p-ar xs update

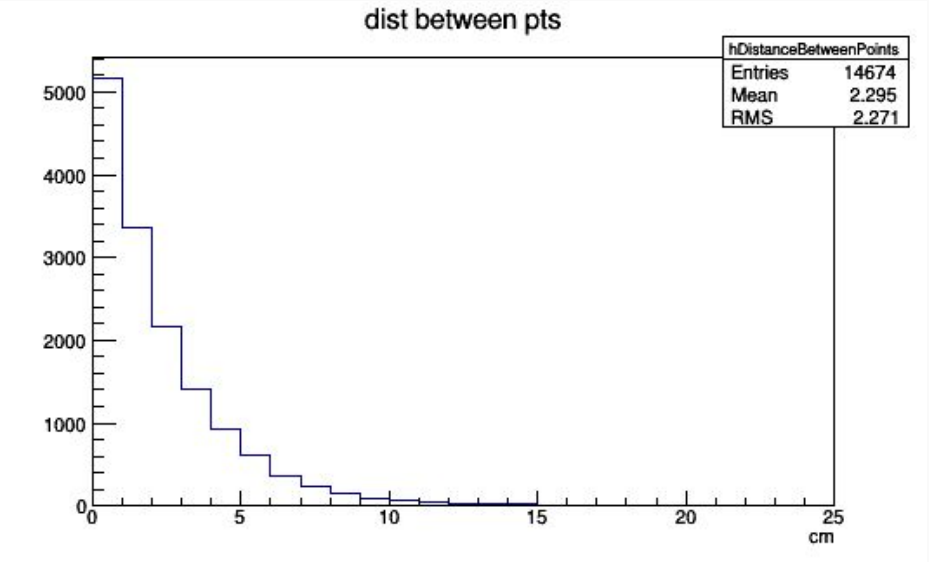
Software and Analysis

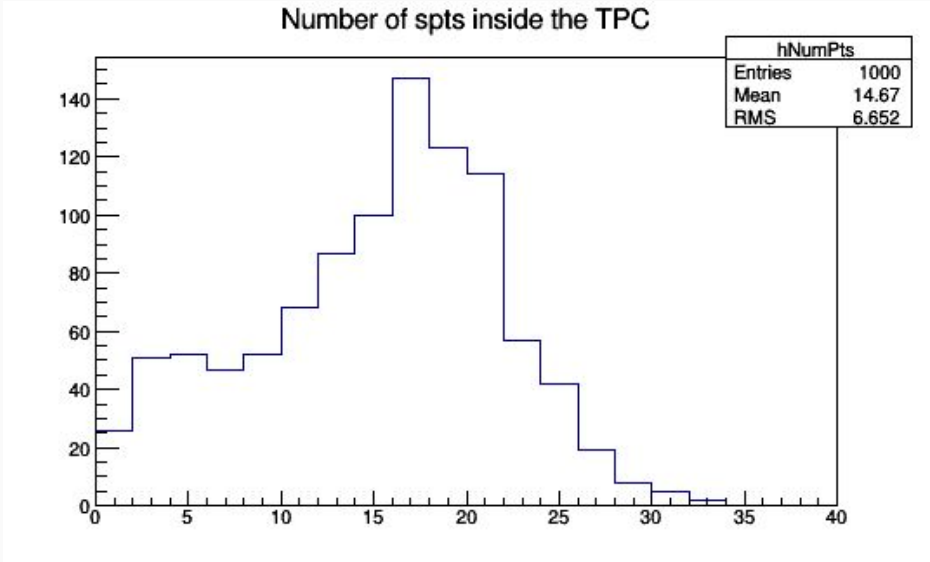
- In the effort to complete MC closure tests for xs measurements (reproduce predicted xs curve using the reconstruction) lots of work is being done coming up with appropriate corrections
- The tools needed to make these corrections motivated some software tweaking that I'll talk about
- I'll also go over the analysis work that I've been making progress on

Software

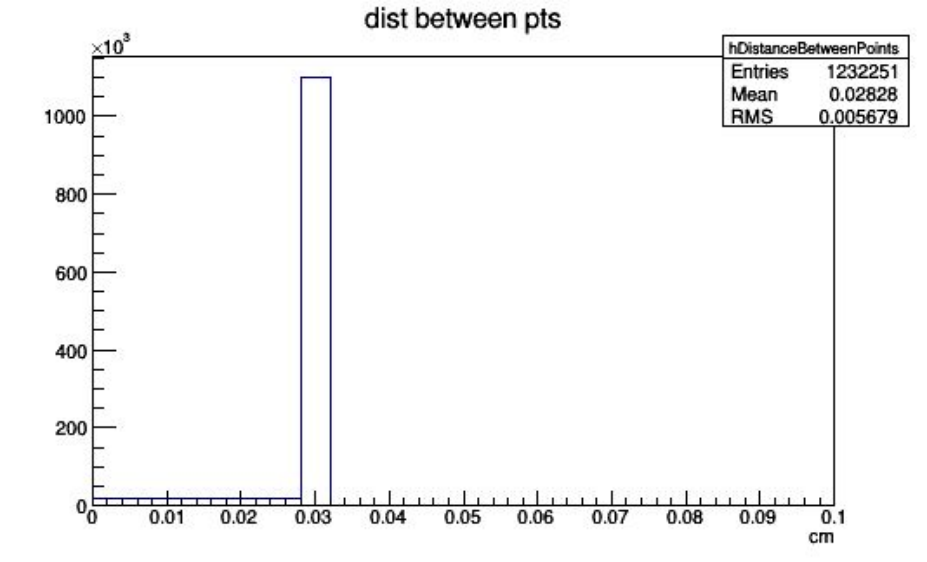
- A lot of the problems that we were running into in this analysis came from having too sparse of g4 points
- Made a tweak in larg4 to give us access to truth information across every voxel (this is normal for g4, but in larg4 we were throwing this info away)
- https://lartpc-docdb.fnal.gov/cgi-bin/private/ShowDocument?docid=2999

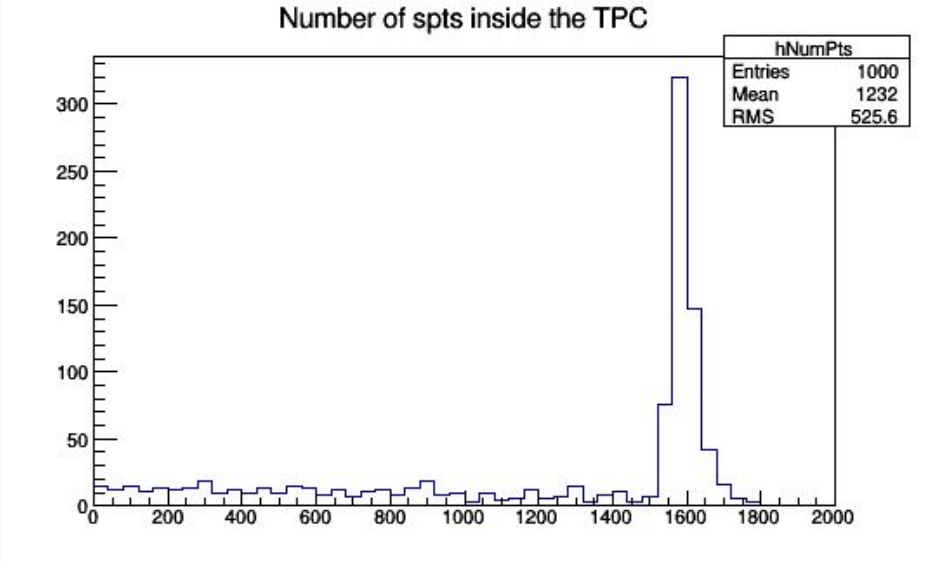
Geant4 space-points before





Geant4 space-points after





Analysis

- What I’ve been working on now is making good use of all this information we now have access to.
  - ~~Calculating a truth level XS with dense points~~
  - Calculating a truth level XS using reco analysis slab size
  - Correcting reco distributions back to sparse truth distributions

Unfolding the Cross-section Better

The interacting and incident N^{True} really need to be:

$$N^{True}(E_{True}) = \frac{U(N^{Reco}(E_{Reco}) - B(E_{Reco}))}{\epsilon(E_{True})}$$

Going into the same cross-section as before:

$$\sigma(E_{True}) = \frac{N^{True}_{Interacting}(E_{True})}{n z N^{True}_{Incident}(E_{True})}$$

Now we can deal with the migration matrix M, and also U on only the signal

We also only have to deal with the background in terms of reconstructed energy rather than true

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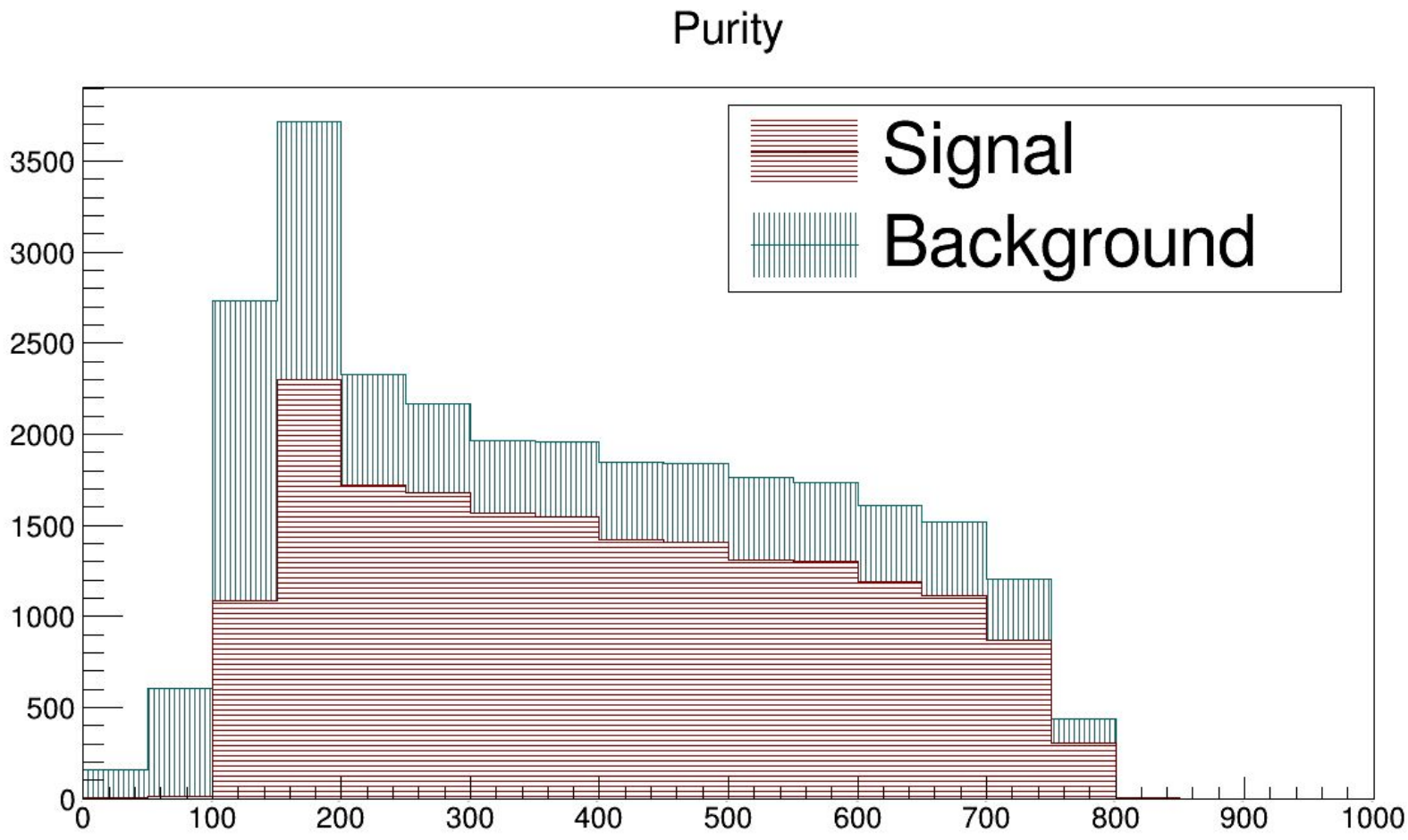
Purity, Unfolding, Efficiency, oh my

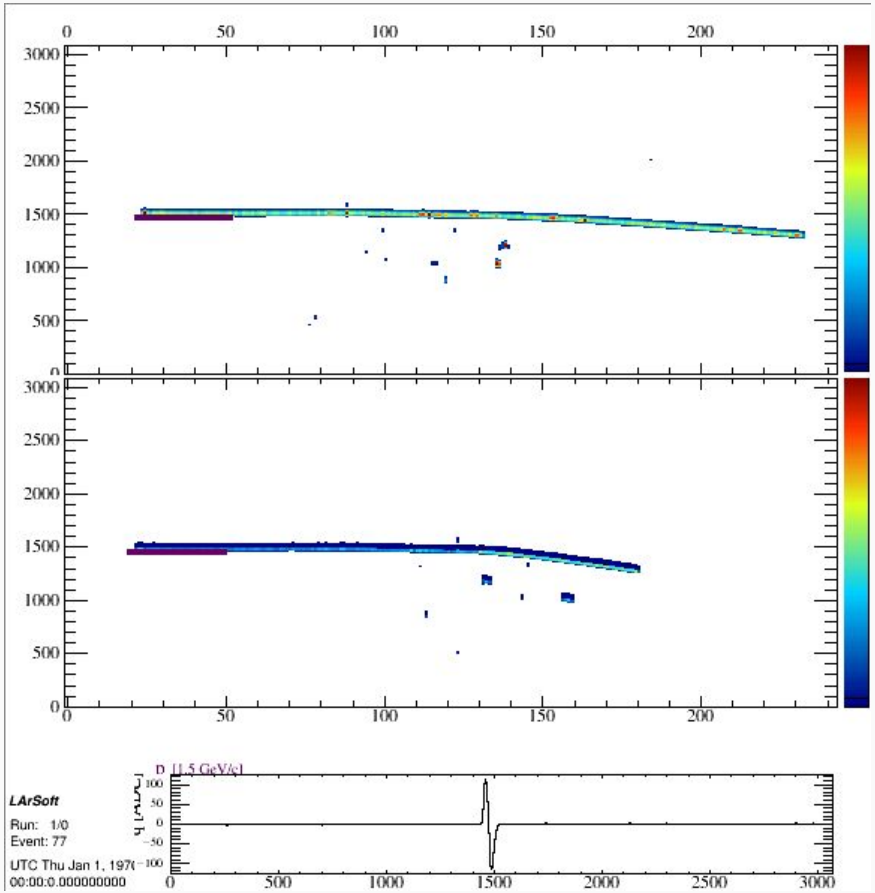
- purities and efficiencies conceptually are pretty easy in the numerator
- The purity (for the numerator) is simply a question of how often we got tricked and MisID’d an inelastic interaction
- The efficiency is how often we missed them


Purity
Signal
Background
3500
3000
2500
2000
1500
1000
500
0
0
100
200
300
400
500
600
700
800
900
1000

Purity, Unfolding, Efficiency, oh my

- But what has been missing in my analysis so far was also applying purity and efficiency corrections to the denominator
- This one is less conceptually obvious, so let me make a case for it!

Incident Energy



- This is an example of an inefficiency in the interacting histogram
- Kink is too small to get flagged so we miss this interaction
- We correct this as a function of energy when we efficiency correct the numerator
- But every slab that gets filled after that interaction is for a different particle with an unknown energy
- Need to know the energy of primary particle at every point along its path so as not to over fill or under fill!

Work right now

- What I’m currently working on is building the tools to be able to do these corrections
- For every slab that we use in every event in this measurement we need to know if the entry is “signal” or “background”
    - We need to know if it’s actually our primary proton or if we’ve missed an interaction somewhere up stream
- This involves doing a lot of reco-true matching step by step. Not the most fun in the world but I’m close!
- More to come!!