

# Updates on $\nu_e$ CC Selection

Mike Wallbank  
20/3/2017

# Intro

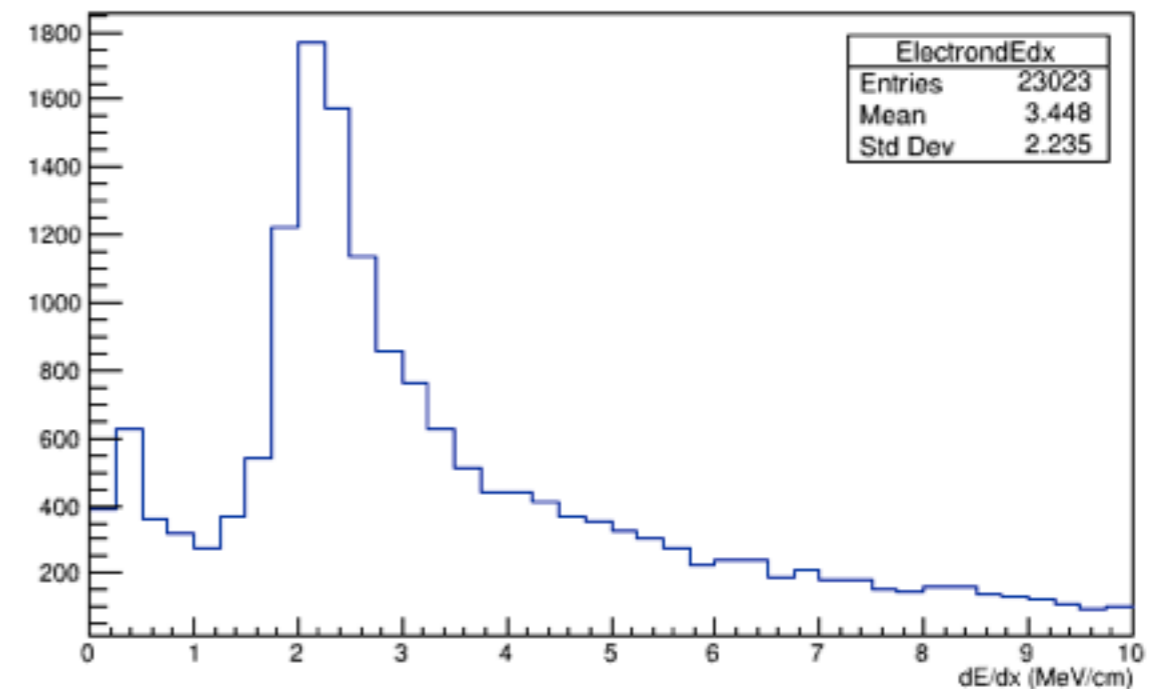
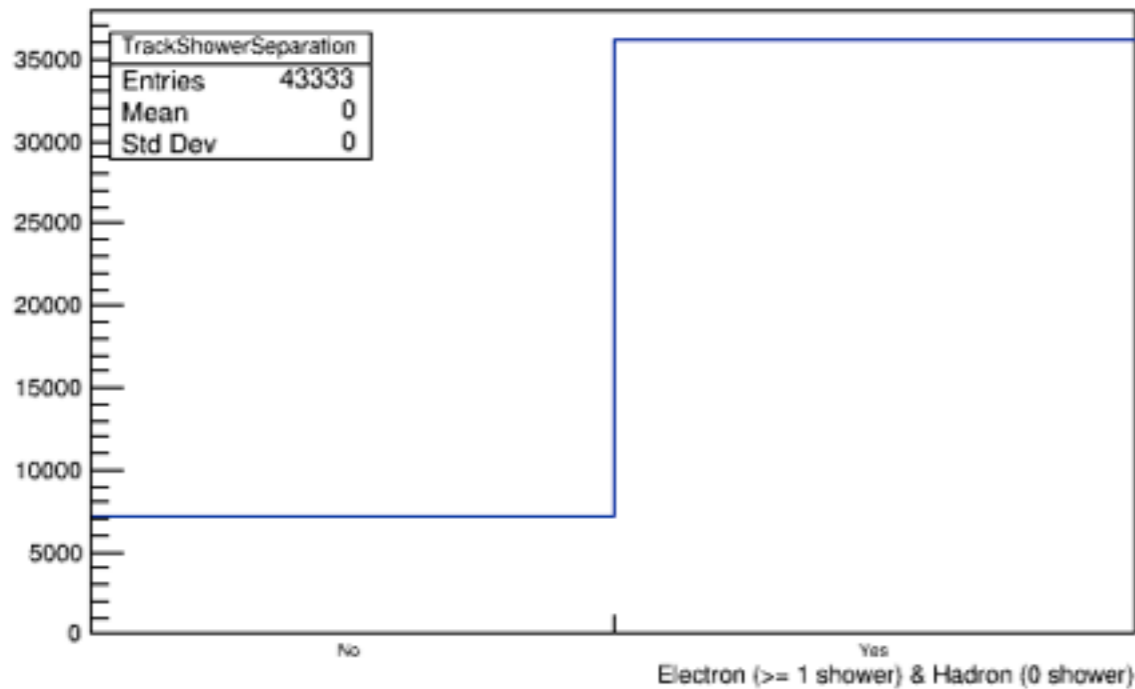
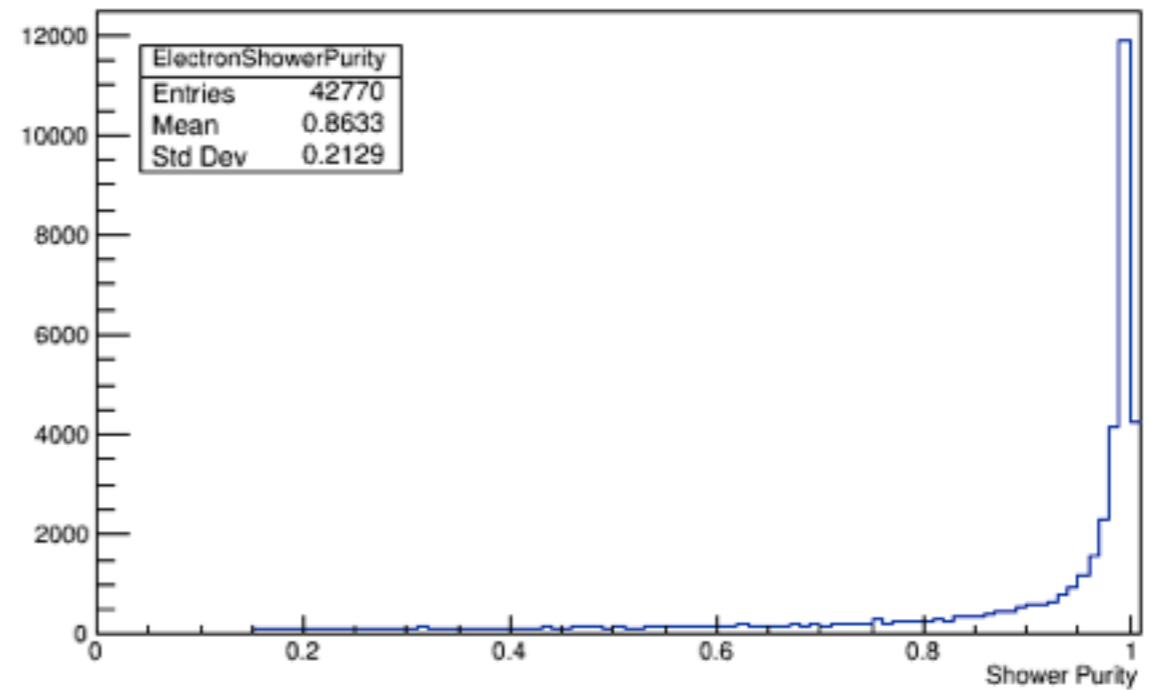
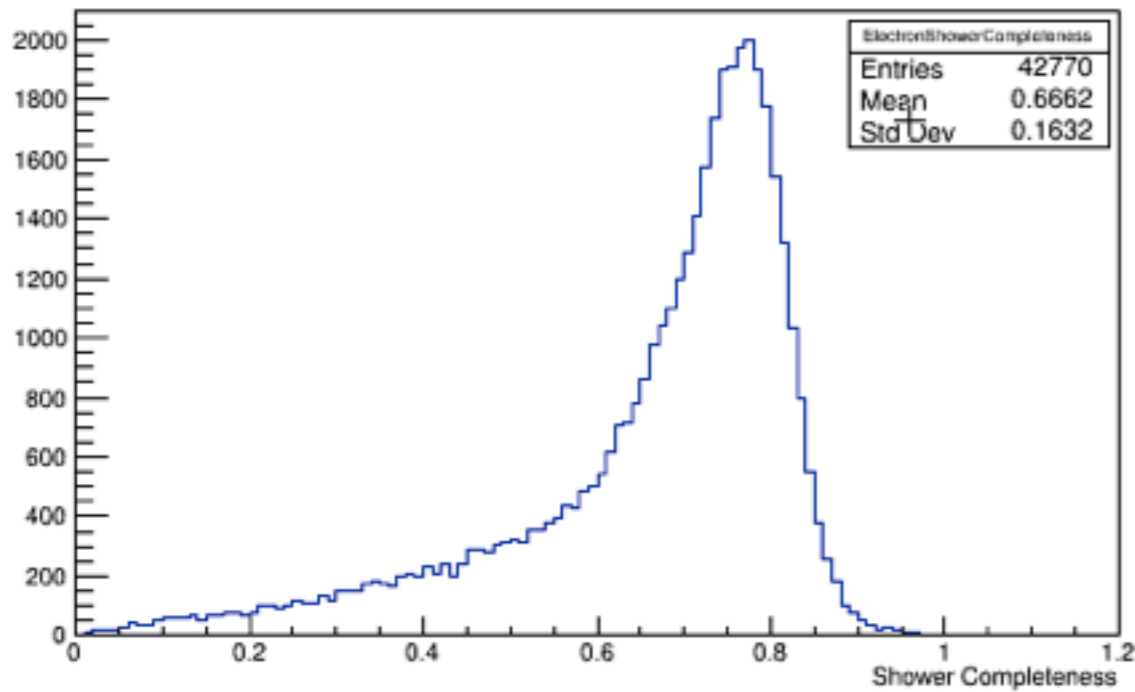
- Gave an update at the CM ([link](#)), not much has changed in the selection since.
- Starting to better characterise the selection;
  - Performance of the reconstruction.
  - Performance of the selection.
- We mentioned last time I should try the reconstruction given the new version of Pandora — however, this is currently broken (see other talks, I believe!). All Pandora has been taken from MCC7 (now nearly 6 months old).
- Bumped up to v06\_26\_00.
  - Includes tracking bug in the BDT fix.

# Reco Chains

- Two reconstruction chains I'm considering:
  - Develop: Pandora (track-shower separation) —> EMShower (showers);
  - New: TrackShower (new track-shower separation) —> BlurredCluster (shower clusters) —> EMShower (showers).
- The main problem is convincing track/shower separation.
- I have been working on this since last September and have developed the new separation algorithm in the second case.
- Will compare these two chains for the rest of the talk...

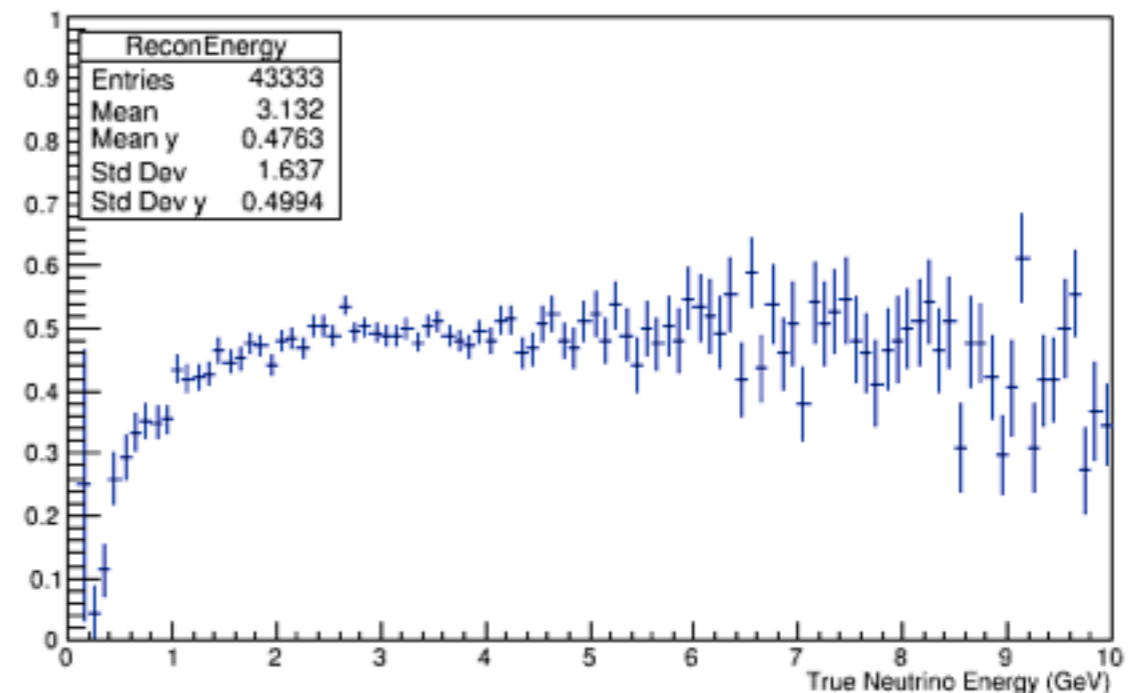
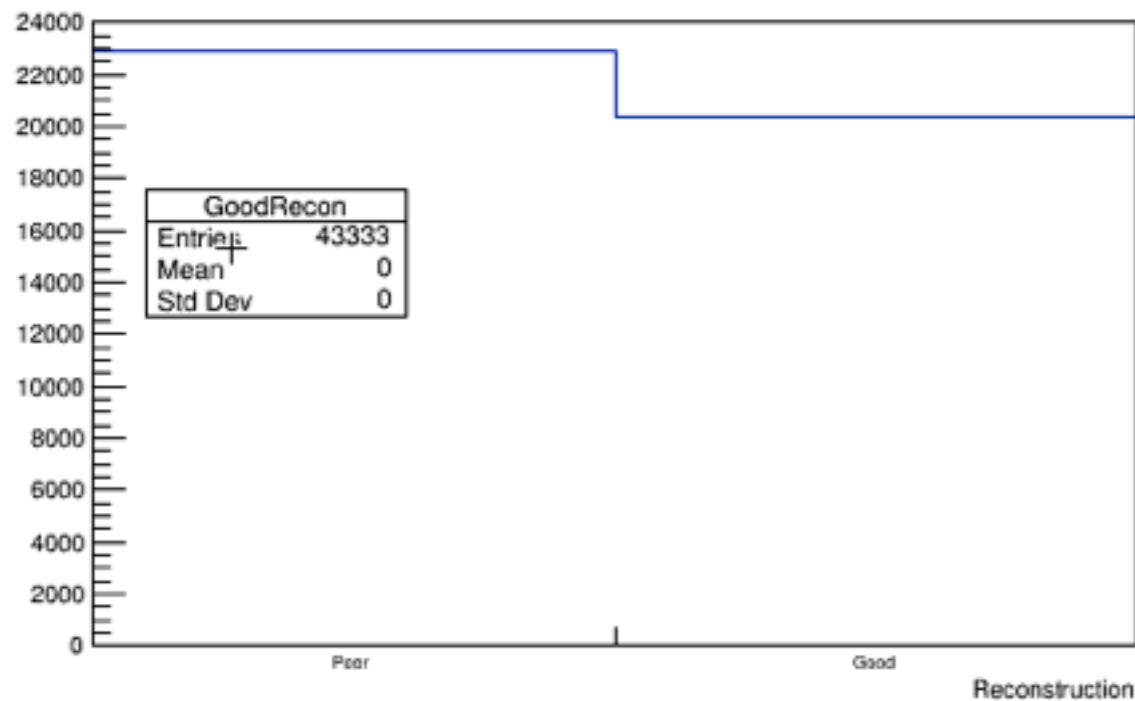
# New: TrackShowerSep

- Reconstruction:



# New: TrackShowerSep

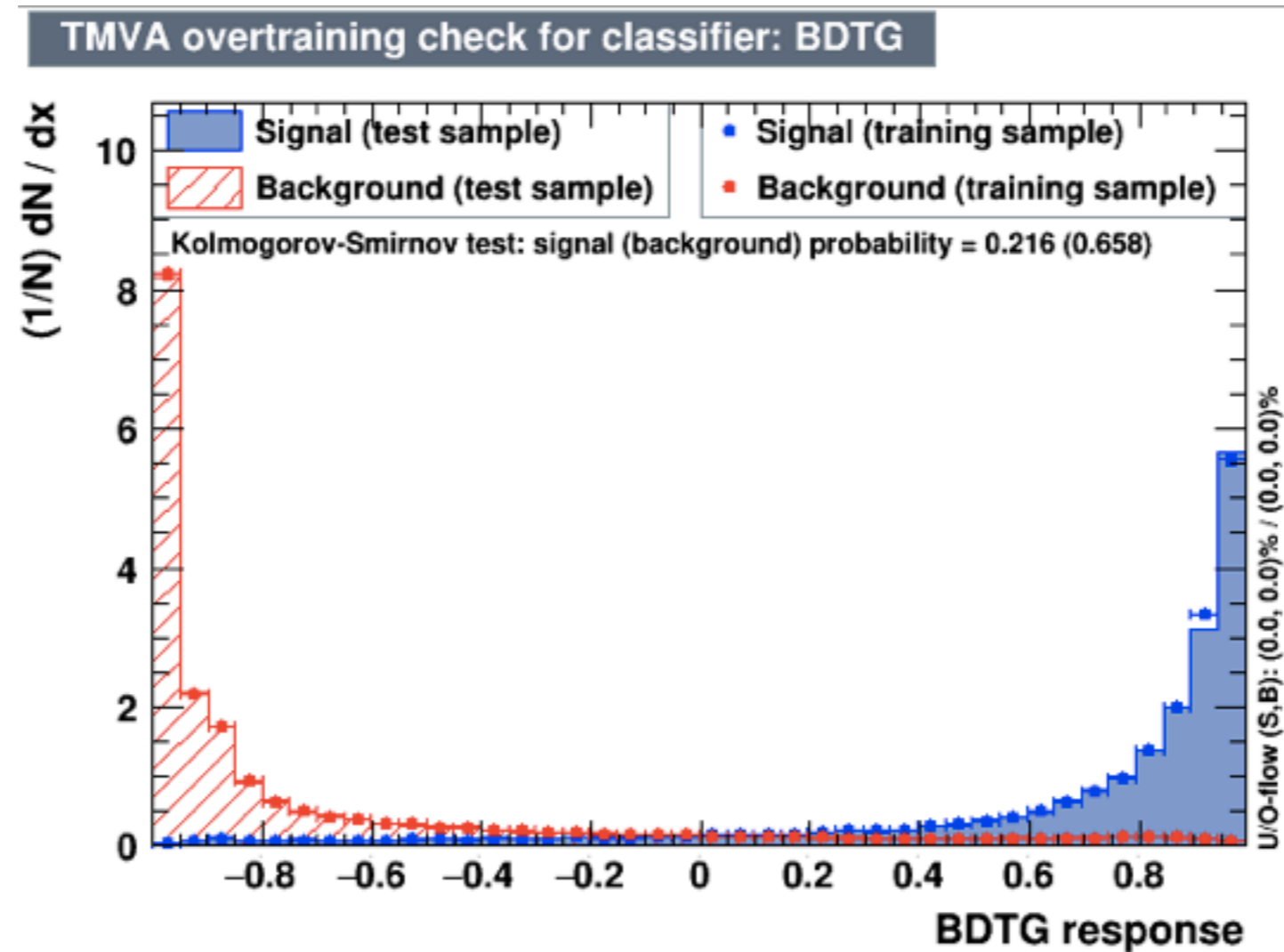
- Reconstruction:
- Good shower: start point < 10 cm from true start, direction < 45 degs, completeness at least 50%.
- Basic track shower recon: electron and longest hadron vertex track separated.  
Full track shower separation: electron and all hadron vertex tracks separated.
- Good reconstruction: basic separation and good shower.



Numbers are on slide 14!

# New: TrackShowerSep

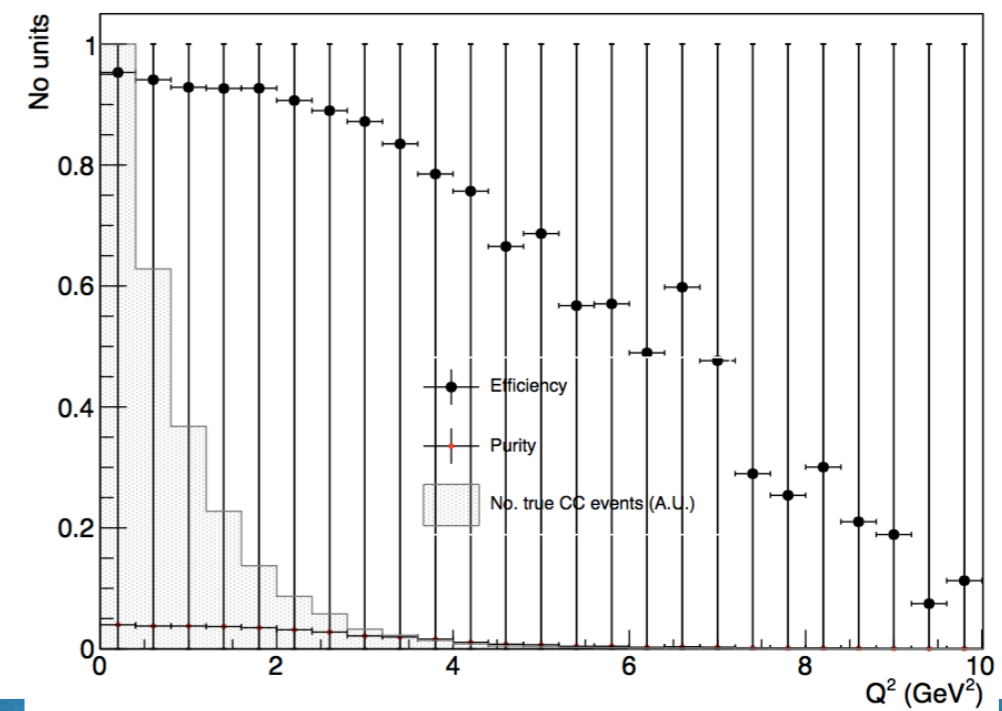
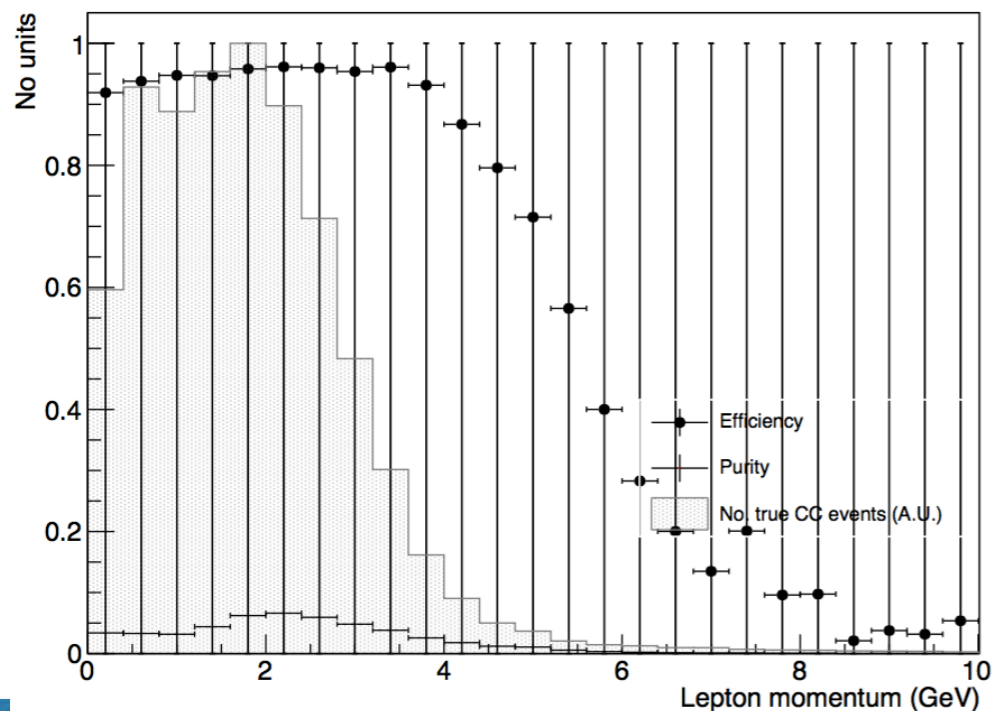
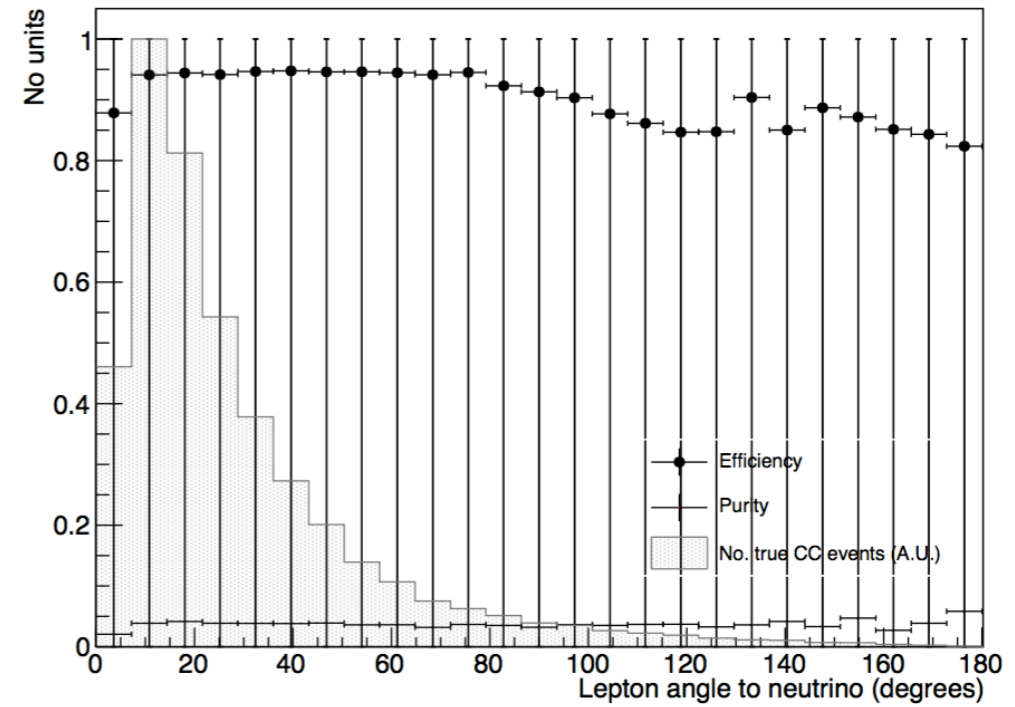
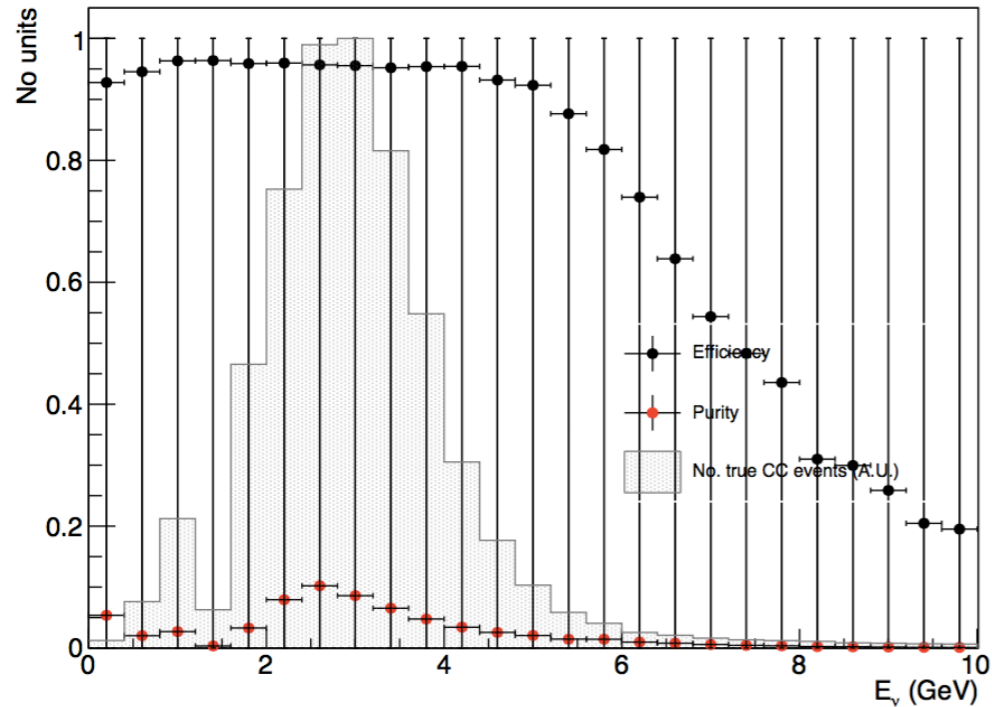
- Selection:



- Cut at 0.8: efficiency 21359/43627 (49%), purity 21359/27078 (79%).

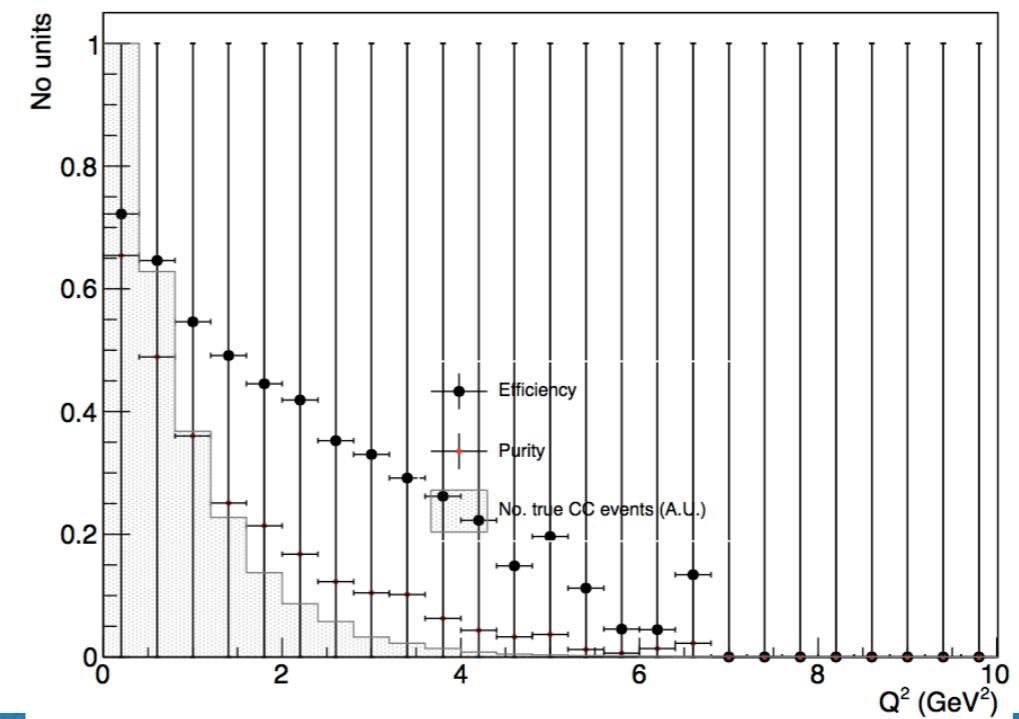
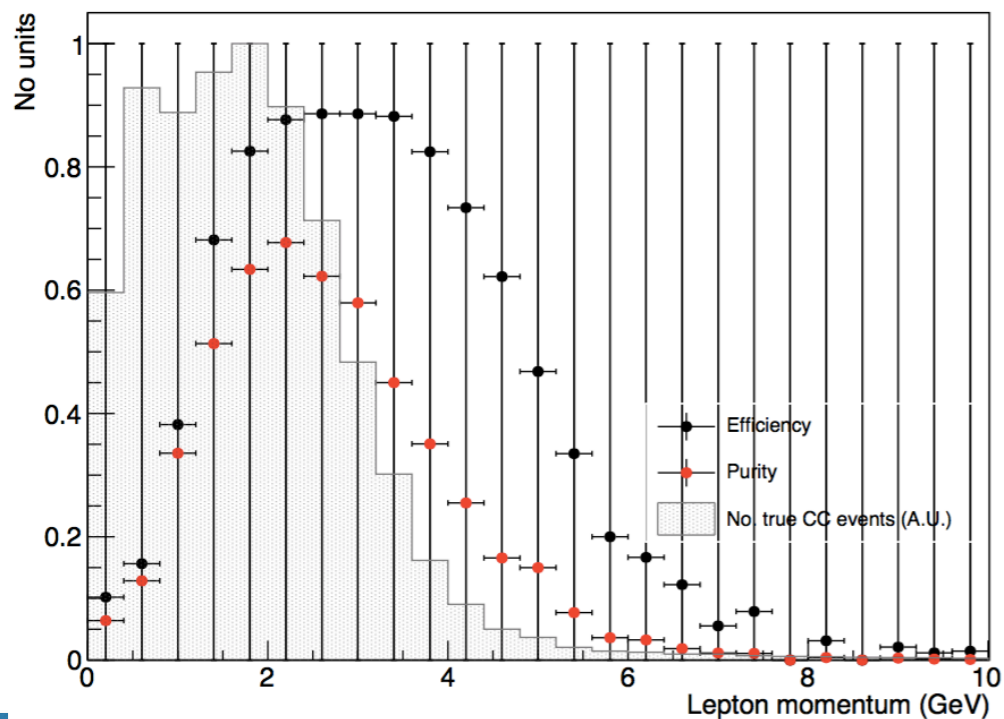
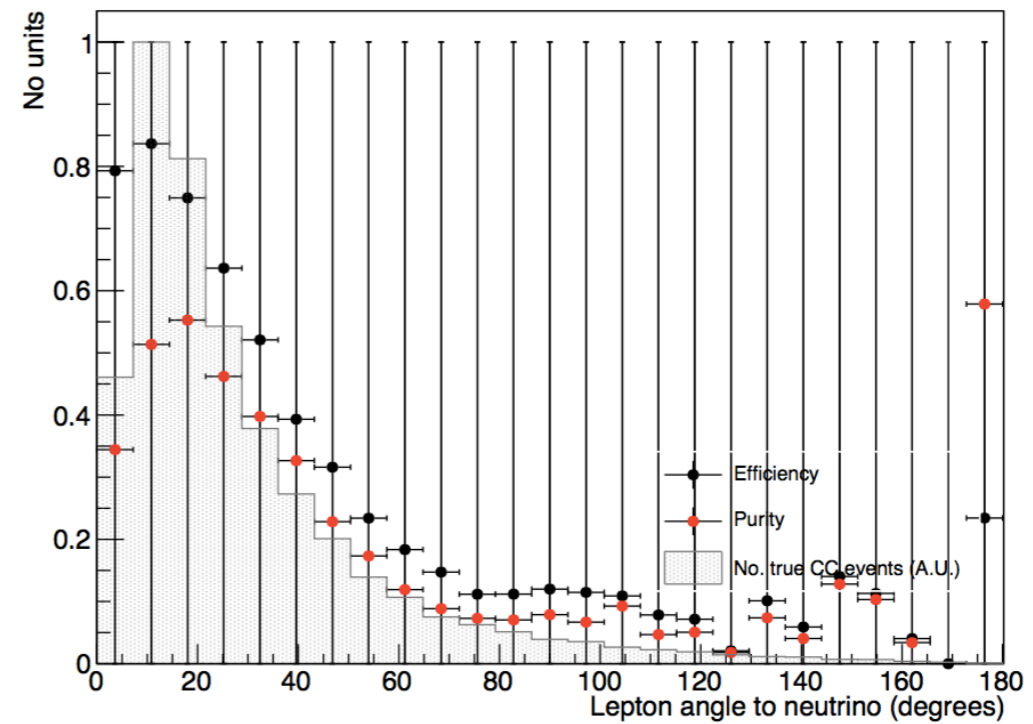
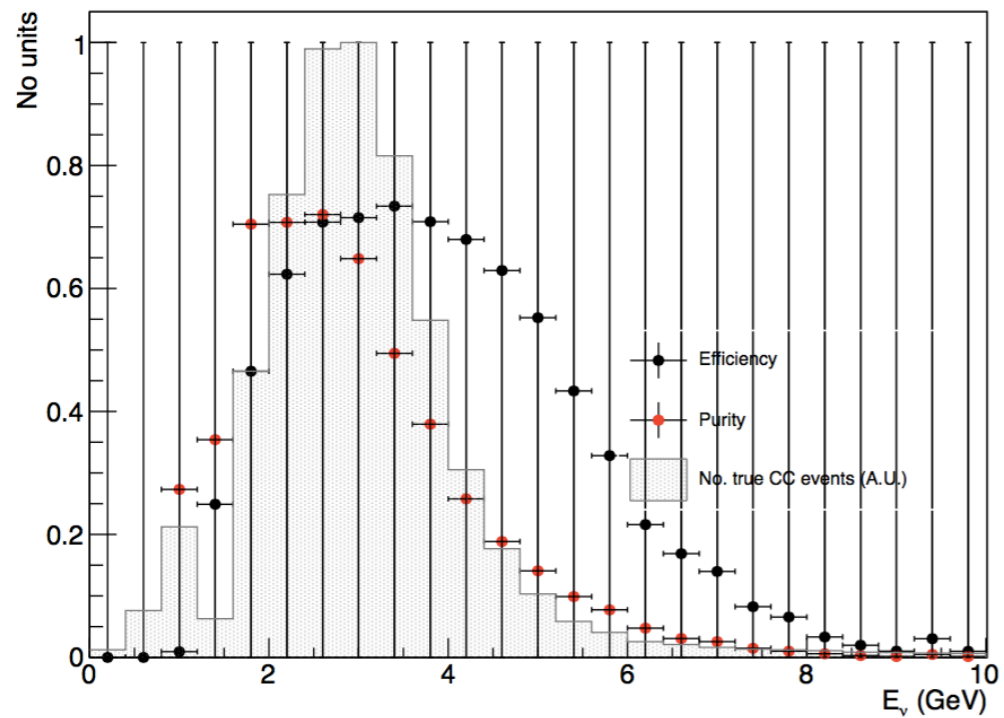
# New: TrackShowerSep

- Before selection: (sorry about the errors, need to understand what's going on...)



# New: TrackShowerSep

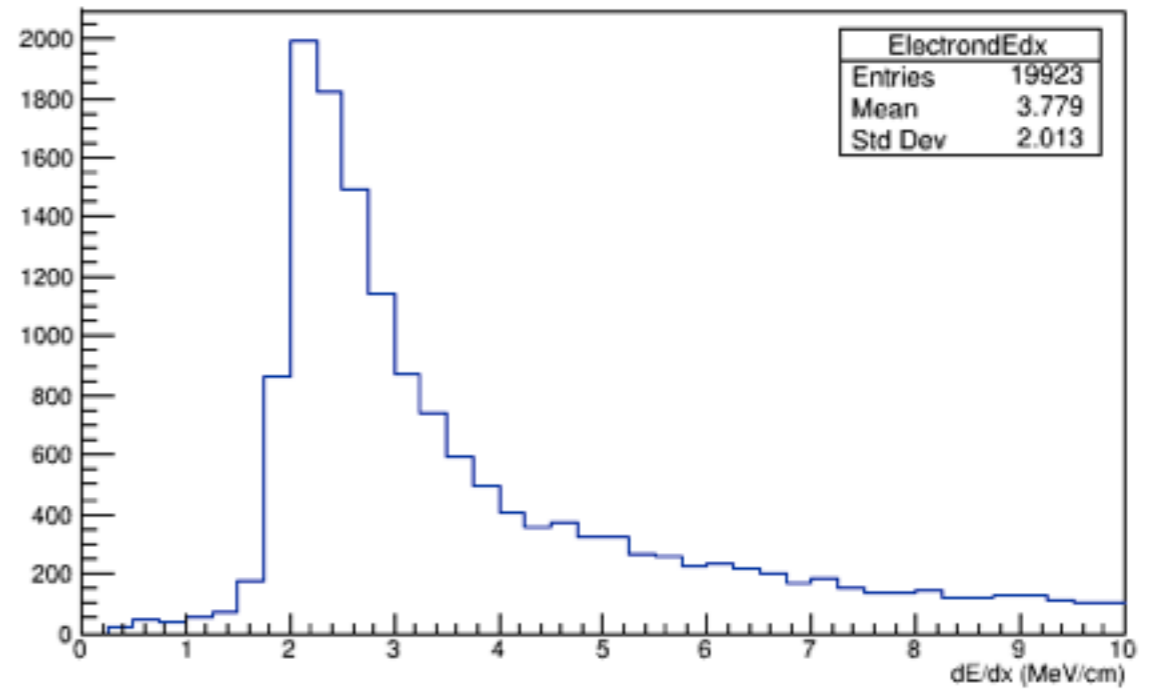
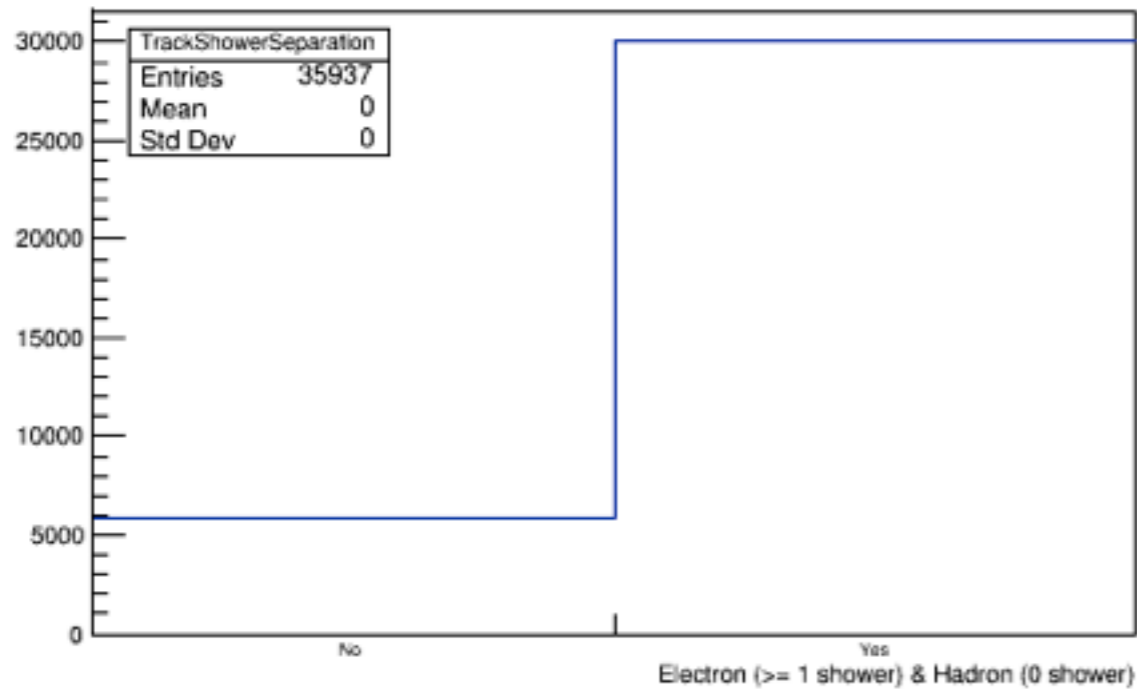
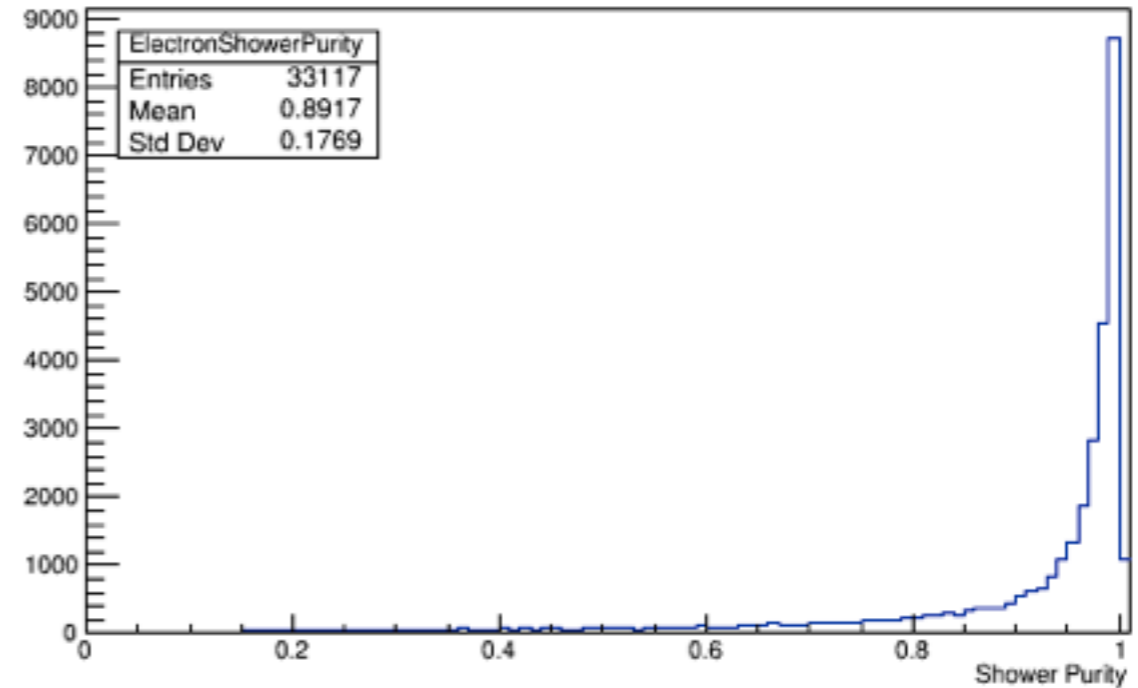
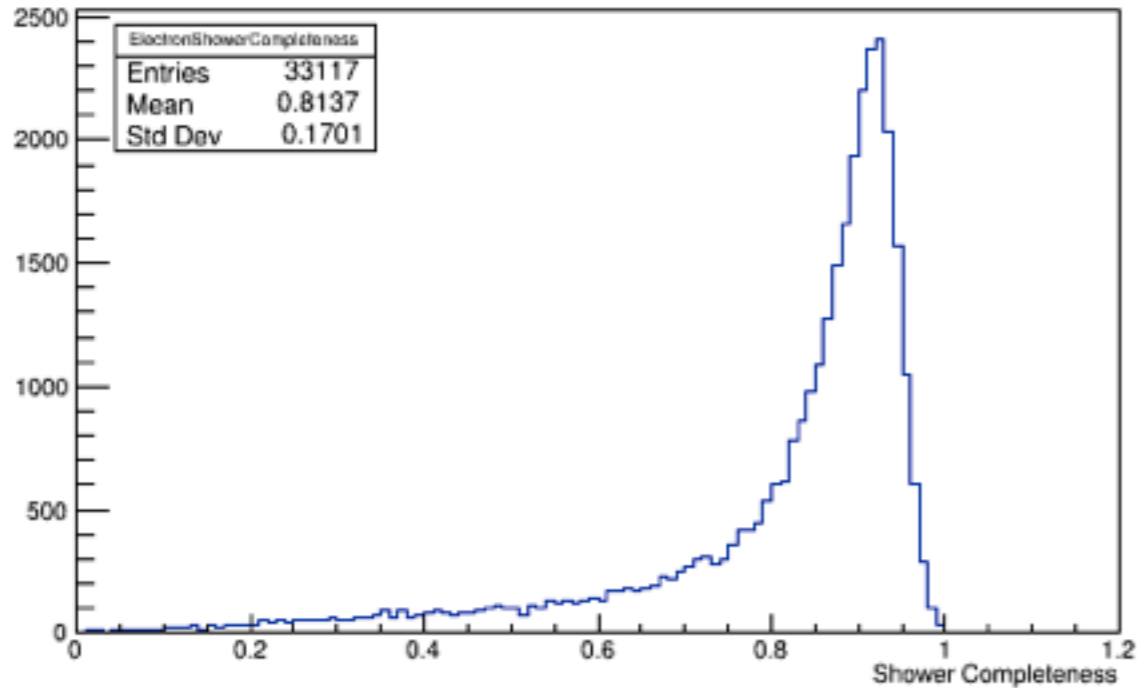
- After selection:





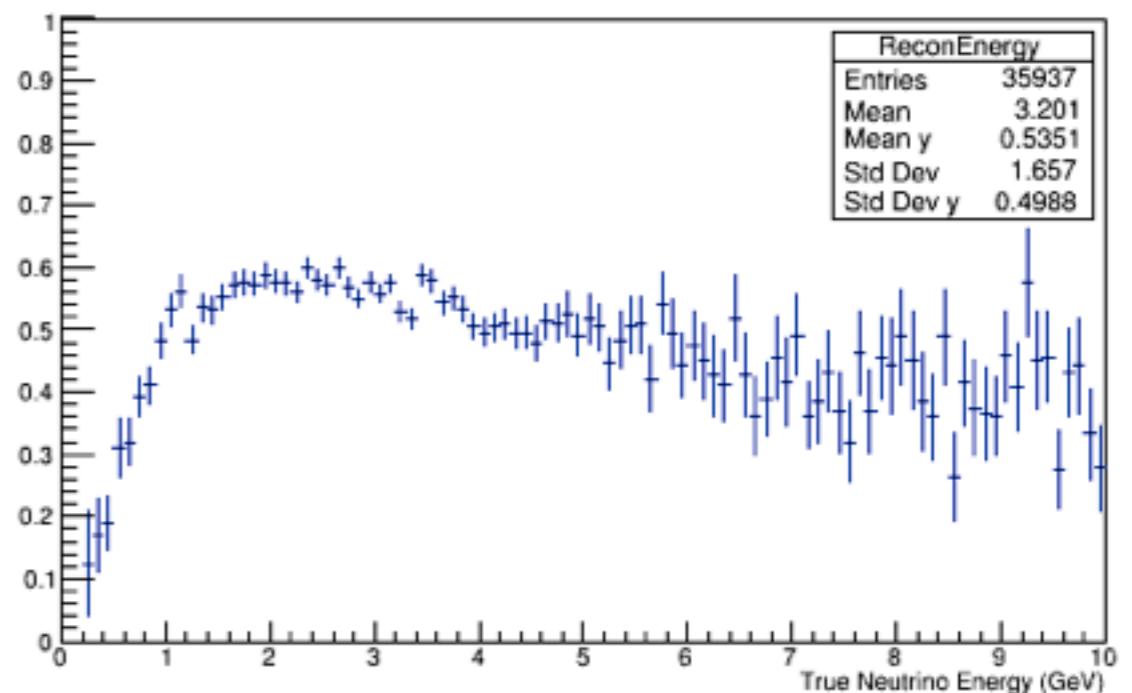
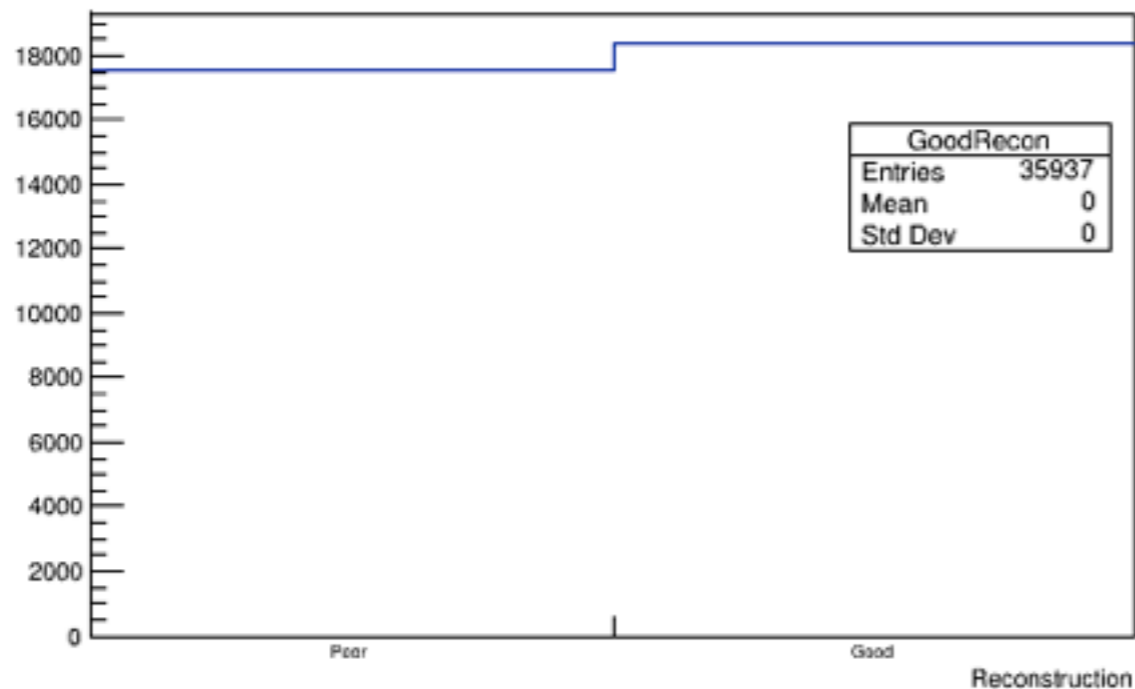
# Using Pandora

- Reconstruction:



# Using Pandora

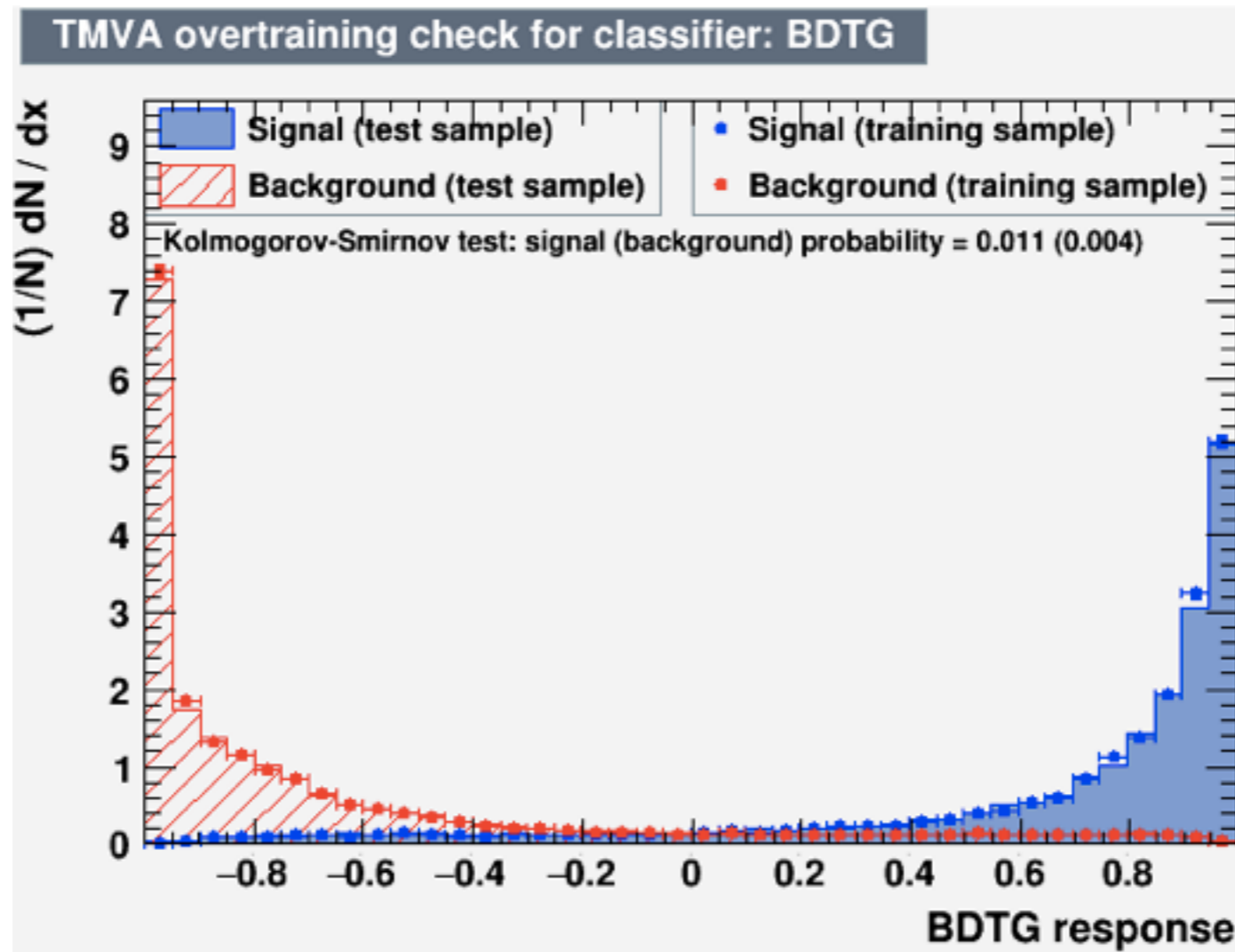
- Reconstruction:
- (Same definitions of 'good shower', 'separation' and 'good reconstruction' as slide 5.)



Again, slide 14 for numbers!

# Using Pandora

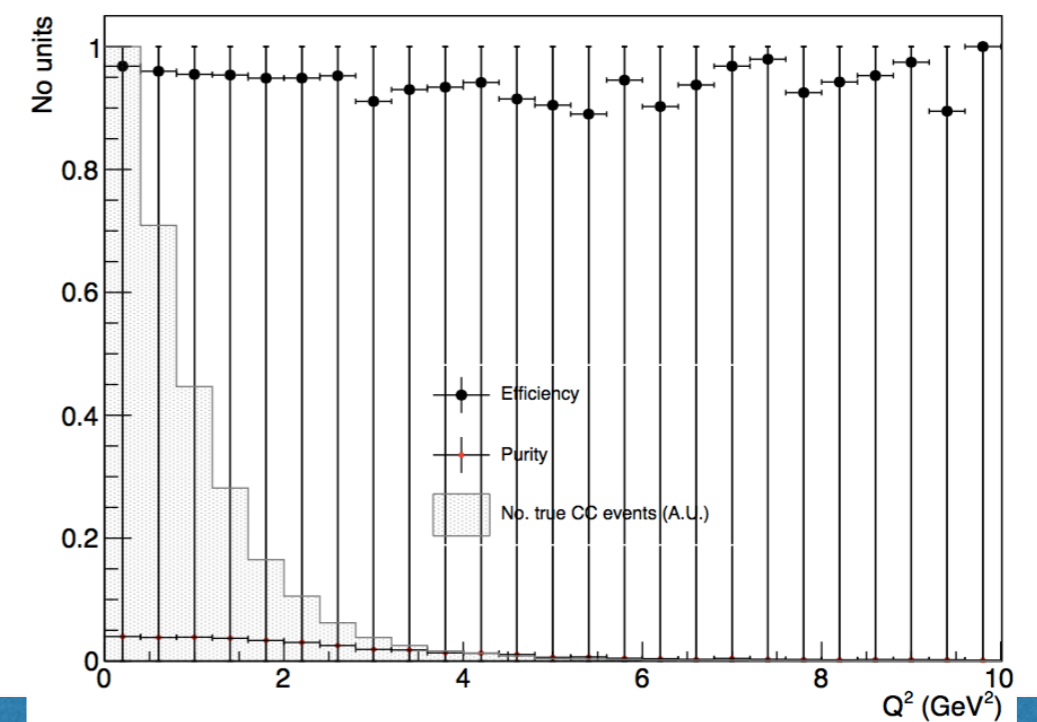
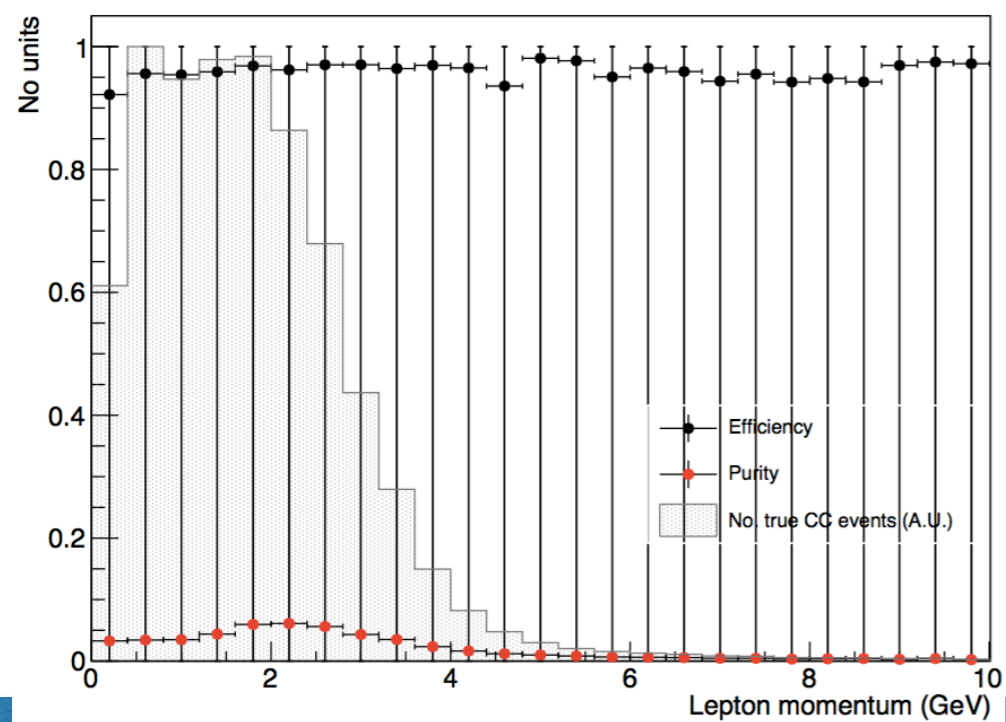
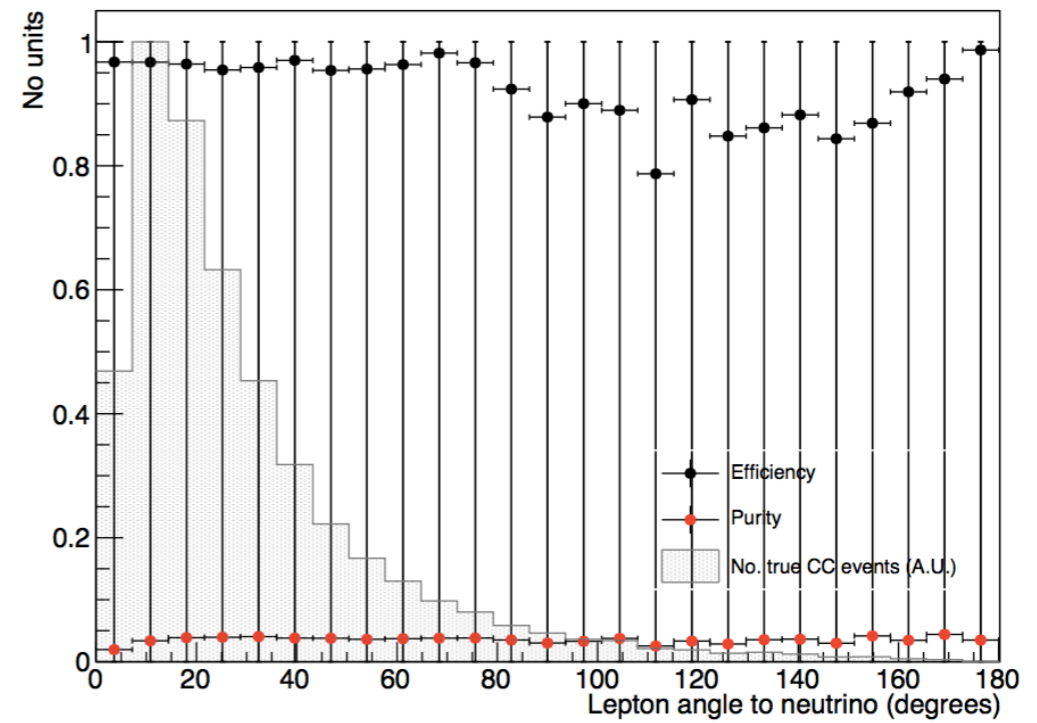
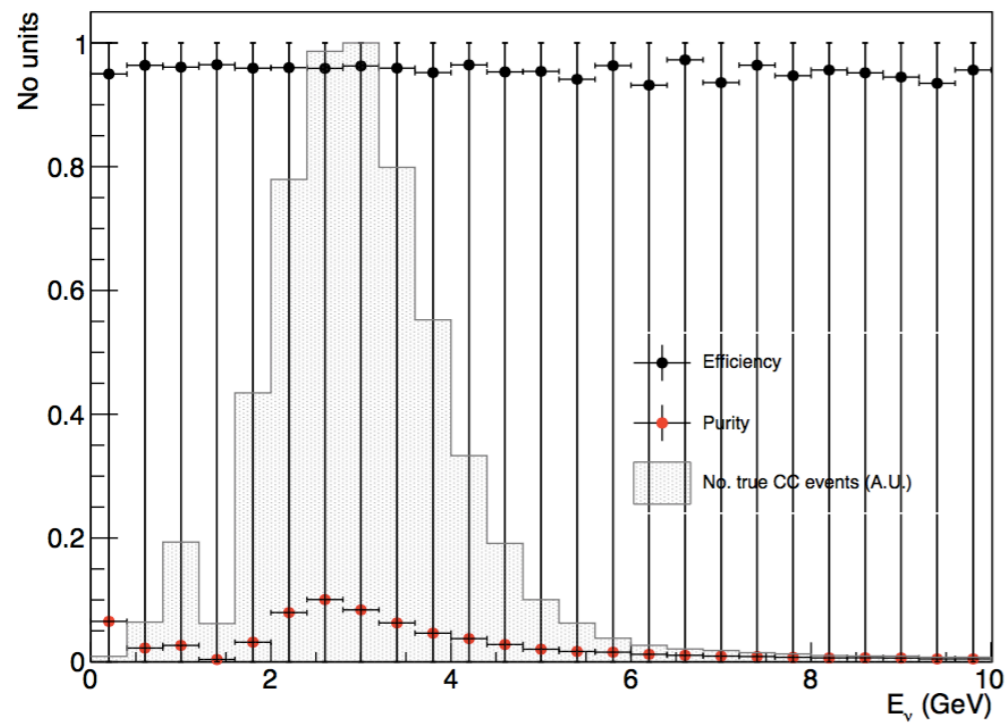
- Selection:



- Cut at 0.8: efficiency 18759/36187 (52%), purity 18759/24216 (77%).

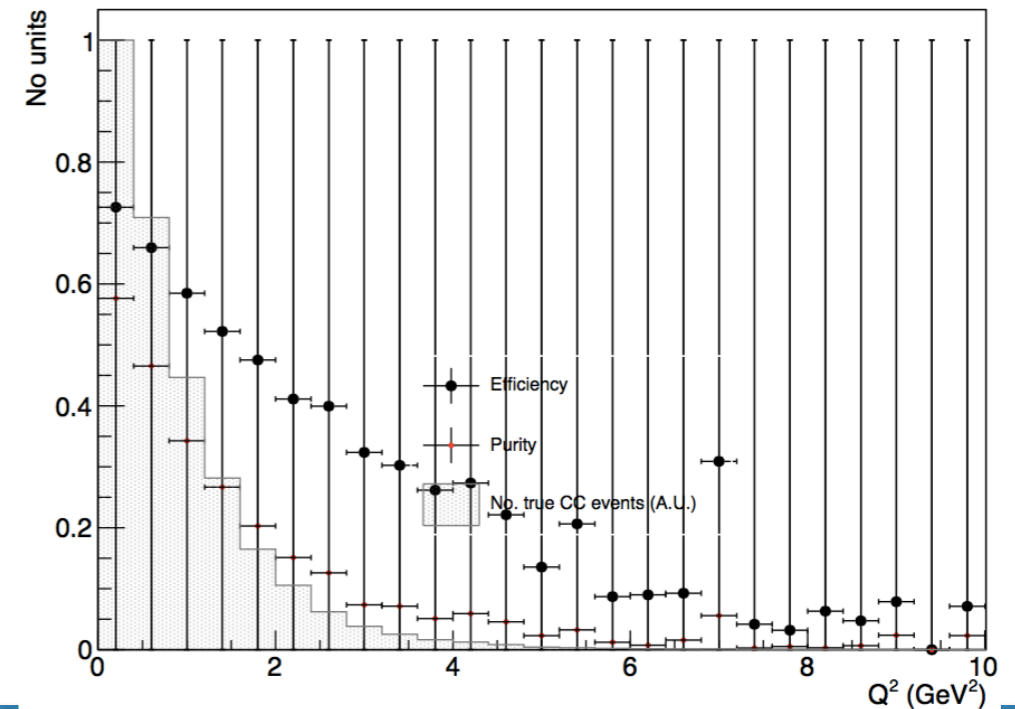
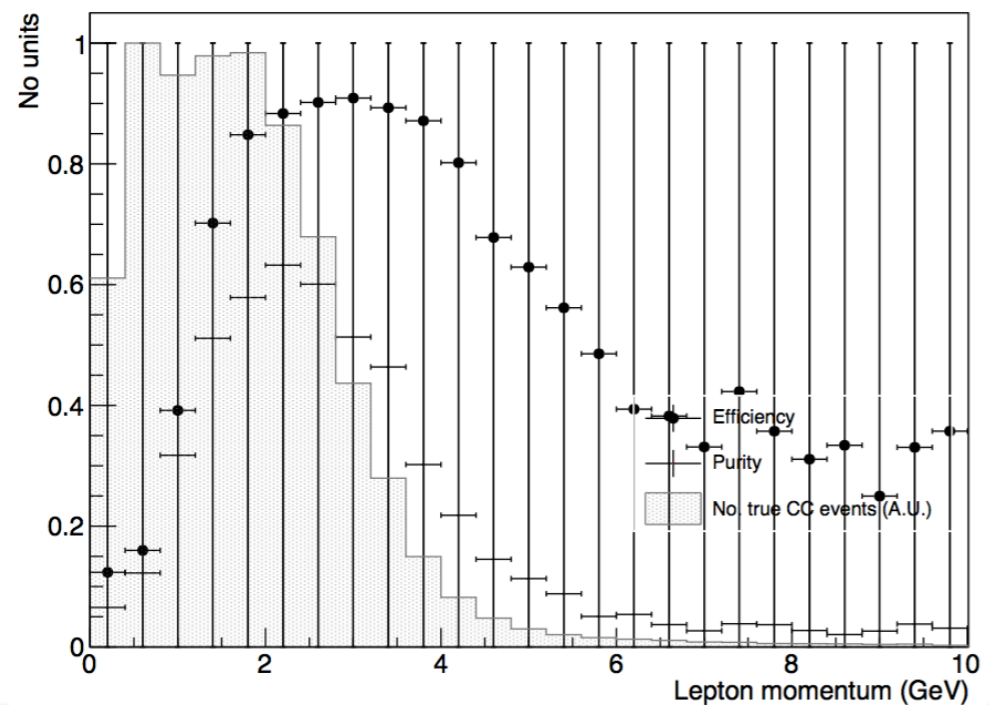
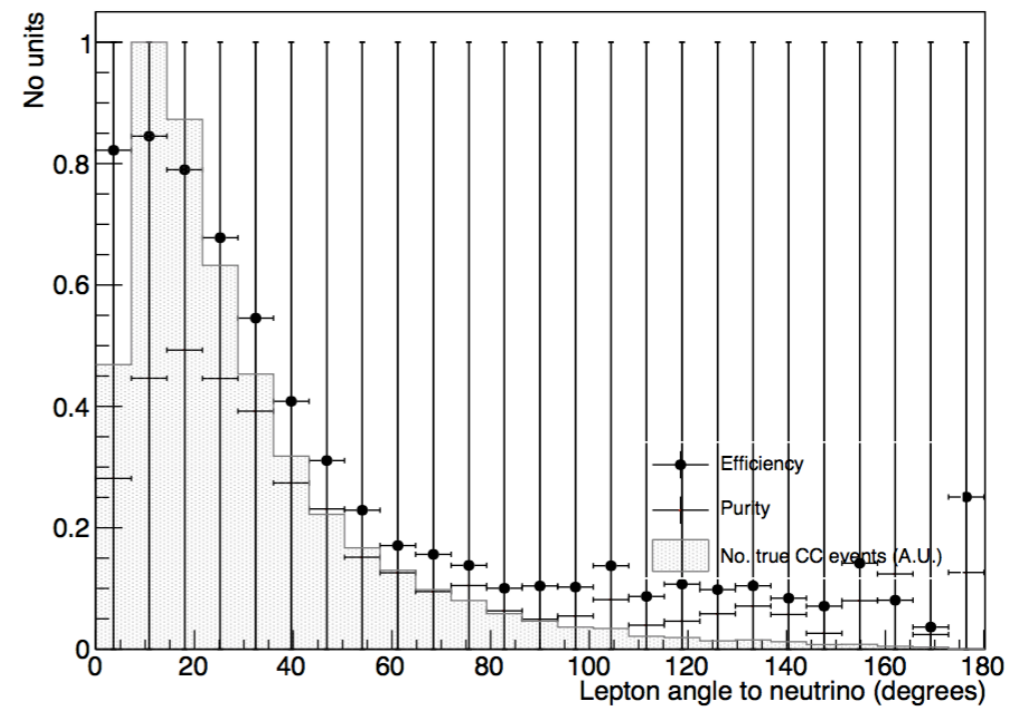
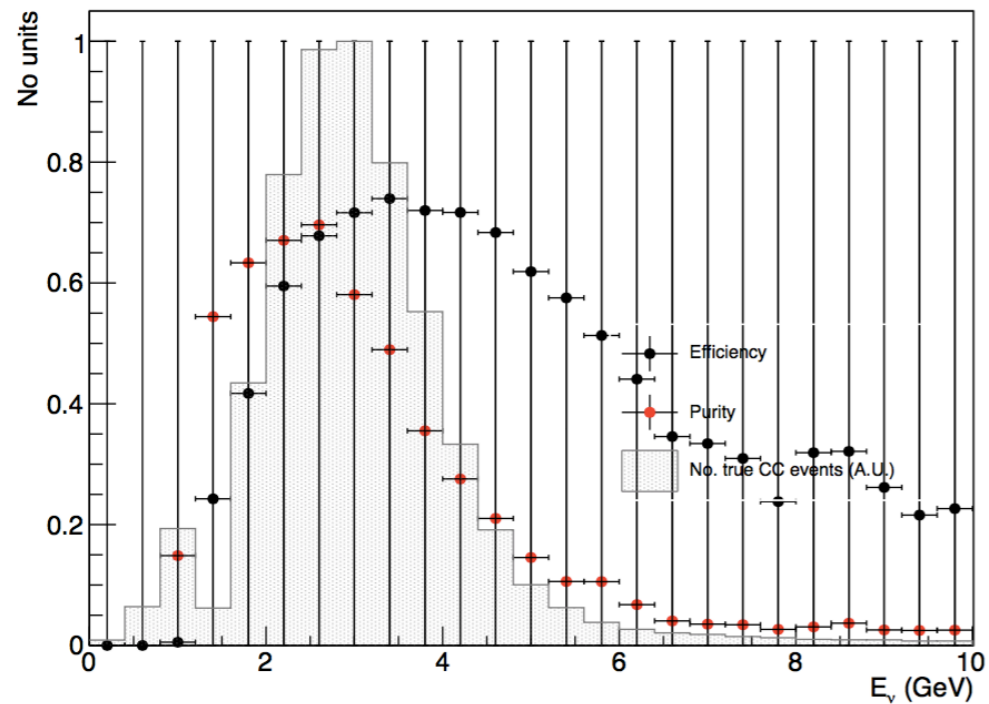
# Using Pandora

- Before selection:



# Using Pandora

- After selection:



# Comparison

- Reconstruction:

|                                   | TrackShowerSep | Pandora     |
|-----------------------------------|----------------|-------------|
| Number of CC events               | 43942          | 36509       |
| 'Good shower'                     | 23023 (52%)    | 19923 (55%) |
| <i>Poor shower – start point</i>  | 17891          | 10636       |
| <i>Poor shower – direction</i>    | 9831           | 9542        |
| <i>Poor shower – completeness</i> | 6367           | 2477        |
| Basic track shower separation     | 36200 (82%)    | 30099 (82%) |
| Full track shower separation      | 32785 (75%)    | 29101 (80%) |
| Good reconstruction               | 20399 (46%)    | 18391 (50%) |
| Very good reconstruction          | 18971 (43%)    | 17921 (49%) |

- Selection (untuned):

|                | Efficiency | Purity |
|----------------|------------|--------|
| TrackShowerSep | 49%        | 79%    |
| Pandora        | 52%        | 77%    |

# Things I Would Like To Do

- Run the chain which uses Pandora for track/shower separation when all issues are fixed.
- Try to see what's going on in the selection!
  - Characterise mva variables for different neutrino energies.
- There are so many issues apparently present in the selection — it appears so biased!  
Don't really know where to start with all this.
- Find a better way of tuning the cut... Dom spoke about this last time.
- Suggestions on next steps will be much appreciated!

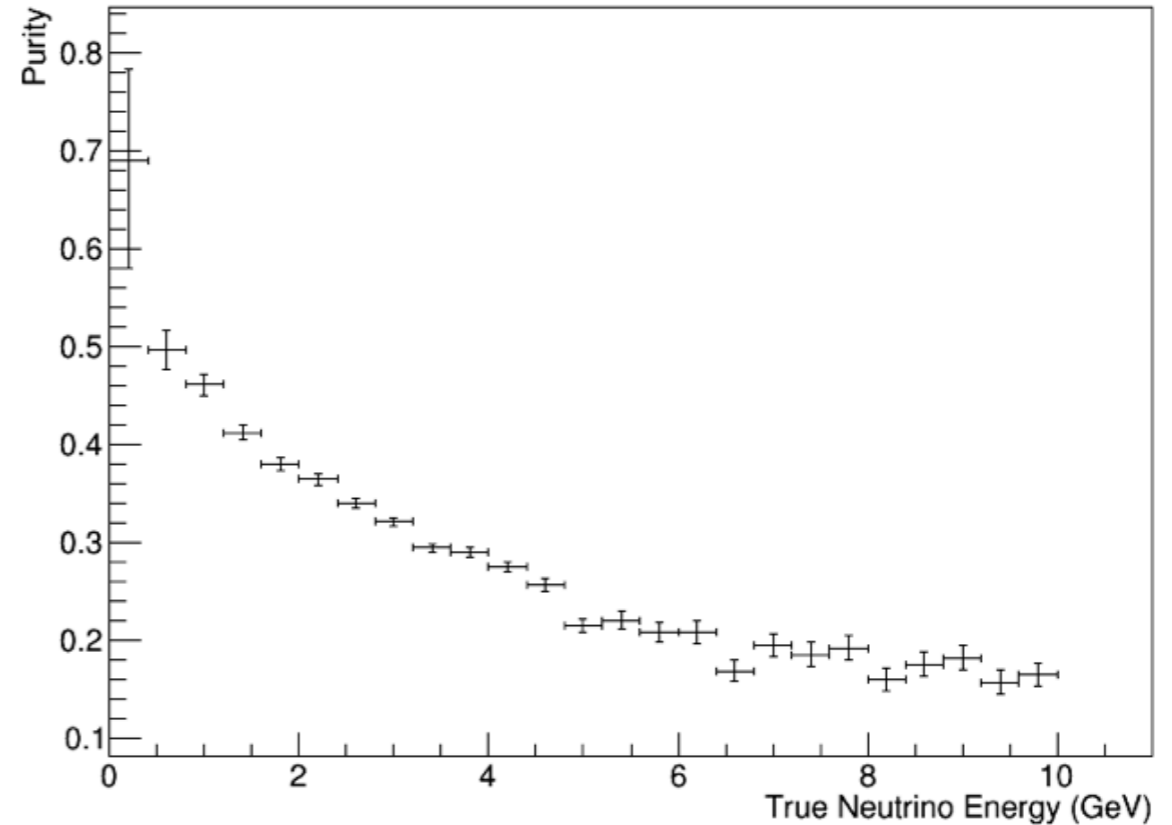
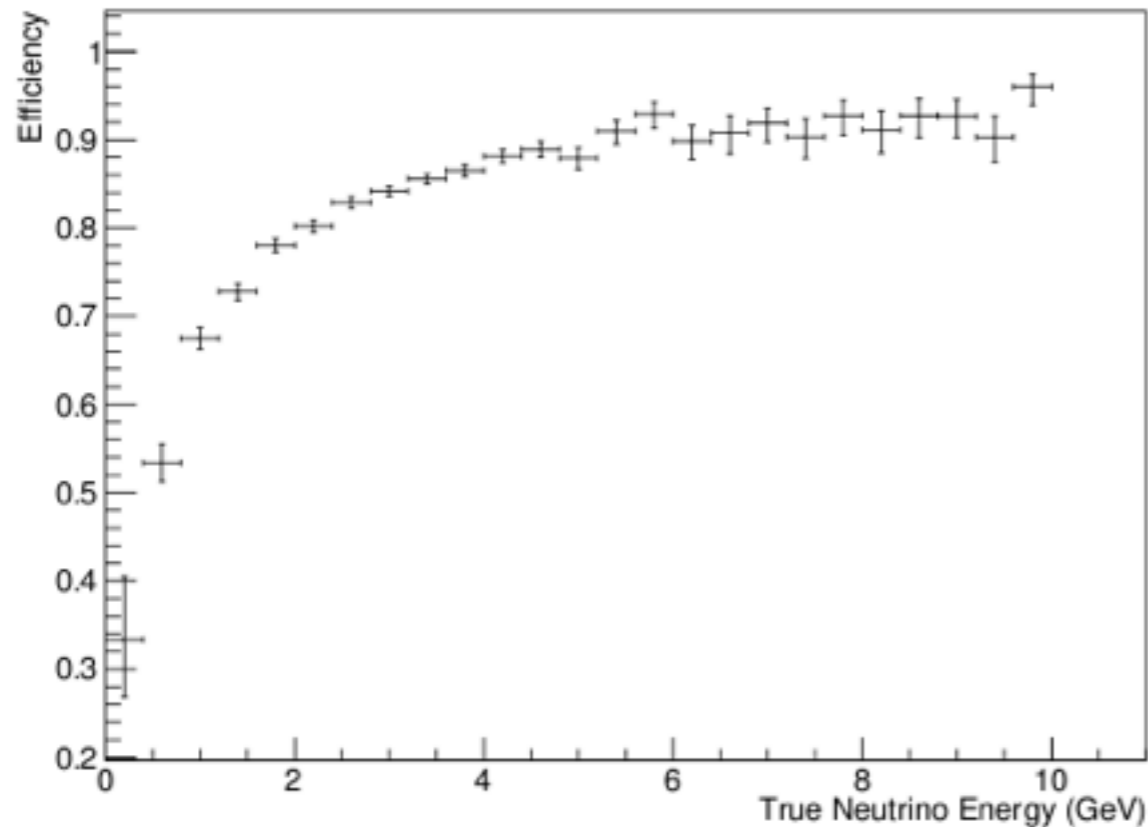
# Simple Selections with Pandora

- Pandora doesn't save recob::Showers so we can't use it directly as input to the MVA.
- Just to get an idea of how well it's performing in general, can apply very simple selections to the PFParticles.
- Example selections:
  - must be at least one showering particle longer than 10 cm;
  - longest prong in event is an electron.



# Shower Size

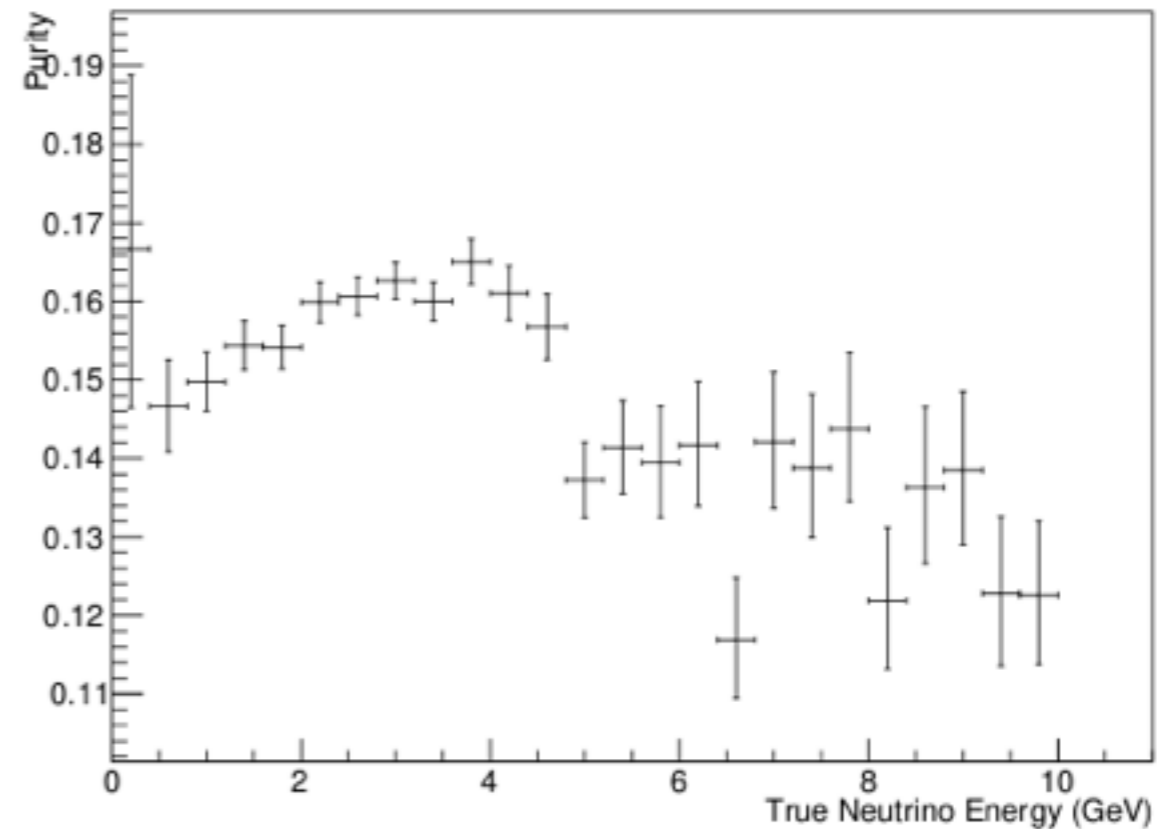
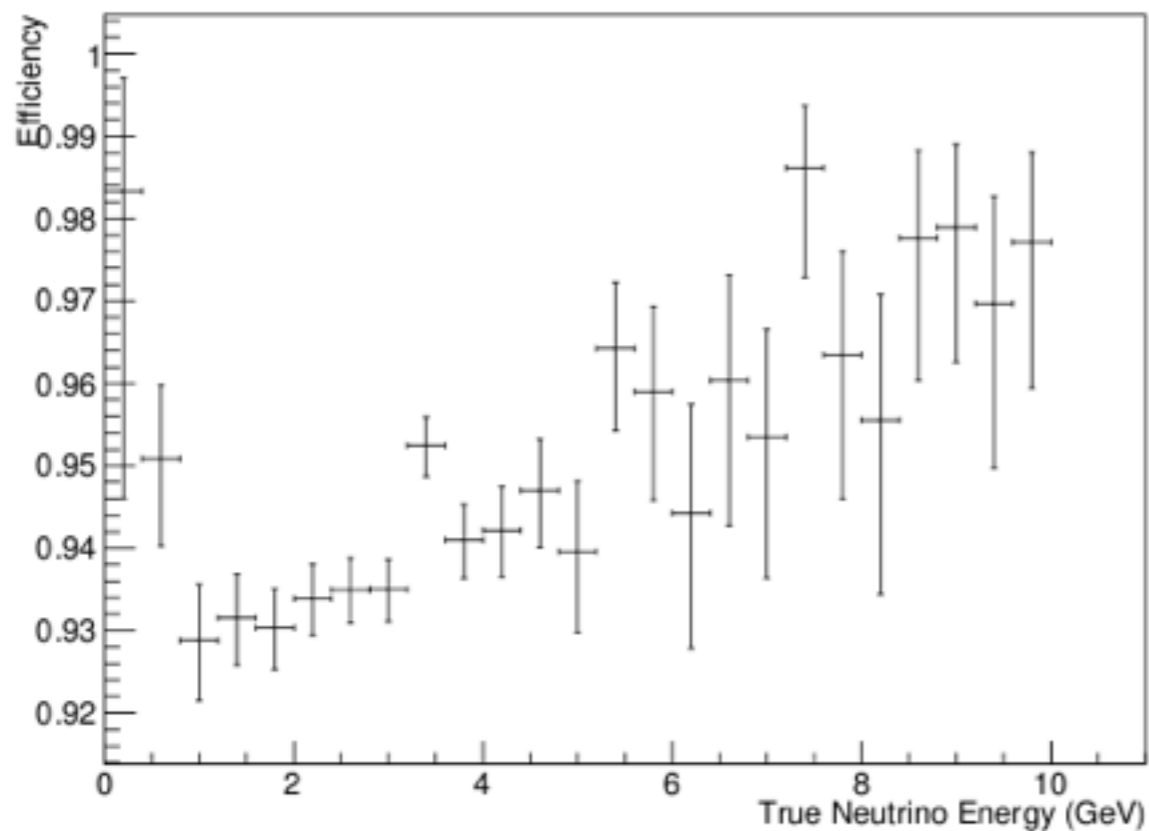
- Event must have electron shower  $> 10$  cm.



- As I expected, the efficiency will tend towards one quite quickly but, since there's no difference between electrons and photons in Pandora PFParticles, the purity falls off sharply.

# Longest Particle

- Longest particle prong is a shower.



- Purity is very low. Again, need more sophisticated selection!

# Summary

- $\nu_e$  selection is challenging and lots to be understood!
- I have a bit more time over the next few months so will look into this — I'm interested in understanding that all a bit more!
- I'm sure we'll have had plenty of discussion, but any more points?
- Next: tune the cut crudely and look at characterising the mva input variables.