Noise Filter Update

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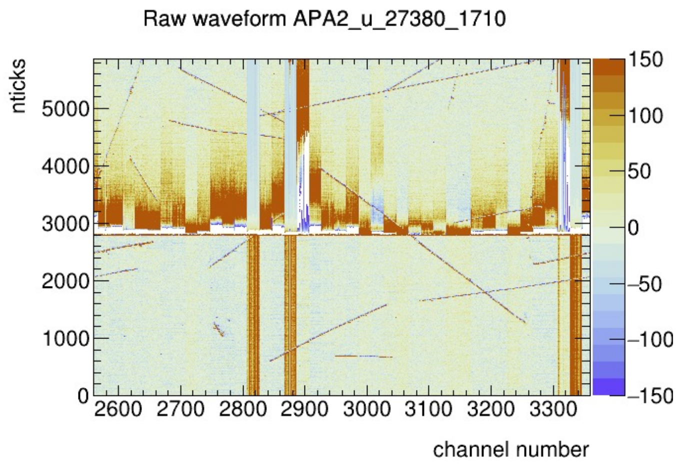
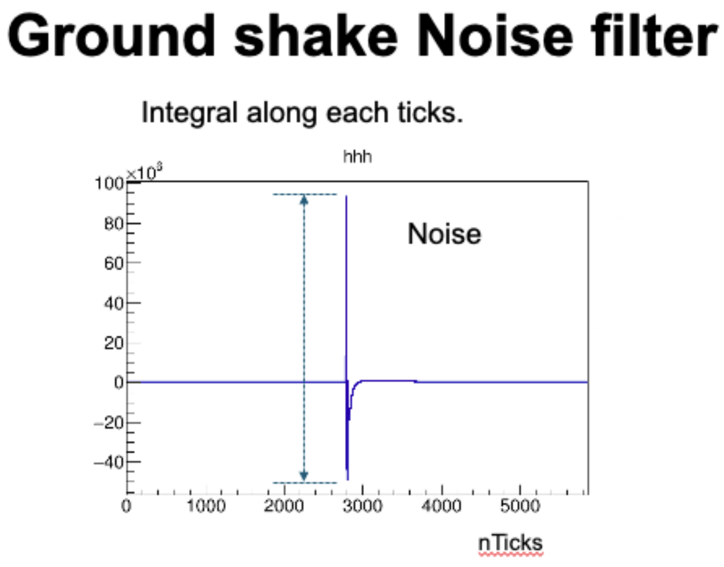
0819

Ground shake noise filter

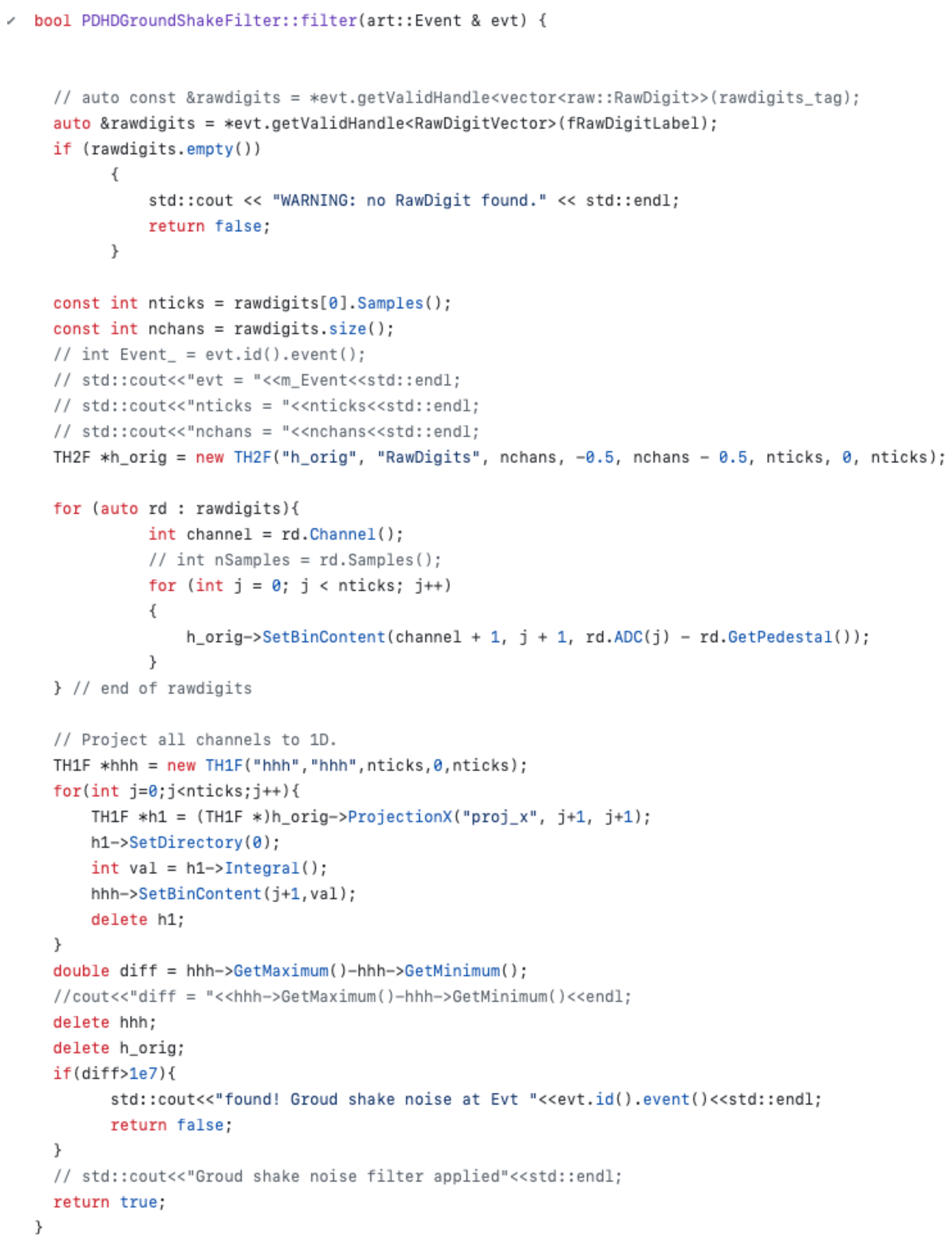
Have created a pull request in DUNE/duneprototypes





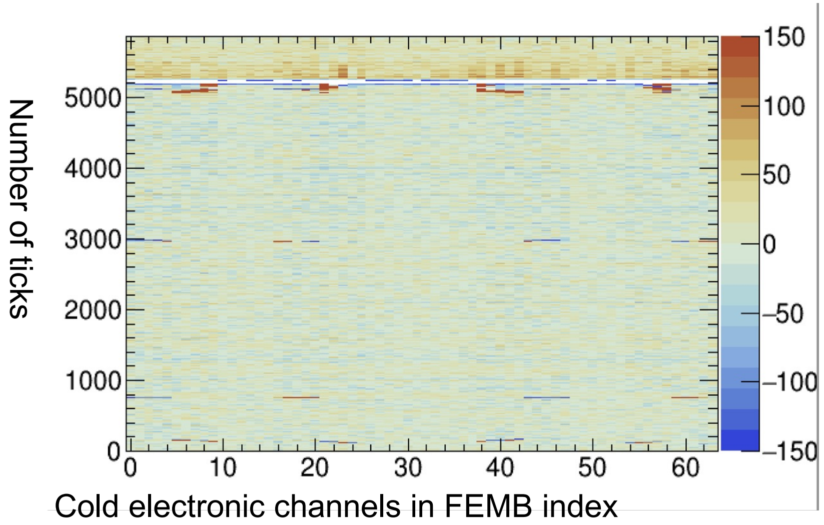
Ground shake Noise filter

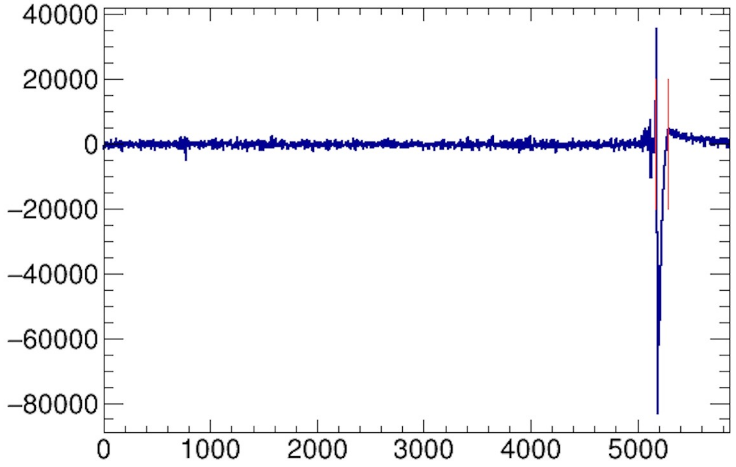
Integral along each ticks.



```
✓ bool PDHDGroundShakeFilter::filter(art::Event & evt) {


    // auto const &rawdigits = *evt.getValidHandle<vector<raw::RawDigit>>(rawdigits_tag);
    auto &rawdigits = *evt.getValidHandle<RawDigitVector>(fRawDigitLabel);
    if (rawdigits.empty())
          {
              std::cout << "WARNING: no RawDigit found." << std::endl;
              return false;
          }

    const int nticks = rawdigits[0].Samples();
    const int nchans = rawdigits.size();
    // int Event_ = evt.id().event();
    // std::cout<<"evt = "<<m_Event<<std::endl;
    // std::cout<<"nticks = "<<nticks<<std::endl;
    // std::cout<<"nchans = "<<nchans<<std::endl;
    TH2F *h_orig = new TH2F("h_orig", "RawDigits", nchans, -0.5, nchans - 0.5, nticks, 0, nticks);

    for (auto rd : rawdigits){
              int channel = rd.Channel();
              // int nSamples = rd.Samples();
              for (int j = 0; j < nticks; j++)
              {
                  h_orig->SetBinContent(channel + 1, j + 1, rd.ADC(j) - rd.GetPedestal());
              }
    } // end of rawdigits

    // Project all channels to 1D.
    TH1F *hhh = new TH1F("hhh","hhh",nticks,0,nticks);
    for(int j=0;j<nticks;j++){
        TH1F *h1 = (TH1F *)h_orig->ProjectionX("proj_x", j+1, j+1);
        h1->SetDirectory(0);
        int val = h1->Integral();
        hhh->SetBinContent(j+1,val);
        delete h1;
    }
    double diff = hhh->GetMaximum()-hhh->GetMinimum();
    //cout<<"diff = "<<hhh->GetMaximum()-hhh->GetMinimum()<<endl;
    delete hhh;
    delete h_orig;
    if(diff>1e7){
          std::cout<<"found! Groud shake noise at Evt "<<evt.id().event()<<std::endl;
          return false;
    }
    // std::cout<<"Groud shake noise filter applied"<<std::endl;
    return true;
  }
```

FEMB “noise” filter





○Find all “- signal ROIs” in this integral histogram:

■ (if ADC-baseline < -3.5 r.m.s)

=> vector<int> roi

If there is a width of the “signal” larger than 50, then it is an FEMB noise. (regular event won’t more than 20)

- Blind region is defined as:

  start_ticks = roi[0]-20;

  end_ticks = roi.back()+20;

- Channel number can be found according to the map

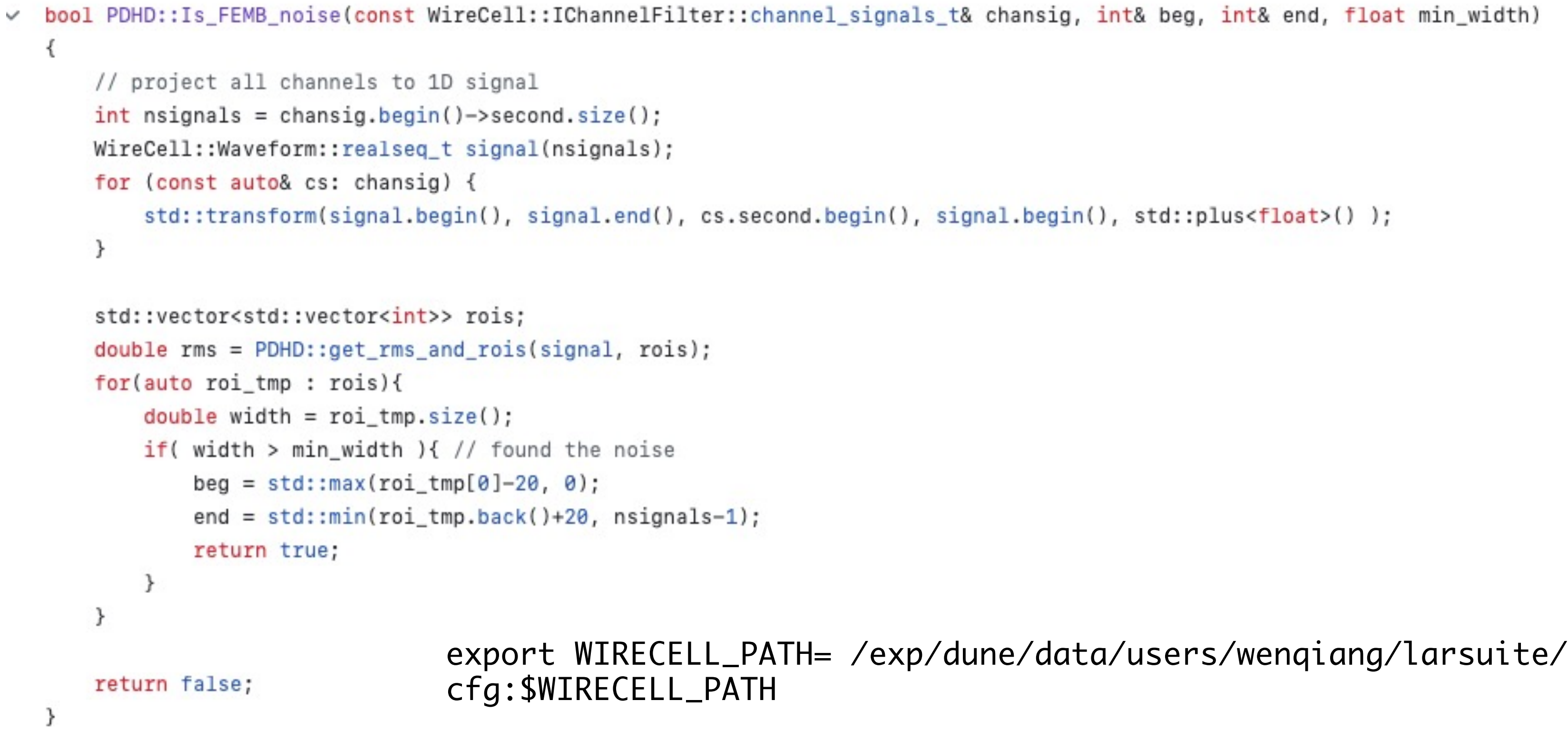
Included in wirecell noise filter

https://github.com/WireCell/wire-cell-toolkit/tree/feature/wgu_fembnoise

1. Add multigroup
2. Include mapping for FEMB groups

Add in

bool PDHD::Is_FEMB_noise(const WireCell::IChannelFilter::channel_signals_t& chansig, int& beg, int& end, float min_width)

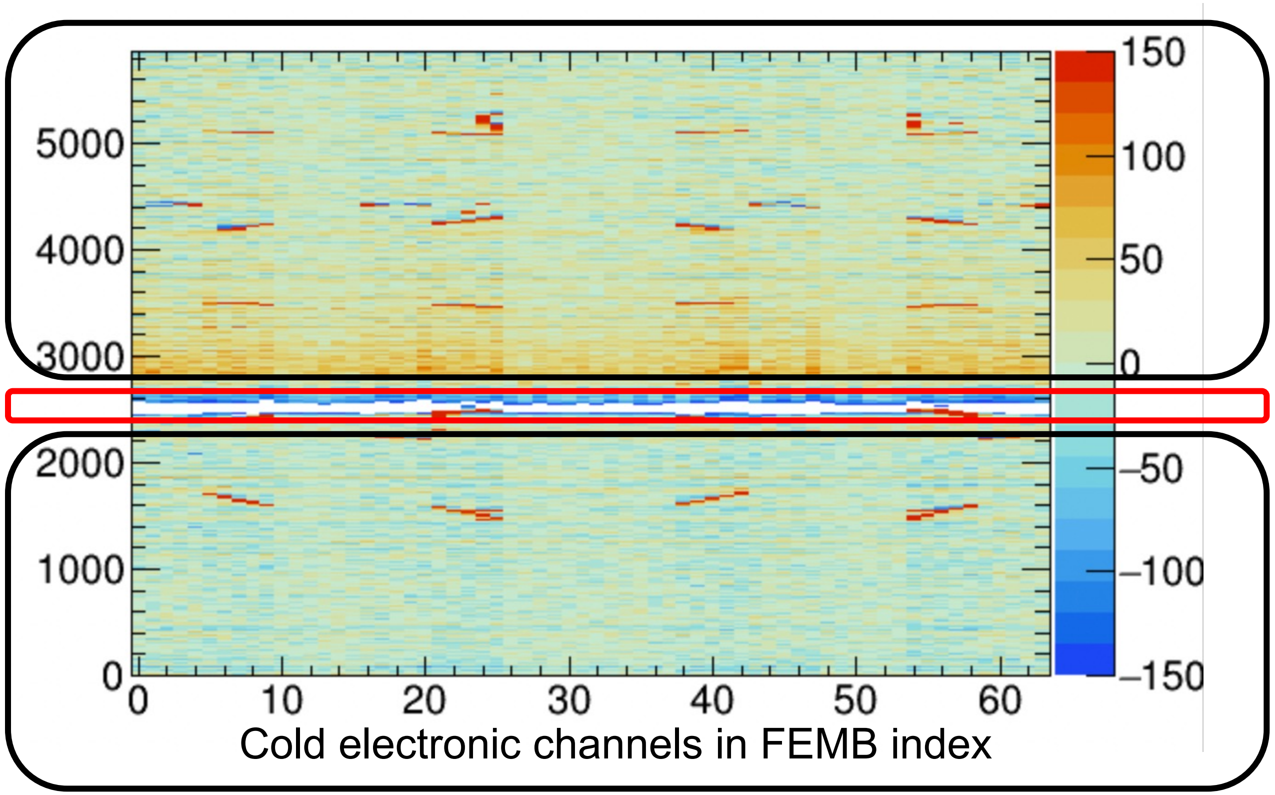


```
bool PDHD::Is_FEMB_noise(const WireCell::IChannelFilter::channel_signals_t& chansig, int& beg, int& end, float min_width)
{
    // project all channels to 1D signal
    int nsignals = chansig.begin()->second.size();
    WireCell::Waveform::realseq_t signal(nsignals);
    for (const auto& cs: chansig) {
        std::transform(signal.begin(), signal.end(), cs.second.begin(), signal.begin(), std::plus<float>() );
    }

    std::vector<std::vector<int>> rois;
    double rms = PDHD::get_rms_and_rois(signal, rois);
    for(auto roi_tmp : rois){
        double width = roi_tmp.size();
        if( width > min_width ){ // found the noise
            beg = std::max(roi_tmp[0]-20, 0);
            end = std::min(roi_tmp.back()+20, nsignals-1);
            return true;
        }
    }

    return false;
}
```

Keep testing

```
export WIRECELL_PATH= /exp/dune/data/users/wenqiang/larsuite/v09_91_03d00/test/tmp/wire-cell-cfg:$WIRECELL_PATH
```

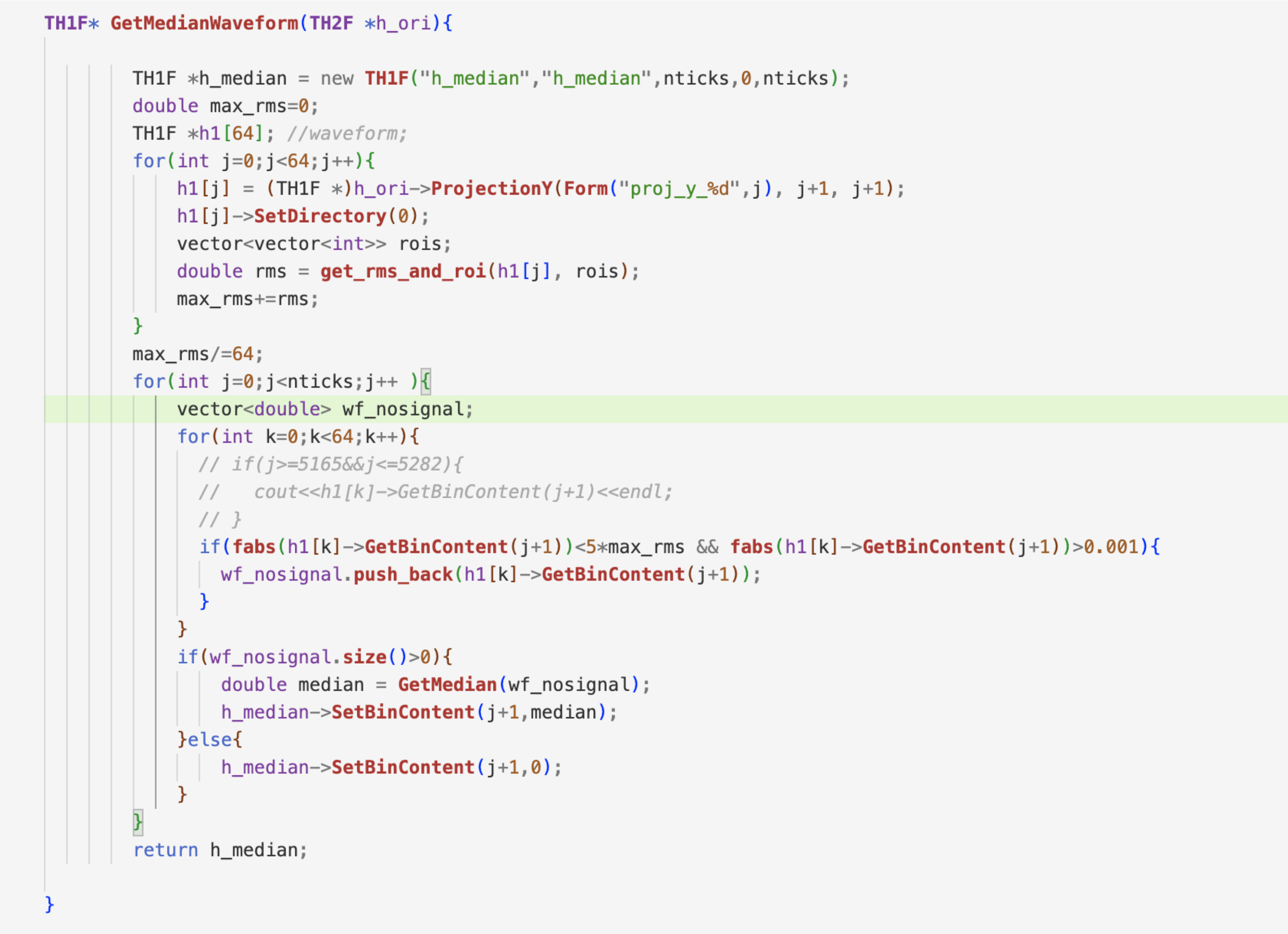
Remove FEMB noise



Get median waveform from the rest (not include signal)

Blind this region

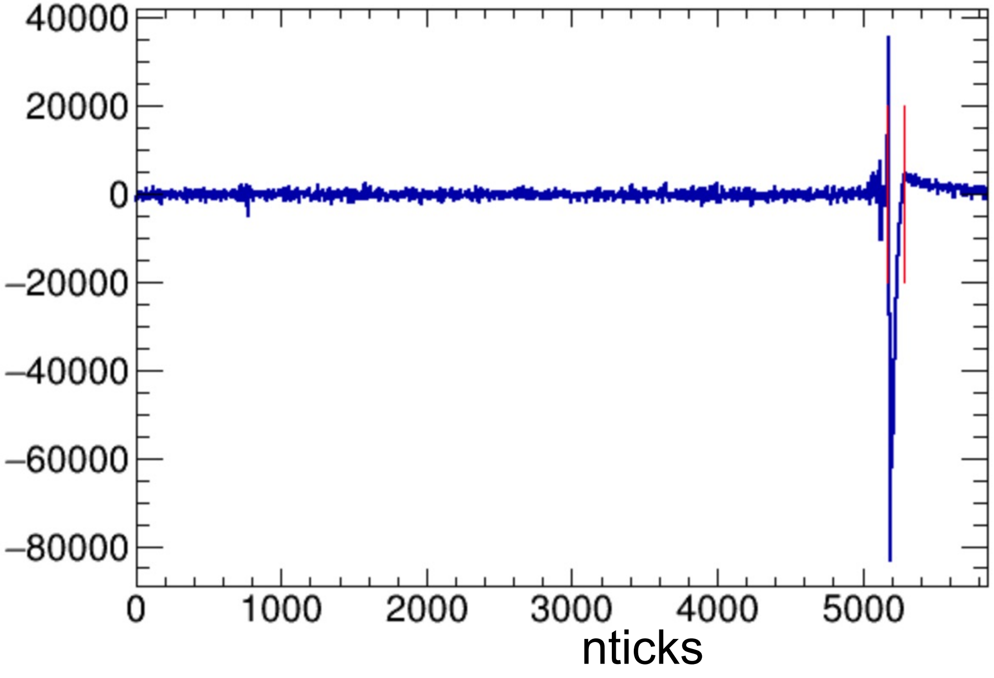
Get Median



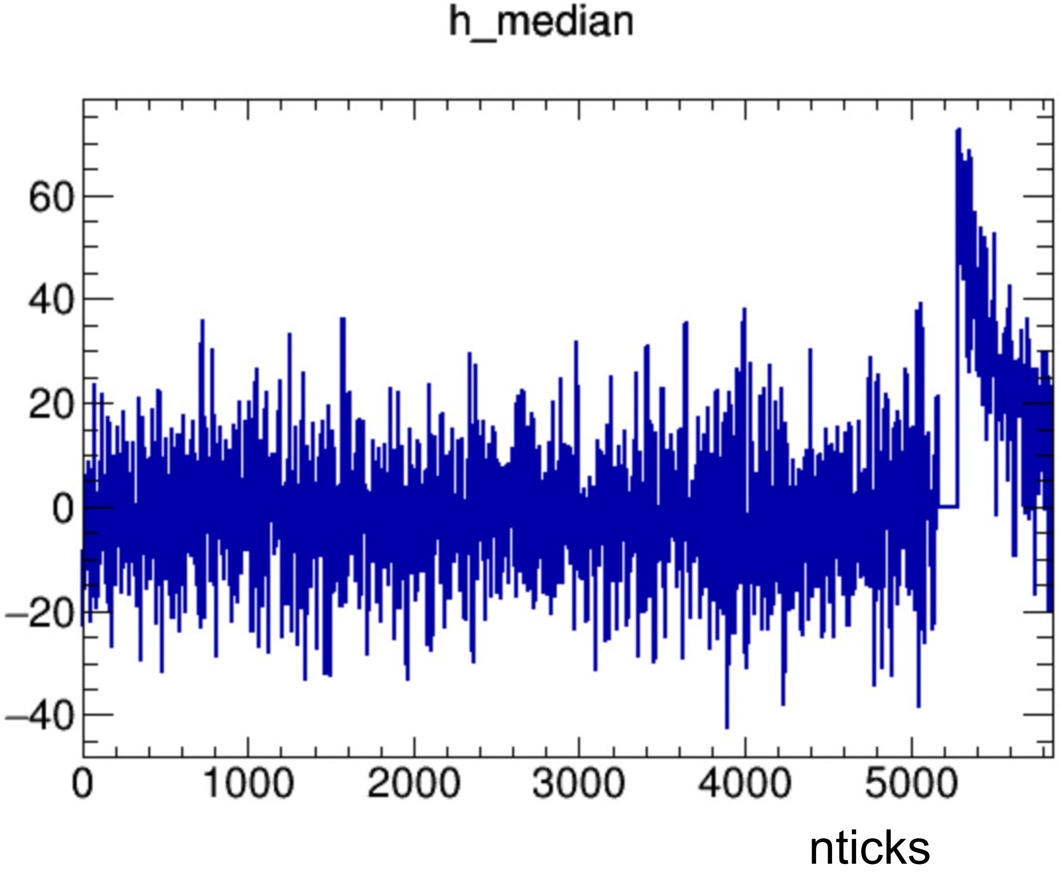
```
TH1F* GetMedianWaveform(TH2F *h_ori){

    TH1F *h_median = new TH1F("h_median","h_median",nticks,0,nticks);
    double max_rms=0;
    TH1F *h1[64]; //waveform;
    for(int j=0;j<64;j++){
      h1[j] = (TH1F *)h_ori->ProjectionY(Form("proj_y_%d",j), j+1, j+1);
      h1[j]->SetDirectory(0);
      vector<vector<int>> rois;
      double rms = get_rms_and_roi(h1[j], rois);
      max_rms+=rms;
    }
    max_rms/=64;
    for(int j=0;j<nticks;j++ ){
      vector<double> wf_nosignal;
      for(int k=0;k<64;k++){
       // if(j>=5165&&j<=5282){
       //   cout<<h1[k]->GetBinContent(j+1)<<endl;
       // }
       if(fabs(h1[k]->GetBinContent(j+1))<5*max_rms && fabs(h1[k]->GetBinContent(j+1))>0.001){
        wf_nosignal.push_back(h1[k]->GetBinContent(j+1));
       }
      }
      if(wf_nosignal.size()>0){
        double median = GetMedian(wf_nosignal);
        h_median->SetBinContent(j+1,median);
      }else{
        h_median->SetBinContent(j+1,0);
      }
    }
    return h_median;

}
```

Median waveform

Integral along each ticks

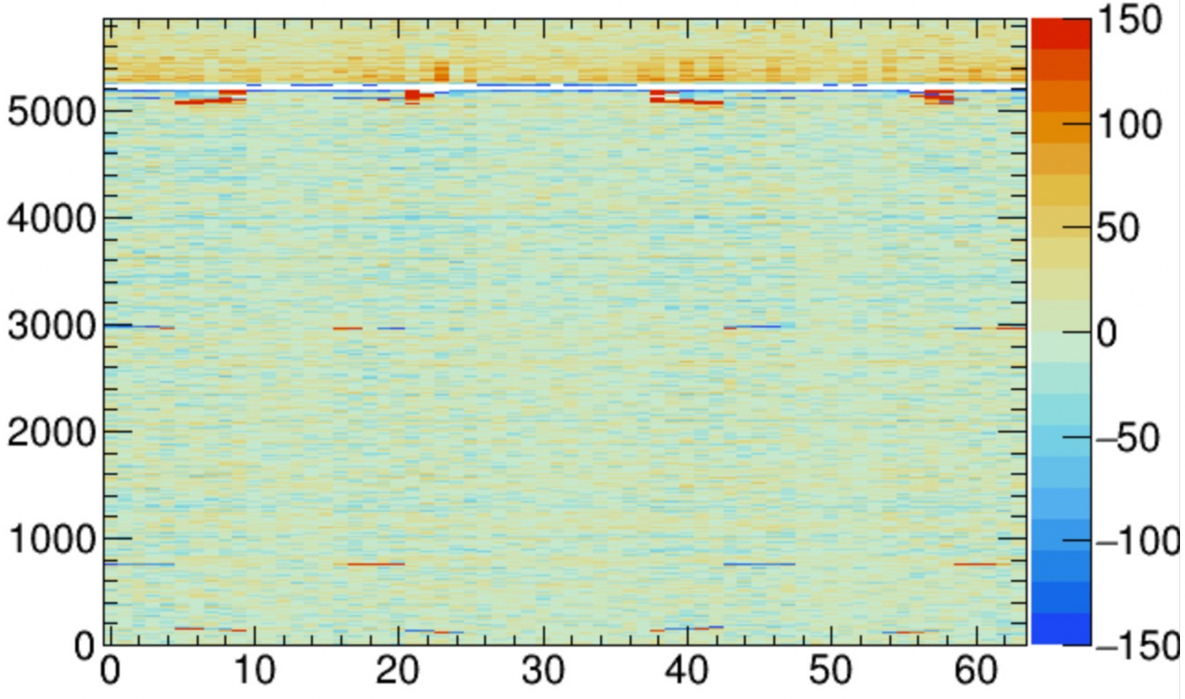


Locate the peak region

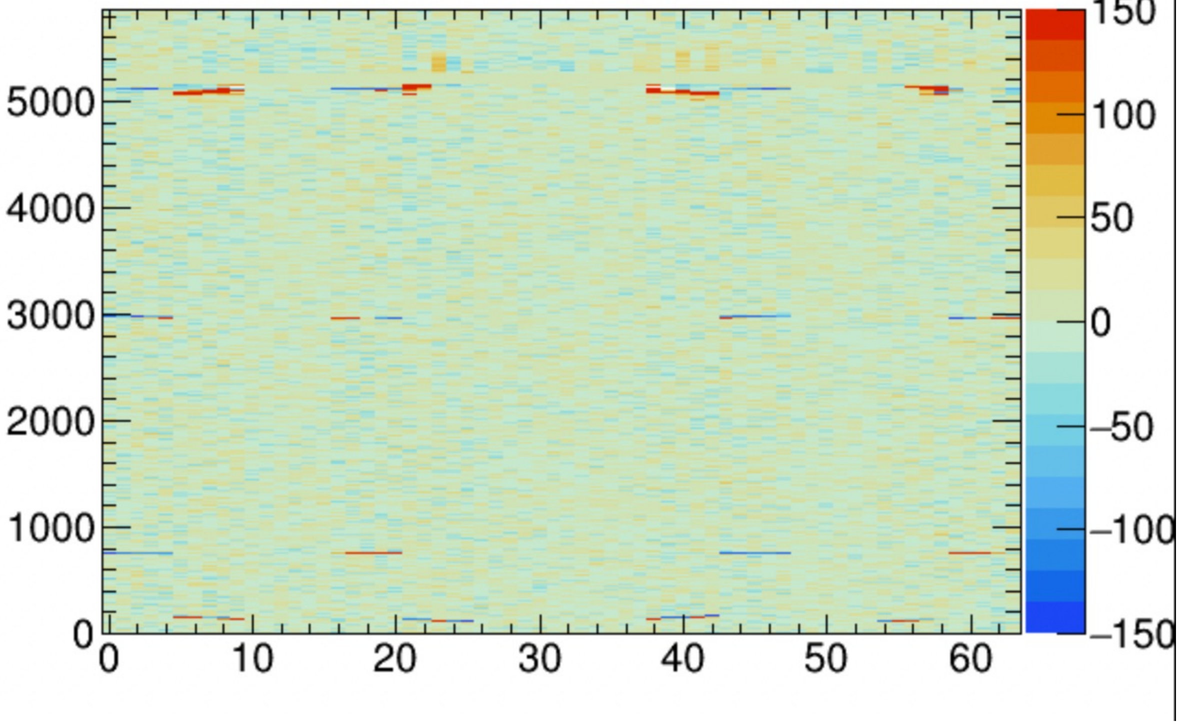


Extract median from the rest

After correction



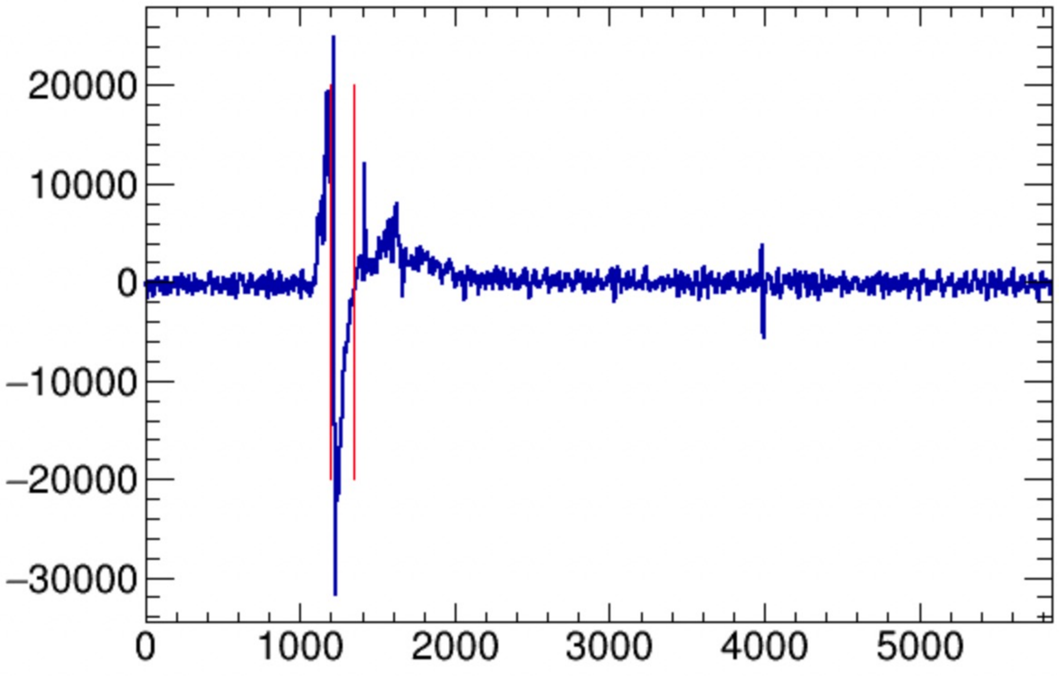
Cold electronic channels in FEMB index



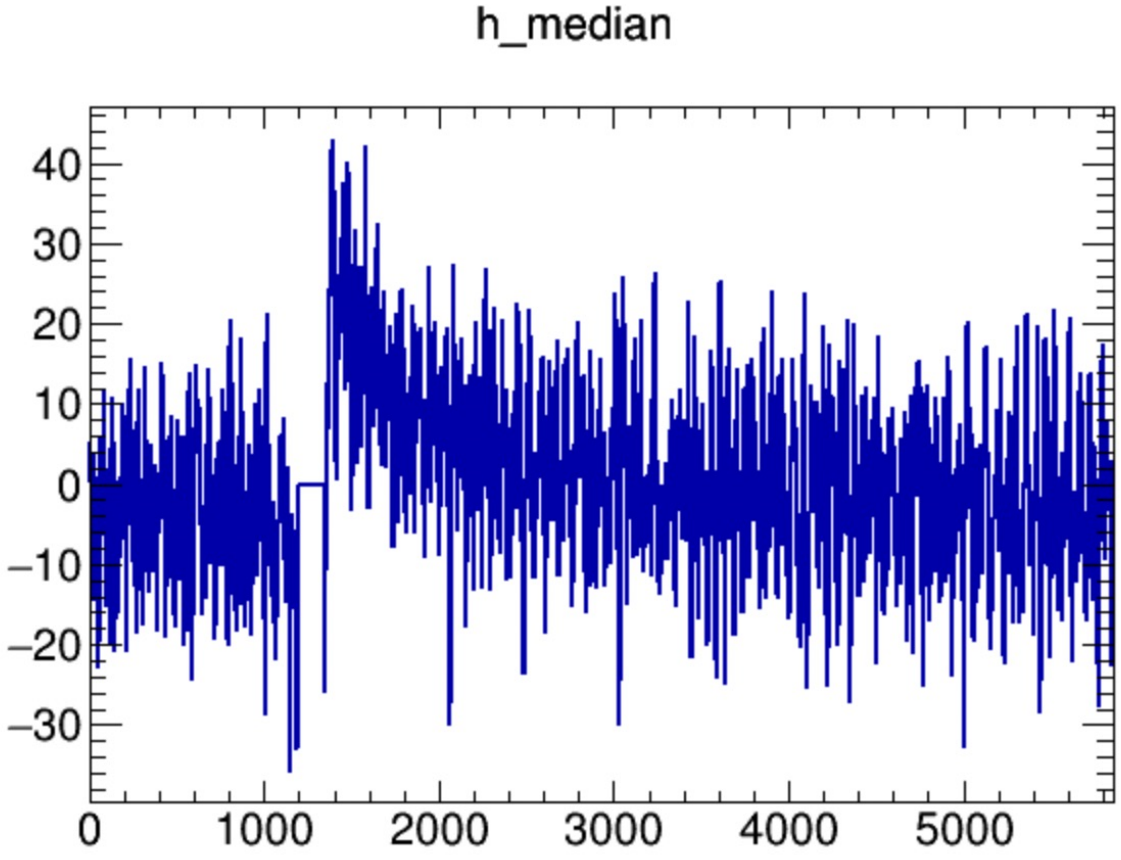
Cold electronic channels in FEMB index

More examples

Integral along each ticks



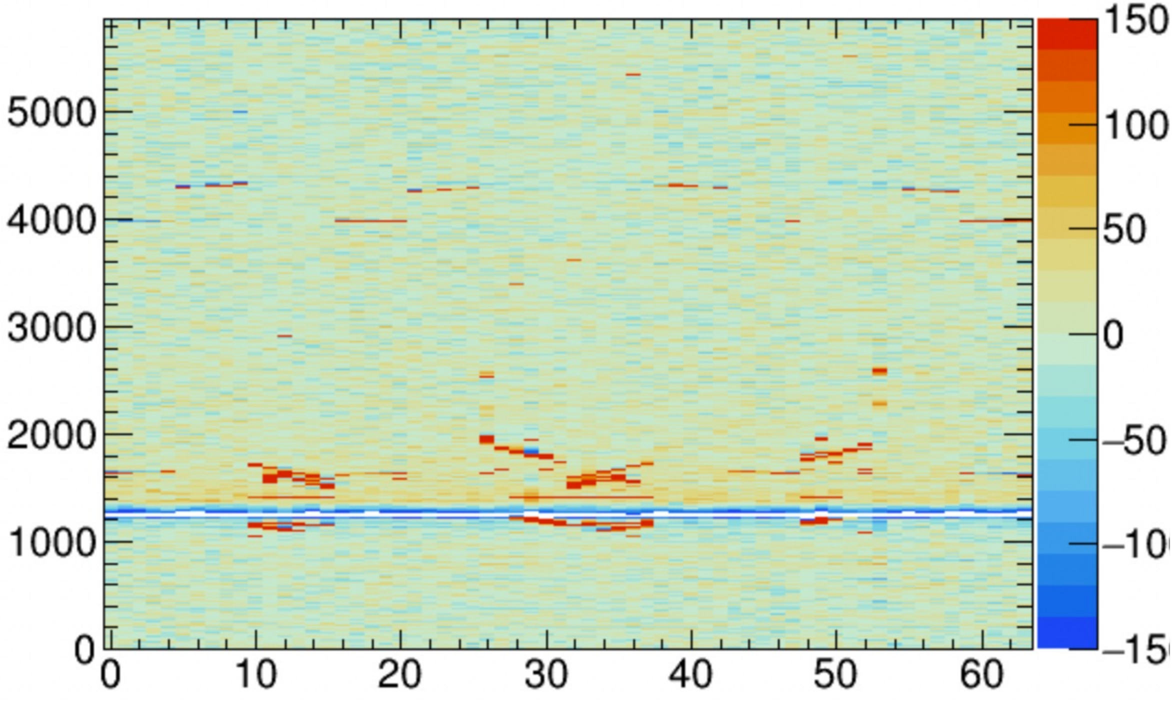
nticks



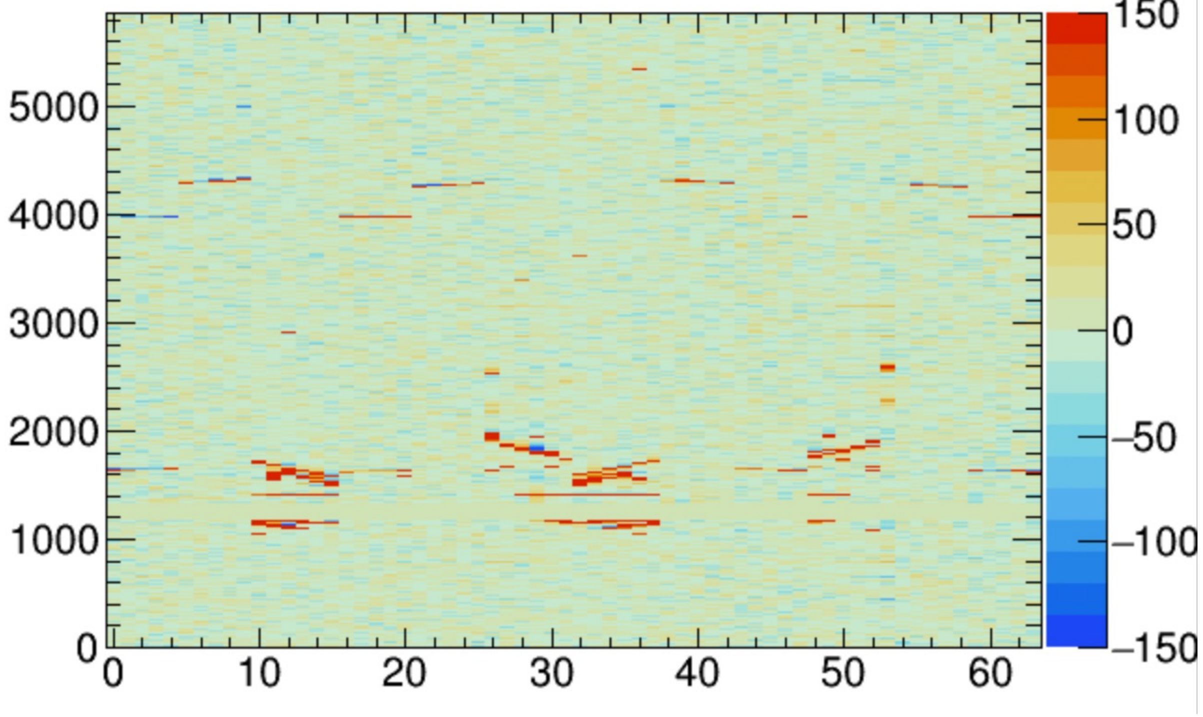
nticks

27425_388128_1_19_2

More examples



Cold electronic channels in FEMB index

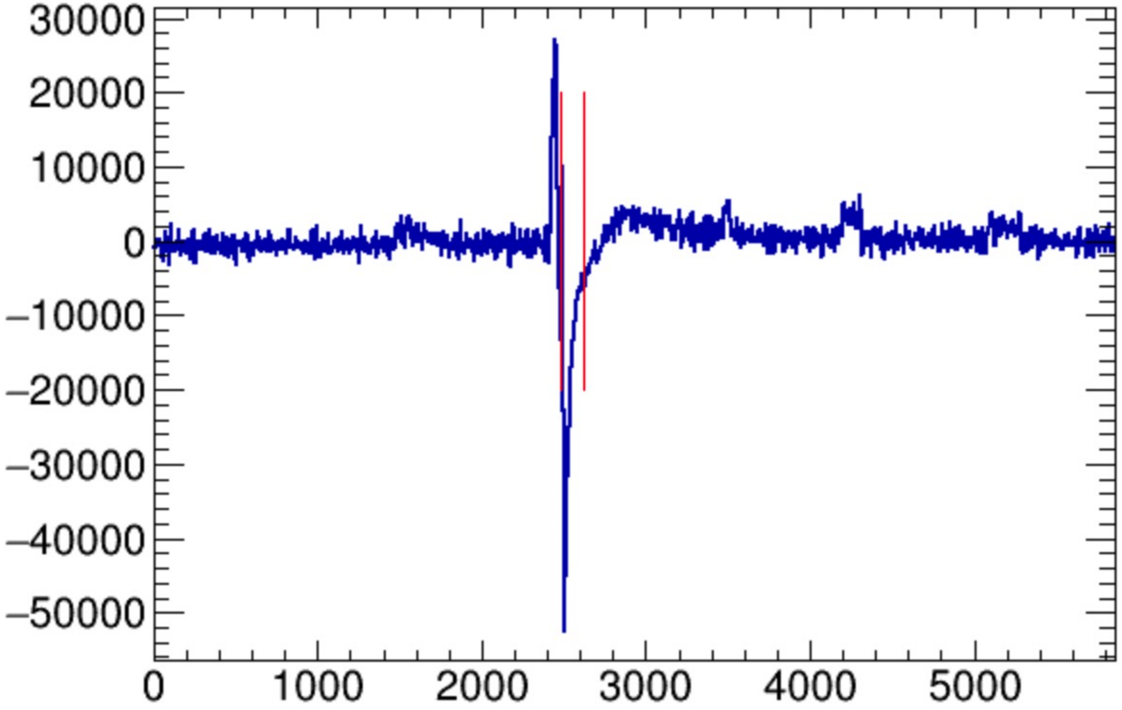


Cold electronic channels in FEMB index

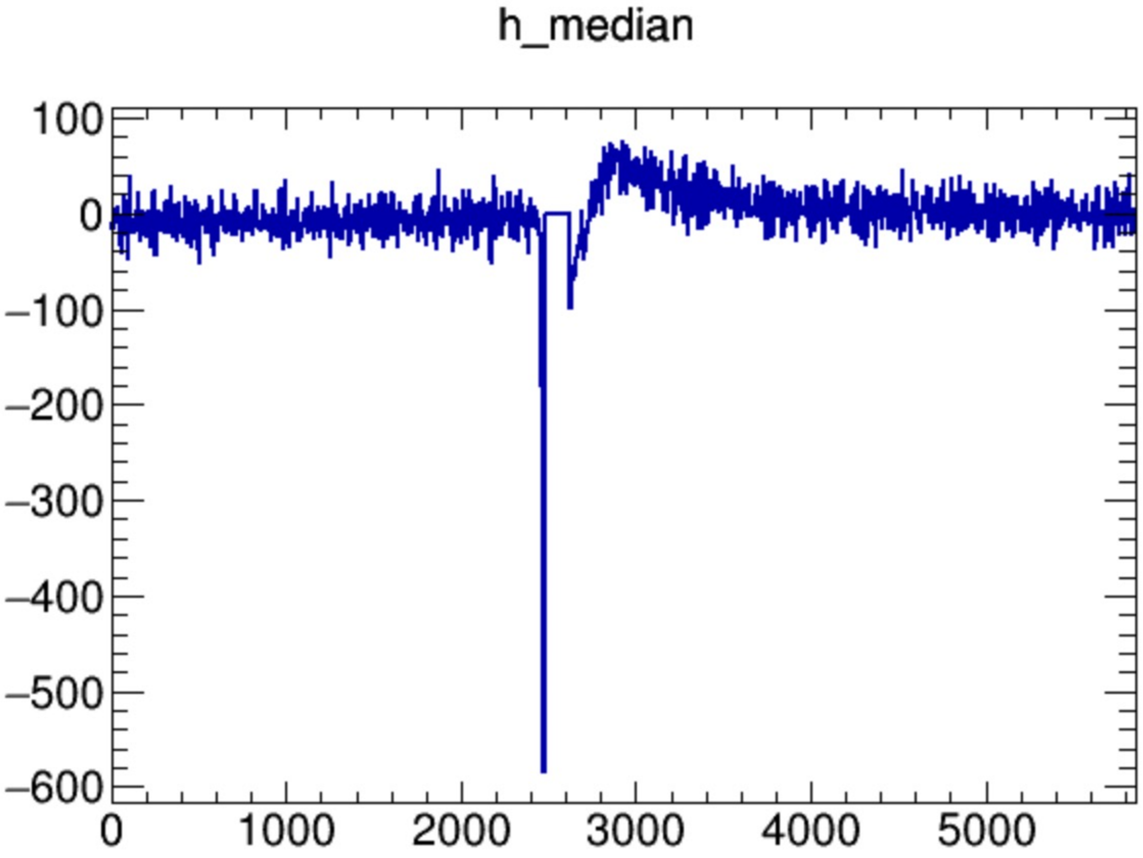
27425_388128_1_19_2

More examples

Integral along each ticks



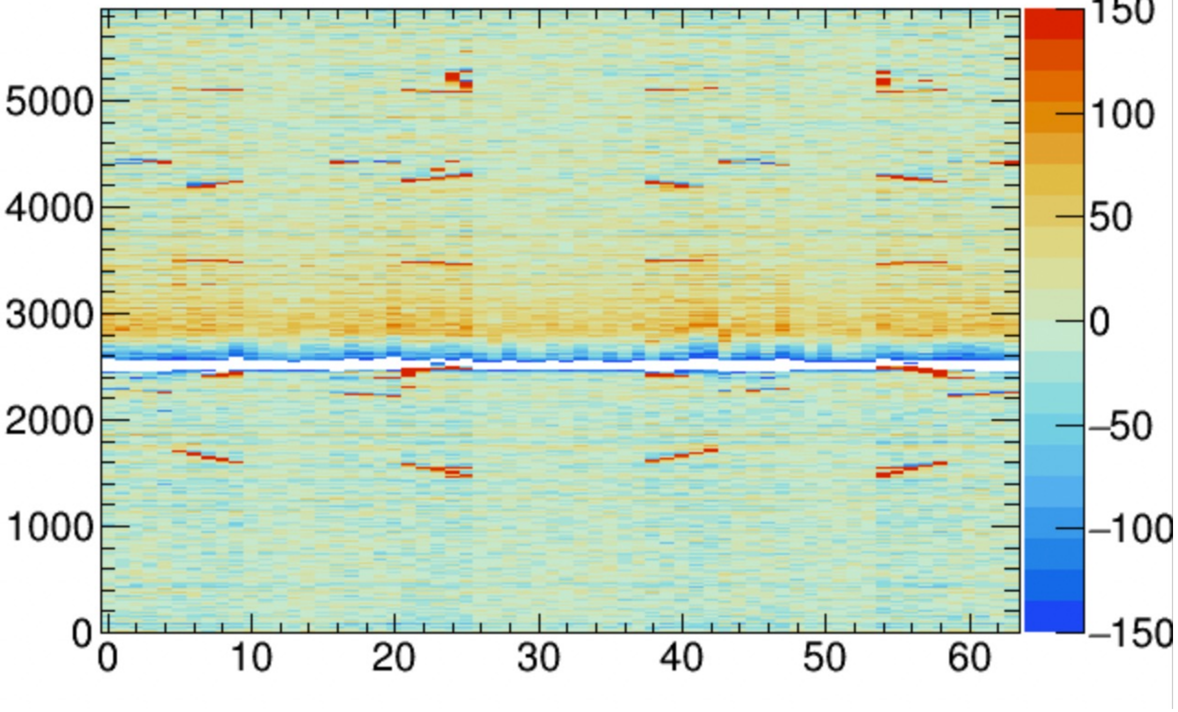
nticks



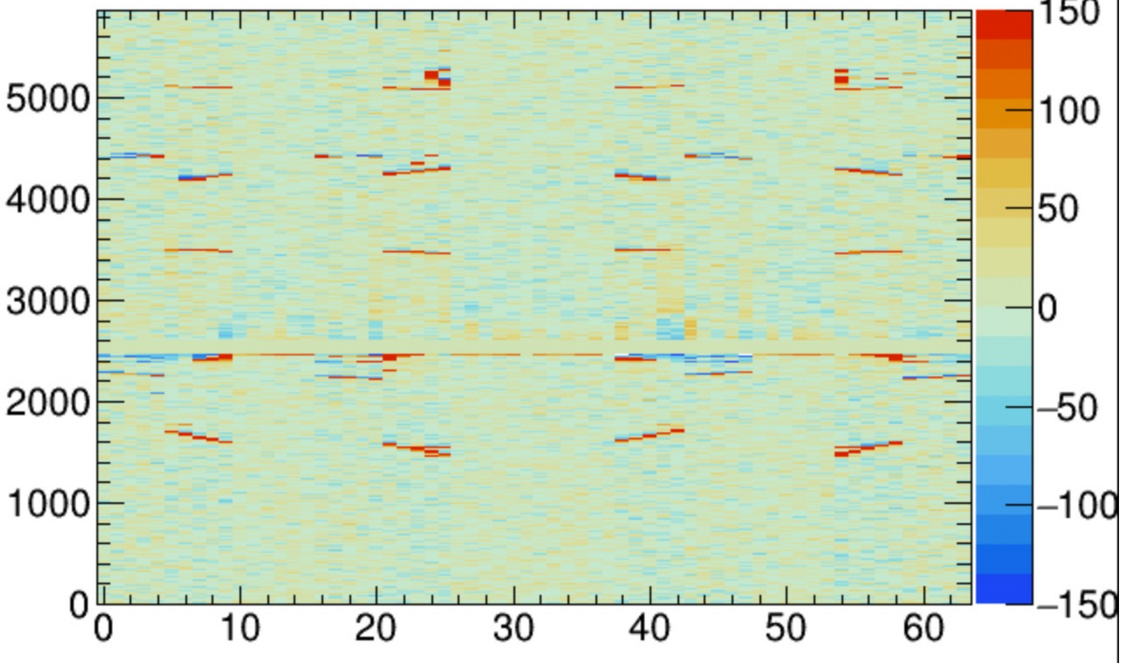
nticks

27425_388132_0_7_1

More examples



Cold electronic channels in FEMB index

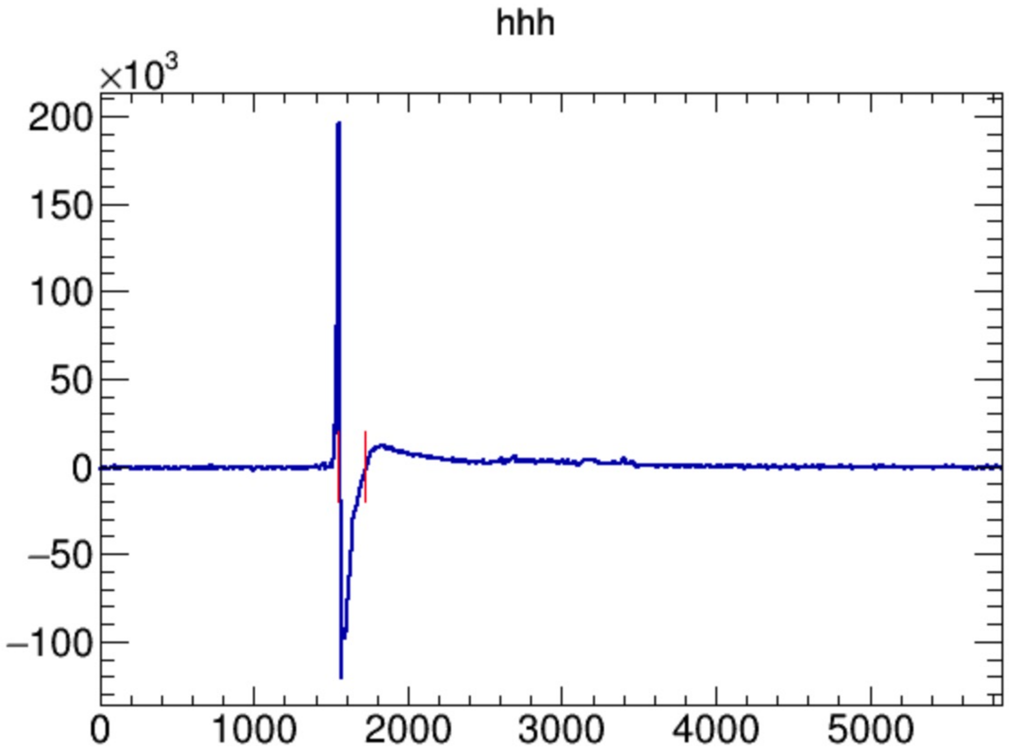


Cold electronic channels in FEMB index

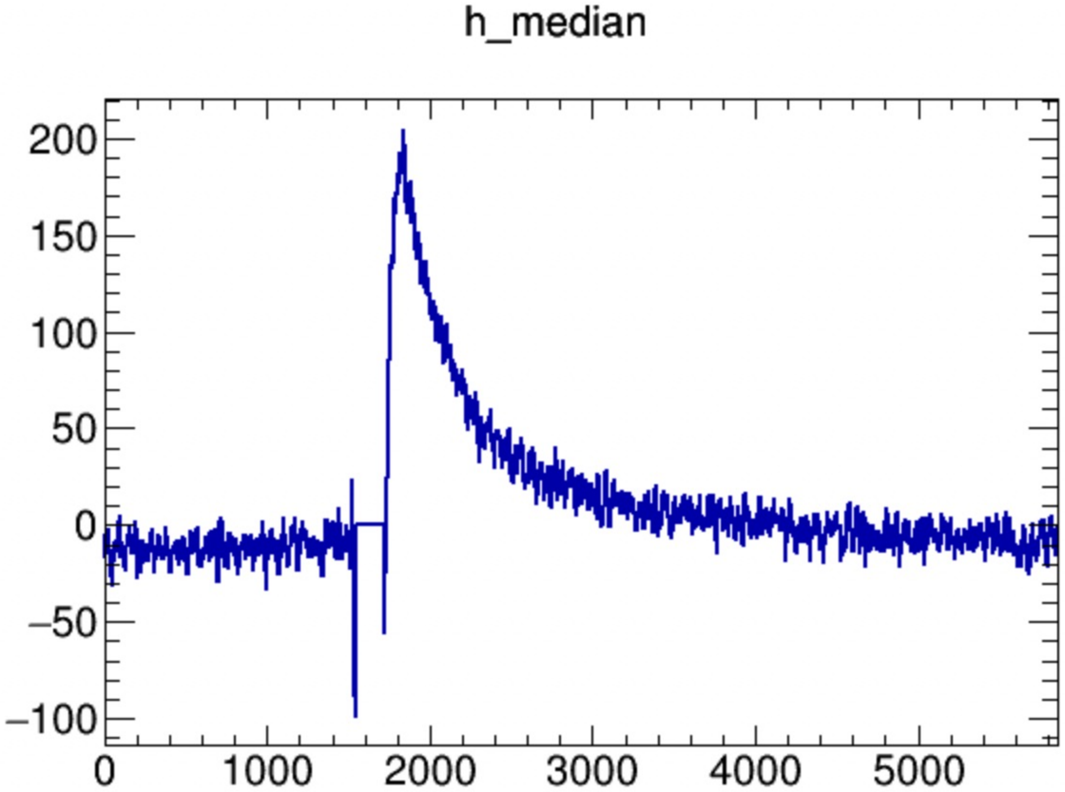
27425_388132_0_7_1

More examples

Integral along each ticks



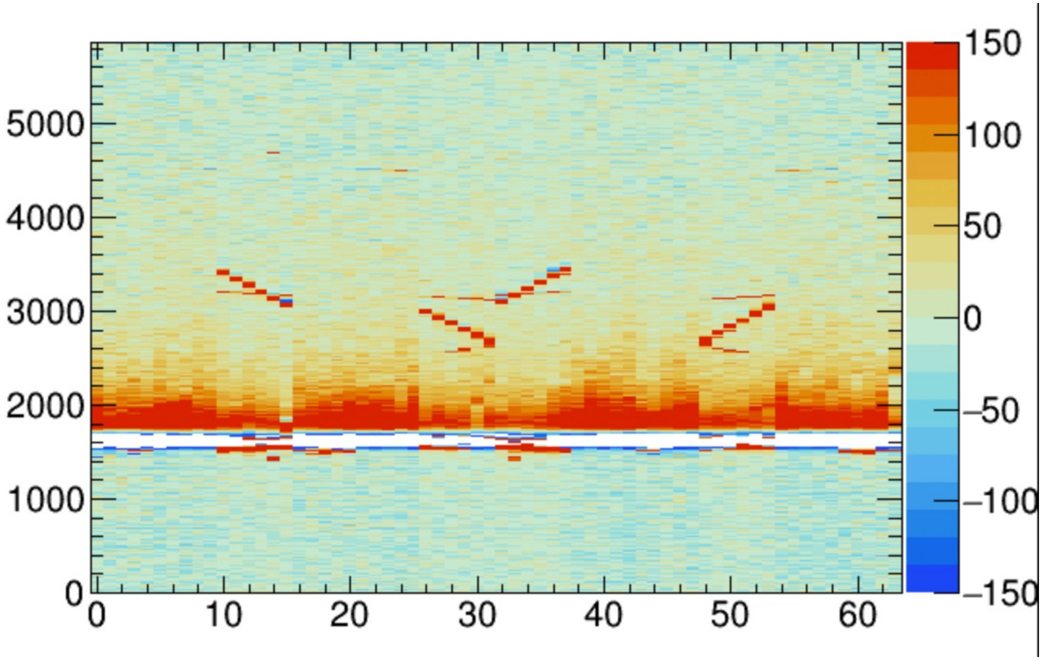
nticks



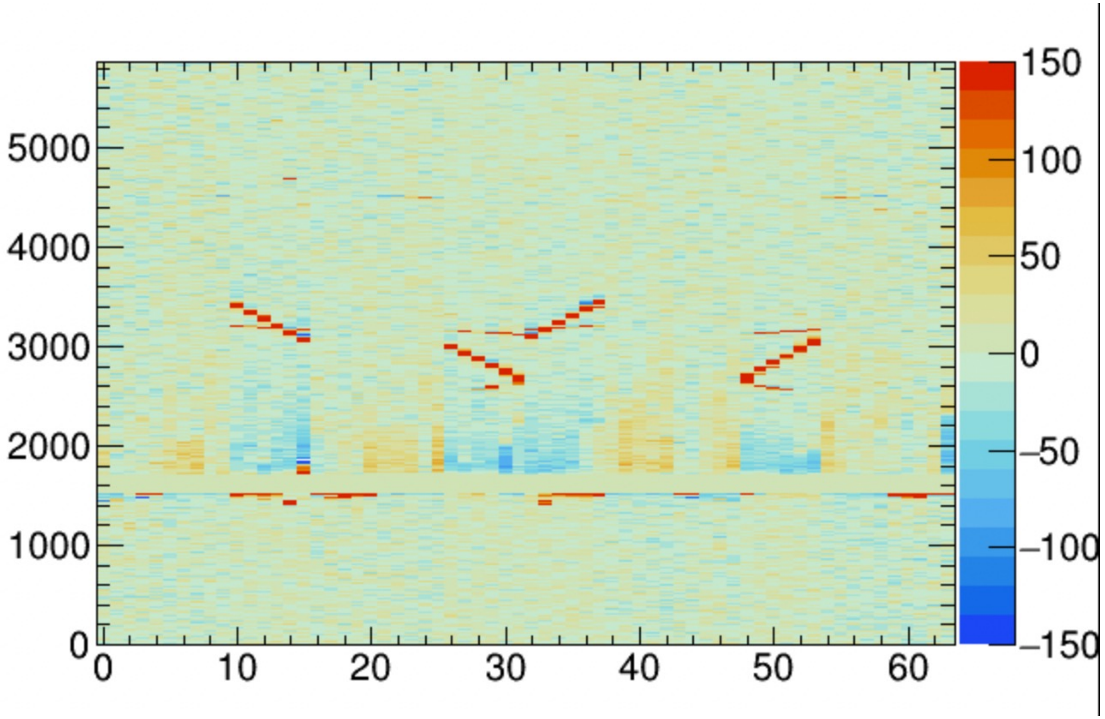
nticks

27425_388160_1_18_1

More examples



Cold electronic channels in FEMB index



Cold electronic channels in FEMB index

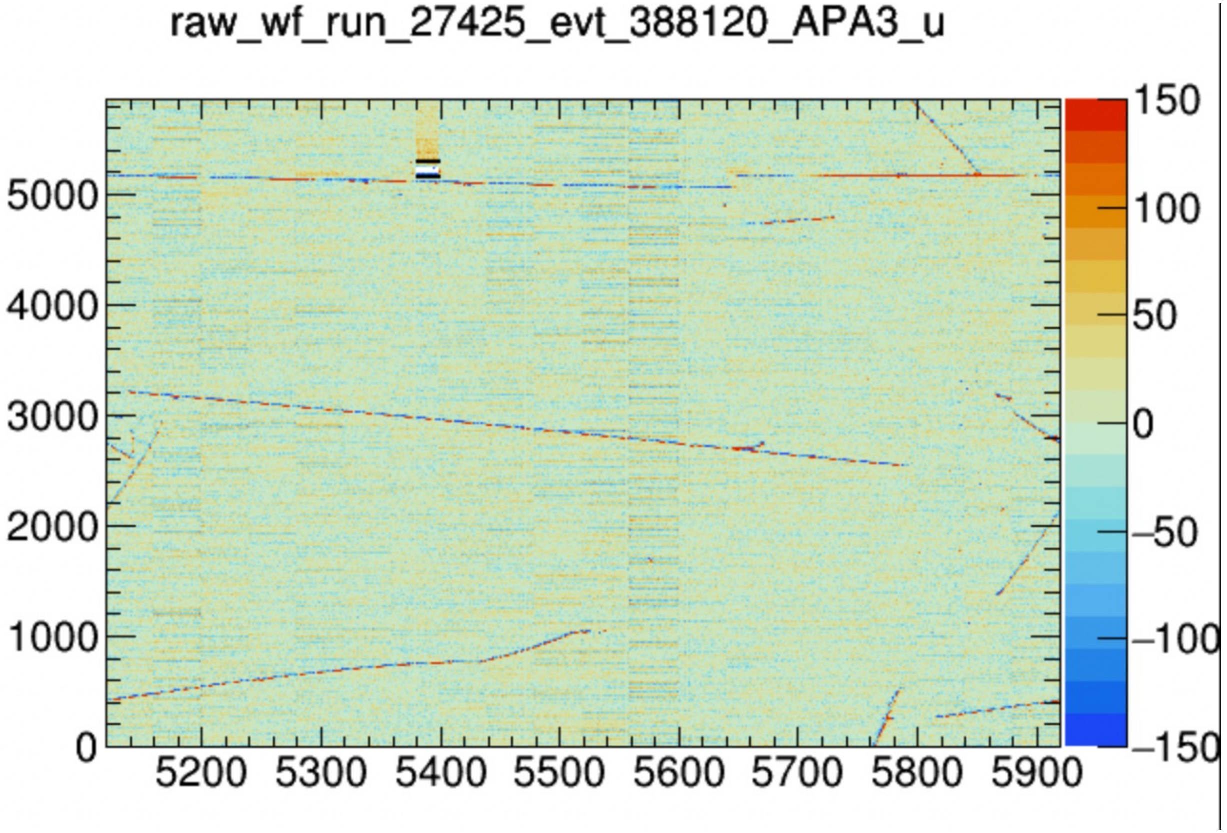
27425_388160_1_18_1

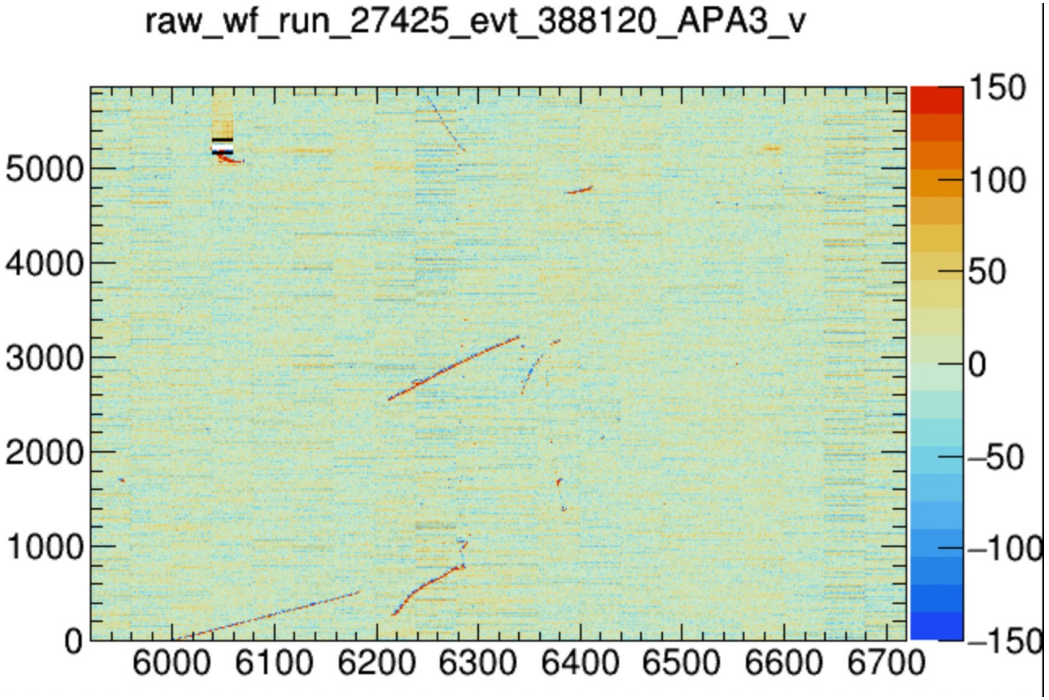
Next:

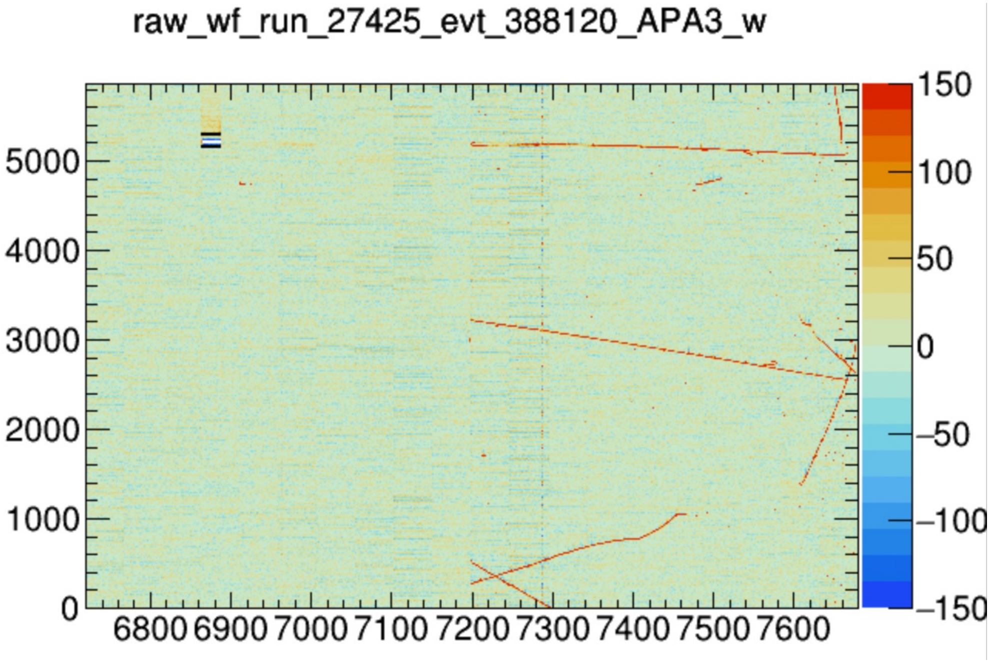
- Test and optimize the FEMB filter
  - Optimize the blind region.
  - Head and tail (add 2 more blind channels in each blind region in each plane)
  - …
- Signal processing:
  - simulate tracks
  - calculation of wiener filter
  - …

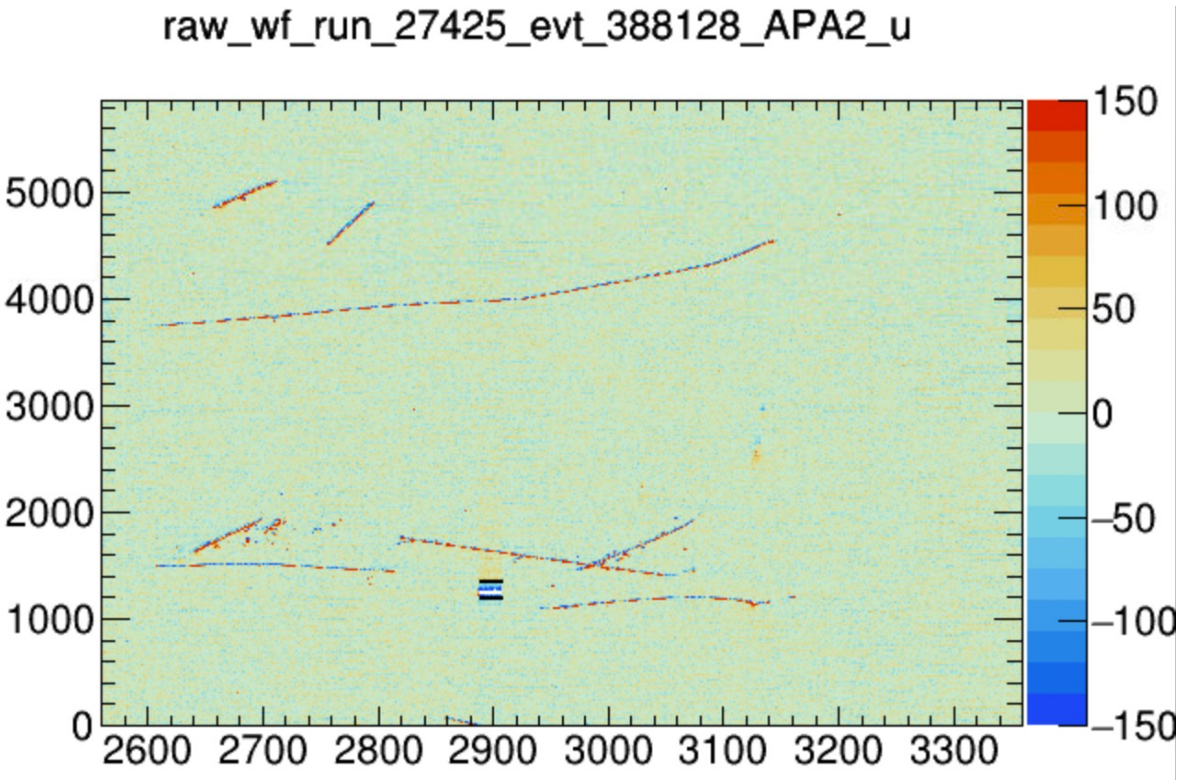
- DQM: We'll discuss with Edinburg team on Thursday this week.

Back up waveform





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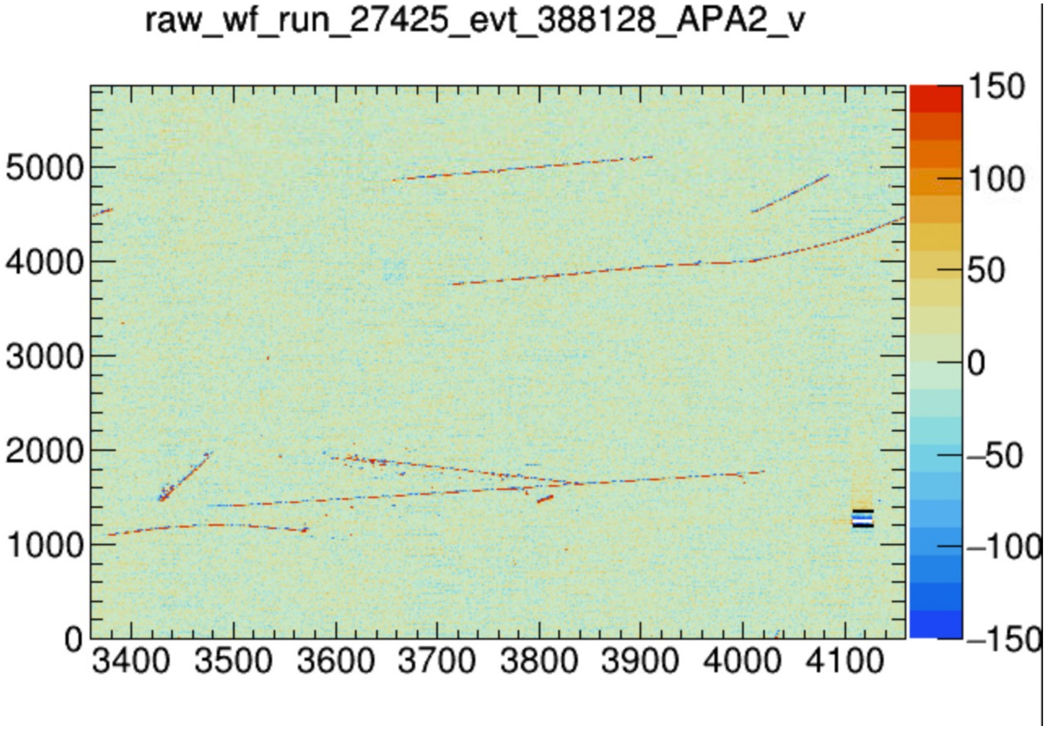
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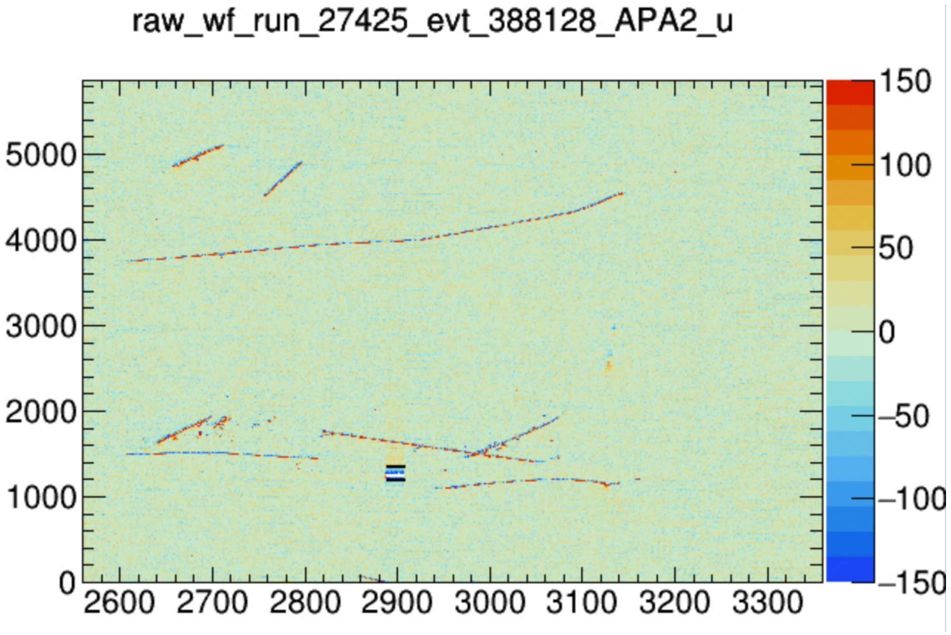
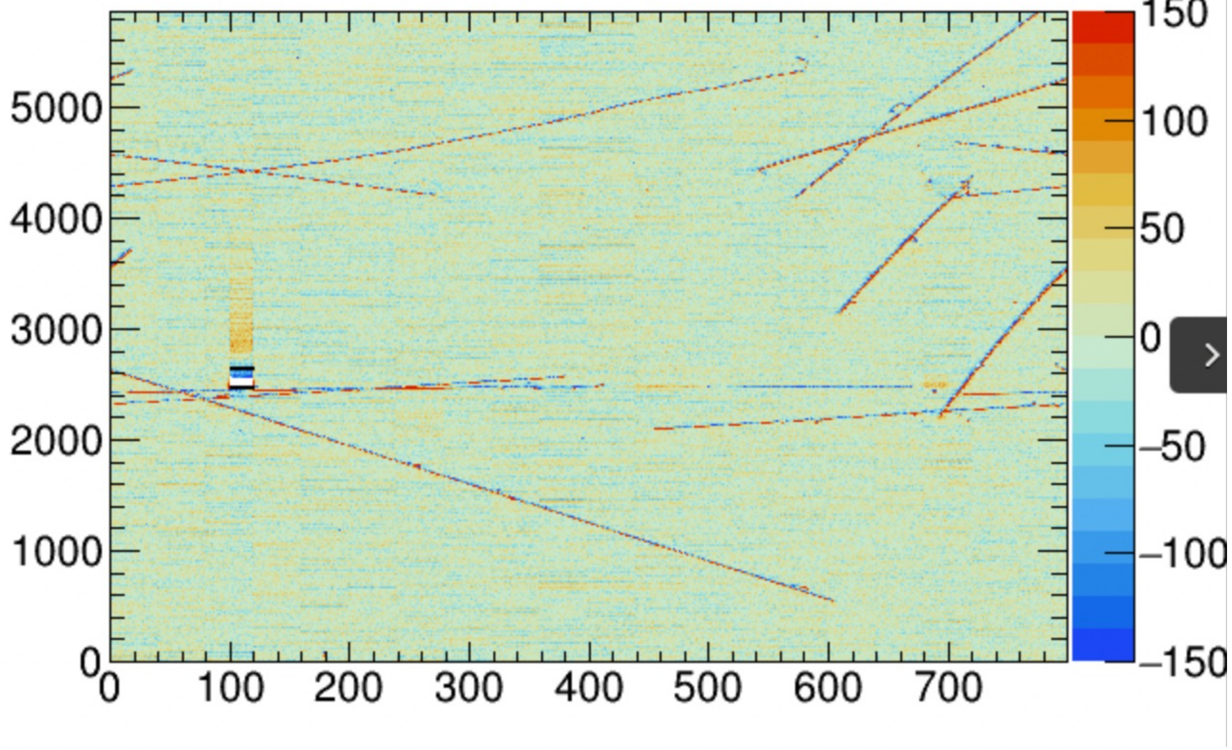
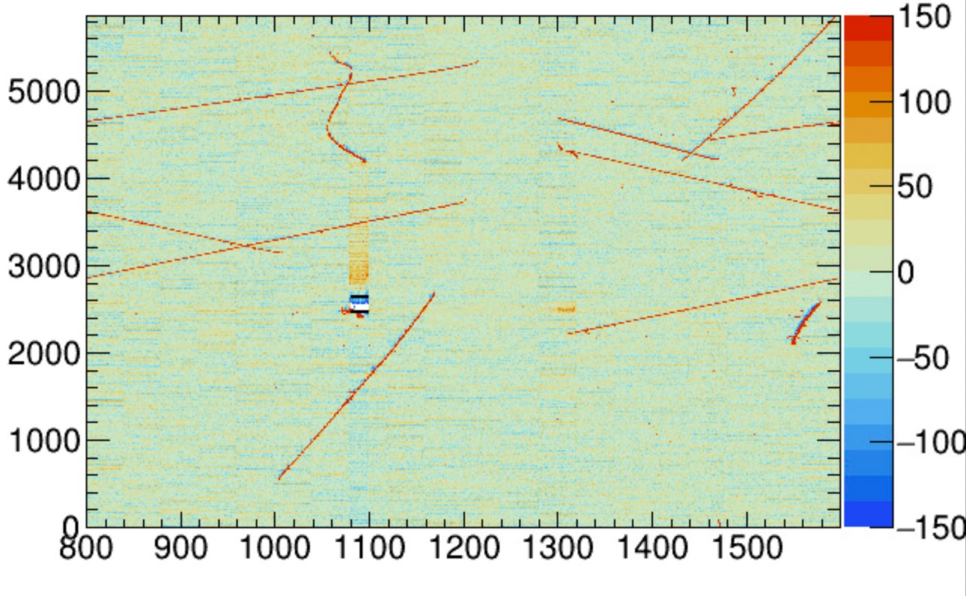

raw_wf_run_27425_evt_388128_APA2_u

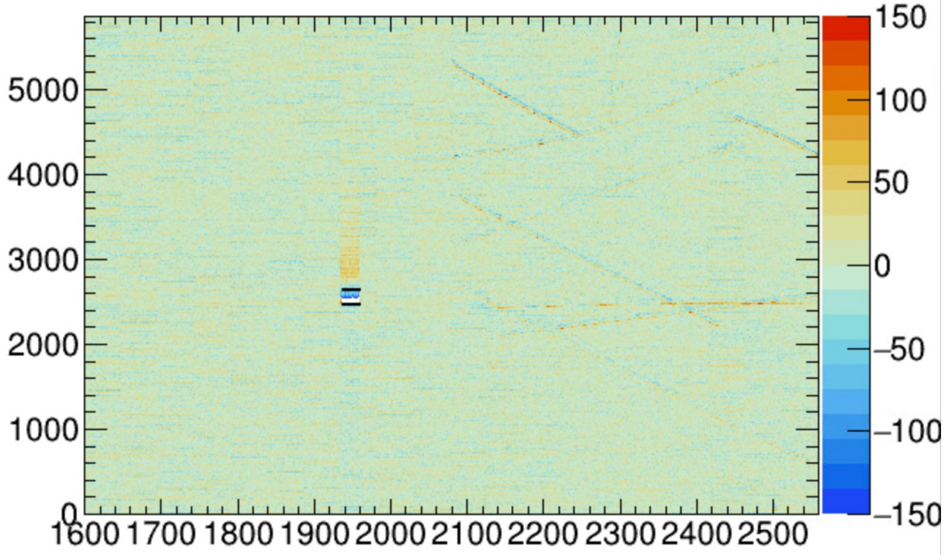
raw_wf_run_27425_evt_388132_APA1_u

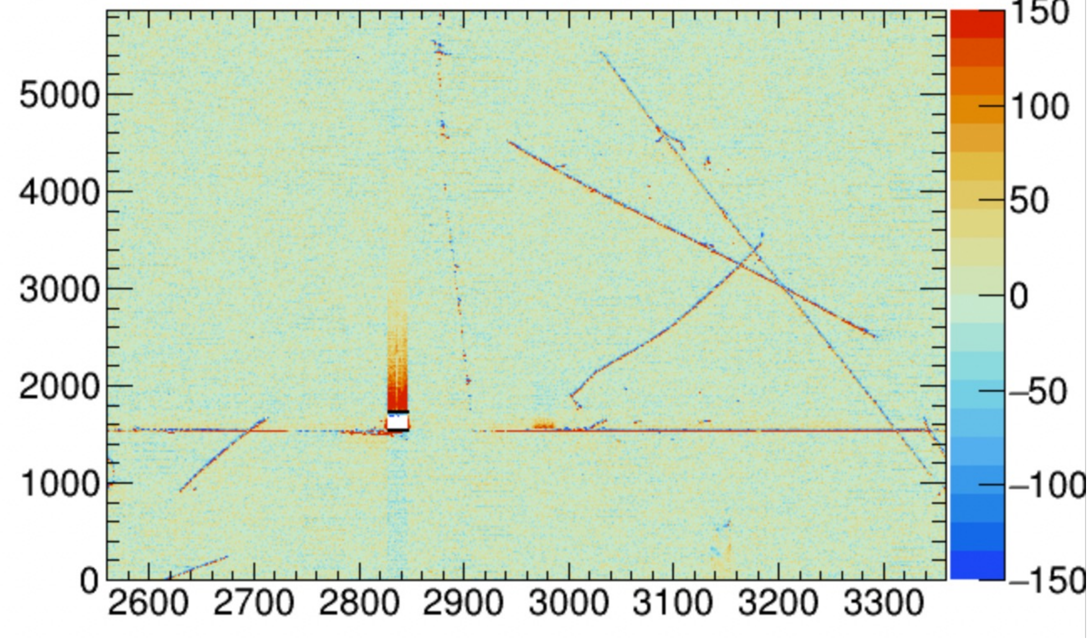


raw_wf_run_27425_evt_388132_APA1_v



raw_wf_run_27425_evt_388132_APA1_w





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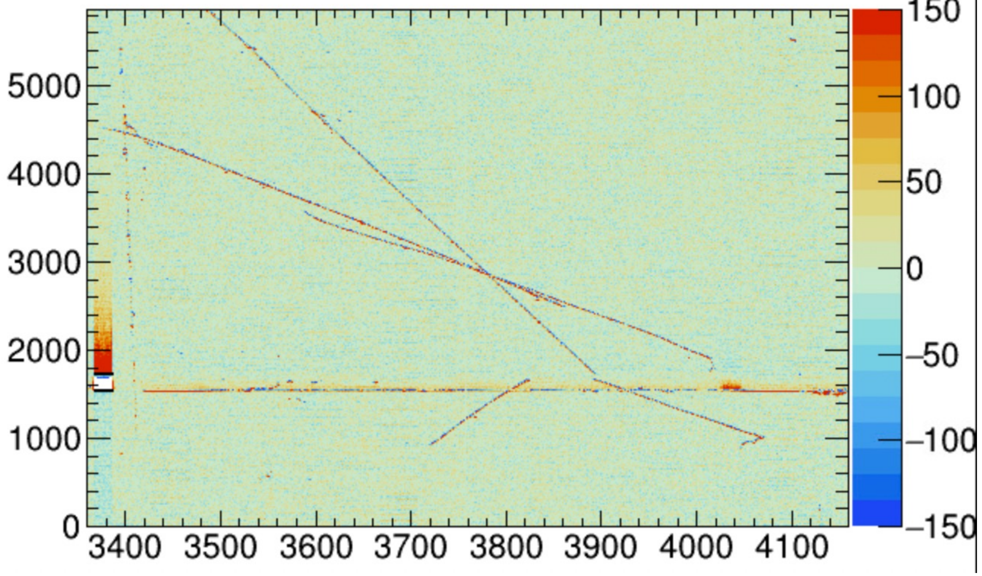

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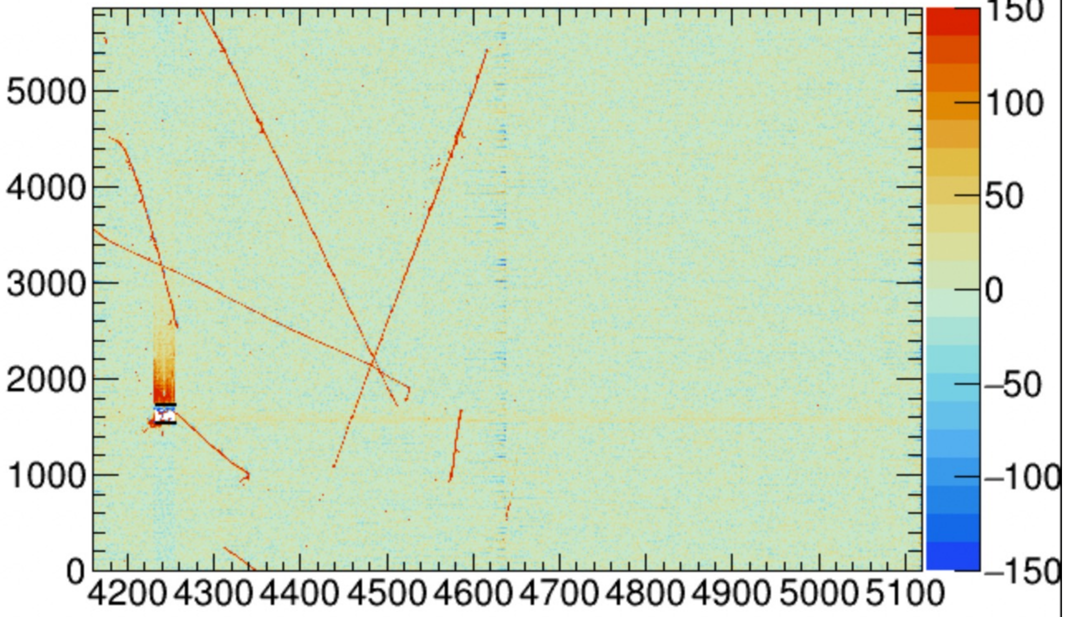

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