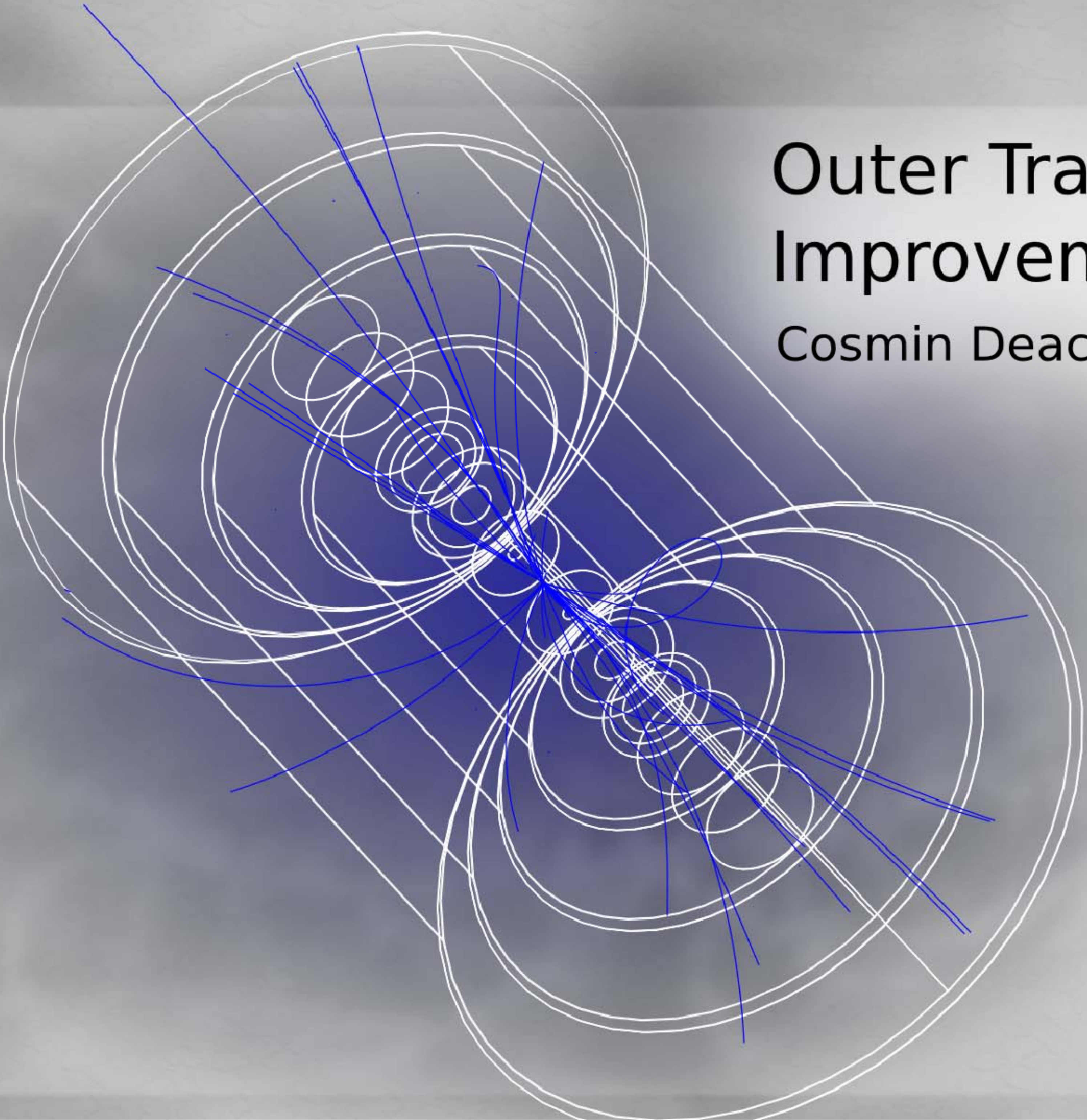


Outer Tracking Improvements

Cosmin Deaconu, SLAC

Outer Tracking Improvements - Introduction

Enhancements on AxialBarrelTrackFinder
-Extension to forward region
-Use of helical fitter instead of circle fitter
-Use of TrackerHitCheater to group
SimTrackerHits

Work on a combination driver for the outer region

Outer Tracking Improvements - Forward Region

Tim Nelson's barrel tracking algorithm was extended to work in the forward region.

The chief complication was dealing with the different layer structure in the forward region (two subdetectors, skipping and combining layers).

Saved in my contrib area as OuterTrackFinder.

Still actively tweaking parameters, thinking of ways to improve

Outer Tracking Improvements - Helical Fitter

Since the forward region has 3D points, the circle fitter is inadequate for fitting.

My version of the tracker uses the helical fitter in org.lcsim.fit.helicaltrack, which does a circle fit in x-y and a linear fit in s-z .

In the barrel configuration, my version of the tracker emulates the circle fit by setting a ridiculously high chisq cut-off. Lori's z-seg code is also used.

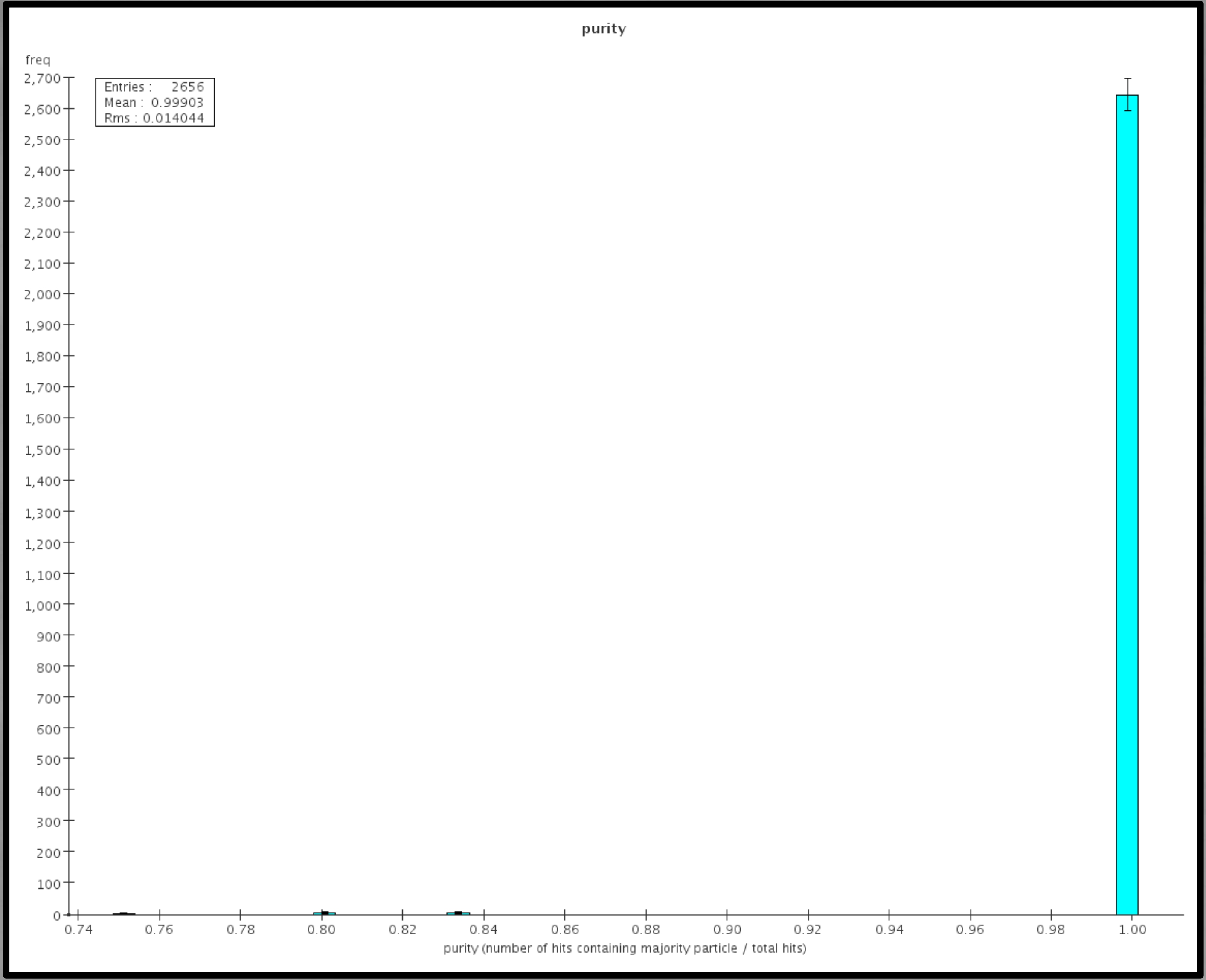
Outer Tracking Improvements - TrackerHits

The use of SimTrackerHits is not optimal, since one can have many SimTrackerHits from a single particle passing through a layer.

Tim Nelson's TrackerHitCheater is used to combine SimTrackerHits and make fake TrackerHits, removing problems associated with having a lot of SimTrackerHits.

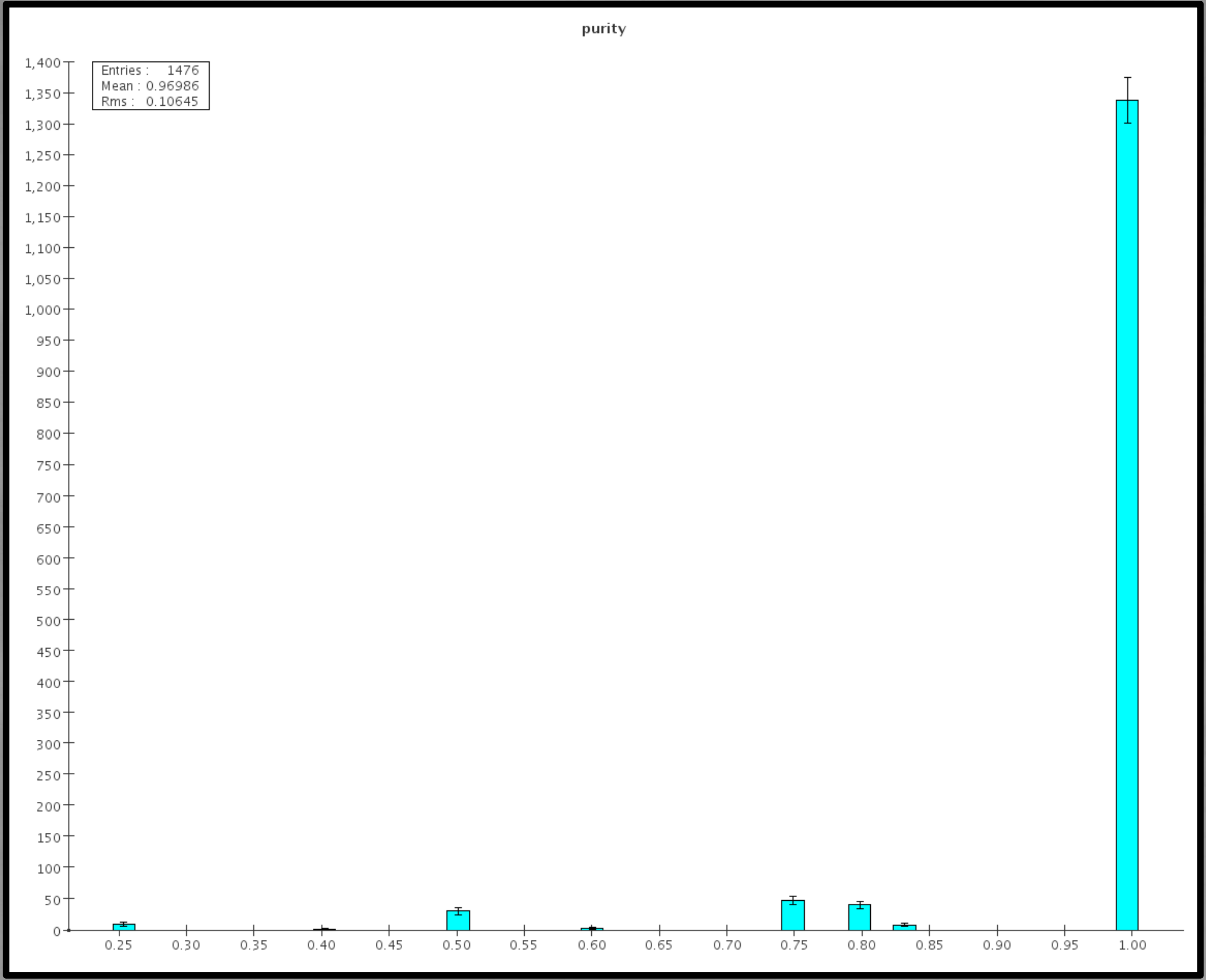
Outer Tracking Improvements - Forward Plots

Purity for single muon diagnostic events:



Outer Tracking Improvements - Forward Plots

Purity for PythiaZpoleuds-7:



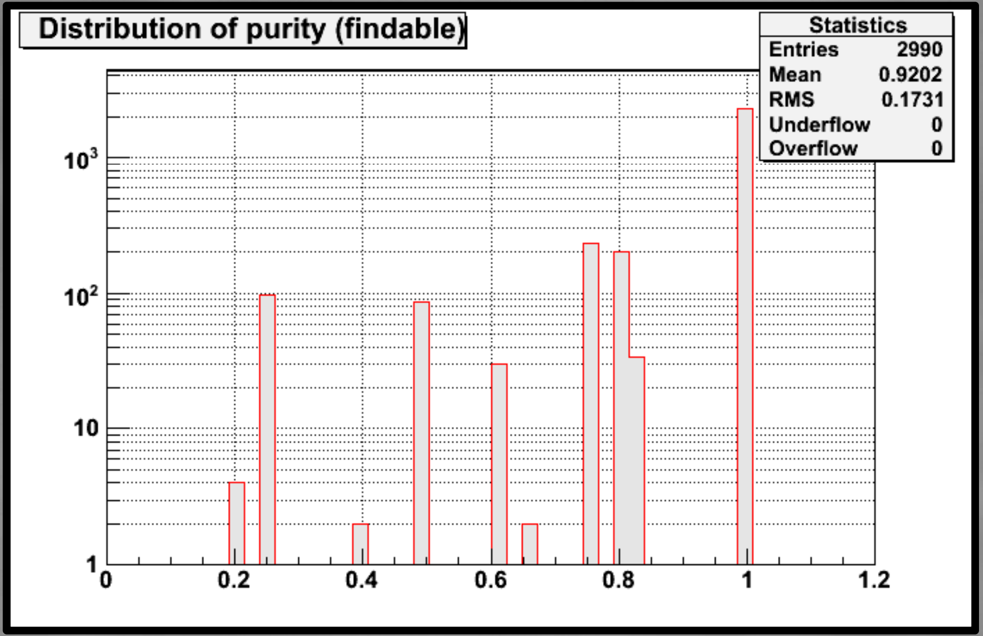
Outer Tracking Improvements - Chris's evaluator

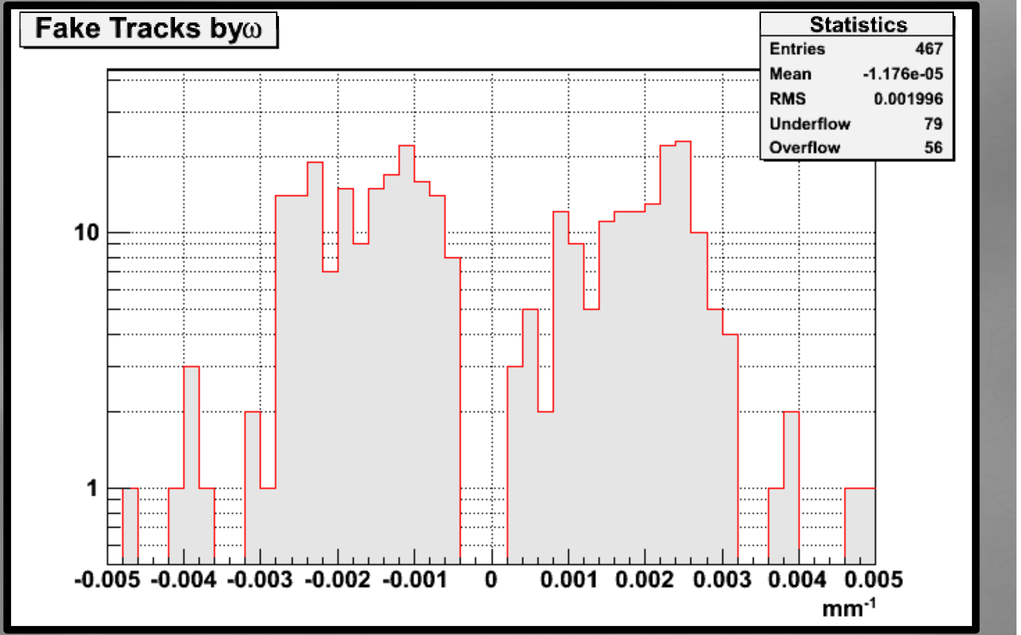
I also tried using Chris Meyer's C++ evaluation package. Here are fake track results for the sample panpyZZ_uds_nobeam_nobrem-0 (500 GeV events). Again, this is in the forward region.

Omega Range (cm^-1)	Fake Tracks	Total Tracks	% Fake
3e-05 to 7.5e-05	0	0	0
7.5e-05 to 0.00012	0	0	0
0.00012 to 0.0002	0	0	0
0.0002 to 0.000375	3	68	4.41
0.000375 to 0.00075	25	360	6.94
0.00075 to 0.0015	100	768	13.02
0.0015 to 0.003	187	1632	11.46
0.003 to 0.0075	27	37	72.97
0.0075 to 0.015	9	9	100

Outer Tracking Improvements - Chris's evaluator

And some plots...





Outer Tracking Improvements – Combo Driver

My combination driver does the following:

- Uses my version of the outer tracker code in the barrel configuration to find barrel tracks, and then outputs unused hits.
- Uses my version of the outer tracker code in the forward configuration to find forward tracks, and then outputs unused hits.
- Uses a new driver I wrote to find tracks from the unused hits output by the two other drivers. This driver is called TrackerHitTrackFinder and can be found in my contrib area (as can CombinationDriver).

Outer Tracking Improvements – THTF Method

TrackerHitTrackFinder uses the following method:

- Input hits are sorted by distance from center.
- Goes through all pairs of points, and then finds the best third point to form a line (in the s-z plane). These are the seed points.
- If the chisq of the seed helix is good enough, a list of candidates is made. The candidates must be well-separated, close to the seed helix, and each of their chisqs with the seed must be good enough.

Outer Tracking Improvements – THTF Method

- All candidates are then added to the track, and if the chisq sucks, the farthest hit is removed until either there are too few points or the recalculated chisq is good enough.

- All hits must be close enough to the new helix. If a candidate is too far, it is removed.

- If a seed is too far from the helix, we give up on the seed and try a new one.

- A minimum number of hits must be satisfied.

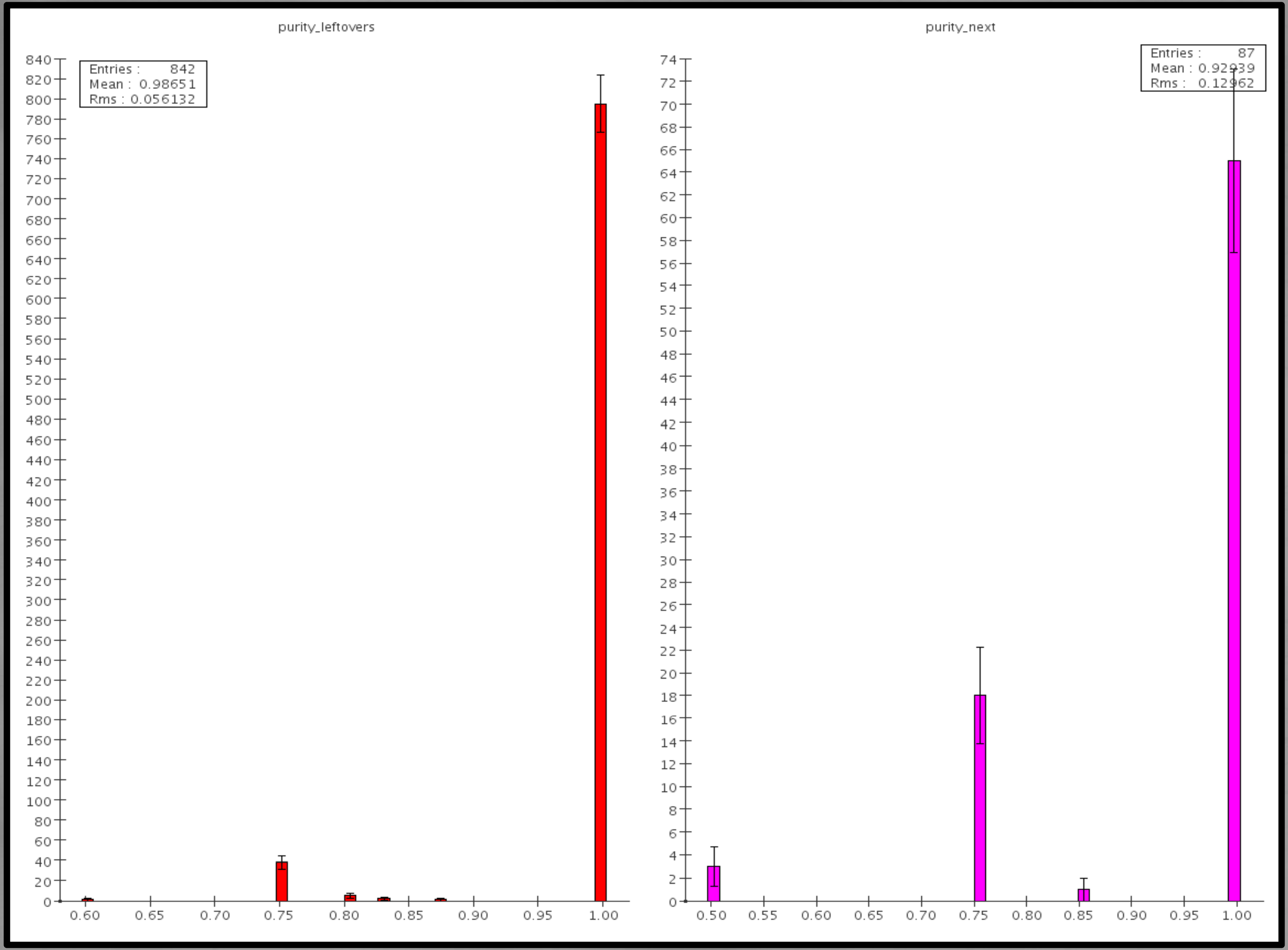
Outer Tracking Improvements – THTF Method

- In the combination driver, two instances of the THTF driver are used. The first has tighter constraints and feeds its output to a second instance, which has slightly relaxed constraints. In principle, you could keep doing this for a while...

- THTF's performance doesn't scale gracefully to a large number of input hits. Feeding THTF a large number of hits will result in a long run time.

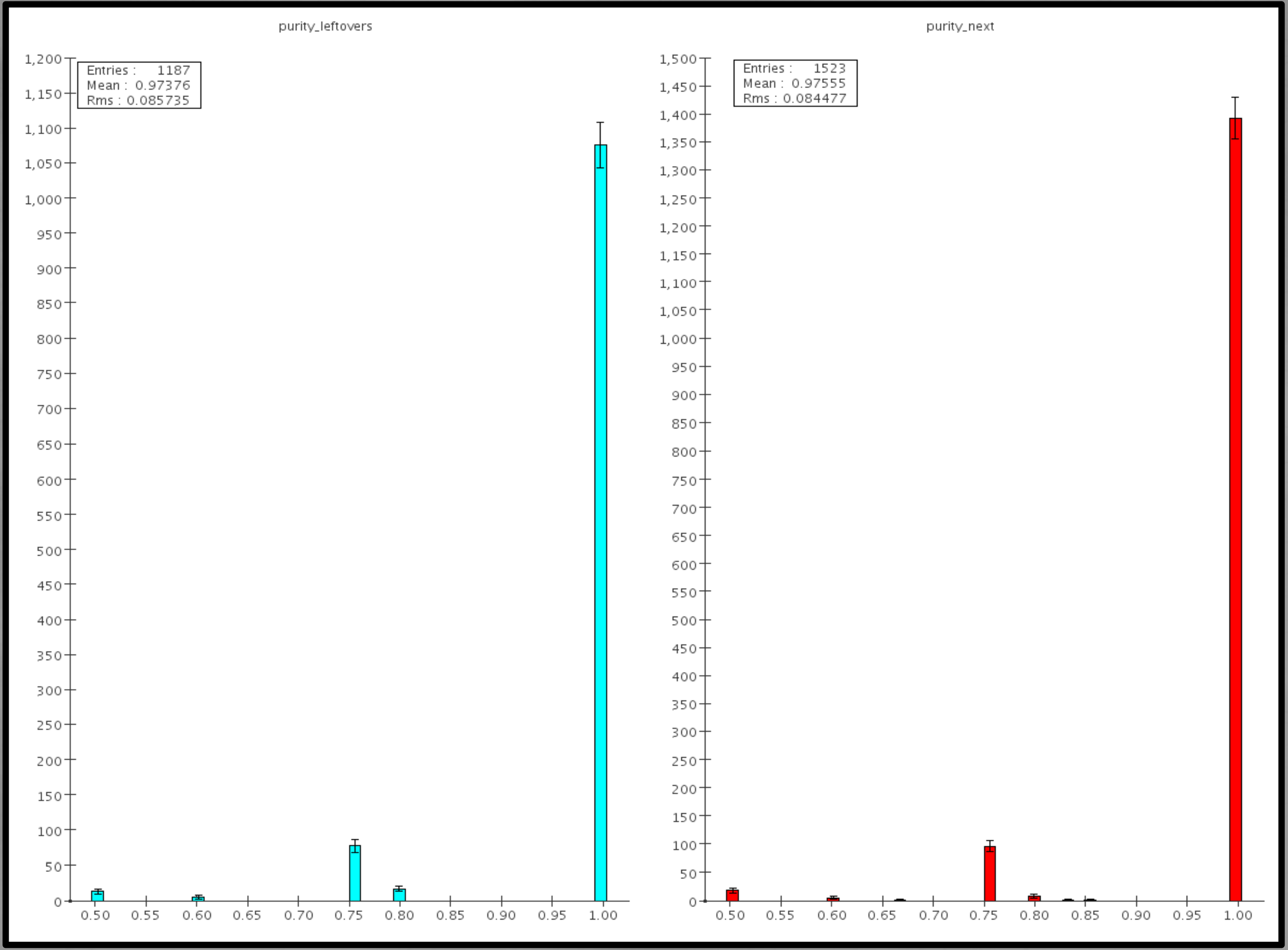
Outer Tracking Improvements – Combo Plots

Purity for single muon diagnostic events:



Outer Tracking Improvements – Combo Plots

Purity for two muon events:



Outer Tracking Improvements – Conclusions

THTF purity not as good in events with lots of input hits, and performance is terrible, making large scale testing difficult.

Purity is expected to improve in complicated events with tweaking of parameters. Optimization may improve performance somewhat.