

Mysterious Peaks and the Anode 2/3 Swapping Issue

Harrison Ritchie-Yates



3rd of February, 2019

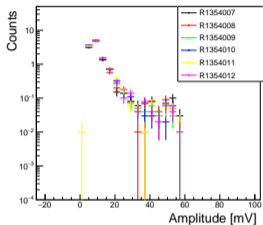
- ▶ Continued investigation into the extra peaks seen in the charge amplitude spectra.
- ▶ The peaks appear in some runs, but not others, and at different amplitudes.
- ▶ Previously, there has been discussion that the peaks may only appear in events containing sparks, We have further investigated the relationship between sparks and extra peaks.

Amplitude spectra

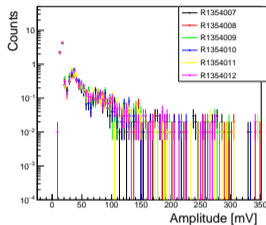
- ▶ In the following amplitude spectra for the three anodes and different cuts are shown
- ▶ On the vertical axis counts are shown, normalised to one event (*i.e.* a 2 s exposure)
- ▶ We compare two sets of runs, taken with the same voltage settings.
- ▶ We corrected the anode IDs in software: Everything you see in a plot labelled *e.g.* anode 2 originates from anode 2 in the detector

Amplitude Spectra for runs with Anode 3 voltage 7400V R1354007-12

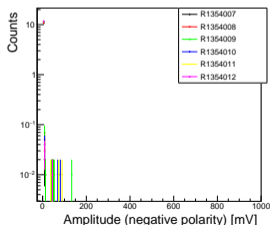
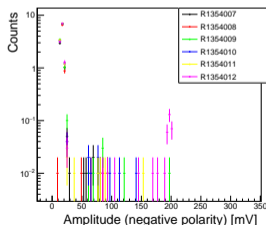
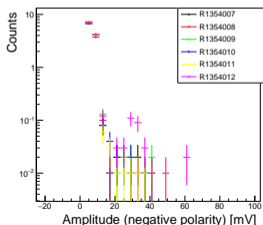
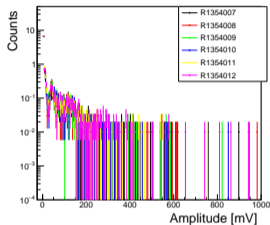
Anode 1



Anode 2

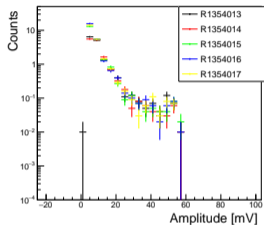


Anode 3

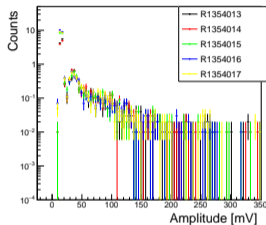


Amplitude Spectra for runs with Anode 3 voltage 7400V R1354013-17

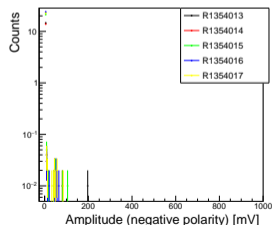
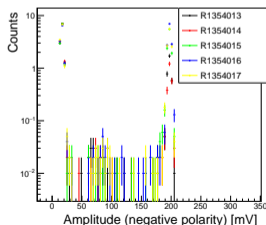
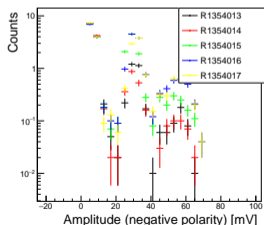
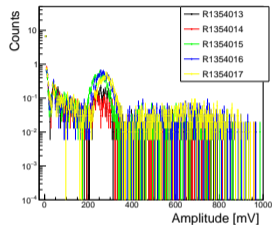
Anode 1



Anode 2

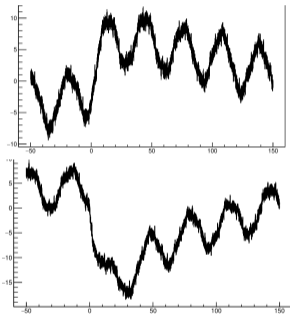


Anode 3

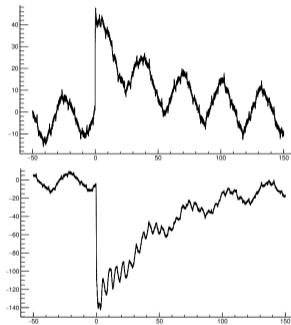


Waveforms

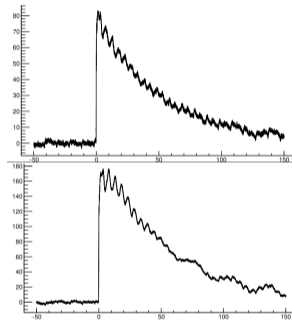
Anode 1



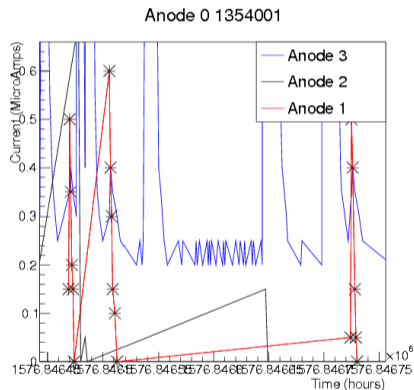
Anode 2



Anode 3



Plots of current draw to investigate sparking

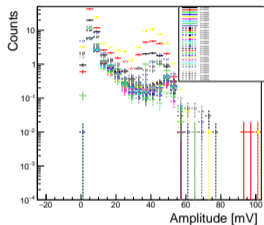


Peak?	~Peak Position (mV)	Any sparking
Y	140	N
Y	140	N
Y	140	Y
Y	140	N
Y	140	Y
Y	140	N
Y	140	N
Y	140	Y
Y	140	N
Y	140	N
Y	140	M
Y	140	Y
Y	140	N
Y	140	N
Y	140	N

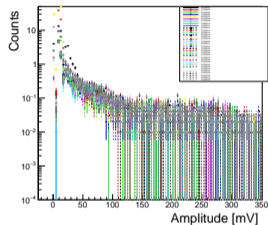
<https://docs.google.com/spreadsheets/d/1MR1Cwc-YCCCvKVTRg-pu3rC3uQaDxg-FlgERDr8tzipY/edit?range=A500#gid=1523035026>

Running in Air

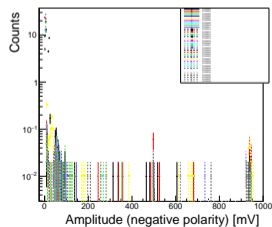
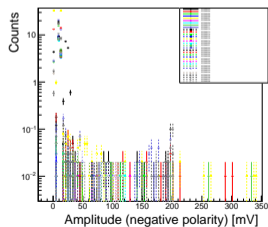
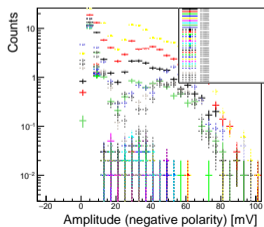
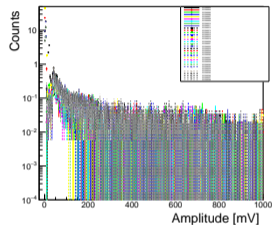
Anode 1



Anode 2



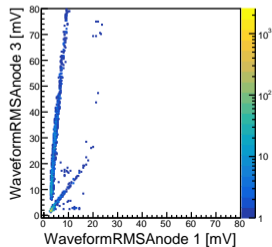
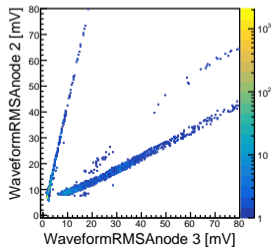
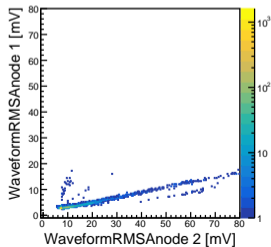
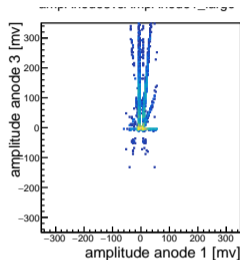
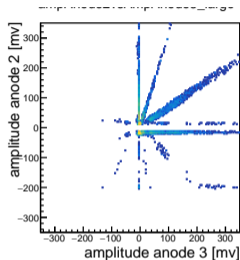
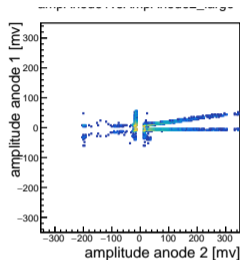
Anode 3



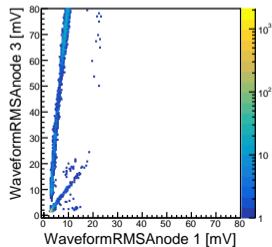
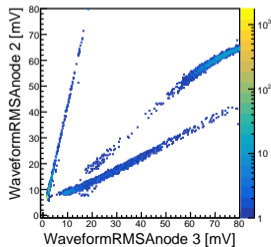
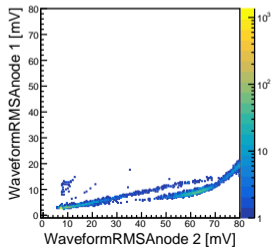
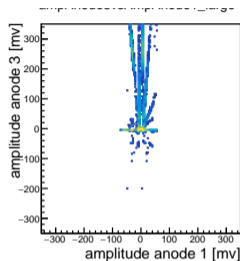
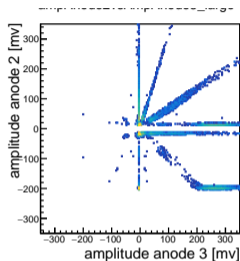
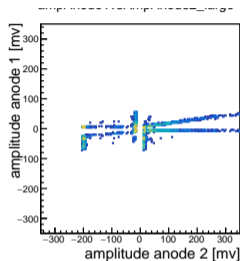
Anode vs anode correlations (amplitude and RMS)

We calculate a positive amplitude (AmplitudeAnode_i) value and a negative amplitude value ($\text{NegAmplitudeAnode}_i$) for each waveform. Both are based on the same calculated baseline and then on the most negative (positive) value subtracted by that baseline. When correlating the amplitude values between waveforms of 2 anodes, we have four pairs to create - *i.e.* ($\text{AmplitudeAnode}_i, \text{AmplitudeAnode}_j$), ($\text{AmplitudeAnode}_i, \text{NegAmplitudeAnode}_j$), ($\text{NegAmplitudeAnode}_i, \text{AmplitudeAnode}_j$), ($\text{NegAmplitudeAnode}_i, \text{NegAmplitudeAnode}_j$). These pairs fill the respective quadrant of the plots below, where $n\text{NegAmplitudeAnodes}$ are drawn as negative values on the amplitude axis.

Anode vs anode correlations (amplitude and RMS) R1354007-12



Anode vs anode correlations (amplitude and RMS) R1354013-17



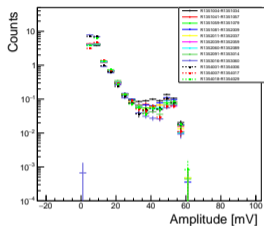
What we know/ plan for the future

- ▶ The extra peaks do not appear to be associated with sparking.
- ▶ We can reduce or remove the extra peaks with cuts on negative signals on anode 2.
- ▶ The peaks do not appear when when running in air, so they seem to be from signals originating inside the gas volume.
- ▶ Some of the spectra for runs taken with the Fe55 source have extra peaks, which can be removed with the same cut, leaving only a single peak.
- ▶ Do we want to continue to investigate the origin of these peaks, or focus on removing them from the spectra?

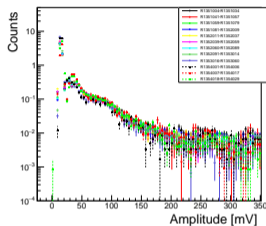
Extra Slides

Bkg vs Signal Spectra (Background)

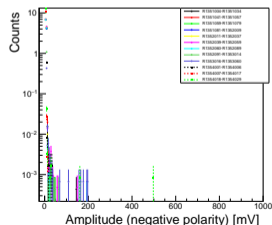
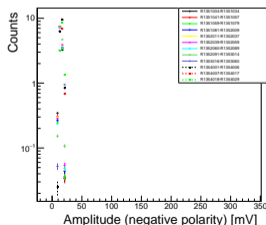
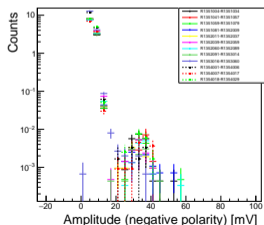
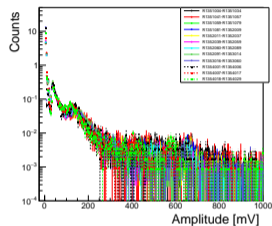
Anode 1



Anode 2

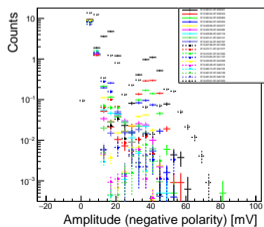
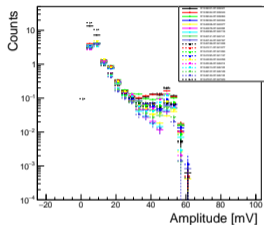


Anode 3

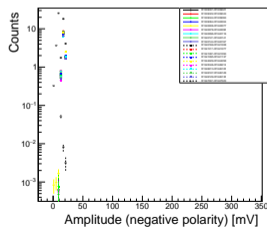
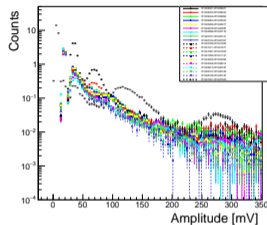


Bkg vs Signal Spectra (Signal)

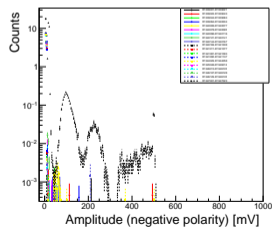
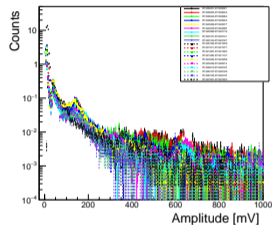
Anode 1



Anode 2



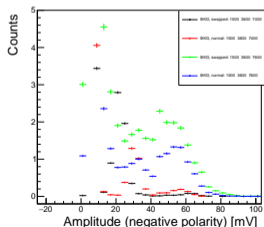
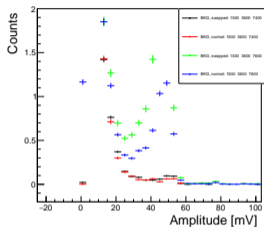
Anode 3



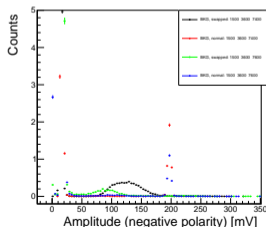
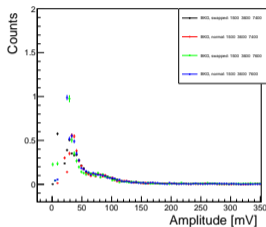
All triggers

Anode amplitude spectra for swapped/normal background runs

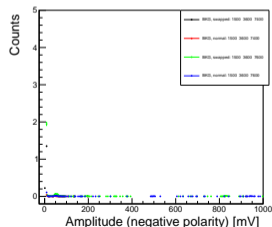
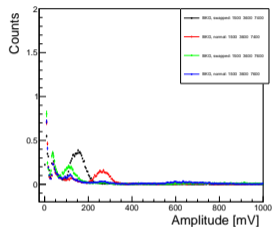
Anode 1



Anode 2

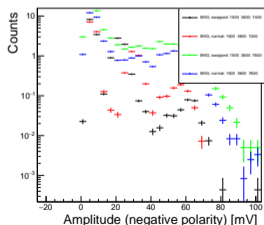
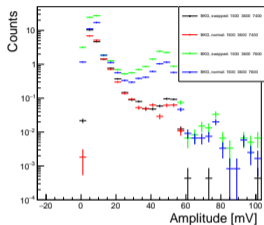


Anode 3

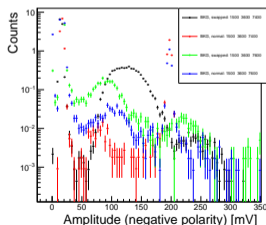
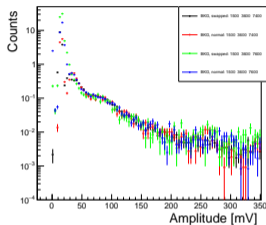


Anode log(amplitude spectra) for swapped/normal background runs

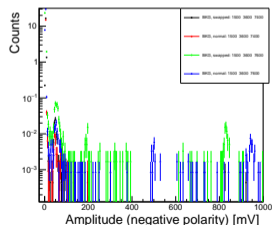
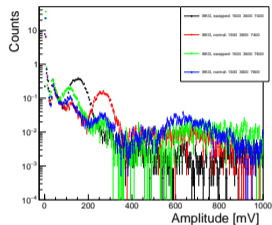
Anode 1



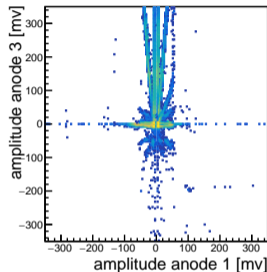
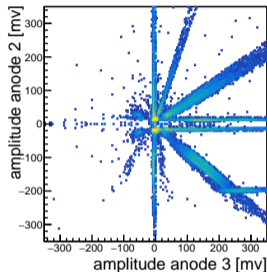
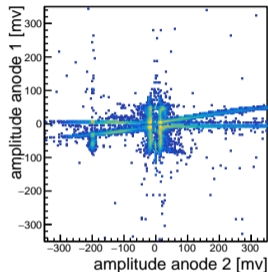
Anode 2



Anode 3



Anode vs anode correlations - negative and positive anodes



We calculate a positive amplitude ($AmplitudeAnode_i$) value and a negative amplitude value ($NegAmplitudeAnode_i$) for each waveform. Both are based on the same calculated baseline and then on the most negative (positive) value subtracted by that baseline. When correlating the amplitude values between waveforms of 2 anodes, we have four pairs to create - *i.e.* ($AmplitudeAnode_i, AmplitudeAnode_j$), ($AmplitudeAnode_i, NegAmplitudeAnode_j$), ($NegAmplitudeAnode_i, AmplitudeAnode_j$), ($NegAmplitudeAnode_i, NegAmplitudeAnode_j$). These pairs fill the respective quadrant of the above plots, where $nNegAmplitudeAnodes$ are drawn as negative values on the amplitude axis.

Run **1354001** and Run **1354003**

Runs 1354001-R1354006 – looking at triggers and baseline

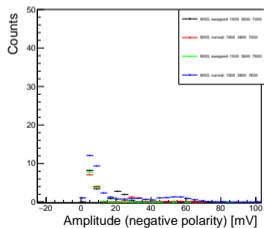
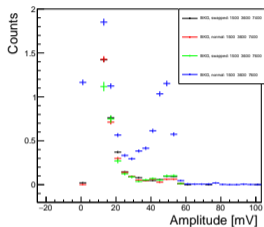
```
./plots/triggerPlots/R1354001-R1354006TriggersVsEvents.png
```

```
./plots/triggerPlots/R1354001-R1354006TriggersVsEvents.png
```

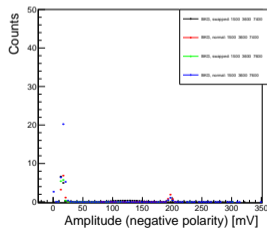
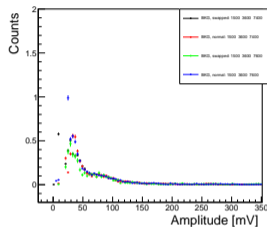
Run **1354001** and Run **1354003** Removed

Runs 1354001/1354003 Removed – spectra for swapped/normal runs

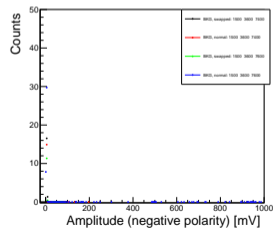
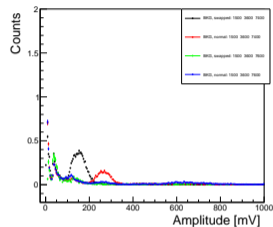
Anode 1



Anode 2

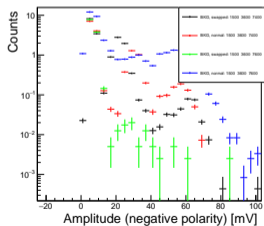
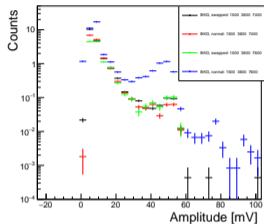


Anode 3

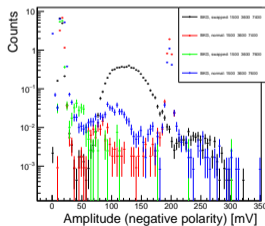
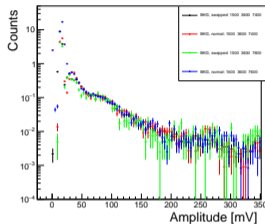


Runs 1354001/03 Removed – $\log(\text{spectra})$ for swapped/normal runs

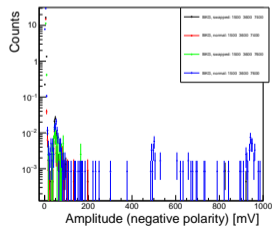
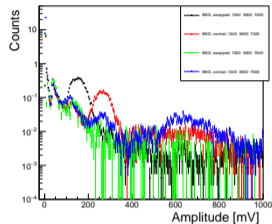
Anode 1



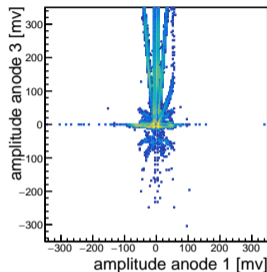
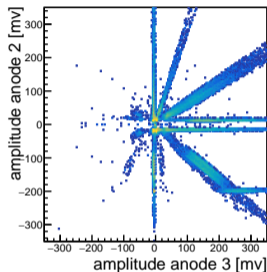
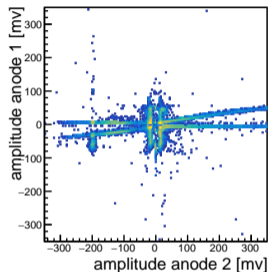
Anode 2



Anode 3



Anode vs anode correlations - negative and positive anodes

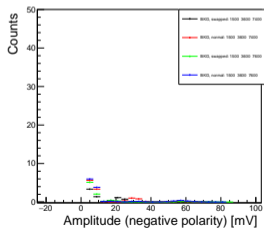
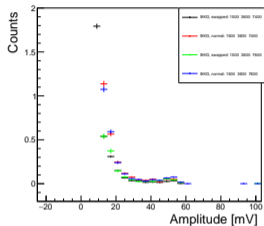


We calculate a positive amplitude (AmplitudeAnode_i) value and a negative amplitude value ($\text{NegAmplitudeAnode}_i$) for each waveform. Both are based on the same calculated baseline and then on the most negative (positive) value subtracted by that baseline. When correlating the amplitude values between waveforms of 2 anodes, we have four pairs to create - *i.e.* ($\text{AmplitudeAnode}_i, \text{AmplitudeAnode}_j$), ($\text{AmplitudeAnode}_i, \text{NegAmplitudeAnode}_j$), ($\text{NegAmplitudeAnode}_i, \text{AmplitudeAnode}_j$), ($\text{NegAmplitudeAnode}_i, \text{NegAmplitudeAnode}_j$). These pairs fill the respective quadrant of the above plots, where $n\text{NegAmplitudeAnodes}$ are drawn as negative values on the amplitude axis.

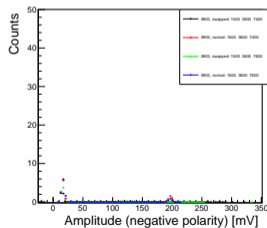
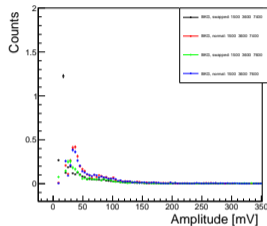
$$-5 < (\text{BaselineRMS} - \text{BaselineAnode3}) > 5$$

Baseline RMS Cut – spectra for swapped/normal runs

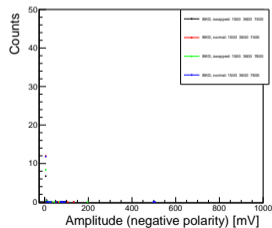
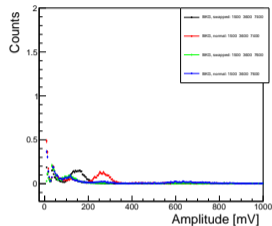
Anode 1



Anode 2

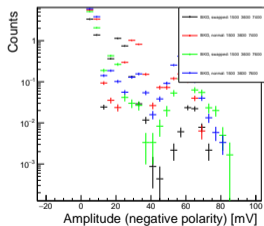
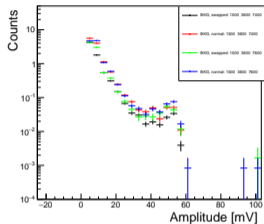


Anode 3

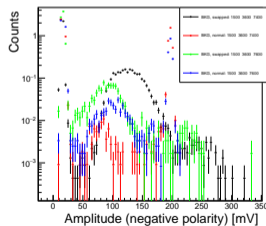
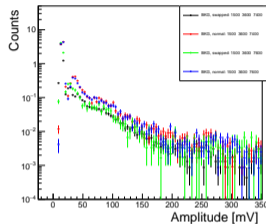


Baseline RMS Cut – log(spectra) for swapped/normal runs

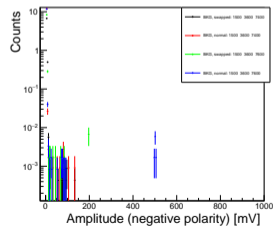
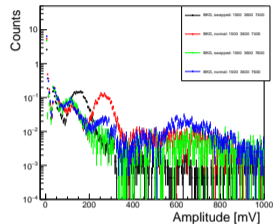
Anode 1



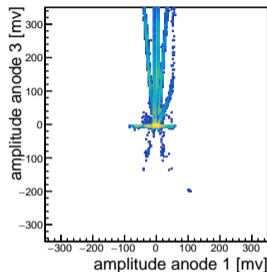
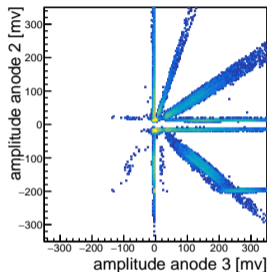
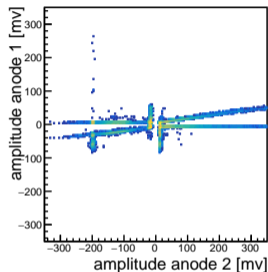
Anode 2



Anode 3



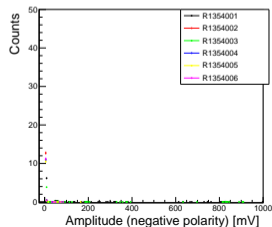
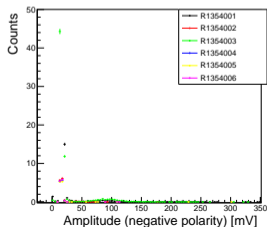
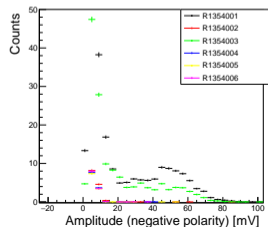
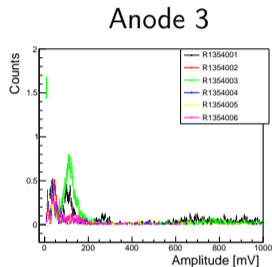
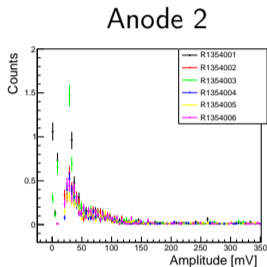
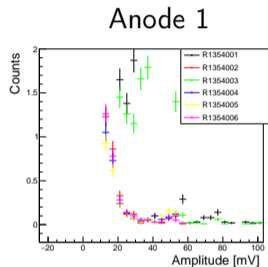
Anode vs anode correlations - negative and positive anodes



We calculate a positive amplitude ($AmplitudeAnode_i$) value and a negative amplitude value ($NegAmplitudeAnode_i$) for each waveform. Both are based on the same calculated baseline and then on the most negative (positive) value subtracted by that baseline. When correlating the amplitude values between waveforms of 2 anodes, we have four pairs to create - *i.e.* ($AmplitudeAnode_i, AmplitudeAnode_j$), ($AmplitudeAnode_i, NegAmplitudeAnode_j$), ($NegAmplitudeAnode_i, AmplitudeAnode_j$), ($NegAmplitudeAnode_i, NegAmplitudeAnode_j$). These pairs fill the respective quadrant of the above plots, where $nNegAmplitudeAnodes$ are drawn as negative values on the amplitude axis.

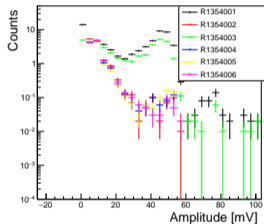
Looking At Individual Runs

Runs 1354001-R1354006 – spectra for swapped, anode 3 = 7600V (Green)

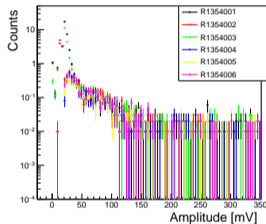


Runs 1354001-R1354006 – (log)spectra for swapped, anode 3 = 7600V (Green)

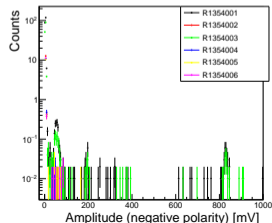
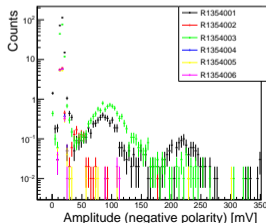
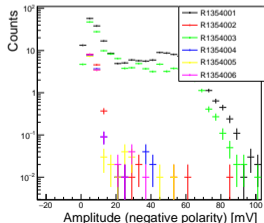
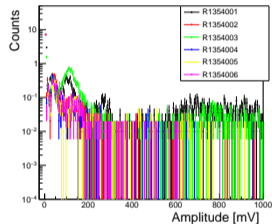
Anode 1



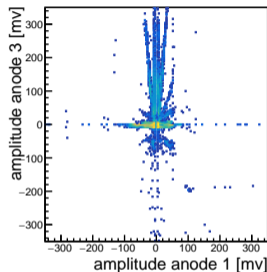
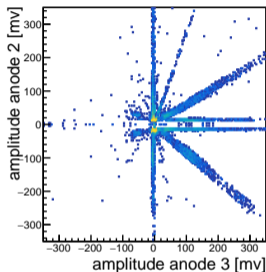
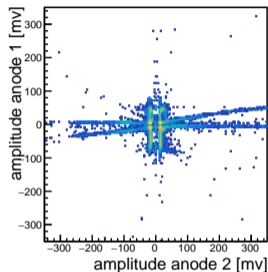
Anode 2



Anode 3



Anode vs anode correlations - negative and positive anodes



We calculate a positive amplitude (AmplitudeAnode_i) value and a negative amplitude value ($\text{NegAmplitudeAnode}_i$) for each waveform. Both are based on the same calculated baseline and then on the most negative (positive) value subtracted by that baseline. When correlating the amplitude values between waveforms of 2 anodes, we have four pairs to create - *i.e.* ($\text{AmplitudeAnode}_i, \text{AmplitudeAnode}_j$), ($\text{AmplitudeAnode}_i, \text{NegAmplitudeAnode}_j$), ($\text{NegAmplitudeAnode}_i, \text{AmplitudeAnode}_j$), ($\text{NegAmplitudeAnode}_i, \text{NegAmplitudeAnode}_j$). These pairs fill the respective quadrant of the above plots, where $n\text{NegAmplitudeAnodes}$ are drawn as negative values on the amplitude axis.

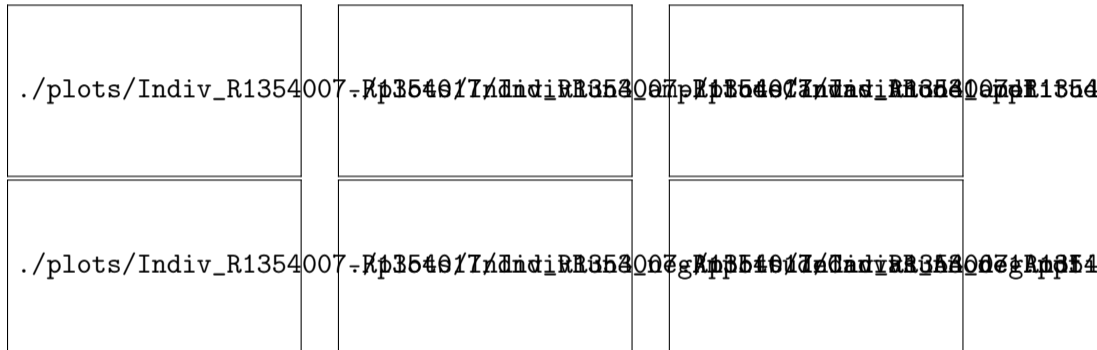
Looking At Individual Runs

Runs 1354007-R1354017 – spectra for normal, anode 3 = 7400V (Red)

Anode 1

Anode 2

Anode 3



Runs 1354007-R1354017 – (log)spectra for normal, anode 3 = 7400V
(Red)

Anode 1

./plots/Indiv_R1354007-R1354017/Indiv_R1354007-
R1354017/Indiv_R1354007-R1354017

./plots/Indiv_R1354007-R1354017/Indiv_R1354007-
R1354017/Indiv_R1354007-R1354017

Anode 2

./plots/Indiv_R1354007-R1354017/Indiv_R1354007-
R1354017/Indiv_R1354007-R1354017

./plots/Indiv_R1354007-R1354017/Indiv_R1354007-
R1354017/Indiv_R1354007-R1354017

Anode 3

./plots/Indiv_R1354007-R1354017/Indiv_R1354007-
R1354017/Indiv_R1354007-R1354017

./plots/Indiv_R1354007-R1354017/Indiv_R1354007-
R1354017/Indiv_R1354007-R1354017

Anode vs anode correlations - negative and positive anodes

`./plots/Indiv_R1354007-R1354017/IndivRun3_amplitudeVsAmplitudeCanvas_combined`

Looking At Individual Runs

Runs 1352091-R1353014 – spectra for swapped, anode 3 = 7400V (Black)

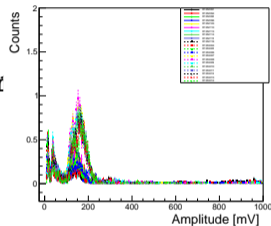
Anode 1

```
./plots/Indiv_R1352091-R1353014/Indiv_R1352091-R1353014_CadvaBuAnode1Amplitude
```

Anode 2

```
./plots/Indiv_R1352091-R1353014/Indiv_R1352091-R1353014_CadvaBuAnode2Amplitude
```

Anode 3



1 amplitude

```
./plots/Indiv_R1352091-R1353014/Indiv_R1352091-R1353014_CadvaBuAnode1Amplitude
```

```
./plots/Indiv_R1352091-R1353014/Indiv_R1352091-R1353014_CadvaBuAnode2Amplitude
```

```
./plots/Indiv_R1352091-R1353014/Indiv_R1352091-R1353014_CadvaBuAnode3Amplitude
```

./plots/Indiv_R1352091-R1353014/Indiv_R1352091-R1353014_CadvaBuAnode3Amplitude

./plots/Indiv_R1352091-R1353014/Indiv_R1352091-R1353014_CadvaBuAnode3Amplitude

Runs 1352091-R1353014 – (log)spectra for swapped, anode 3 = 7400V (Black)

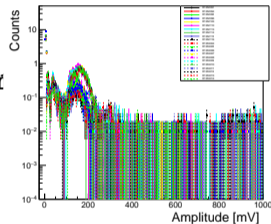
Anode 1

```
./plots/Indiv_R1352091-R1353014/Indiv_R1352091-R1353014/Anode1
```

Anode 2

```
./plots/Indiv_R1352091-R1353014/Indiv_R1352091-R1353014/Anode2
```

Anode 3



```
./plots/Indiv_R1352091-R1353014/Indiv_R1352091-R1353014/Anode1
```

```
./plots/Indiv_R1352091-R1353014/Indiv_R1352091-R1353014/Anode2
```

```
./plots/Indiv_R1352091-R1353014/Indiv_R1352091-R1353014/Anode3
```

1 amp ipdf

./plots/Indiv_R1352091-R1353014/Indiv_R1352091-R1353014/Anode3

./plots/Indiv_R1352091-R1353014/Indiv_R1352091-R1353014/Anode3

Anode vs anode correlations - negative and positive anodes

`./plots/Indiv_R1354007-R1354017/IndivRun3_amplitudeVsAmplitudeCanvas_combined`