ProtoDUNE-SP Beamline Filter

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ProtoDUNE Sim/Reco Meeting

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Introduction

- I've been working on a preliminary beamline instrumentation filter for LArSoft
- Uses only the TOF and Cherenkov information
- In dunetpc/dune/Protodune/Analysis/
  - ProtoDUNEBeamlineFilter_module.cc and fcl
  - Example fcl's to run: runProtoDUNEBeamlineFilter_*.fcl
- The PID funcionality is in ProtoDUNEDataUtils so you can use it in your own module
- All of the code is in develop, so it should be in this week's dunetpc release

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Cherenkov PID

0.3/0.5/1/2 GeV/c

	High Pressure Cherenkov	Low Pressure Cherenkov
Electron	-	1
Pion	-	0
Proton	-	0

3 GeV/c

	High Pressure Cherenkov	Low Pressure Cherenkov
Electron	1	1
Pion	1	0
Proton	0	0

6/7 GeV/c

	High Pressure Cherenkov	Low Pressure Cherenkov
Electron / Pion	1	1
Kaon	1	0
Proton	0	0

- **Tables show how to identify particles with 1 (hit) 0 (no hit) in Cherenkovs**
- **In BeamEvent:**
  - **HP is CKov0Status**
  - **LP is CKov1Status**

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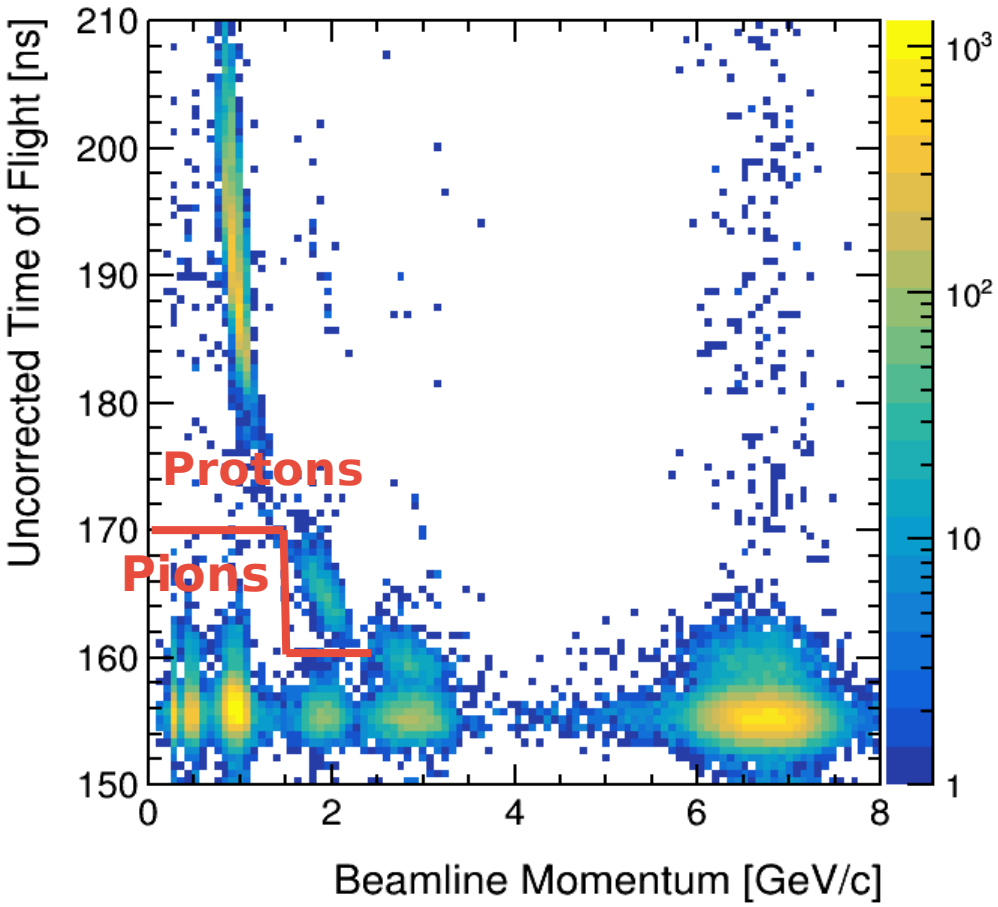
Time of Flight



- **For 0.3/0.5/1/2 GeV/c:**
  - **If not classified as electron by the Cherenkov, then TOF is used to differentiate pions and protons**
  - **For 2 GeV/c:**
    - **TOF < 160 ns: pions**
    - **Else: protons**
  - **For 0.3/0.5/1 GeV/c:**
    - **TOF < 170 ns: pions**
    - **Else: protons**
  - **These cuts are configurable in fcl**

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Invalid TOF and Cherenkov

- A lot of the officially processed data doesn't have a good TOF
  - This is due to issues Jake has since resolved and can be improved by reprocessing the data
- There were also some runs where the Cherenkovs wasn't properly recorded
- I put a couple of fcl flags in to deal with these cases: StrictTOF and StrictCherenkov
  - When they are true, events with invalid data are rejected, if they are false they pass
- I set the strict flags to true by default
  - Cleaner, less efficient sample by default

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How to use the module?

- **I created standard configurations for each particle type and nominal beam momentum like: standard_protodunebeamlinefilter_Pion_0p3GeV**
  - **And similar for Electron/Pion/Kaon/Proton and 0p3GeV/0p5GeV/1GeV/2GeV/3GeV/6GeV/7GeV**
  - **They are all listed in ProtoDUNEBeamlineFilter.fcl**
- **You can use runProtoDUNEBeamlineFilter_Pion_1GeV.fcl as an example**
- **You can change, for example, StrictTOF to false on a filter called “filter” with the line:**

  physics.filters.filter.DataUtils.StrictTOF: false

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Beamline Good Event Cuts: % of All

Cumulative Cuts Percentage of Top Row	Run 5387: 1 GeV/c	Run 5430: 2 GeV/c	Run 5826: 0.5 GeV/c	Run 5834: 0.3 GeV/c
All	100.0	100.0	100.0	100.0
CTB Beam Trigger	47.7	58.6	77.0	42.9
CTB BI Info Valid	45.3	53.5	77.0	42.9
CTB TOF Coincidence	45.3	53.5	77.0	42.9
CTB-BI Matched	28.9	50.3	74.2	42.1
> 0 Beam Tracks	28.5	49.5	73.1	41.7
> 0 Beam Momenta	26.7	41.3	63.7	39.6

- **This is using BeamEvent reprocessing from develop**
- **Starting from 5k-2k events / run**

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Pion Selection Cuts: % of All

Cumulative Cuts Percentage of Top Row				
	Run 5387: 1 GeV/c	Run 5430: 2 GeV/c	Run 5826: 0.5 GeV/c	Run 5834: 0.3 GeV/c
All	100.0	100.0	100.0	100.0
Good Beamline Event	26.7	41.3	63.7	39.6
TOF Pion	15.3	29.3	63.2	39.5
Cherenkov Pion	15.3	29.3	6.0	1.0
Pandora Beam Slice	11.3	24.7	1.9	0.3
Pandora Tracklike	10.2	21.3	1.5	0.2

- **Good fraction of 1, 2 GeV/c seem to be pions**
- **0.3, 0.5 GeV/c are mostly electrons, so this makes sense**

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Electron Selection Cuts: % of All

Cumulative Cuts Percentage of Top Row				
	Run 5387: 1 GeV/c	Run 5430: 2 GeV/c	Run 5826: 0.5 GeV/c	Run 5834: 0.3 GeV/c
All	100.0	100.0	100.0	100.0
Good Beamline Event	26.7	41.3	63.7	39.6
TOF Electron	26.7	41.3	63.7	39.6
Cherenkov Electron	0.0	0.0	57.6	38.6
Pandora Beam Slice	0.0	0.0	33.8	15.6
Pandora Showerlike	0.0	0.0	21.7	9.3

- **Cherenkov electron veto for runs 5387, 5430?**
- **0.3, 0.5 GeV/c good fraction of electrons reconstructed**

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Proton Selection Cuts: % of All

Cumulative Cuts Percentage of Top Row				
	Run 5387: 1 GeV/c	Run 5430: 2 GeV/c	Run 5826: 0.5 GeV/c	Run 5834: 0.3 GeV/c
All	100.0	100.0	100.0	100.0
Good Beamline Event	26.7	41.3	63.7	39.6
TOF Proton	11.4	12.0	0.4	0.1
Cherenkov Proton	11.4	12.0	0.1	0.0
Pandora Beam Slice	7.7	9.9	0.1	0.0
Pandora Tracklike	7.0	8.6	0.1	0.0

- 1,2 GeV/c fractions make up the non-pion sample
- 0.3, 0.5 GeV/c no high TOF, so makes sense

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Conclusions & Next Steps

- I implemented ProtoDUNEBeamlineFilter
  - It should be available in this weeks release
  - Please let me know if you need assistance using it or find a bug
- Working on combining beamline cuts and Pandora products
  - Seems like we have ~10% of the sample as good pions for 1 / 2 GeV/c (and a little less for protons) and similar for electrons in 0.3 / 0.5 GeV/c

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Backup Slides

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Beamline Good Event Cuts: % of previous line

Cumulative Cuts Percentage of Previous Row

	Run 5387: 1 GeV/c	Run 5430: 2 GeV/c	Run 5826: 0.5 GeV/c	Run 5834: 0.3 GeV/c
All	100.0	100.0	100.0	100.0
CTB Beam Trigger	47.7	58.6	77.0	42.9
CTB BI Info Valid	94.9	91.3	100.0	100.0
CTB TOF Coincidence	100.0	100.0	100.0	100.0
CTB-BI Matched	63.8	94.0	96.3	98.3
> 0 Beam Tracks	98.4	98.5	98.6	98.9
> 0 Beam Momenta	93.7	83.4	87.0	94.9

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