SBND signal processing threshold output debugging

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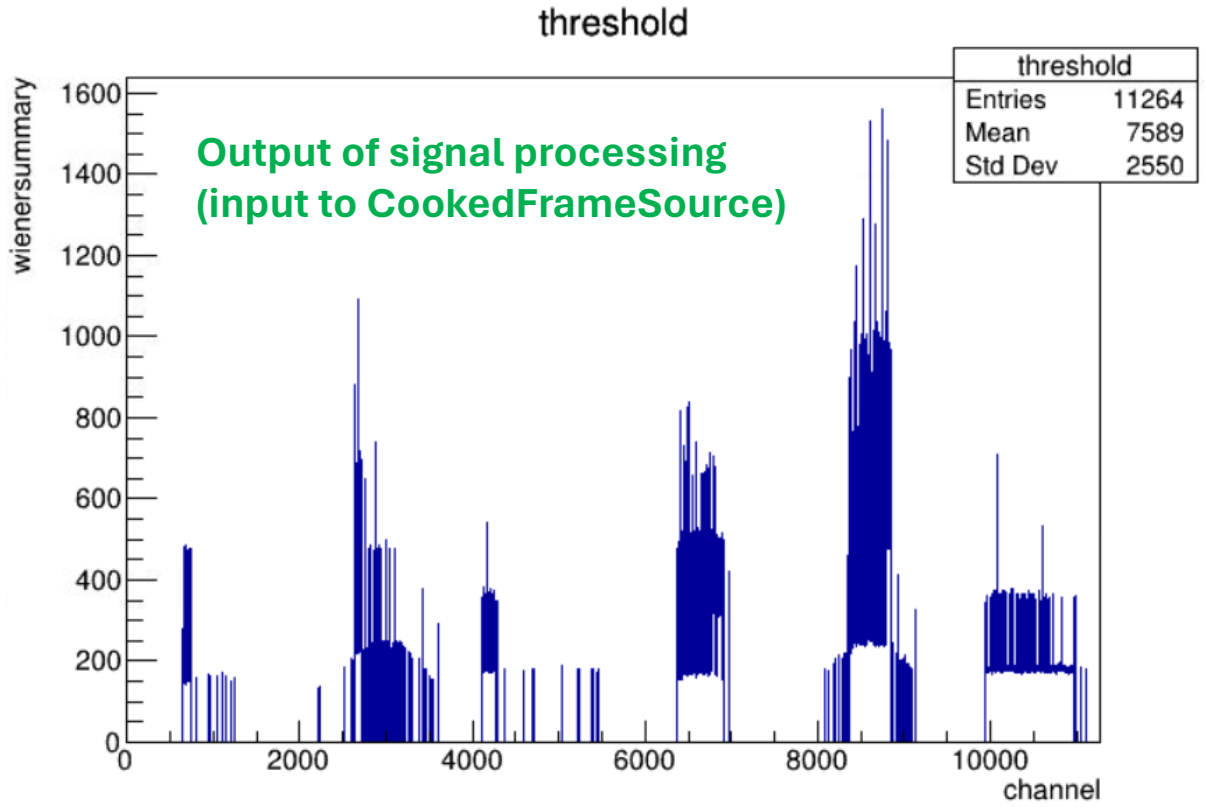
Recap (wirecell v26)

- **From the last presentation about imaging, the RMS used as input to imaging workflow did not look like having the correct shape. Below is the RMS from signal processing.**

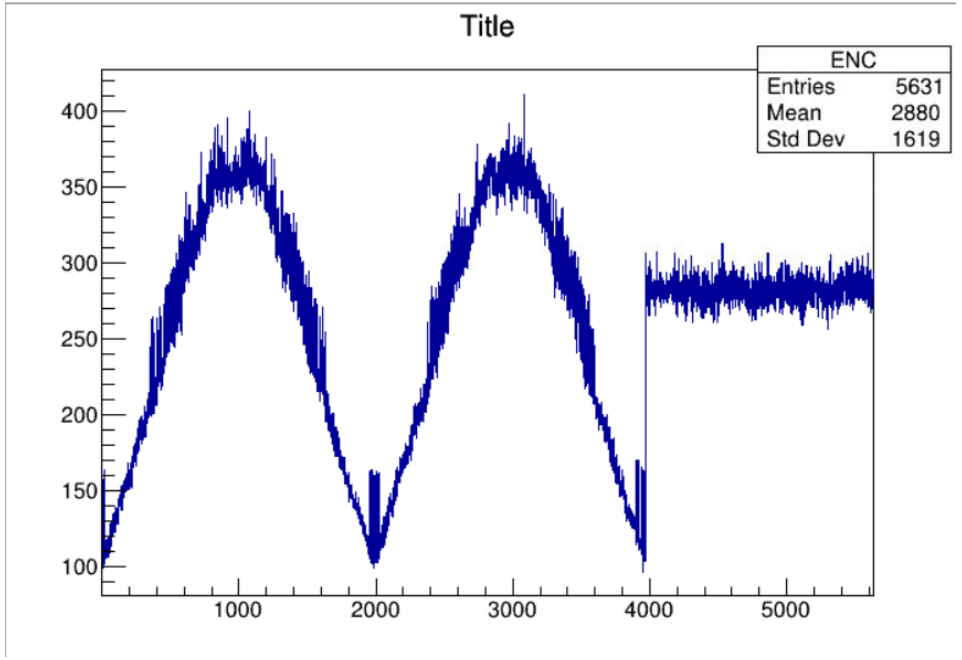
Event with a muon track!



Noise from RawWaveforms

- **To check if there was any issue with noise simulation in signal processing workflow, I manually calculated the noise ENC using the output RawWaveforms from signal processing chain. The shape looks as expected.**

Event with noise only!



RMS debugging

To understand the RMS given by the ROI formation module in signal processing (link below*), three different type of events were analysed**:**

(A) Two isochronus tracks overlapping with each other up to a certain position;
(B) One isochronus track (backup);
(C) Noise only.

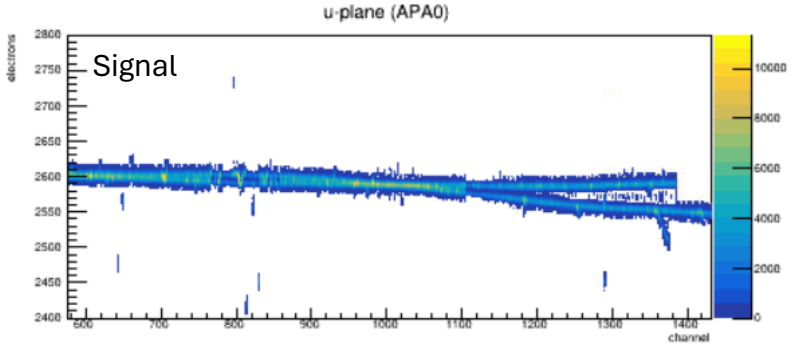
One thing that was noticed is that RMS values (shape) changed depending on the event topology. So, some questions to look for answers were:

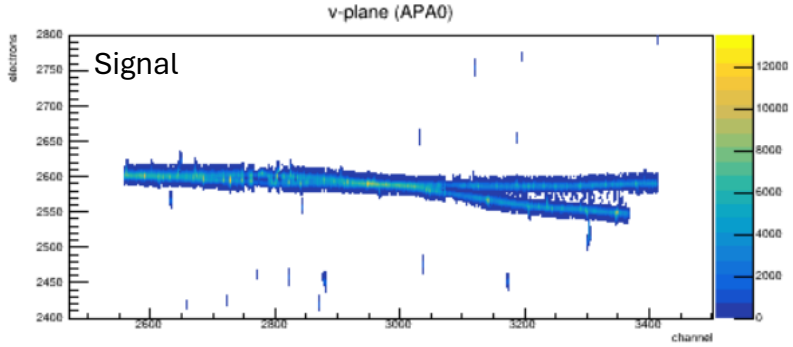
- Why RMS depend on the event topology?
- Why RMS values in the case of noise only and noise plus track are so different? (next slides)

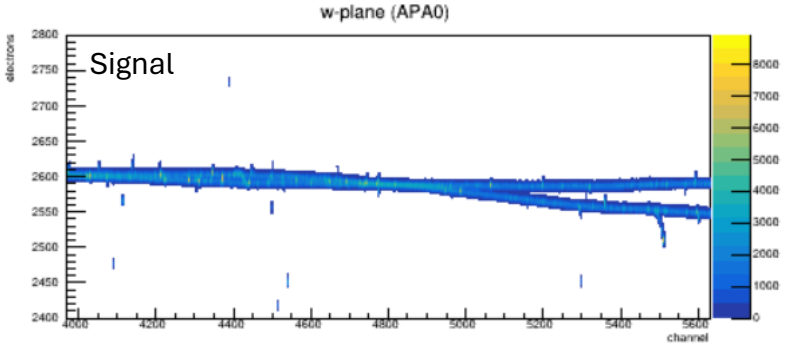
* https://github.com/WireCell/wire-cell-toolkit/blob/master/sigproc/src/ROI_formation.cxx#L364

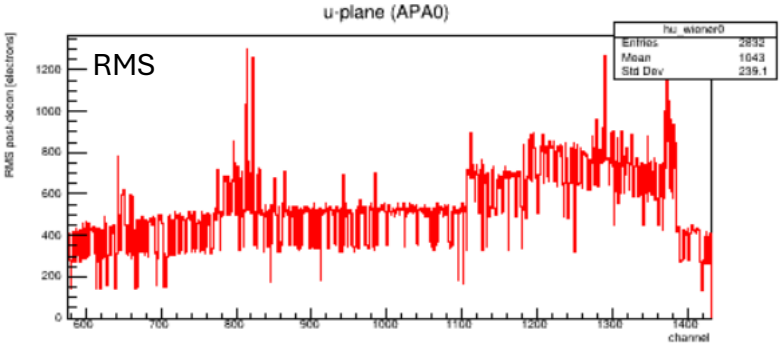
Two isochronus tracks overlapping

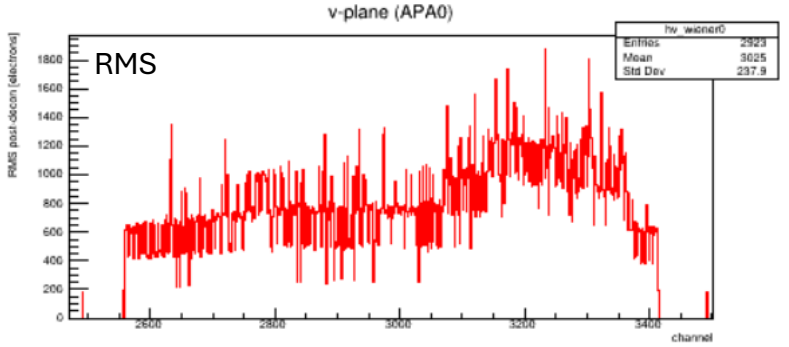
Looking at **u-plane**, the RMS for channels lower than 1100 (point where the tracks start to diverge) is generally around **~400e-**, with higher RMS after that channel. For **v-plane**, RMS is around **600e-** where the tracks overlap, increasing where they diverge. For **w-plane**, we see that RMS double their value in the point where the tracks start to diverge (**around channel 5050, RMS jumps from 170e- to 340e-**) .

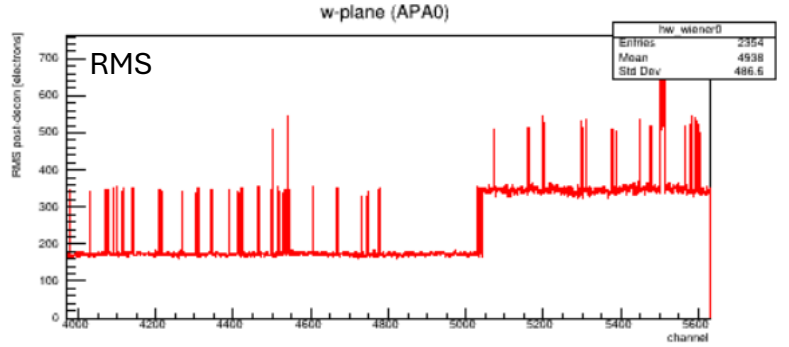


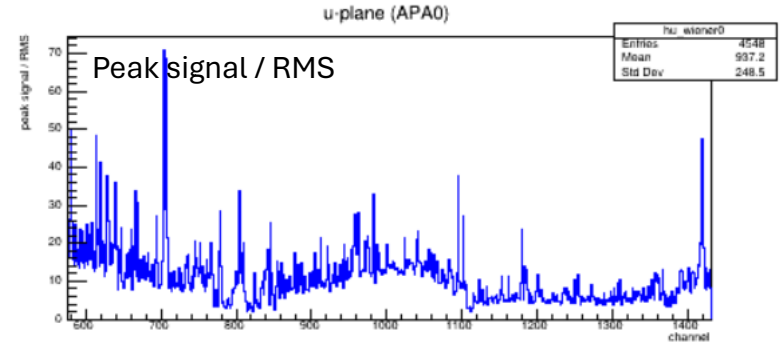


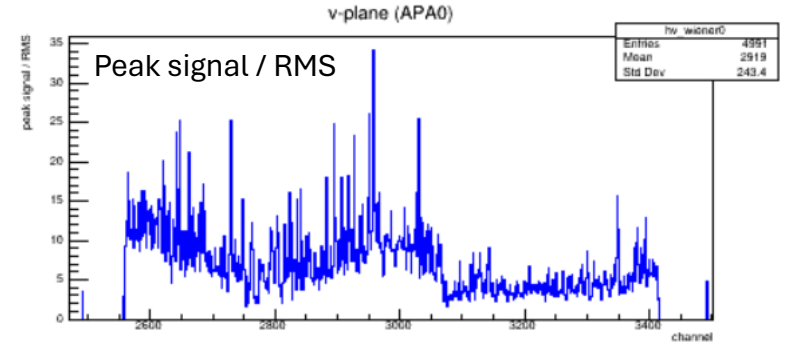


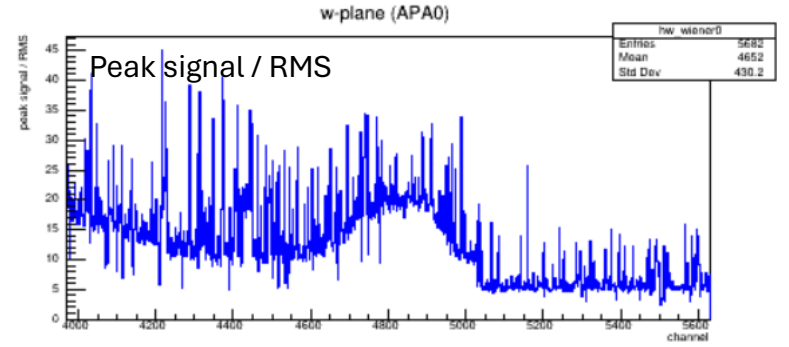






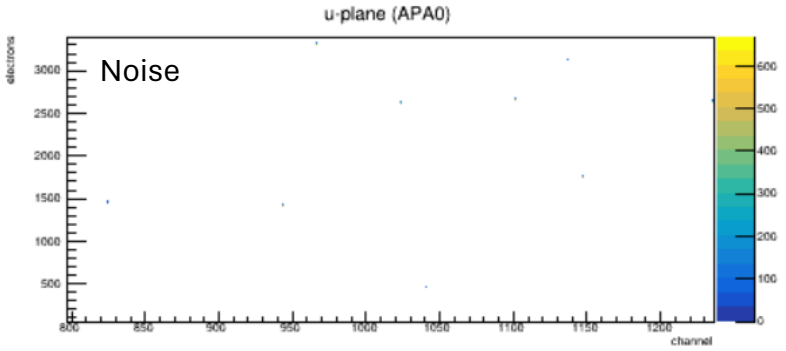


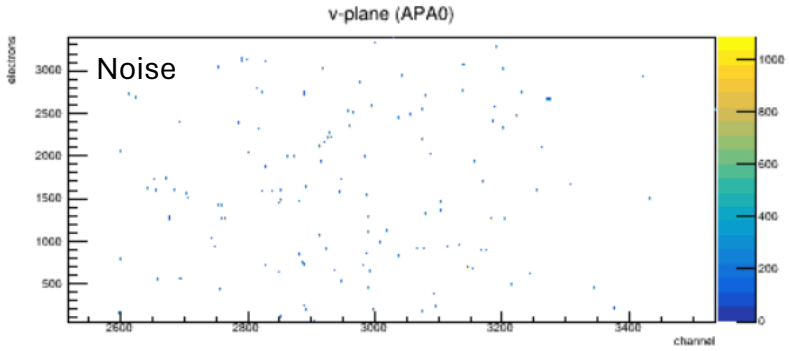


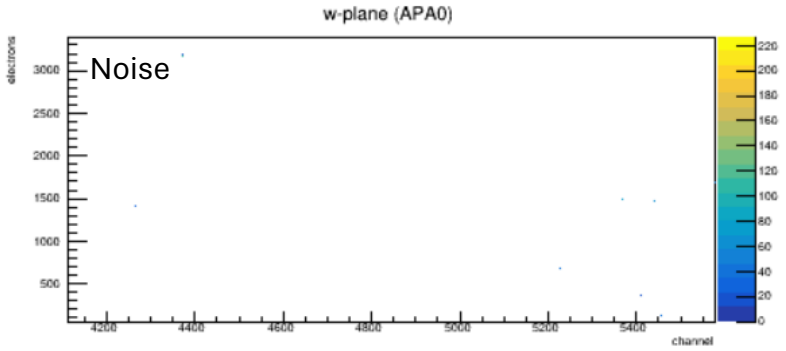


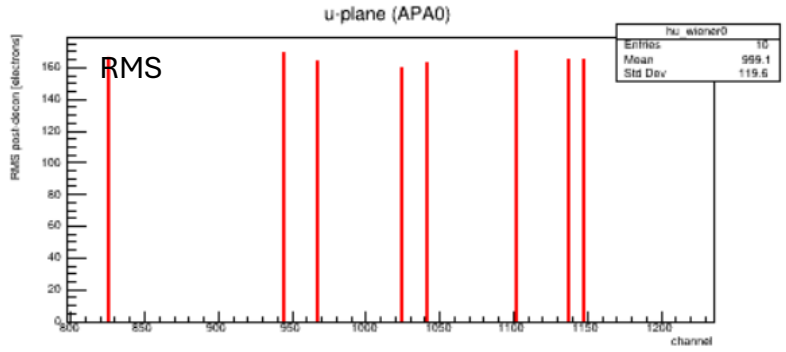
Noise only

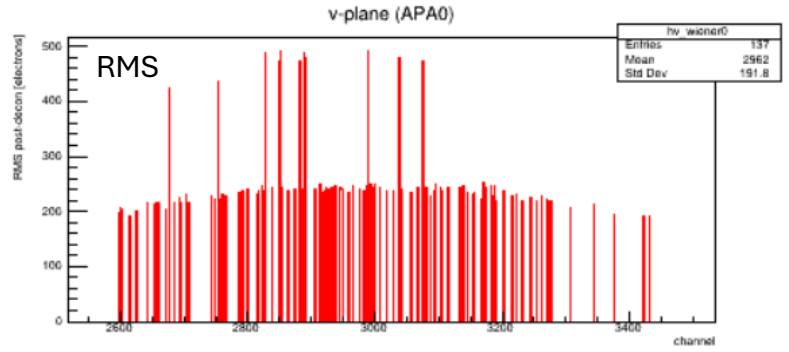
For noise only, RMS is around **160e-** in **u-plane**, **200e-** in **v-plane** and **170e-** in **w-plane** (similar to previous events).

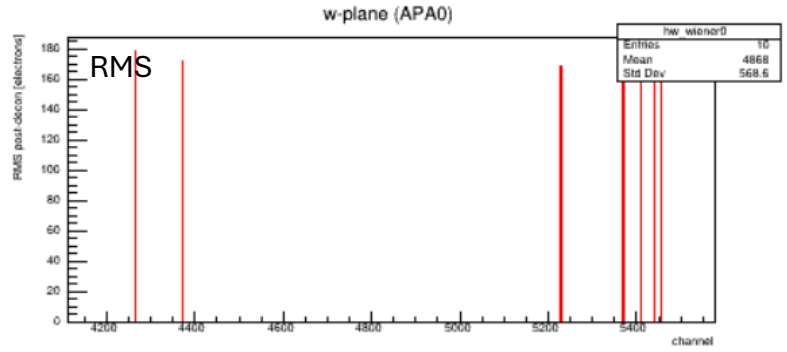


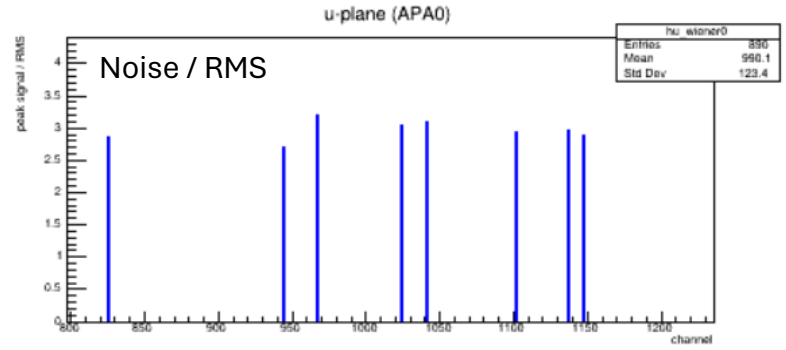


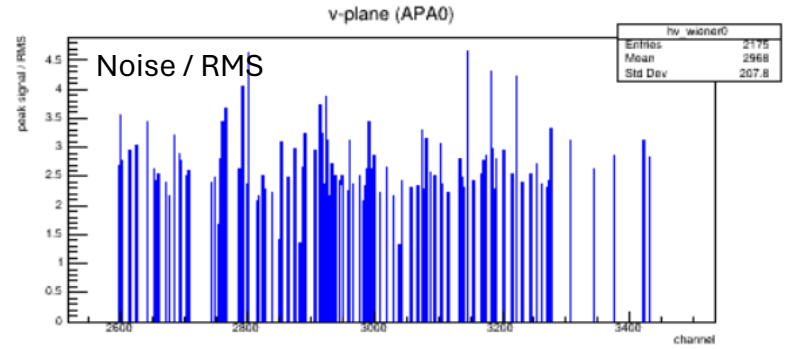


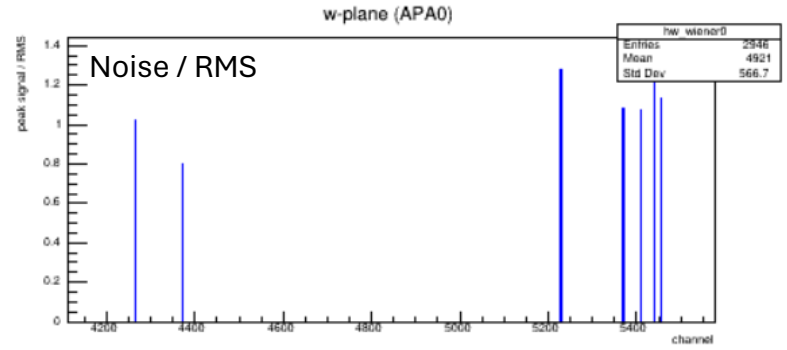






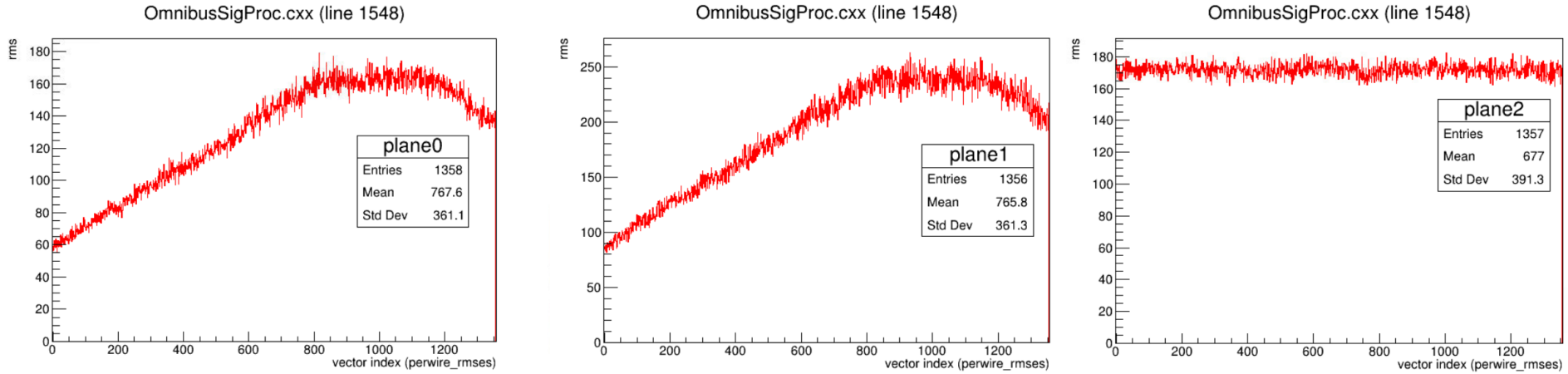




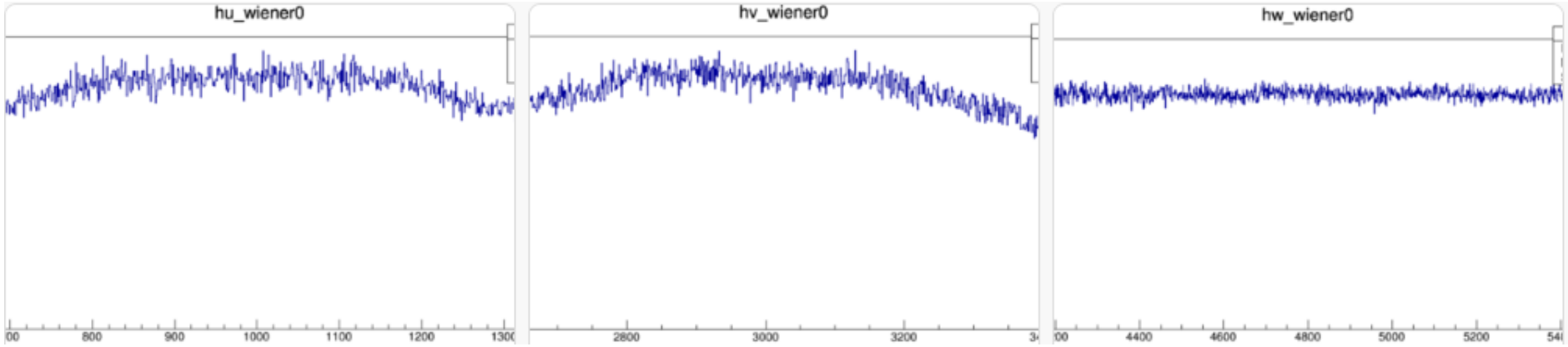


Further debugging

To further debug signal processing workflow, we directly looked at RMS in line L1548 in OminbusSigProc.cxx. Everything looked good.



Going to the module which generated the plots we were looking at (MagnifySink.cxx), we noticed that the parameter **“summary_operator”** was the one which determined the way RMS was being handled for each channel. **After changing it from “threshold” to “wiener”**, we got the correct shape for the RMS output from MagnifySink:



Further debugging

We have the same parameter in **FrameSaver** that needs to be correctly set up (**larwirecell**, initial place were we spotted the issue).

One good place to comment on that (avoid this issue to happen again) are at places which use MagnifySink/FrameSaver (jsonnet mainly. For C++ code we already have comments explaining this feature).

There is still a question we are trying to understand:

- What's the usage case or motivation for this 'sum' choice?

Backup

One isochronus track

For u-plane and v-plane, we have roughly the same RMS as before (except that now we don't see the increase we had previously in the channel where the tracks diverged). For w-plane, RMS ~170e- (values similar to the region where tracks overlap in previous slide).