

Beamline Reconstruction Status

Brought to you by Brian Dung, Johnny Ho, Jason St. John, Doug Jensen, Daniel Smith, Ryan Linehan, Greg Pulliam, Elena Gramellini, and Irene Nutini

Overview

So you have a bunch of sliced events. What can you do with them?

Answer: do beamline reconstruction!

How? Produce reconstructed beamline objects!

Several objects (data products) exist in develop already:

1.) WCTrack

2.) TOF

3.) MuonRangeStackHits

Each of these objects is produced by a module in the LArIATRecoModules directory:

1.) WCTrack: WCTrackBuilderSlicing_module.cc

2.) TOF: TimeOfFlightSlicing_module.cc

3.) MuonRangeStackHits: MuonRangeStackHitsSlicing_module.cc

First Things First: Running the Reconstruction

Let's suppose you have a file of sliced events: SlicedEvents.root. To run beamline reconstruction on it:

```
cd $MRB_TOP  
lar -c srcs/lariatsoft/LArIATRecoModule/beamline_fullreco_lariat.fcl -s SlicedEvents.root
```

This produces WCTrack objects, TOF objects, and MuonRangeStackHits objects and puts them in the output file (default):

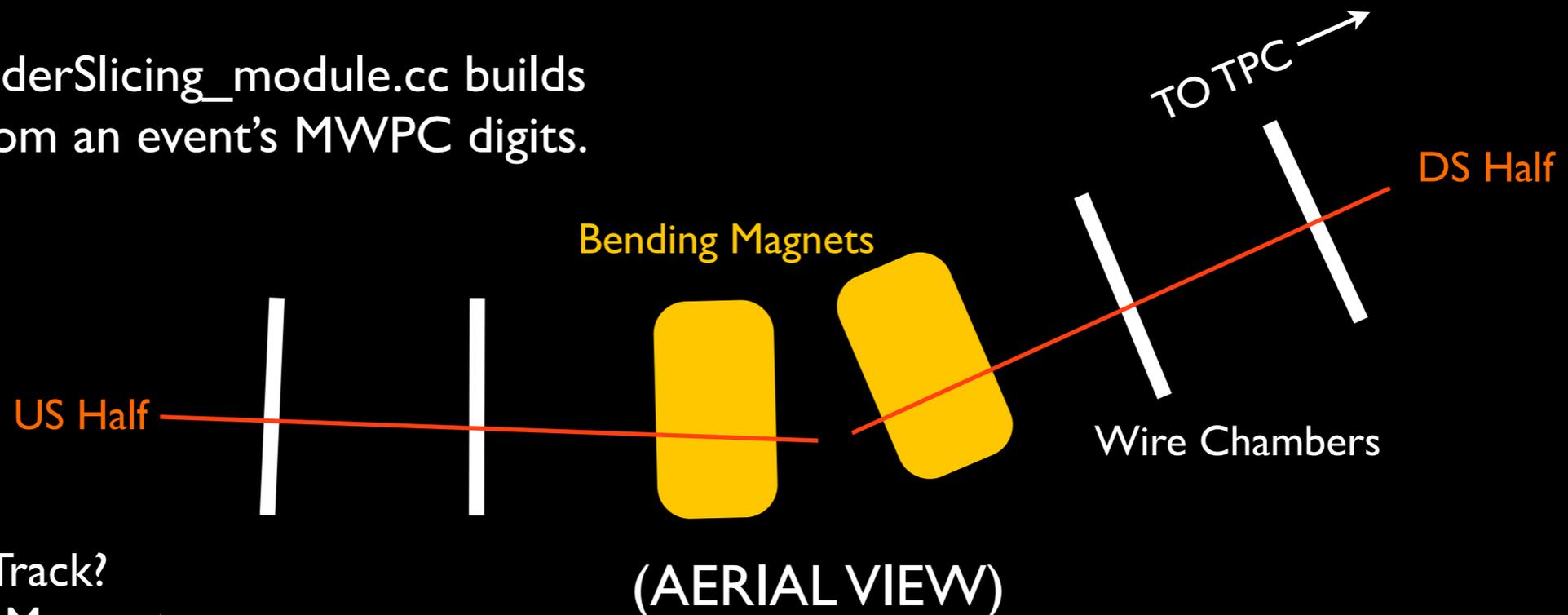
```
reconstructed_beamline.root
```

To see the parameter sets for the modules called in this file, look in:

```
srcs/lariatsoft/LArIATRecoModule/lariatbeamlinereco.fcl
```

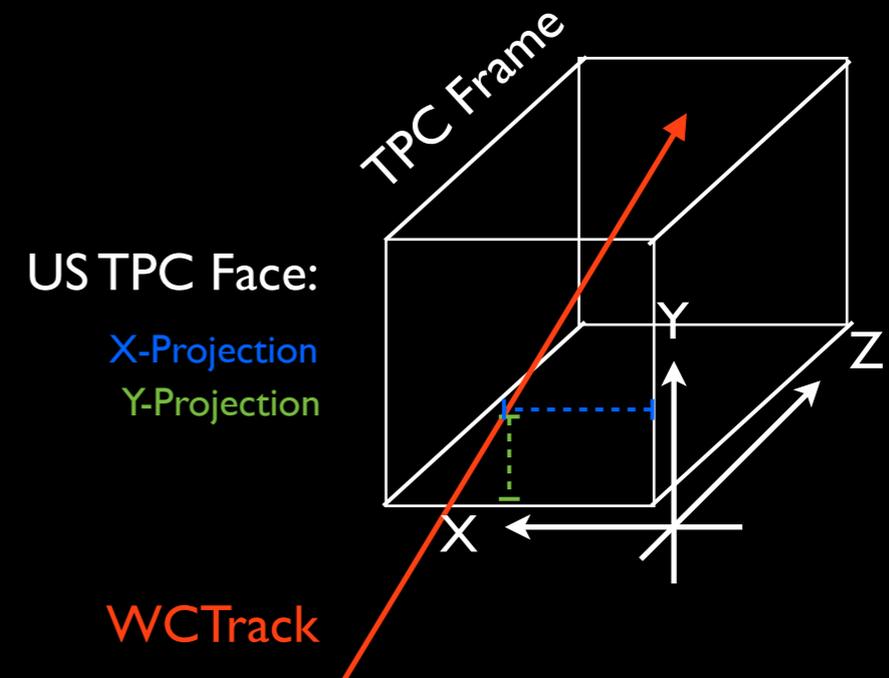
WCTrack

WCTrackBuilderSlicing_module.cc builds WCTracks from an event's MWPC digits.



What's in a WCTrack?

- Reconstructed Momentum
- Track quality information:
 - + Vertical (Y) kink in US/DS halves
 - + X,Y,Z Distance between US/DS half endpoints at bending magnets
- Track-On-TPC Info:
 - + X/Y projections onto US TPC face
 - + Theta in TPC coordinate system (polar angle)
 - + Phi in TPC coordinate system (azimuthal angle)
- Hit information:
 - + Hit WC #
 - + Hit Wire
 - + Hit Time



For specifics, look in:

[LArIATDataProducts/WCTrack.h](#)

TOF

TimeOfFlightSlicing_module.cc builds TOF objects from an event's time of flight counter digits.

What's in a TOF object?

- Number of times-of-flight: usually one.
- Vector of times-of-flight
- Vector of corresponding timestamps, where:

$\text{Timestamp} = \text{Time since spill started} + \text{DSTOF hit time}$

For more information on these variable names, look in:

[LArIATDataProducts/TOF.h](#)

MuonRangeStackHits

MuonRangeStackHitsSlicing_module.cc builds MuonRangeStackHits objects from an event's MuonRangeStack digits.

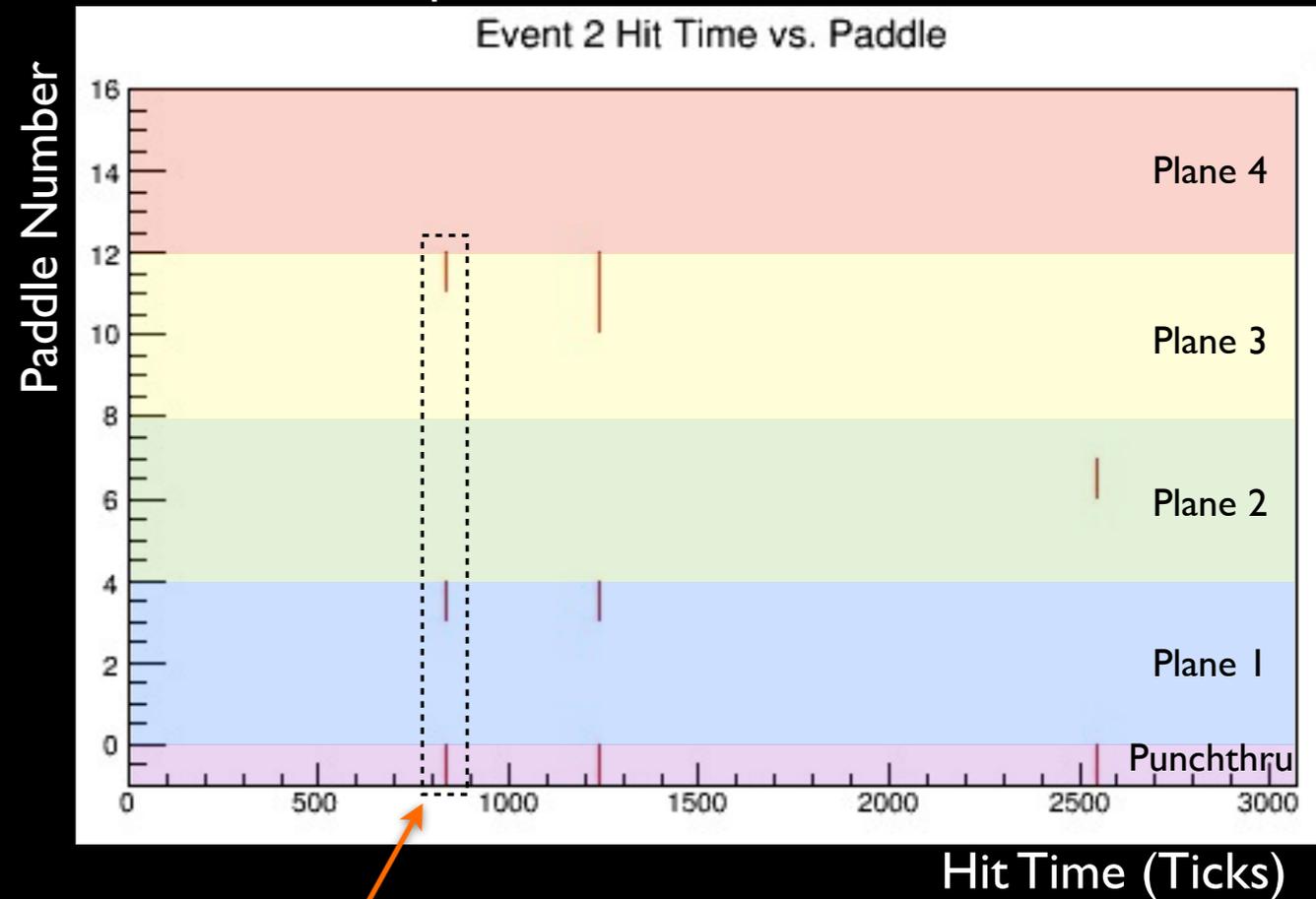
What's in a MuonRangeStackHits object?

- A map: paddle number to vector of hit times
 - + Human readable form of digits' data
- A vector of MuRSTracks
 - + MuRSTrack: built from coincidence of hits on 2 separate planes (including punchthrough)
- Info for each MuRSTrack:
 - + Penetration depth
 - + Arrival time (since hits are basically simultaneous)

For more specific information, look in:

[LArIATDataProducts/MuonRangeStackHits.h](#)

Example Hit Time vs. Paddle Plot



Example: hits grouped together as a MuRSTrack

Accessing these objects (in later modules)

Code snippet from an example
analysis module

```
*  
*  
*  
void ParticleIdentificationSlicing::produce(art::Event & e)  
{  
    //Get the collection of WCTracks produced by the WCTrackBuilder module  
    art::Handle< std::vector<ldp::WCTrack> > WCTrackColHandle;  
    e.getByLabel(fWCTrackModuleLabel,WCTrackColHandle);  
  
    //Get the collection of TOF objects produced by the TOF module  
    art::Handle< std::vector<ldp::TOF> > TOFColHandle;  
    e.getByLabel(fTOFModuleLabel,TOFColHandle);  
  
    //Get the collection of MuonRangeStackHits objects produced by the MuonRangeStackHitsBuilder module  
    art::Handle< std::vector<ldp::MuonRangeStackHits> > MuRSColHandle;  
    e.getByLabel(fMuRSModuleLabel,MuRSColHandle);  
  
    //Loop through the WCTracks and find the momentum for each  
    for( size_t iWCTrack = 0; iWCTrack < WCTrackColHandle->size(); ++iWCTrack ){  
        float reco_momentum = WCTrackColHandle->at(iWCTrack).Momentum();  
    }  
}
```

Use the getByLabel
method to put the
objects built by our
beamline reco modules
into handles...

```
*  
*  
*  
...then use the handles like  
pointers to vectors of the  
objects!
```

And that's it!

Future Plans

In the works:

- Aerogel Counter objects have also been created, and are being pushed to develop soon!
- Particle ID based on WCTrack/TOF, MuRS, and Aerogel Counters is being worked on, and should be done relatively soon (~1.5 weeks)
- Track matching: WCTracks with TPC Tracks

Things for people to do:

- Improvement/patching of existing “quick-and-dirty” algorithms for better efficiency:
 - + WCTracking
 - + TOF Finding
 - + MuRS Tracking