

DUNE FD Production - Working Shower Rollup

Ryan Cross



Where we are...

I have been looking over the FD HD small production files, to check them from a reconstruction point of view. I produced some CI infrastructure to compare two versions of `dunetpc` (or equivalent now it is split), such that the performance / output of Pandora can be checked.

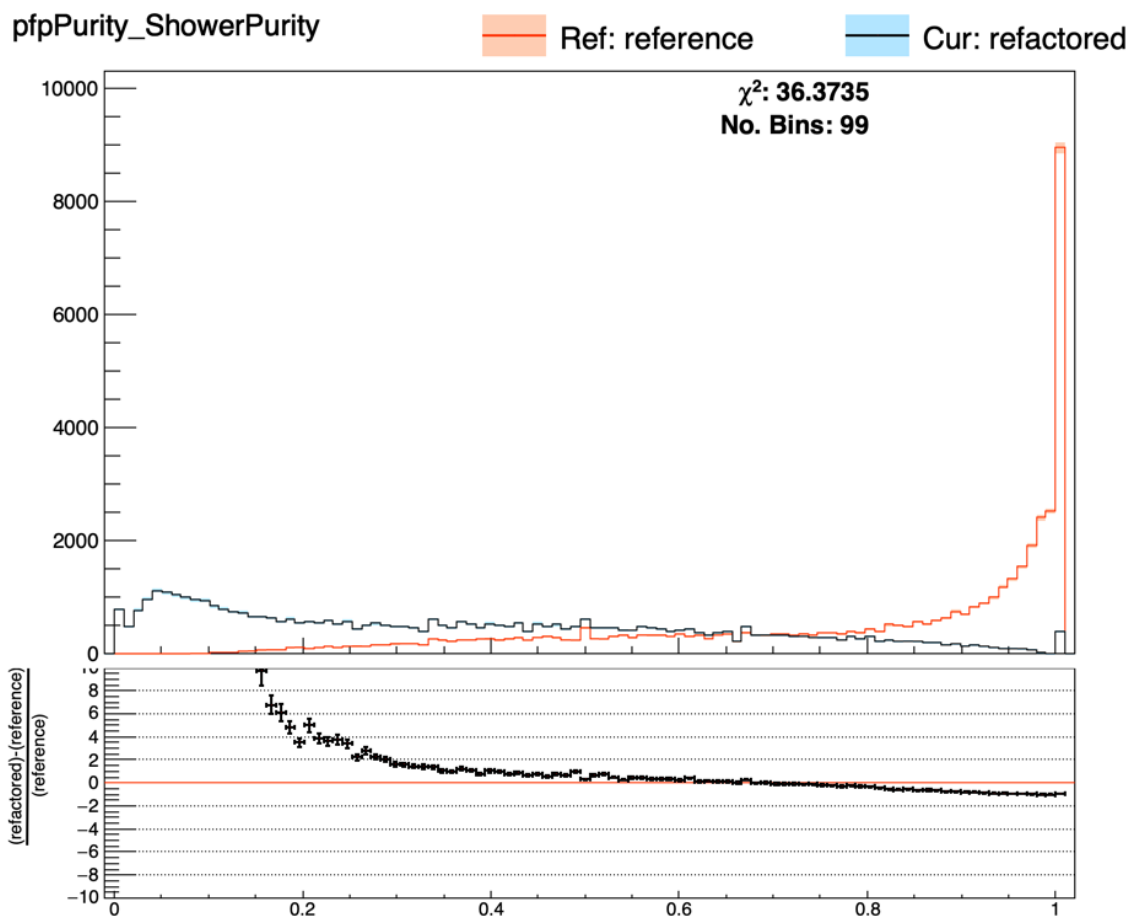
There has been a few main worries:

- Strange offset: Sorted now. An offset was being applied by Wire-Cell and elsewhere, which has now been fixed.
- Verify that showers are okay: Shower roll-up was disabled, which was obscuring a lot of plots, but the reconstruction performance of showers needs to be validated.
- Tracks also had some odd features in their plots, shown later. It was less understood where these features come from.
- Finally, some differences in the reconstructed object plots, such as shower length and shower opening angle.

This talk focuses on the final 3 points.

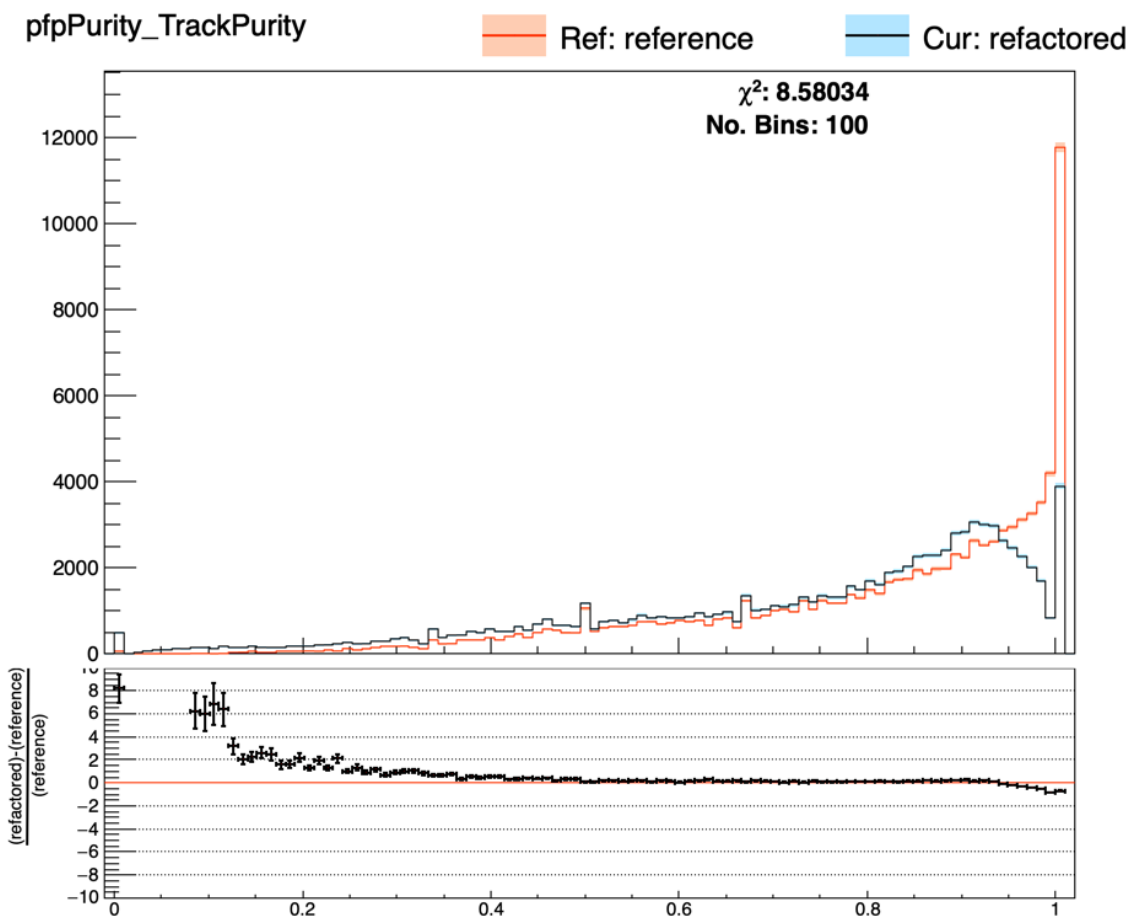
Existing Metrics

Without roll-up, we had plots that look like this which are due to the MC not being in the expected form. These plots are area normalised, which can exaggerate certain issues.



Existing Metrics

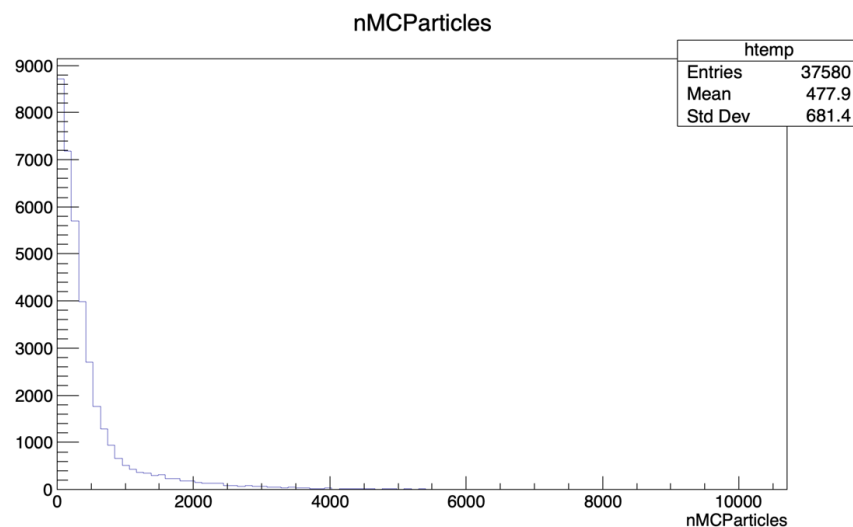
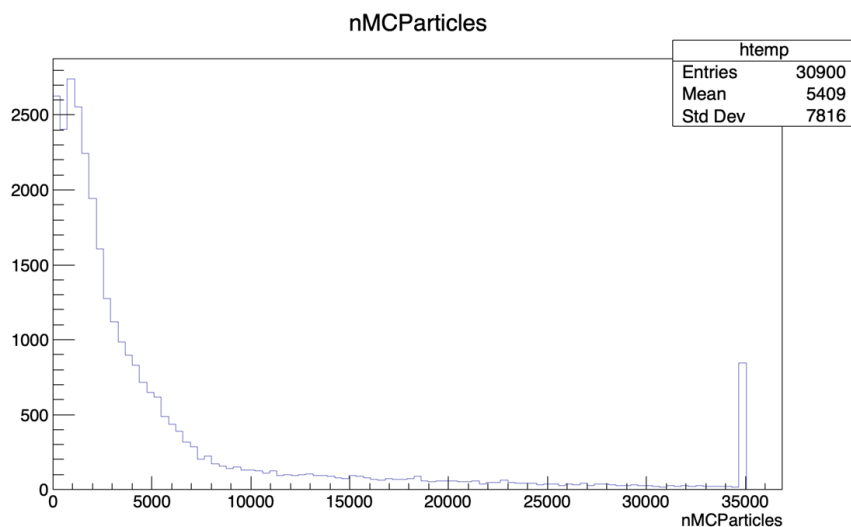
Similarly, for the tracks there was a similar strange shape. Here the impact is much lower, as delta rays impact these plots much less, but do prevent high completeness being achieved.



The Fix

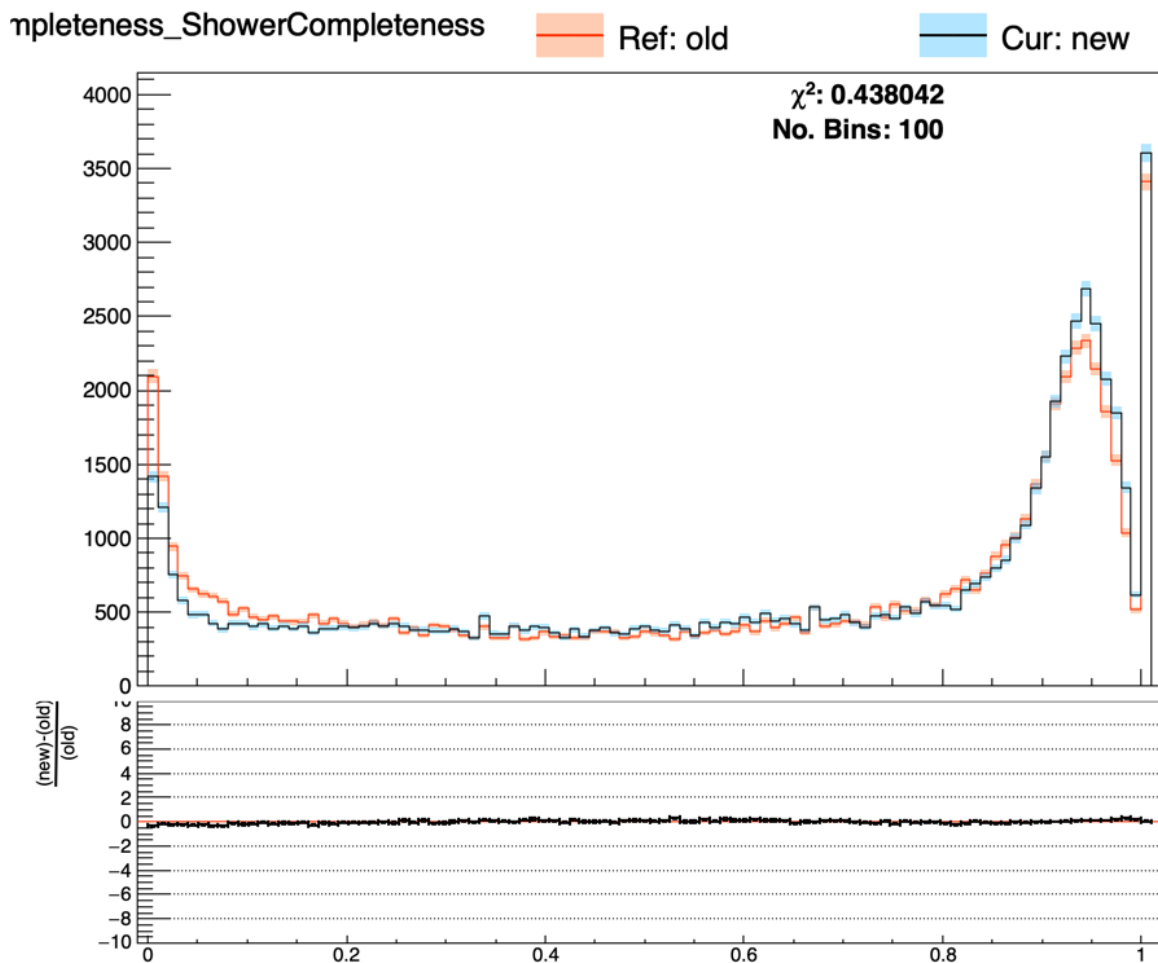
Pull requests #37 and #38 to `larg4` added the same rollup behaviour as implemented in the legacy version of `larg4`.

It should work the same as the previous implementation: Certain EM activity has its track ID set to -1 times their top level parent track ID for each of the daughter MC particles.



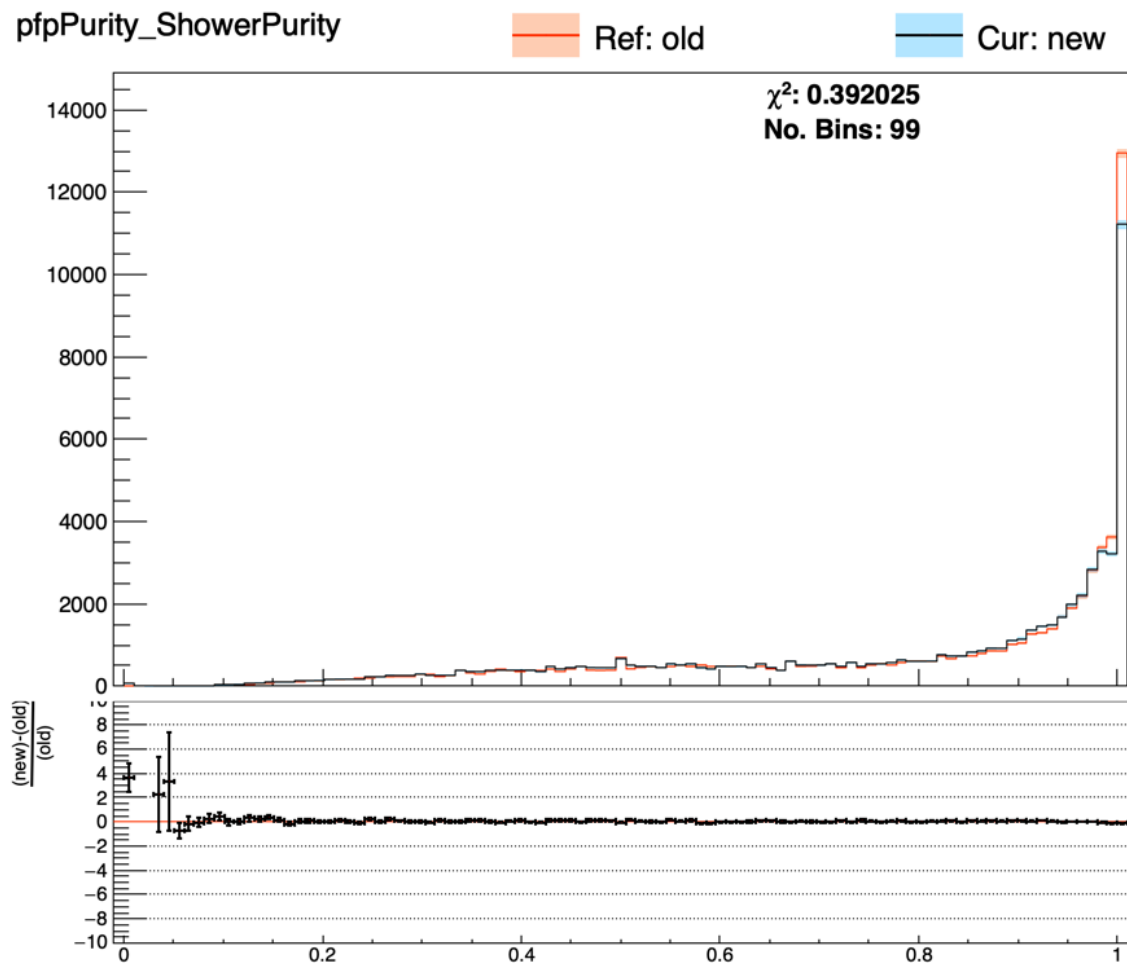
Metrics Now - Shower Completeness

With properly implemented shower roll-up, we get the following plots for completeness and purity.



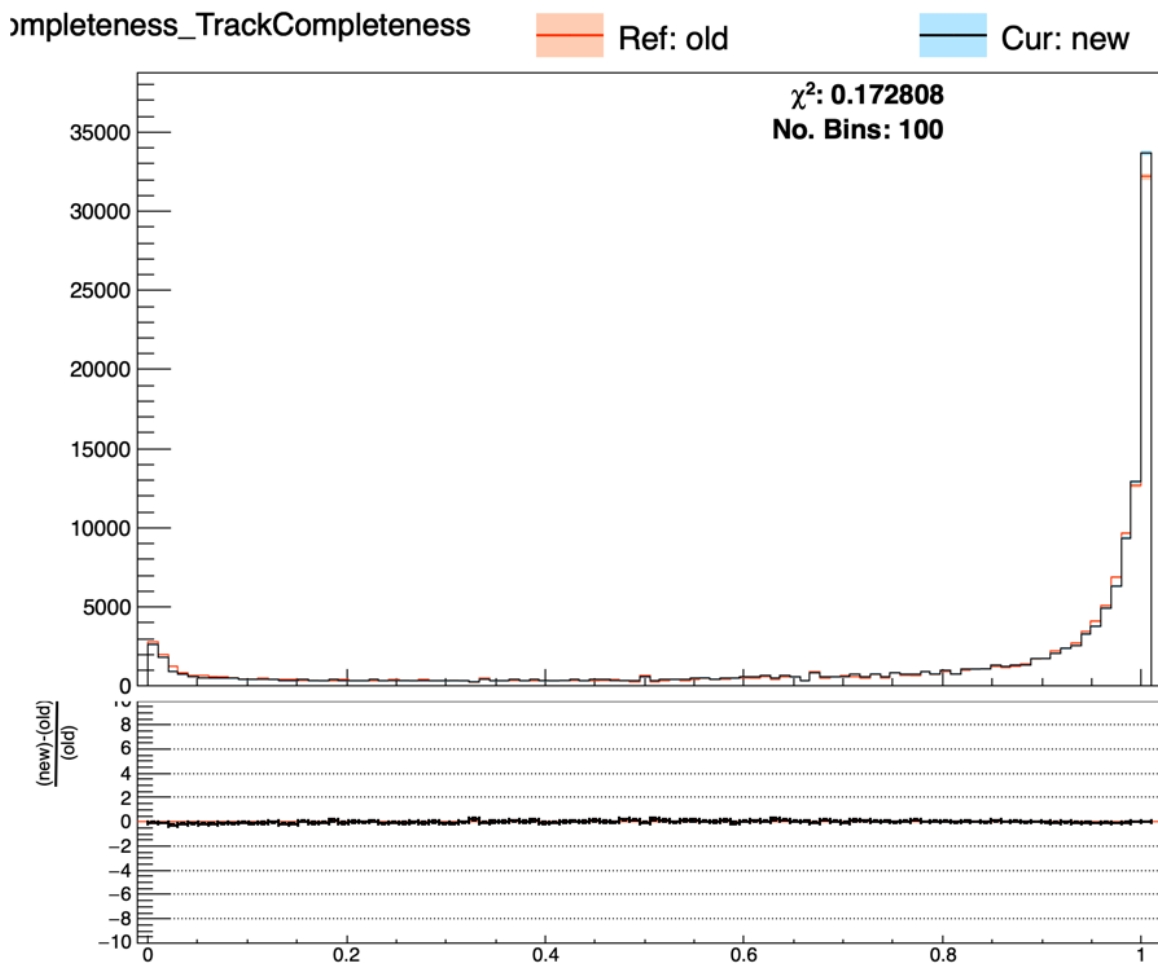
Metrics Now - Shower Purity

With properly implemented shower roll-up, we get the following plots for completeness and purity.



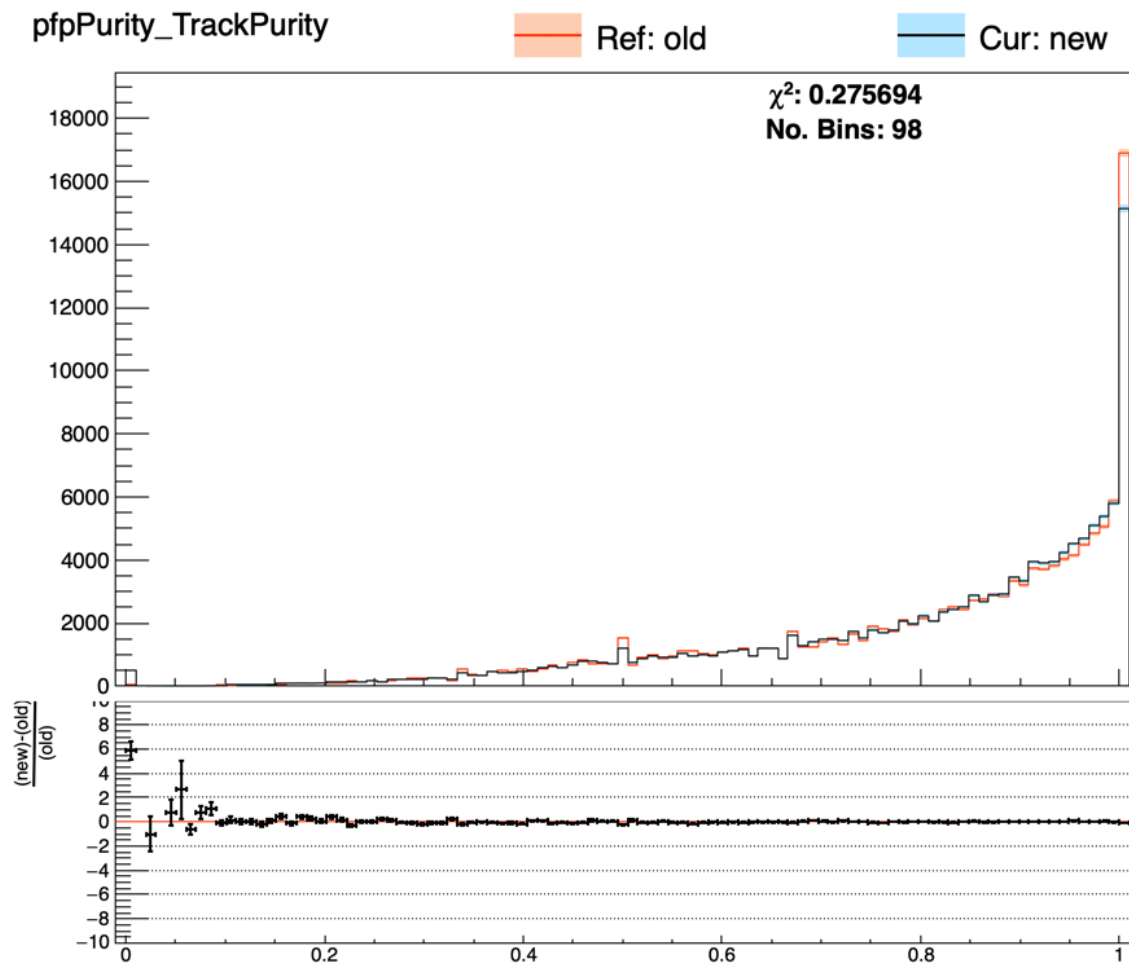
Metrics Now - Track Completeness

Similarly, the track plots look more aligned.



Metrics Now - Track Purity

Similarly, the track plots look more aligned.



Remaining Differences

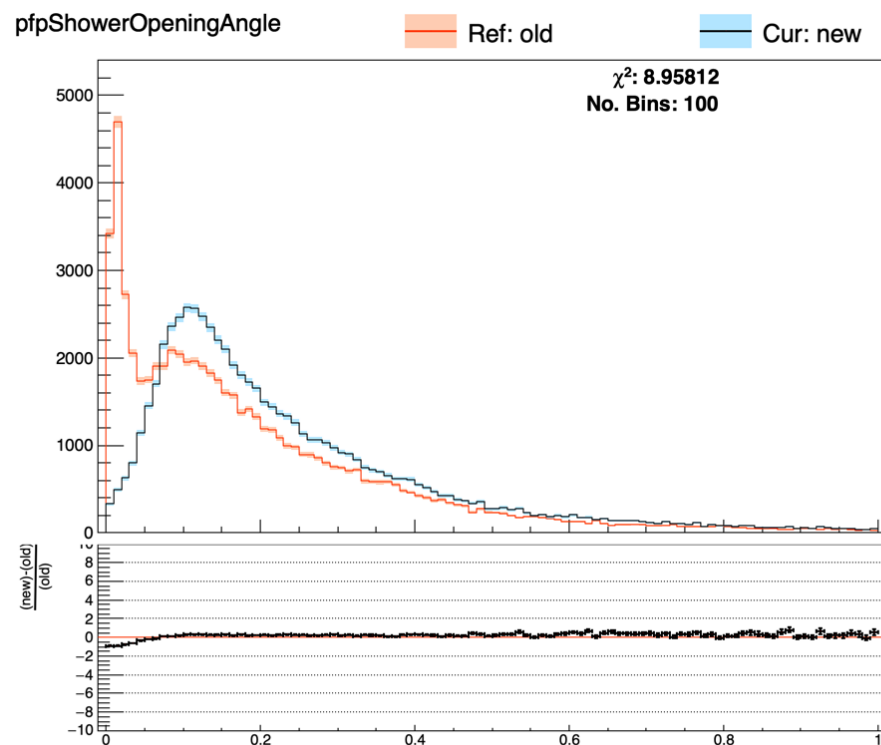
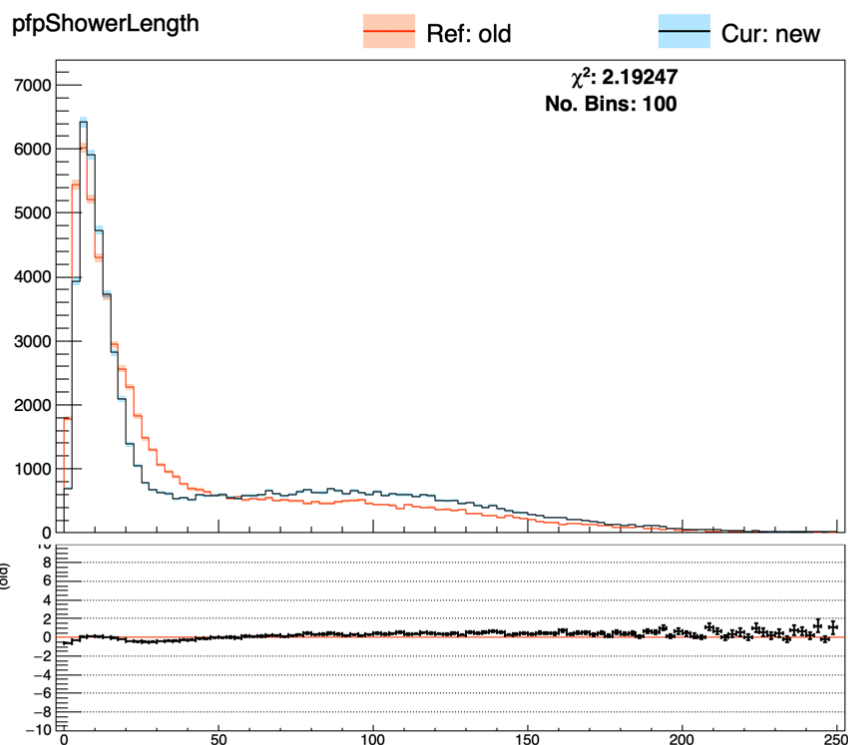
The previous plots show that there is still some amount of difference between the pre and post refactor. Broadly, completeness is a touch higher, purity is a touch lower.

I've not got a real answer for the differences shown here, as there is so many changes that could lead into the differences seen here, due to changes in Pandora, or GEANT or Wire-Cell etcetc.

By eye, everything looks good in actual event displays still, so I'm not too worried that the remaining differences in the plots shown are major ones, rather just a compounding of many small changes. However, the second issue could be related here as well...

Remaining Differences

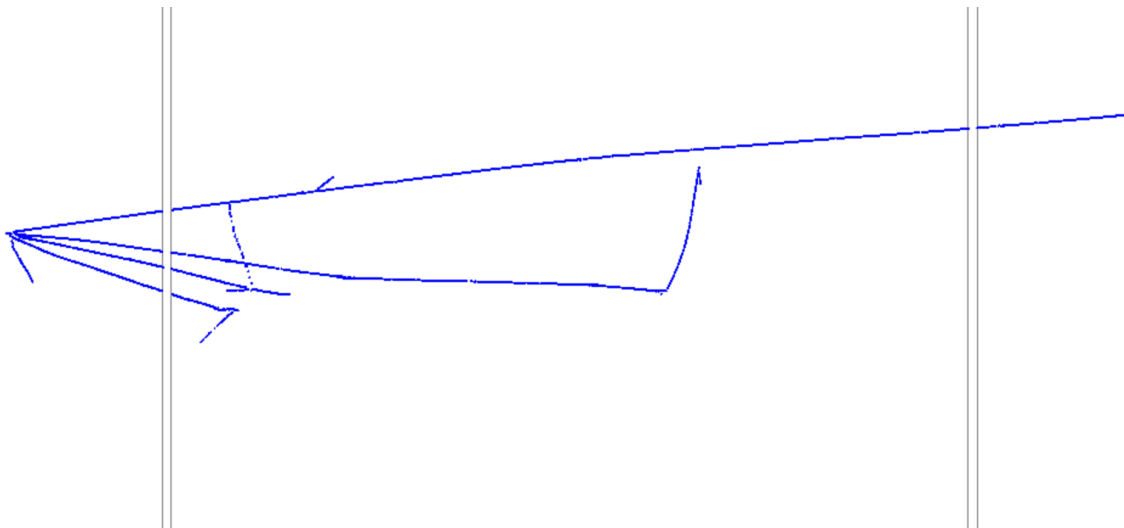
There is also a potential issue with two of the reconstructed object plots. I plot out start positions, start directions, angle distributions etc. for the tracks and showers, and the only one with appreciable differences is the shower length and shower opening angle. Neither property (`Length()`, `OpenAngle()`) is set in Pandora, and the configuration for the shower module has seemingly not changed, so need to check deeper.



Next Steps

The only remaining point is the shower property plots, so I need to look deeper into that, and work out the issue. I've checked the used FCL config and the shower module code so far, and it doesn't seem to have changed. Additionally, re-running both the versions of the shower module on the same reconstructed file yielded no change, so I'm inclined to say its not the shower module, rather some difference in the reconstruction or simulation. I need to continue back up the chain and find the first place I see the difference, and go from there.

The events look good in event display that I've seen, but as so much of the chain has changed (basically GEANT onwards) doing an exact "before vs after" is fairly challenging as so much has changed.



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