

HV EVENTS ANALYSIS

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HV EVENTS

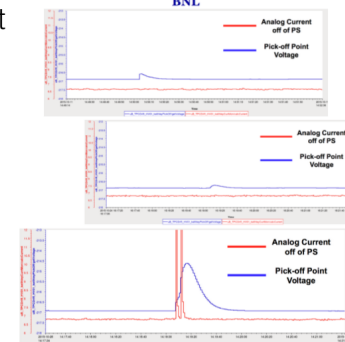
- Based on a presentation of Joseph Zennamo (DocDB 5007) me and Andy started investigating the HV events, looking mostly at the PickOff Voltage variable.
- Joseph simulated a “spark” from any element to the ground, using Dave's SPICE model of the TPC and compared this to the actual data.
- The model agrees very well with the data leading to the interpretations of these events as tubes breakdown.
- This suggest we should look at this in more detail, especially if we intend to ramp the HV higher.

HV “Events”?



Recent Drift HV
Fluctuations
DocDB 4998

Michael Mooney
BNL



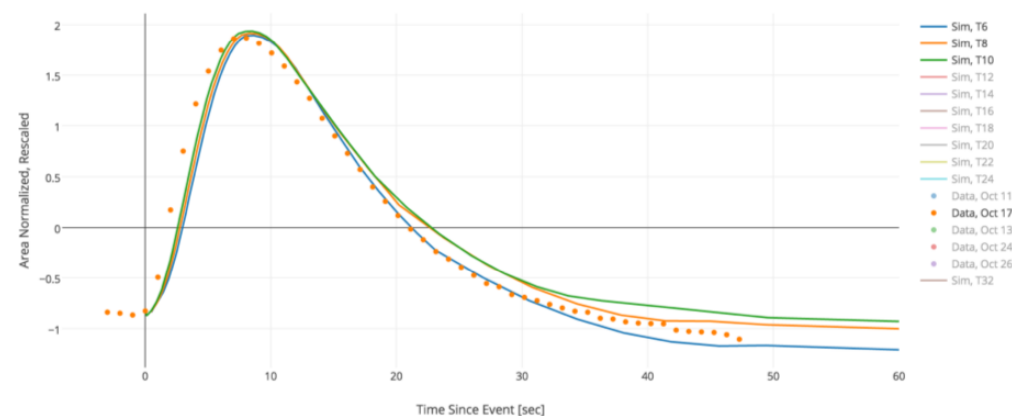
- Mike Mooney sent around some slides that pointed out some HV instabilities related to the “pick-off point” voltage and the current draw by the Glassman
- These caught my eye because the shapes were similar to our SPICE models of the TPC (long RC tails)

J. Zennamo, UChicago

Data-Simulation Shape Comparison

- You can see that these curves reproduced the October 17th “event” well, this would imply that this event could be interpreted as a breakdown from one of the tubes from 6 and 10 to ground

Data-Simulation Comparison , Area Normalized, Rescaled

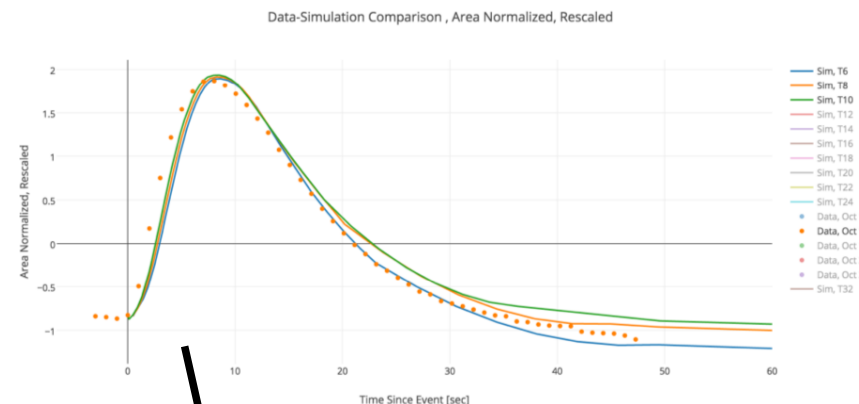


HV EVENTS

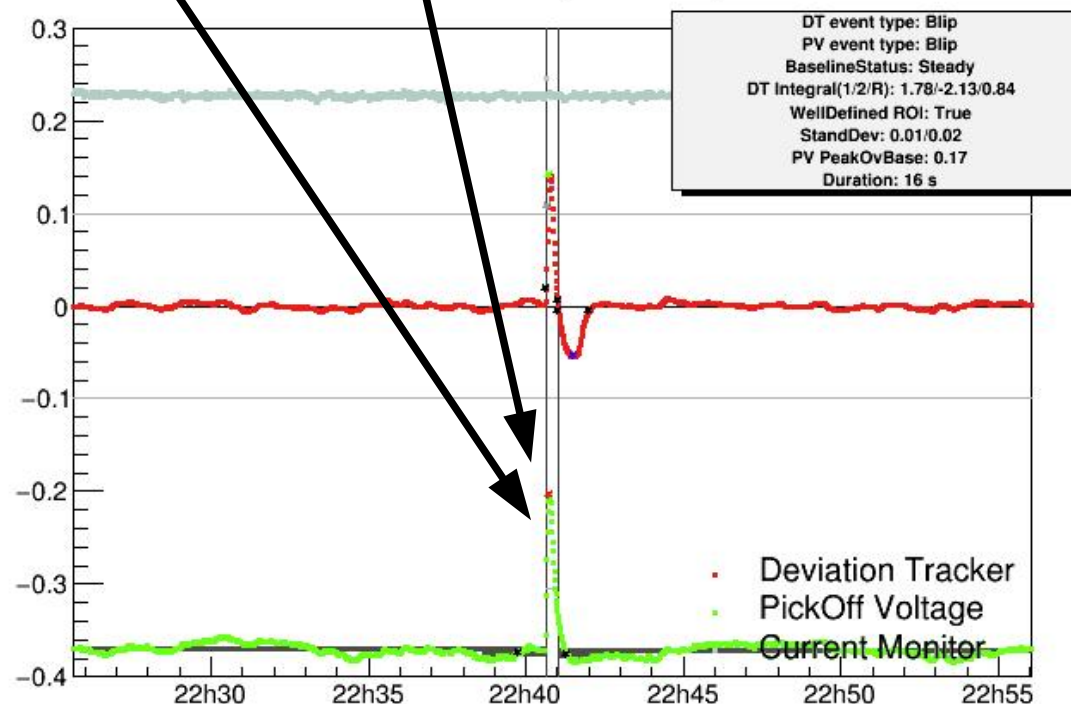
- Events look very similar to the simulations of Joseph.
- Most events are “blips” looking like this. But there are different types.
- In green is the PickOff Voltage, which is the variable currently investigated.
- In red is the Deviation tracker which shows the difference between the 5 seconds average and the 60 seconds average. In this way noise is minimised and events present this “double peak” feature, which is very useful for identifying the type of event.

Data-Simulation Shape Comparison

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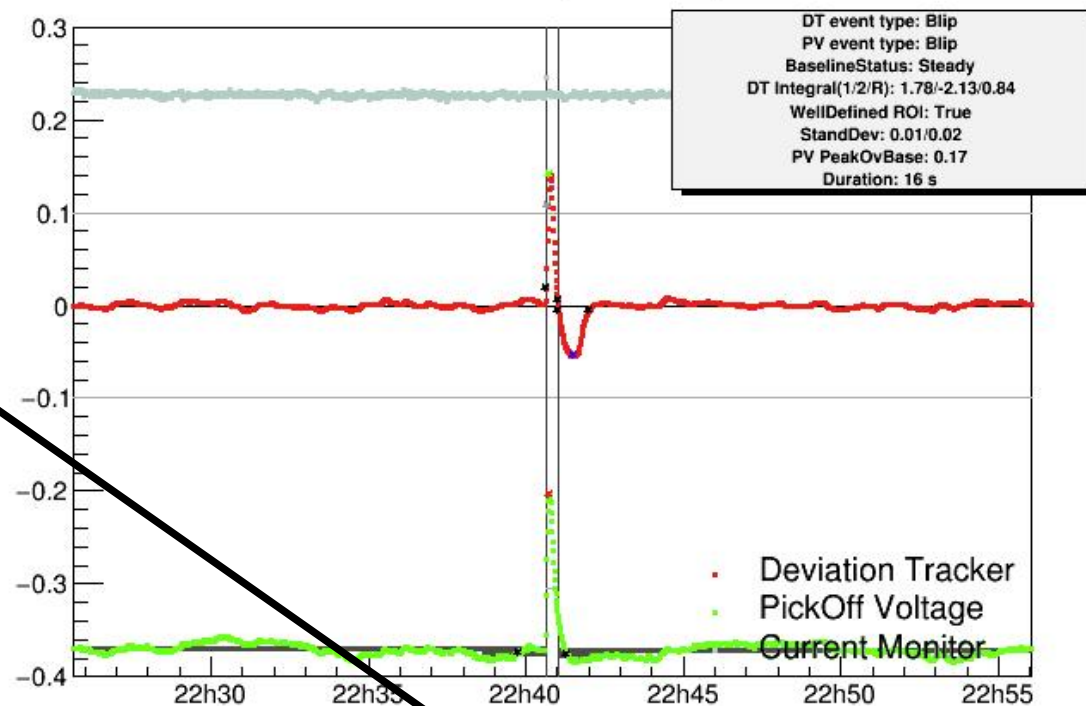
2 October [22:40:39]



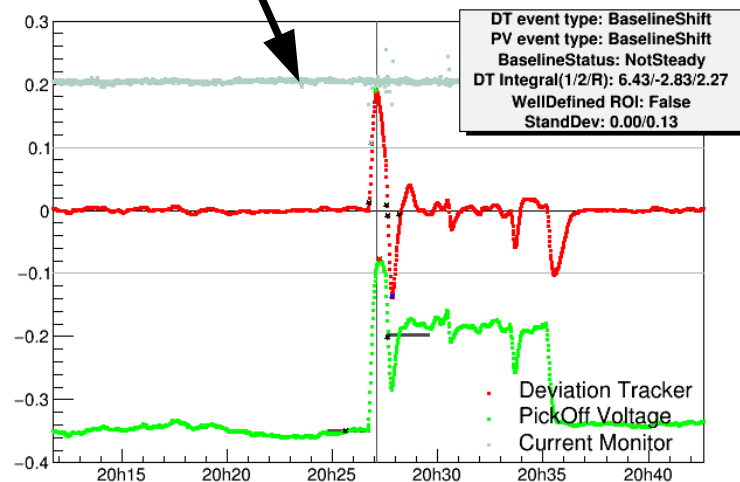
BASELINE SHIFTS

- Other than peaks, also baseline shifts appear.
- When the voltage undergoes a baseline shift, the DifferenceTracker doesn't show a secondary peak (or the secondary peak is much smaller than the main one).

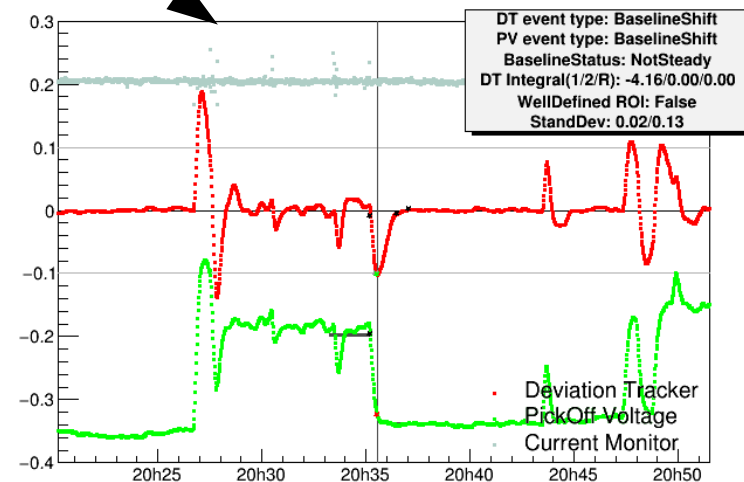
2 October [22:40:39]



13 December [20:26:45]

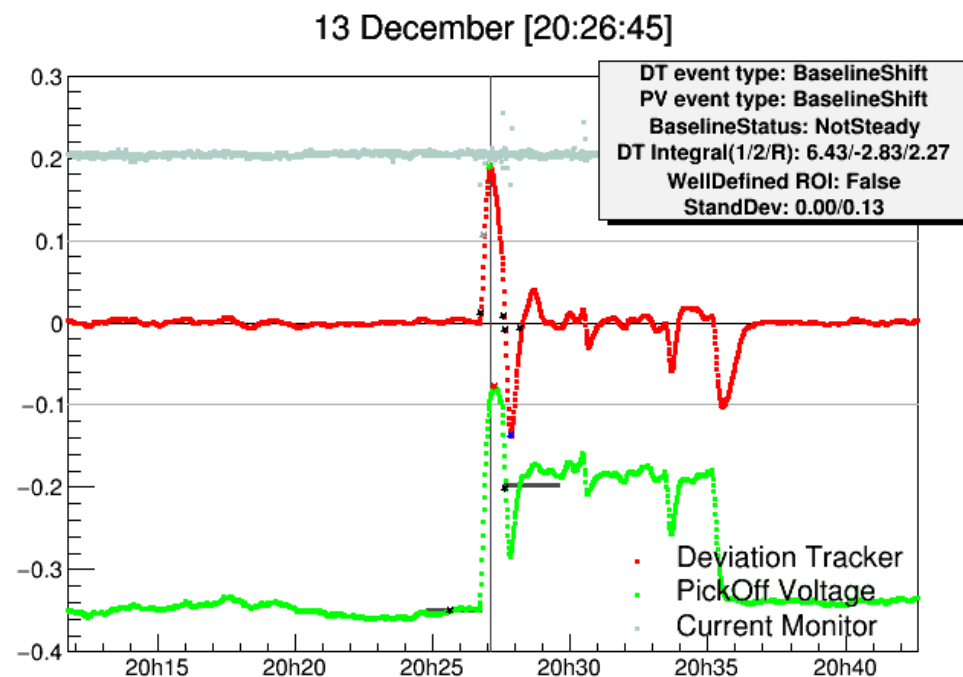
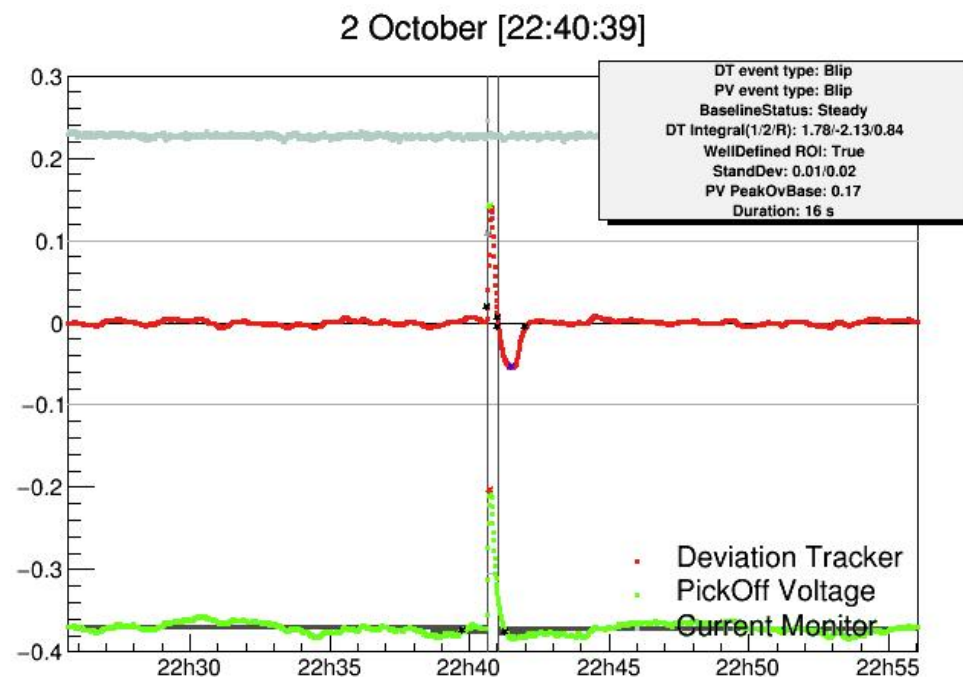


13 December [20:35:14]



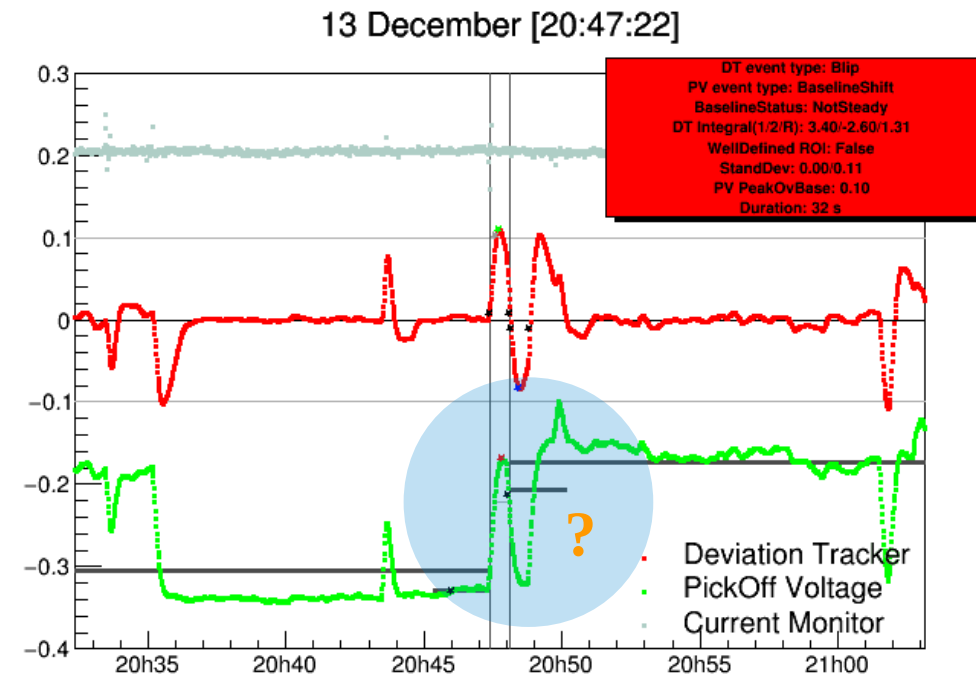
ALGORITHM PROCEDURE

- An algorithm scans through the Deviation Tracker data looking for values above a certain threshold (current threshold is 0.1).
- Once an event is found, the algorithm identifies the key points (black, blue and green stars) of the event and makes an initial estimate of the type of event by looking at the ratio of the integral between the main and the secondary peak (DT event type).
- The same time frame is investigated in the voltage data. On the right and on the left of the region of interest, short (2 m) and long (15 m) averages and the standard deviations around their values are calculated.
- Based on these quantities a second estimate of the type of event is made (PV event type) and other variables are calculated (BaselineStatus).



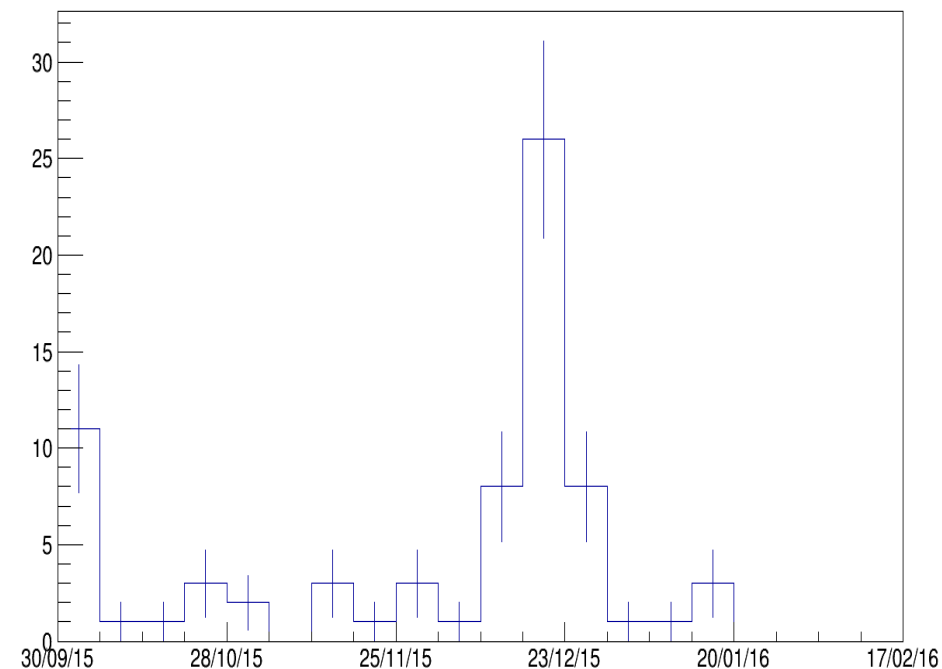
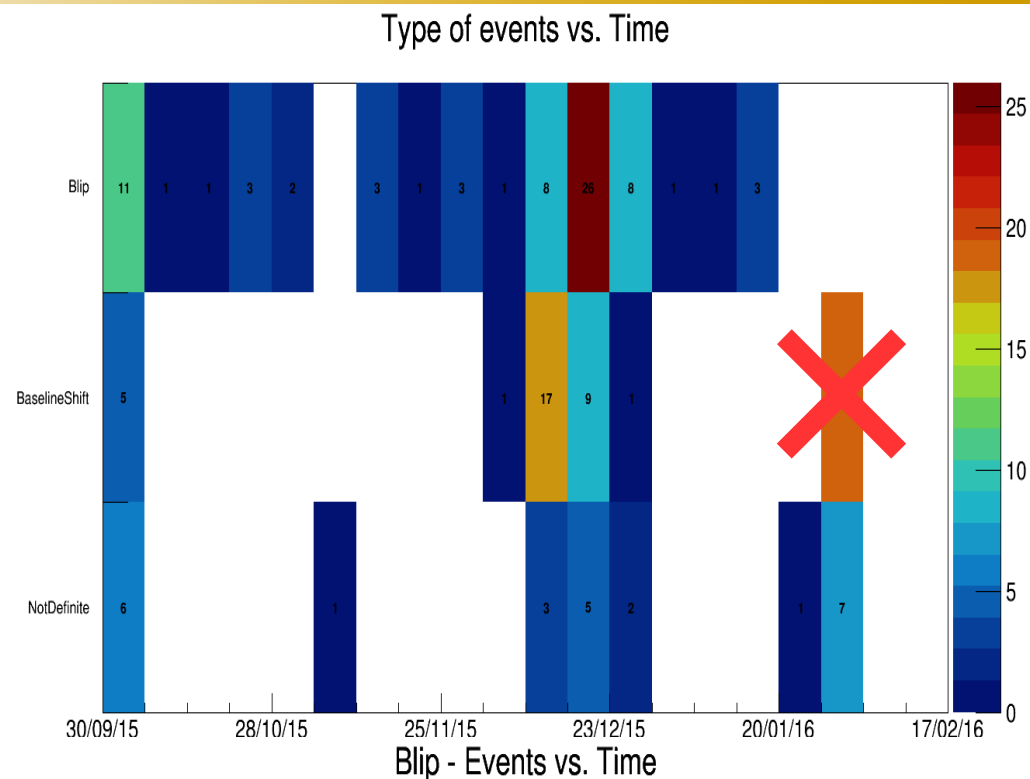
NOT DEFINED EVENTS

- If there's a mismatch between the type of event determined via PickOffVoltage and via DifferenceTracker, the event is labelled as NotDefined.



EVENTS FREQUENCY

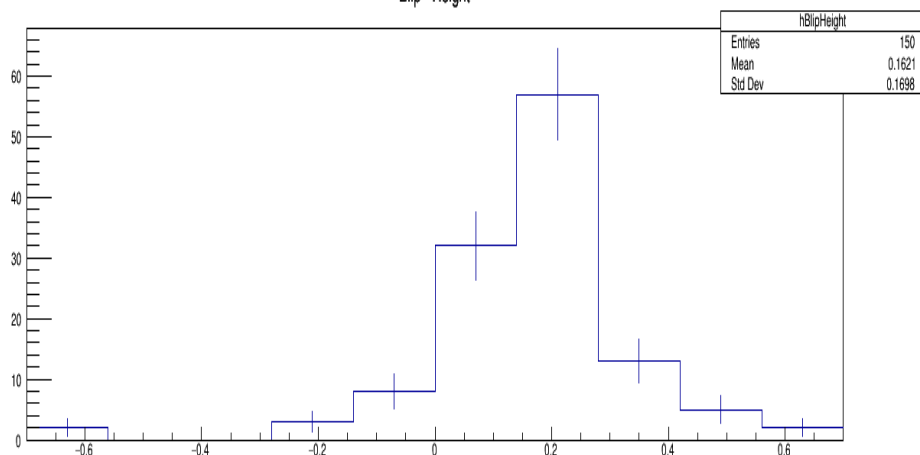
- Blips seem to be evenly distributed in the past months with the exception of a “black day” (21st December). The week before and after also show an higher number of blips than average.
- Strong blips somehow stop after half of January (there still may be weak blips below the algorithm threshold though).
- Baseline shifts seem to appear only during the month of December (please ignore the bin in January, I'll explain that in the next slides)



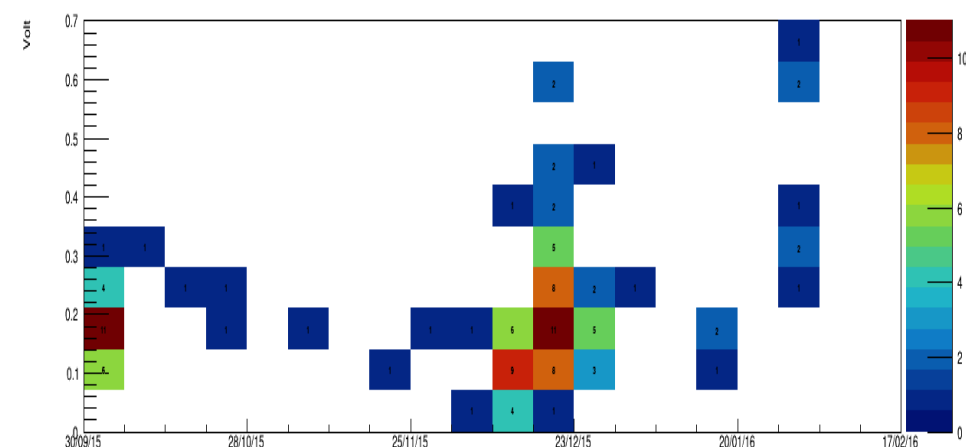
BLIPS FEATURES VS TIME

- The blips have an average peak of 0.2 ± 0.1 V over the baseline and an average duration of 22 ± 10 seconds (FWHM).
- Almost all the blips are positive, although a few negative blips appear.
- There doesn't seem to be a particular trend in time

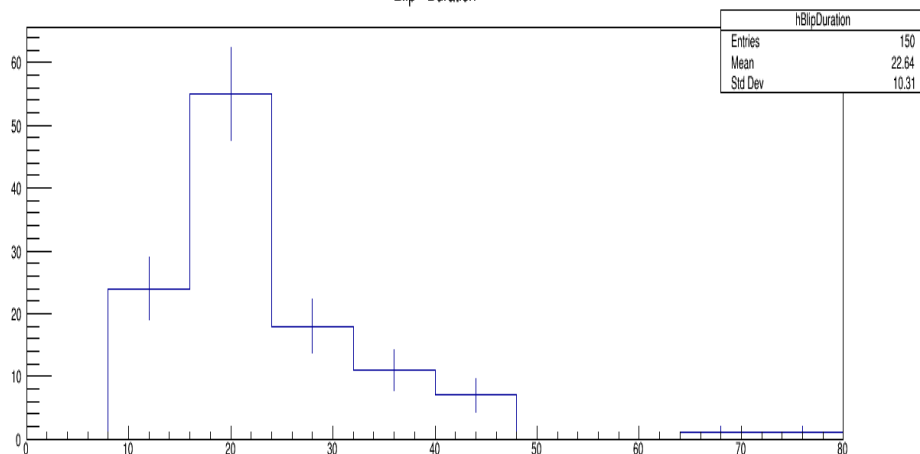
Blip - Height



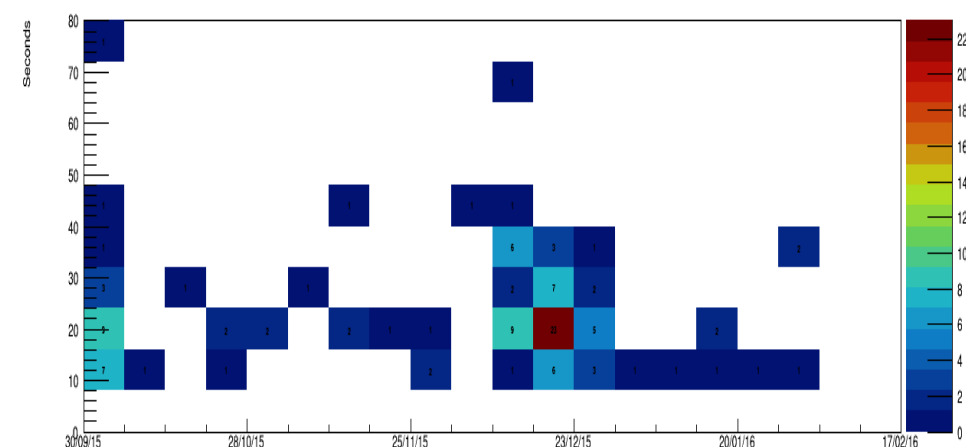
Blip - Height (over baseline) vs. time



Blip - Duration

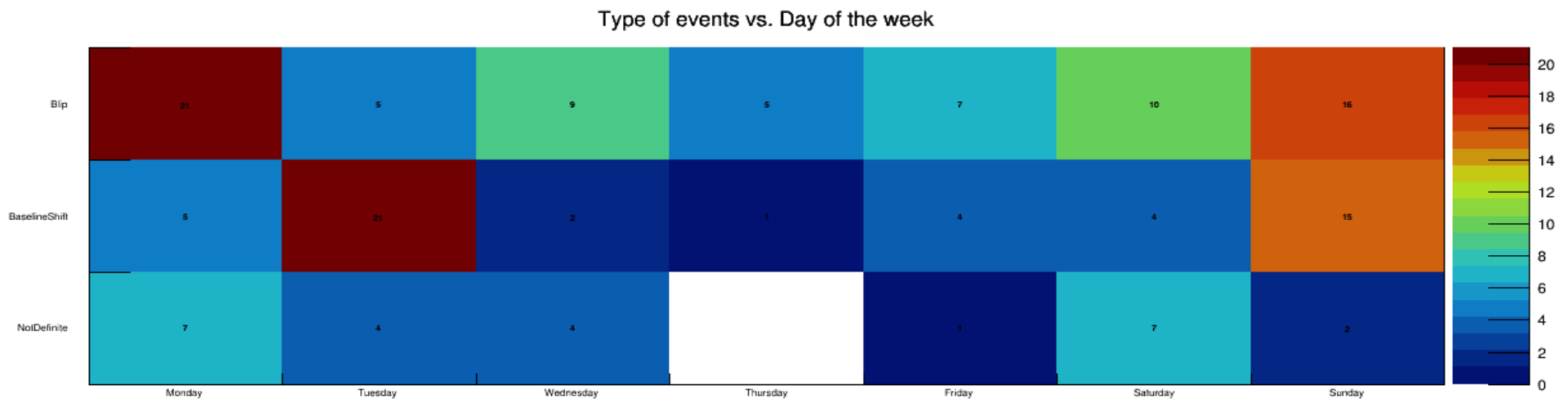
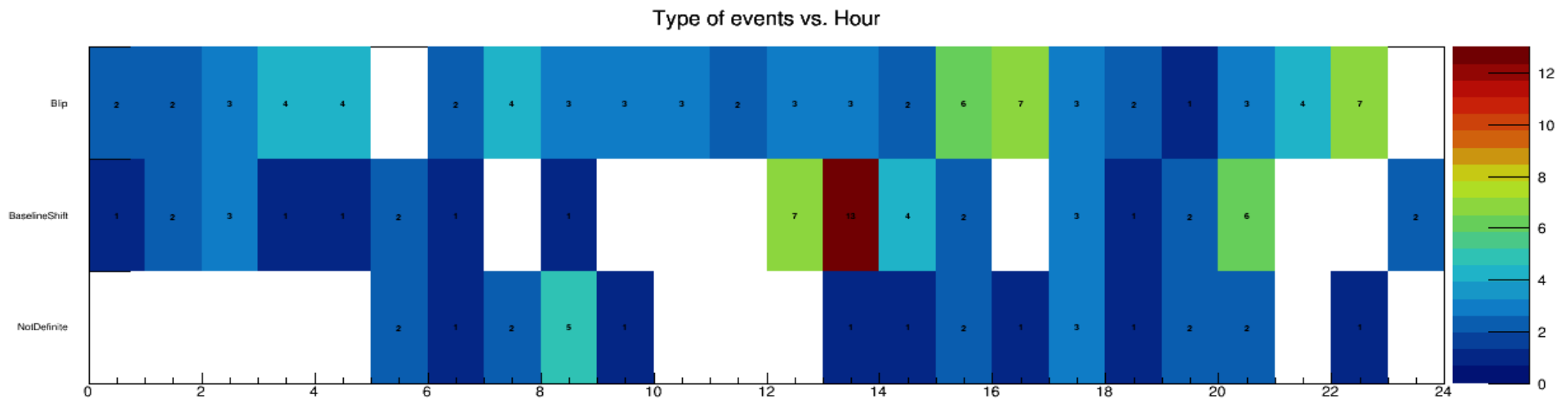


Blip - Duration vs. time



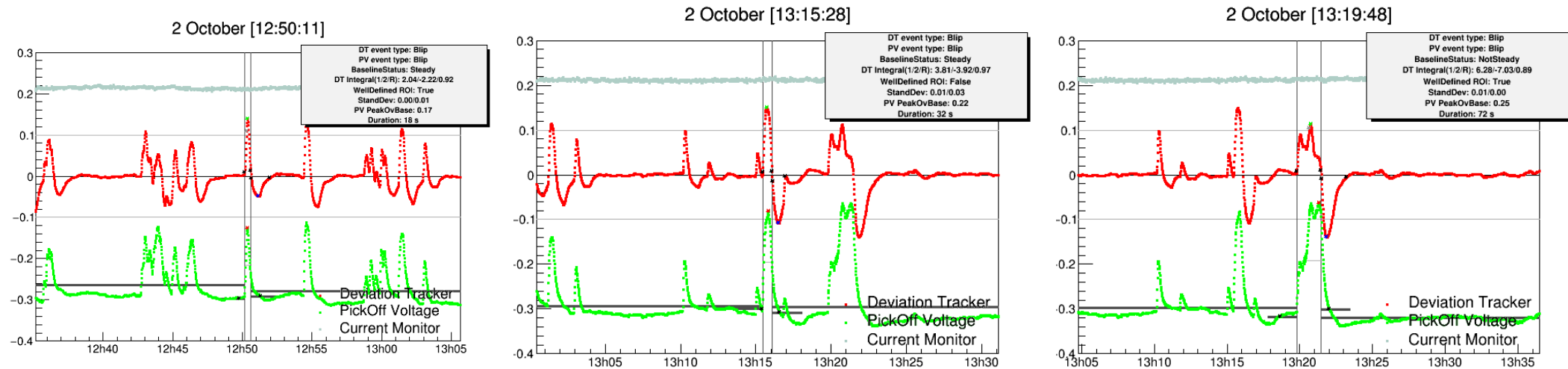
CORRELATION WITH SPECIFIC D/H

- Out of curiosity, I've checked if there was any particular correlation with a specific day of the week or a specific hour. Since a lot of events took place on 21st December (Monday) there's not much that can be said from these plots.



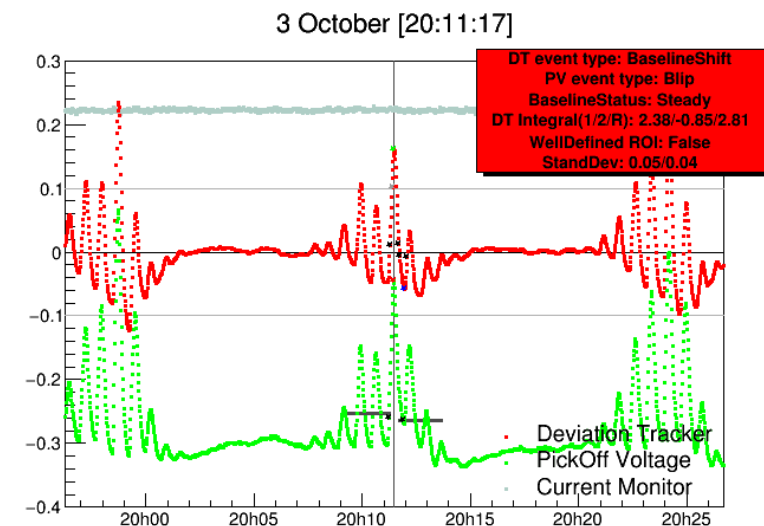
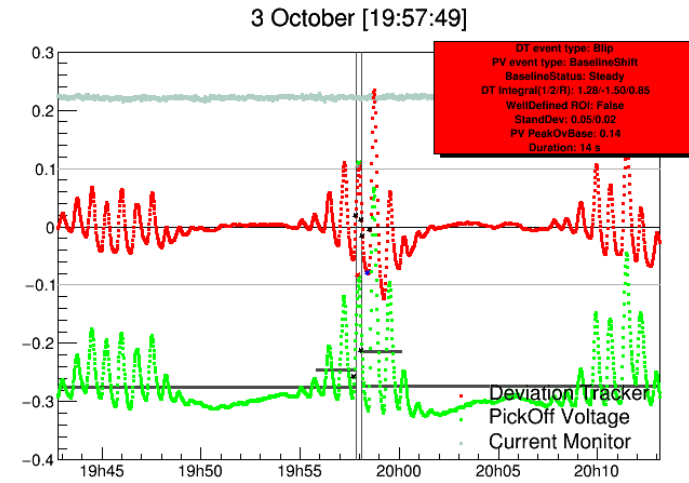
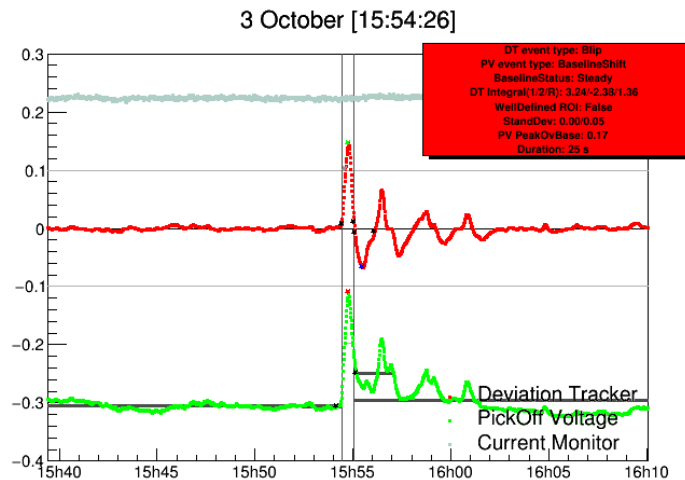
INTERESTING EVENTS

- There are a few interesting events that I've spotted.
- 2nd October, for example, shows an usually high number of peaks



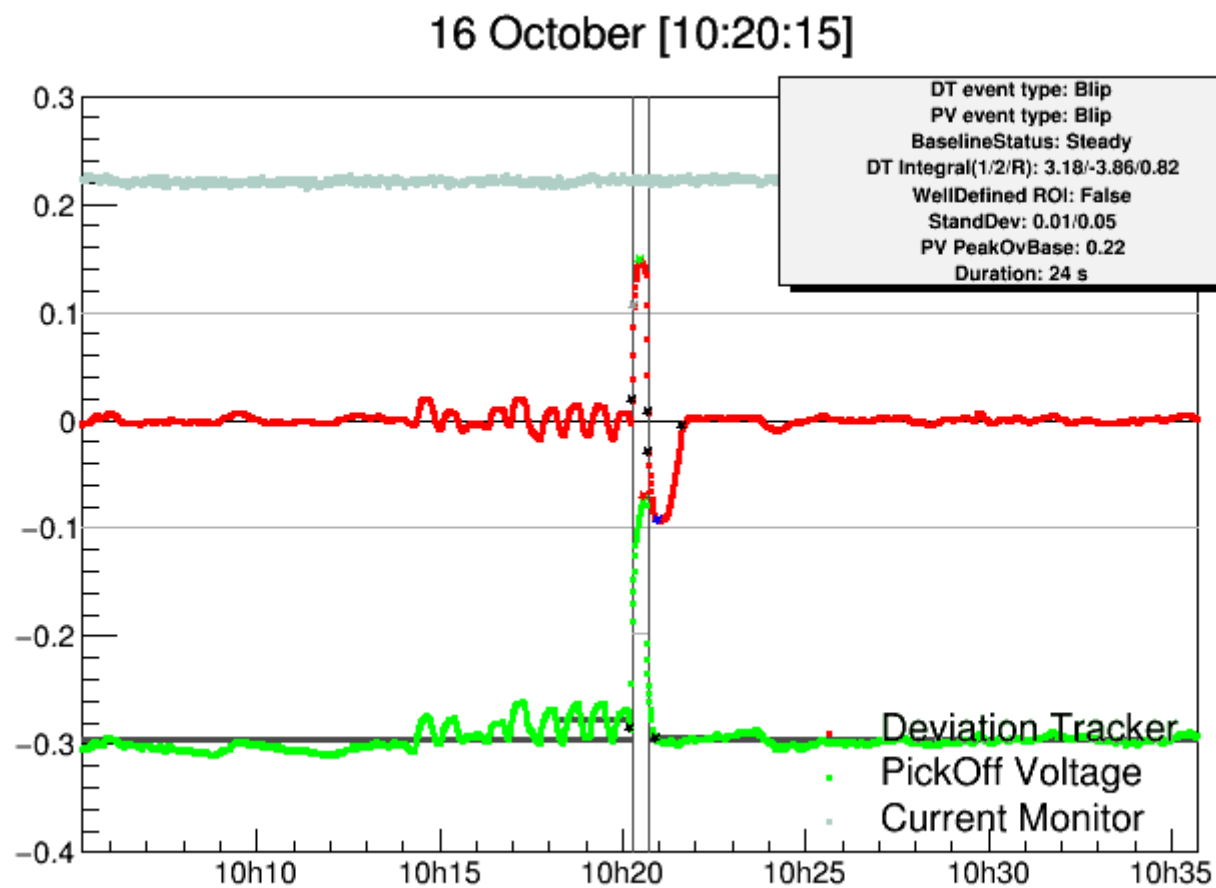
INTERESTING EVENTS

- On 3rd October strange waveforms appear.



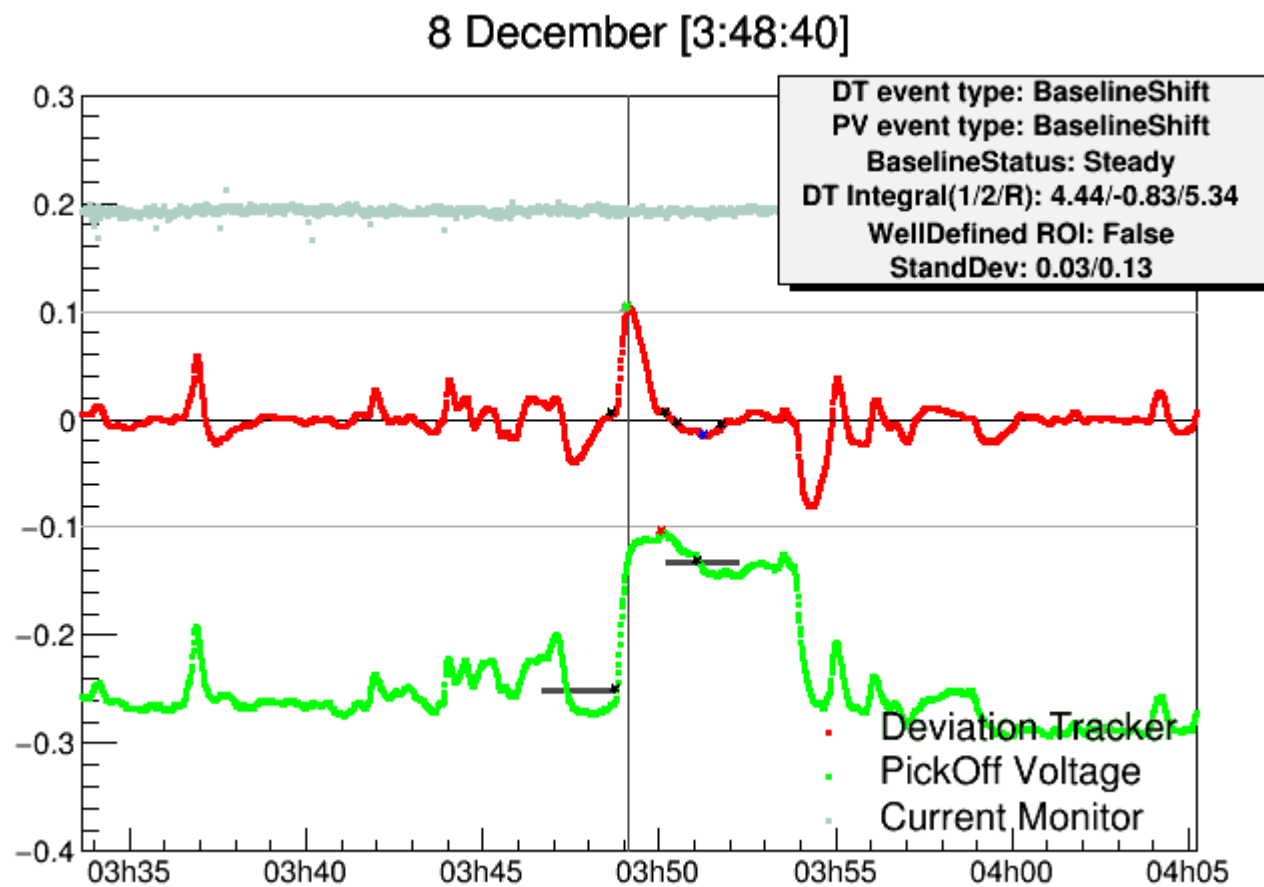
INTERESTING EVENTS

- Strange peak on 16th October



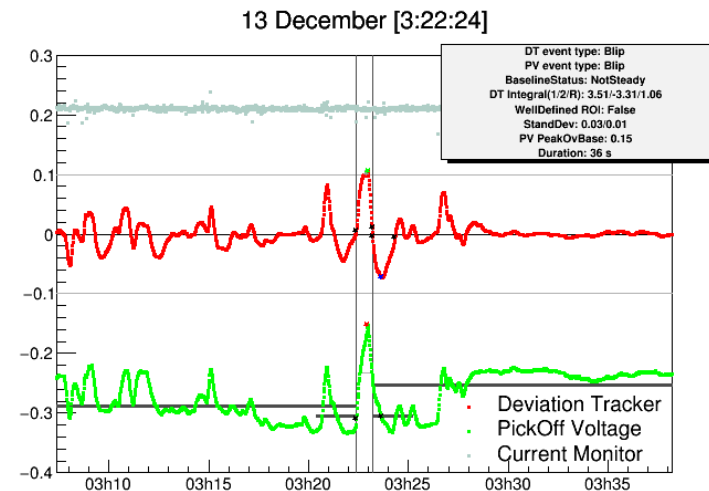
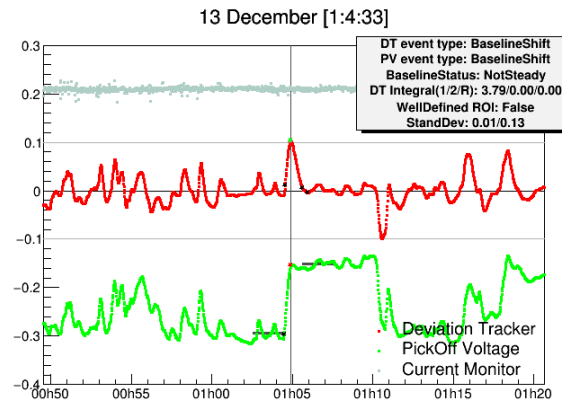
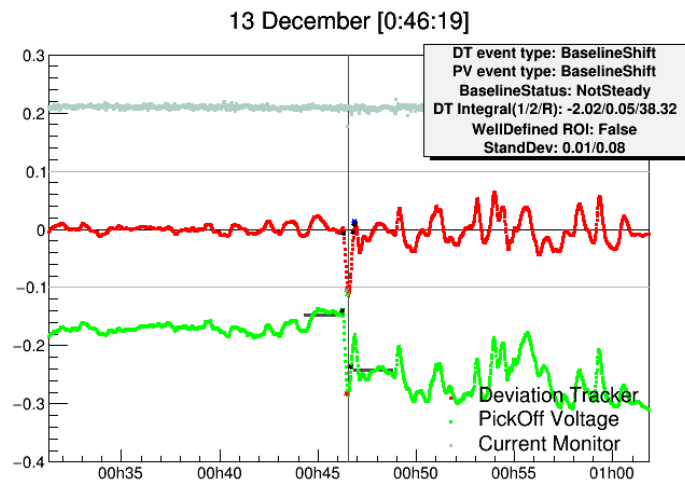
INTERESTING EVENTS

- Baseline shifts start to appear only after 8th December.



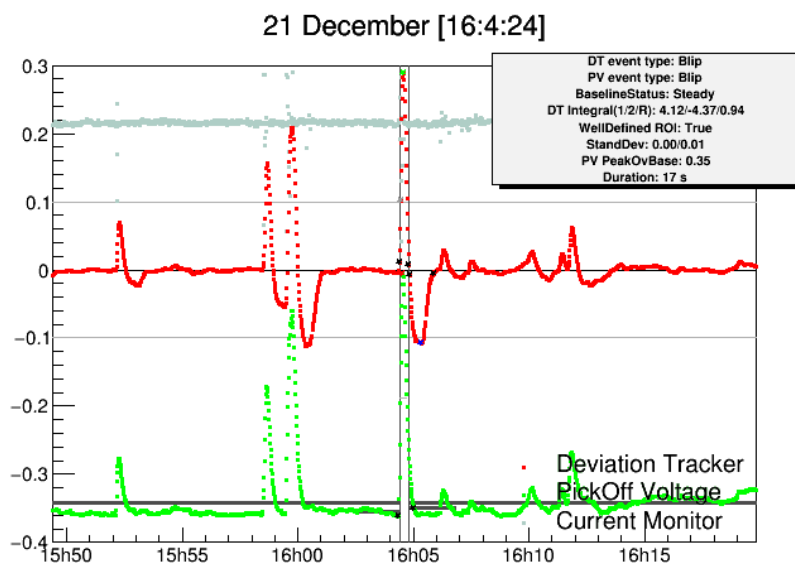
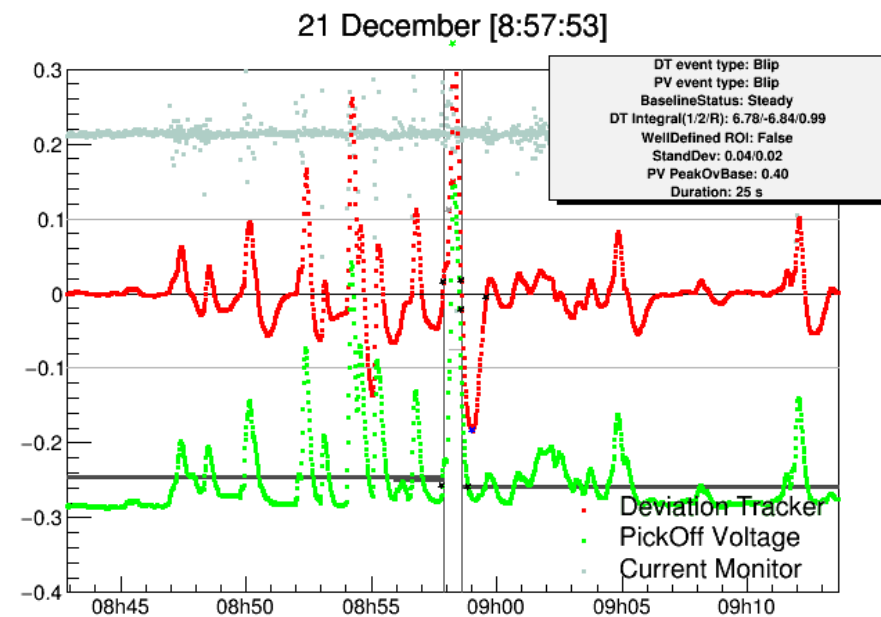
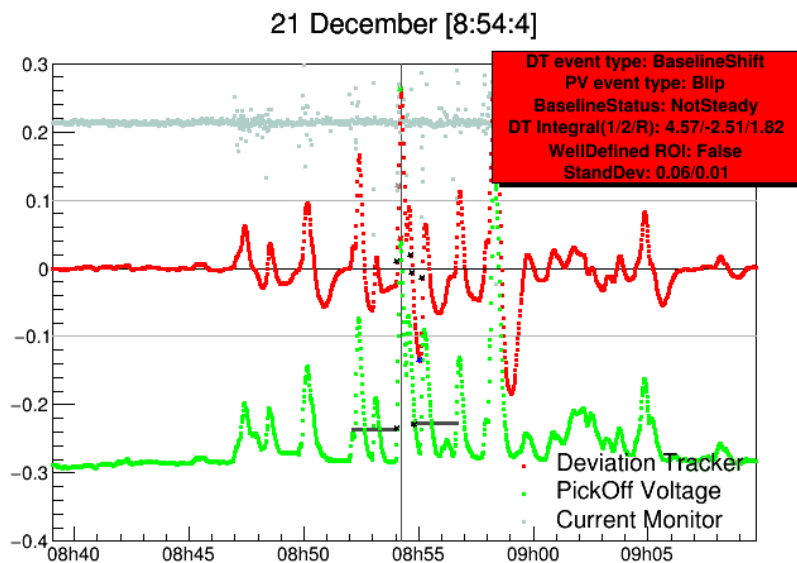
INTERESTING EVENTS

- Very noisy 13th December and many baseline shifts.



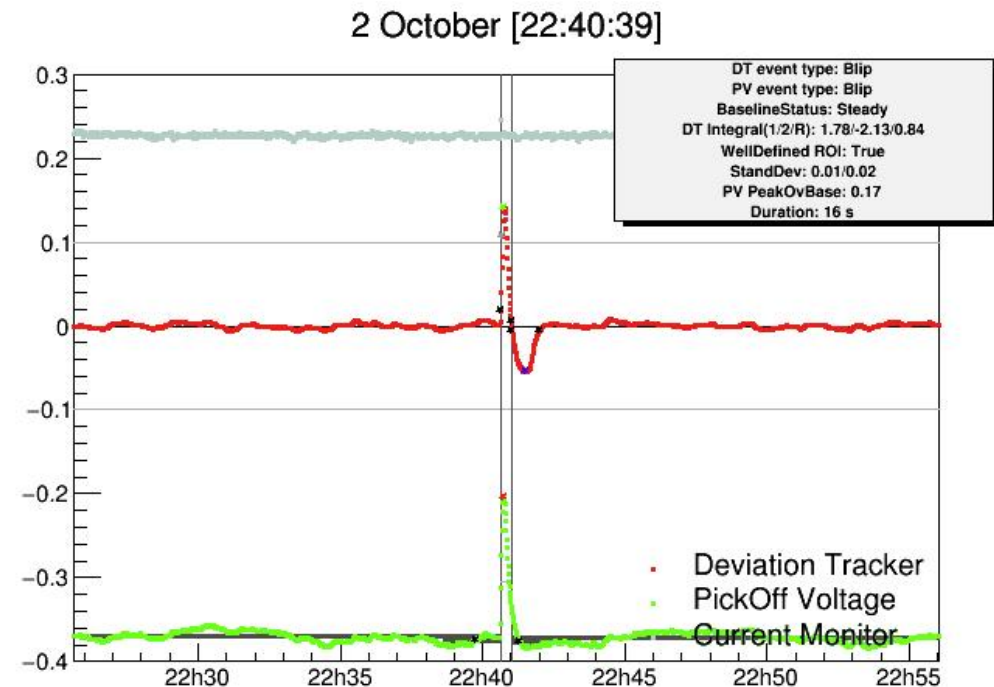
INTERESTING EVENTS

- Many peaks on 21st December



FUTURE DEVELOPMENTS

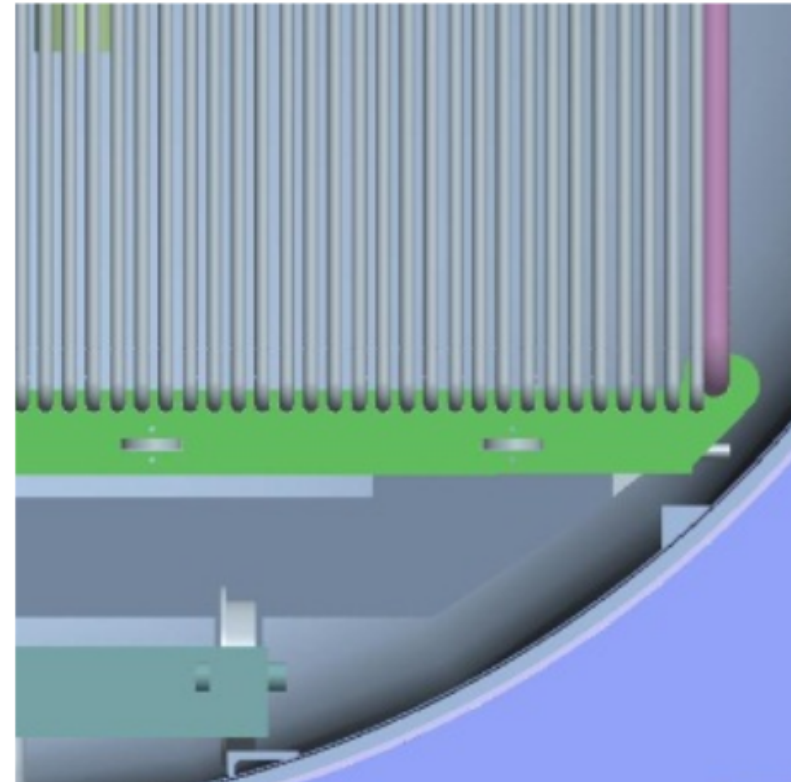
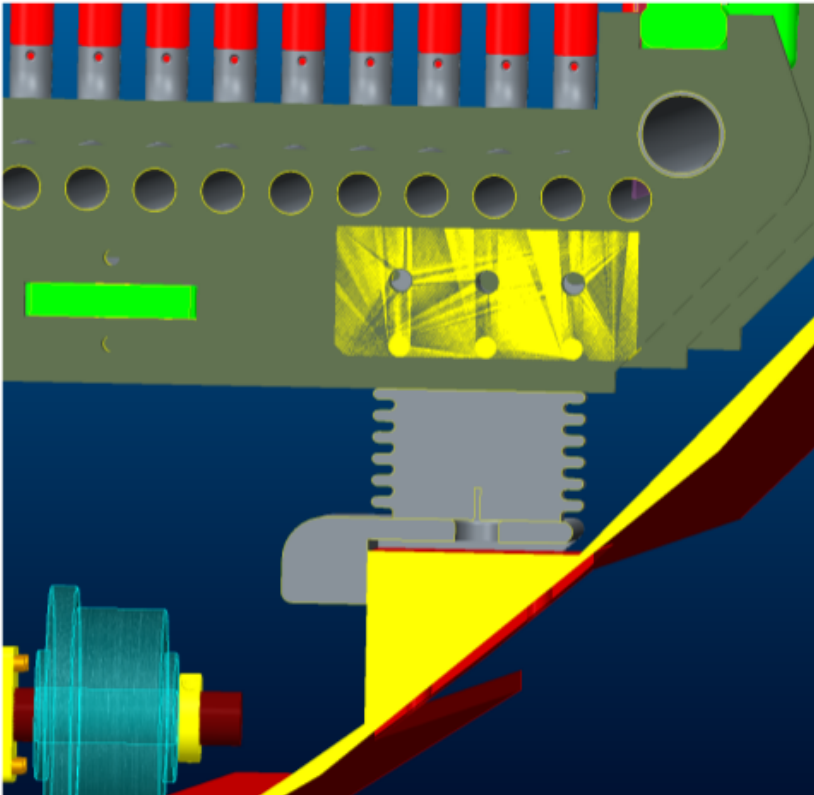
- The threshold to start investigating an event is currently set to 0.1 because below this threshold many more events are identified, but determining the type and quantities such as duration and height is much harder.
- The algorithm gets very confused when peaks are close to each other or the baseline is very noisy (these tend to intensify as the threshold is lowered).
- Currently working on improving event identification by looking at short and long average standard deviations and iterating DT and PV event ID algorithms if these quantities are too large, so that the time frame of interest can be extended to accommodate multiple peaks (and probably including a forth category: “cluster of peaks”).
- Overlaying the peaks, looking at width and shape and comparing with Joseph's SPICE simulation predicted peaks.
- Most important, looking for correlation with PMT/TPC data.
- Given time, take a look at the E-log and see if there's any HV event reported there that the algorithm missed.



BACKUP

Possible Interpretation, TPC-Cryostat Connection

TPC Cryostat Connection



- From tube 1 to tube 6 we are stilling very close to the feet

Possible Interpretation, Voltage Divider Chain



- From tubes 0 until tube 16 contain the “Zebra resistors” and for an additional 16 tubes after that we have the varistor boards
- Though tube-to-tube breakdowns are disfavored in our models