Status of TPC Cosmic Tagger

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Cosmic Tag Plan

- We associate a CosmicTag object to tracks and/or clusters

- TrackFinder/CosmicTagger_module.cc produces this for tracks right now

  - These are considered "TPC-IDed" cosmics

  - Track passes two Y or Z boundaries, or hits are outside of beam spill window (3200-6400 ticks)

- (B. Jones *et al.* have this for clusters associated to PMT flashes -- not discussed here)

```
CosmicTag(
        std::vector<float> ePt1,
        std::vector<float> ePt2,
        //      double flashTime,
        float cScore,
        int cType);

CosmicTag(float cScore);
```

Current Thresholds

- Associated hit ticks less than 3200 or greater than 6400 --> Type 1

  - Cluster start/end point --> Type 4 -- Not sure why this happens

- Two Y or Z end points within 5 cm of the Y or Z detector boundary --> Type 2

  - X boundary requires time information (Type 3)

- Any of these lead to a **cosmic score** of 1

  - Currently, tracks touching only one boundary get a score of 0.5 (will help estimate the x type)

Evaluating Performance

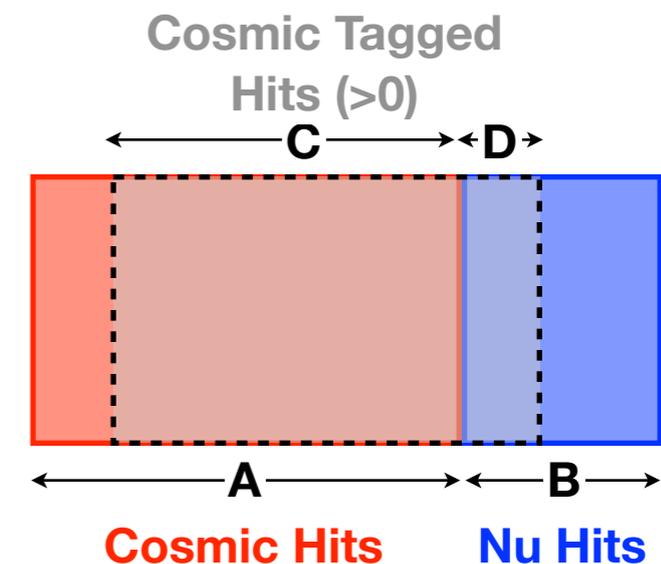- J. Asaadi and B. Jones worked on an Ana Module for this at the Yale Workshop

- I have an update that I haven't quite checked in

  - (Additionally, I had to make a change to backtracker -- not sure if this is universally needed or if it was unique to my area):

```
unsigned int start_tdc = detprop->ConvertTicksToTDC(startTim
unsigned int end_tdc = detprop->ConvertTicksToTDC(endTime);
start_tdc = round(startTime);
end_tdc = round(endTime);
//        std::cerr << "In BackTracker::ChannelToTrackID " << 
std::vector<sim::IDE> simides = schannel->TrackIDsAndEnergie
//        std::cerr << "simides size " << simides.size() << st
```
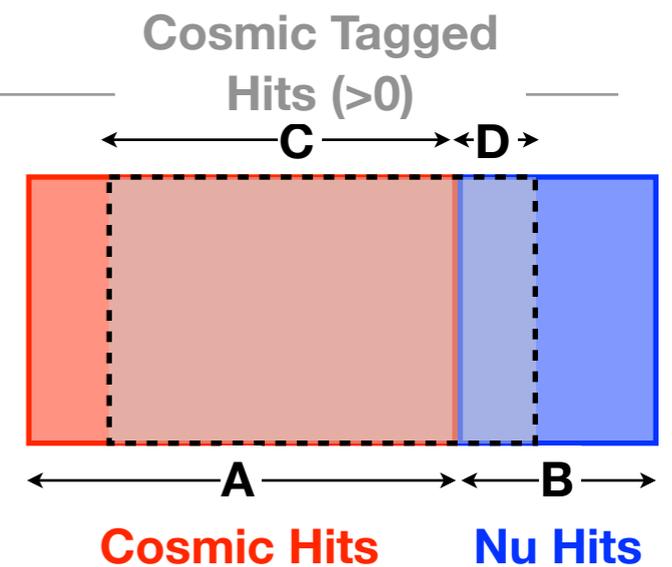
- Something to evaluate:

  - C/A is an efficiency of ID of cosmic hits

  - D/B gives a measure of purity of cosmic hits

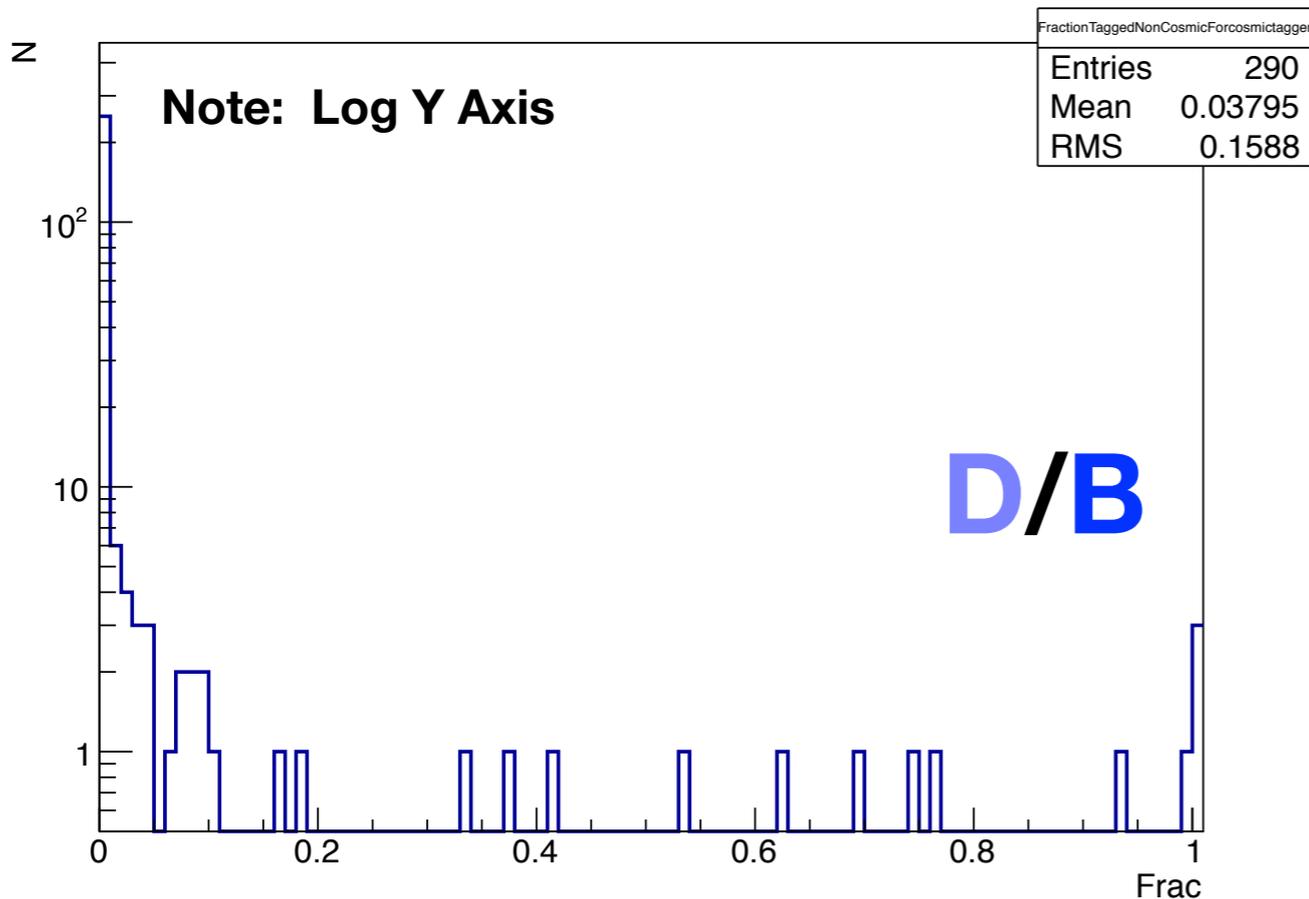**Cosmic Tagged Hits (>0)**

C ⟶ ‹D›

A ⟶ ‹B›

Cosmic Hits **Nu Hits**

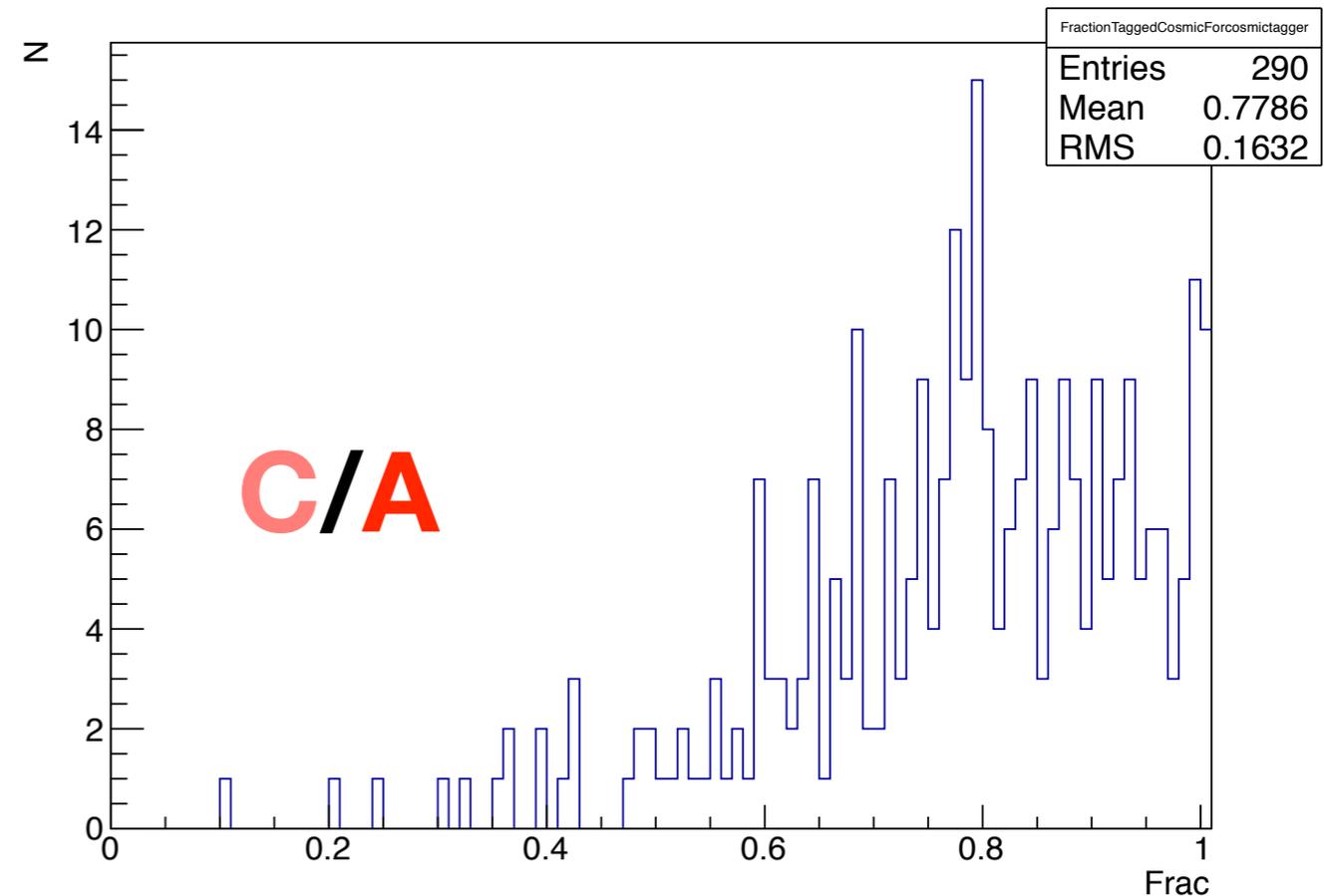# Plots! (these are using BezierTracks)

Cosmic Tagged Hits (>0)

• Caveat: some hits (#) do not successfully find truth info: "BackTracker: No ParticleId found"

• also -- these are only hits associated to tracks

Cosmic Hits   **Nu Hits**

Fraction of NonCosmic Charge Tagged as Cosmic For cosmictagger

FractionTaggedNonCosmicForcosmictagger	
Entries	290
Mean	0.03795
RMS	0.1588

Note: Log Y Axis

D/B

Fraction of Cosmic Charge Tagged as Cosmic For cosmictagger

FractionTaggedCosmicForcosmictagger	
Entries	290
Mean	0.7786
RMS	0.1632

C/A

Plots! (these are using BezierTracks)

- Caveat: some hits (#) do not successfully find truth info: "BackTracker: No ParticleId found"

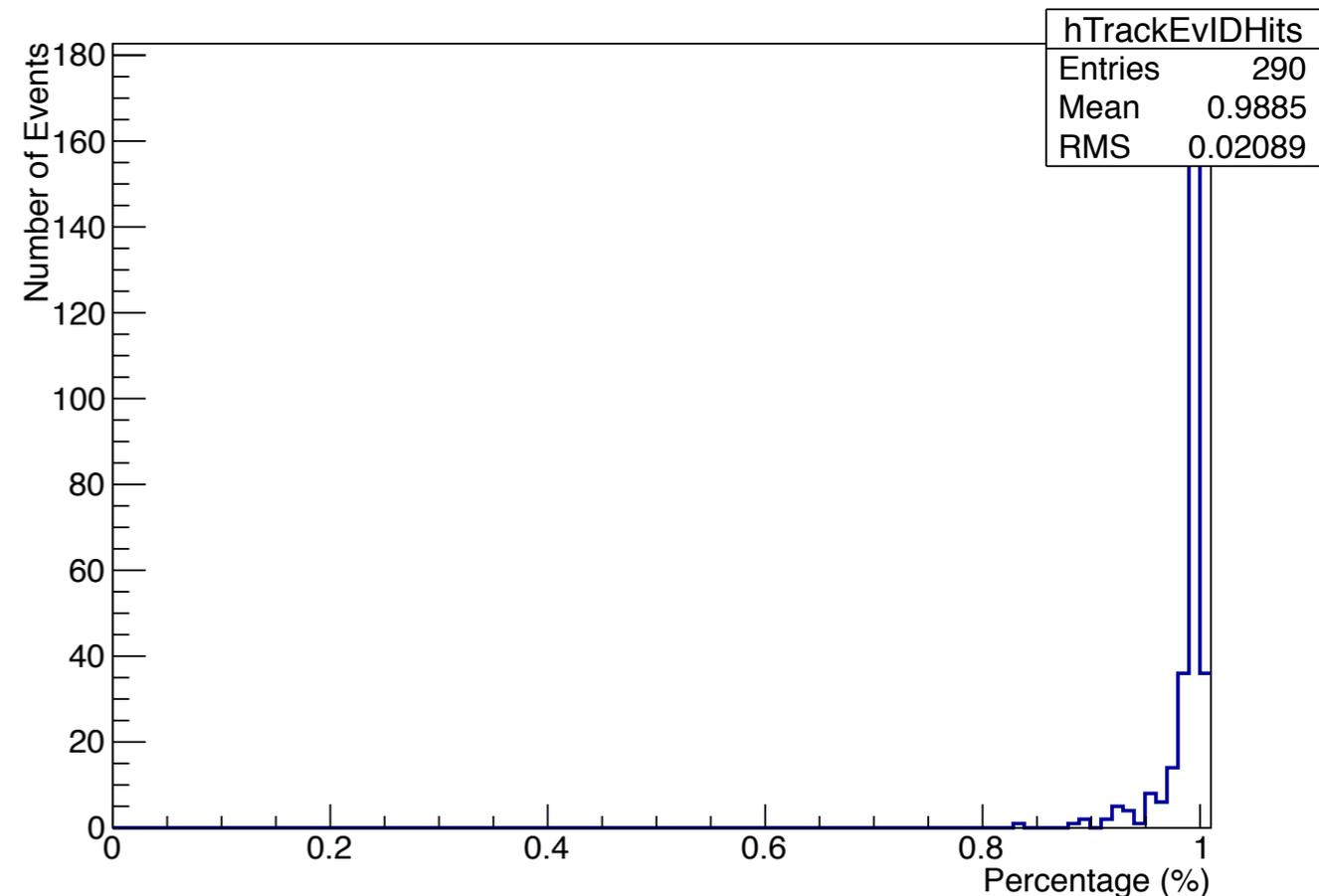 - also -- these are only hits associated to tracks

Percentage of Hits Associated to Tracks

hTrackHits	
Entries	290
Mean	0.7204
RMS	0.06905
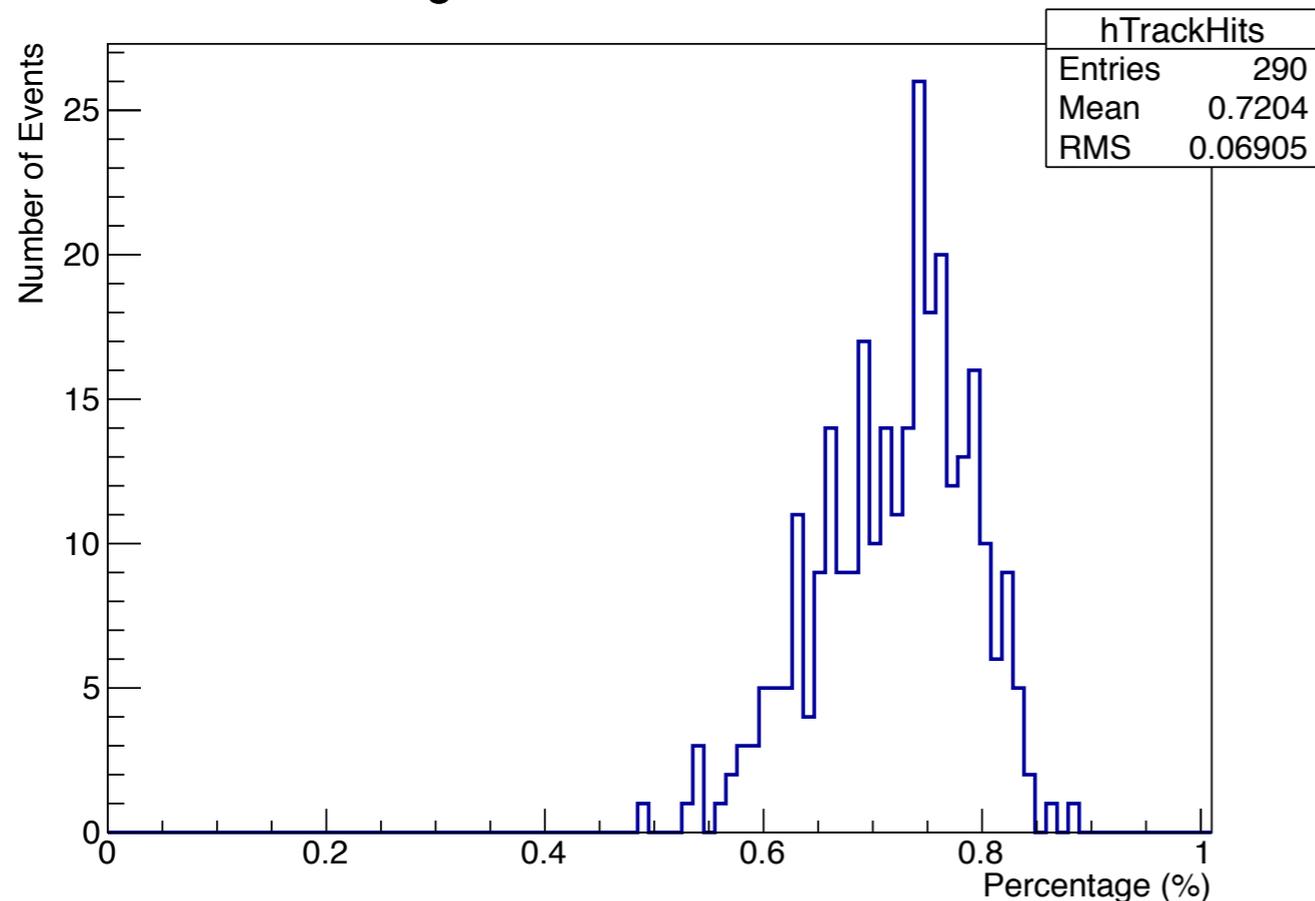
Fraction of Track Associated Hits with an EvID

hTrackEvIDHits	
Entries	290
Mean	0.9885
RMS	0.02089

Conclusions/Plans

- I haven't checked this in yet; I'm still working on it. In evaluation, it probably makes more sense to check energy deposited.

- 3D reconstruction at some level is needed to know if an object passed a detector boundary

- However, just using tracks blindly misses a lot of hits

- I plan to move toward tagging clusters instead, but will need to work out how to best get at least some of the 3D information