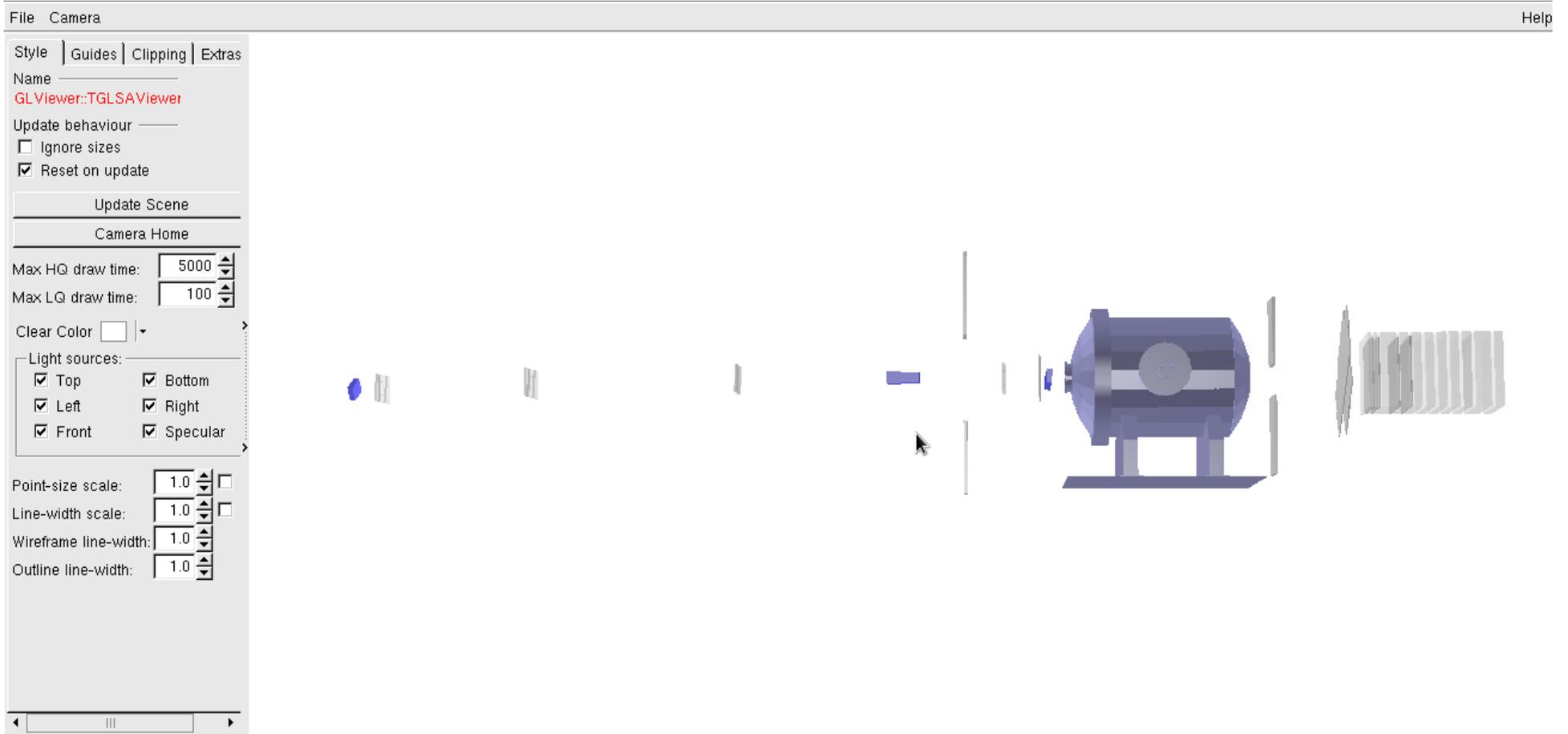


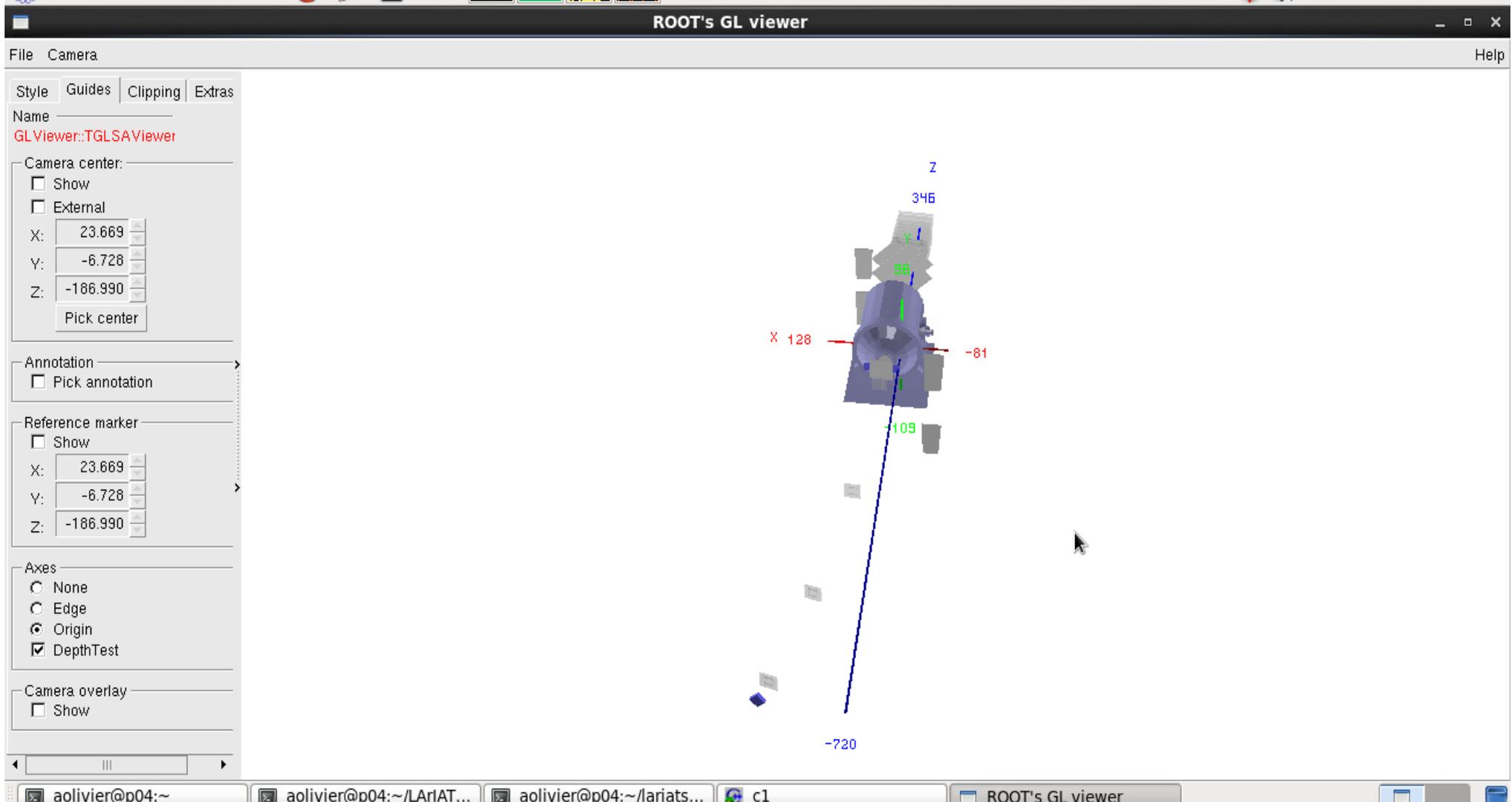
LArIAT Geometry Overview



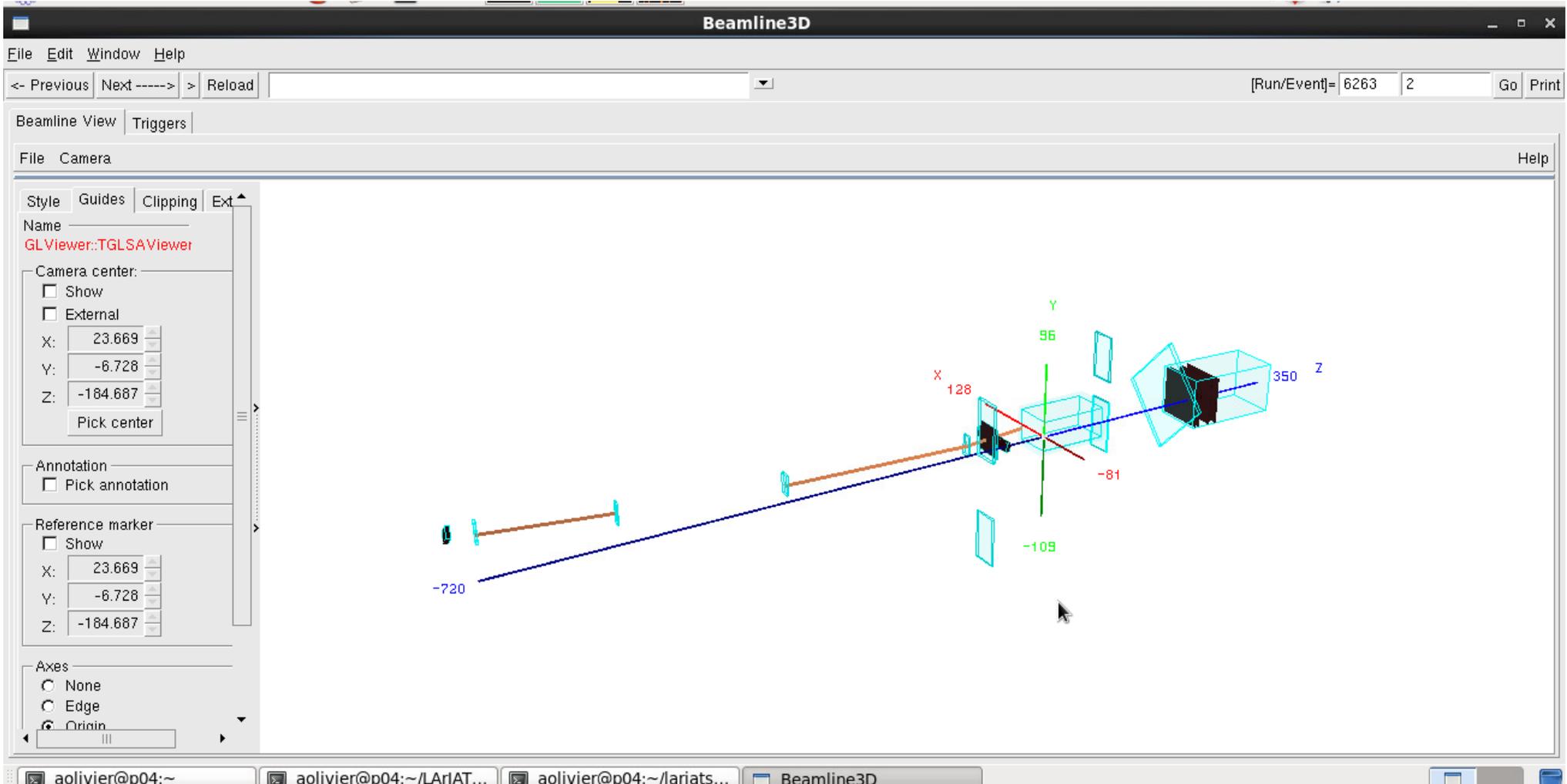
Where is this used?

- Anywhere the Geometry service is used
 - Setting up GEANT geometry for MC simulation
 - Event Display
 - WCTrackBuilderAlg
 - ParticleIdentificationSlicing_module.cc
- Anywhere the AuxDetGeometry service is used
 - As far as I know, only the 3D beamline event display

Lariatsoft Coordinate System: ROOT Geometry Editor



lariatsoft Coordinate System: Event Display



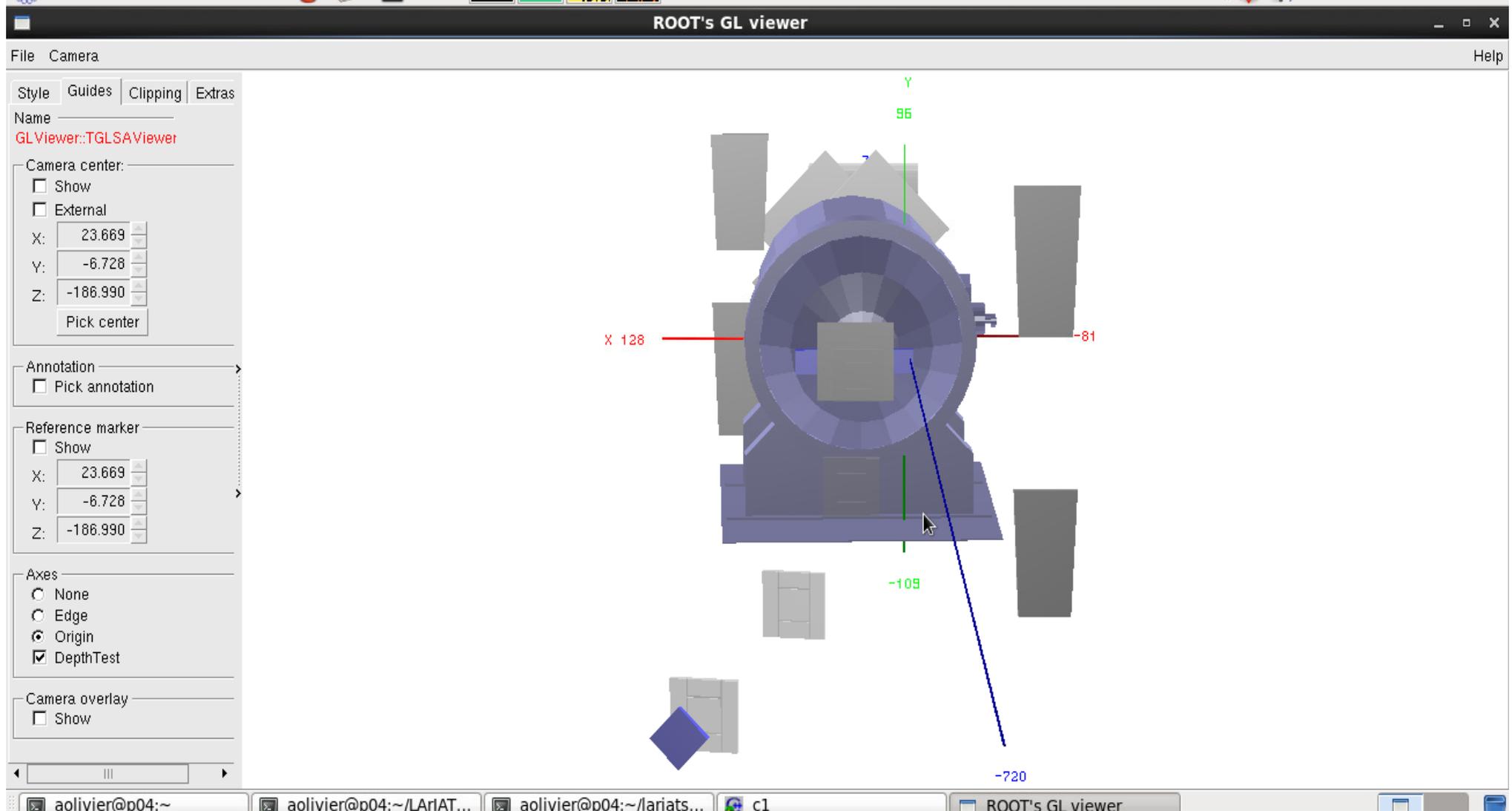
How was the Beamline Geometry Added to the LArIAT Geometry File?

- Got detector positions from the latest survey of the LArIAT beamline
- Made a G4Beamline file in the coordinate system of the survey with z instead of y along beam direction and x adjusted accordingly
 - This G4Beamline file represents a different geometry from the G4Beamline files used for beamline MC input in the past because it is based on newer survey results
- ROOT script on feature/LArIATevd converts G4Beamline file to gdml file used by LArSoft
 - Matches TPCs between source LArIAT detector file and beamline information to get transformation from modified survey coordinates to LArSoft coordinates
 - Creates a new gdml file with beamline detector volumes (not TPC) added to source geometry

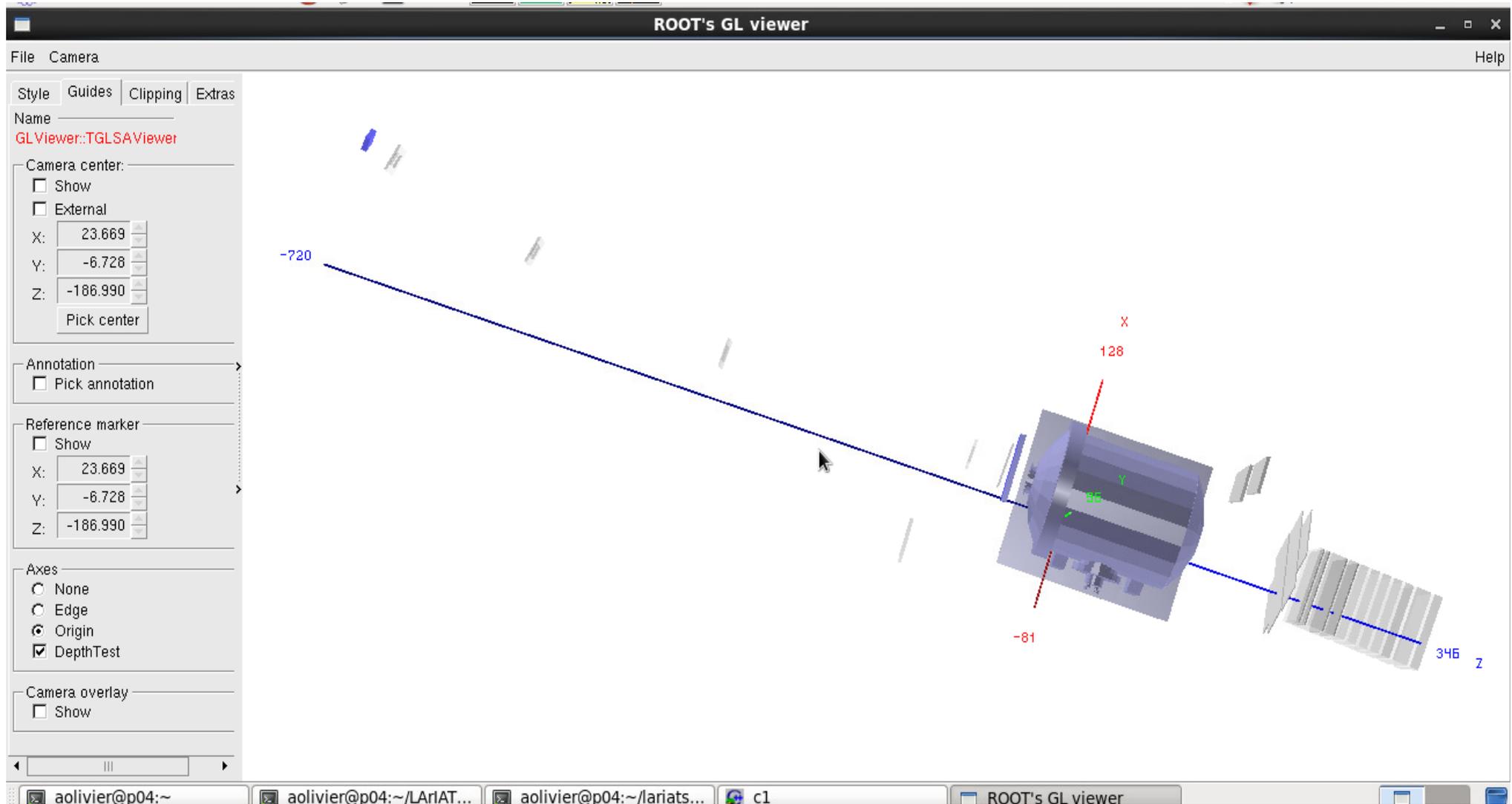
Problems Being Searched for in LArIAT Geometry File

- Incorrect rotation of beamline detector volumes
- Incorrect volume placements in G4Beamline file
 - Does the center of a detector volume in the survey file correspond to its geometrical center?

Beam View of ROOT Geometry

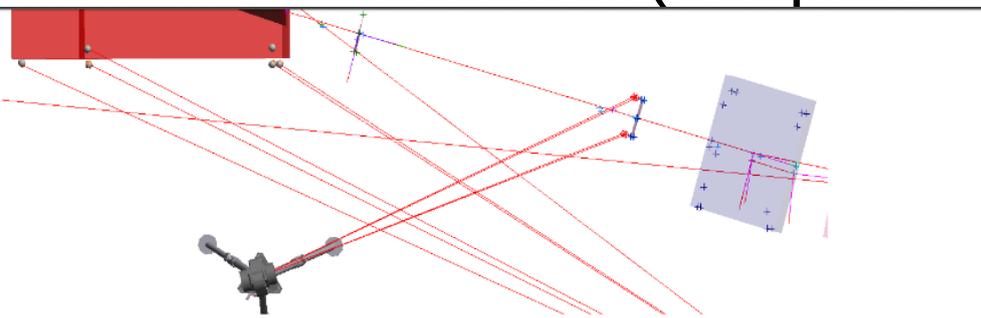


Overhead View of ROOT Geometry



Detector Positions

- Detectors currently placed under assumption that positions in survey are centers
- Magnets seem to be represented this way in the survey, but not WCs on second glance
- Collimator in g4bl file needs to be moved (not placed in gdml)



Tue Mar 24, 2015 03:41:03 PM
24Mar15A\$Founds_jck transformed to FSCsz.xit

AS-FOUND MC7MWPCM (MWPC "M")				MIPP Beamsheet FSCsz in dbase (9/29/2003)			
Point Name	FSCS_X	FSCS_Y	FSCS_Z		X	Y	Z
	[Metres]	[Metres]	[Metres]		Inches	Inches	Inches
MC7MWPCM_UBR	30263.66174	32250.01183	227.86282	MC7MWPCM_UBR	32.756	124.922	-3.726
MC7MWPCM_UBL	30263.47171	32250.02769	227.86230	MC7MWPCM_UBL	25.478	126.766	-3.746
MC7MWPCM_UTL	30263.46989	32250.02651	228.05275	MC7MWPCM_UTL	25.400	126.730	3.752
MC7MWPCM_UTR	30263.66043	32250.01088	228.05344	MC7MWPCM_UTR	32.699	124.891	3.779
MC7MWPCM_CT	30263.56594	32250.01923	227.95783	MC7MWPCM_CT	29.083	125.827	0.015
MC7MWPCM_ROLL	30263.54511	32250.00506	230.49770	MC7MWPCM_ROLL	28.183	125.384	100.010

Geometry Debugging Efforts

- Angles on downstream wire chambers seem to be correct based on ROOT print out
- Wrote a ROOT script on feature/LArIATevd to print positions, sizes, rotation matrices, and local origins of all volumes
 - ROOT transformation matrices are in their parent frames
- Plan to compare distances between objects from survey and geometry file
- Plan to confirm WC locations in Iariatsoft by varying MC particle starting positions and plotting AuxDetSimChannels

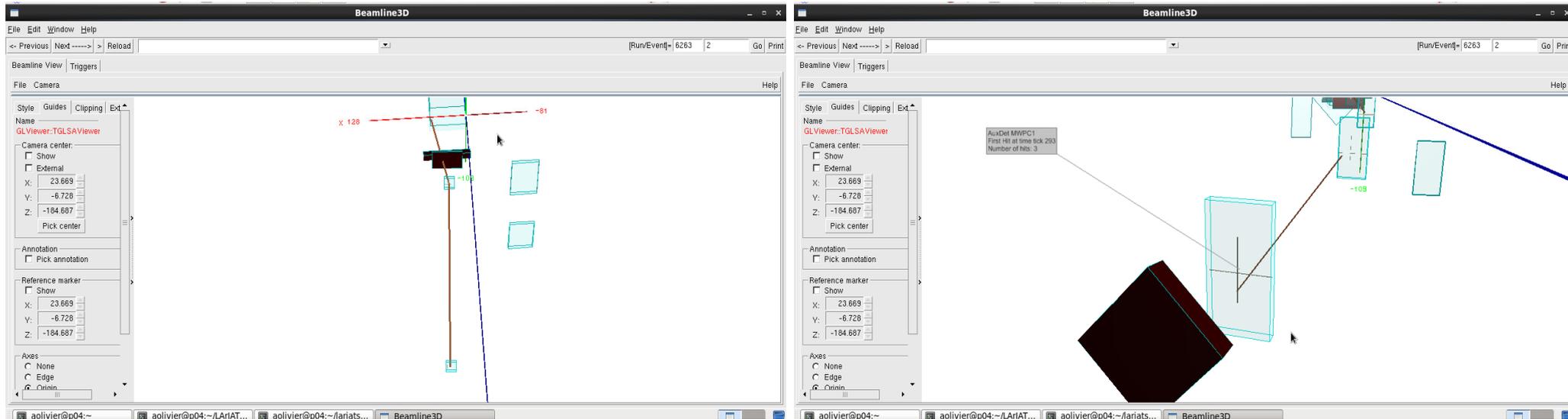
Example Output from Geometry Printing Script

```
Applications Places System Andrew Olivier 73 °F Tue Nov 10, 1:28 PM
TigerVNC: p04.phys.lsu.edu:23 (aolivier)
aolivier@p04:~/LArIATGeo
File Edit View Search Terminal Help
***** Level 3 *****
***** End Level 3 *****
== Volume: volAuxDetMwPC1 type TGeoVolume positioned 3 times
*** Shape MwPC1: TGeoBBox ***
  dX = 6.40000
  dY = 12.70000
  dZ = 1.25000
  origin: x= 0.00000 y= 0.00000 z= 0.00000
Mixture Vacuum Aeff=1 Zeff=1 rho=1e-25 radlen=5.73815e+26 intlen=3.49999e+26 index=0
  Element #0 : VACUUM Z= 1.00 A= 1.00 w= 1.000
matrix - tr=1 rot=1 refl=0 scl=0
  0.974370 0.000000 -0.224951 Tx = -39.217600
  0.000000 1.000000 0.000000 Ty = -0.002540
  0.224951 0.000000 0.974370 Tz = 169.824400
***** Level 3 *****
== Volume: volAuxDetSensitiveWC1 type TGeoVolume positioned 1 times
*** Shape volAuxDetDet: TGeoBBox ***
  dX = 6.40000
  dY = 6.25000
  dZ = 1.25000
  origin: x= 0.00000 y= 0.00000 z= 0.00000
Mixture Vacuum Aeff=1 Zeff=1 rho=1e-25 radlen=5.73815e+26 intlen=3.49999e+26 index=0
  Element #0 : VACUUM Z= 1.00 A= 1.00 w= 1.000
matrix - tr=1 rot=0 refl=0 scl=0
  1.000000 0.000000 0.000000 Tx = 0.000000
  0.000000 1.000000 0.000000 Ty = 0.000000
  0.000000 0.000000 1.000000 Tz = 0.000000
***** Level 4 *****
***** End Level 4 *****
== Volume: ChFram type TGeoVolume positioned 8 times
*** Shape ChFram: TGeoBBox ***
  dX = 6.40000
805,20 44%
```

Backup: AuxDet Versus Regular Geometry Service

- Geometry service
 - Knows positions of all AuxDets
 - Can return AuxDetGeos with transformation methods
- AuxDetGeoemtry service
 - Knows positions of all AuxDets
 - Can return AuxDetGeos with transformation methods
 - Can map positions to AuxDetGeos
 - Can map AuxDet channels to positions or AuxDetGeos
 - Knows about wire chamber wires

Backup: Symptoms of Problem?



- WCTrack angle change before TPC first noticed with early beamline display during June 2015
- Have not yet come up with a good way to check the accuracy of WC hit drawing

Backup: Angles in Event Display

- Could not find support for Euler angles in ROOT visualization classes (pre-EVE), so made TMarker3DBoxEuler for 3D beamline display
- Example: USTOF volume:
- Rotations in radians:
 - Theta: -0.785398
 - Phi: -2.9147
 - Psi: 1.5708

