Track3DKalmanSPS update

Eric Church, 20-Feb-2013

Reminder: This approach uses Spacepoints

- We rely on SpacepointServices to produce 3D spacepoints and their errors from its underlying hits and sensible Fuzzy clusters. Then we run a Kalman track through those spacepoints.

physics.producers.fuzzy.fuzzyClusterAlg.HoughBaseAlg.HoughLineMergeAngle: 25
physics.producers.fuzzy.fuzzyClusterAlg.HoughBaseAlg.HoughLineMergeCutoff: 8
physics.producers.spacepoints.ClusterModuleLabel: "fuzzy"
physics.producers.spacepoints.Merge: false
physics.producers.spacepoints.Filter: true
physics.producers.spacepoints.useMC: false

On 1st pass through each vector of Spacepoints

- sort in z
- no spacepoint >8cm away from previous
- no spacepoint closer than 0.01 mm to previous spacepoint
- Require Nsppts>4 to even bother to fit a track to this clump of spacepoints

For now, single muons

- Everything I show here up until the last slide, consists of single muons of sigma_XZ, sigma_YZ=25 deg and momenta 0.2, 1.0, 2.0 GeV/c

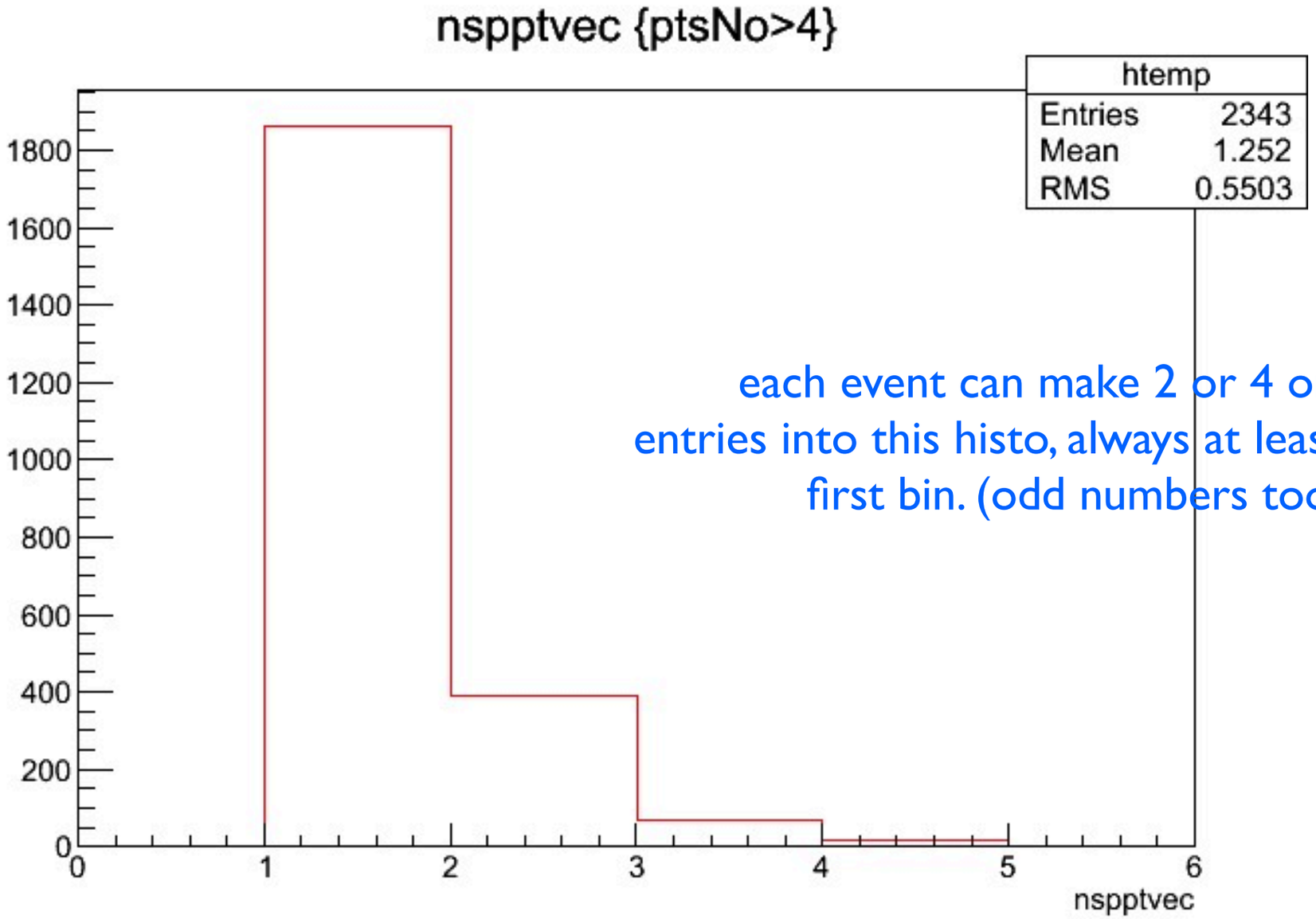
Contained/Uncontained

- Containedness: look for first/last spacepoint outside of boundary-5cm
- **New:** Fit each vector of spacepoints twice.
  - contained: initial momentum is merely 2.2*length. Momentum from range. Second time take initial guess and reduce by 20% , drop chi2>1000 sppts.
  - uncontained: initial momentum is 2* 2.2*length. Drop poor chi2 hits, force 3 (20)cm spacepoint separation on second pass, use best guess from first pass as initial momentum for 2nd pass, as in contained case.

What else is new

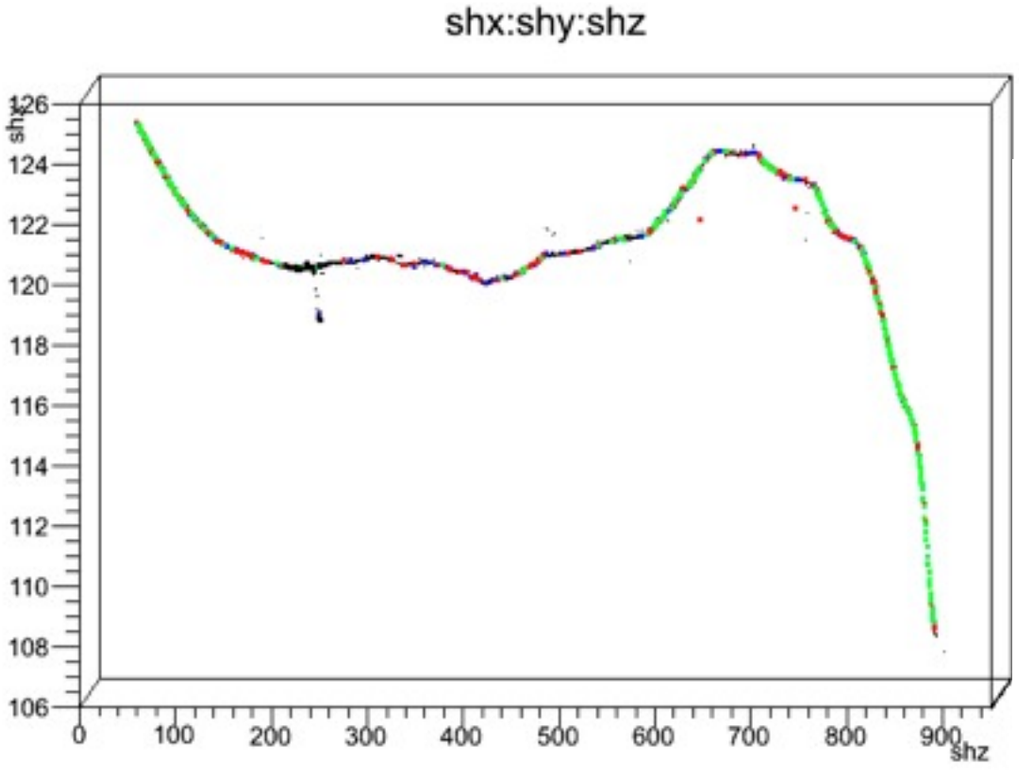
- deltaTheta calculated from propagation of delta(x,y,z) at each spacepoint
- Bug fixes to do the proper linear algebra to update state and covariance at each sppt

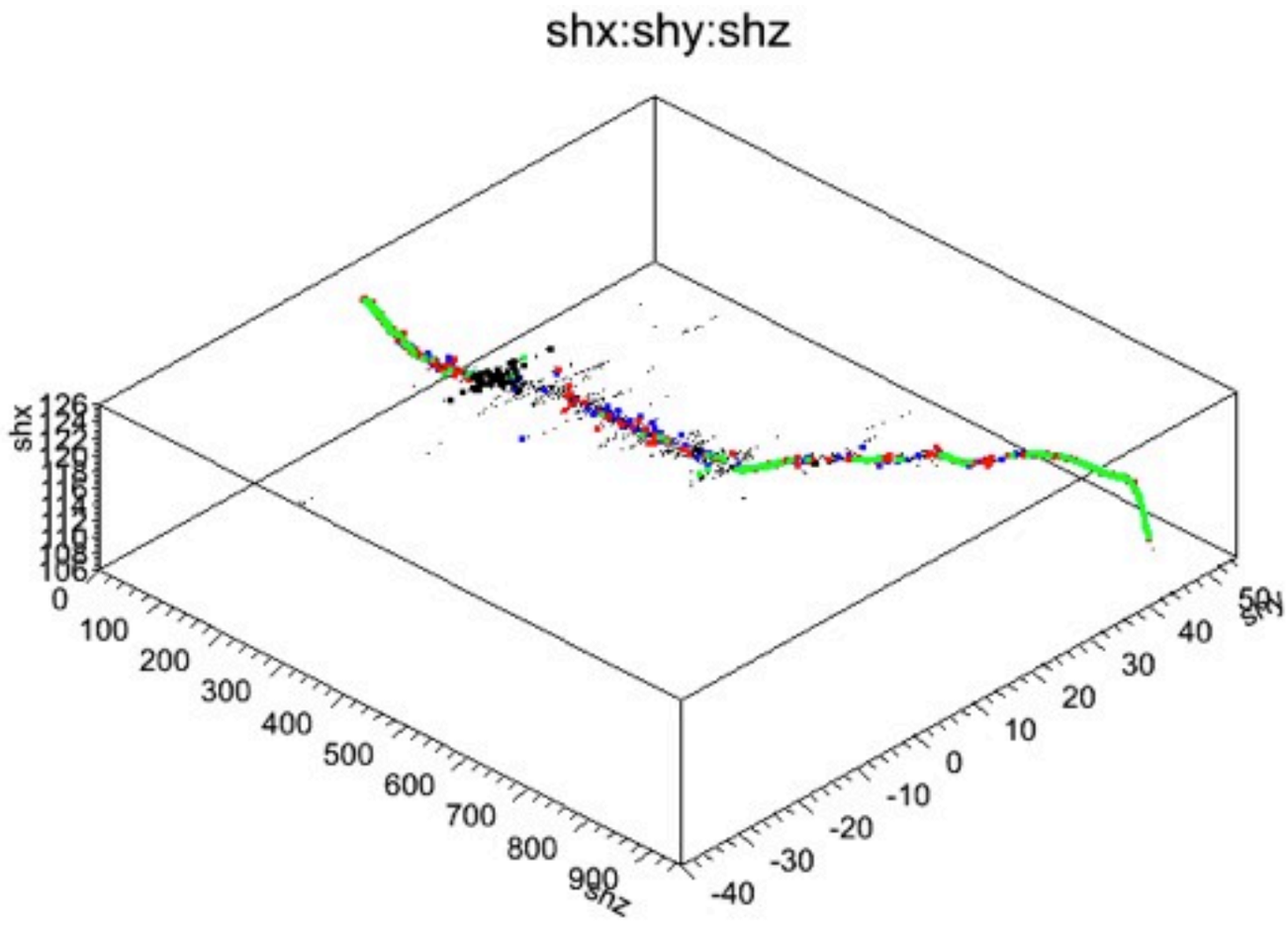
spptvec element # for which a track was created



each event can make 2 or 4 or 6 ...
entries into this histo, always at least one into first bin. (odd numbers too)

chi2hit along track. Motivates 2 passes.

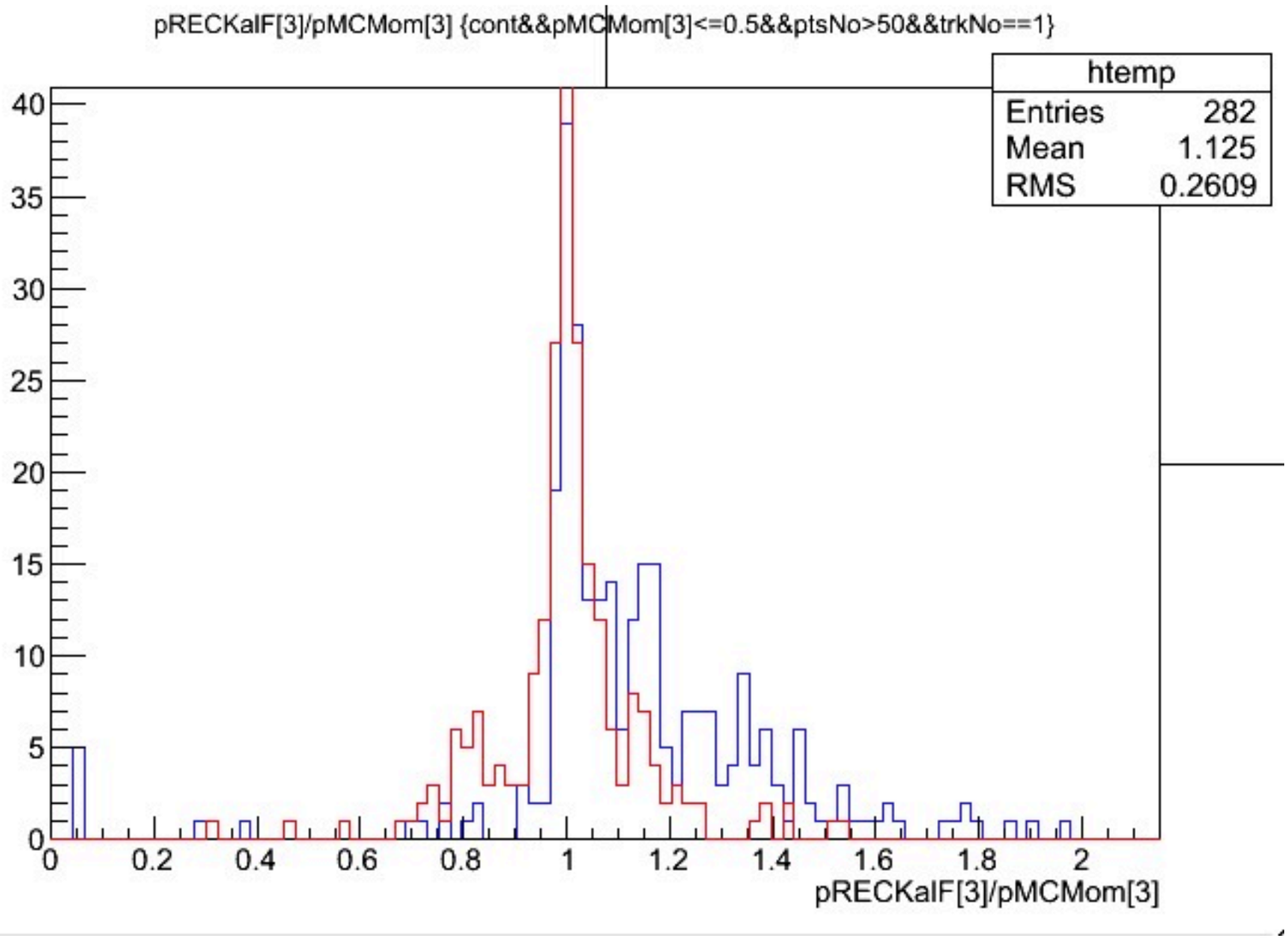




green are best chi2
red are next best
blue next
heavy black are negative chi2!
light black dots are all

0.2 GeV/c

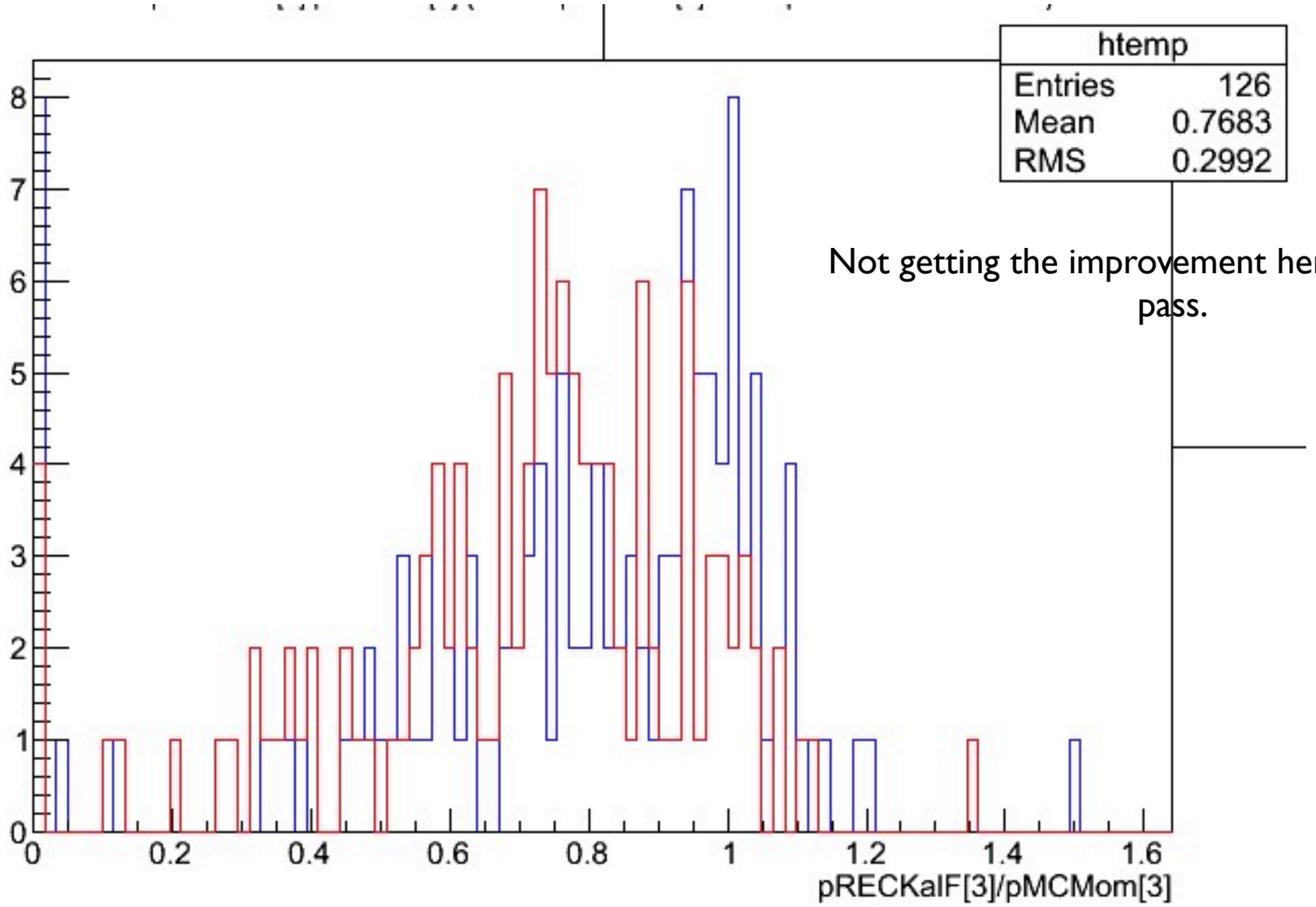
Red (blue) shows second (first) pass spacepoints.



1.000
+/-0.15

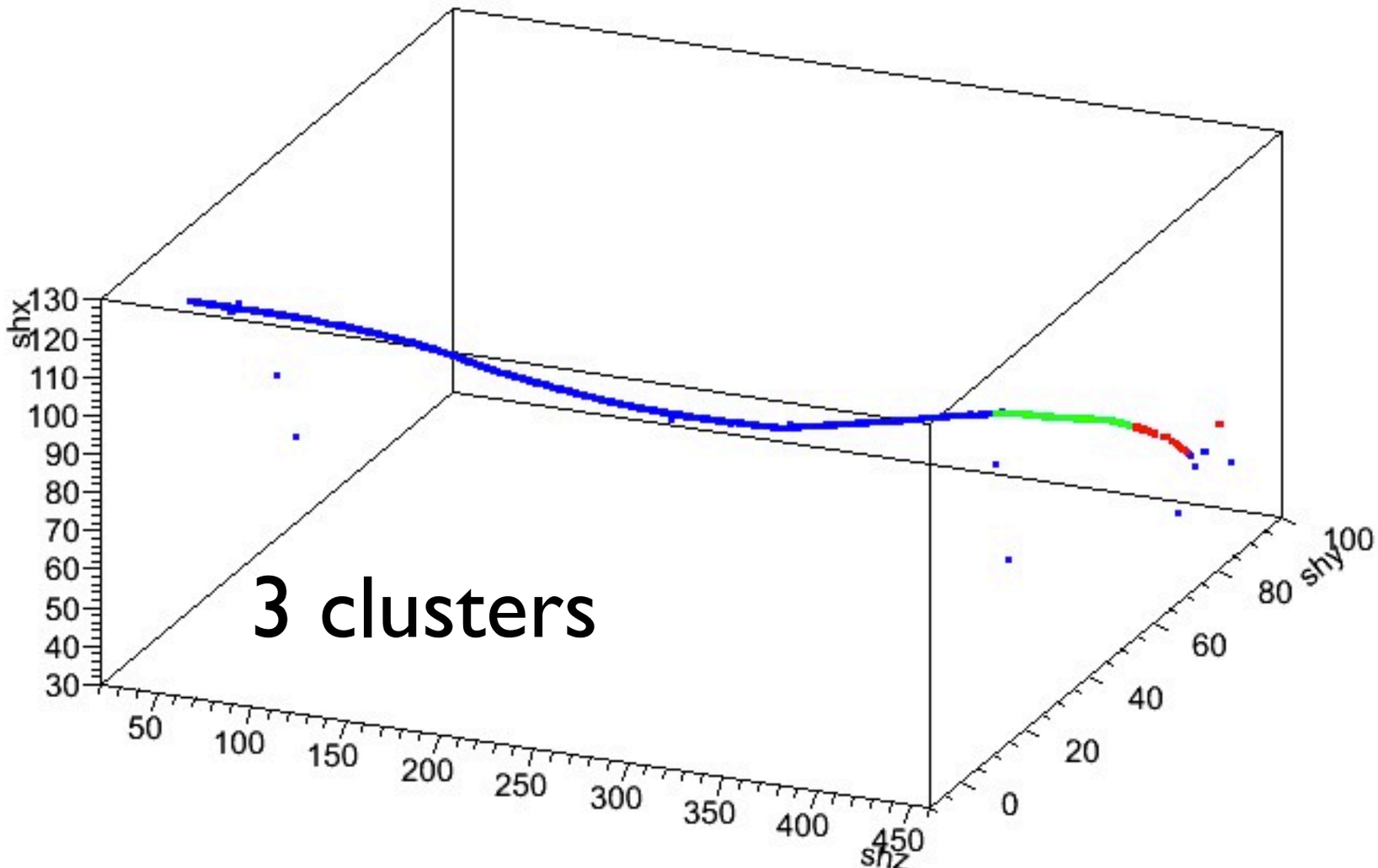
1.0 GeV/c

Red (blue) shows second (first) pass spacepoints.



Not getting the improvement here on the 2nd pass.

Thinks all 3 are contained.



3 clusters

root [115] GENFITttree->Scan("pMCMom[3]:pRECKalF[3]:cont:ptsNo:trkNo","evtNo==19")

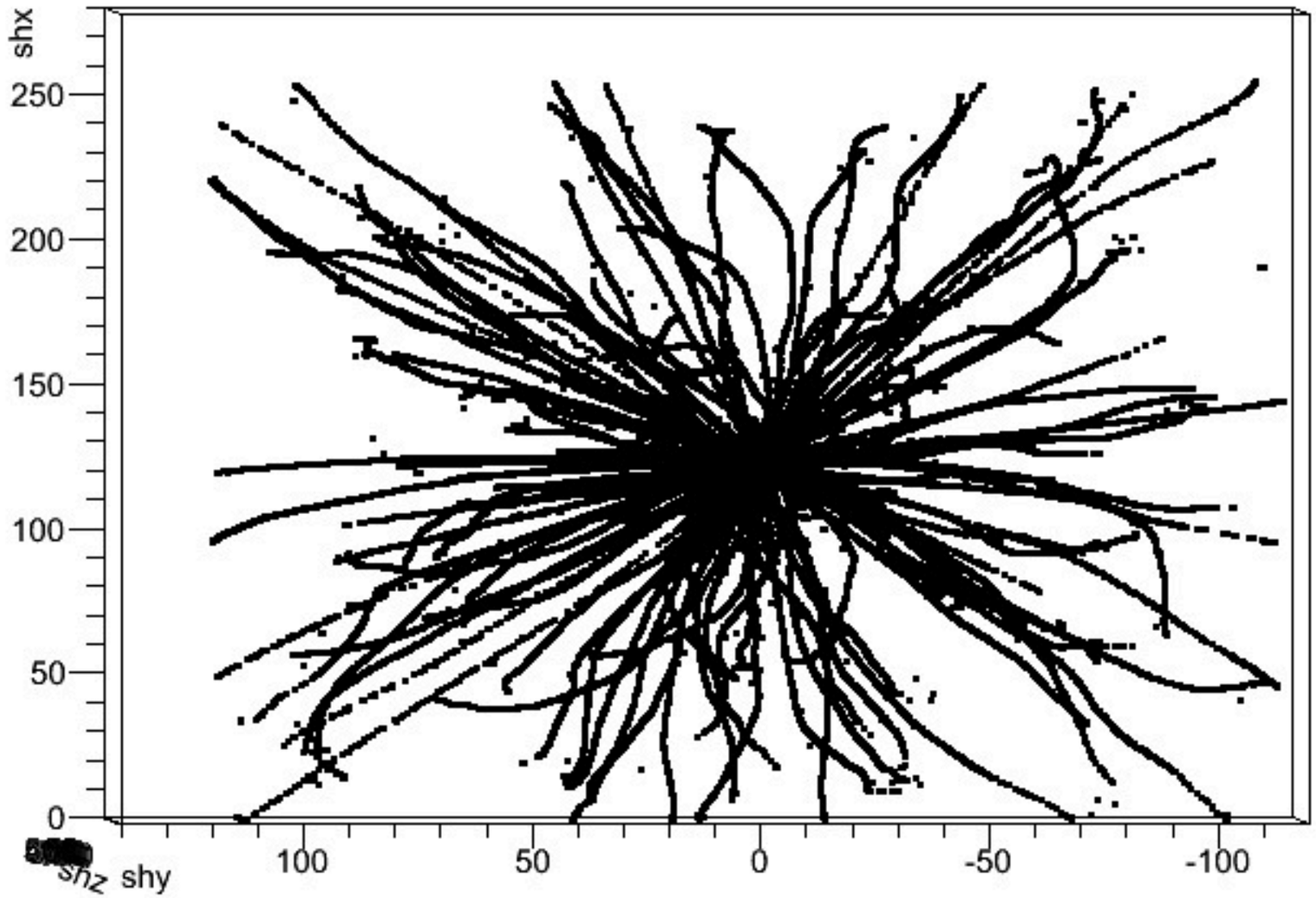
Row	pMCMom[3]	pRECKalF[	cont	ptsNo	trkNo
41	1	0.0099999	1	1036	1
42	1	0.8814994	1	1031	2
43	1	0.2283571	1	154	3
44	1	0.2317864	1	154	4
45	1	0.1738314	1	33	5
46	1	0.1745007	1	33	6

==> 6 selected entries

Sometimes this relation holds for multiple contained clusters: 1/1.0 ~ 1/0.88+1/0.23+1/0.17

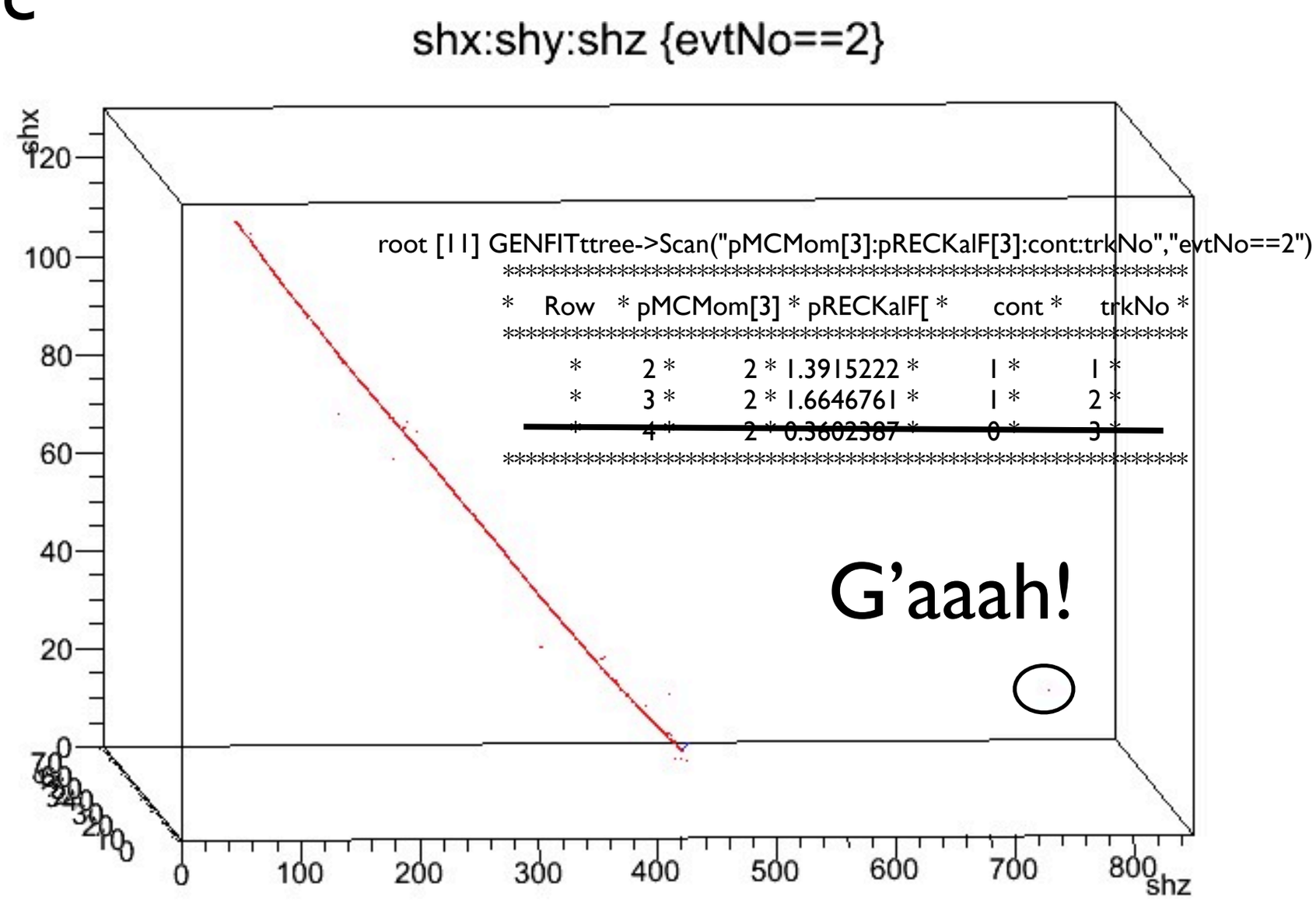
1.0 GeV/c

end-on view shows a lot of these tracks seem to actually escape, which explains the low estimation of momentum in contained assumption



Thinks its contained

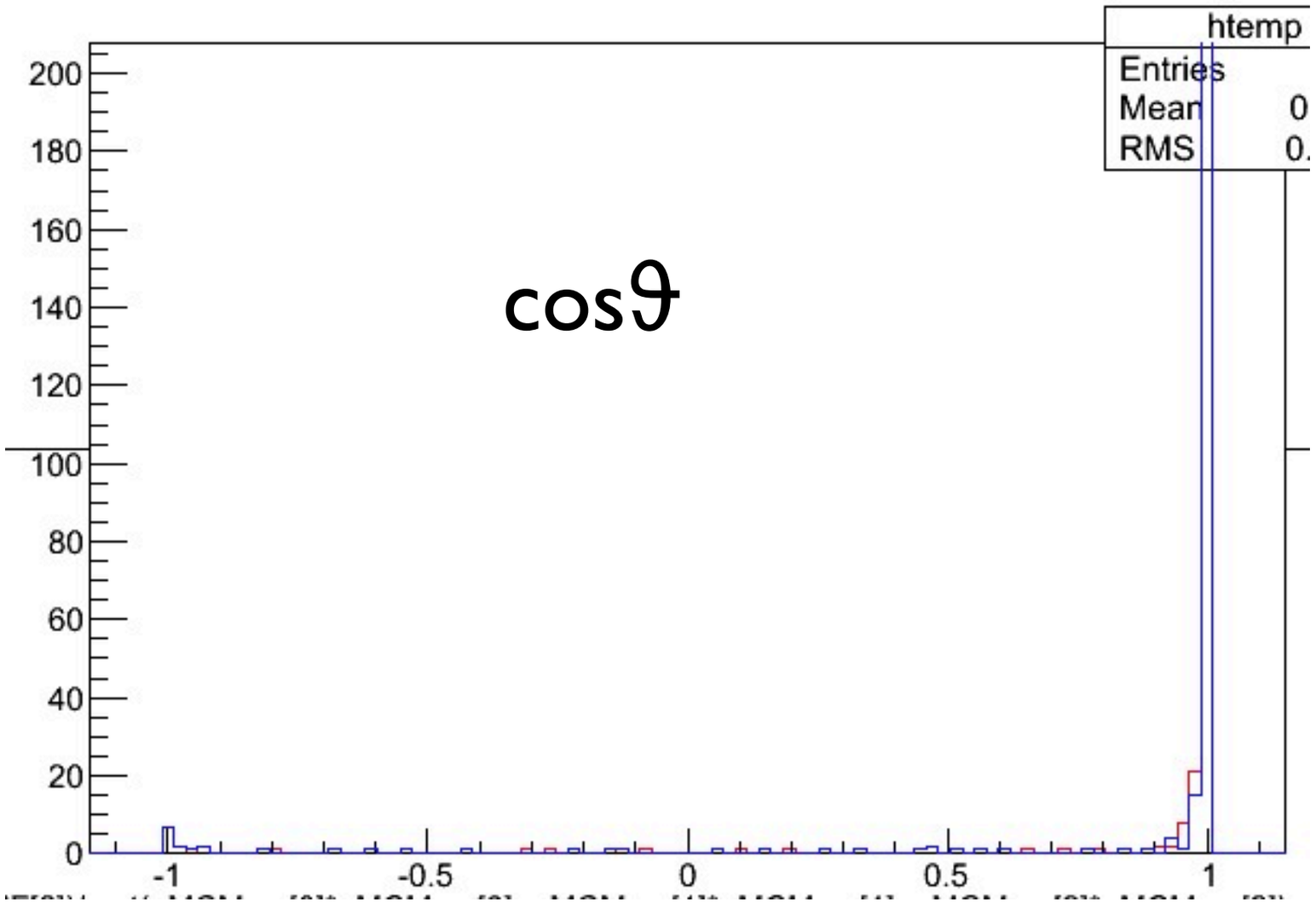
2.0 GeV/c




```
root [11] GENFITttree->Scan("pMCMom[3]:pRECKalF[3]:cont:trkNo","evtNo==2")
************************************************************
*    Row   * pMCMom[3] * pRECKalF[ *      cont *     trkNo *
************************************************************
*      2 *       2 * 1.3915222 *         1 *         1 *
*      3 *       2 * 1.6646761 *         1 *         2 *
*      4 *       2 * 0.3602387 *         0 *         3 *
************************************************************
```

G’aaah!

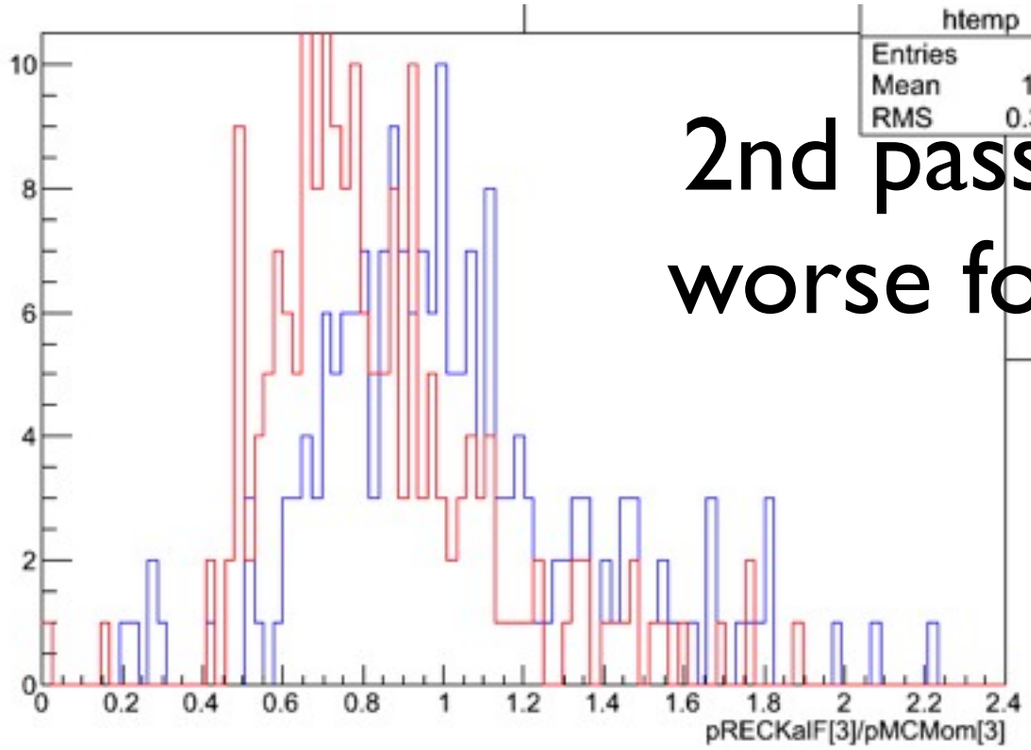
Pointing 0.2 GeV/c



Uncontained: where the effort is/needs to be

70% ? of BNB CCInc evts have exiting muons

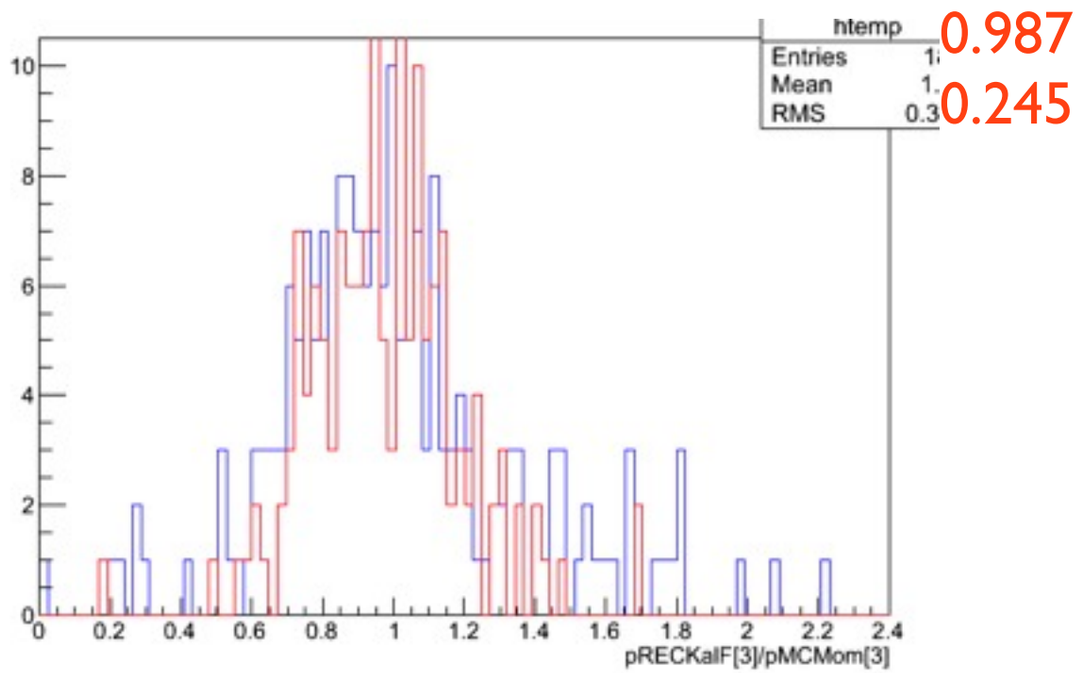
1GeV/c



first pass

2nd pass does worse for 3cm

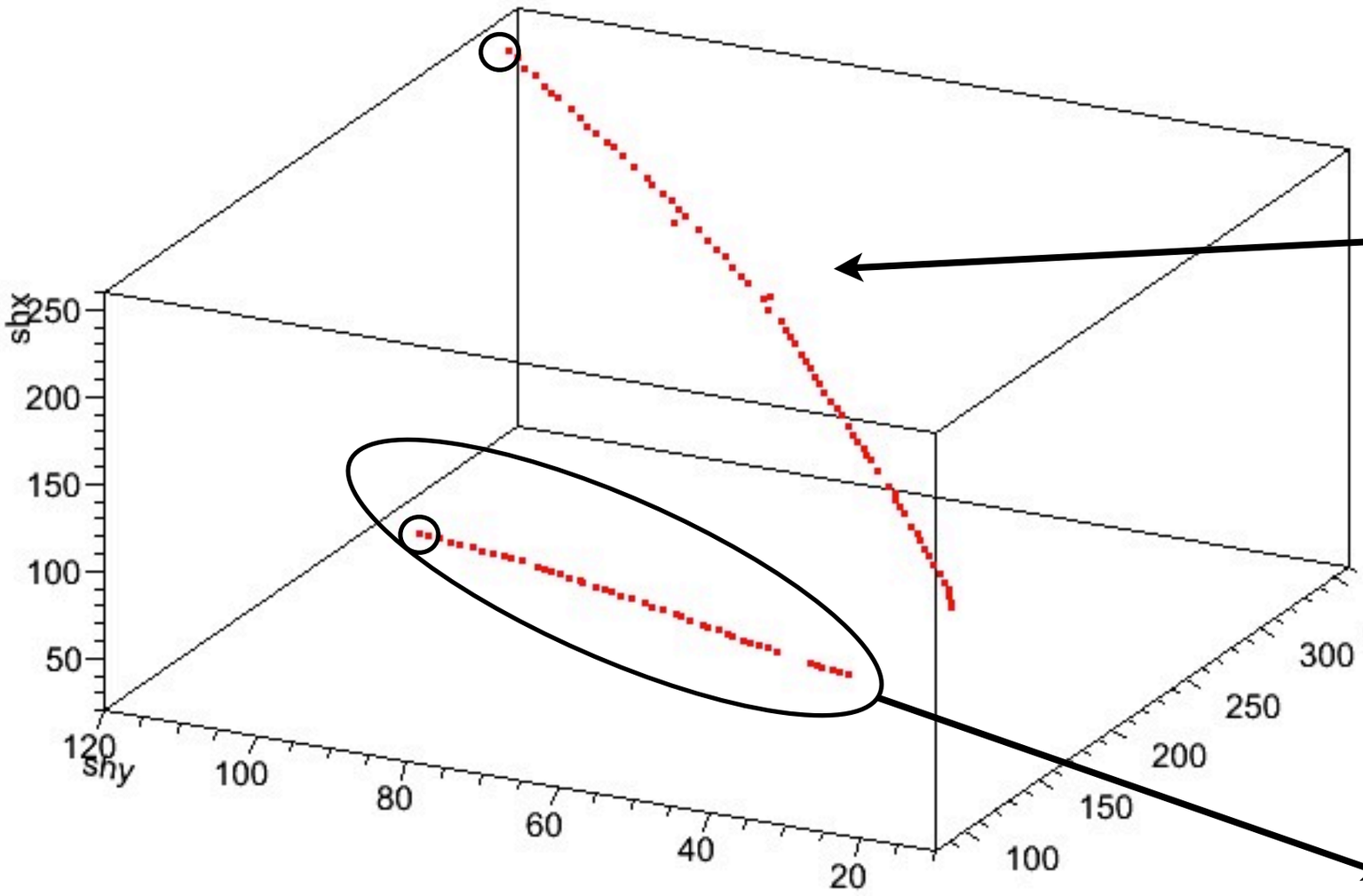
2nd pass does better for 10cm



0.987

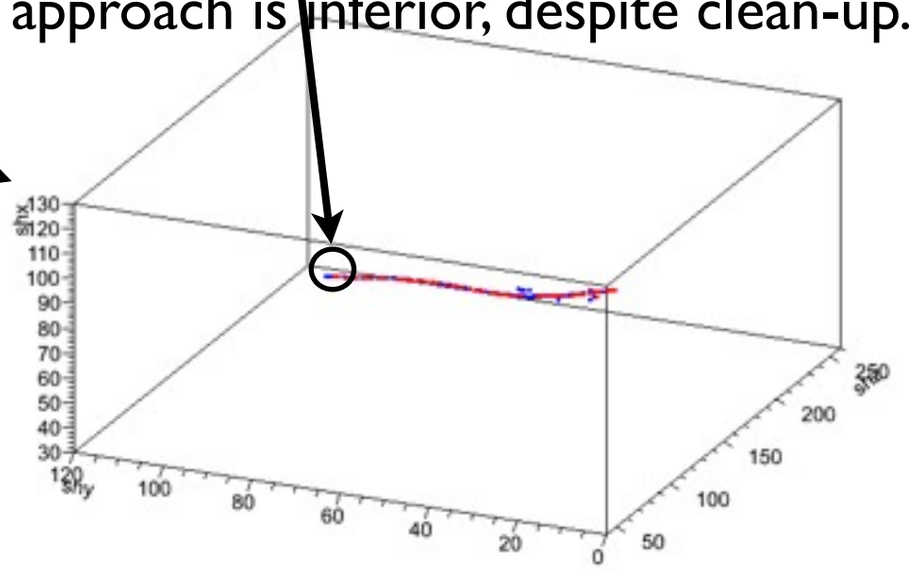
0.245

2 examples of recon'd momentum being 30% low: 2 events here



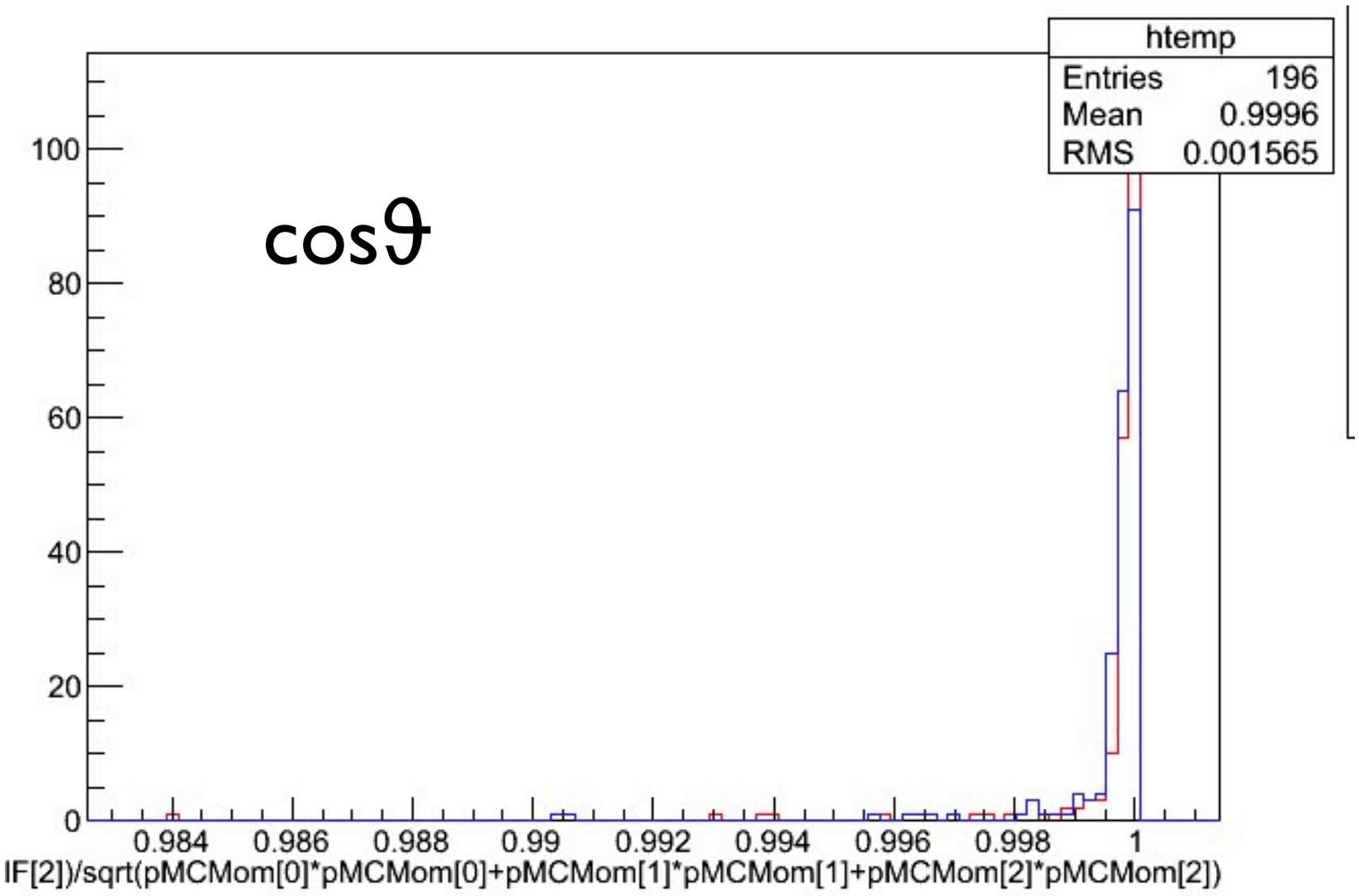
I have no good story for this truly uncontained track.

This point is in fact contained.
My Fiducial cut is wrong here: MS approach is inferior, despite clean-up.

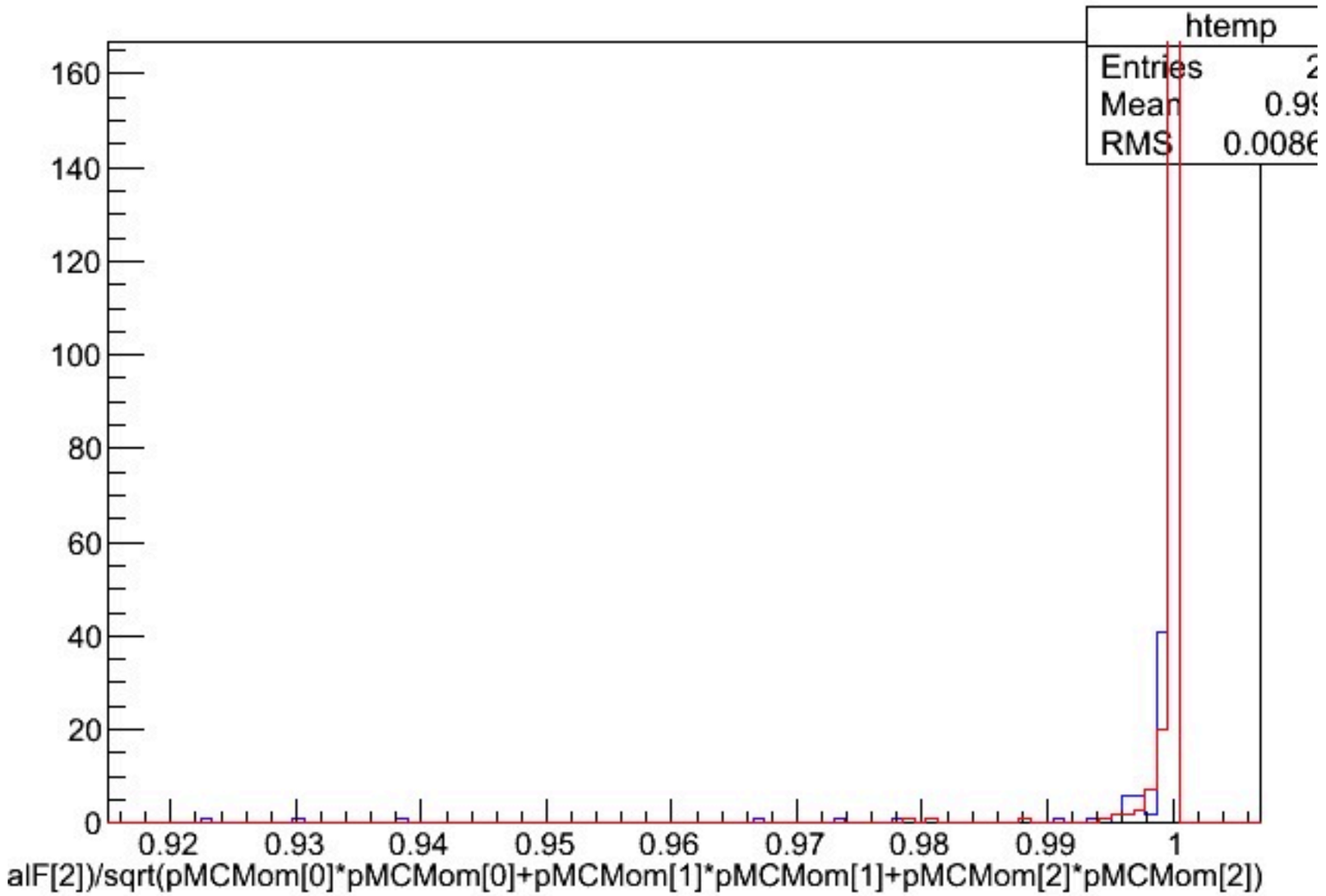


Red (blue) shows second (first) pass spacepoints.

Pointing: 1 GeV/c



Pointing 2 GeV/c

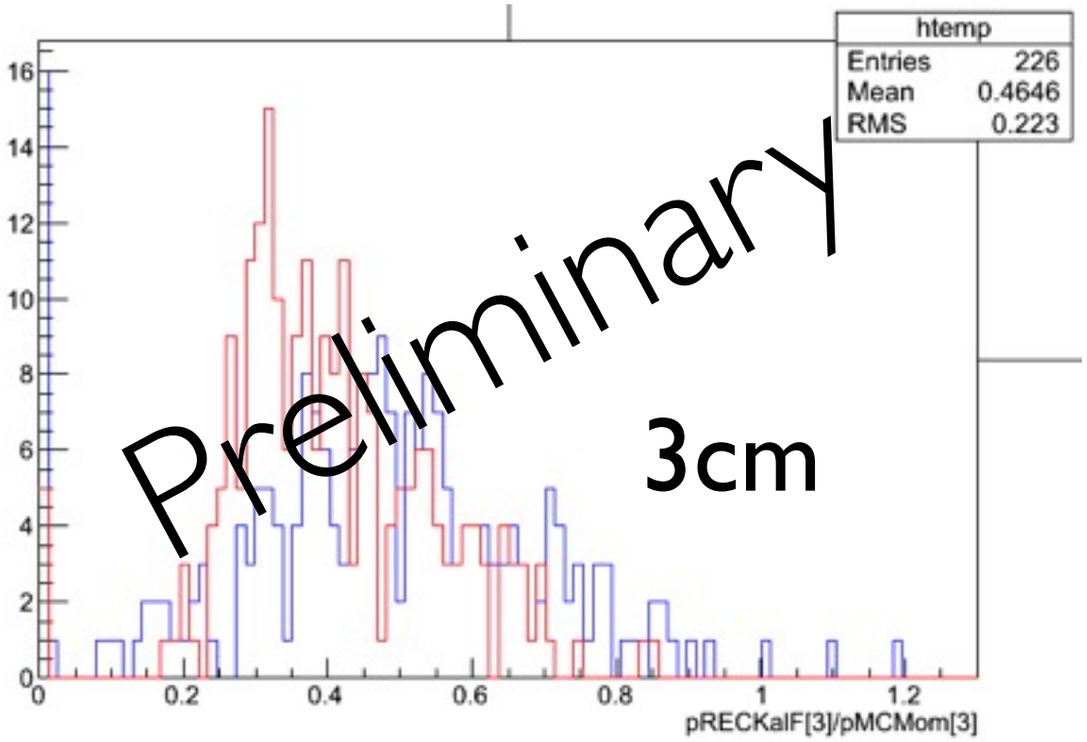


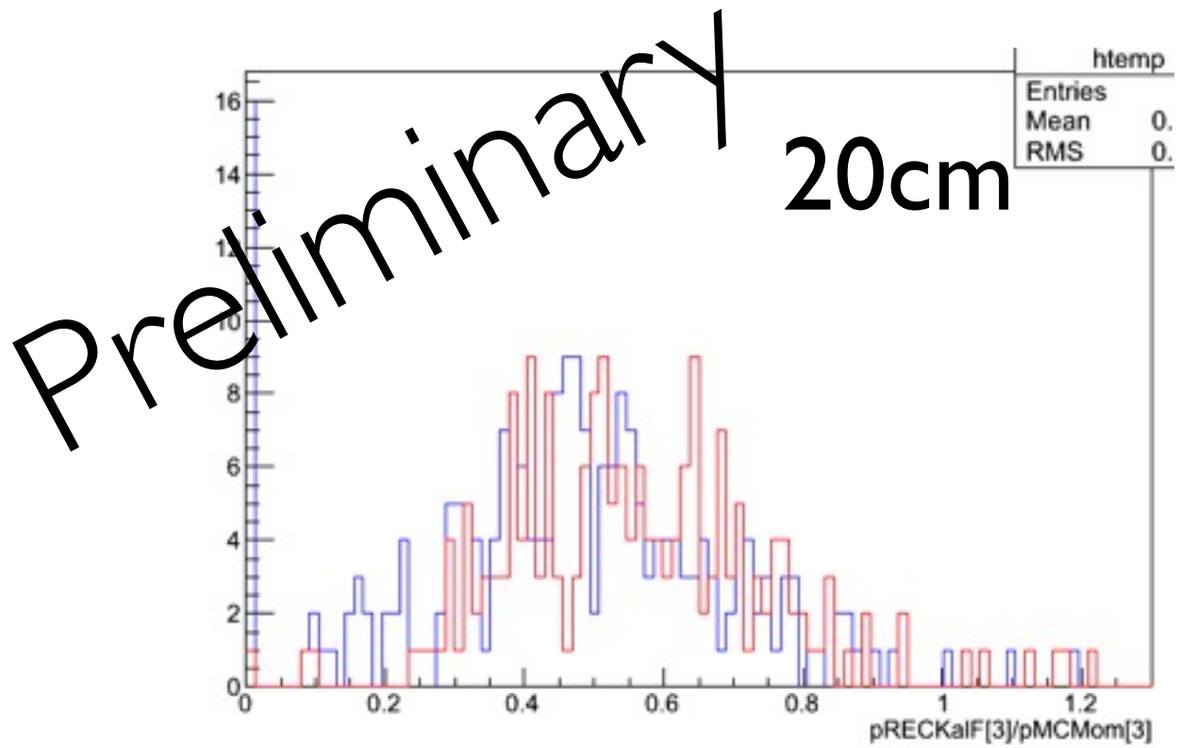
What's still frustratingly persistent

- calculating the momentum of uncontained tracks with any accuracy for all momentum
- arXiv::Icarus2006 says 20-30% resolution, depending on how many Ispacepoints used
- I can get <30% for 1 GeV/c tracks. I'm worried however I've tuned everything, even 2+ GeV /c tracks to give 1 GeV/c as the answer.

2 GeV/c

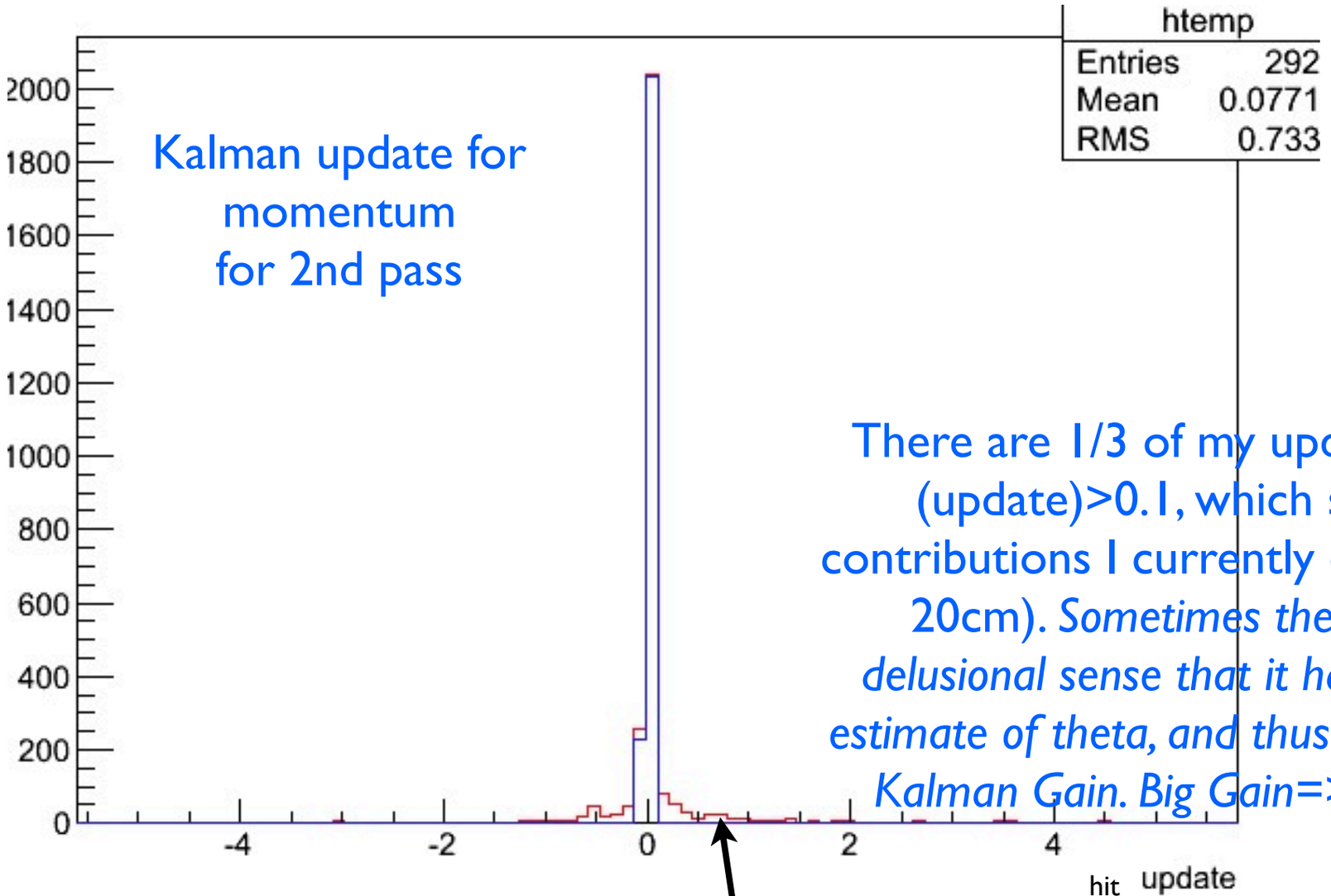
Ugggh. Can do better with starting 2nd pass with higher initial momentum, but that wrecks the 1 GeV/c tracks.





Ongoing investigation

2 GeV/c



Kalman update for momentum for 2nd pass

There are 1/3 of my updates with abs (update)>0.1, which spacepoint contributions I currently don't apply (for 20cm). *Sometimes the filter has a delusional sense that it has a very good estimate of theta, and thus calculates a big Kalman Gain. Big Gain=> big Update.*

I can not allow big updates that jerk the track around and make 1/p go negative are exceedingly large.

Big tail

Difficulty

- 1/p *13 MeV*sqrt(dist/16cm) = theta
- dtheta depends on spacepoint errors and variation inherent in MS
- At each spacepoint I draw from a random Gaussian with expected mean theta and compare to the observed deflection over previous two measurement surfaces. **It's a weak relation, for any given point.**

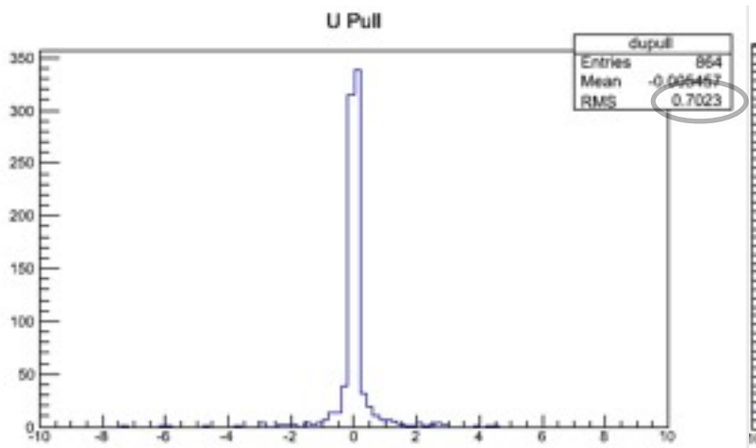
Ongoing Work/ progress

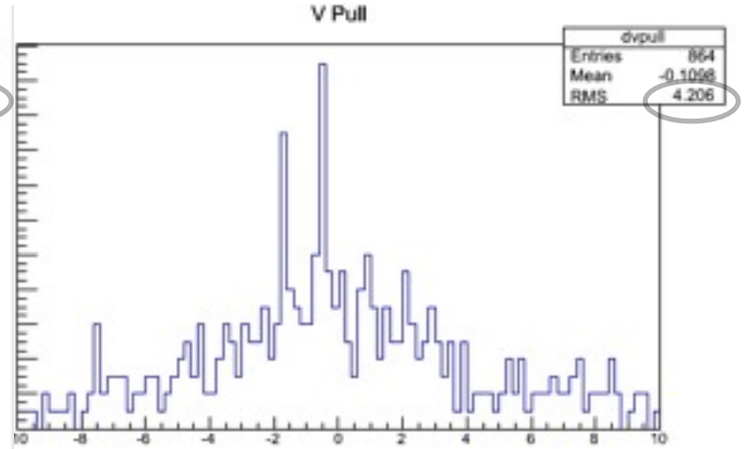
- TrackAna module now running to allow direct comparisons between Track3DHitKalman and Track3DKalmanSPS
- Genie CC evts with BNB flux: first ones looked at with Track3DKalmanSPS last night!

TrackAna

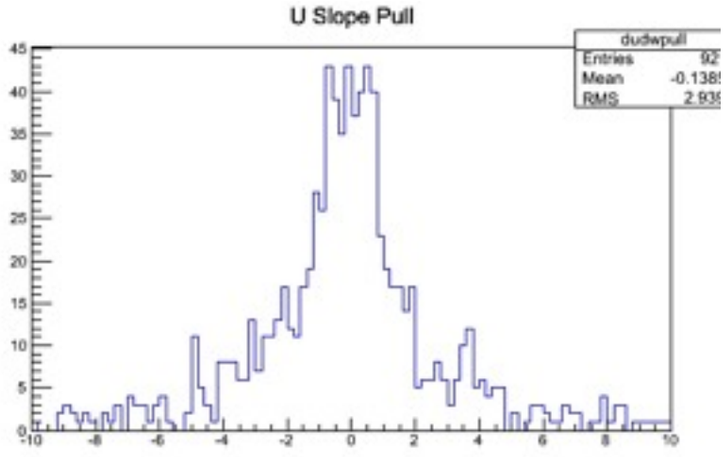
- I am not yet picking desired track in TrackAna to match to MC, and so efficiencies are artificially reported to be low. So, nothing yet to show there to compare to Herb's Track3DHitKalman results.

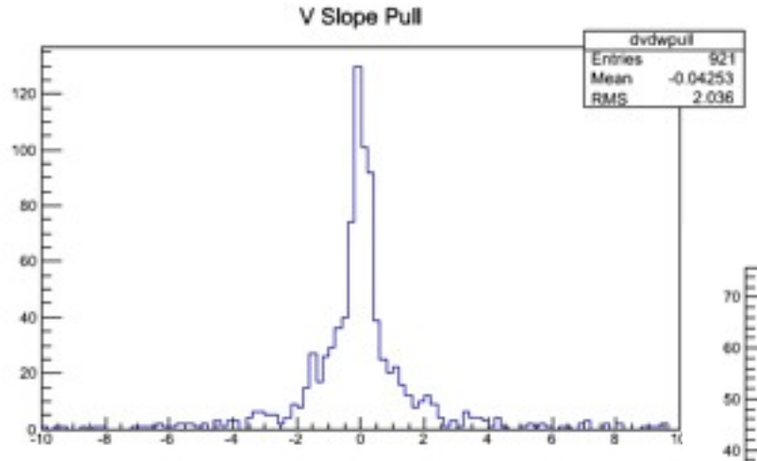
pulls (Recon-MC)/sigma

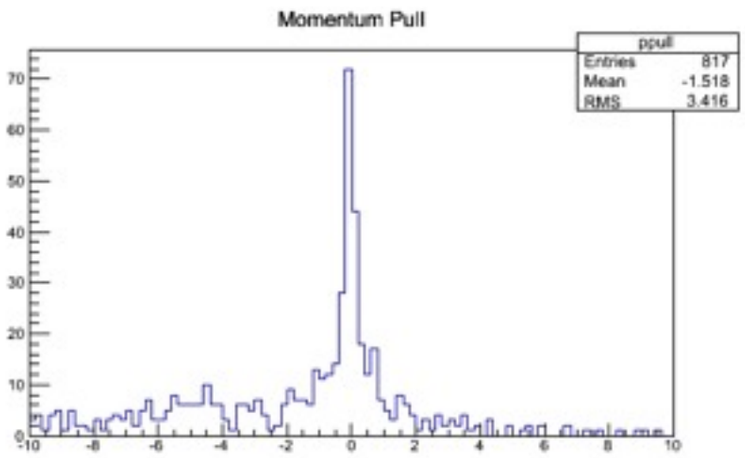




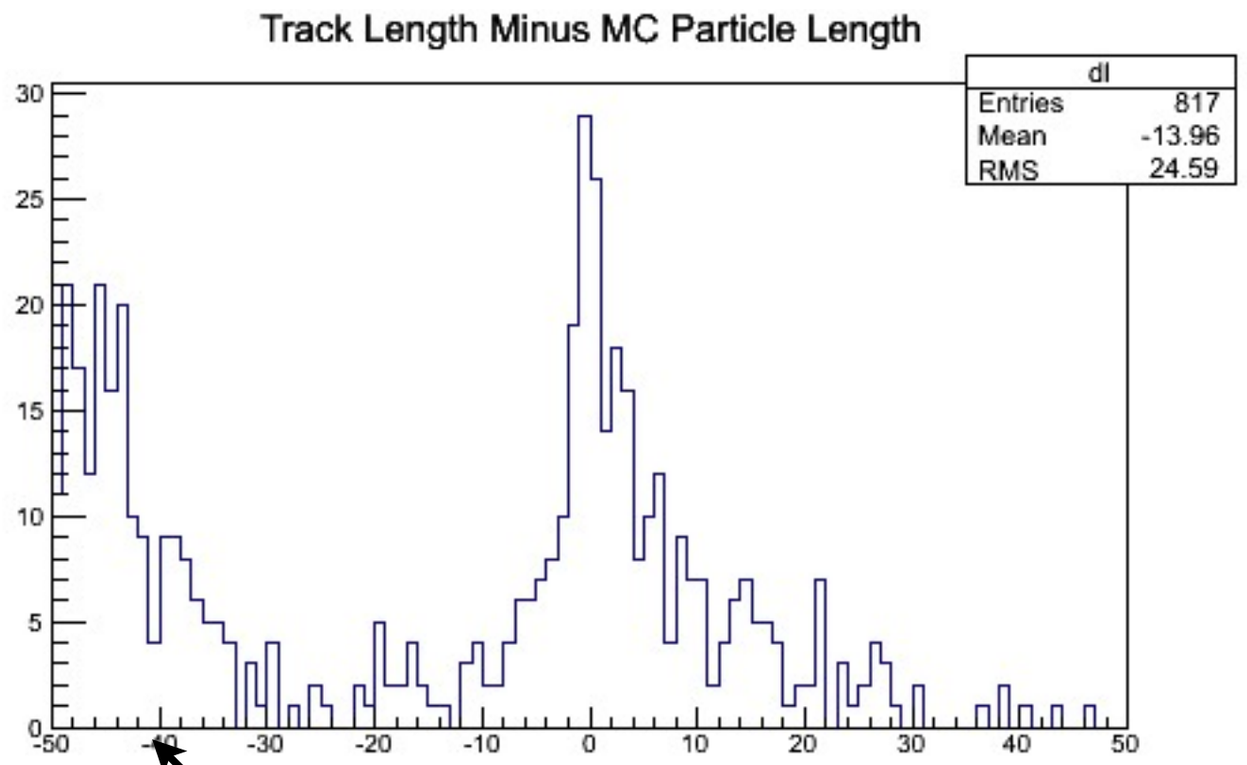
This difference is attributable to the fact that I am not yet conforming to the TrackAna-assumed convention of u,v,w when I put my Track on the event. I need to make a rotation first. Will do that soon.







TrackAna



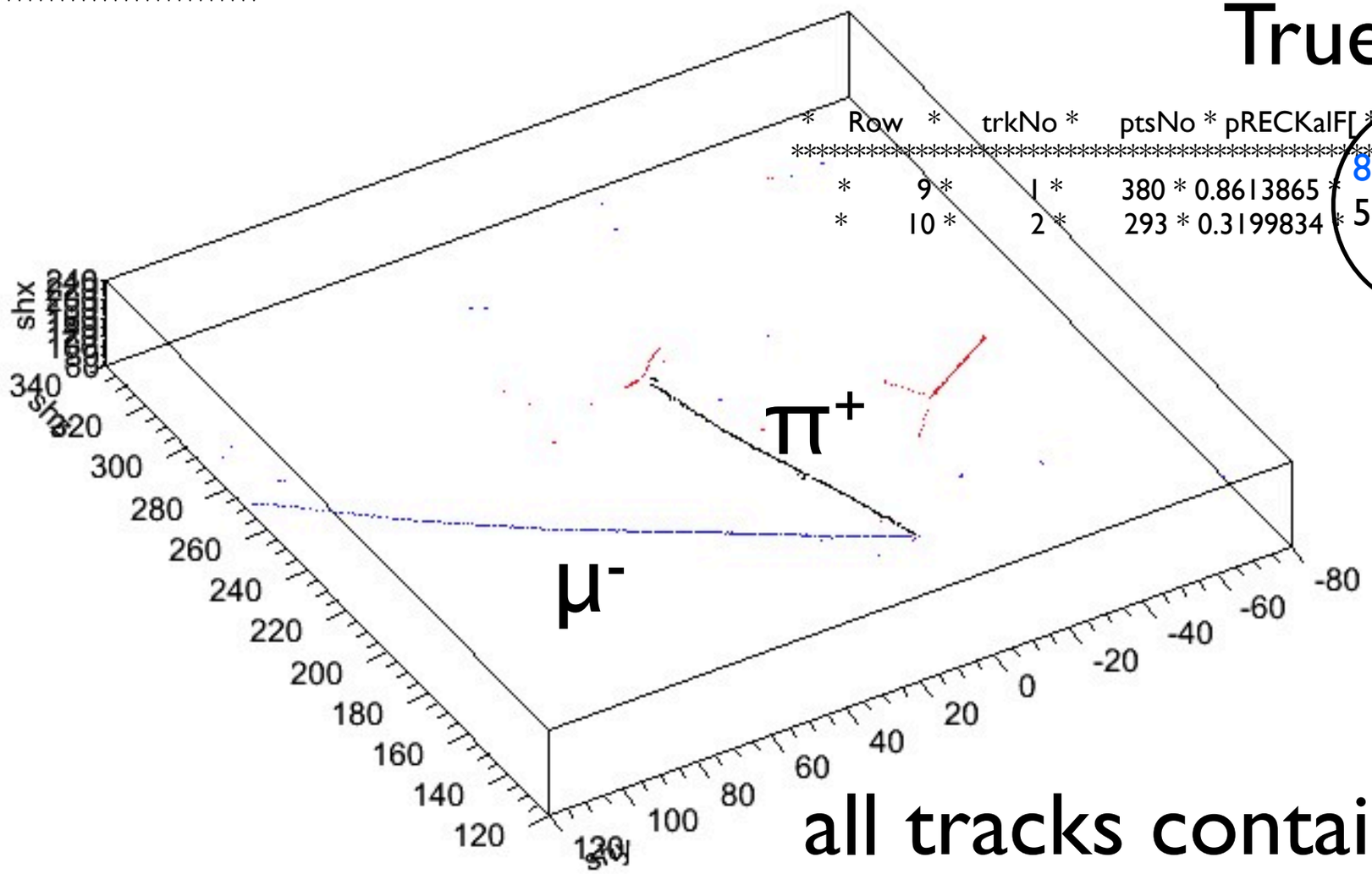
These are clusters that are truncated, I believe.

CC numu

Energy

```
*****************************************
*  Row   *     MCPdg * MCEnergy * MCDProces *
*****************************************
*      134 *       13 * 0.8440466 * muMinusCa *
*      135 *     2112 * 1.4427317 * NeutronIn *
*      136 *      211 * 0.5717023 * PionPlusI *
*      137 *     2212 * 1.0143212 *          *
*****************************************
```

shx:shy:shz {evtNo==3}



True Momenta

```
*****************************************
*  Row   *    trkNo *    ptsNo * pRECKalF[ *
*****************************************
*       9 *       1 *     380 * 0.8613865 *
*      10 *       2 *     293 * 0.3199834 *
*****************************************
```

836 GeV/c

553 GeV/c

all tracks contained