Calibrating the APV System

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Motivation

- Right now we are injecting a known voltage into an APV system and measuring its resulting ADC count to see how the system responds to the inputed voltage

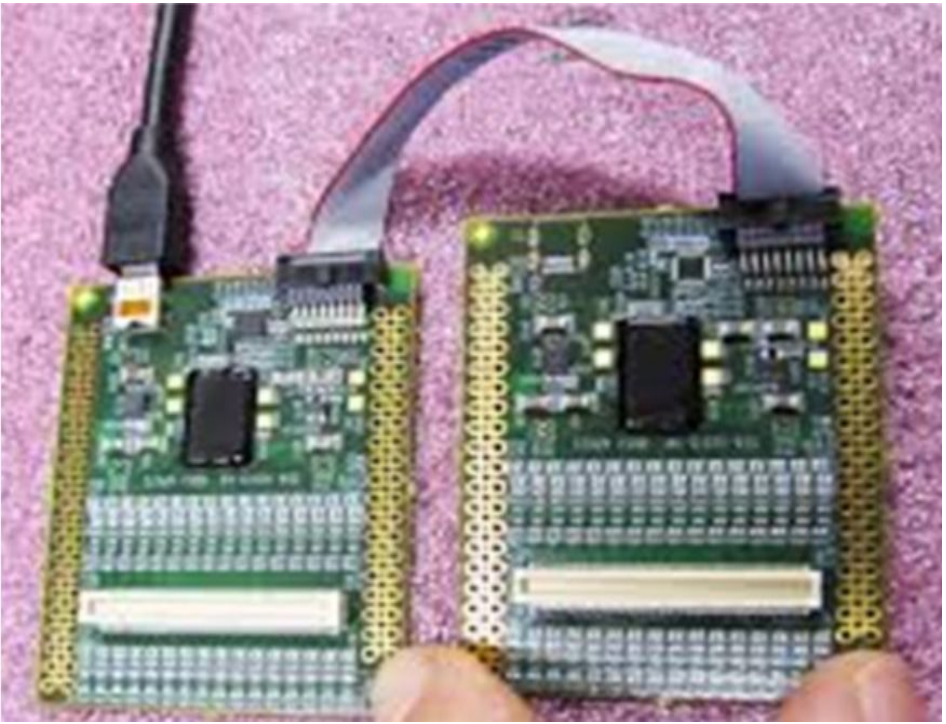
- Having an accurate measure of this will allow us to see how the apparatus works

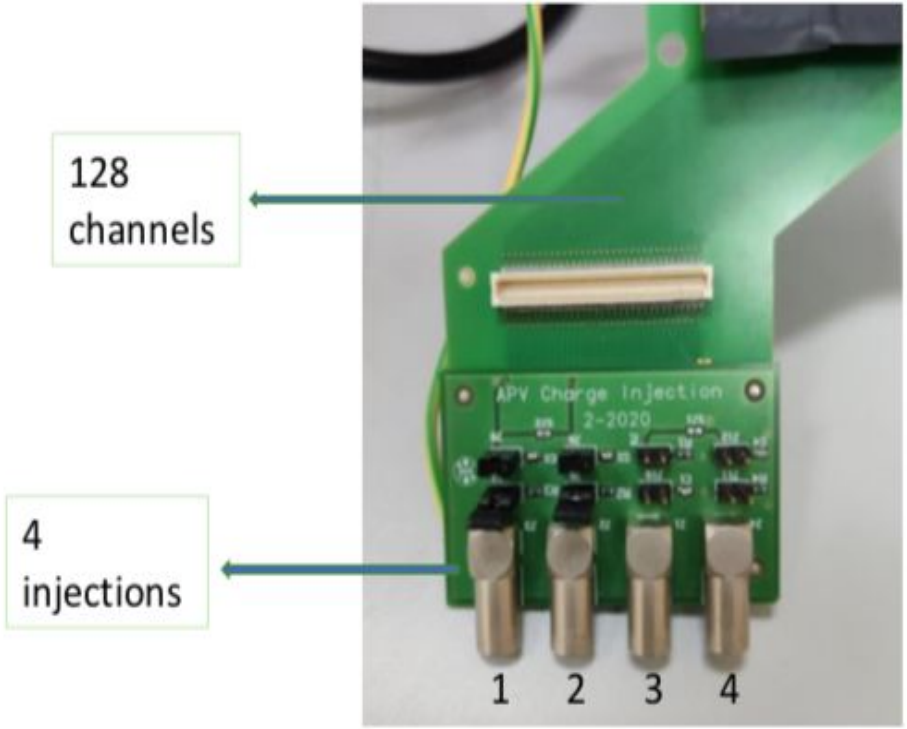
- The end goal is to have a reliable APV system so in the final experiment, we can use it to find an unknown charge accurately

The APV Apparatus

- The APV system takes voltages from an oscilloscope through 128 channels.
- The system has four inputs, or injections, and each one activates different channels
  In1 – channels 1,5,9 etc.
  In2 – channels 3,7,11 etc.
  In3 – channels 0,4,8 etc.
  In4 – channels 2,6,10 etc.
- The channels then divide into 2 APV's, creating 256 channels. 128 of the channels take in the original signal (REG) and the other 128 take in a suppressed signal (DIV).
- Every channel has a partner channel in the other APV
  - For example, channel 5 on the REG APV is paired with channel 122 on the DIV APV
  - The last channel (127) on the DIV APV is paired with the first channel (0) on the REG APV, so the formula to figure out the correct channel pairing is DIV= 127- REG

The APV Apparatus



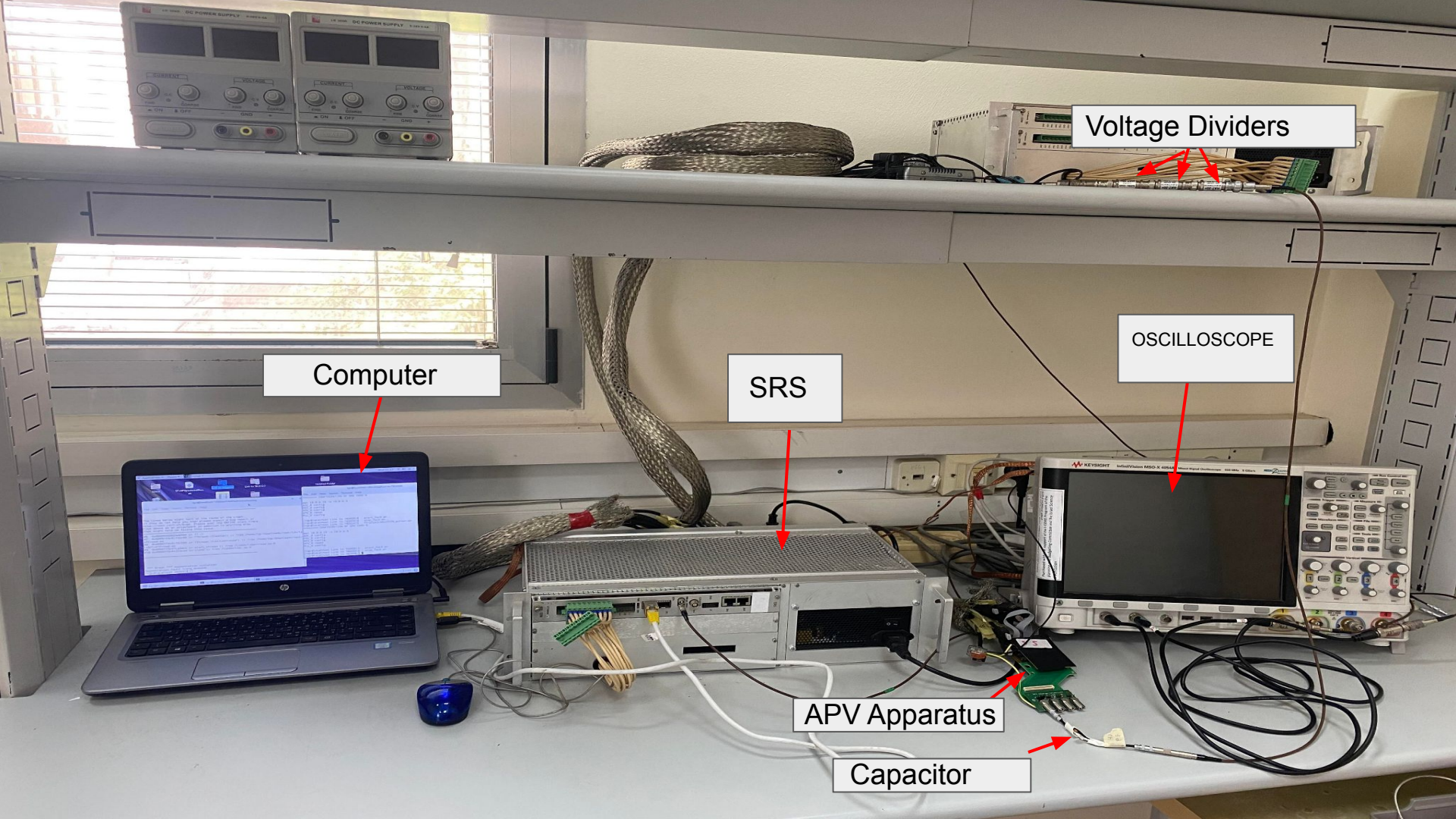


The Entire System

- From an oscilloscope, voltage is generated then passed through 3 20 dB voltage dividers and a 40 pf capacitor before reaching the APV system.

- The device is then connected to a Scalable Readout System (SRS) that transmits the data to a computer.

- An mmDaq software reads the imputed data and saves it as a ROOT file


Voltage Dividers
OSCILLOSCOPE
Computer
SRS
APV Apparatus
Capacitor

Taking The Data

- The APV takes in 21 samples for every event, and each event is performed every 25ns.
- We ran the voltage through the system at select amplitudes and measured the systems ADC count response. Every time it was ran it was called a run.
- For every voltage amplitude we analyzed 1000 events per run
- For every event, we took the max ADC value that was read per channel and averaged the max over the entire run
- We plotted the channel’s voltage over its ADC count
- There are 2 plots, one with both channels plugged in and one where only one was plugged in

Taking the Data

- The first goal was to see how the data differs when you measure the APV's separately and the other APV is unplugged.

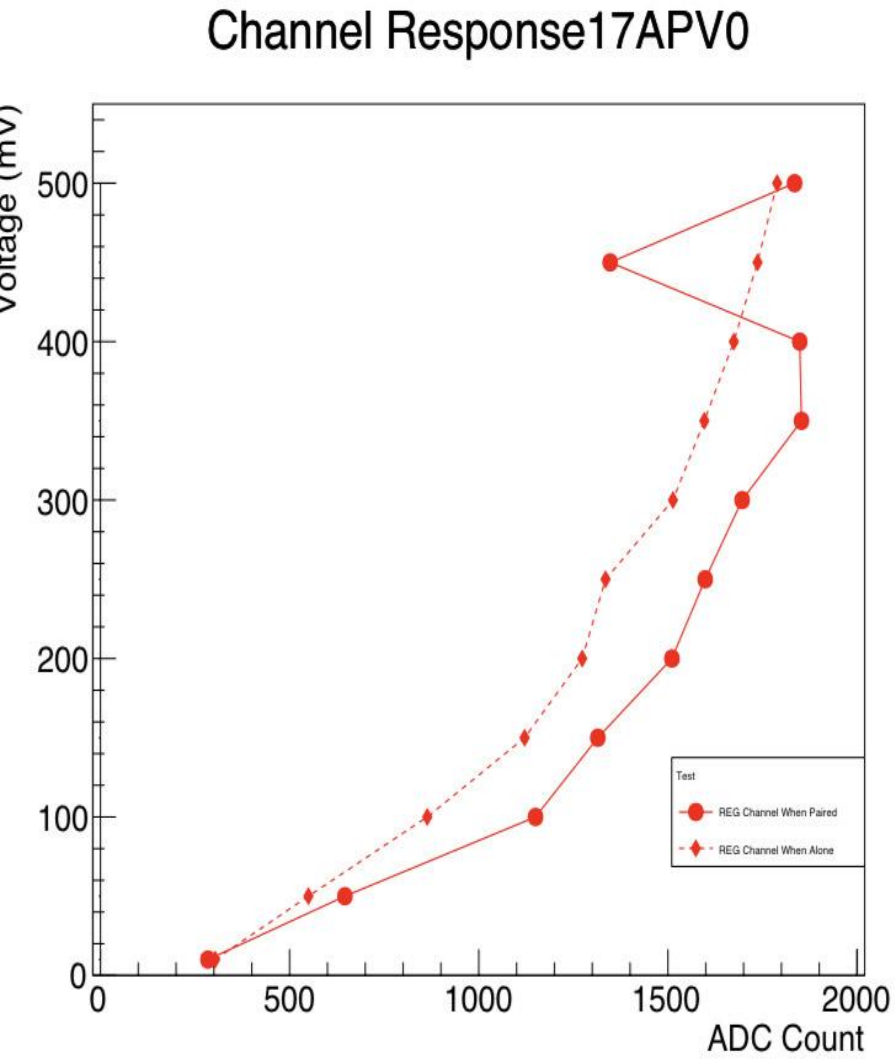
- The second goal for taking the data is too find the ratio between the REG APV and the DIV APV

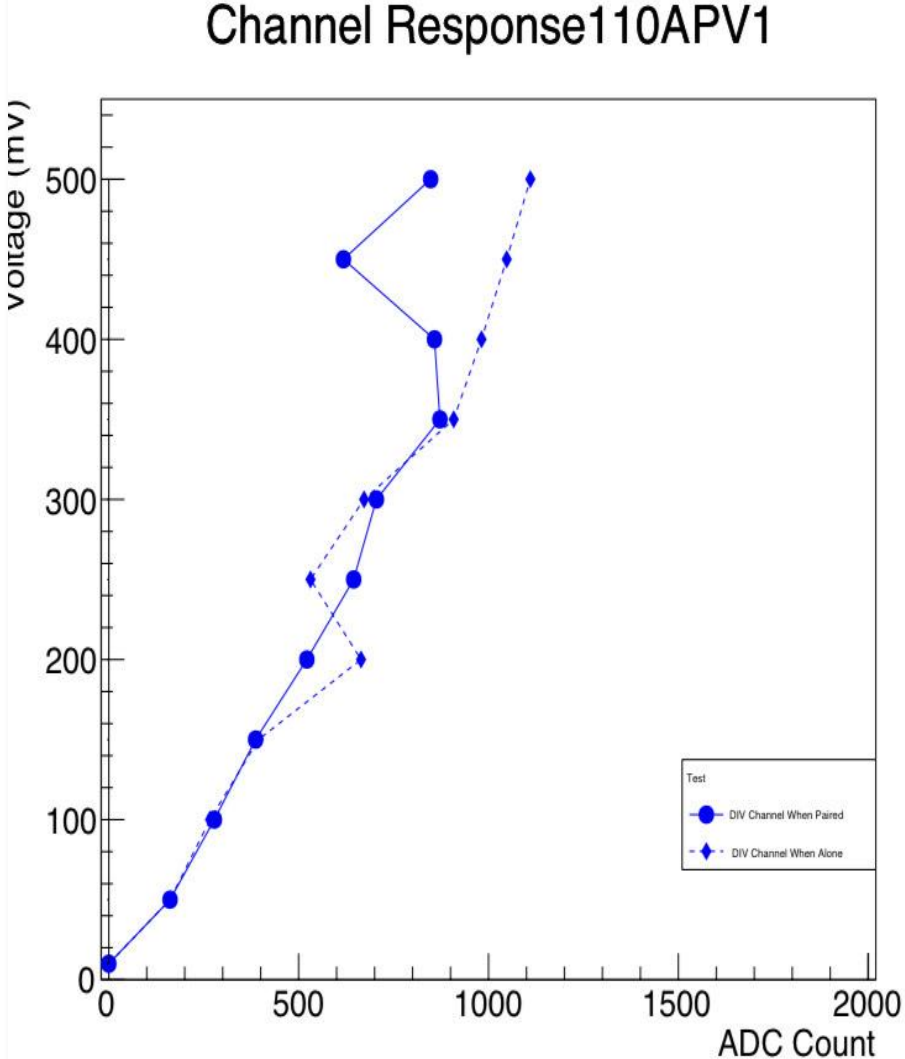
- The ratio is the difference between the ADC count of the REG APV and the DIV APV

The Saturation

- The APV is supposed to saturate around a certain voltage

- We want to see if there is a difference between the same channel when it saturates while the other APV is plugged in and when it’s not

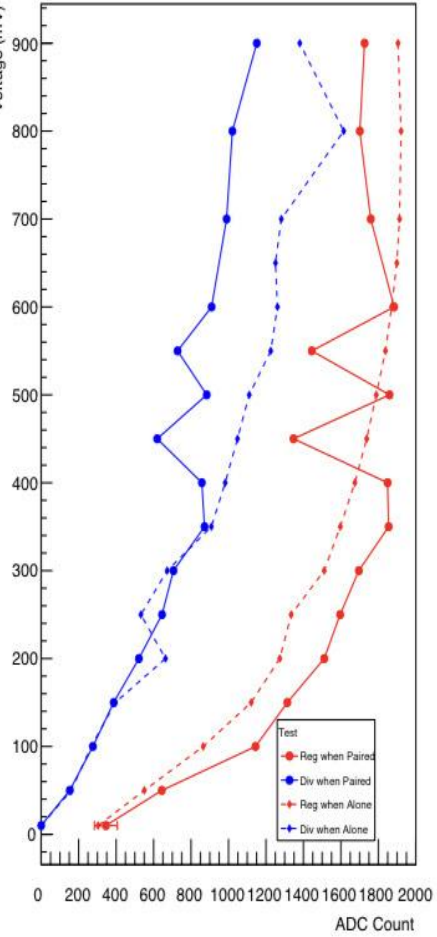

Channel Response17APV0
Voltage (mV)
0
100
200
300
400
500
0
500
1000
1500
2000
ADC Count
Test
REG Channel When Paired
REG Channel When Alone


Channel Response110APV1
Voltage (mV)
0
100
200
300
400
500
0
500
1000
1500
2000
ADC Count
Test
DIV Channel When Paired
DIV Channel When Alone

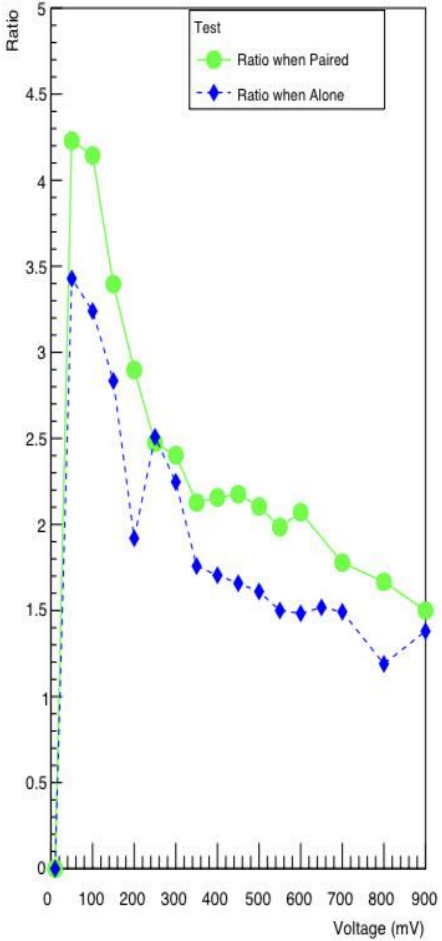
Saturation Results

- The REG APV saturates at around 400mV (1600 ADC), and before 400mV the unpaired APV obtains a lower ADC count
- After the REG saturates, the unpaired REG and the paired REG obtain around the same ADC count
- The DIV APV saturates also at around 400mV (500 ADC), but before that the unpaired and paired DIV APV get similar results, and after 400mV, the unpaired APV gets higher ADC counts

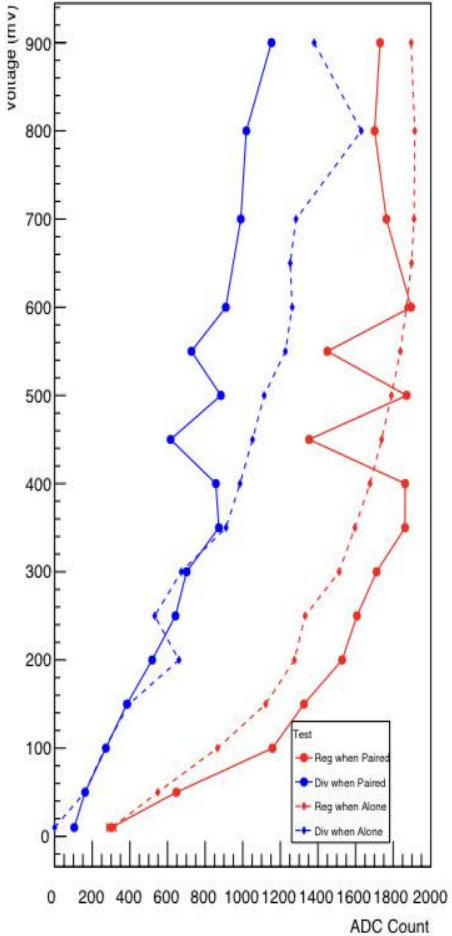
REG 17 DIV 110



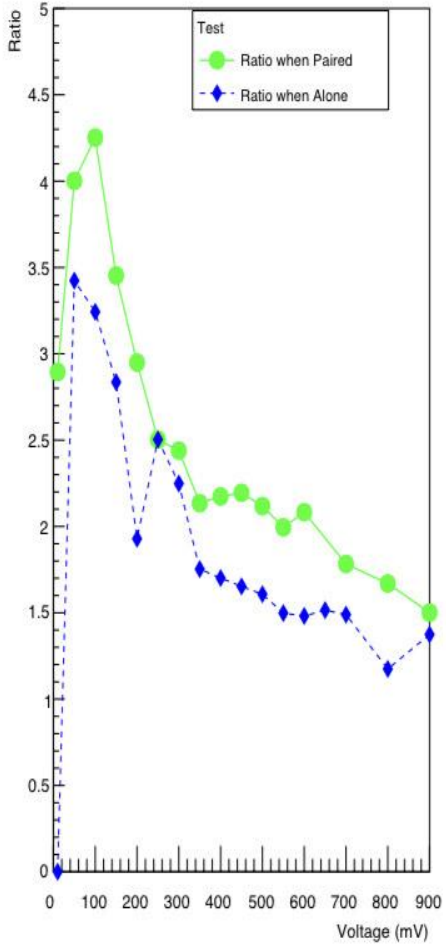
Ratio17



REG 25 DIV 102



Ratio25



Ratio Results

- As the system saturates, the ratio decreases to around 2
- It hits its max around 150mV with a ratio of around 4.2
- The ratio of the unpaired APV’s calculated together is lower than the paired ratio
- The data is fairly consistent between channels
- Voltage effects the ratio and ADC count