Current status of PDHD SigProc & Imaging

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PDHD SigProc

- Signal processing for APA1 w plane is ready in wirecell-toolkit
  - New field response for APA1 w plane
  - Add a 2D FilterResponse for ROI finding

```
namespace WireCell {
    namespace SigProc {
        class FilterResponse : public IChannelResponse, public IConfigurable {
           public:
            FilterResponse(const char* filename = "", const int planeid = 0);

            virtual ~FilterResponse();

            // IChannelResponse
            virtual const Waveform::realseq_t& channel_response(int channel_ident) const;
            virtual Binning channel_response_binning() const;

            // IConfigurable
            virtual void configure(const WireCell::Configuration& config);
            virtual WireCell::Configuration default_configuration() const;

           private:
            std::string m_filename;
            int m_planeid;
            std::unordered_map<int, Waveform::realseq_t> m_cr;
            Binning m_bins;
        };
```

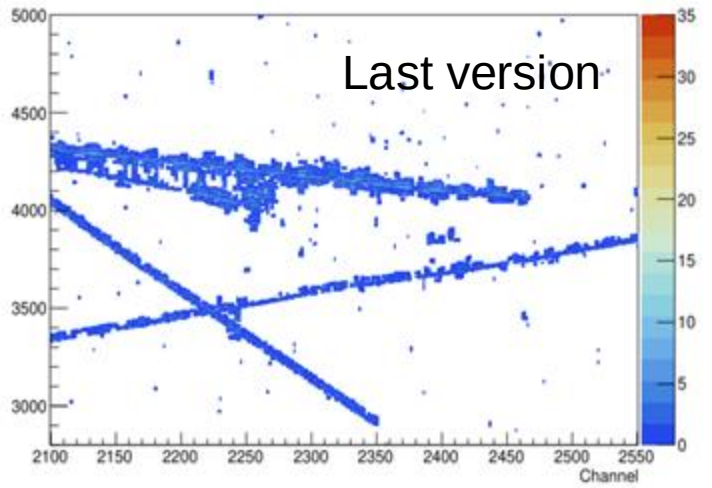
overall_resp_filters.json

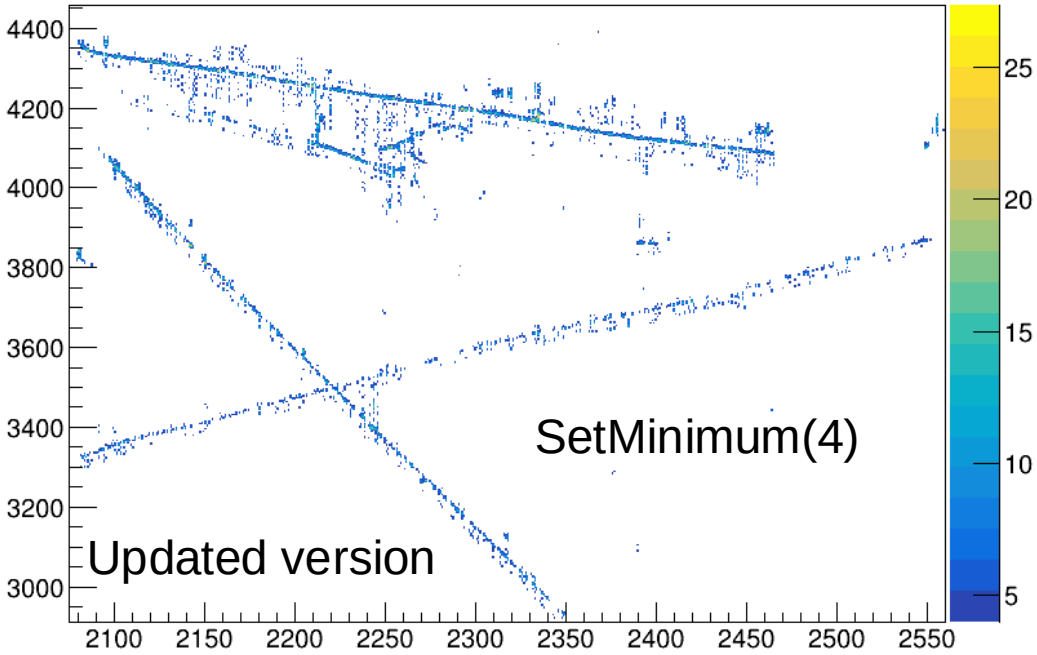
```
{
   "nwires": 11,
   "nticks": 6000,
   "filters": [
     {
       "plane": 0,
       "wire": 0,
       "values": [0.9, 0.85, … ,1],
     },
     {
       "plane": 0,
       "wire": 1,
       "values": [0.9, 0.85, … ,1],
     },

    …

  ]
}
```

sigproc/src/OmnibusSigProc.cxx

```
1633            // initial decon ...
1634  +
1635  +         // additional filters for overall resposne
1636  +         if (!m_filter_resps_tn.empty()) {
1637  +             for (size_t i = 0; i !=
        overall_resp[iplane].size(); i++) {
1638  +                 auto fltresp =
        Factory::find_tn<IChannelResponse>(m_filter_resps_tn[iplane]);
1639  +                 const Waveform::realseq_t& flt = fltresp-
        >channel_response(i); // filter at wire: i
1640  +                 for (int j = 0; j != std::min<int>
        (m_fft_nticks, flt.size()); j++) {
1641  +                     overall_resp[iplane].at(i).at(j) *=
        flt.at(j);
1642  +                 }
1643  +             }
1644  +         }
1645  +
1646            decon_2D_init(iplane);  // decon in large matrix
1647            check_data(iplane, "after 2D init");
```

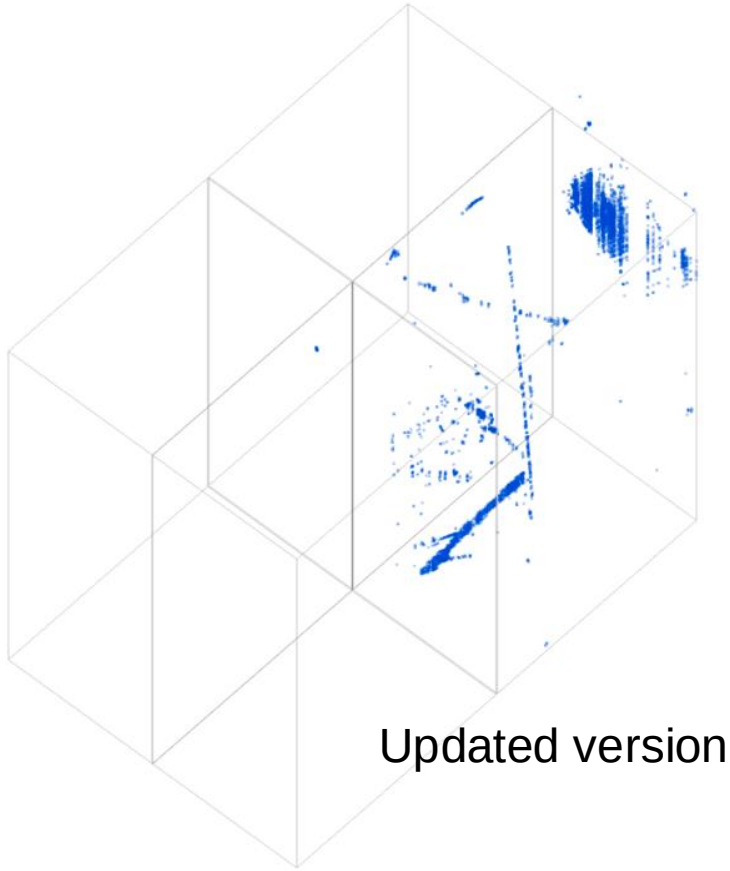
```
t_pointer& in, output_pointer& out)

1801                    wiener_traces.insert(wiener_traces.end(),
        perframe.begin(), perframe.end());
1802                }
1803
1804  +             if (!m_filter_resps_tn.empty()) {
1805  +                 // reload data and field response
1806  +                 init_overall_response(in);
1807  +                 load_data(in, iplane);
1808  +                 decon_2D_init(iplane);  // decon in large
        matrix
1809  +             }
1810  +
1811               decon_2D_charge(iplane);
1812               std::vector<double> dummy_thresholds;
1813               if (m_use_roi_debug_mode and
        !m_decon_charge_tag.empty()) {
```





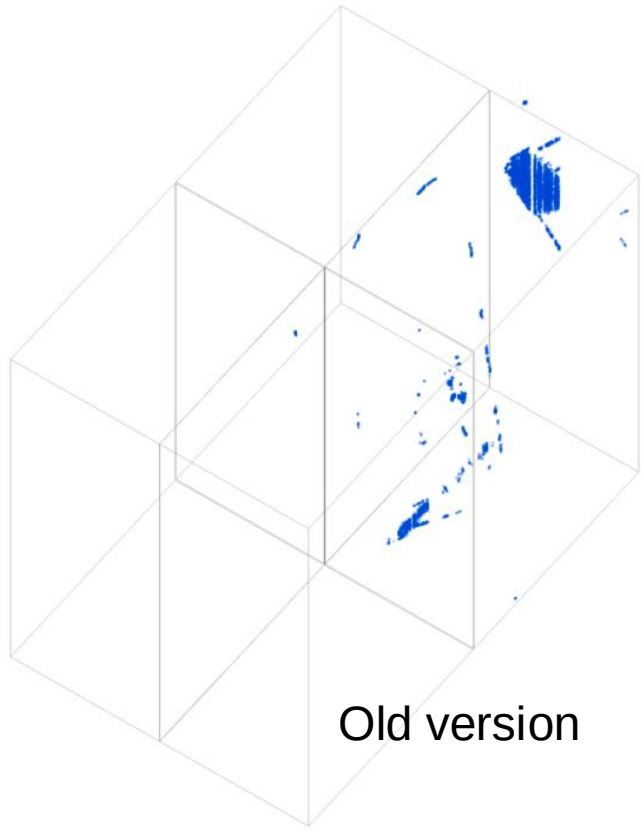
Imaging in APA1

- Two version has same ROI region.
- In our imaging, the new field response provides a better decon charge.
  - But the tracks still have lots of gaps.
- Leigh helped to check the new signal processing in their pandora reconstruction.
  - beam particle efficiency is about the same as with the previous version
- The ROI region will be further improved with DNN ROI (Hokyeong Nam)



Updated version

https://www.phy.bnl.gov/twister/bee/set/0625c215-8b46-44e3-b07f-088093360924/event/0/

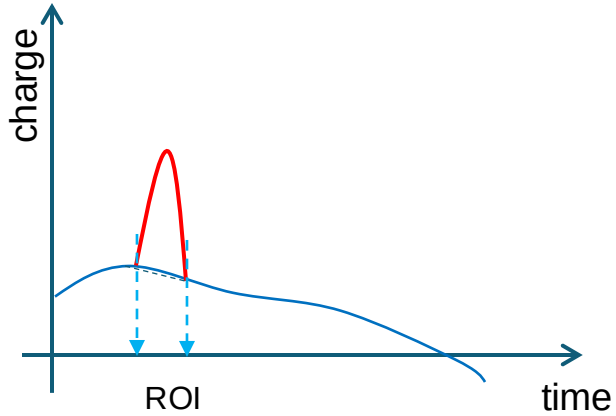


Old version

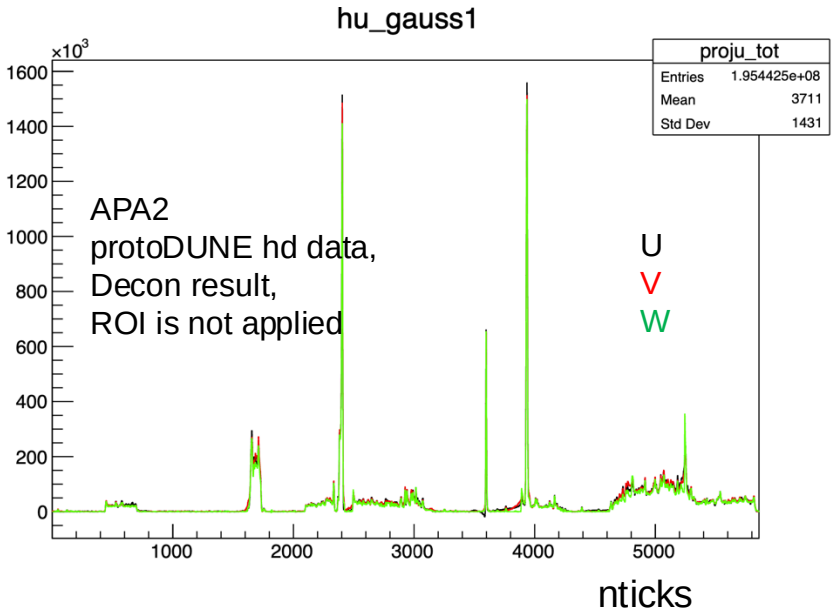
https://www.phy.bnl.gov/twister/bee/set/b0c89584-b971-4122-a7a0-4a63560e183d/event/0/

Imaging validation; charge

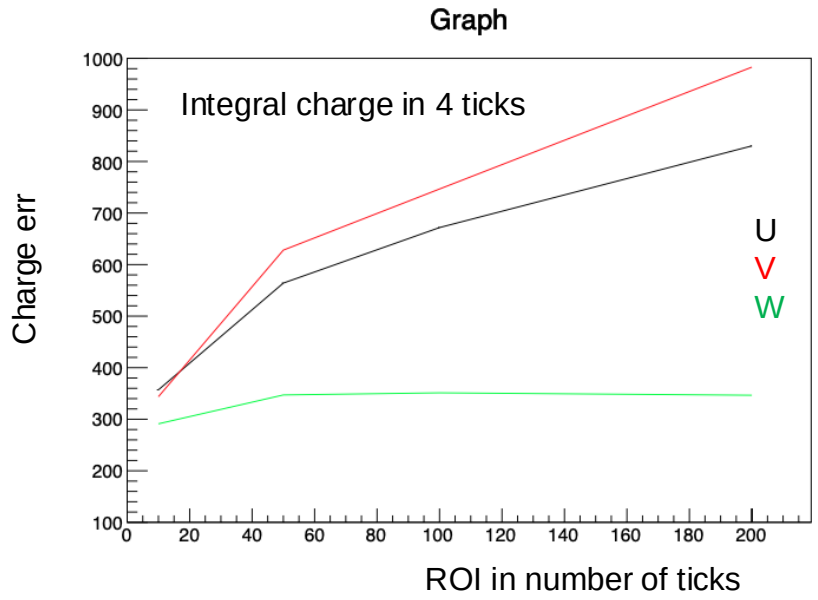
- Start with normal PDHD APAs
- From result of signal processing:
  - Charge consistency:
    - project decon charge to time tick, compare 3 planes
  - Charge uncertainty vs ROI region



Charge consistency

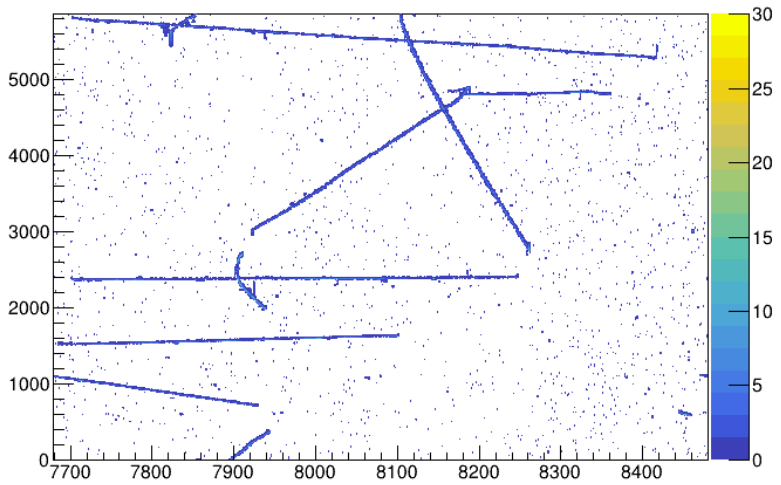


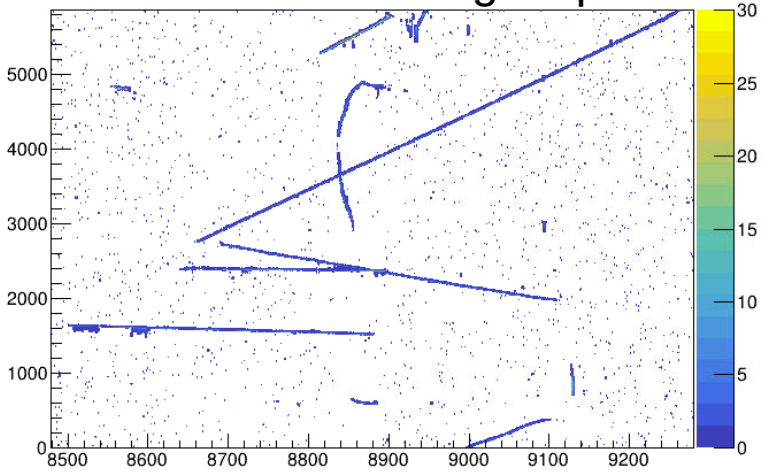
Charge uncertainty

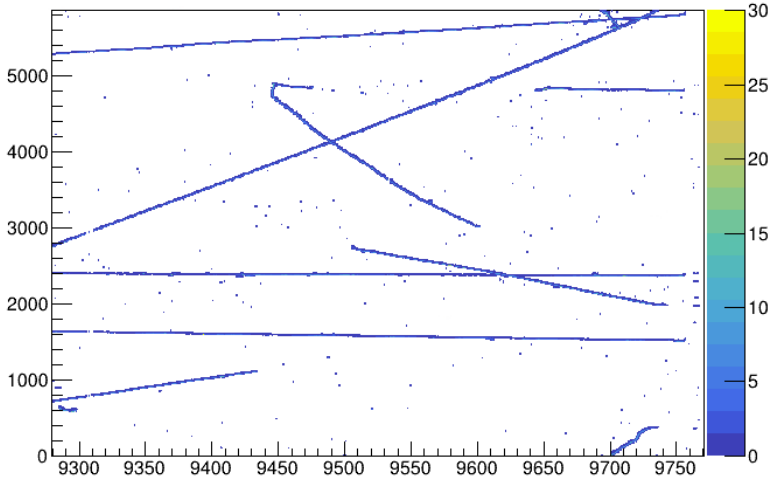


Compare projection of tiling vs. signal processing

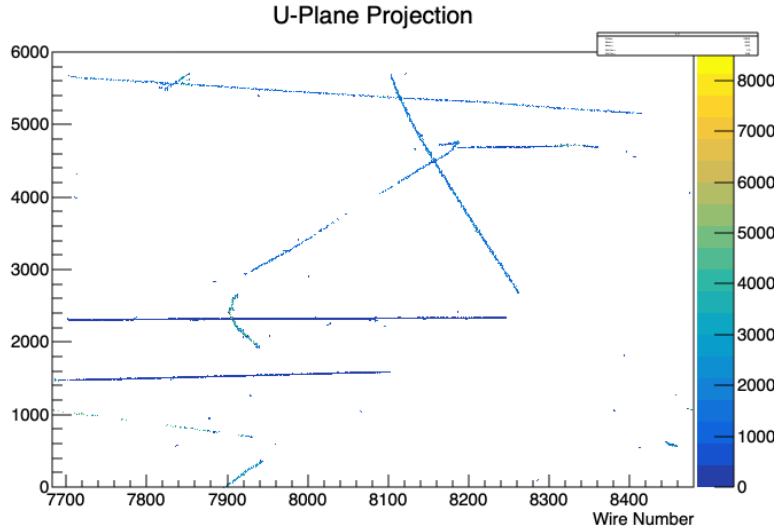
Decon result from signal processing

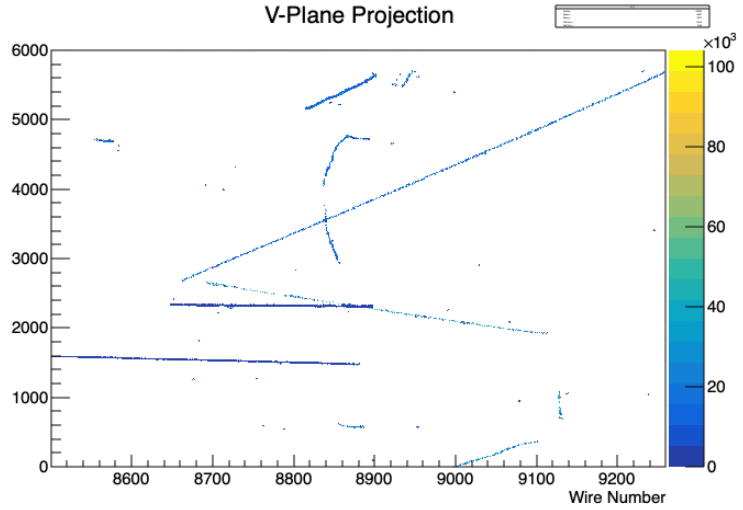


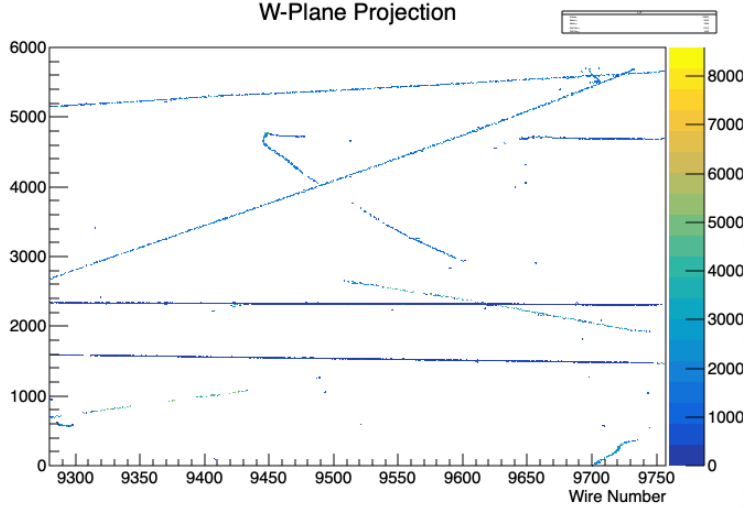




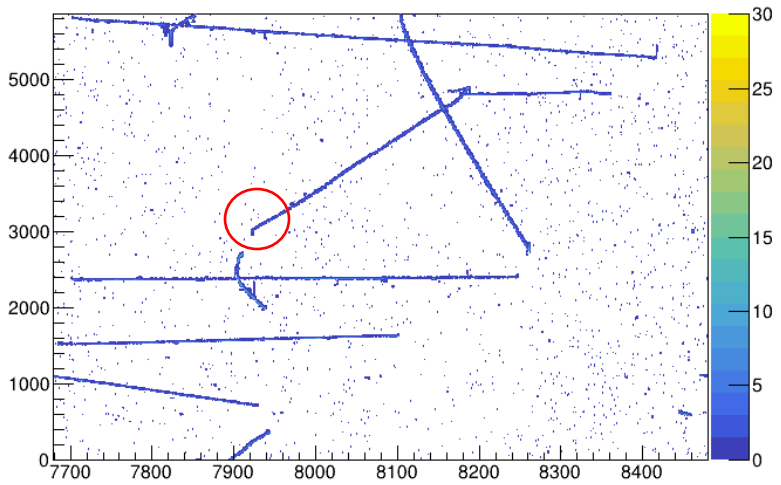
Project back after wire-cell-imaging



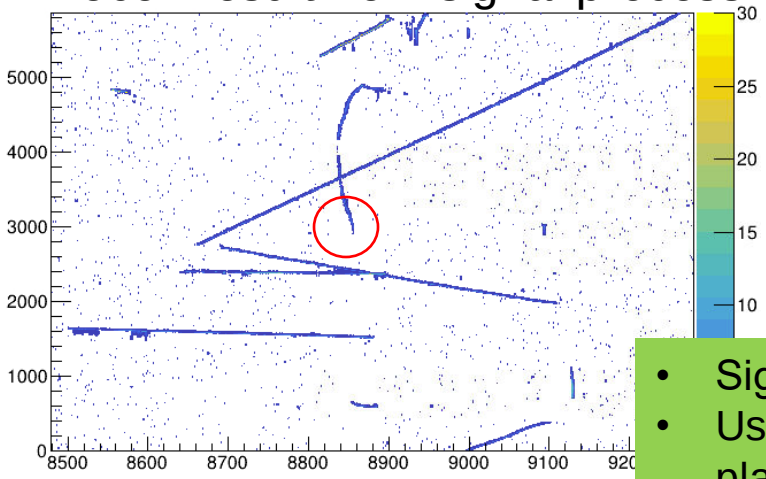


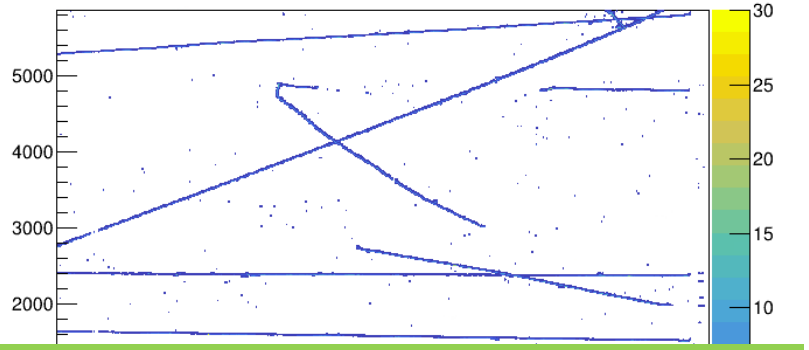


Compare projection of tiling vs. signal processing



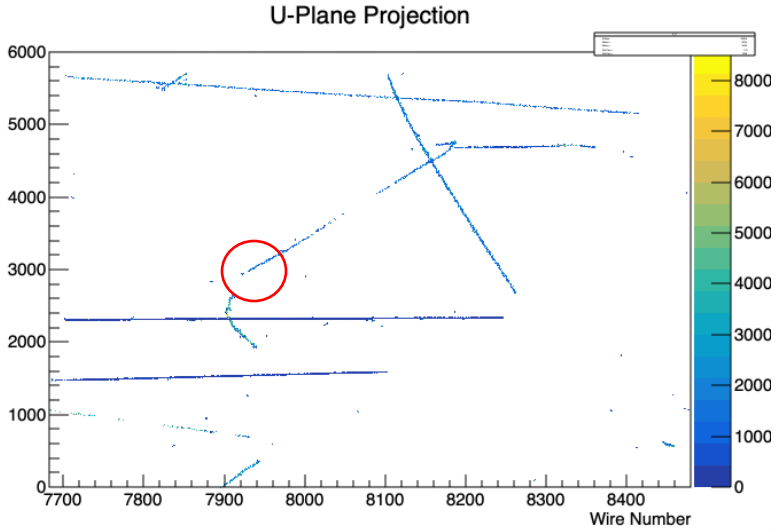
Decon result from signal processing

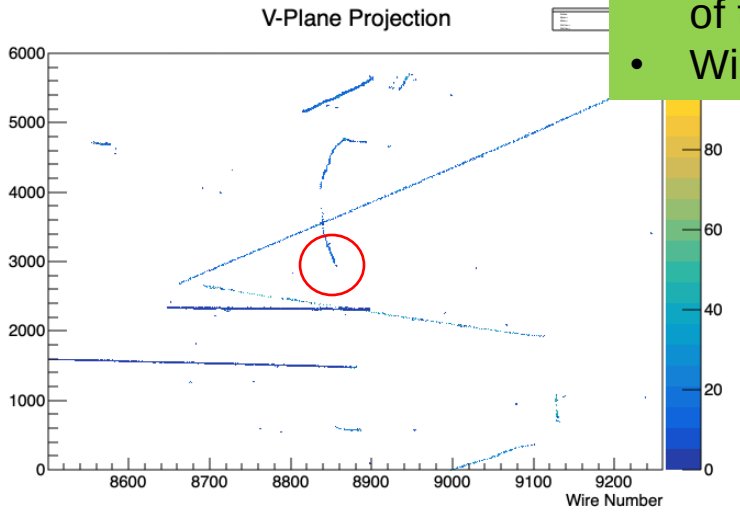


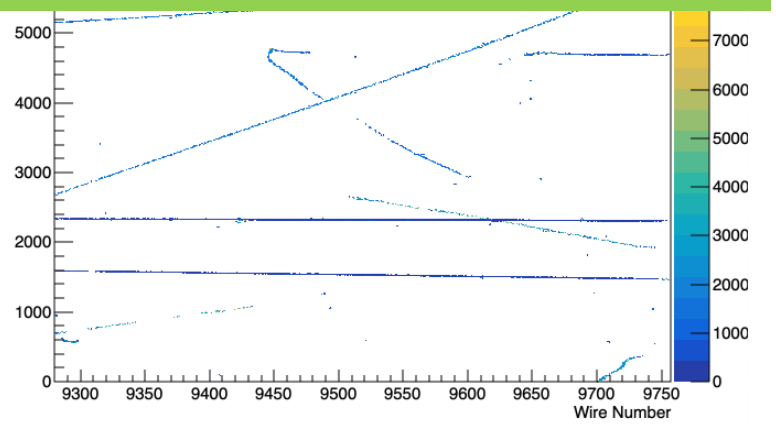


- Signal processing may have this kind of “tails”
- Usually found at the end of track in induction plane.
- Raw waveform is unipolar negative peak.
- Mismatch between field response and shape of the signal
- Will use imaging result to correct ROI

Project back after wire-cell-im

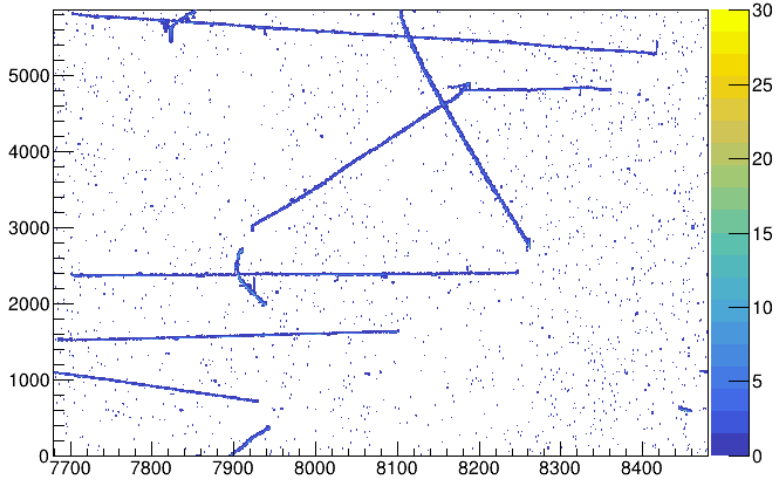




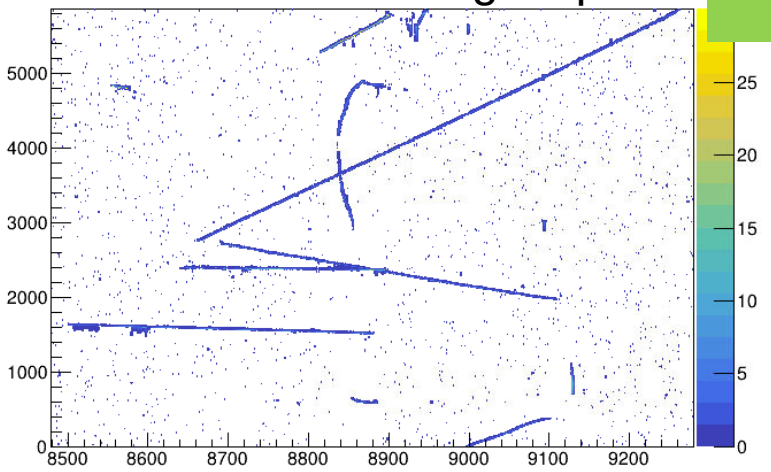


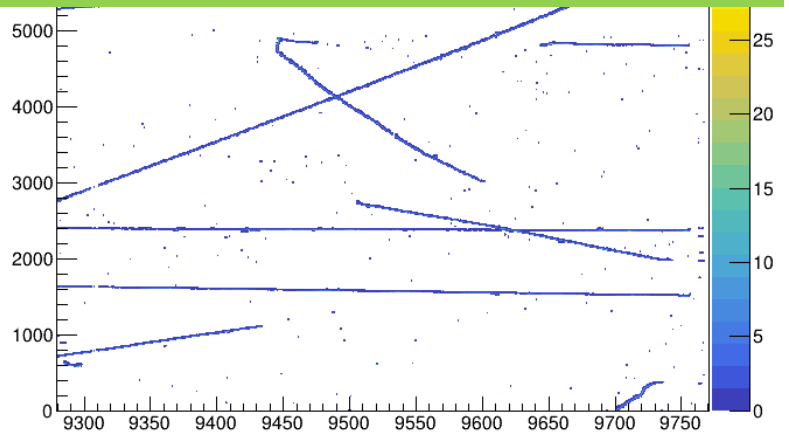
Compare projection of tiling vs. signa

- Understand all the gaps.
  - This one can be temporarily fixed by lower the threshold
  - (nthreshold:[3.6,3.6,3.6]->[1e-6,1e-6,1e-6])

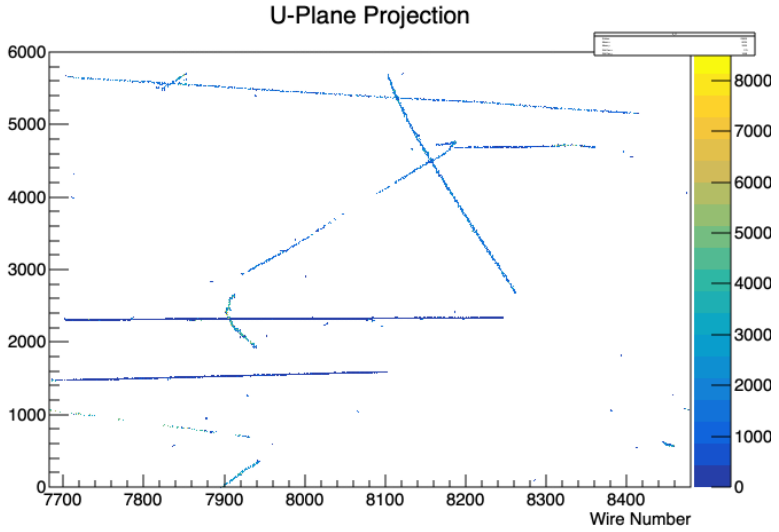


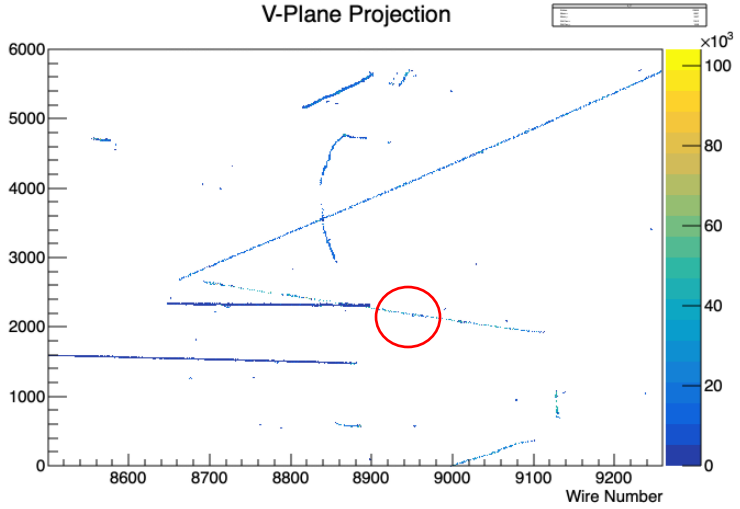
Decon result from signal proces

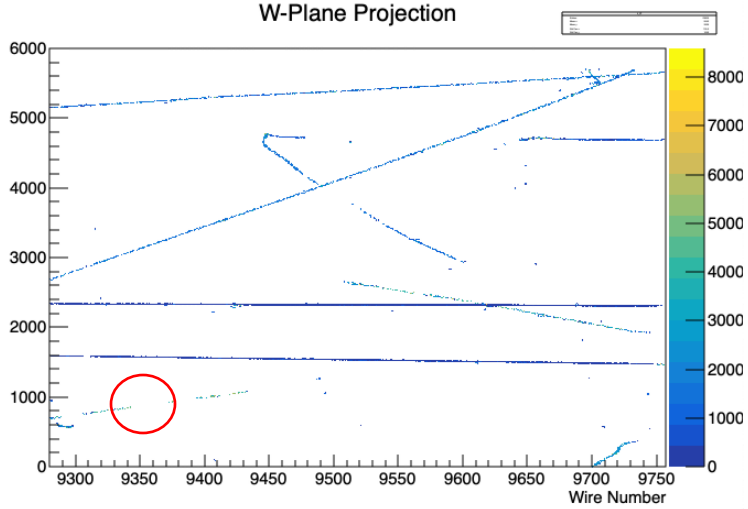




Project back after wire-cell-imaging







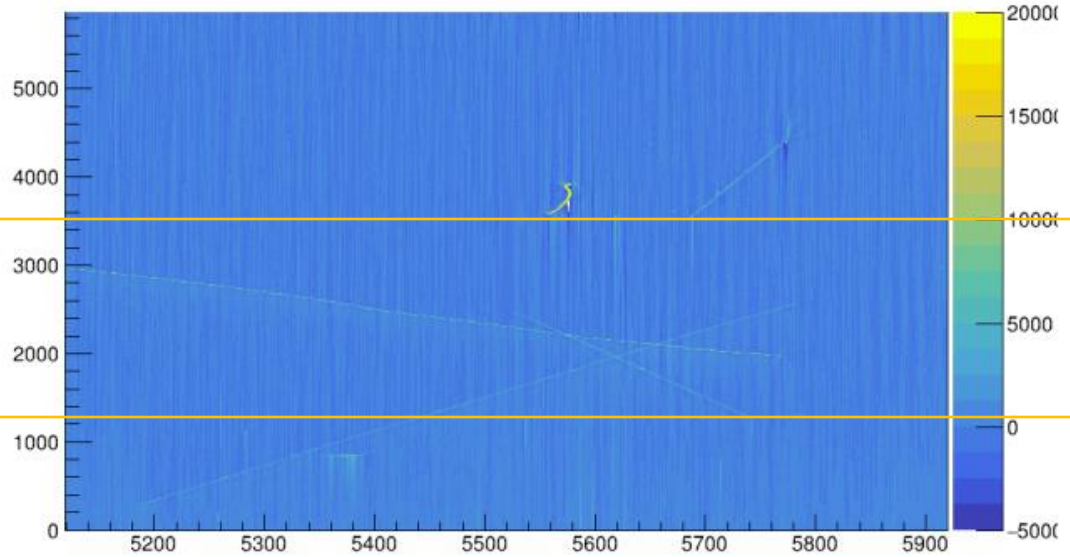
Next

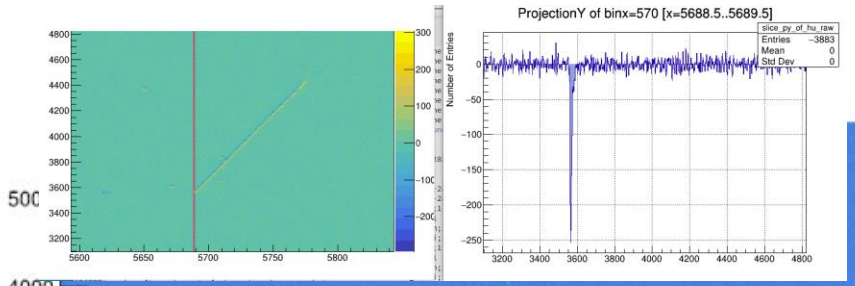
- Do imaging validation in PDHD.
  - Understand the basic logic
  - Check charge alignment and charge uncertainty from signal processing result (input)
  - With the imaging result, compare the projection of tiling vs. signal processing input,
    - understand all the gaps.
  - Deghosting..clustering…
- Use imaging result to help signal processing ROI finding.

Backup

magnify-28548-456814-2.png

hu_decon_ori2





hv_decon_ori2