

ProtoDUNE Beam Cuts

Jake Calcutt
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Introduction



Implemented new class to handle selecting good beam events

protoana::ProtoDUNEBeamCuts

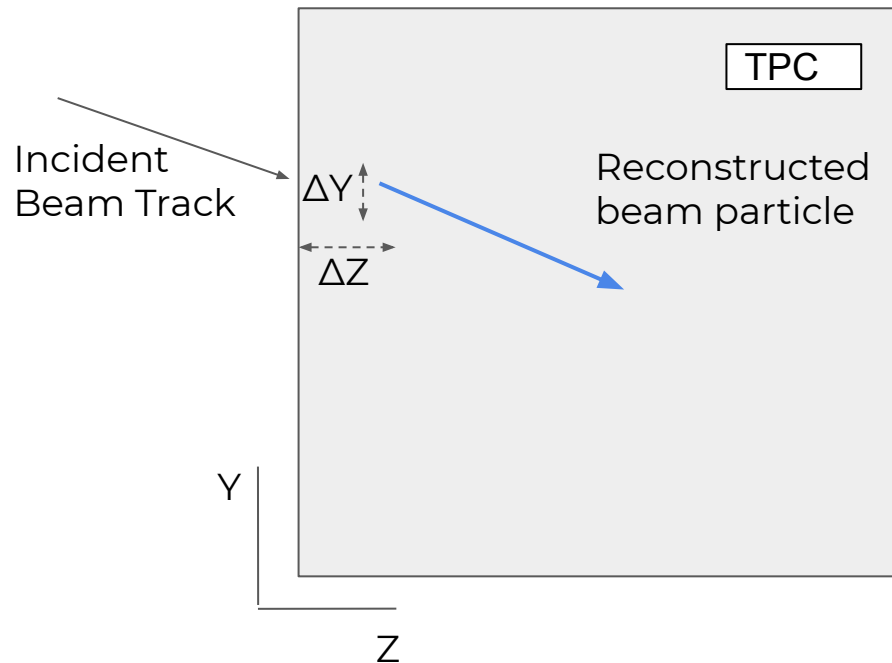
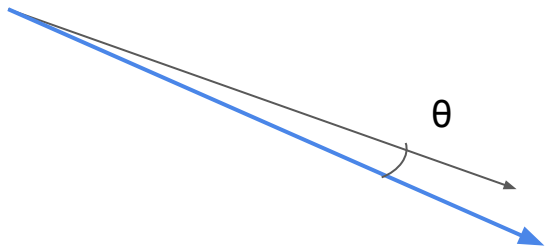
Refinement/expansion on the method within ProtoDUNETrackUtils class

Takes in a FHiCL parameter set to create cuts for each momentum for both data & MC

- Automatically chooses between data/MC
- MC: Compares to beam MCParticle projected to TPC face ($z=0$)
- Data: Compares to ProtoDUNEBeamEvent Track at TPC face

Cut Technique

Cut on $\Delta X, \Delta Y, \Delta Z, \text{Cos}(\theta)$



Parameter Set Structure



```
35 SPProd2_MC_sce_p5GeV:{  
36   TrackStartXCut: [-3., 0.]  
37   TrackStartYCut: [-1., 2.]  
38   TrackStartZCut: [28., 32.]  
39   TrackDirCut:    .93  
40  
41   Momentum: ".5"  
42 }
```

[Lower, Upper] limits on
difference in track
positions

Lower limit on cosine of
angle between beam &
reco track

Momentum setting

FHiCL File Structure

Within ProtoDUNEBeamCuts.fcl

```
102 Prod2BeamCuts: {  
103   MCCuts: @local::MCCuts_List  
104   DataCuts: @local::DataCuts_List  
105 }
```

Within module FHiCL file

```
14 #include "ProtoDUNEBeamCuts.fcl"  
15 #
```

...

```
39 BeamCuts: @local::Prod2BeamCuts  
40
```

```
76 MCCuts_List: [  
77  
78   @local::SPProd2_MC_sce_p3GeV,  
79   @local::SPProd2_MC_sce_p5GeV,  
80  
81   @local::SPProd2_MC_sce_1GeV,  
82   @local::SPProd2_MC_sce_2GeV,  
83   @local::SPProd2_MC_sce_3GeV,  
84  
85   @local::SPProd2_MC_sce_6GeV,  
86   @local::SPProd2_MC_sce_7GeV  
87 ]  
88  
89 DataCuts_List: [  
90  
91   @local::SPProd2_Data_sce_p3GeV,  
92   @local::SPProd2_Data_sce_p5GeV,  
93  
94   @local::SPProd2_Data_sce_1GeV,  
95   @local::SPProd2_Data_sce_2GeV,  
96   @local::SPProd2_Data_sce_3GeV,  
97  
98   @local::SPProd2_Data_sce_6GeV,  
99   @local::SPProd2_Data_sce_7GeV  
100 ]
```

Usage

```
1 #include "dune/Protodune/Analysis/ProtoDUNEBeamCuts.h"
2
3 namespace example {
4   class ExampleAnalyzer;
5 }
6
7 class example::ExampleAnalyzer : public art::EDAnalyzer {
8 public:
9   //Constructors and other public members here
10 private:
11   //Other Members Here
12   fhicl::ParameterSet BeamCuts;
13   protoana::ProtoDUNEBeamCuts beam_cuts;
14 }
15
16 example::ExampleAnalyzer::ExampleAnalyzer(fhicl::ParameterSet const & p)
17   : EDAnalyzer{p} ,
18   /*Initialize Other Members Here,*/
19   BeamCuts(p.get<fhicl::ParameterSet>("BeamCuts"))
20 {
21   beam_cuts = protoana::ProtoDUNEBeamCuts( BeamCuts );
22 }
23
24 void example::ExampleAnalyzer::analyze(art::Event const& evt)
25 {
26
27   //Get the track pointer: *thisTrack
28   bool pass_beam_cuts = beam_cuts.IsBeamLike( *thisTrack, evt, "1");
29 }
```

Include beam cuts class

Declare the parameter set and beam cuts class

Import beam cut parameters and initialize the class

Check the track

Miscellanea



```
28 bool pass_beam_cuts = beam_cuts.IsBeamLike( *thisTrack, evt, "1");
```

```
36     std::vector< std::string > valid_momenta = {  
37         ".3", ".5", "1", "2", "3", "6", "7"  
38     };
```

```
54 if( std::find( valid_momenta.begin(), valid_momenta.end(), momentum ) == valid_momenta.end() ){  
55     std::cerr << "Error. Momentum provided not in range" << std::endl;  
56     std::exception e;  
57     throw e;  
58 }
```

Can only use these settings

Will throw exception otherwise. Up to users to decide what to do (i.e. let crash or catch it and carry on)

Tip: use fcl parameter to easily switch between different momentum settings

Miscellanea

```

126 BeamVals result;
127 result.Valid = false;
128
129 if( !true_beam_particle ){
130     std::cout << "No true beam particle" << std::endl;
131     return result;
132 }
133
GetMCBeam

```

```

158 const std::vector< recob::Track > & beamTracks = beamEvent.GetBeamTracks();
159 if( beamTracks.size() == 0 ){
160     std::cout << "Warning: no tracks associated to beam data" << std::endl;
161     return result;
162 }
163 else if( beamTracks.size() > 1 ){
164     std::cout << "Warning: mutiple tracks associated to beam data" << std::endl;
165     return result;
166 }
GetDataBeam

```

```

61 BeamVals theBeamVals = ( evt.isRealData() ? GetDataBeam( track, evt ) : GetMCBeam( track, evt ) );
62 if( !theBeamVals.Valid ){
63     return false;
64 }
IsBeamLike

```

Current implementation:

Cut method returns 'false' if no MC particle describing beam **or** the beam event from data has != 1 track associated

Is there a better way to handle this?

Thanks for listening