Cluster Reconstruction Studies

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Outline

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2. Fuzzy Clustering
3. My Evaluation
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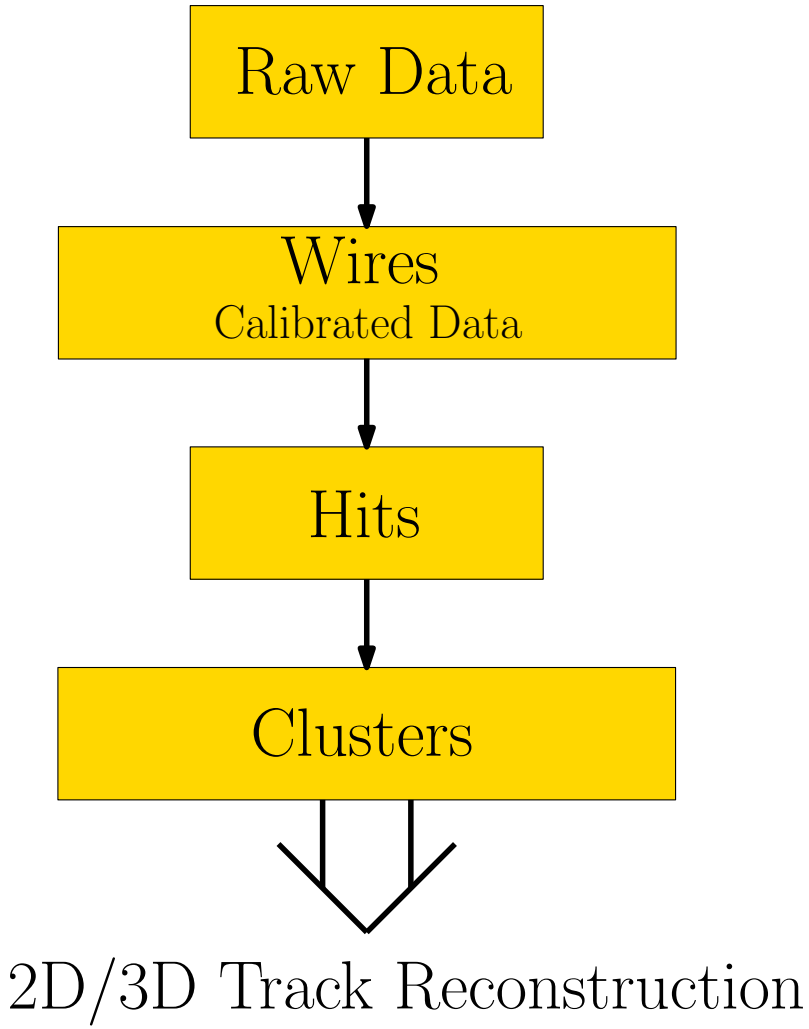
   - Purity & Efficiency - Protons
   - Purity & Efficiency - All Tracks

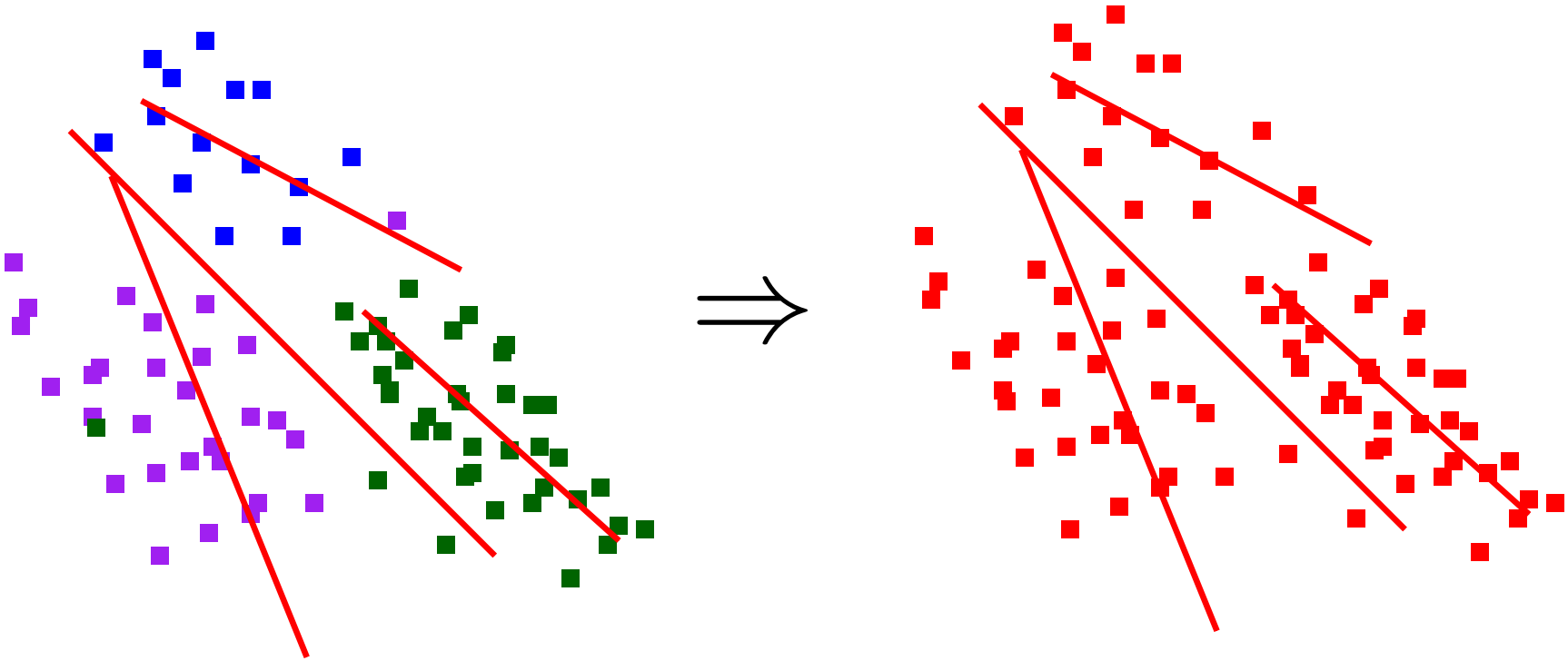
Clustering in LArSoft

- **Clustering** algorithms identify reconstructed wire hits which are correlated both spatially and temporally
- **Hits** are signal vs time information from a calibrated Wire object and looks for peaks that indicate real energy deposition occurred
- **DBscan** and **Fuzzy Clustering** are two such algorithms



Fuzzy Clustering

- Developed by Ben Carls at Fermilab
- Algorithm assigns "degrees of belonging" to reconstructed hits, instead of "definite belonging" as in DBscan $\rightarrow$ fed through an optimization criterion $\rightarrow$ clusters merged if necessary [1].
- Promising algorithm providing 2D physics-based clusters that track algorithms can utilize



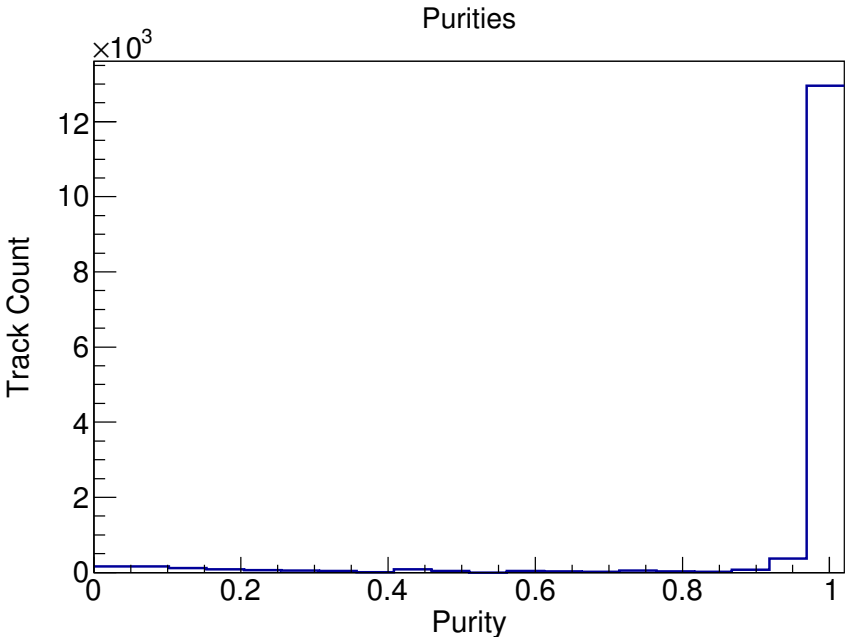
My Evaluation

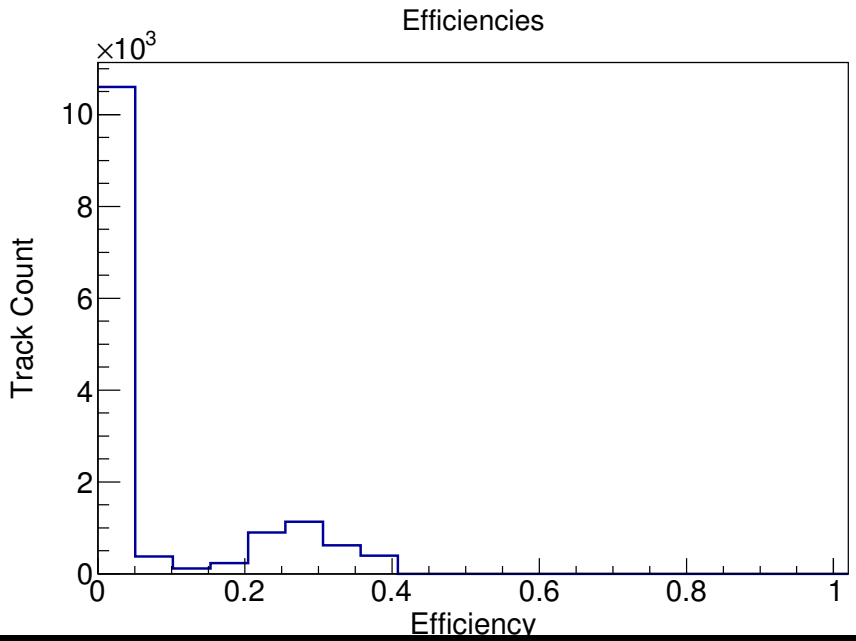
1. Generate uniform flux CC ν_e events with GENIE, filter for $1e^- + \mathrm{N}p$ final states
2. Reconstruct clusters with modified uboone offline .fcl script
3. Feed to a module I created to calculate purity and efficiency of reconstructed clusters

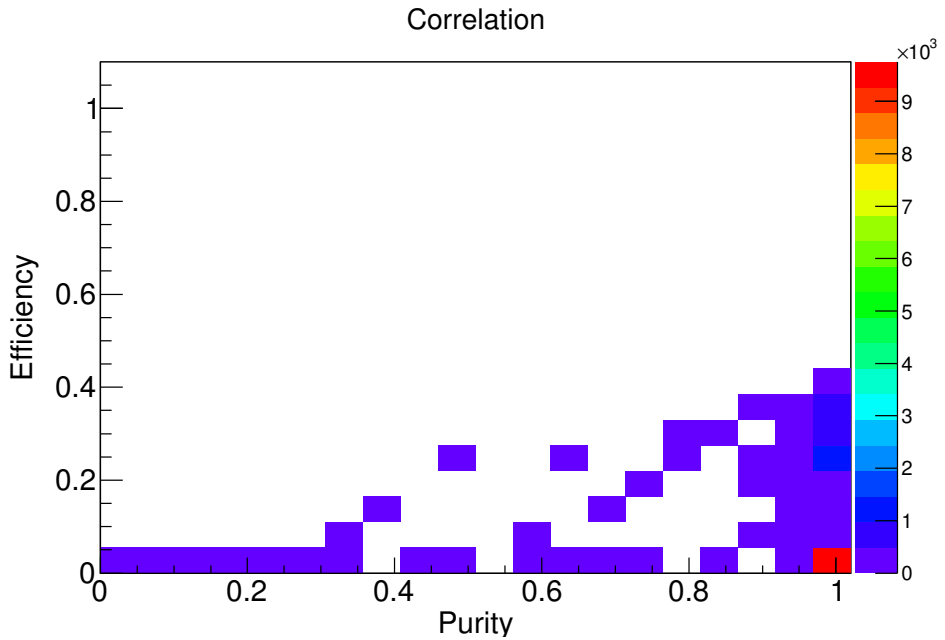
$$\text{Purity} = \frac{\#\text{ of hits from trackID in cluster}}{\text{total }\#\text{ of hits in cluster}}$$

$$\text{Efficiency} = \frac{\#\text{ of hits from trackID in cluster}}{\text{total }\#\text{ of hits for that trackID}}$$

Electrons

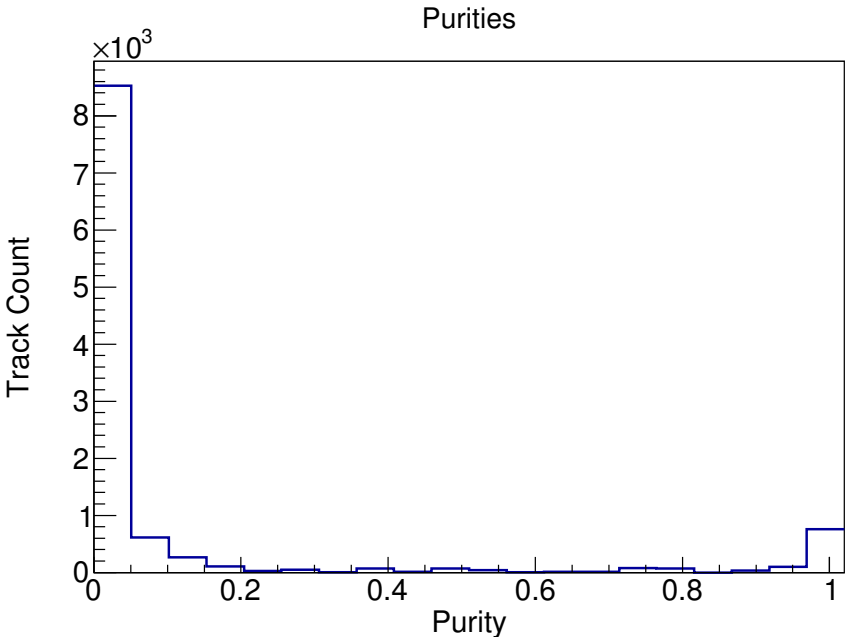


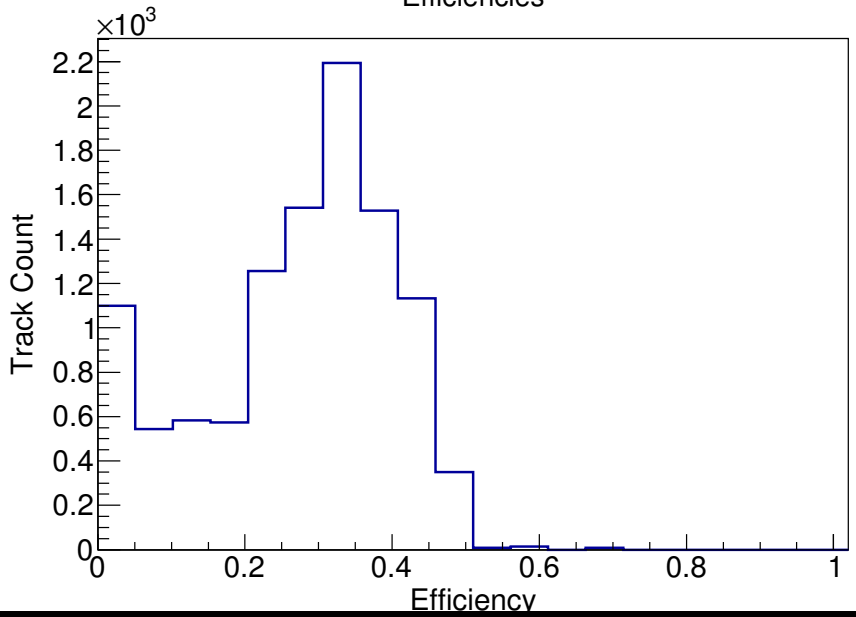


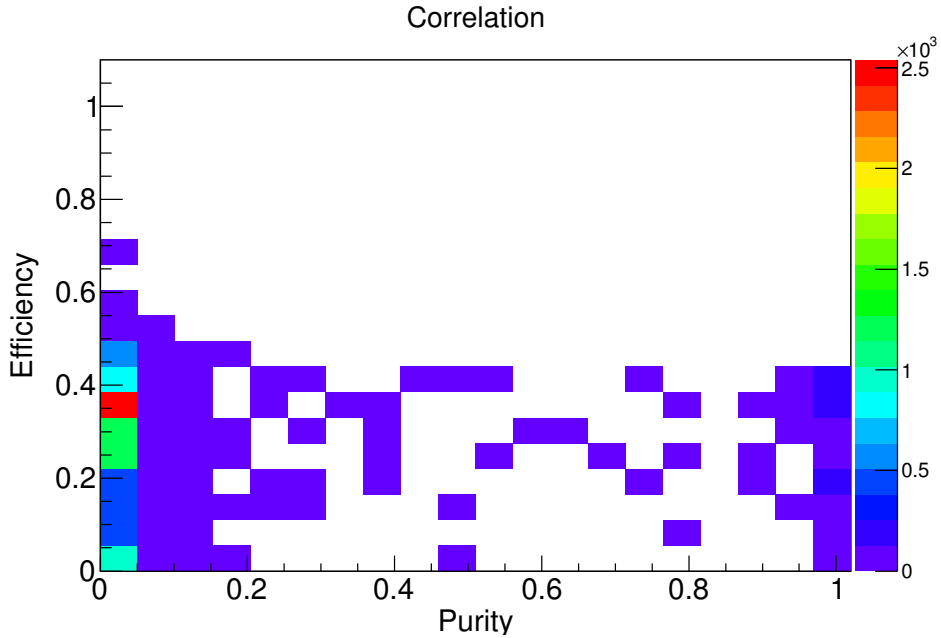


- 14365 electron tracks analyzed

Protons

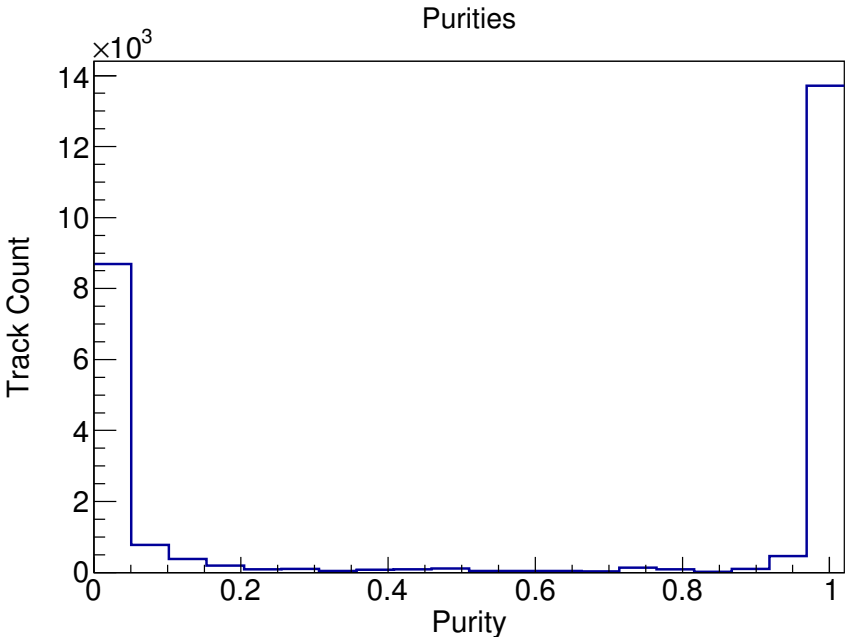


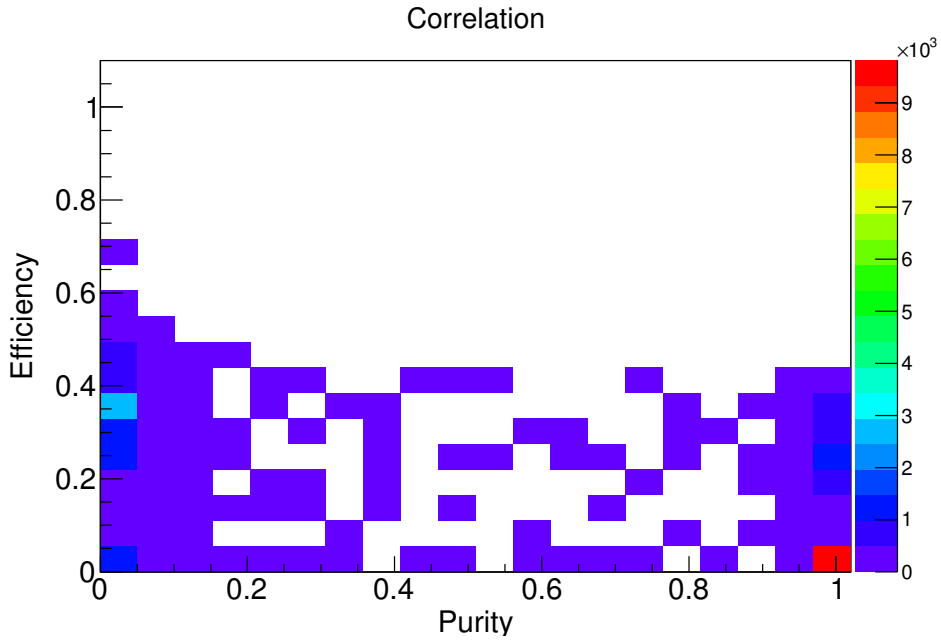




- 10831 proton tracks analyzed

All Tracks





- 25196 tracks analyzed in 91 clusters over 3 wire planes

Future & References

Future

- Compare with DBscan and ClusterCheater
- Get neutrino flux files working
- Test 2/3D track finding algorithm

References

[1] "*Quick overview on fuzzy clustering for the March collaboration meeting*"
http://microboone-docdb.fnal.gov:8080/cgi-bin/ShowDocument?docid=2439