

Status: Implementation of raw hit finding for the dual phase in LArSoft

Christoph Alt

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ETH zürich

Current status

- After projecting charge on channels, signal is convoluted with electronic response function to obtain raw waveform
- raw waveform is deconvoluted (remove elect. response) and shaped → Gaussian waveform
- Hit finding and higher reco based on deconvoluted (Gaussian) waveform

What I am working on

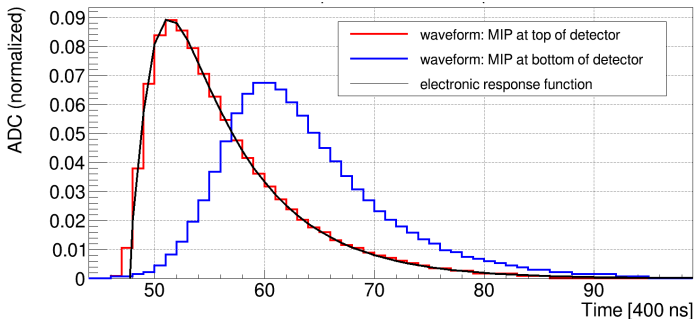
- Implement electronic response function for dual phase ✓
- Skip the deconvolution ✓
- Do hit finding based on raw waveform (ongoing)
- Implement drawing of the raw hit fitting in event display ✓
- Push changes to repository ✗

Electronic response function for dual phase

- Implement fast preamp response ✓

$$f_{FastPreAmp}(t) = \frac{\tau_D \cdot e^{-\frac{(t-t_0)}{\tau_D}} - \left(\tau_D + (t - t_0)\frac{\tau_D - \tau_I}{\tau_I}\right) \cdot e^{-\frac{(t-t_0)}{\tau_I}}}{(\tau_D - \tau_I)^2}$$

with: $\tau_D = 2.83\mu s$, $\tau_I = 0.47\mu s$



- Diffusion (6m drift) from red to blue

Skipping deconvolution ✓

dataprep module:

dunetpc/dune/DataPrep/Module/DataPrepModule_module.cc

- table in srcs/dunetpc/dune/DataPrep/fcl/dataprep_dune.fcl:

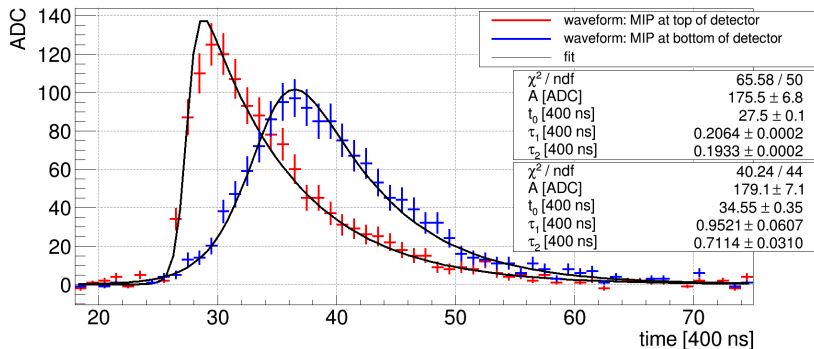
```
producer_adcprep: {  
  module_type: "DataPrepModule"  
  LogLevel: 1  
  DigitLabel: "daq"  
  WireName: ""  
  DoAssns: true  
  DoGroups: true  
  IntermediateStates: []  
}
```

- in reco.fcl:

```
physics:  
{  
  producers:  
  {  
    # random number saver  
    rns: { module_type: RandomNumberSaver }  
    # convert raw::RawDigit to recob::wire  
    # caldata: @local::dunefddphase_calwire  
    caldata: @local::producer_adcprep
```

```
physics.producers.caldata.DoGroups: false
```

- Fit every identified peak with: $f(t) = A \cdot \frac{e^{-\frac{t-t_0}{\tau_1}}}{1+e^{-\frac{t-t_0}{\tau_2}}}$ ✓



- Hit finding and fitting works well for single hits

Saving the fit parameters... (many thanks to Robert)

Problem:

- Hit parameters are stored in `recob::Hit` object
- `recob::Hit` doesn't provide space to save the additional fit parameters (raw fit: 4 parameters, Gaussian fit: 3 parameters)

Solution:

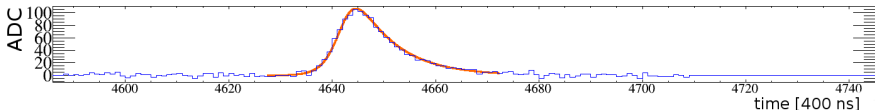
- Save raw waveform fit parameters in a separate vector and assign this vector to the `recob::Hit` object ✓
 - Needed to plot raw fit in event display ✓
 - Probably not needed for cluster and track reconstruction
- current idea: merge τ_1 and τ_2 into one factor to describe the width of the waveform and save it in `recob::Hit` for higher reco

Raw waveform fit in event display

- Implemented function to read the vectors with raw fit parameters assigned to `recob::Hit` in: `lareventdisplay/lareventdisplay/EventDisplay/RecoBaseDrawer.cxx`

```
void RecoBaseDrawer::FillTQHistoDP(const art::Event&    evt,  
                                   unsigned int       plane,  
                                   unsigned int       wire,  
                                   TH1F*             histo,  
                                   std::vector<double>& htau1,  
                                   std::vector<double>& htau2,  
                                   std::vector<double>& hitamplitudes,  
                                   std::vector<double>& hpeaktimes)  
{
```

- Call function and draw ADC vs. time:
`lareventdisplay/lareventdisplay/EventDisplay/TQPad.cxx`



- Tune hit finding and fitting for multiple hits
- Check performance of clustering and tracking with new input (raw waveform fit instead of Gaussian fit)
- Once working stable, push everything to the repository (let me know if you want to try already)