

# UK Pandora Efforts



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UNIVERSITY OF  
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# Introduction

- After a bit of a change of the guard, we are starting to ramp up our new activities in Pandora
- I wanted to give an overview of these efforts today to show what we are doing
- We can expect to hear more on these topics in these meetings early next year



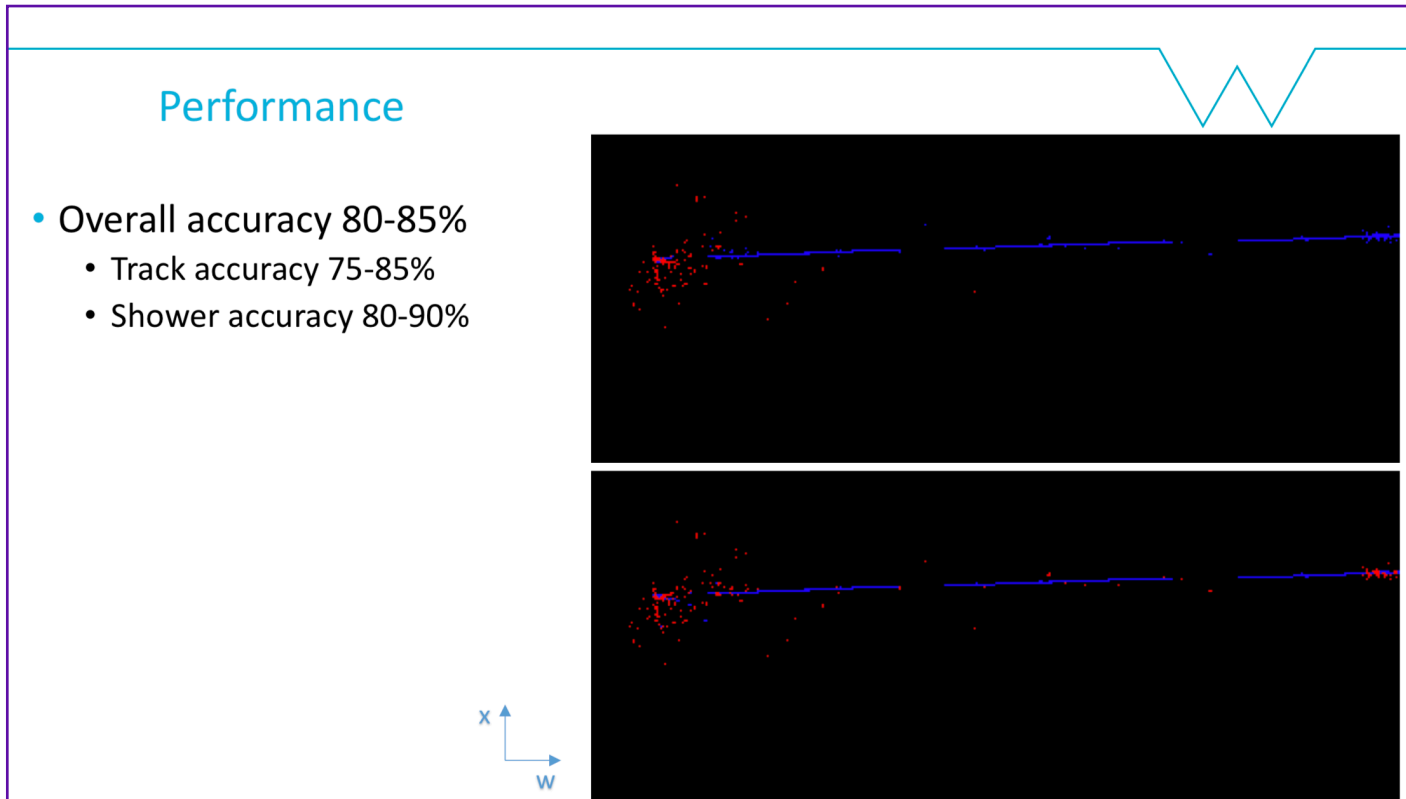
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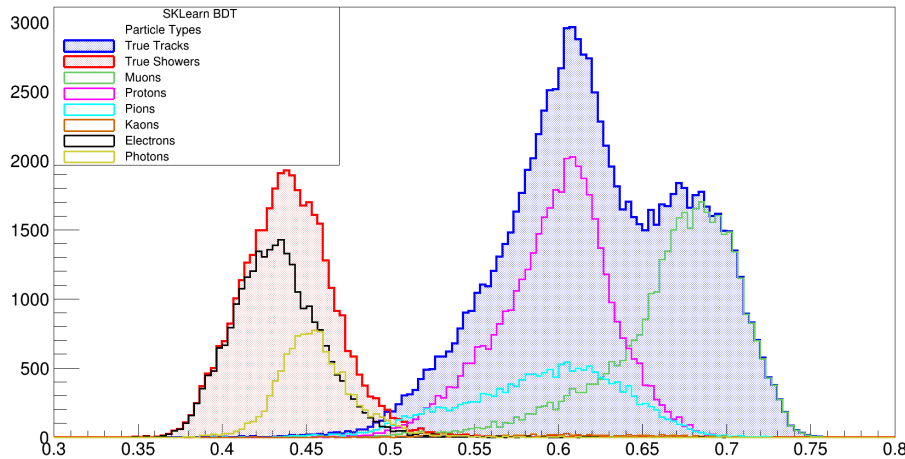
# Ongoing work

- Current topics include:
  - Track / Shower hit discrimination with semantic segmentation
  - Track / Shower discrimination using machine learning
  - Using charge information to improve 2D/3D matching
  - Improving vertexing with machine learning
  - Improving 3D hit creation
  - Analysis utilities
- These developments are aimed at the DUNE FD, but will be tested on ProtoDUNE-SP data and MC

- Goal is to improve clustering by tagging hits as track or shower like early in the reconstruction chain
  - Use semantic segmentation to classify hits



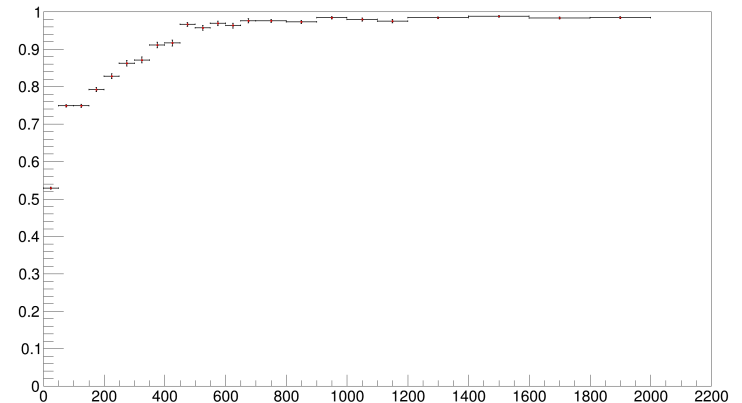
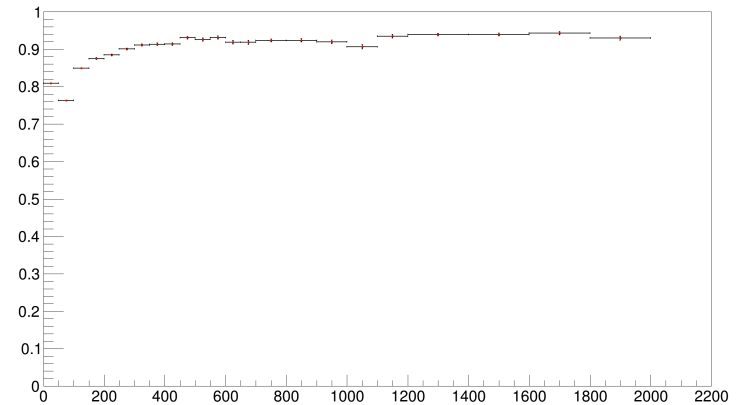
- Use machine learning to correctly identify particles as tracks or showers



COMPLETENESS AND PURITY  $\geq$  80%

Note: cut applied at 0.5 for efficiencies

## Efficiency vs nHits

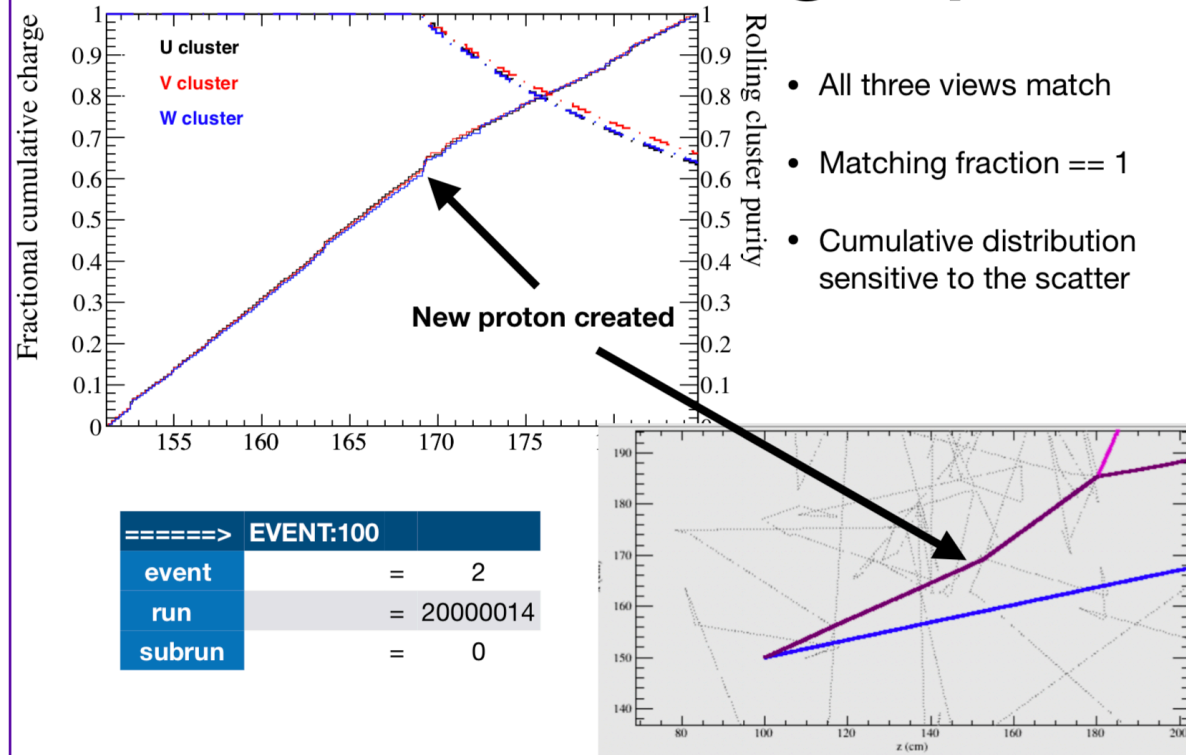


- Pandora currently makes little use of charge information
- Can provide an orthogonal source of information

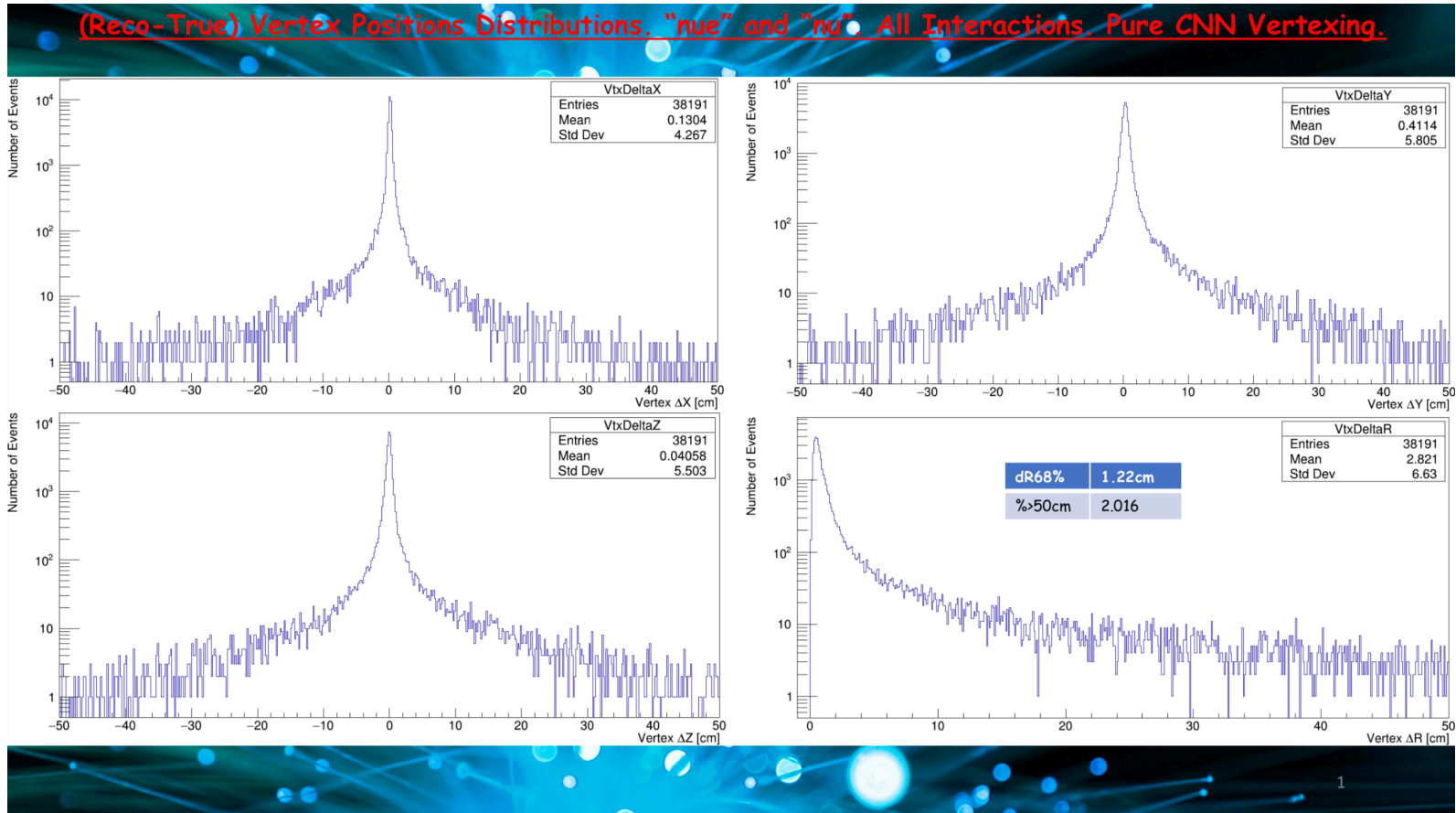
## Lots of potential use cases

- Enhancing the view to view matching
- Feature identification
- Single view mis-clustering
- Cluster splitting
- Other stuff

## Correct matching triplet



- Use a CNN to perform vertexing - outperforms current BDT
- Can combine with BDT approach for best performance



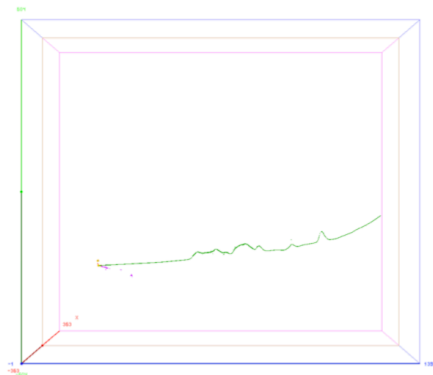
- 3D hit creation generally works well, but a number of issues will be addressed

## Current Issues

However, when the 3D hit creation fails, it can fail fairly dramatically. Some of the failures are simple to restrict, by using more detector knowledge, and others issues are caused by the 3D reconstruction pipeline.

The issues that need addressing (in no particular order):

- Detector geometry is not considered when making 3D hits.
- Different algorithm outputs can be combined, creating disjoint trajectories.
- Compounding of issues by smoothing.
- Addition of more sophisticated algorithms for 3D hit production.





- Produce utilities to provide easy access to the Pandora particle hierarchy
  - These functions help users access the track or shower associated to the particle, etc
- Utility classes will exist for most recob objects
  - PFParticles
  - Tracks
  - Showers
  - Clusters
  - Slices
  - Spacepoints
- Similar utilities proved successful in ProtoDUNE-SP

# Summary

- The UK Pandora effort has many on-going activities
  - These will continue for the next seven years!
- Many improvements planned to all steps of the reconstruction chain
  - These improvements will be benchmarked on DUNE FD simulation as well as ProtoDUNE-SP data and simulation
- Watch for individual presentations on each of the different topics early in the new year