

Finding peaks

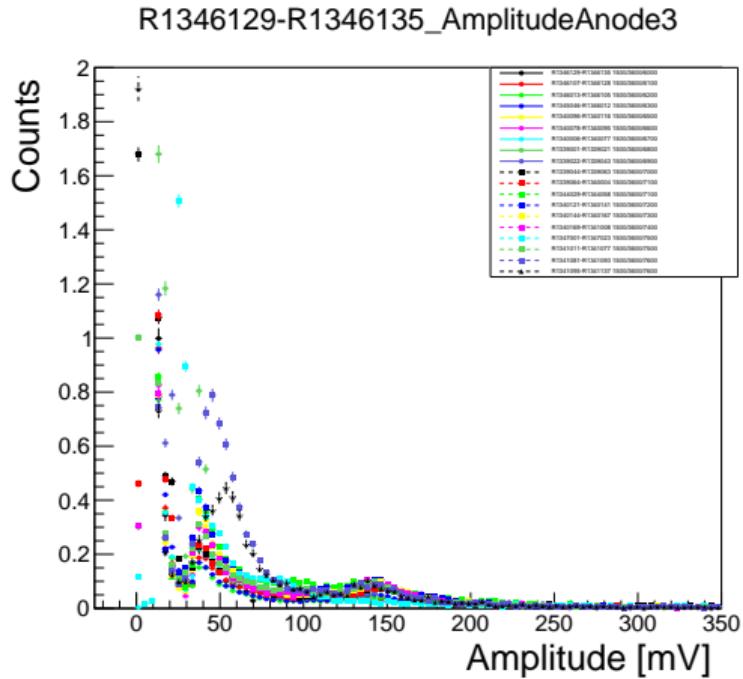
Alexander Deisting



20th of December, 2019

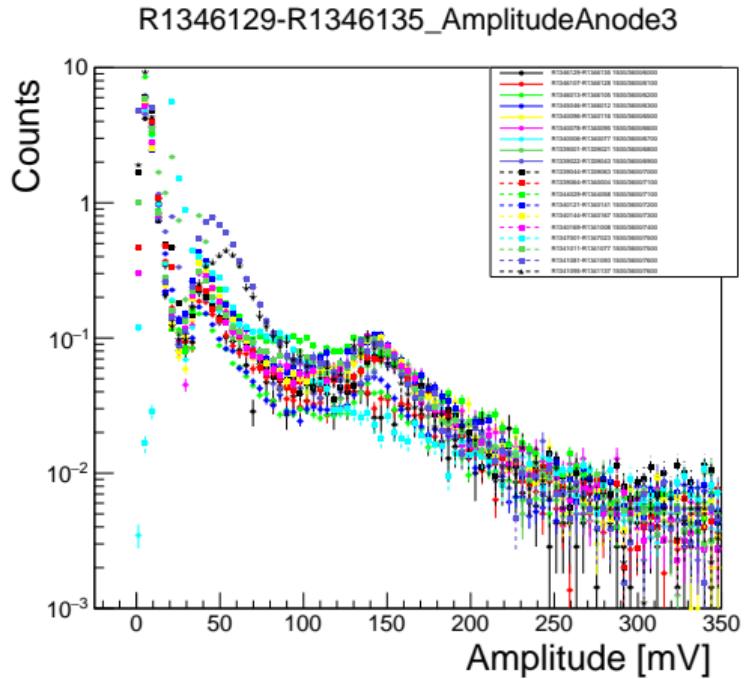
Introduction

- ▶ A very few, not too messy slides and quite a lot slides which may be called otherwise...
 - ▶ In our ^{55}Fe data taking campaign we face the problem that we do not see a moving peak for changing voltages
Disclaimer: In two sets of runs for different voltages Ed managed to see one with appropriate cuts
 - ▶ In the following plots (and in the one on the right) various runs are grouped into one data series. Each of these series is normalised by the number of events contained in the respective runs



Introduction

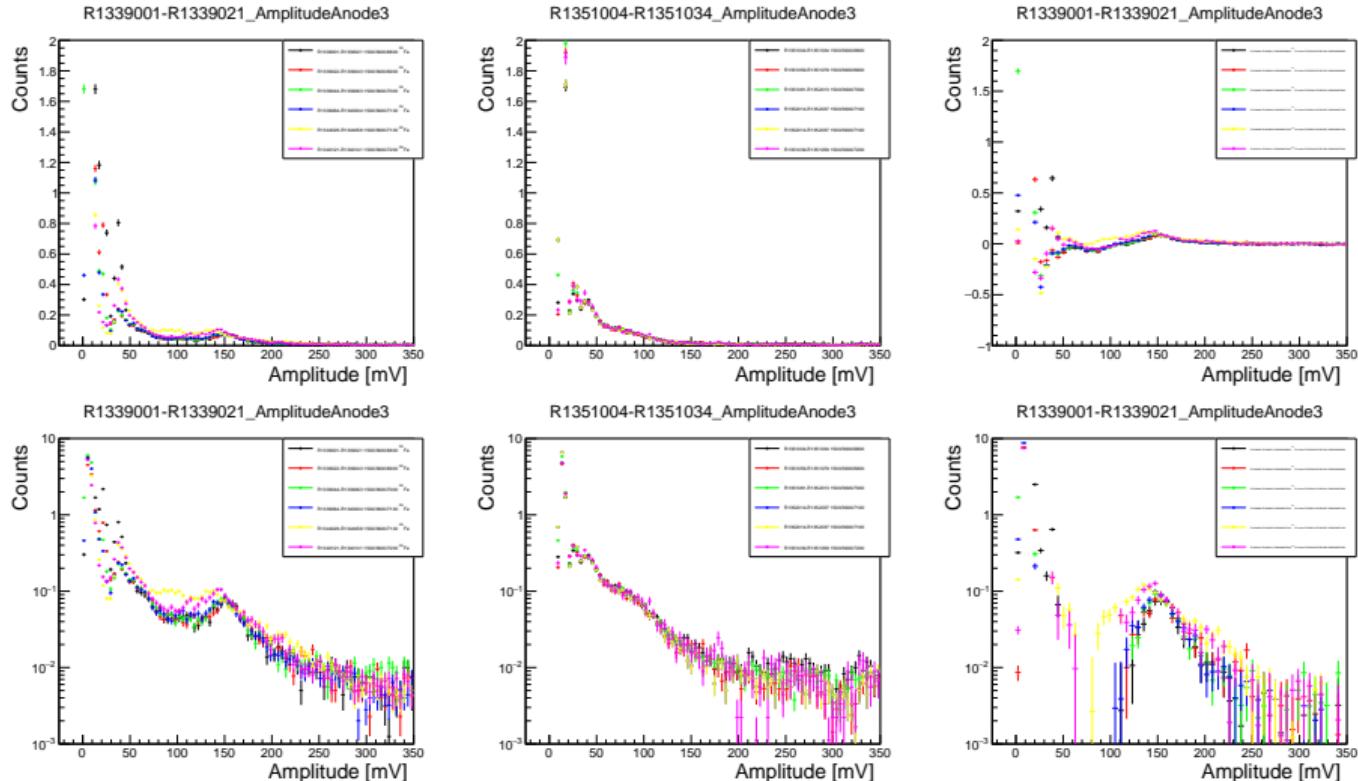
- ▶ A very few, not too messy slides and quite a lot slides which may be called otherwise...
 - ▶ In our ^{55}Fe data taking campaign we face the problem that we do not see a moving peak for changing voltages
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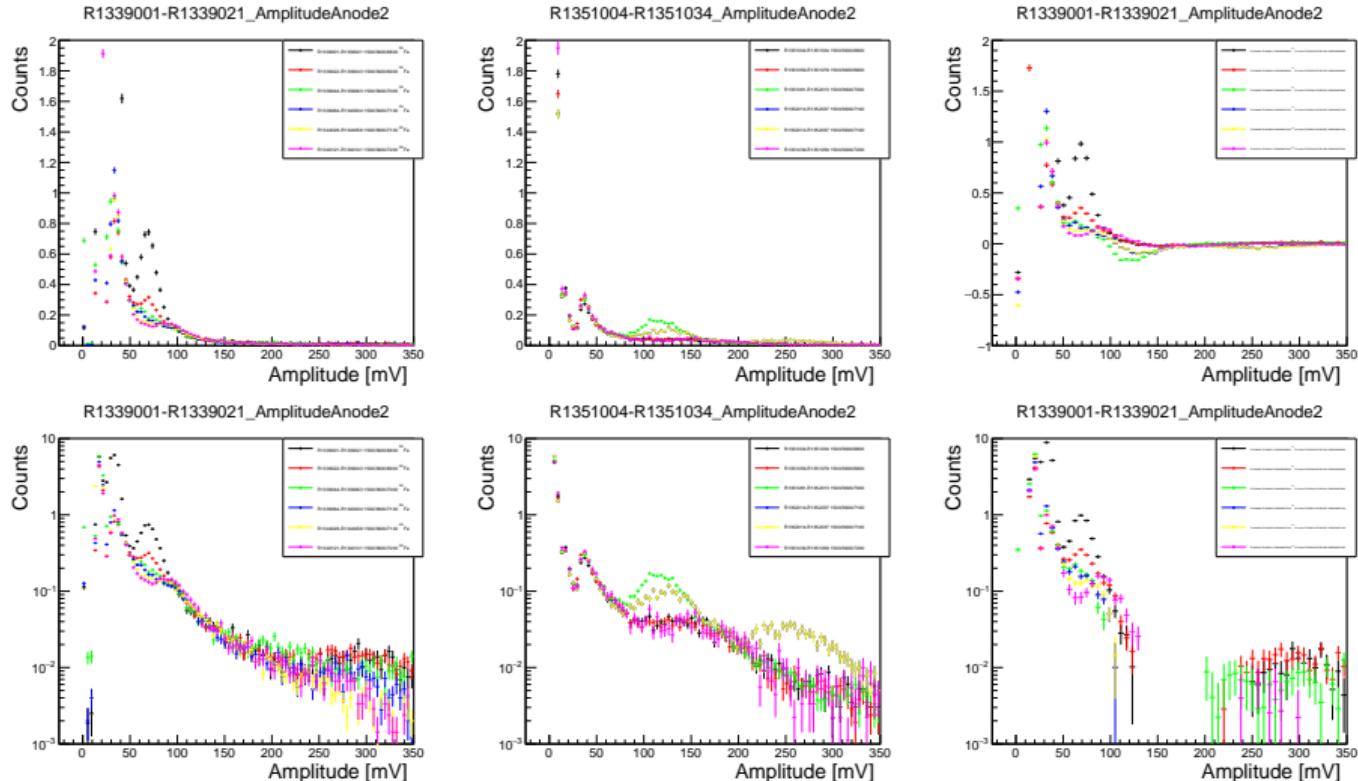
Amplitude spectra

- ▶ On the next slides I show in row 2 the same plots as in row 1, but log-scale
- ▶ The first column shows data of ^{55}Fe data taking, the second one background data taking and the third shows the result of subtracting the second from the first

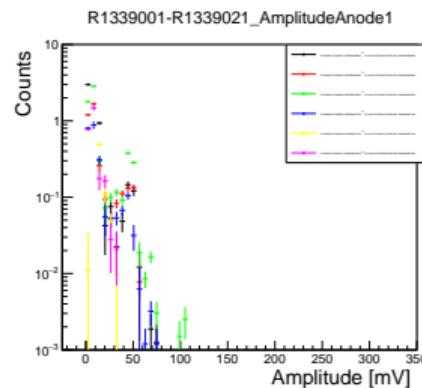
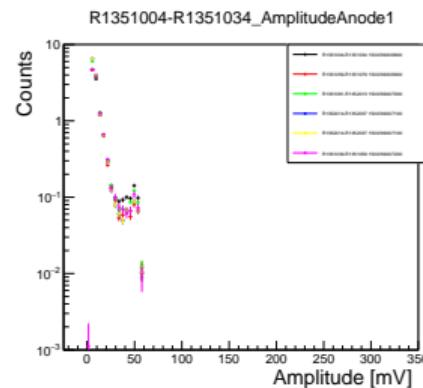
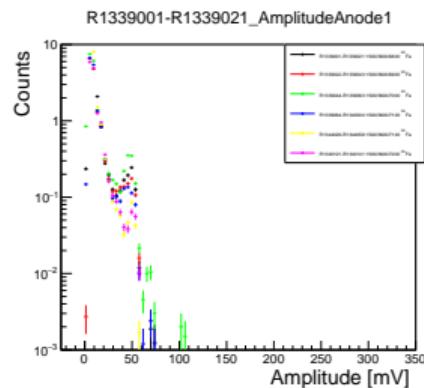
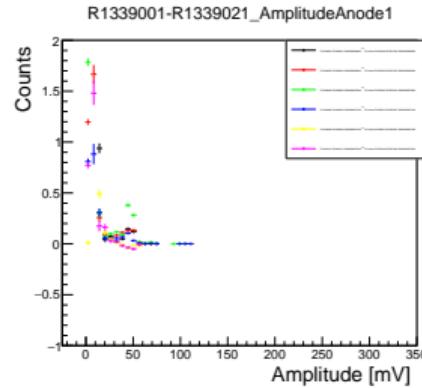
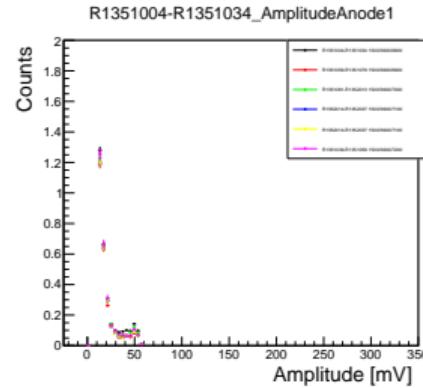
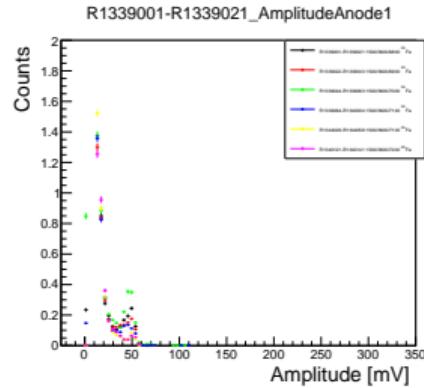
Amplitude anode 3: ^{55}Fe , No source, ^{55}Fe —no source



Amplitude anode 2: ^{55}Fe , No source, ^{55}Fe —no source



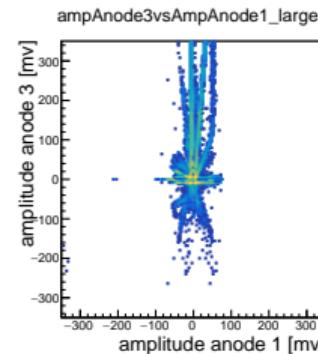
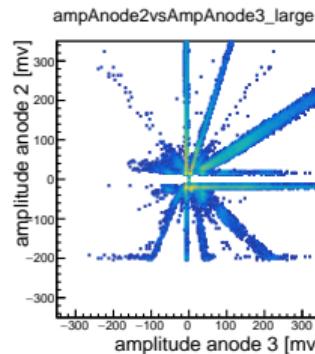
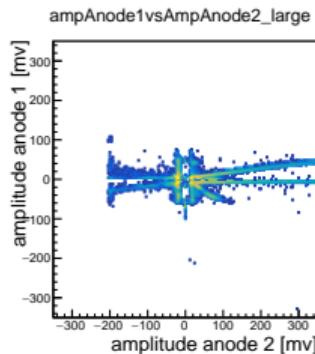
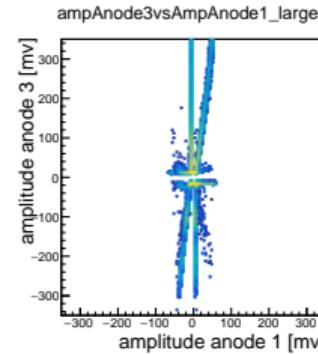
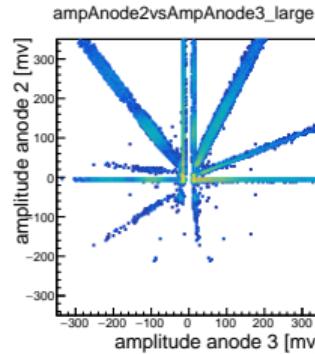
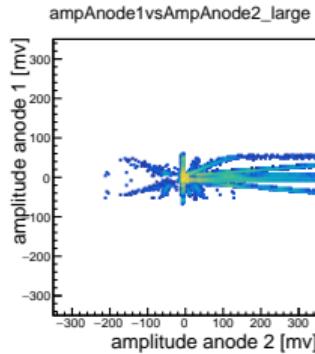
Amplitude anode 1: ^{55}Fe , No source, ^{55}Fe —no source



Amplitude correlation plot

- ▶ For each waveform the most positive and the most negative ADC value is determined and, using the baseline, an amplitude is calculated for both using the same calculated baseline
- ▶ This means there are two amplitude values per signal
- ▶ On the next slides these two values for each signal are correlated between different amplitudes. There are thus four different combinations to be taken into account
- ▶ First row is the result of the background runs, the second row of the signal runs. Both plots are not normalised yet

Amplitude correlations: Background only and ^{55}Fe only



Extra slides

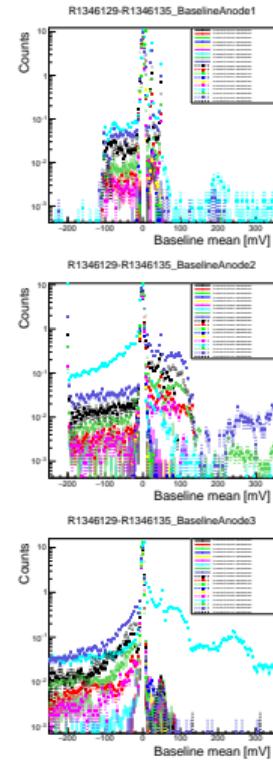
All voltage settings

Amplitude spectra: General comments

- ▶ On the following slides are amplitude spectra (positive and negative), and of the waveform RMS. All are normalised to one event (*i.e.* nb of waveforms recorded during one camera exposure)
- ▶ Voltage settings from 1500 V/3600 V/6000 V to 1500 V/3600 V/7600 V are covered. (These are grouped by different voltage settings on latter slides to enhance visibility.)
- ▶ We see one peak just after zero, one peak at about 40 mV (40 mV) and one peak/shoulder at about 150 mV (80 mV) in the anode 3 (anode 2) amplitude height spectrum. In the anode 1 amplitude spectrum there is one peak just after zero and another one at about 50 mV
- ▶ We are fairly sure that the ~ 0 peak is noise. In case of the second peak we are still discussing whether it is due to noise or the source and the third peak / shoulder we assumed to be due to the source

Amplitude spectra: Peaks vs voltage – 1/2

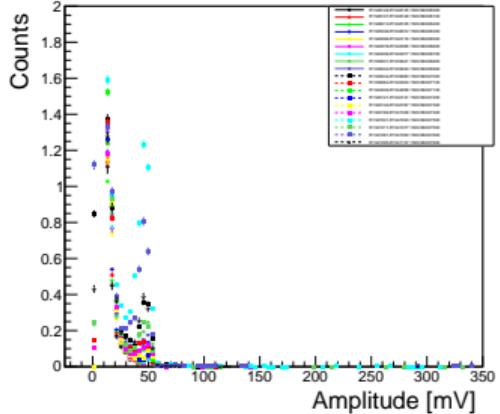
- ▶ R1347001-R1347023 1500 V/3600 V/7500 V follows quite a different trend than the others. It has the most pronounced negative polarity anode 3 and positive polarity anode 2 spectrum. It shows furthermore significant upwards fluctuations in the anode 3 baseline. It is likely that here something went wrong (sparking) and anode 3 was permanently triggered
- ▶ Above an anode 3 voltage of 6300 V, the peak at 150 mV (positive polarity anode 3 amplitudes) is larger than below. This peak seems to increase with voltage up to an anode 3 voltage of about 6800 V, 6900 V. After it does not change much any-more
- ▶ In the region anode 2 positive polarity amplitude spectrum there is as well a separation between data with anode 3 above 6300 V and below. (About 100 mV \pm a few 10 mV)



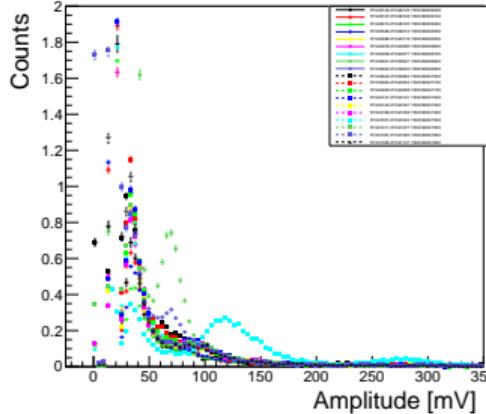
Amplitude spectra: Peaks vs voltage – 2/2

- ▶ Negative polarity anode 1 and anode 2 amplitude spectra show something like a peak – maybe slightly moving with voltage – from anode 3 voltages of 7400 V and upward
- ▶ In the positive polarity anode 2 spectrum we a peak at 60 mV which is only present for anode 3 voltages of 6800 V, 6900 V
- ▶ The second peak in the positive polarity anode 3 spectrum seems to increase with voltage throughout all runs and to move at an anode 3 voltage of 7600 V. However the peak position is different for both run groups at 7600 V

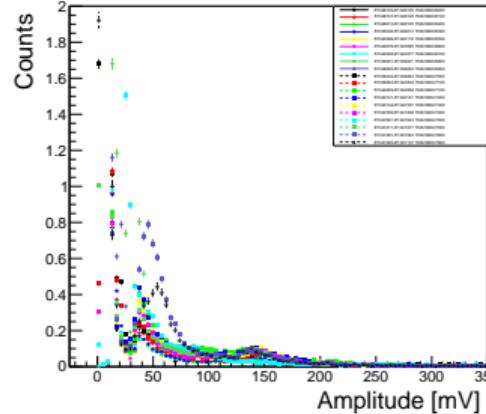
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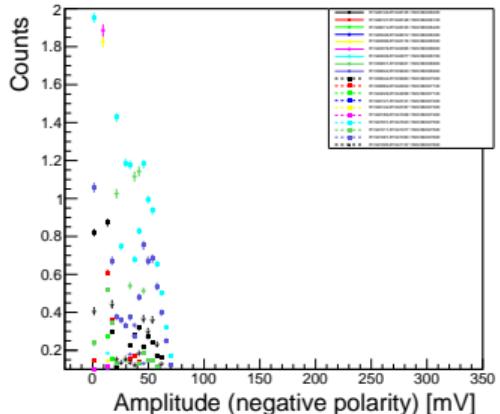
R1346129-R1346135_AmplitudeAnode2



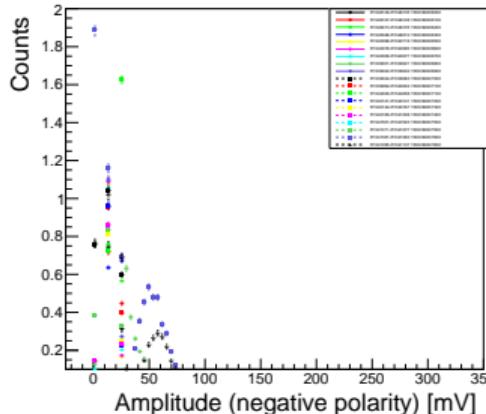
R1346129-R1346135_AmplitudeAnode3



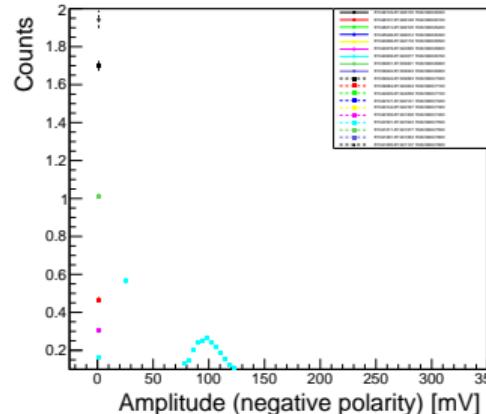
R1346129-R1346135_NegAmplitudeAnode1



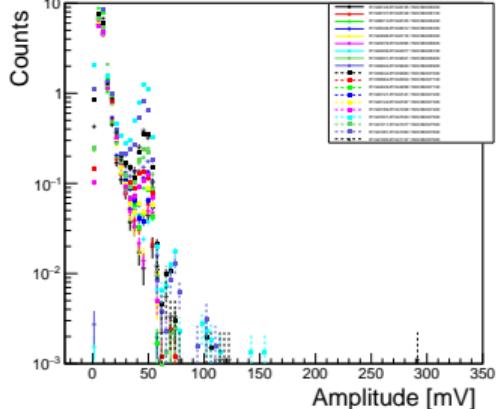
R1346129-R1346135_NegAmplitudeAnode2



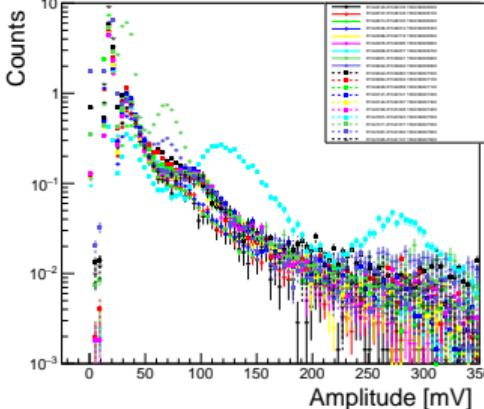
R1346129-R1346135_NegAmplitudeAnode3



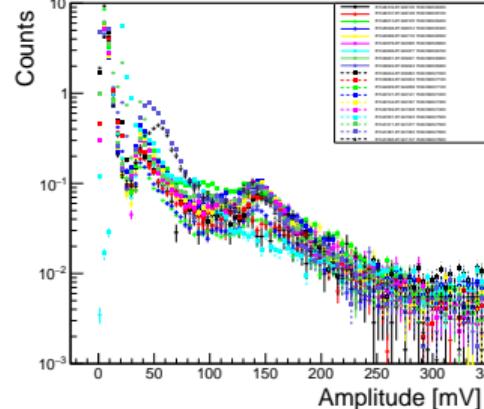
R1346129-R1346135_AmplitudeAnode1



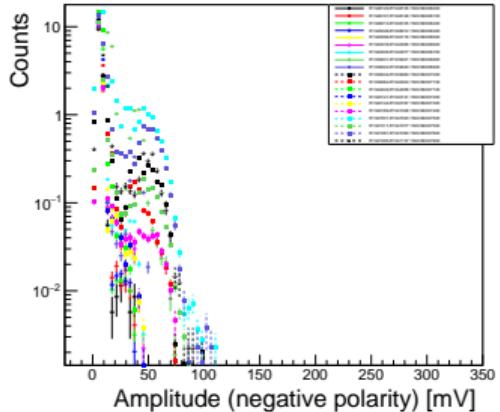
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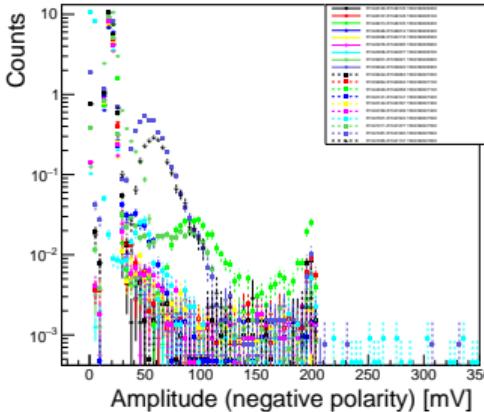
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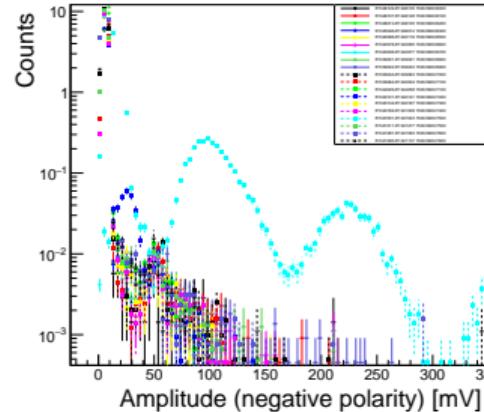
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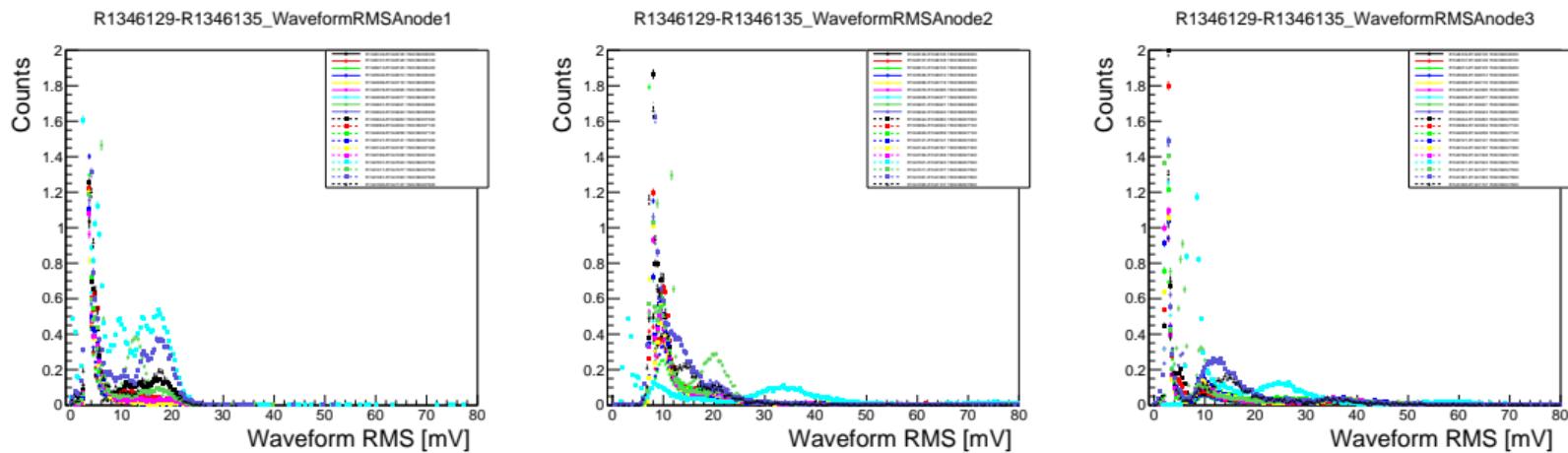


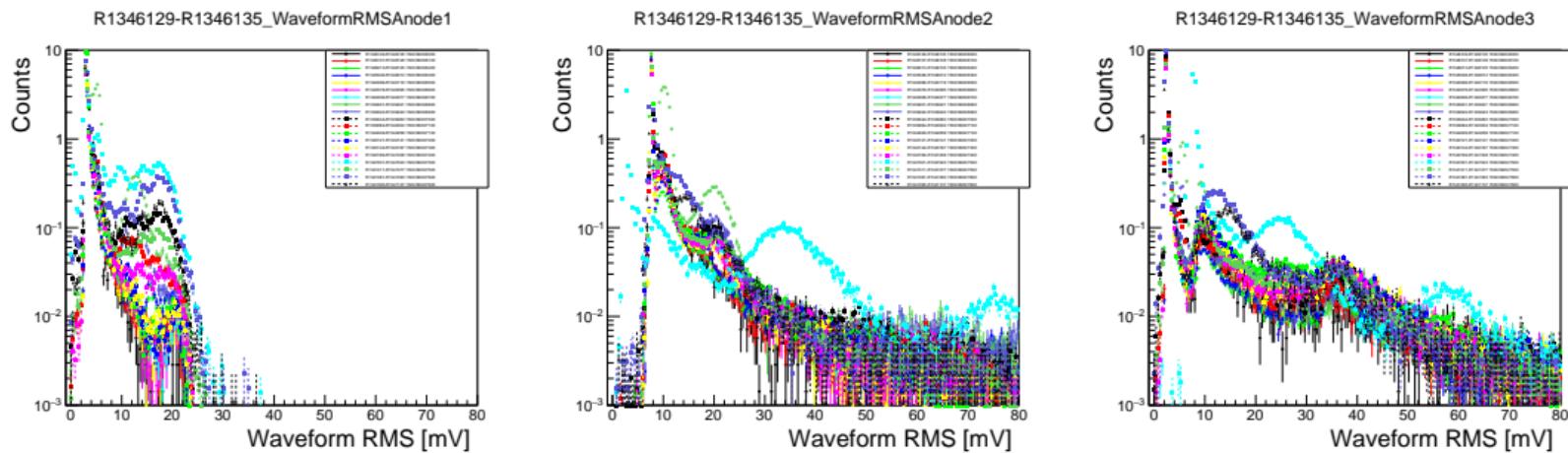
R1346129-R1346135_NegAmplitudeAnode2



R1346129-R1346135_NegAmplitudeAnode3

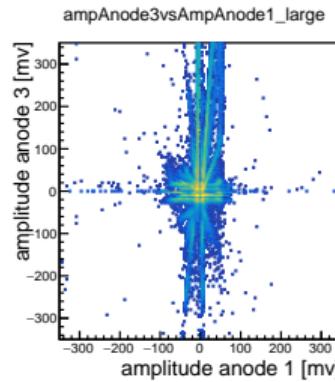
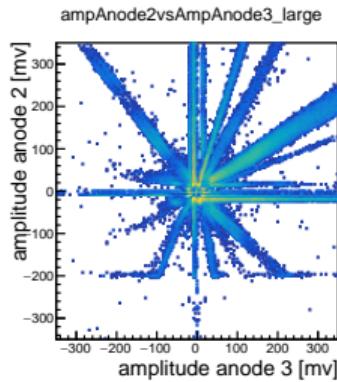
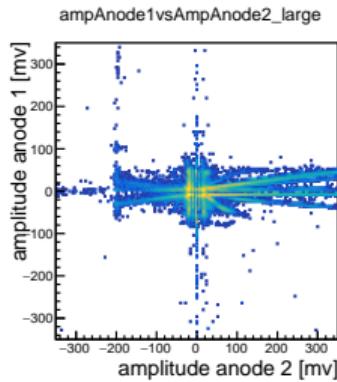


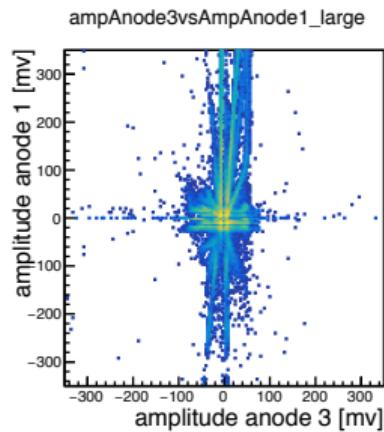
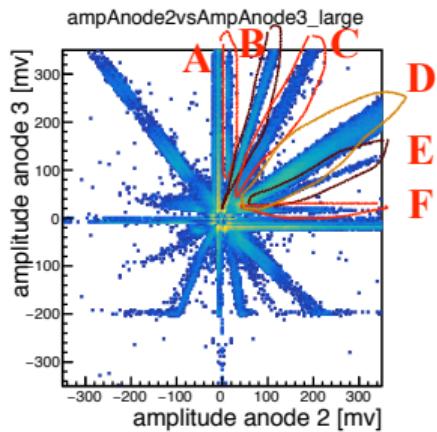
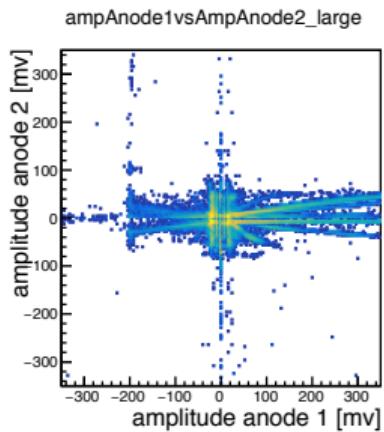




Amplitude correlation plots

All voltages

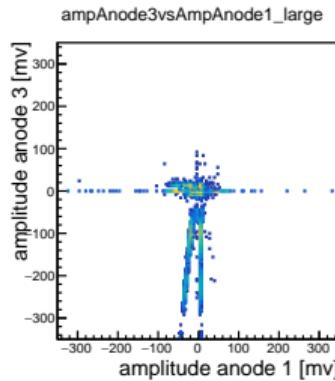
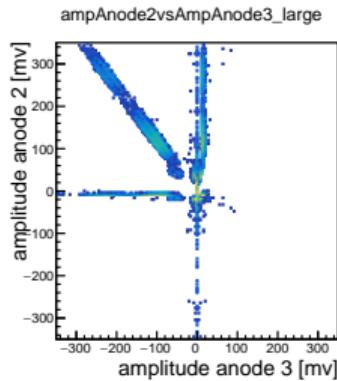
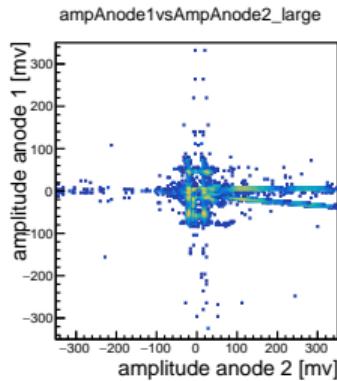




Axis labels swapped by accident

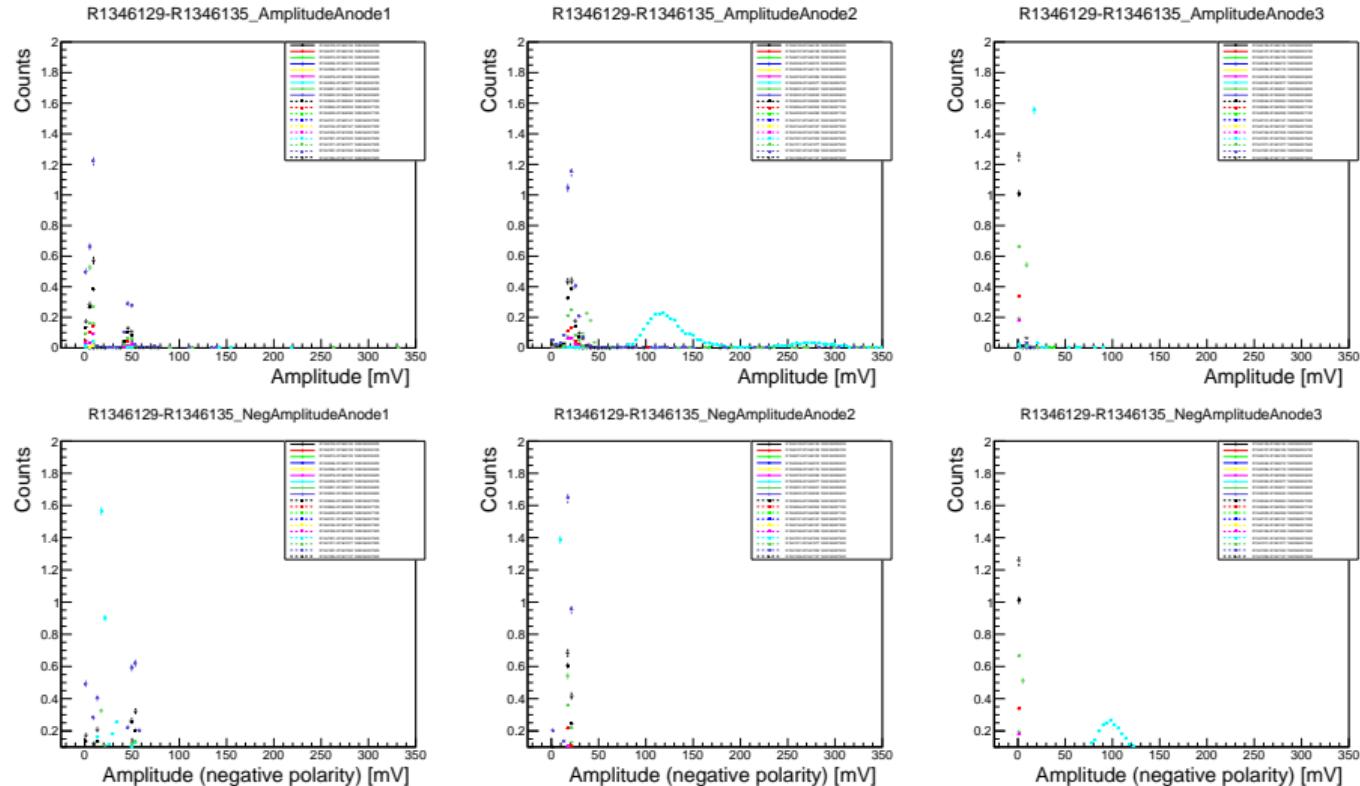
Amplitude correlation plots: Region A

All voltages

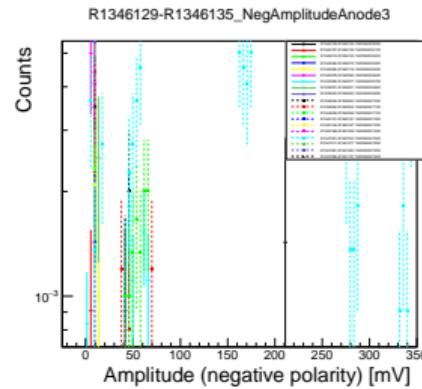
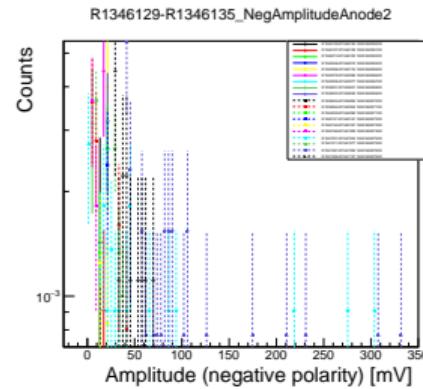
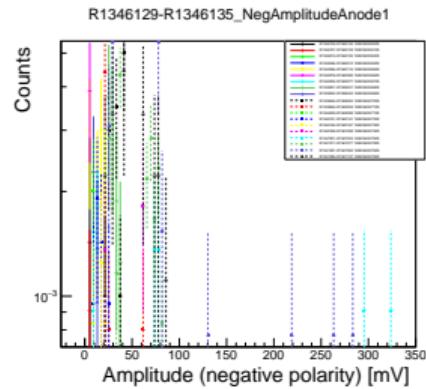
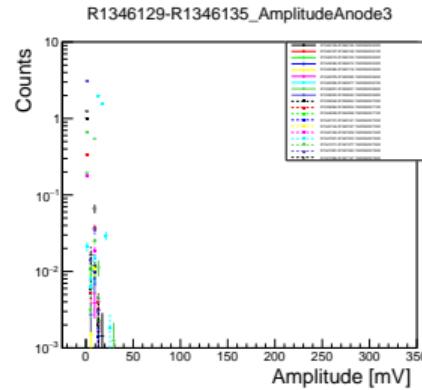
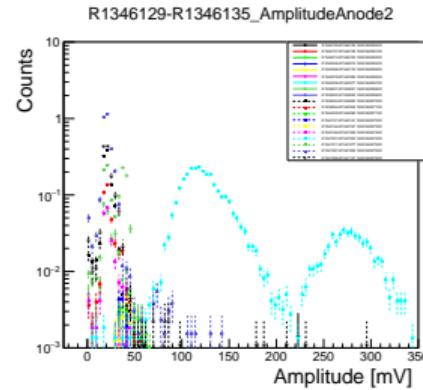
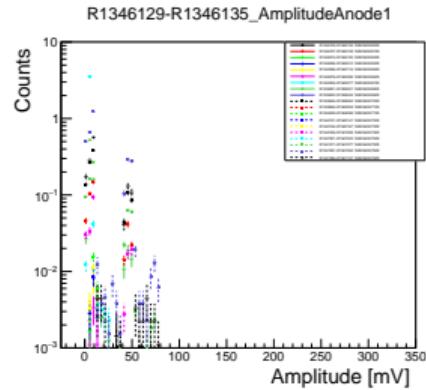


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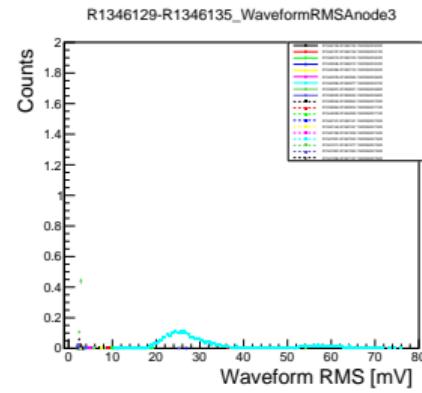
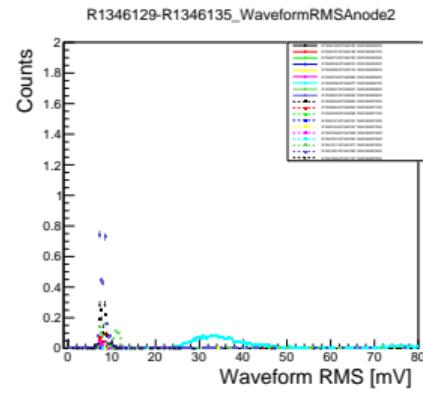
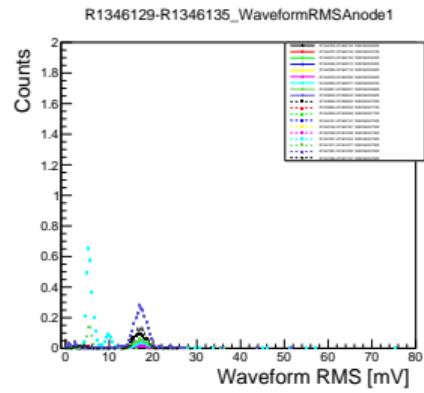
Region A: Positive and negative polarity amplitude spectra



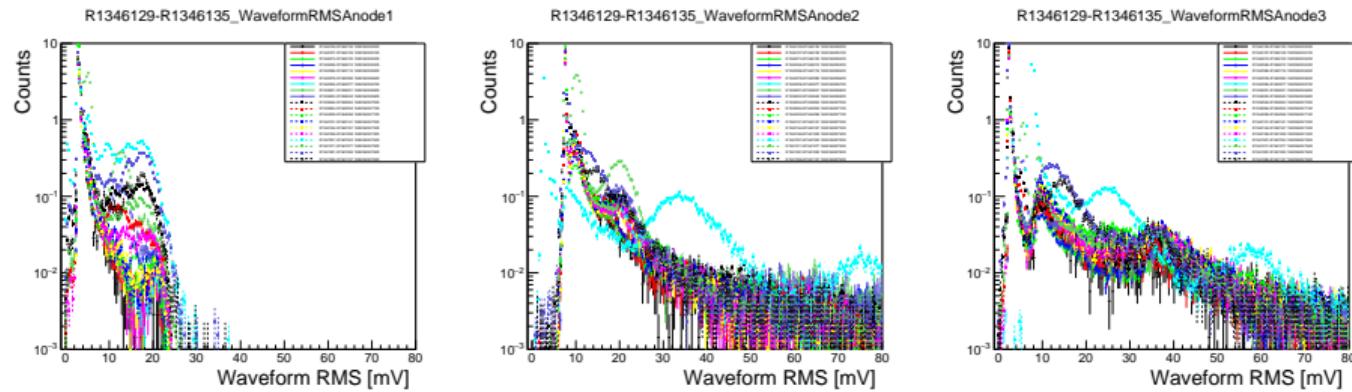
Region A: Positive and negative polarity amplitude spectra, log scale



Region A: Waveform RMS

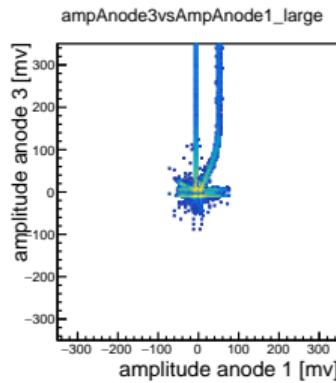
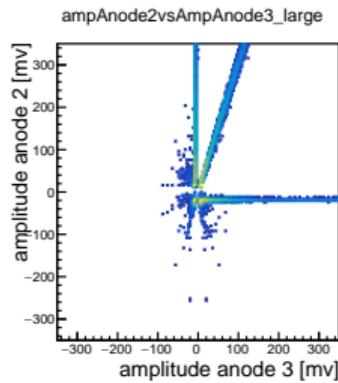
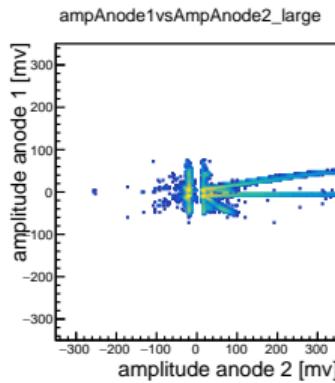


Region A: Waveform RMS, log scale



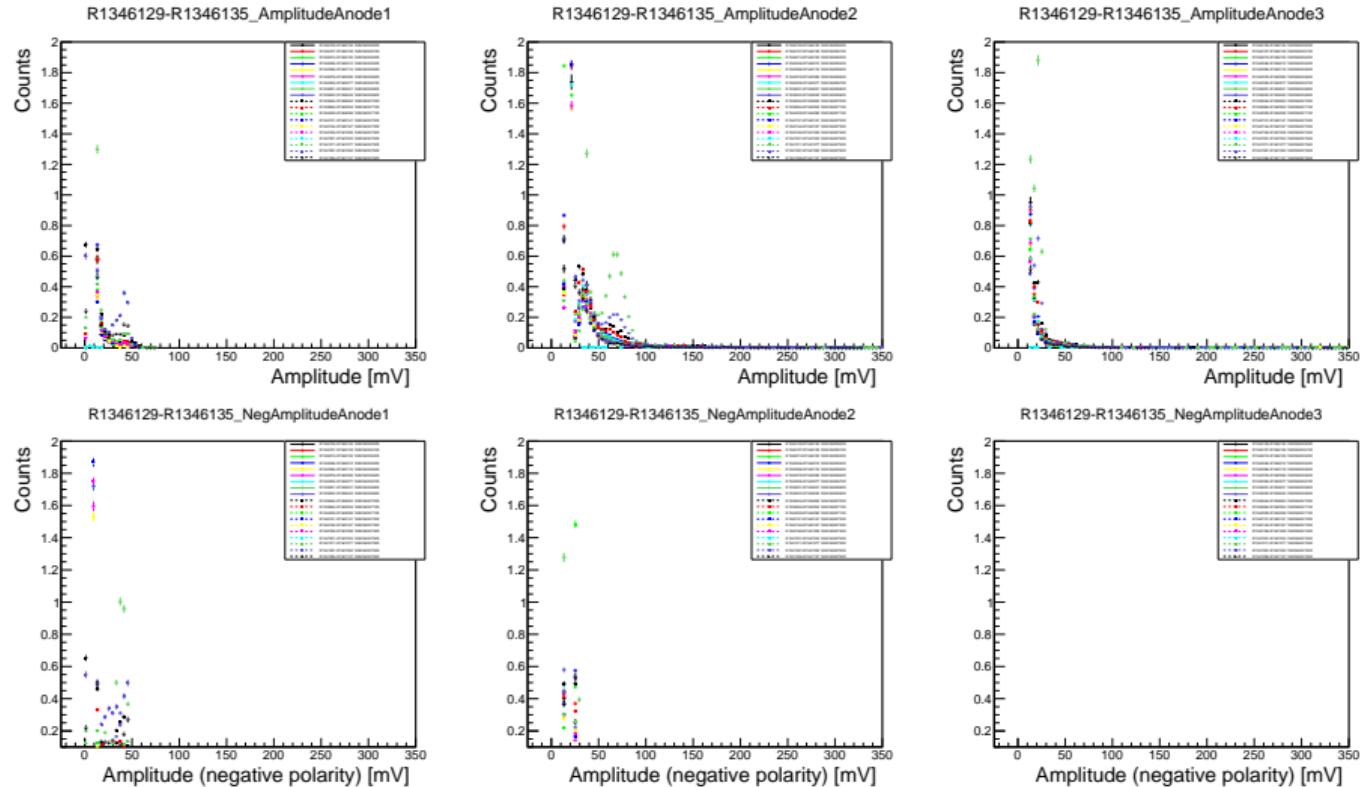
Amplitude correlation plots: Region B

All voltages

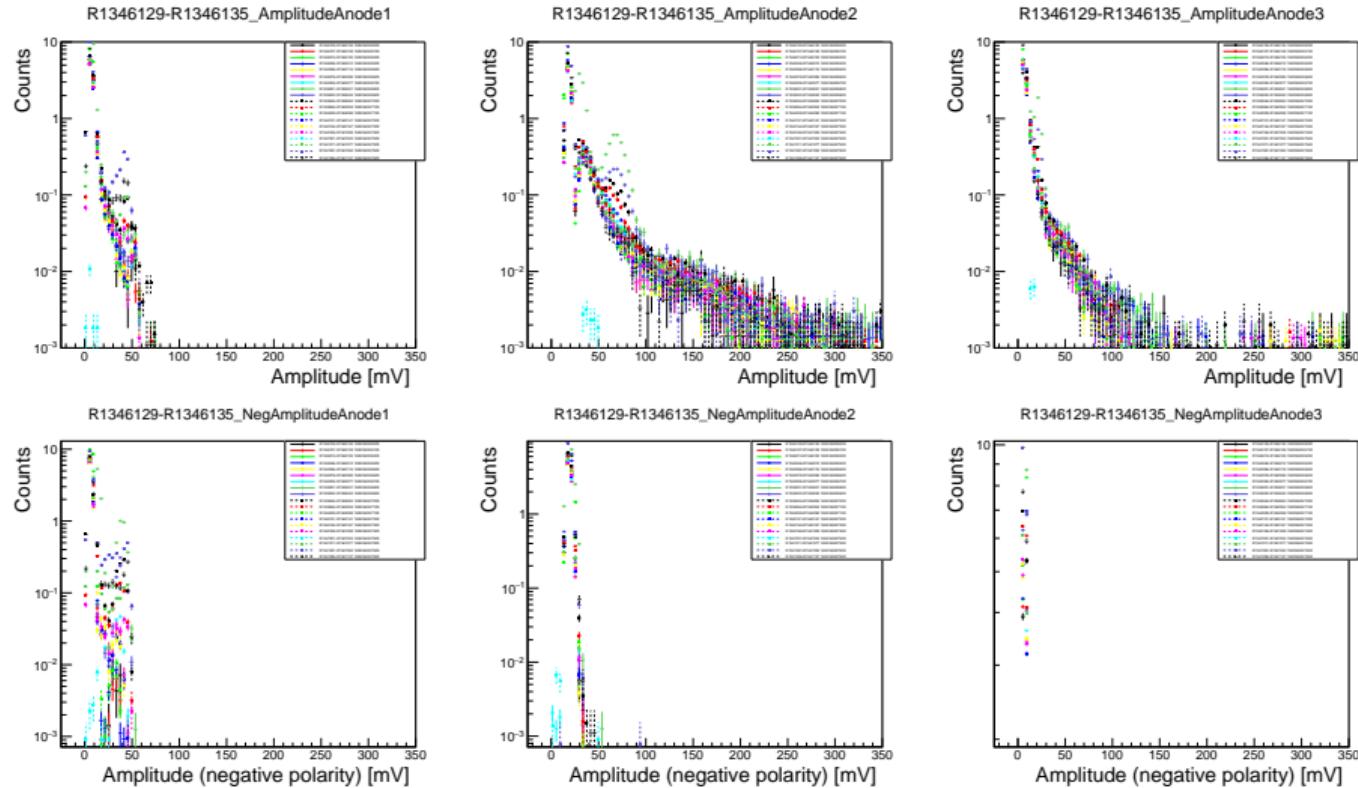


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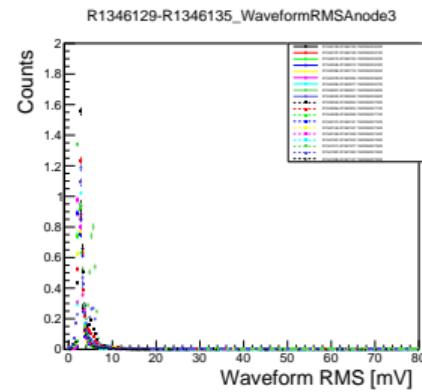
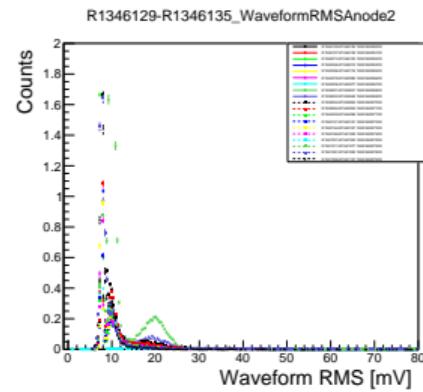
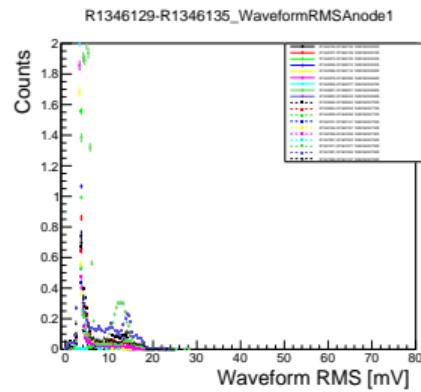
Region B: Positive and negative polarity amplitude spectra



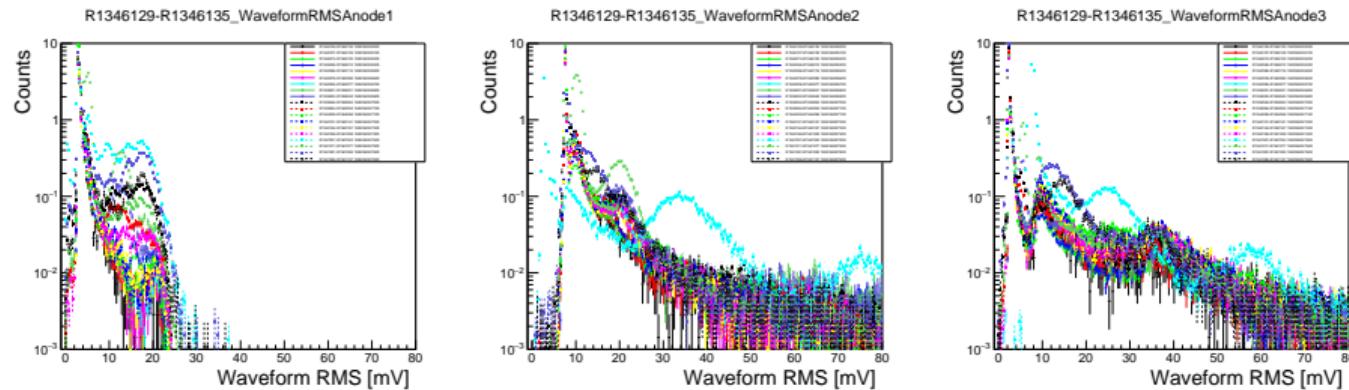
Region B: Positive and negative polarity amplitude spectra, log scale



Region B: Waveform RMS

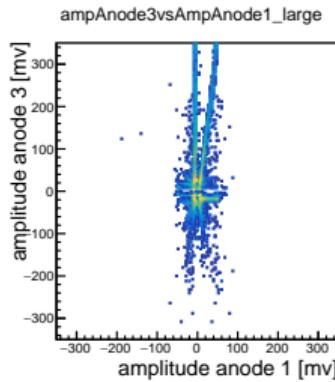
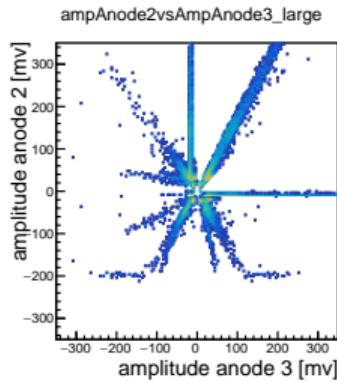
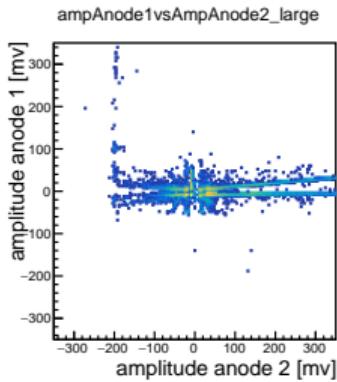


Region B: Waveform RMS, log scale



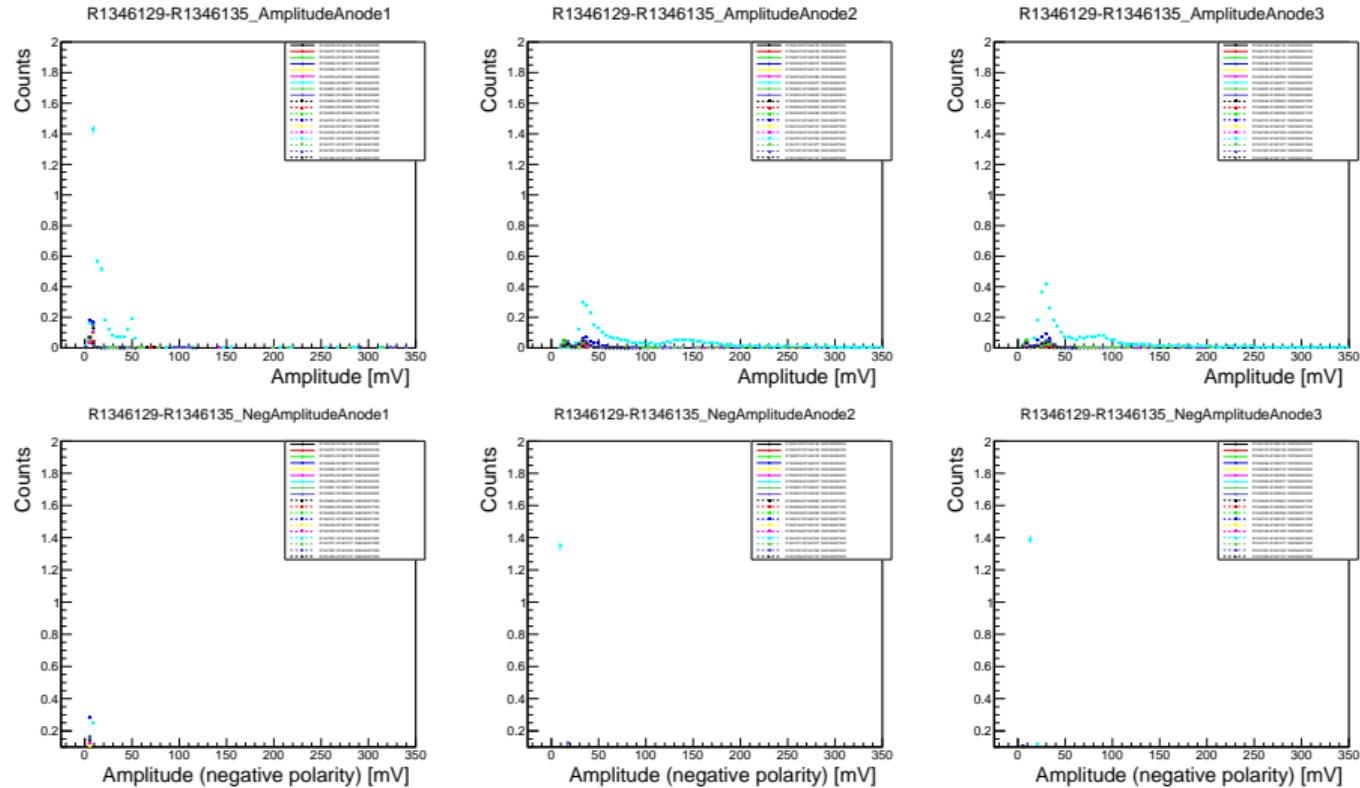
Amplitude correlation plots: Region C

All voltages

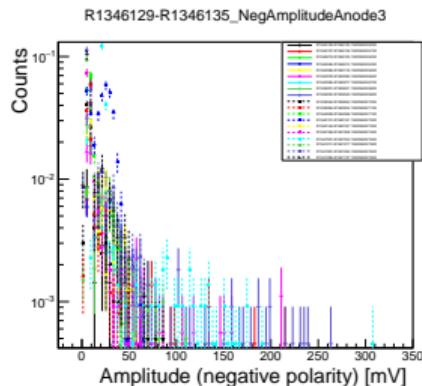
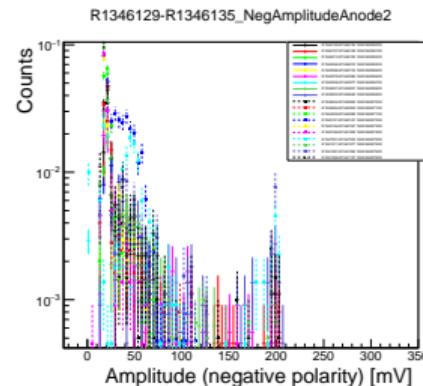
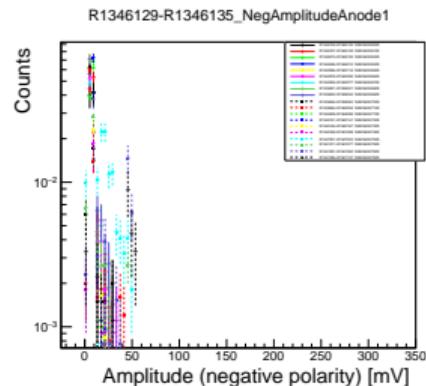
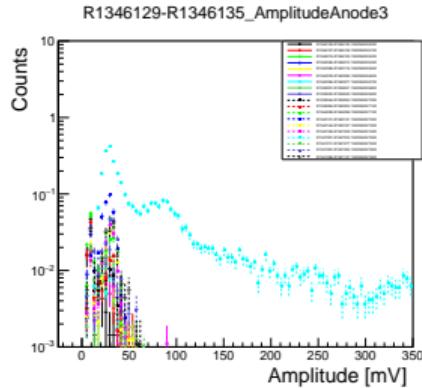
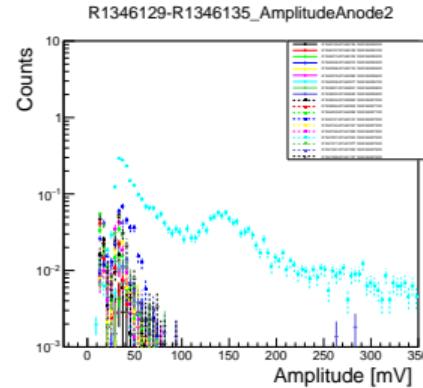
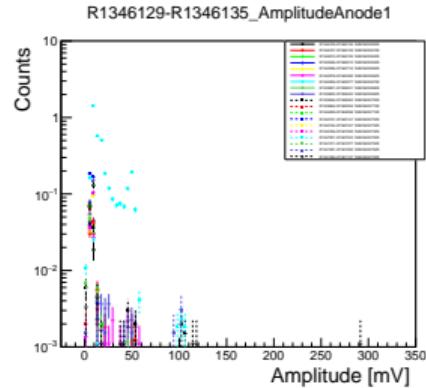


(AmplitudeAnode3*2 > AmplitudeAnode2 && AmplitudeAnode3 < AmplitudeAnode2)

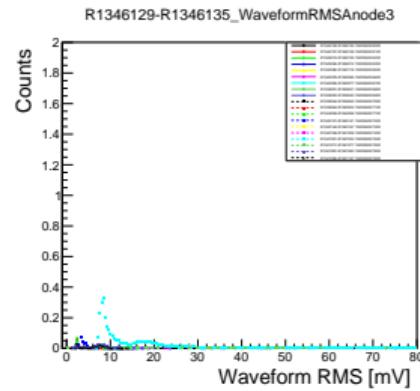
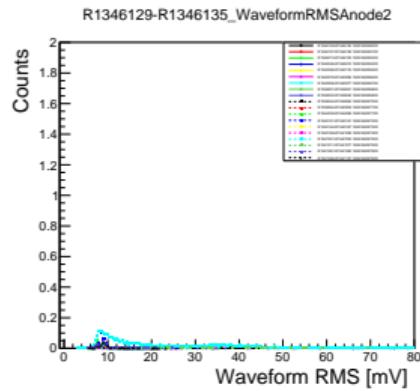
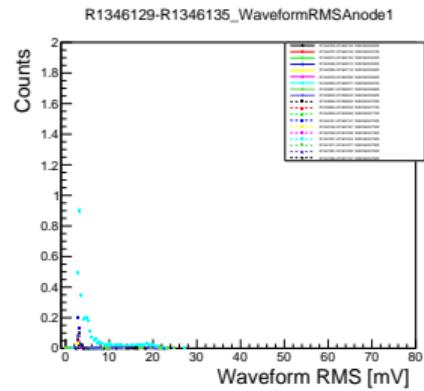
Region C: Positive and negative polarity amplitude spectra



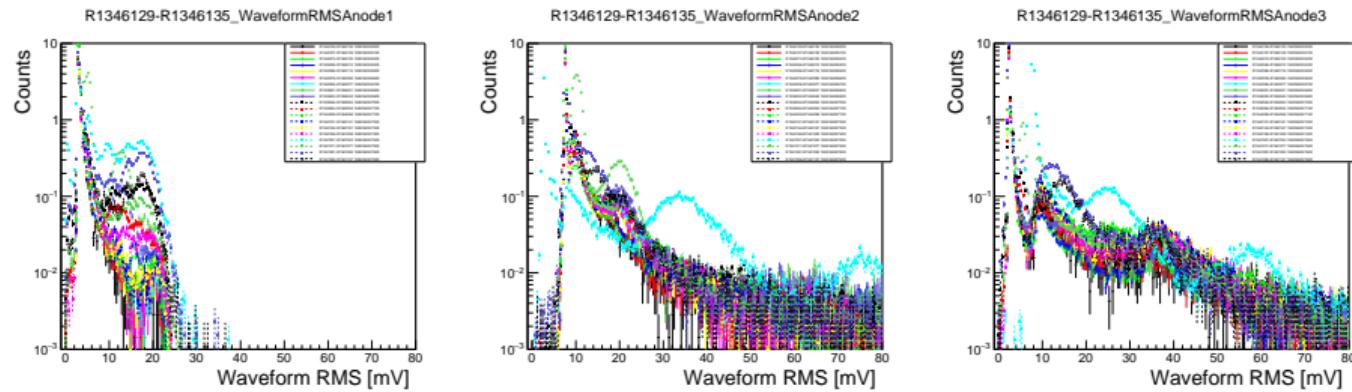
Region C: Positive and negative polarity amplitude spectra, log scale



Region C: Waveform RMS

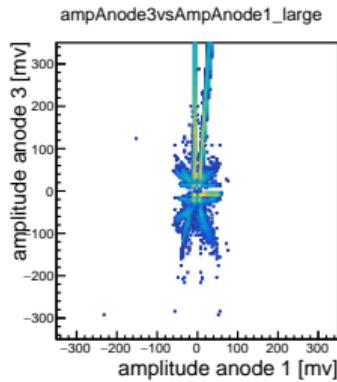
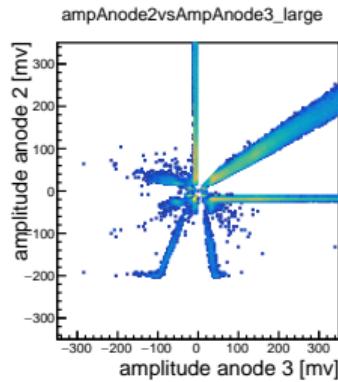
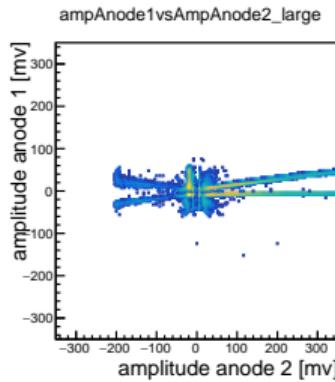


Region C: Waveform RMS, log scale



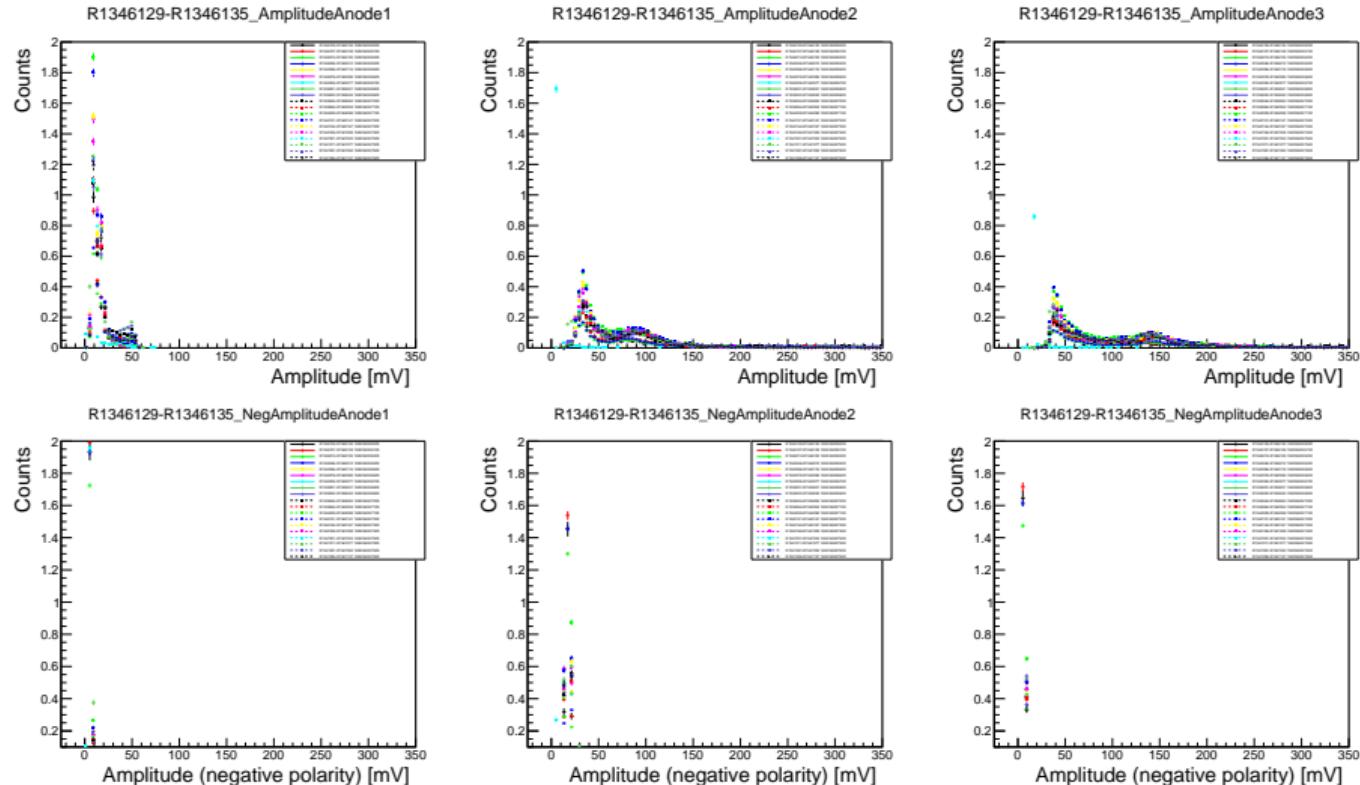
Amplitude correlation plots: Region D

All voltages

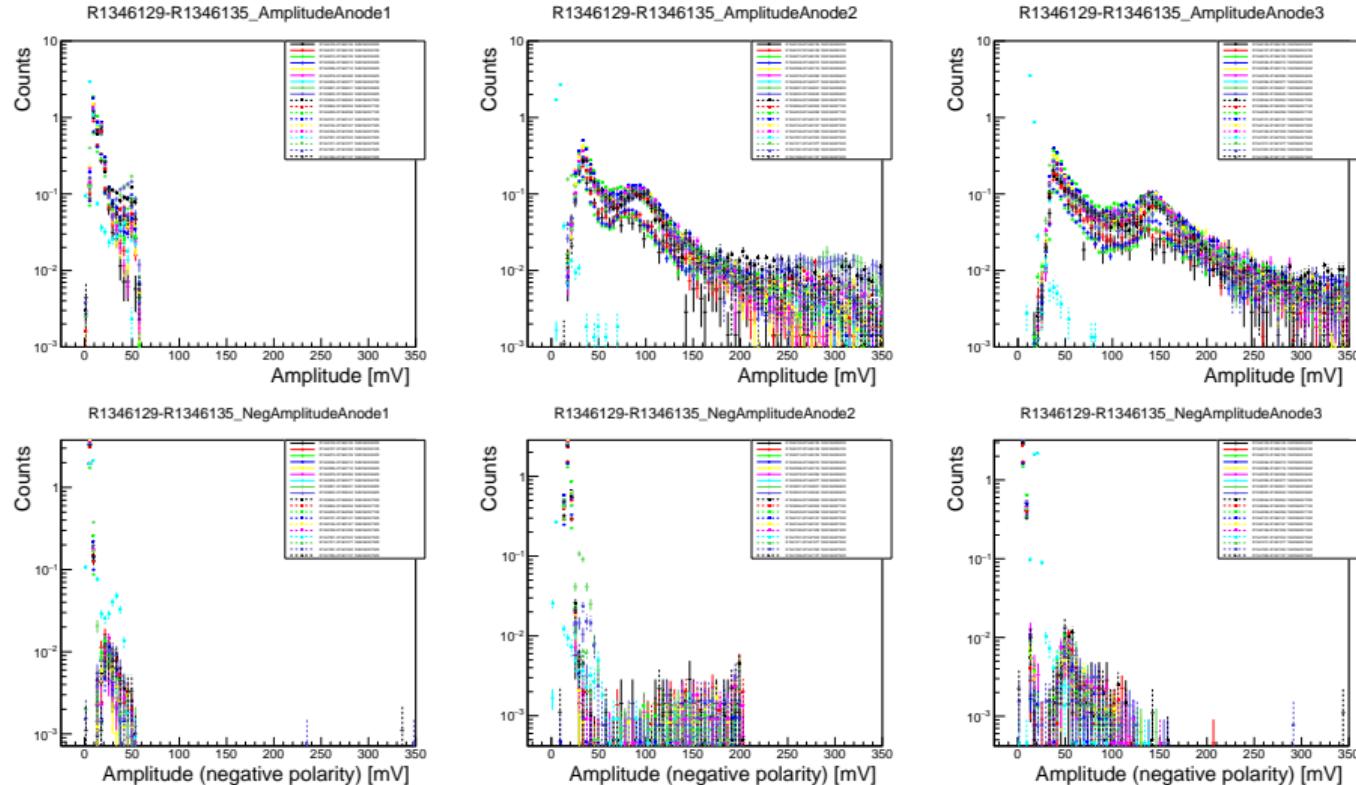


(AmplitudeAnode3 > AmplitudeAnode2 && AmplitudeAnode2*2 > AmplitudeAnode3)

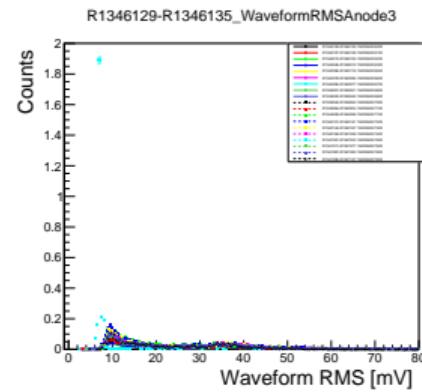
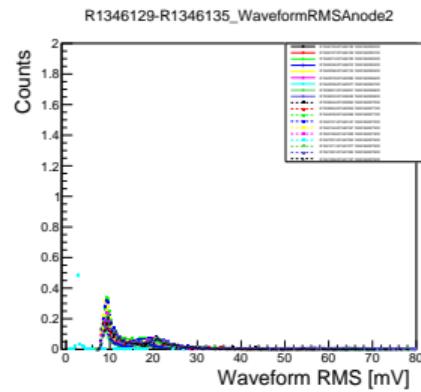
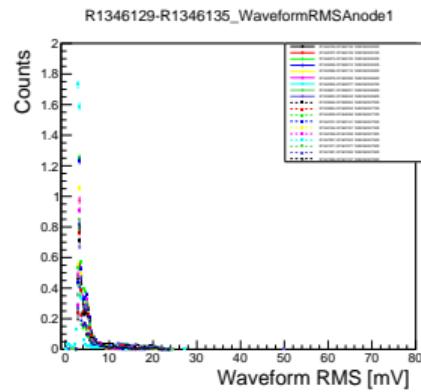
Region D: Positive and negative polarity amplitude spectra



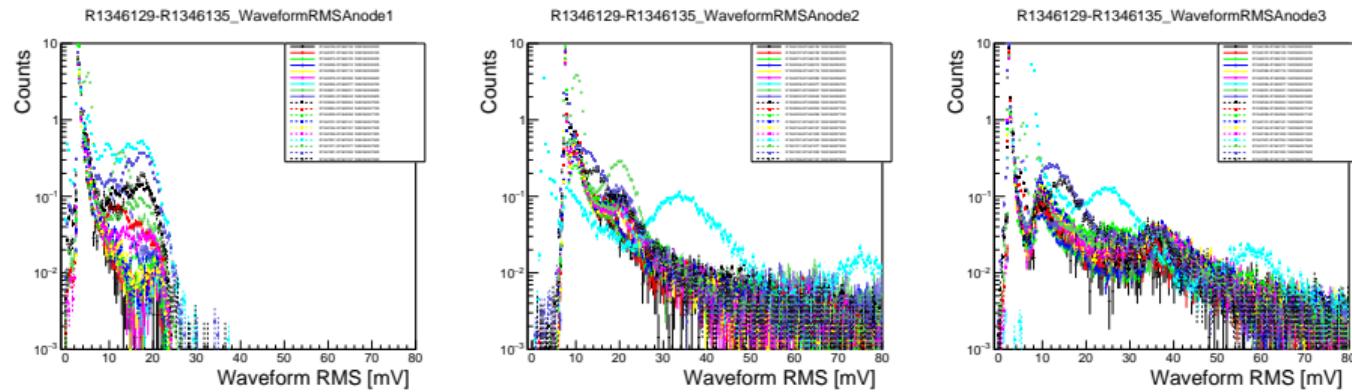
Region D: Positive and negative polarity amplitude spectra, log scale



Region D: Waveform RMS

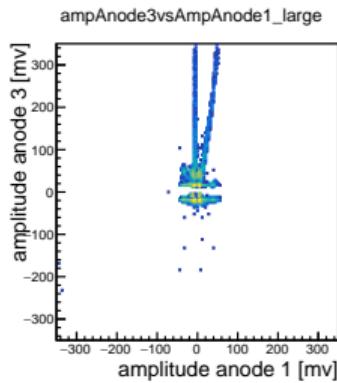
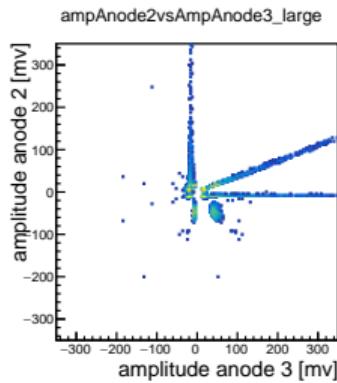
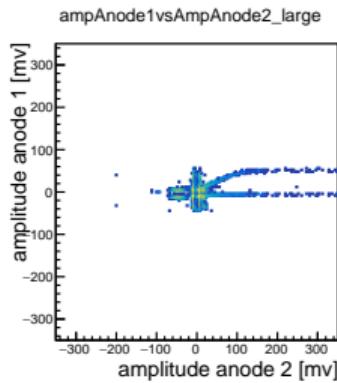


Region D: Waveform RMS, log scale



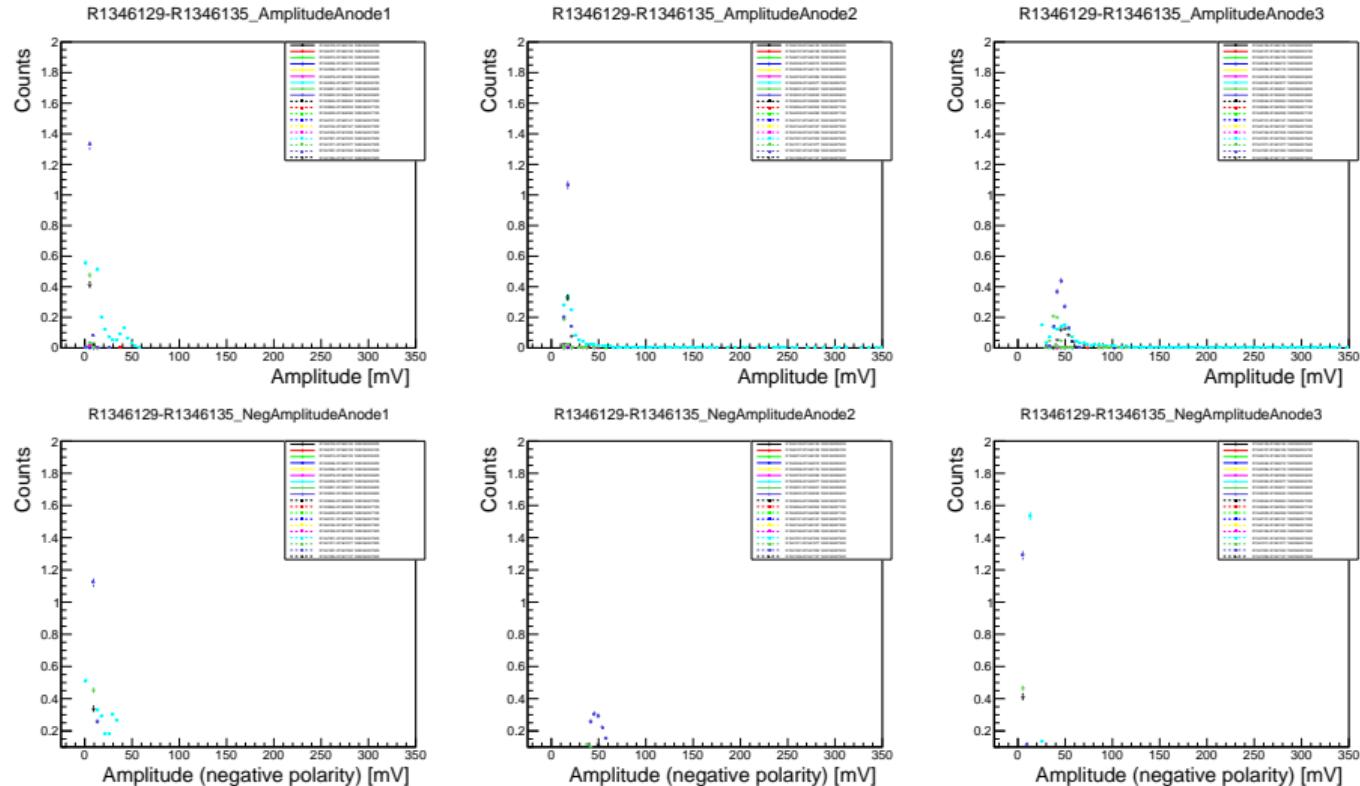
Amplitude correlation plots: Region E

All voltages

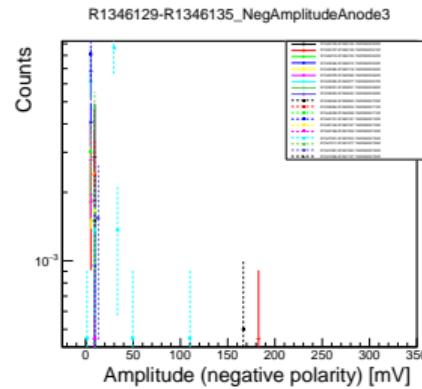
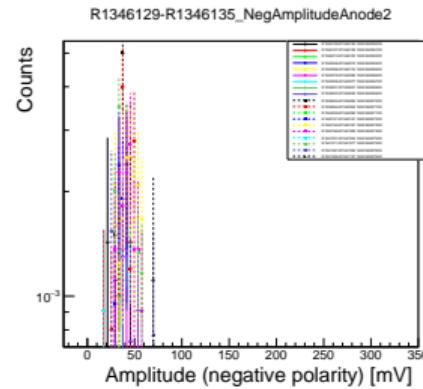
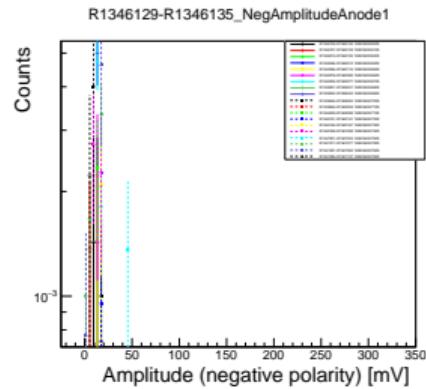
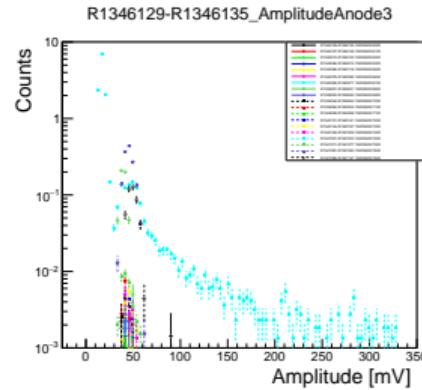
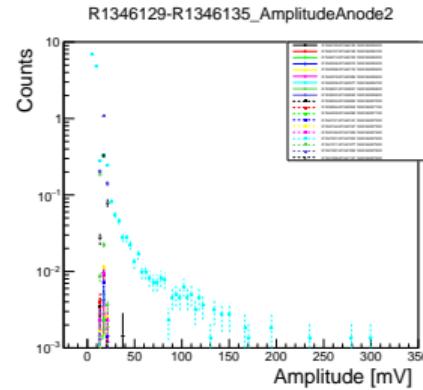
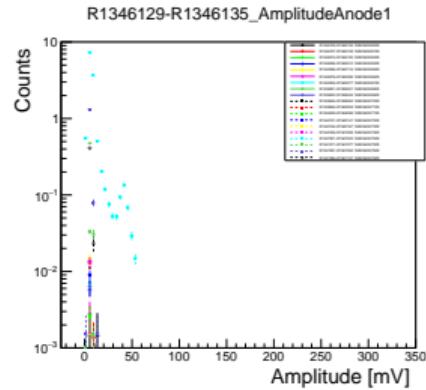


(AmplitudeAnode2*2.3 < AmplitudeAnode3 && AmplitudeAnode2*3 > AmplitudeAnode3)

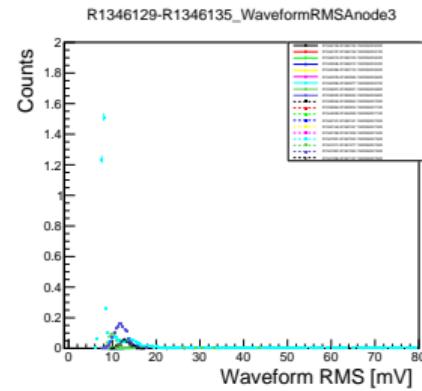
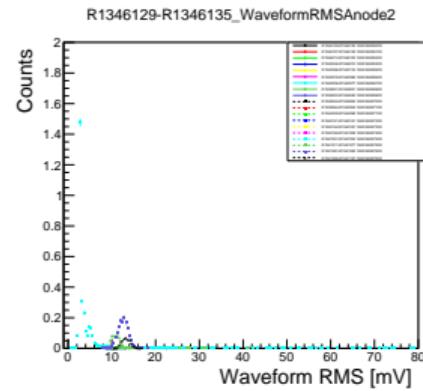
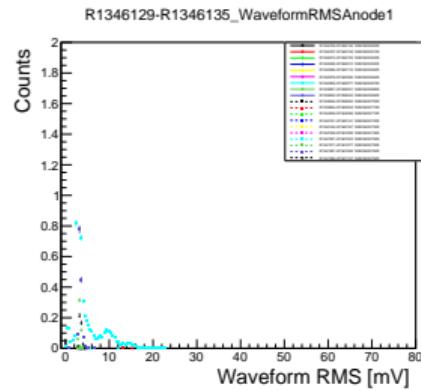
Region E: Positive and negative polarity amplitude spectra



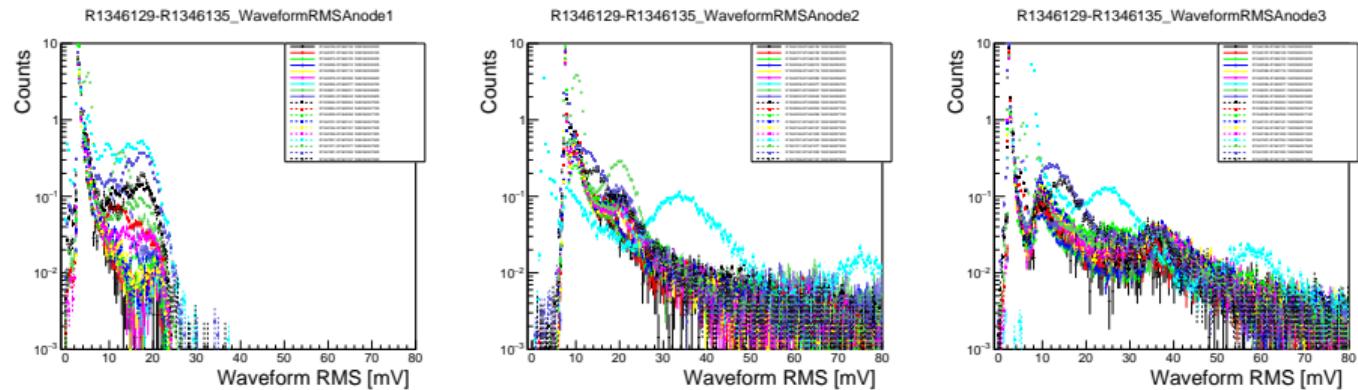
Region E: Positive and negative polarity amplitude spectra, log scale



Region E: Waveform RMS

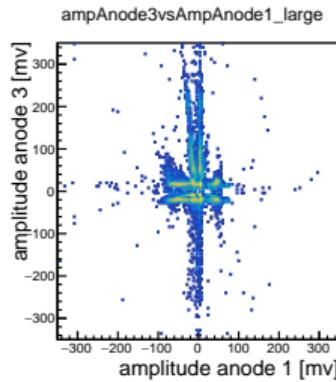
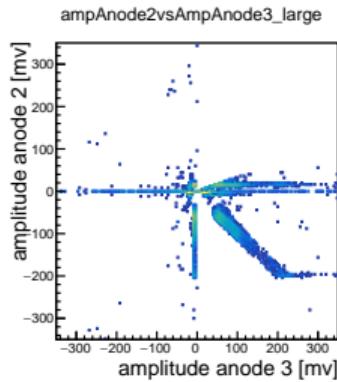
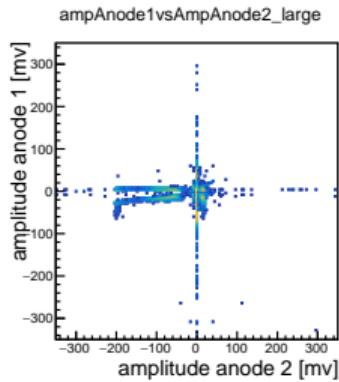


Region E: Waveform RMS, log scale



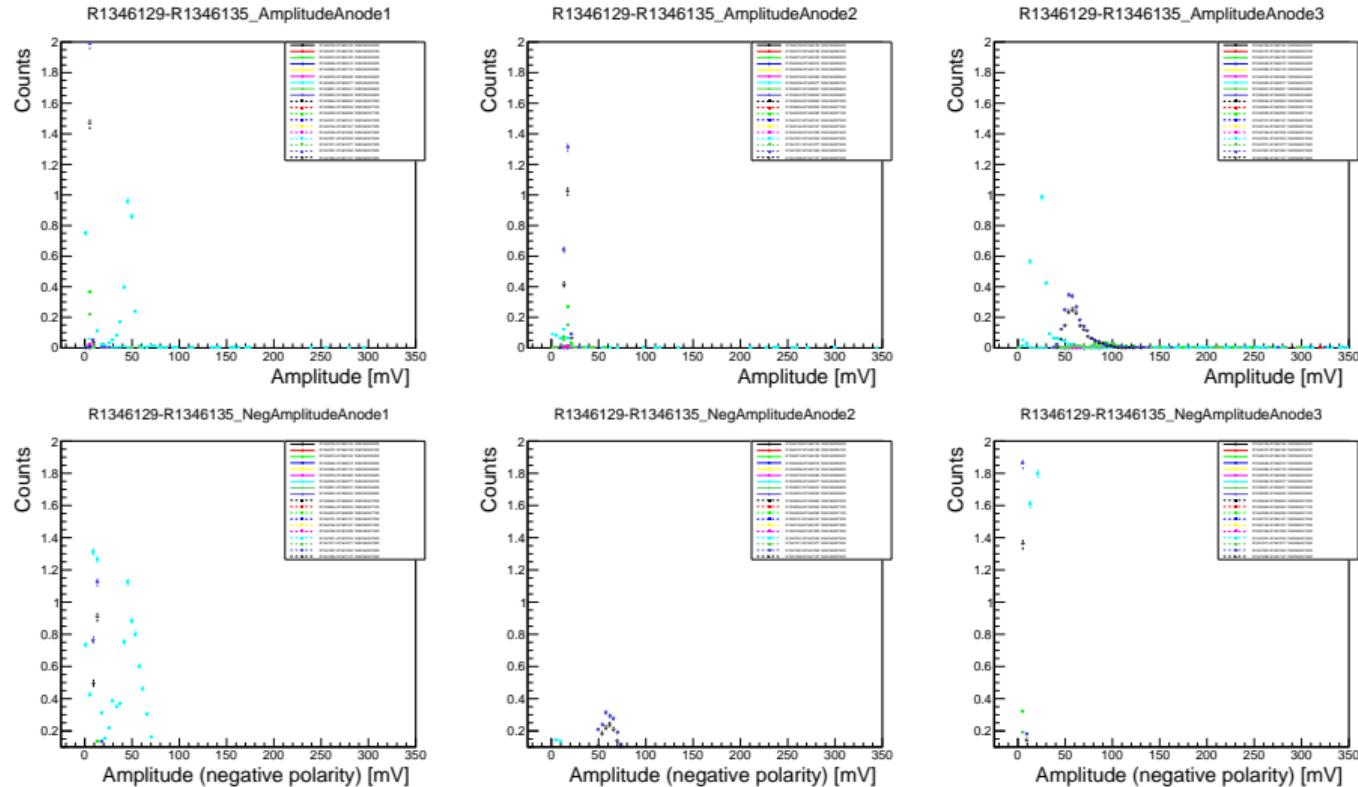
Amplitude correlation plots: Region F

All voltages

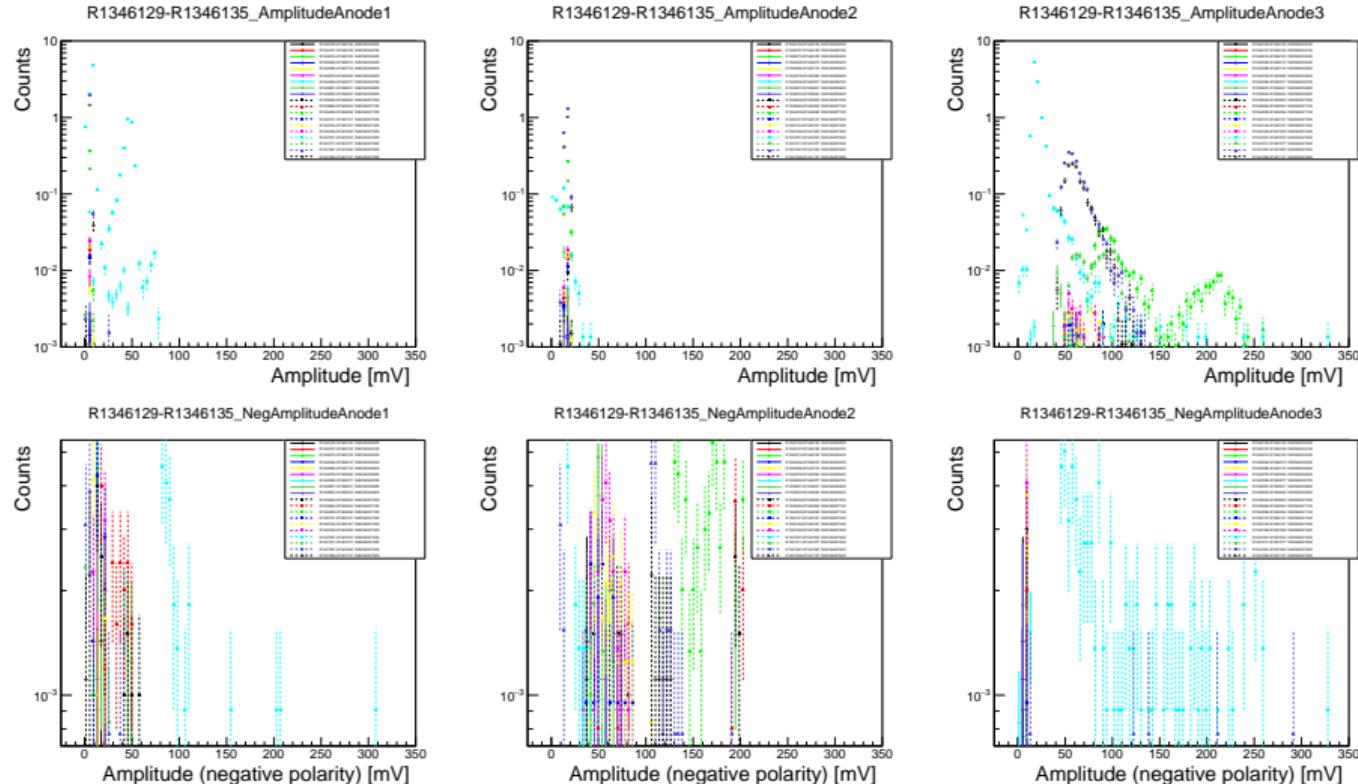


(AmplitudeAnode2*3 < AmplitudeAnode3)

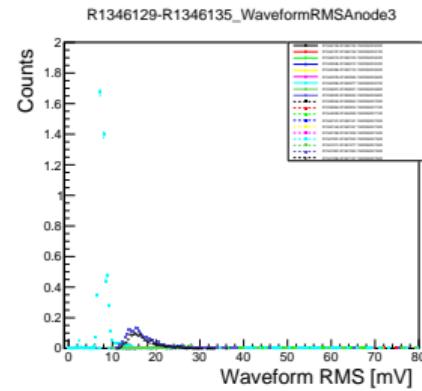
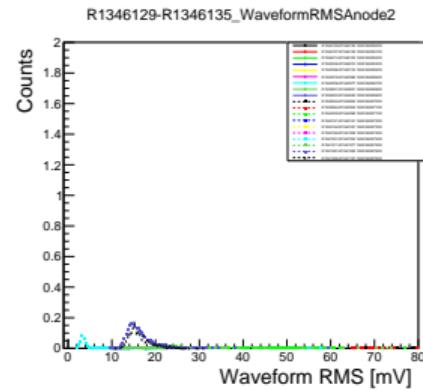
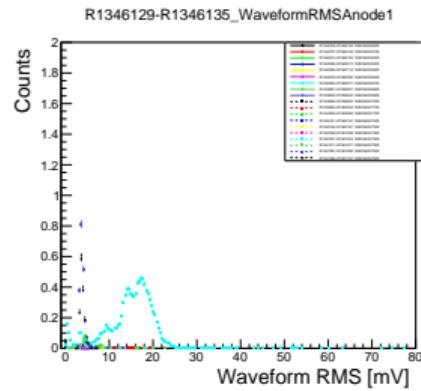
Region F: Positive and negative polarity amplitude spectra



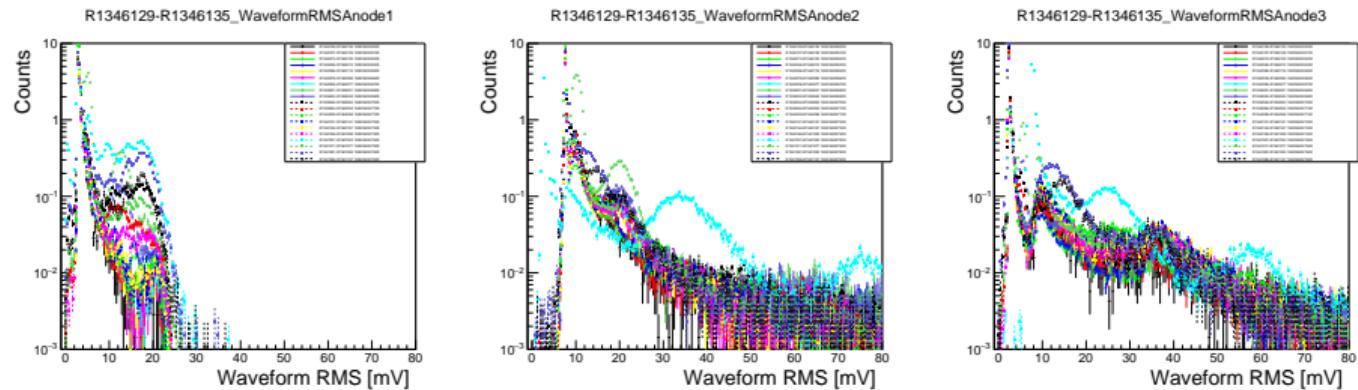
Region F: Positive and negative polarity amplitude spectra, log scale



Region F: Waveform RMS



Region F: Waveform RMS, log scale



Backup

ToDo's

Week 46 – Waveform RMS: Data (^{55}Fe) vs background (no source)

Closing remarks

- ▶ There is a good indication that the peaks in the RMS are due to the source
- ▶ The nice spectra from anode 2 and anode 1 may result from negative polarity signals
 - ⇒ Check for negative signals in the analysis code
- ▶ Amplitude and RMS correlation looks as if we could calibrate that
- ▶ I don't have yet Ed's triptych code to check the different regions as well
 - ⇒ Do triptych's for the three signal regions
- Still pending: sin-fit correction on pre-selected waveforms

ToDo's

Week 36 – Waveform analysis

Analysis overview

- ▶ A fraction of the August data - pure Ar and Ar-CO₂ at various pressures has been analysed using exponential smoothing as well as a sin fit to subtract periodic noise

On the noise-fit:

- Check more advanced fit-functions than just a plane sin fit
 - Check whether the fit range can be changed to improve the overall results
 - Do detailed χ^2 cuts and checks with the current data set to see where the fit improves the analysis
- ⇒ A more detailed presentation will follow

ToDo's

Week 30 – Hardware report

General HPTPC news:

- ▶ Over the last week-end we took data until the DAQ decided to not take data anymore.
(This cost us the highest voltage setting)
- ▶ On Monday we had once more Imperial man-power ⇒ See the slides on the OROC holder test
- ▶ Evacuation over the rest of Monday, and the full Tuesday
- ▶ Right now we are back to about Ar-CO₂ (88-12) at 1 atm
- ▶ Data taking at these voltages is still pending

Coming up:

- ▶ **Power outage in the HPTPC lab on Mon, T111 probaly more than one day**
- Couple test pulses in one of the meshes and readout the other preamplifiers
- Look into changing the T111 and T133 clean room filters

OROC updated

- ▶ All shortening cards are in place
- ▶ The OROC is back in its box and awaits testing
- ▶ Everything needed for the HV distribution boxes I have in hand
- ▶ The following list of OROC ToDo's applies:
 - Put cooper shims
 - Do the HV distribution network
 - HV tests in air
 - Pulser test in air
 - Construction of the field line termination plane
- ▶ We ordered pre-mixed Ar-CO₂ (85-15) – as soon as this arrives and the tests in air are done, we will start flushing



OROC holder tests

- ▶ The production of the OROC holder for the vessel is progressing well
- ▶ In the pictures you see a fitting test to the vessel
- ▶ The full holder should be completed in the next weeks

Readout Electronics update

- Two digitiser board with the APV assembled
- Components for the attenuation/protection board arrived at Imperial and the assembly is under-way
- First iteration of the firmware written (@Imperial)
- Felix integration tests with the digitiser board only (@Imperial)
- Commissioning with a small detector ...



Bias T sparking

- ▶ At about 3.5 kV on anode 3 sparking in the anode 3 bias T occurred
 - ▶ Previously higher voltages had been achieved, all components in the anode 3 bias T are rated for high voltage
 - ▶ It turns out that the *signal-to-preamp* (which should be at ground potential) leg of bias T discharged against the nearest ground
 - ▶ The same could be observed at the anode 2 bias T for high voltages
 - ▶ As a measure the anode 3 *signal-to-preamp* leg has been connected to ground via a $3\text{ M}\Omega$ resistor to provide a path to ground in case there is some charging up
 - ▶ We observed once more discharges in a bias T, but could not determine whether it was in the anode 3 one
- We'll keep an eye....
 - Check that there are no effects on the signal readout with the extra resistor

- ▶ All shortening cards which we could put, are in place
- ▶ The OROC is back in its box and awaits testing
- ▶ We have the aircon again running in the MWPC and MPGD lab
- ▶ Copper shims should arrive tomorrow or next week
- ▶ A slightly reduced list of the usual OROC ToDo's still applies:
 - Put cooper shims
 - Do the HV distribution network
 - HV tests in air
 - Pulser test in air
 - Construction of the field line termination plane

ToDo's

Hardware report week 29

A word on high frequency noise

- ▶ There is 1.35 MHz noise in the data
- ▶ However: It turns out that is only there at certain instances and permanently, uncorrelated with changes to the HPTPC → Possibly something else in the building is responsible
- ▶ In other news: The signal from the preamp at anode 2 looks different, because the evaluation board there has a different capacitor
- ▶ Hence:
 - Test the response of the modified preamp to test pulses on the test input
 - Do the same, but with pulses coupled into the real input using a capacitor
 - Drive the preamps into saturation (check first on the old scope as a safety measure)
 - Do the same test with a non modified preamp
 - Drive **only** standard preamps into saturation (check first on the old scope as a safety measure)

- ▶ The first samples for the copper shims arrived, they fit and the rest is ordered
- ▶ Annora measured dust counts and I did a clean of the floor in T111 – We will see whether this helped
- ▶ The next OROC step:
 - Put shortening cards (cooper shims)
 - Mount the OROC back to the lid of the test box (copper shims can also be placed after this)
 - Do the HV distribution network
 - HV tests in air
 - Pulser test in air
 - Construction of the field line termination plane



ToDo's

Hardware report week 26

- ▶ Jocelyn fixed the burst disk:
 - ▶ We discovered where was a puncture in the burst disk
 - ▶ It was replaced with a 5 barG burst disk
- ▶ ^{55}Fe is in the vessel now → We will explore with one fill if we can see a peak related to this source
- Filling the vessel again
- Decision on a gas mixture / pressure for a diffusion measurement will be made when we have first insights from the light gain analysis
- Talk to FIKE what they think is the best solution for our use case (possibly another pressure relieve valve)

ToDo's

Waveform report week 25

Update on the toy Monte-Carlo to model the energy deposited in the detector

- ▶ Using the known decay energies the ^{241}Am sources (α , γ) and the ^{137}Cs (β , γ) decay energy spectra are modelled
 - ▶ ^{137}Cs β -spectrum: Based on interpolated IAEA data
 - ▶ γ - and α -spectra: Approximated using Gaussians with an arbitrary width
- ▶ The γ absorption as well as charged particle ranges are extracted from ESTAR, PSTAR and XCOM
- ▶ γ s and α s are assumed to deposit their full energy in the detector
- Currently cosmic μ are added
- Garfield/heed will be used for the energy deposit of charged particles
- Furthermore the detector geometry is being put in
- ^{55}Fe is added