NF/SP update in PDVD

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The Shield Plane Coupling

From [Laura's DRA meeting talk](#)
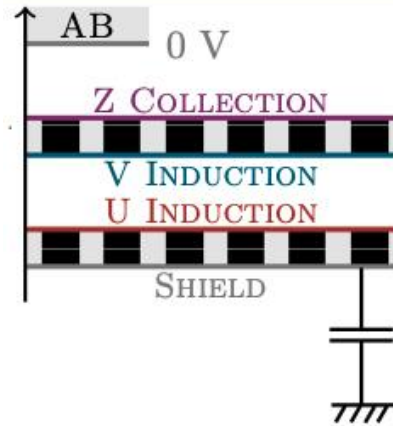
That capacitor is different for Top and Bottom CRPs:

$C_{TDE} = 100$ nF and $C_{BDE} = 800$ nF

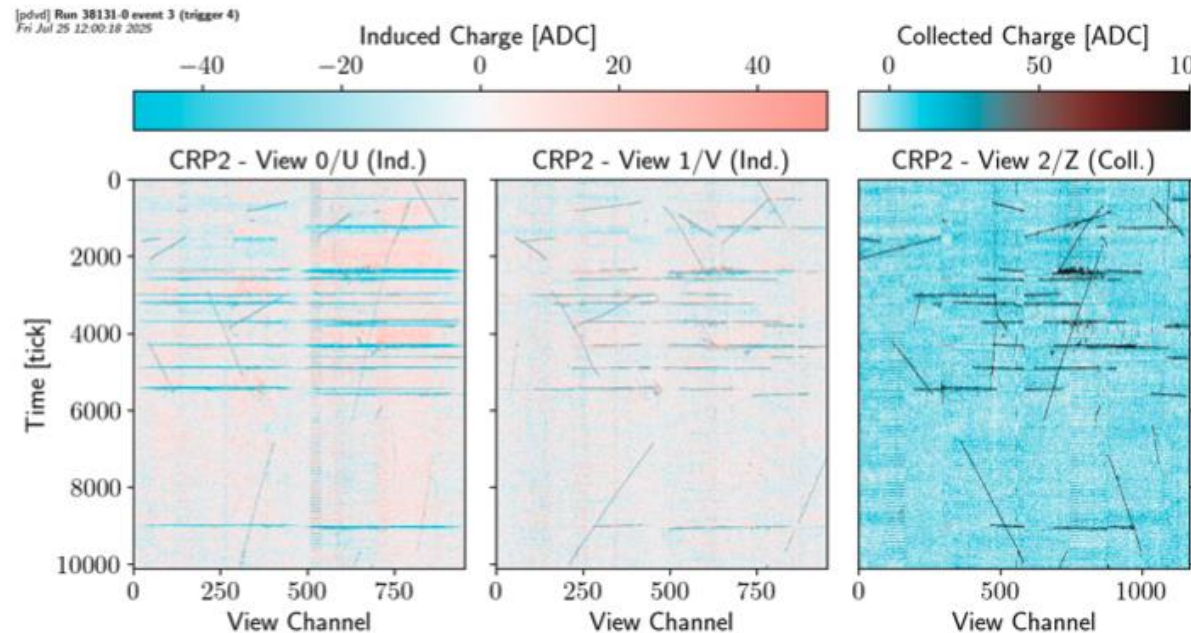Meanwhile the shield plane is also capacitively coupled to the strips of the View 0 (2 nF/strips, ~1μF total)

—> For TDE, the capacitor is not big enough.
—> The shield current is flushed to the View 0 strips.

Small strips see less shield current (coupled capacitance is lower)

This is visible for large deposition (shower, muon halo) and affects the signal processing
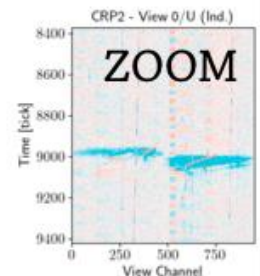
[pdvd] Run 38131-0 event 3 (trigger 4)
Fri Jul 25 12:00:18 2025

Induced Charge [ADC] — Collected Charge [ADC]

<u>Muon halo</u> (mostly summer runs)

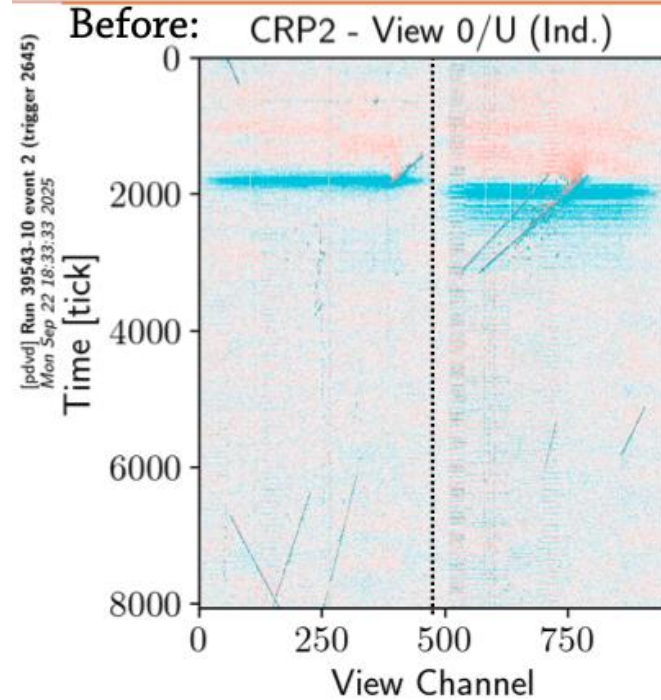We believe muon halo enters the TPC around Top CRPs level.

We see a large negative current on all strip in a given CRU over the muon halo tracks. The duration of the shield current is as large as the track angle.

2

7

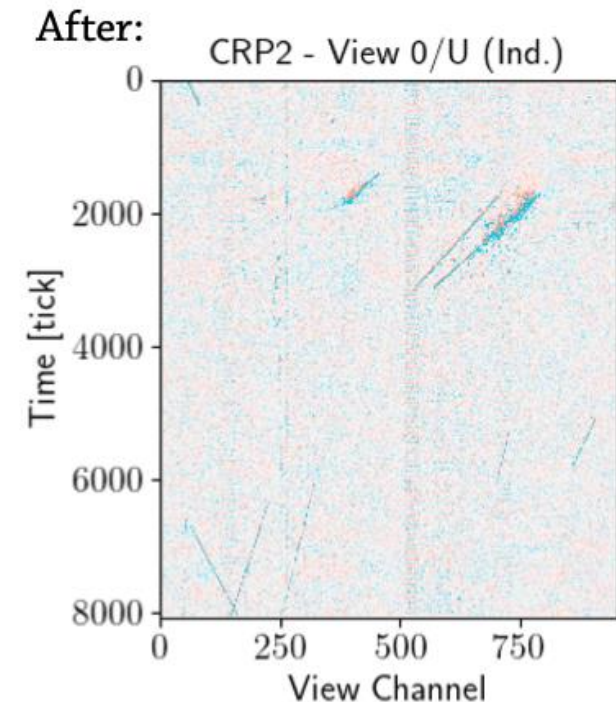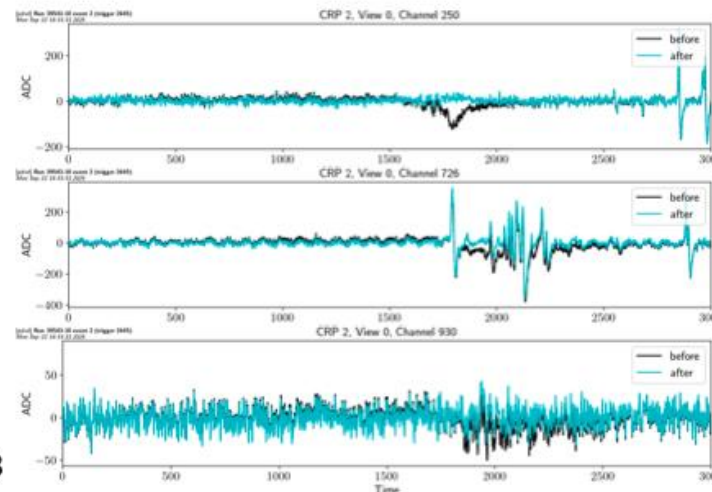# Shield Coupling removal (TDE view 0 only)

[LARDON's Shield Coupling removal](#)

Plan to add it into our noise filter.

LARDON's procedure to remove the shield current from View 0:

1. All ADCs are weighted by their corresponding strip length
2. The median weighted-ADC value computed over all channels in the same CRU is subtracted
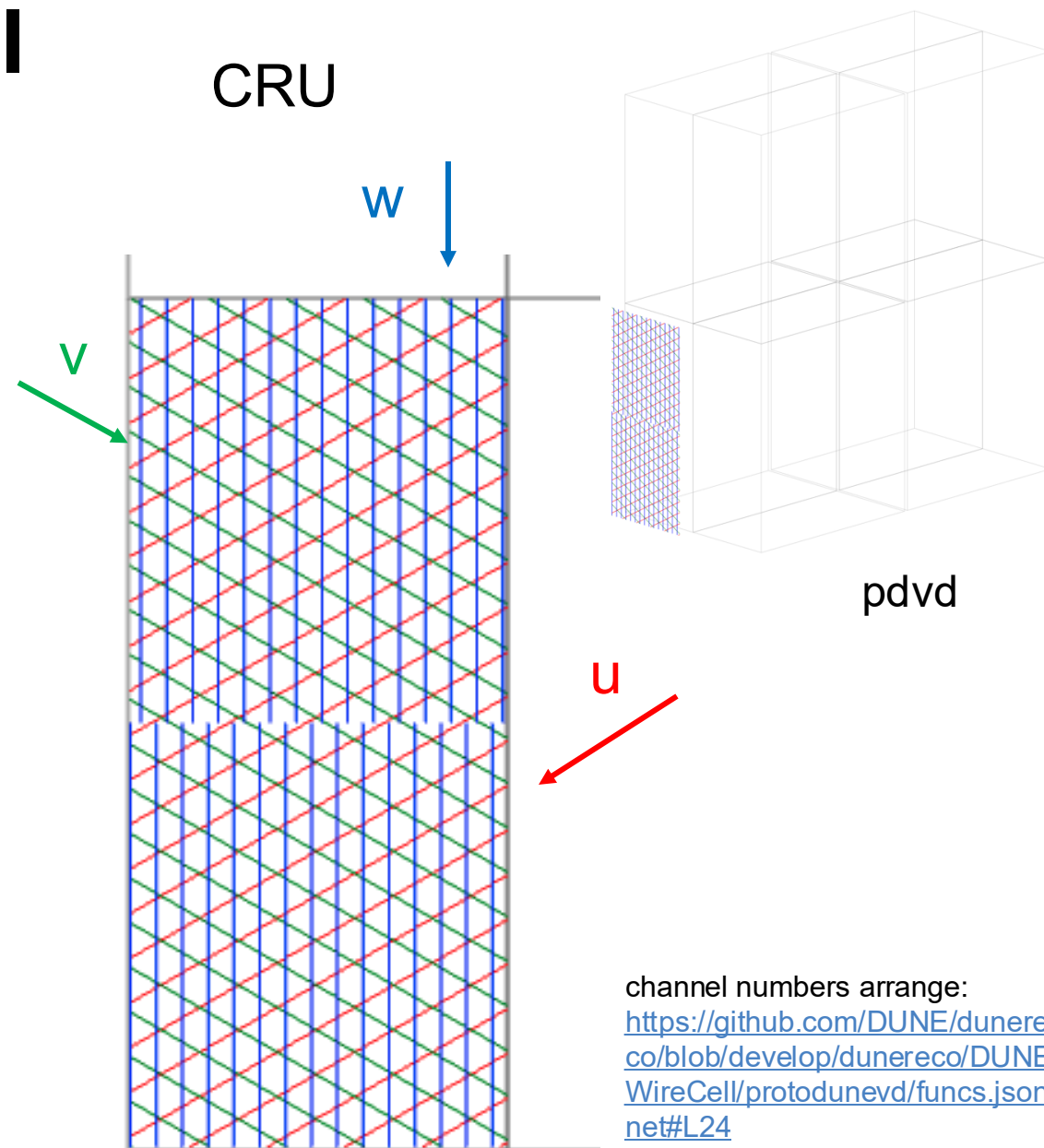3. ADCs are de-weighted

Add shield coupling removal

- Group **TDE u planes** in one **CRP**
  - 4 groups in total

- Apply **strip-length weighting** to ADC waveforms
  - Files provided by Laura

- **Signal tagging and protection**
  - For each channel:
  - If **weighted ADC value > 4 × RMS**, Flag a window of **70 ticks before** and **70 ticks after** as signal.
  - Only use positive part

- **Calculate median:**
  - For each time tick across channels:
  - Exclude all channels currently flagged as signal. Calculate median waveform.

- Remove signal mask, subtract median waveform

- Remove strip-length weighting for all channels

- Idea same as **Lardon** but I add **Signal protection** and use **median waveform** instead of mean waveform.

- This correction will apply to all TDE u plane, we don't have a selection to find if noise is happened.
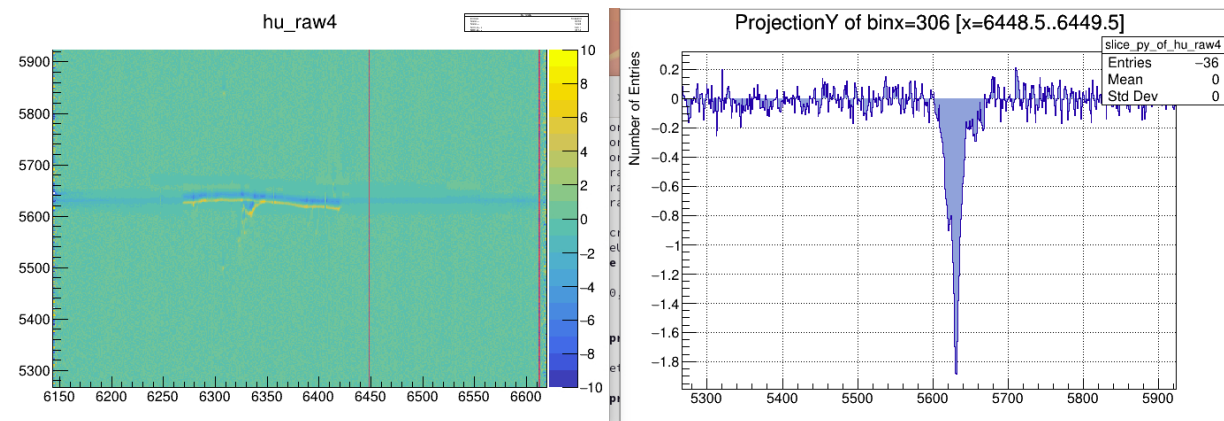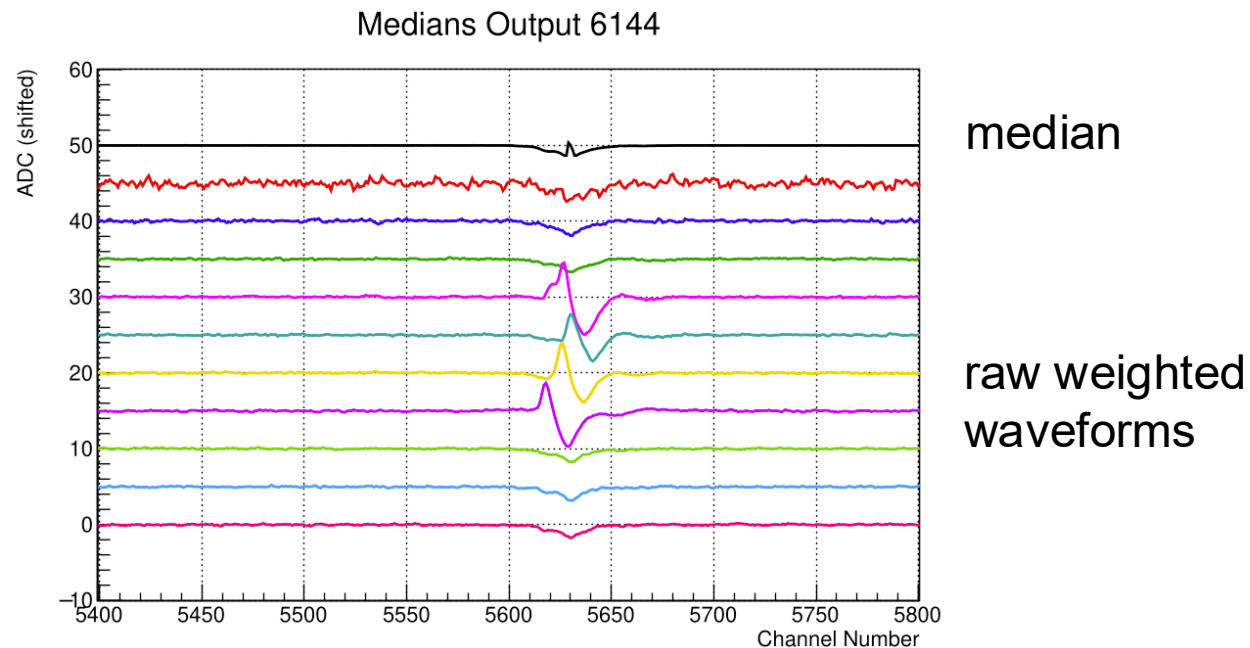
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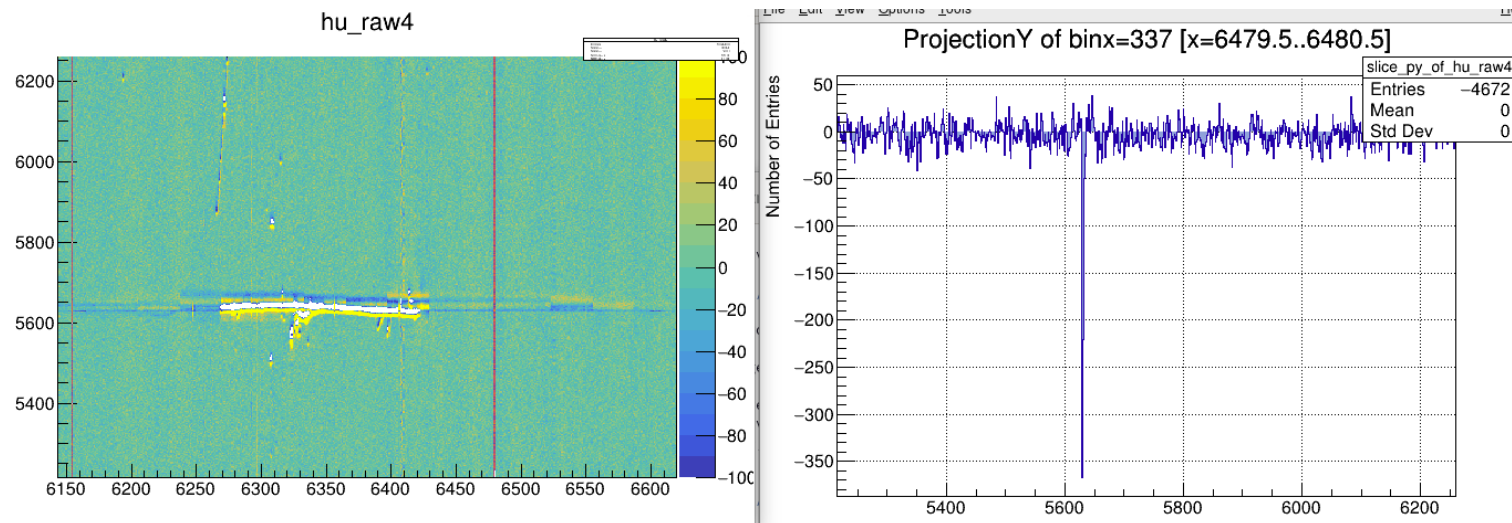
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CRU

w

v

u

pdvd

channel numbers arrange: https://github.com/DUNE/dunereco/blob/develop/dunereco/DUNEWireCell/protodunevd/funcs.jsonnet#L24

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A strip-length weighted waveform noise is almost same negative peak across the whole channels, usually induced by a large signal. use the region with no signal to calculate median.

If no signal protection:

- Median waveform will be affected by the large positive signal.

Medians Output 6144

median

raw weighted waveforms

- Still residual noise

hu_raw4

ProjectionY of binx=337 [x=6479.5..6480.5]

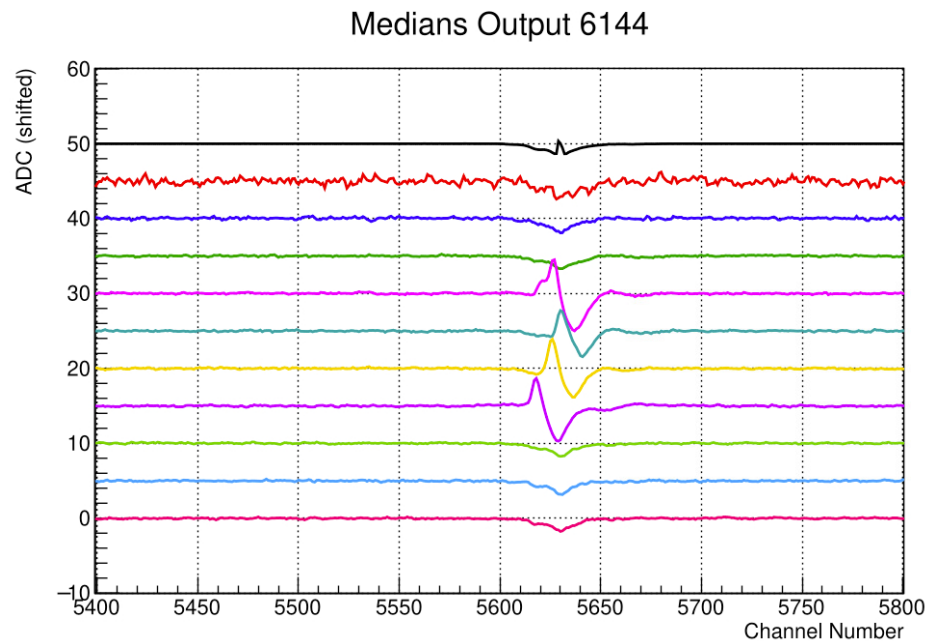# Add signal tagging

- **Signal tagging and protection**
  - For each channel:
  - If **weighted ADC value > 4 × RMS**, Flag a window of **70 ticks before** and **70 ticks after** as signal.
  - Only use positive part
  - Add a value of 200000 for protection.

- **Calculate median:**
  - For each time tick across channels:
  - Exclude all channels currently flagged as signal. Calculate median waveform.
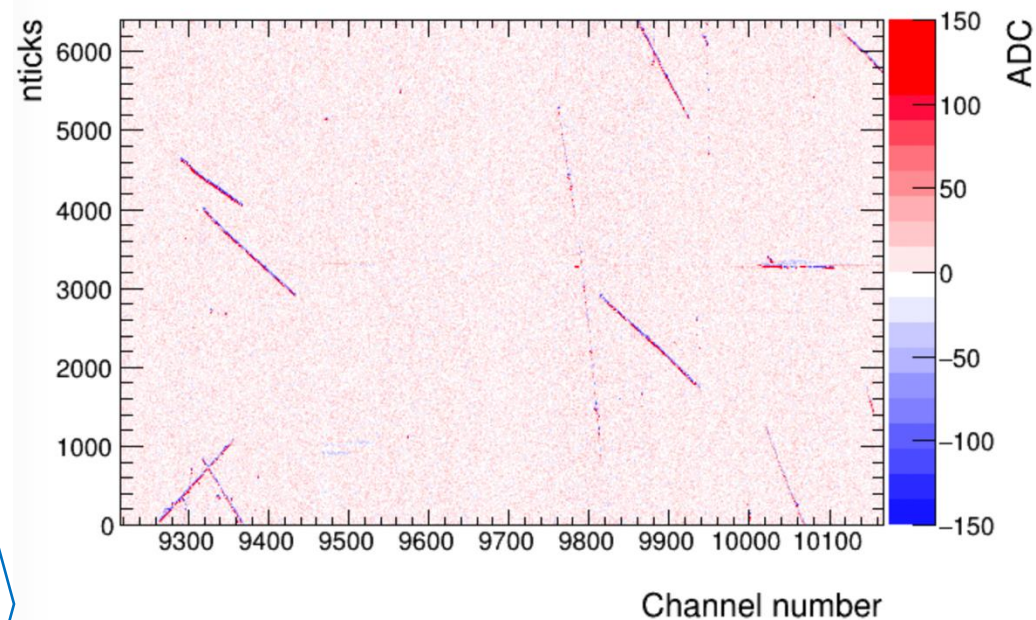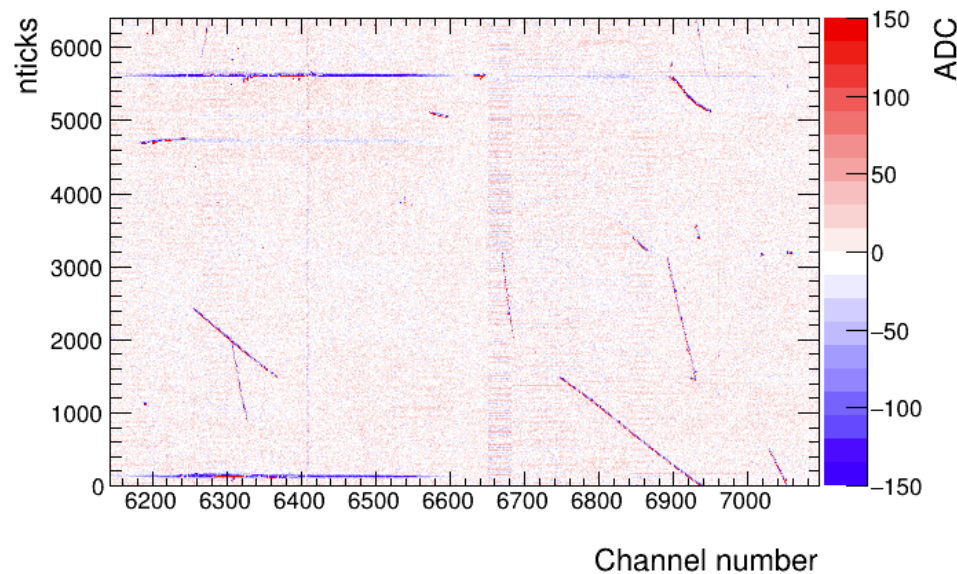

median

raw weighted waveforms
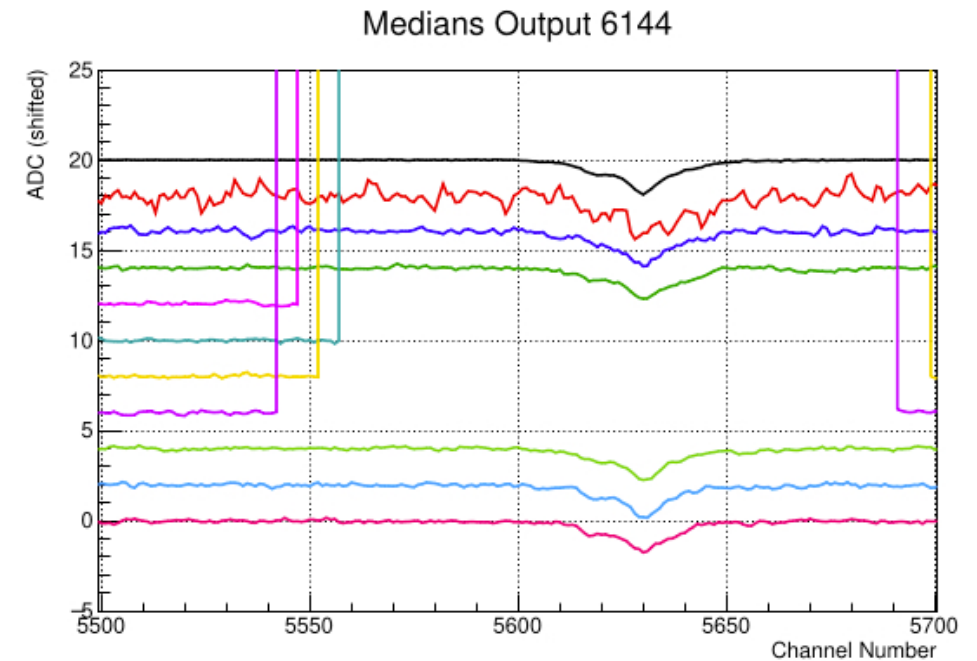
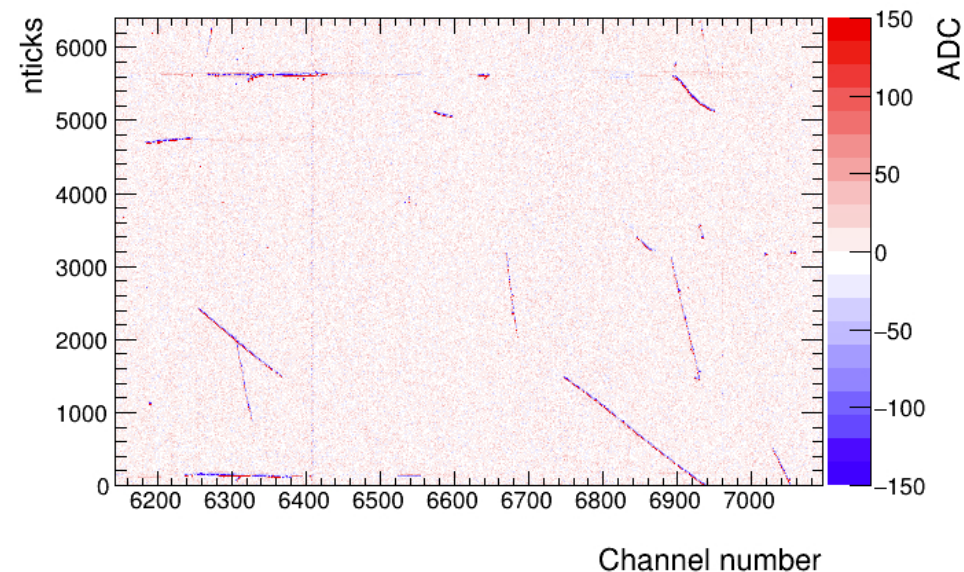# Final performance

Raw waveform CRP4_u_39324_1183563
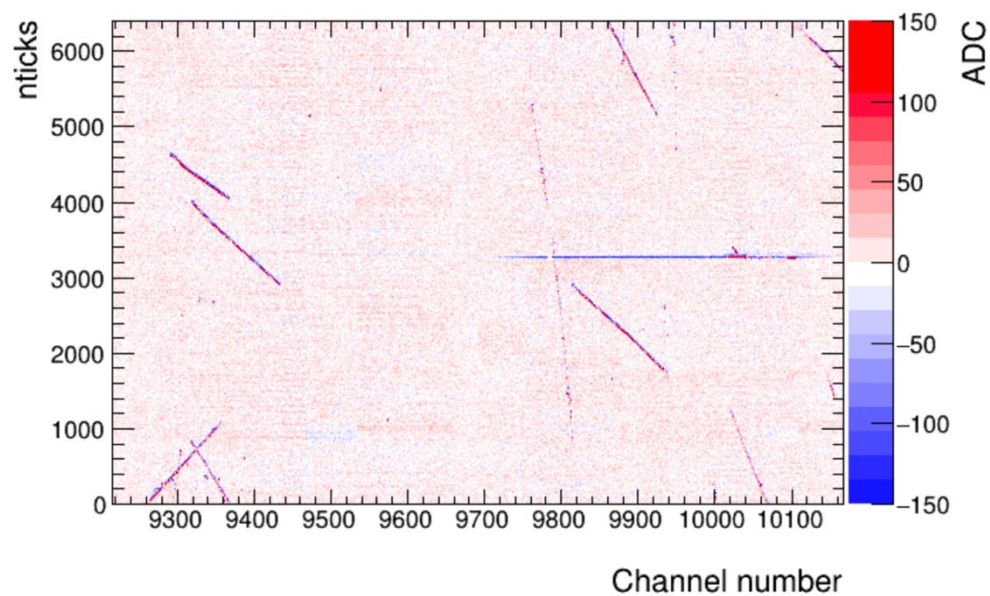
Raw waveform ANf CRP4_u_39324_1183563
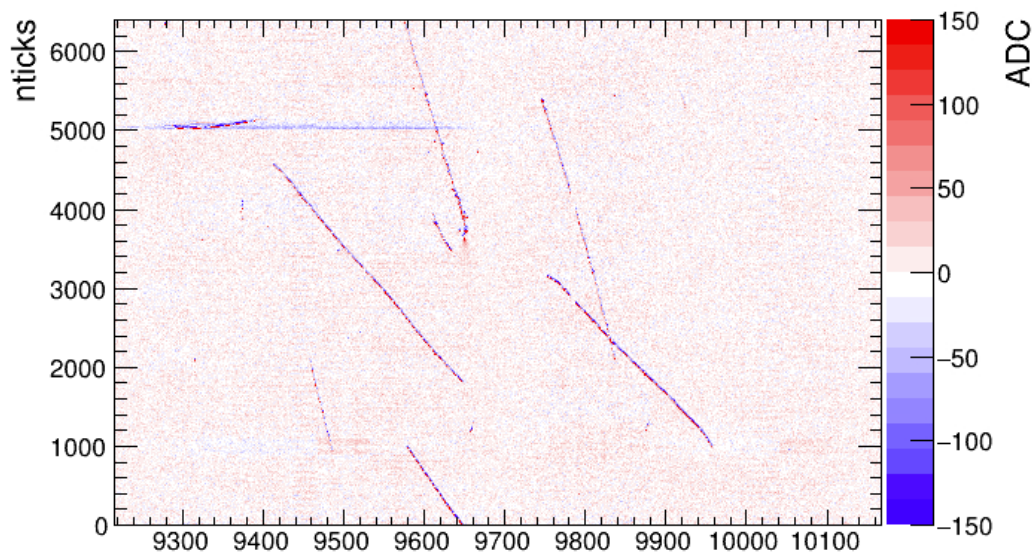
Raw waveform CRP3_u_39324_339870
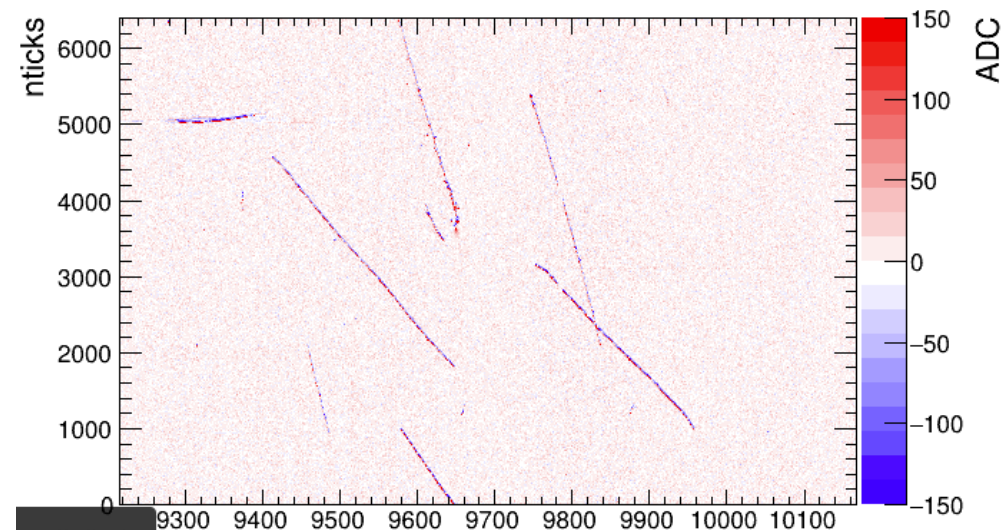
Raw waveform ANf CRP3_u_39324_339870
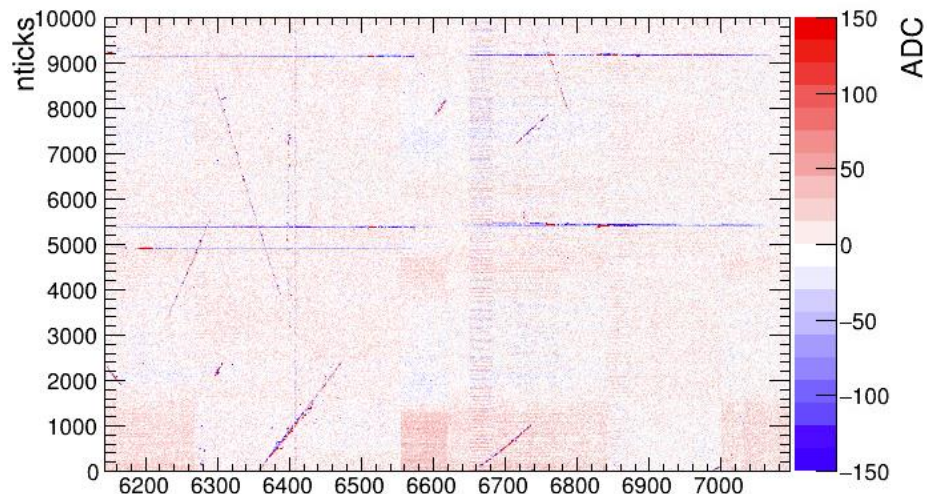
9

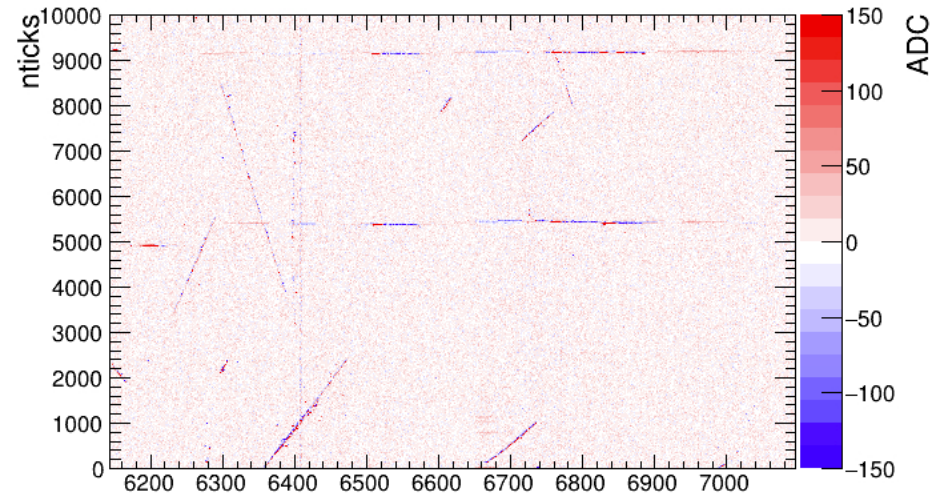# Final performance

Raw waveform CRP4_u_39324_339870

Raw waveform ANf CRP4_u_39324_339870

Raw waveform CRP3_u_39273_357863

Raw waveform ANf CRP3_u_39273_357863

Some code details:

wire-cell-cfg/pgrapher/experiment/protodunevd/chndb-base.jsonnet

```
top_u_groups:
  [std.range(n*3072, n*3072+475) for n in std.range(2,3)]
  +[std.range(n*3072+476, n*3072+951) for n in std.range(2,3)]
,
```

wire-cell-cfg/pgrapher/experiment/protodunevd/ params.jsonnet

```
files: {
    wires: "protodunevd-wires-larsoft-v3.json.bz2",
    strip_length: "PDVD_strip_length.json.bz2",
```

- Also add a ProtoduneVD.cxx and ProtoduneVD.h specific for PDVD noise filter.
  - Remove the Is_partial noise.
  - Add ShieldCouplingSub.

wire-cell-cfg/pgrapher/experiment/protodunevd/nf.jsonnet
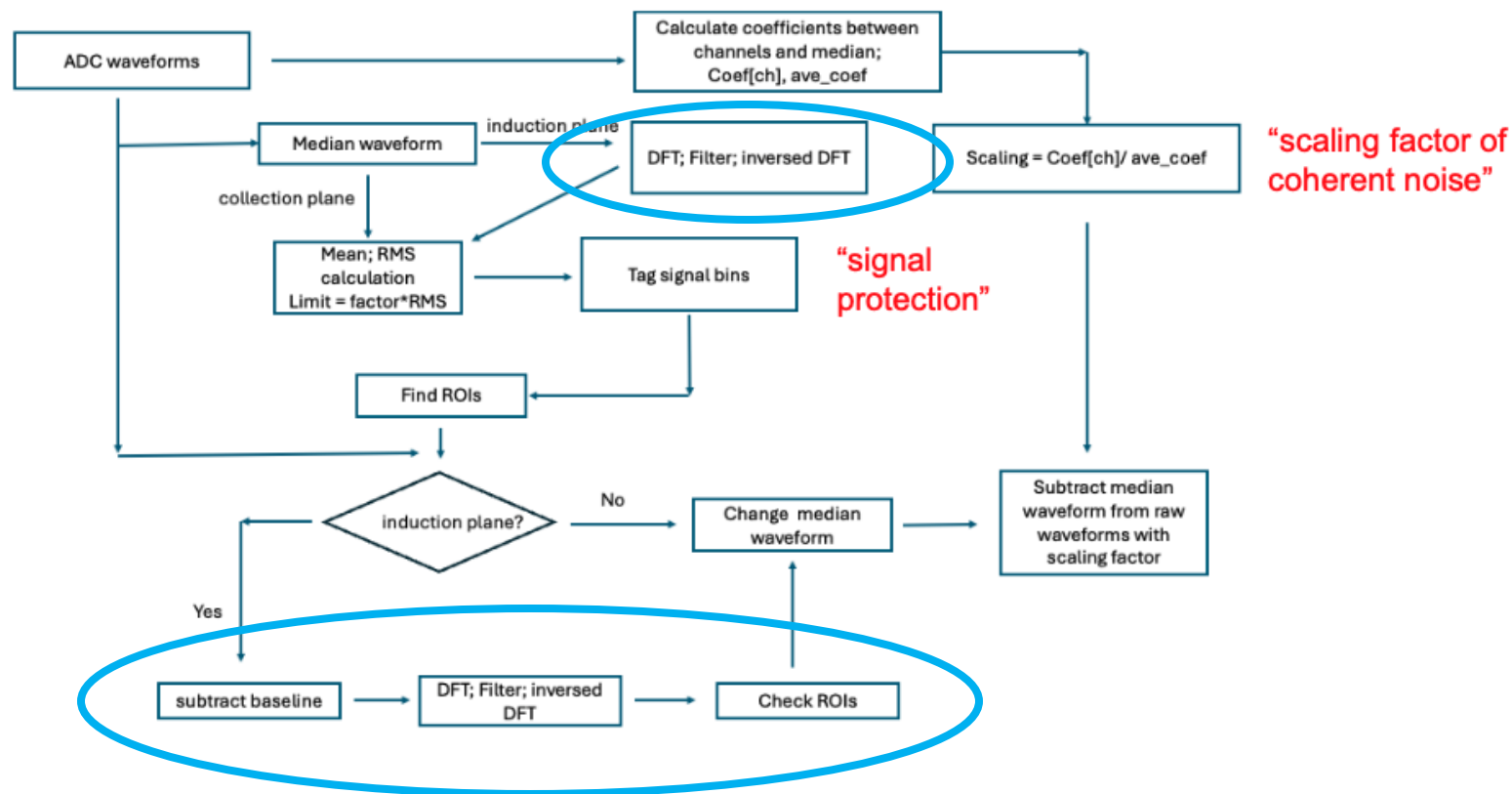
```
local shieldcoupling_grouped = {
    type: 'PDVDShieldCouplingSub',
    name: name,
    uses: [anode],
    data: {
        anode: wc.tn(anode),
        noisedb: wc.tn(chndbobj),
        strip_length: params.files.strip_length,
        rms_threshold: 0.0,
    },
},
```
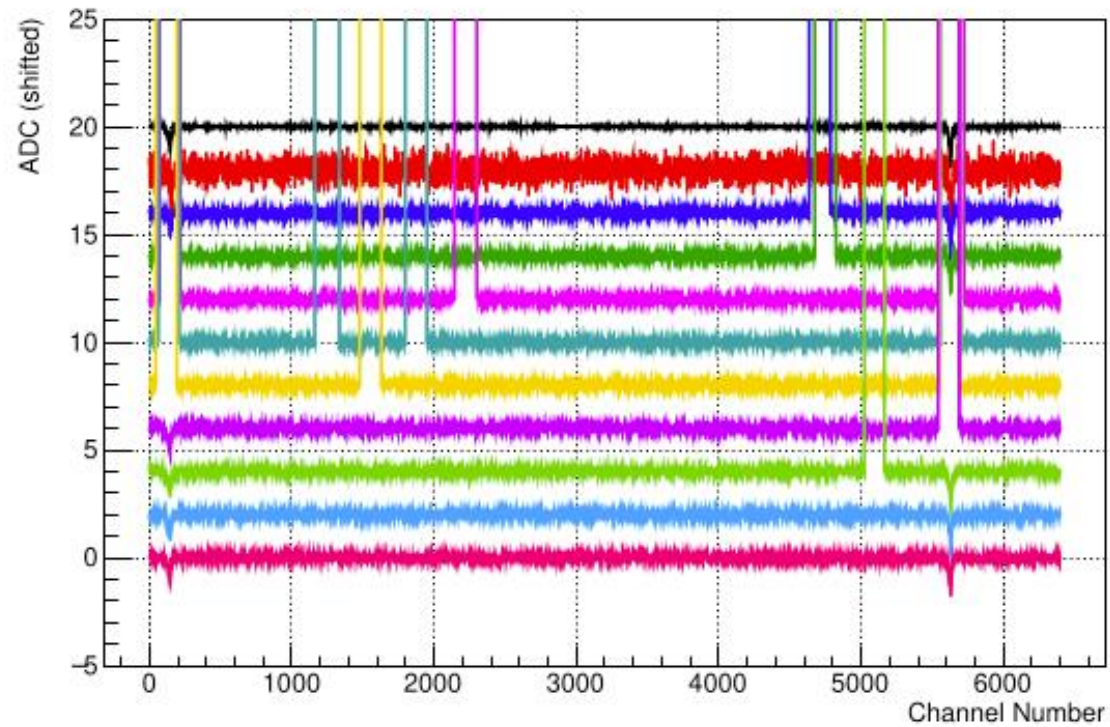
CNR signal protection

- A total field response should be provided here to enable decon and detailed ROI finding for induction plane.

- Currently it is not available for PDVD.

- I didn't notice it from the NF performance, but from reviewing the code.

- How important it is?
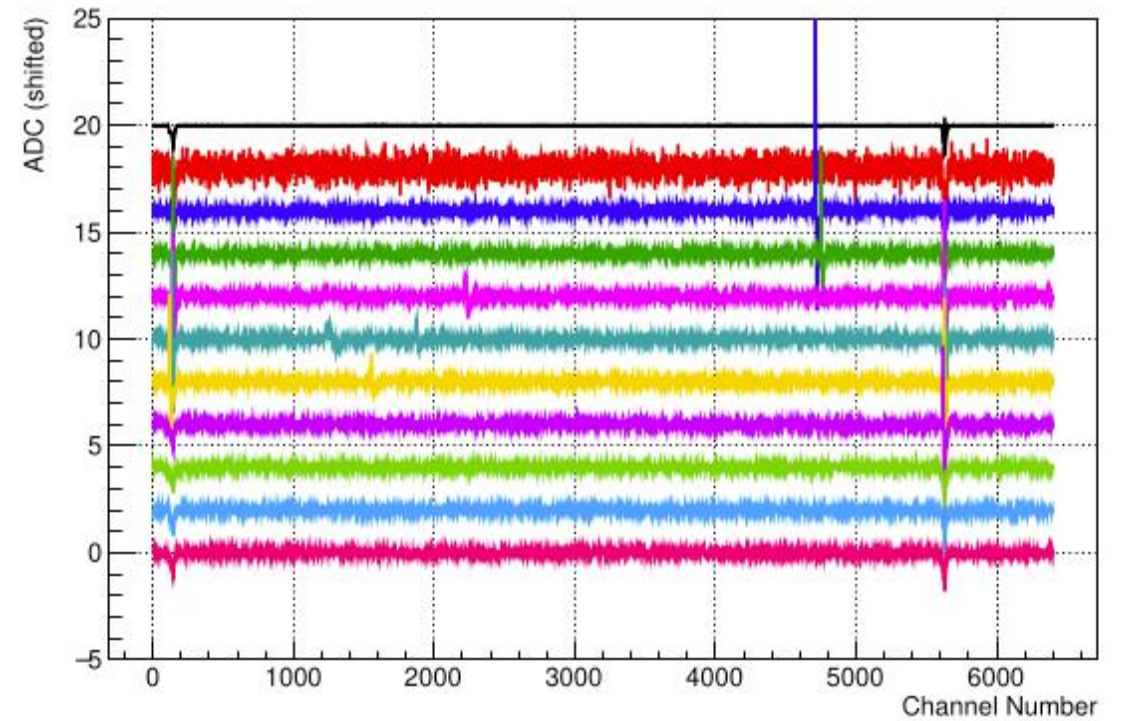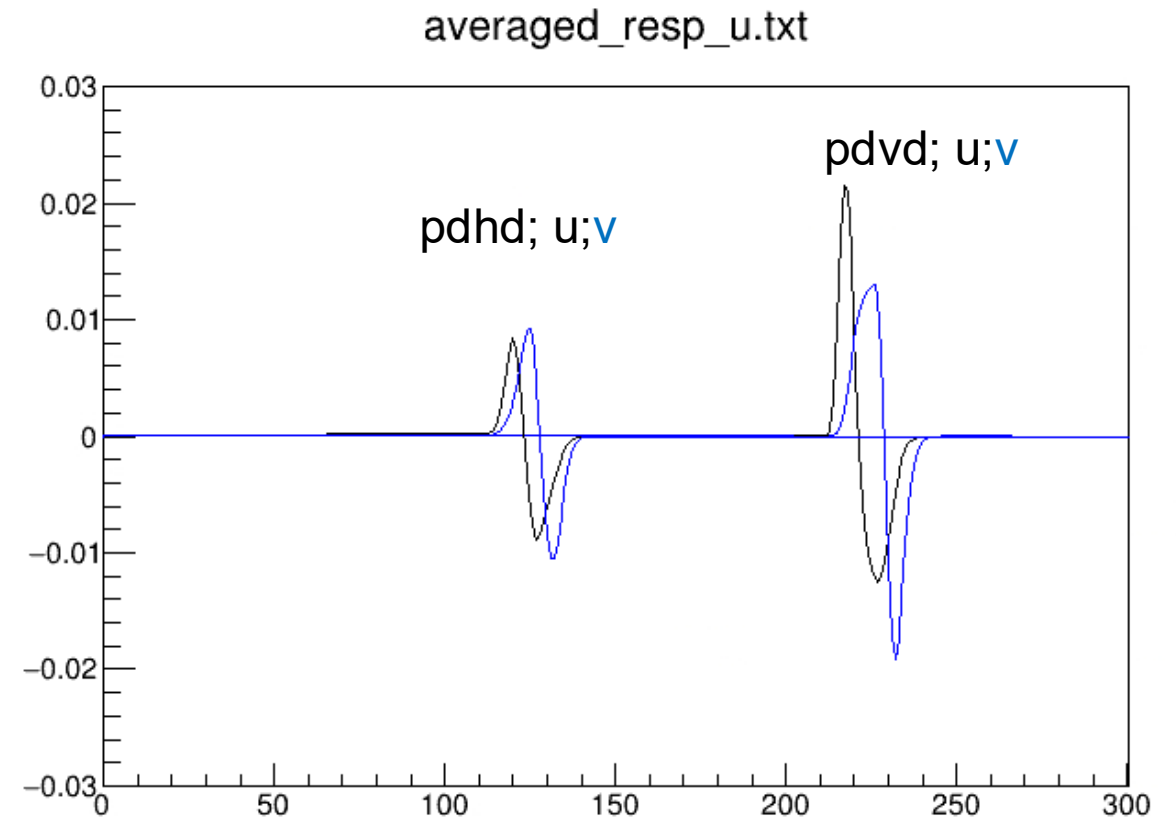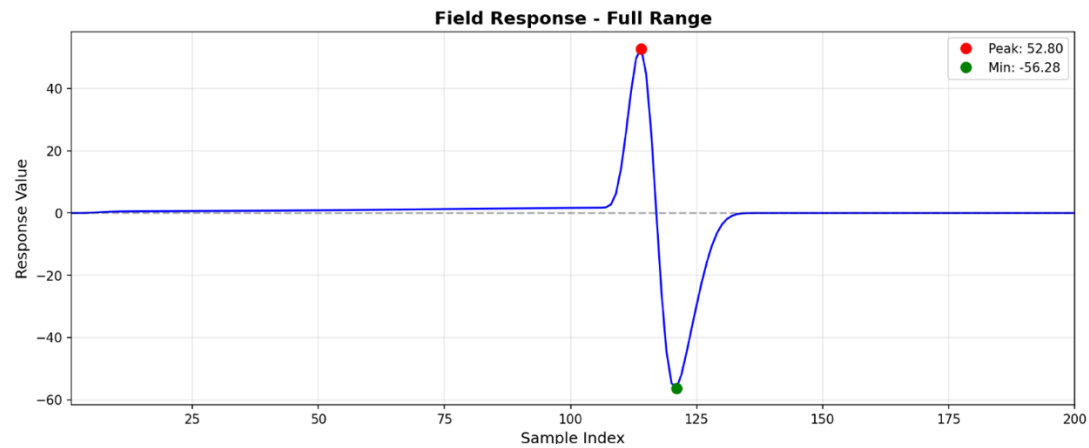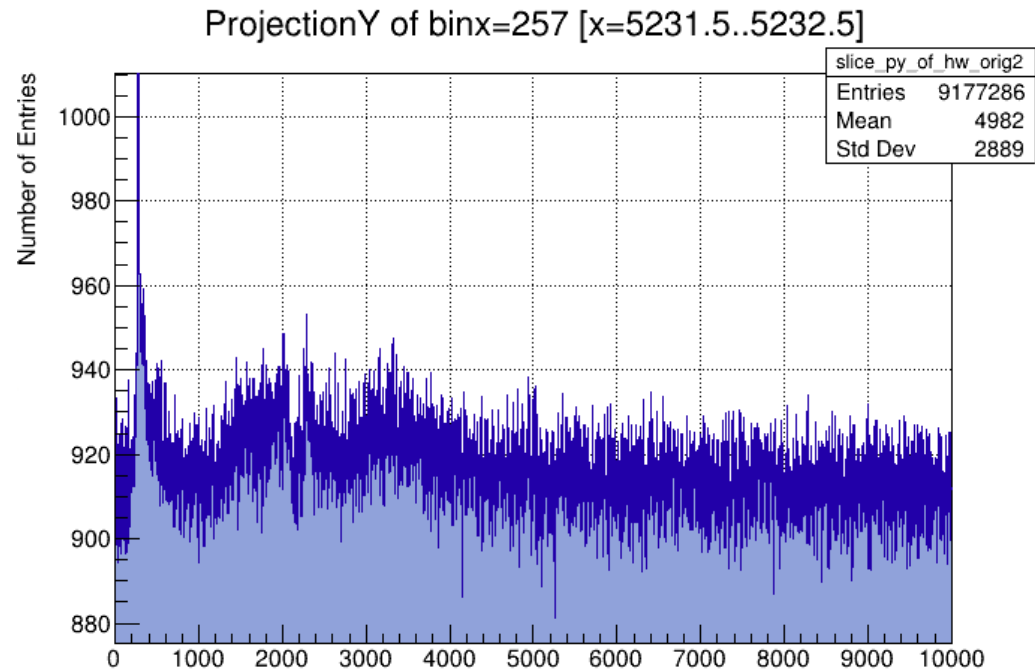
Coherent noise removal (CNR)

backup

Backup: Field response

Backup: ls_partial

ProjectionY of binx=257 [x=5231.5..5232.5]

32923.1 6659.11 13648.3 13321.3 14808.6
[PDVD] is_partical channel: 5232