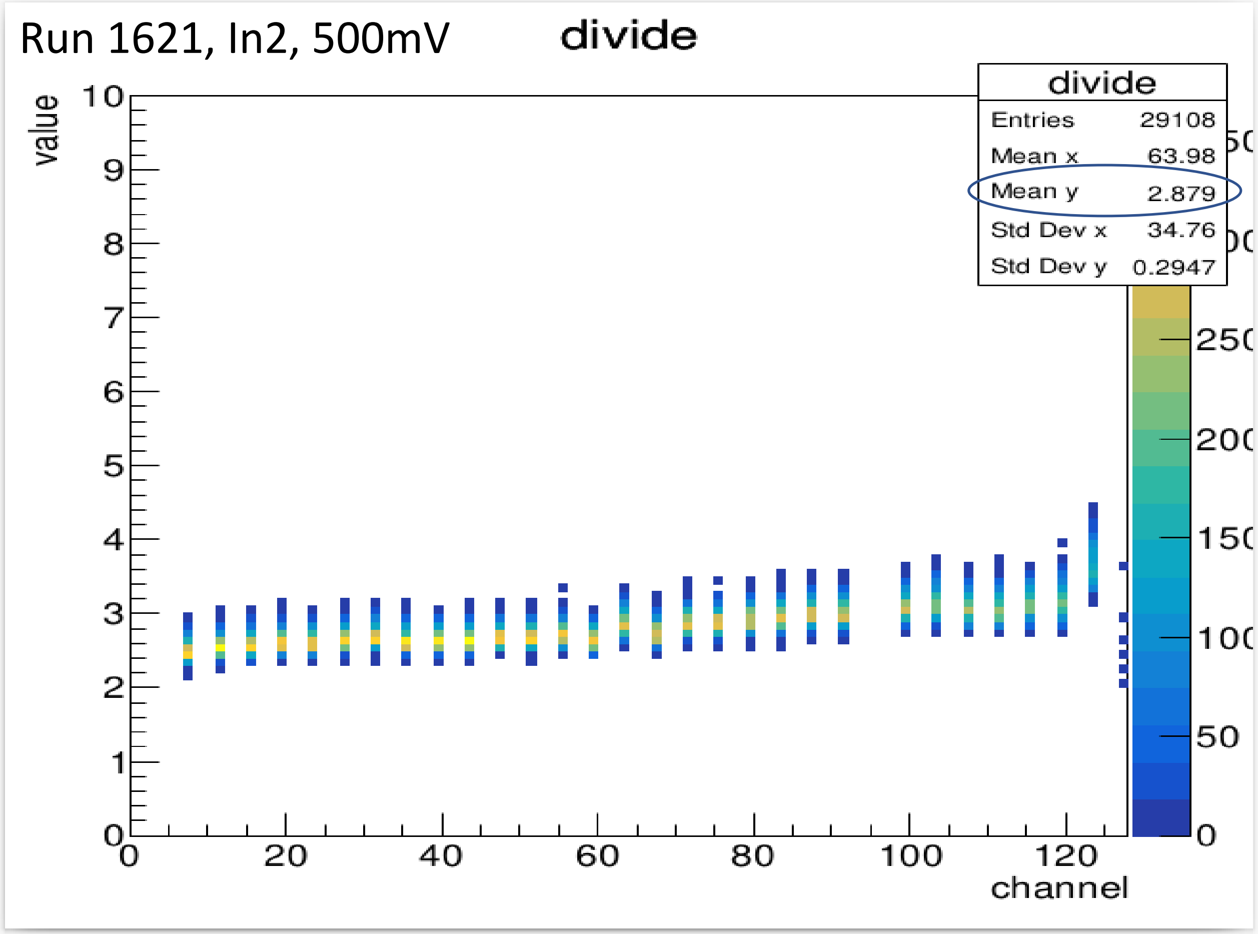




We can see for this channels that most of the time the ratio is around 3.

Finding the ratio



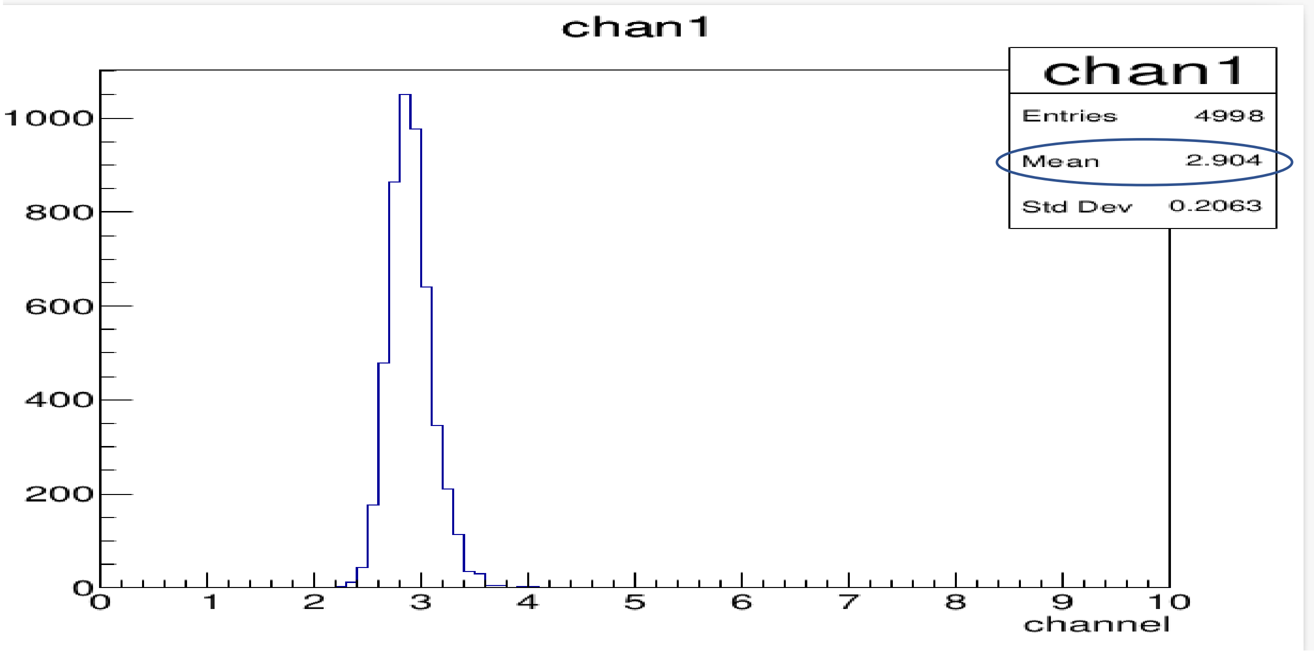


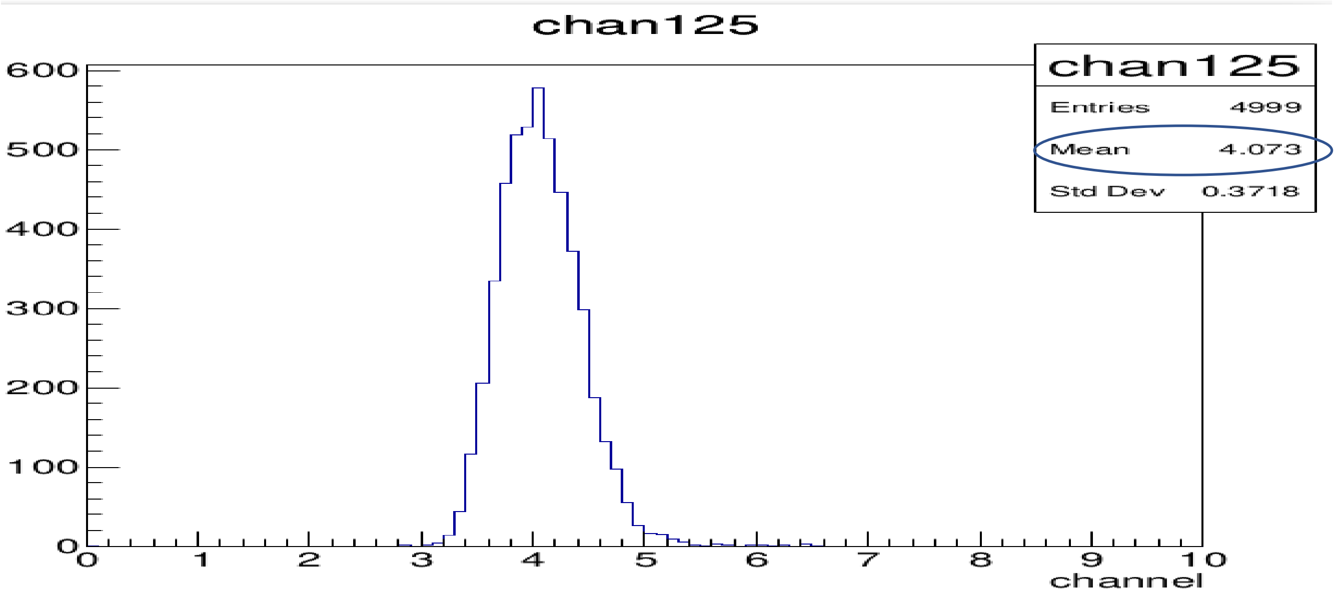
- The following histogram are filled with the ratio between the APVs for every single event

Finding the ratio

- The increase of the ration is something foreseen because of the internal effect of the APV (the more cannel, the more capacitance)

- In the first main channels it has smaller value and grows bigger as we move to last ones



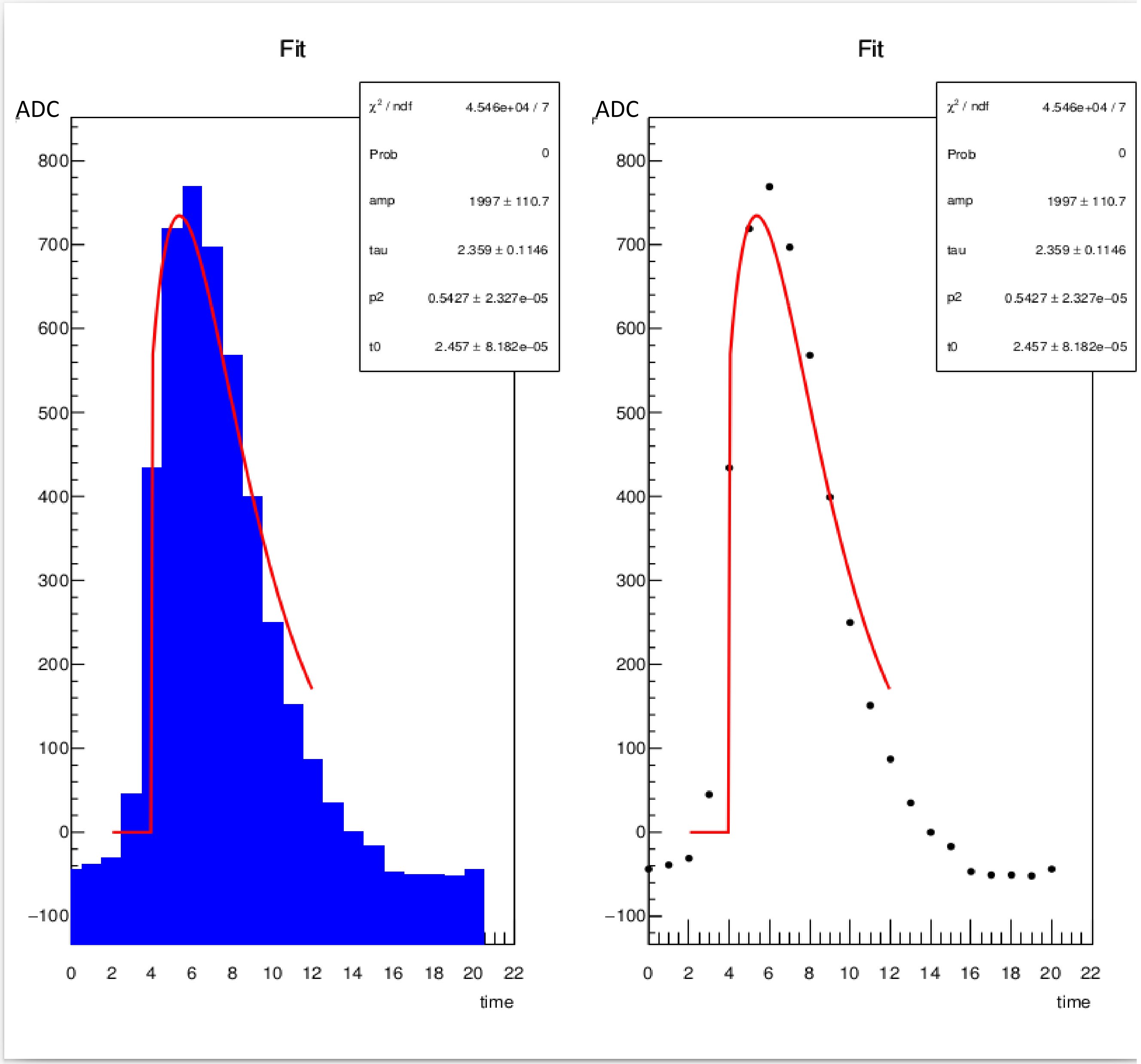


Fitting the pulse

- Using the function:

$$V = \frac{e^{\frac{t0-t}{\tau}}(t-t0)P0}{\tau}$$

- Tau is around 2.5 but not exactly.
- It seems the wave is not exactly as it should be.



Conclusion

- The ratio between the APVs is going around 3.
- though it changes depends on different terms such as:
  - Amplitude
  - Channel number
  - Noise
  - runs
- The shape of the wave Is still not accurate and should be modified, probably by changing the circuits component
- It is possible that once the wave will be correct the results of the ratio would be more stable.