



Vertex Finding from 3D Tracks in ArgoNeut

Saima Farooq

Tim Bolton

Kansas State University

June 29th, 2011



Introduction

PrimaryVertexFinder

- Find the 3D Vertex using the 3D Tracks reconstructed by Track3DKalman
- Today, I am presenting the work on the Primary Vertex Reconstruction



Reconstruction

- CCQE, CCDIS, CCRES and CCCOH events are generated: 5000 each
- The MC files are passed through the full reconstruction chain
 - HitFinder
 - ClusterFinder (DBSCAN) : Groups Hits into clusters and remove noise hits
 - HoughLineFinder : Finds Line-like clusters
 - LineMerger : Merges hough lines based on their slopes and end point in 2D
 - SpacePts : Matches hits from 2D to give it a position in 3D space (x, y, z)
 - TrackFinder (kalman) : Reconstructs tracks... 3D object
 - VertexFinder (PrimaryVertexFinder) : Reconstructs a vertexes... 3D object



PrimaryVertexFinder

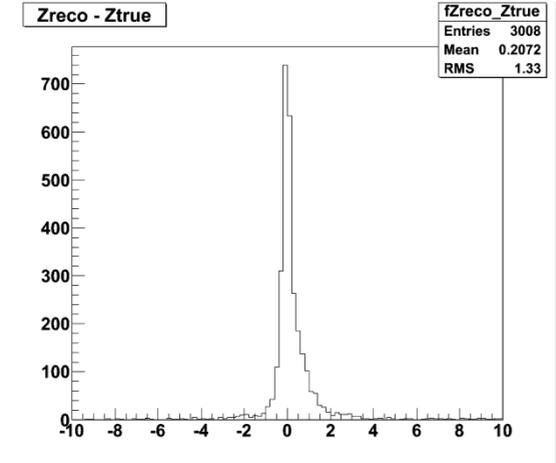
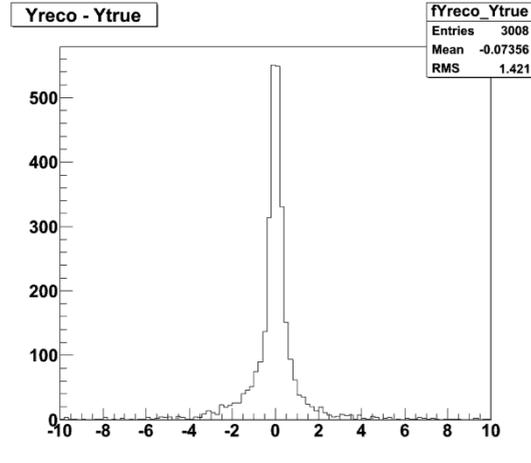
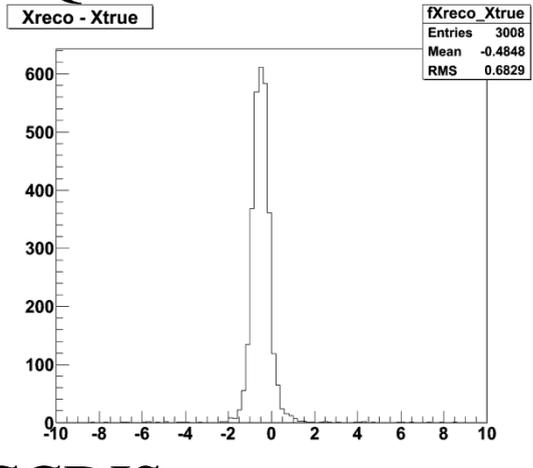
- Sort the Tracks with respect to their **length in 3D space**
- Using the **start point** (s_1) and the **direction cosines** of the Track, Extend the first 2 Tracks to find the **distance of closest approach (dca)** between a pair of tracks
- 'Vertex' two tracks if the **dca < 0.5cm** AND if the **|dca point on track - s_1 | < 0.5cm**
- **Continue matching** rest of tracks to the longest track in an event
- Can have **more than 2 tracks associated to the vertex**
- If a **single track event**, the **most upstream point** on the longest track is the Primary Vertex

Vreco - Vtrue (cm)

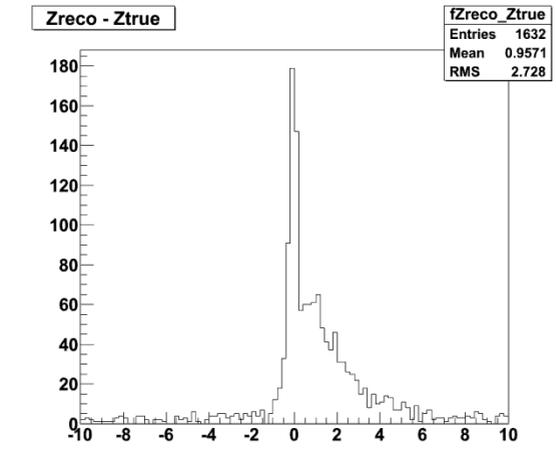
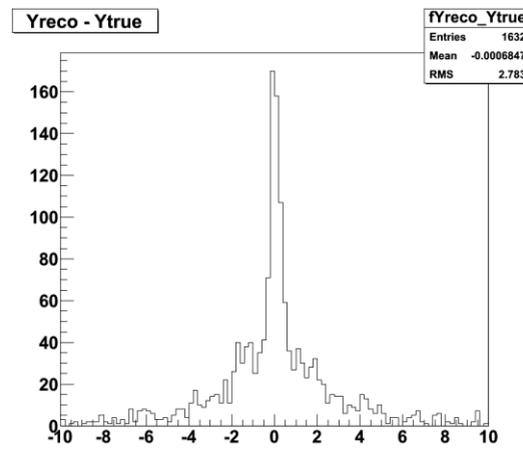
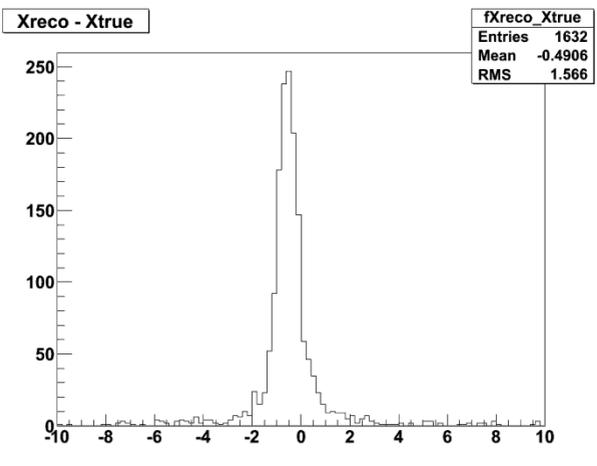
Generated 5000 CC- QE, DIS, RES, COH Interactions: Each



CCQE Preliminary



CCDIS



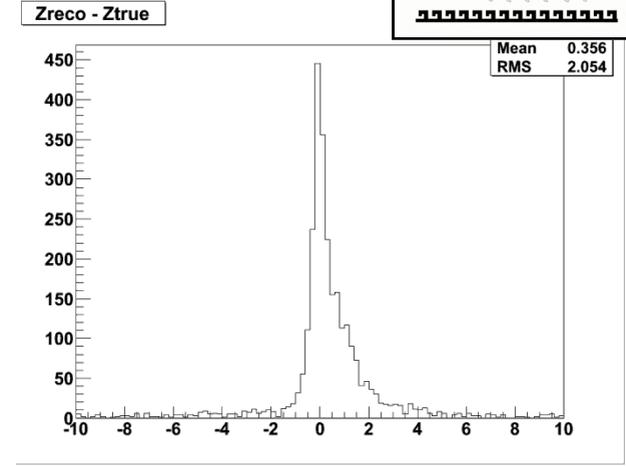
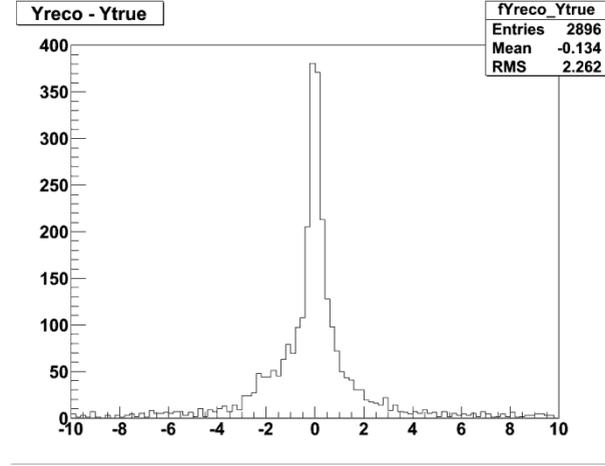
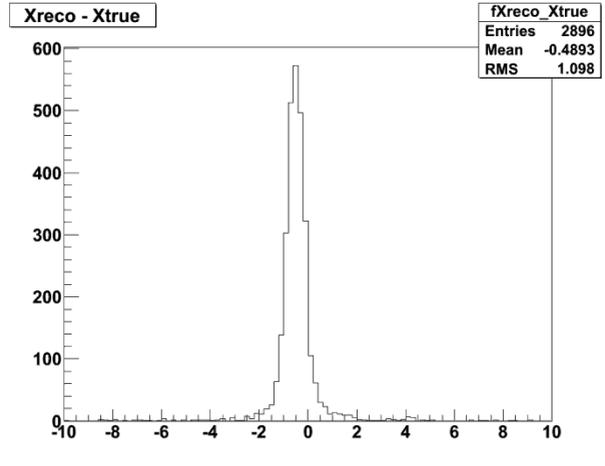
$3 < X_{reco} < 44 \text{ cm}$, $-16 < Y_{reco} < 16 \text{ cm}$, $6 < Z_{reco} < 86 \text{ cm}$

Vreco – Vtrue (cm)

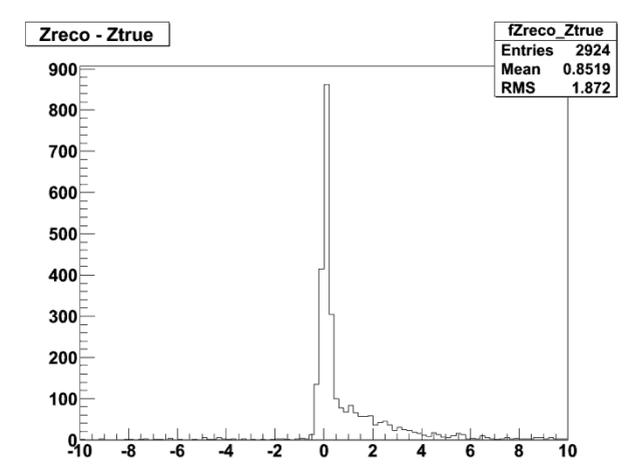
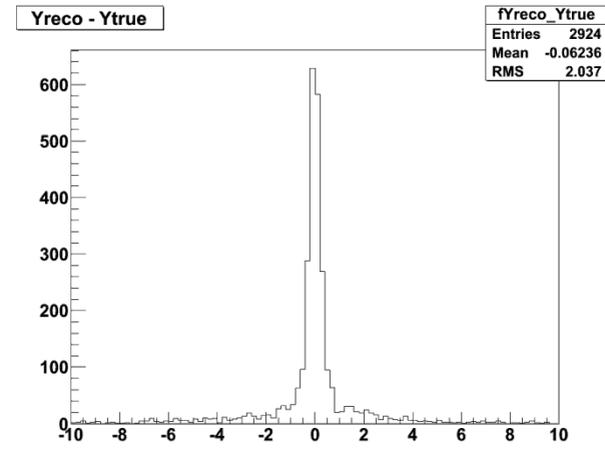
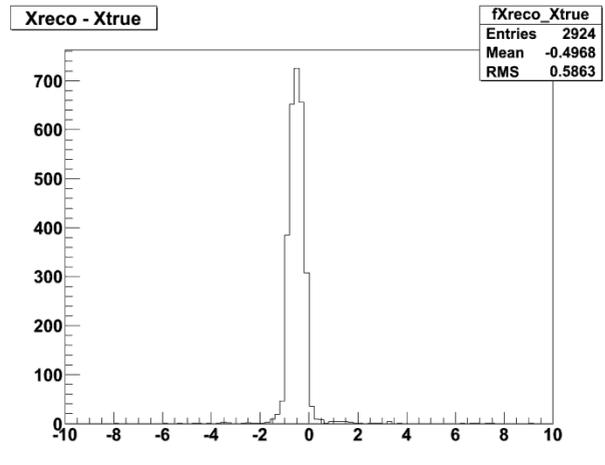


CC-RES

Preliminary



CC-COH





Vreco – Vtrue (cm)

	CCQE	CCDIS	CCRES	CCCOH
Mean x	-0.4848	-0.4906	-0.4892	-0.4968
RMS x	0.6829	1.566	1.098	0.5863
Mean y	-0.0736	-0.0006847	-0.134	-0.06236
RMS y	1.421	2.783	2.262	2.037
Mean z	0.2072	0.9571	0.356	0.8519
RMS z	1.33	2.728	2.054	1.872

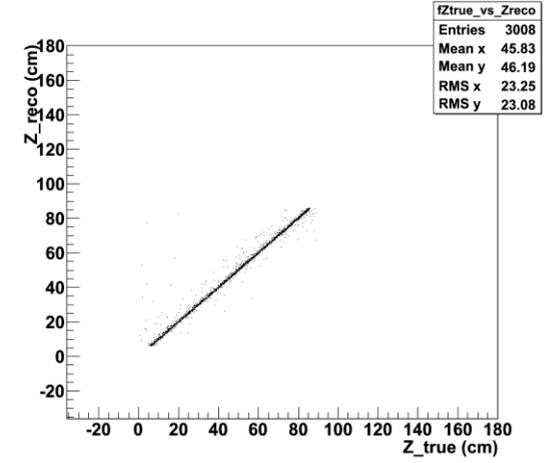
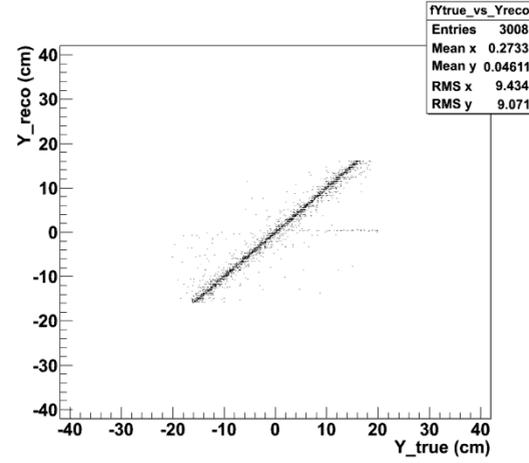
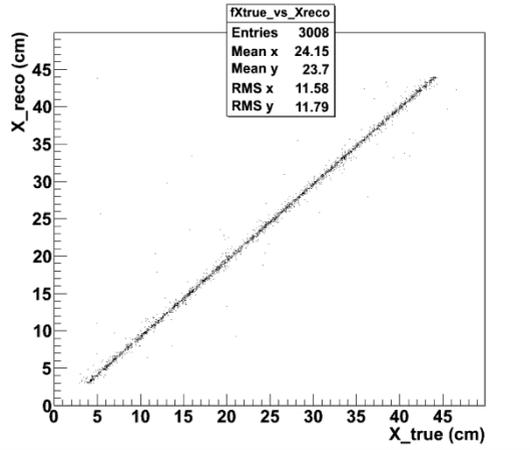
$3 < X_{reco} < 44\text{cm}$, $-16 < Y_{reco} < 16\text{cm}$, $6 < X_{reco} < 86\text{cm}$

Vreco Vs Vtrue

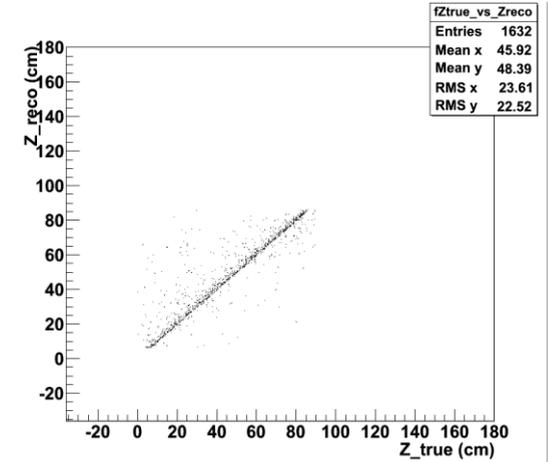
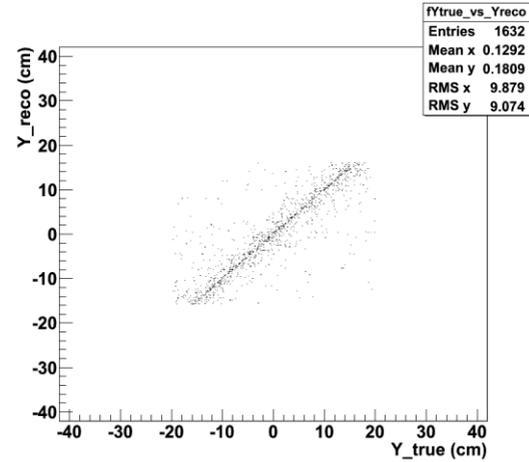
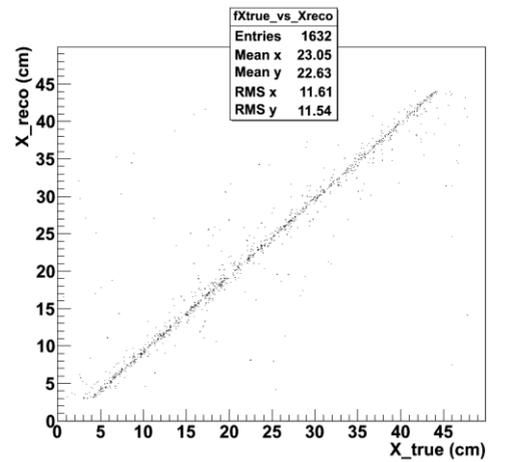


CCQE

Preliminary



CCDIS

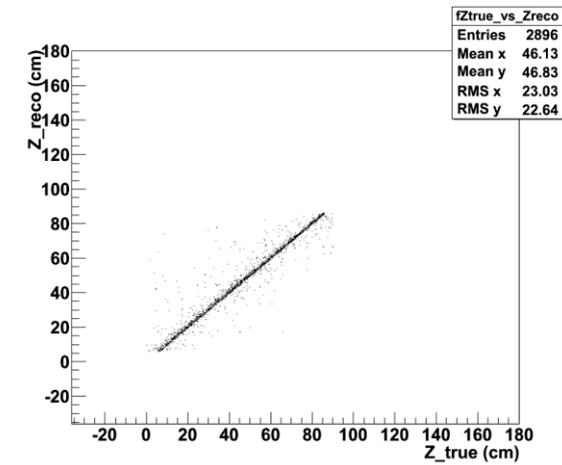
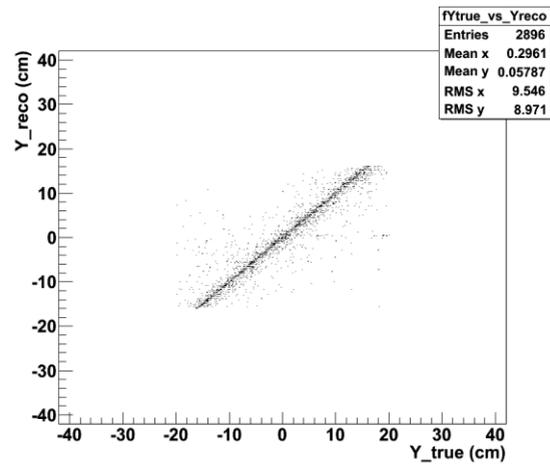
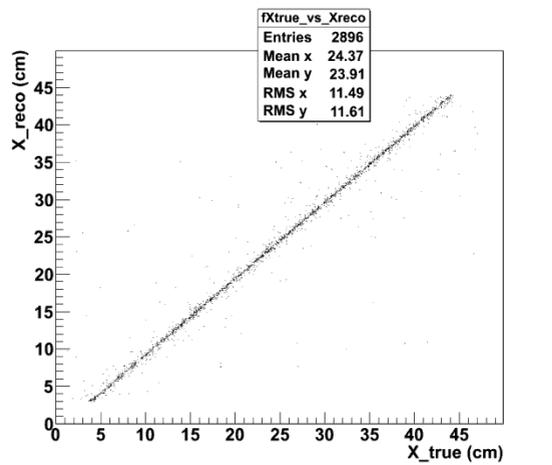


Vreco Vs Vtrue

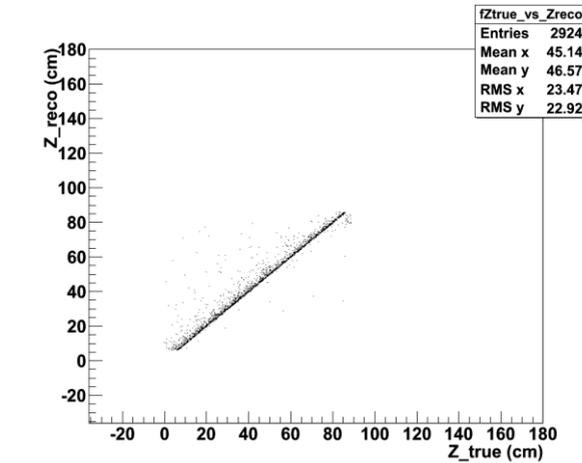
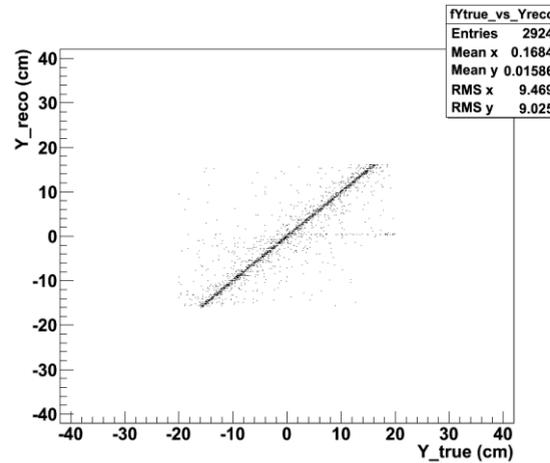
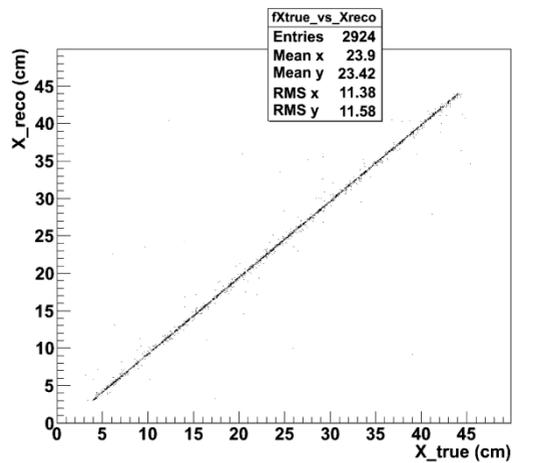
Preliminary



CCRES



CCCOH



Vreco – Vmuon (cm)

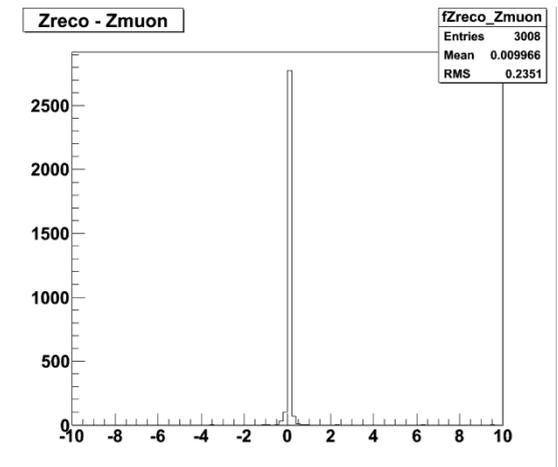
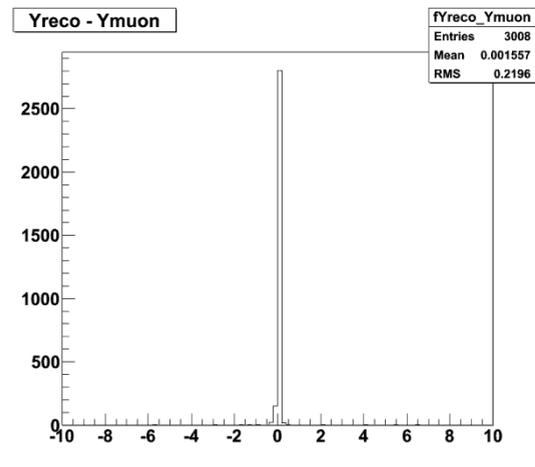
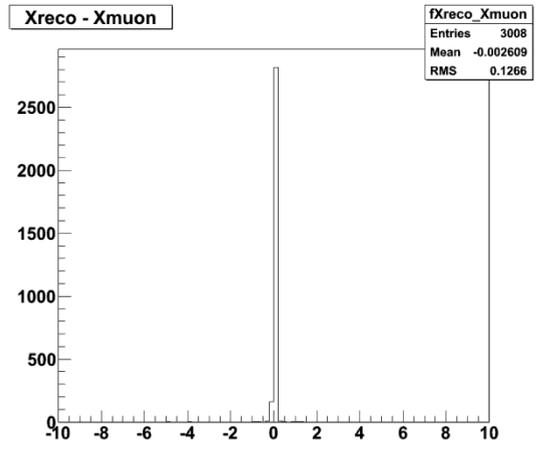


The plots show that the off set in the true and reconstructed vertex mainly comes from 3D tracks reconstruction

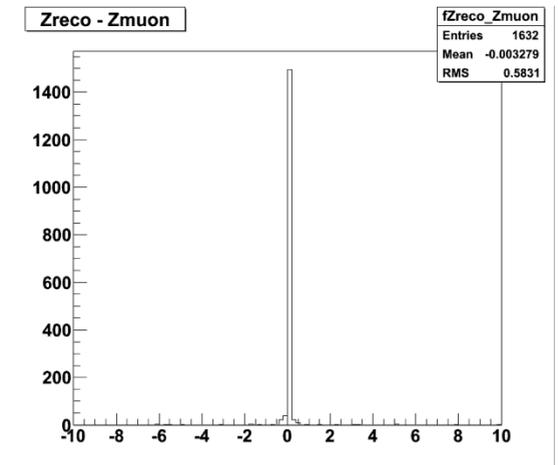
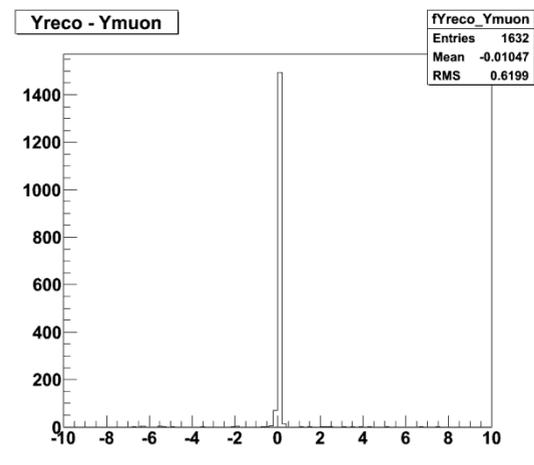
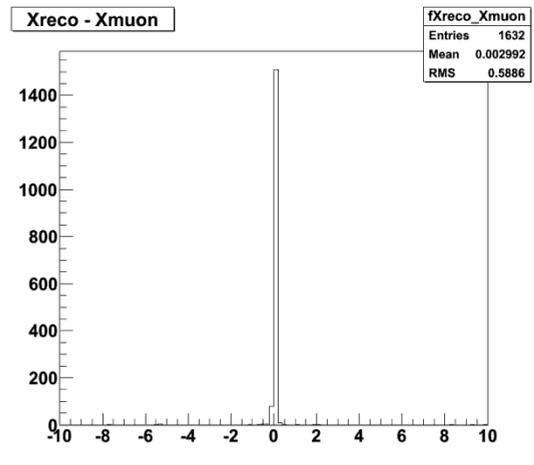
Preliminary

Vmuon is the start point of reconstructed longest track

CCQE



CCDIS

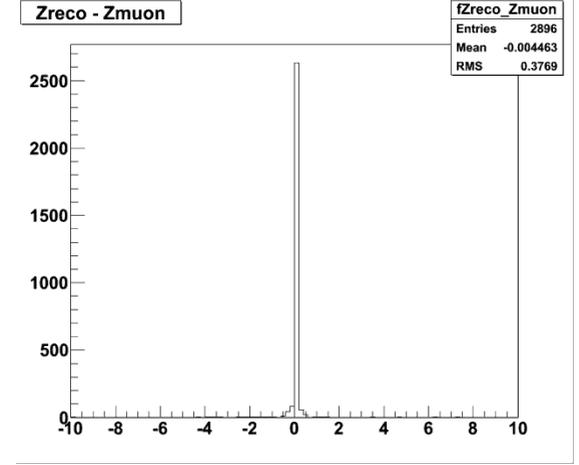
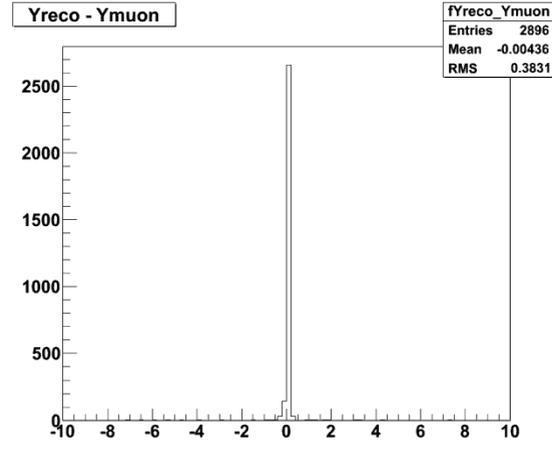
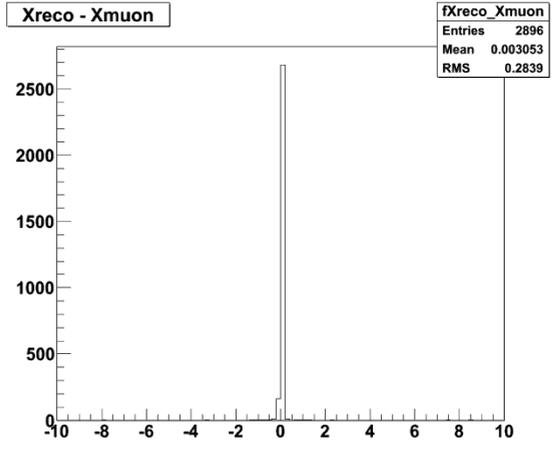


Vreco – Vmuon (cm)

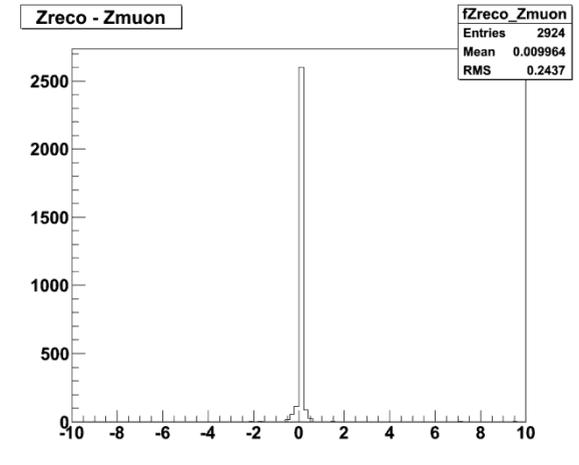
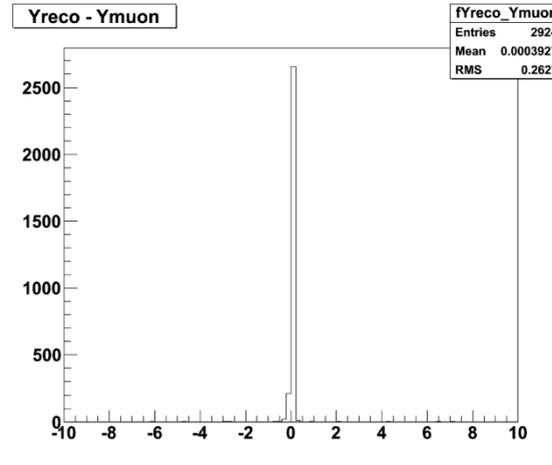
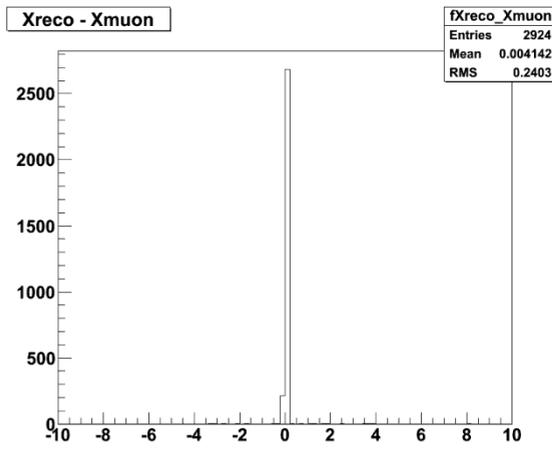


CCRES

Preliminary



CCCOH

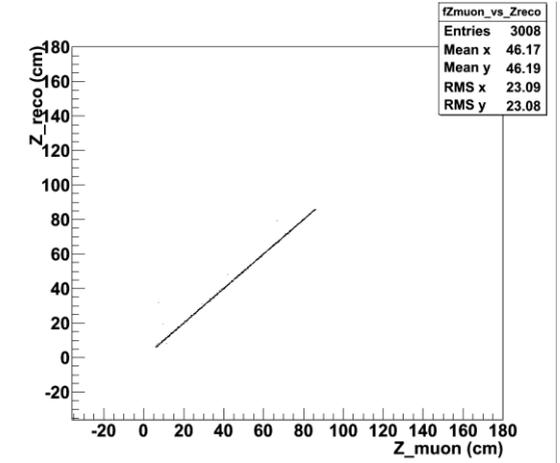
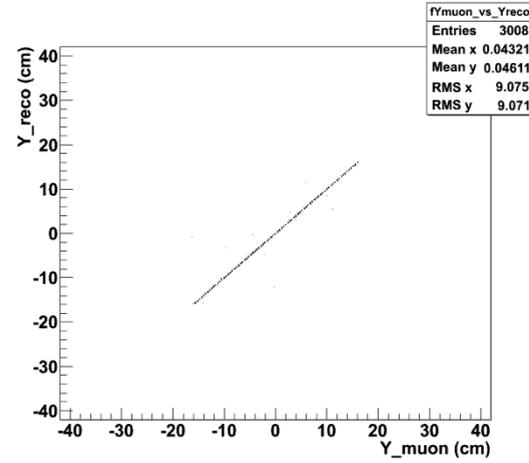
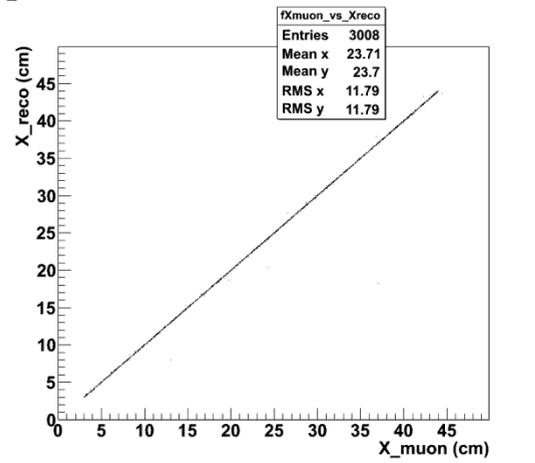


Vreco vs Vmuon

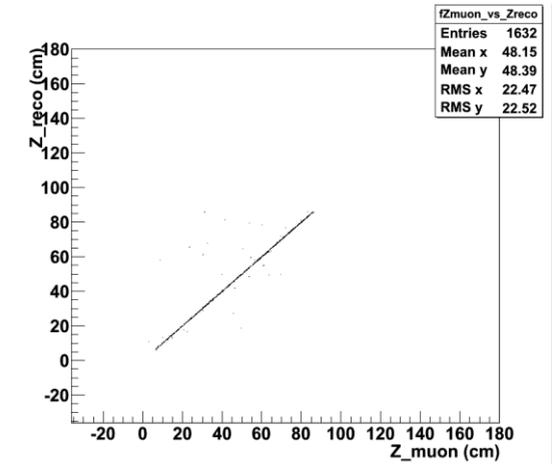
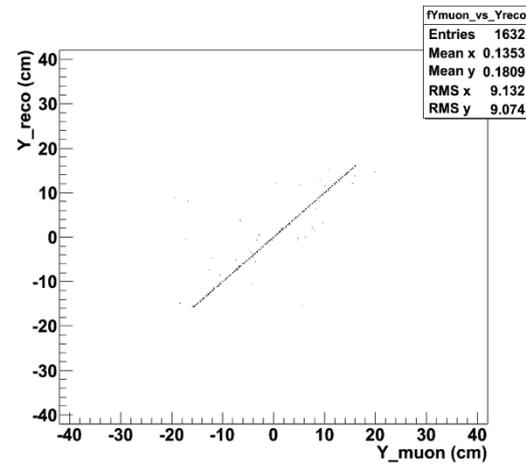
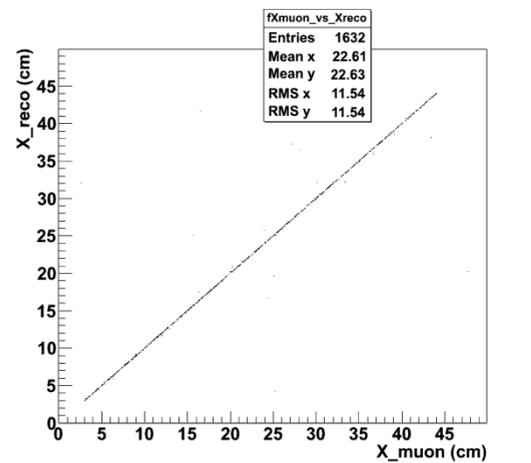


Preliminary

CCQE



CCDIS

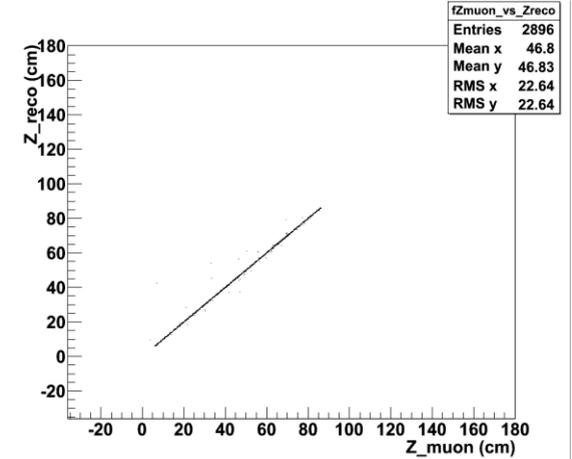
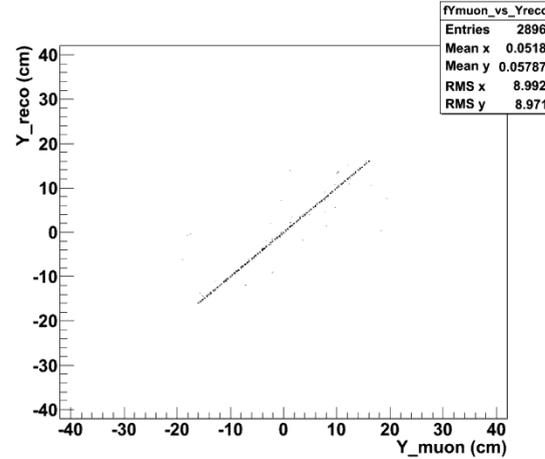
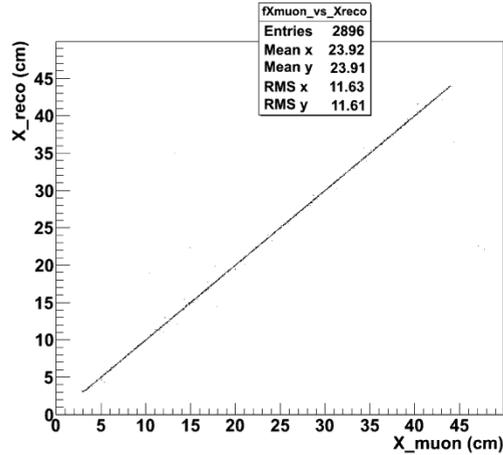


Vreco vs Vmuon

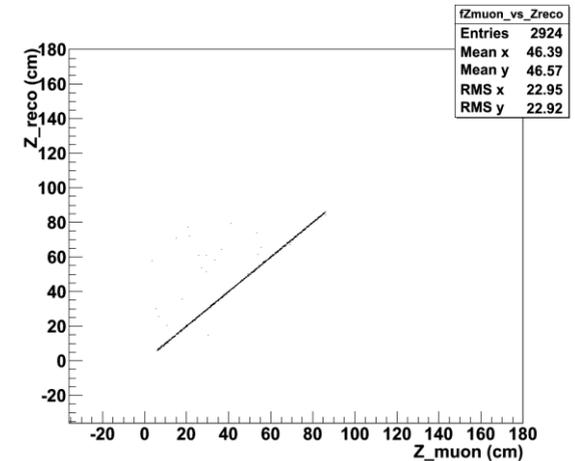
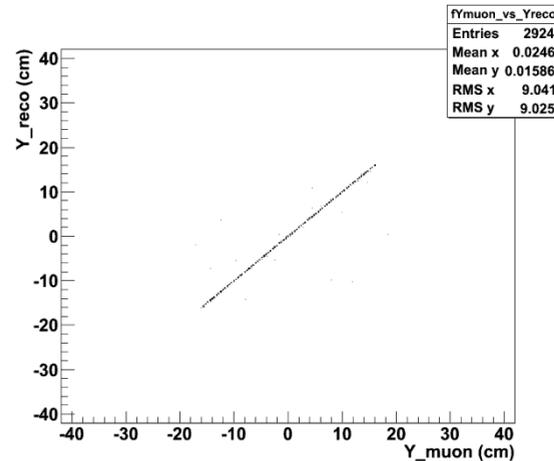
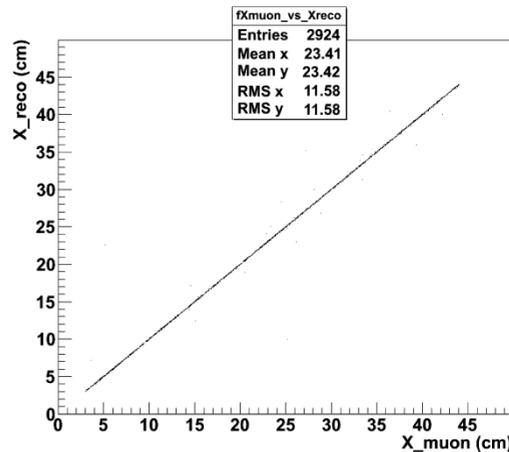


CCRES

Preliminary



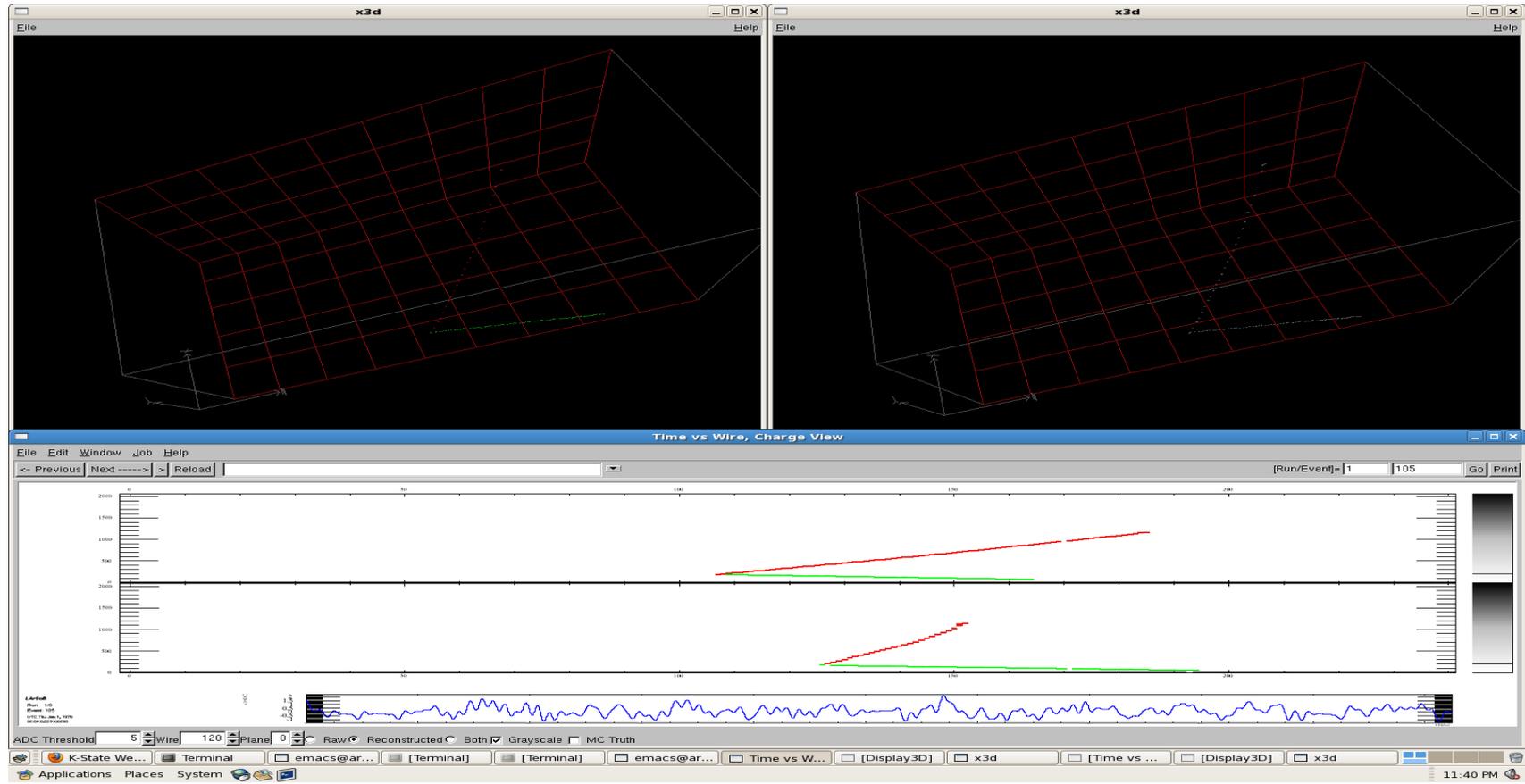
CCCOH



EventDisplay : 3D vertex

Matched Tracks

Vertex Visible

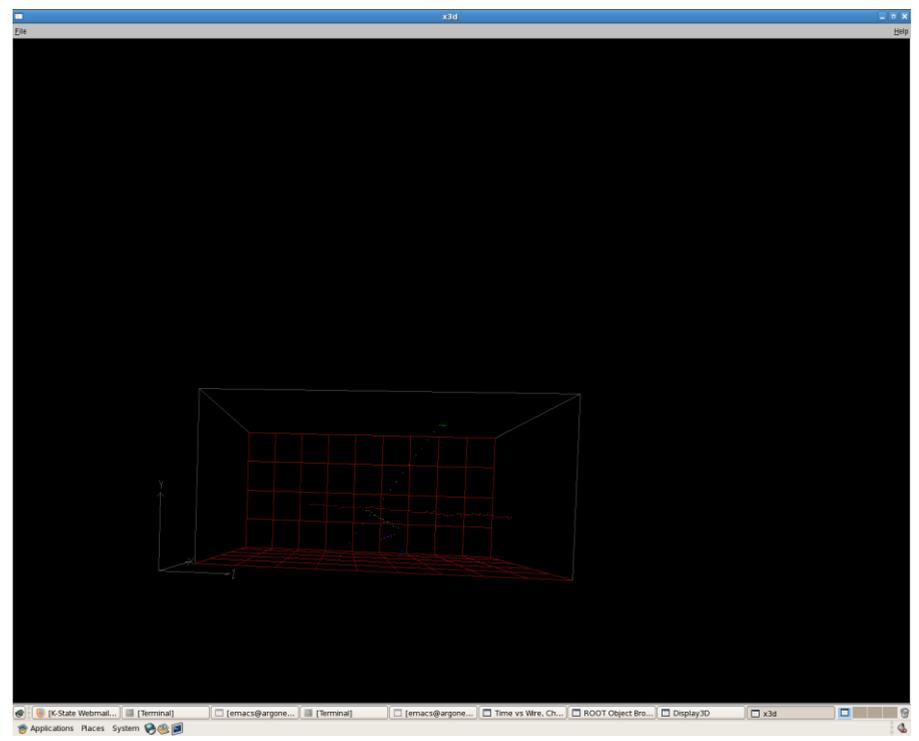
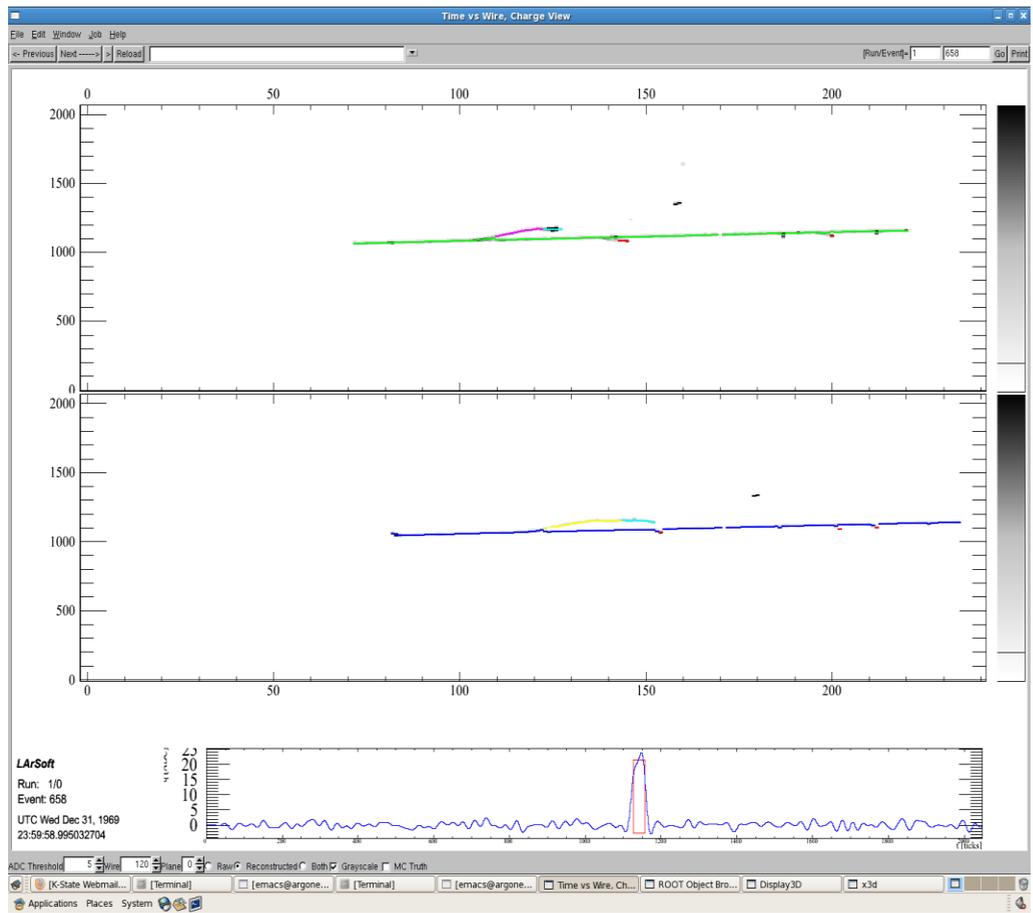




Few Things to Mention..

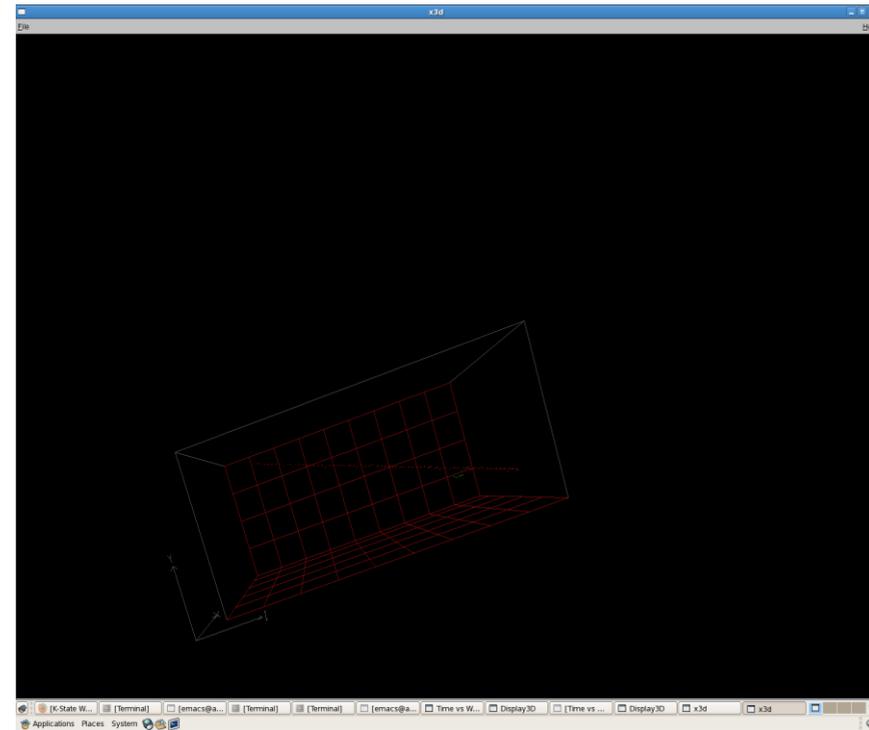
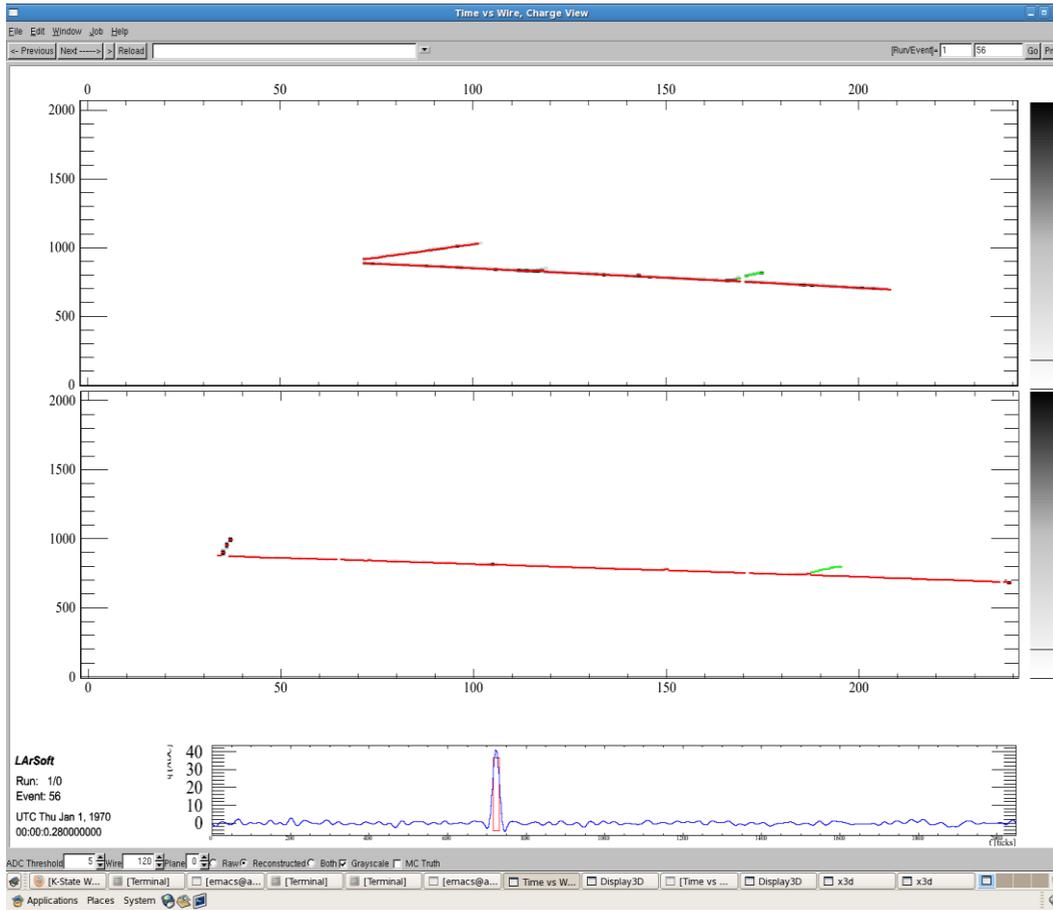
- Working on VertexFinder led to look into TrackFinder in detail
 - Found that calculation for drift coordinate has been done as if shield plane is the $x=0$. (Corrected, since Induction Plane is $x=0$)
 - Found that `geom->WirePitch()` returns a negative value; -0.381cm (Taken account of this -ve number)
 - Found that `geom->DetHalfHeight()` returns 40cm and not 50cm anymore (taken account for this change)
- Mitch & Eric Helped me a lot in getting started with Reco and understanding TrackFinder... Thank you

1) Tracks Parallel to Wire Planes



Multiple Fake Tracks

2) Short Proton Tracks



Only Muon Track Reconstructed



Conclusion

- Demonstrated the VertexFinder based on 3D tracks
- It seems to work well on Events with small number of tracks
- Vertex Finding Efficiency depends on Track Finder



Thanks