Druid: Display root module used for ILC Detectors

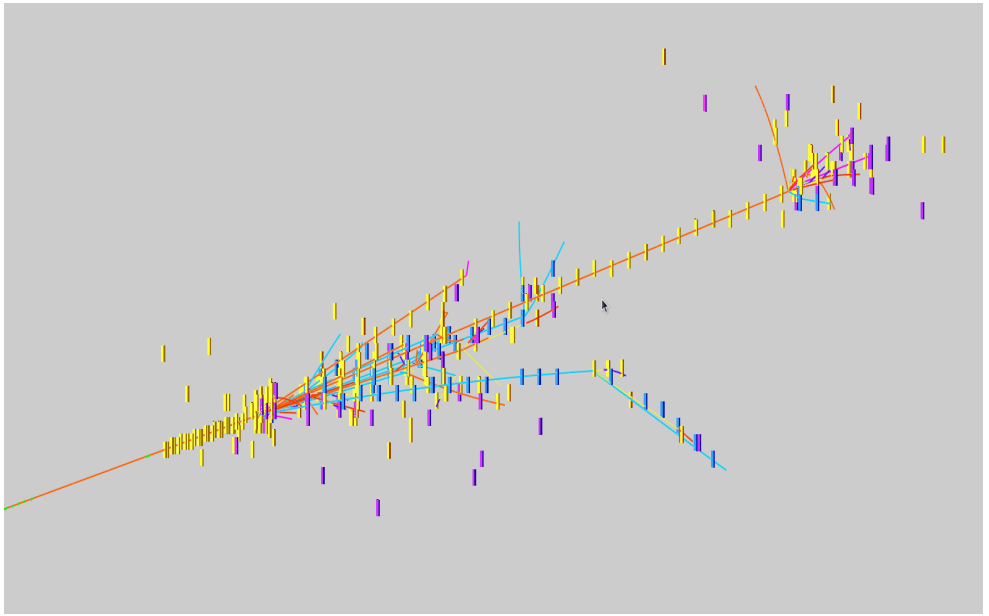
Manqi

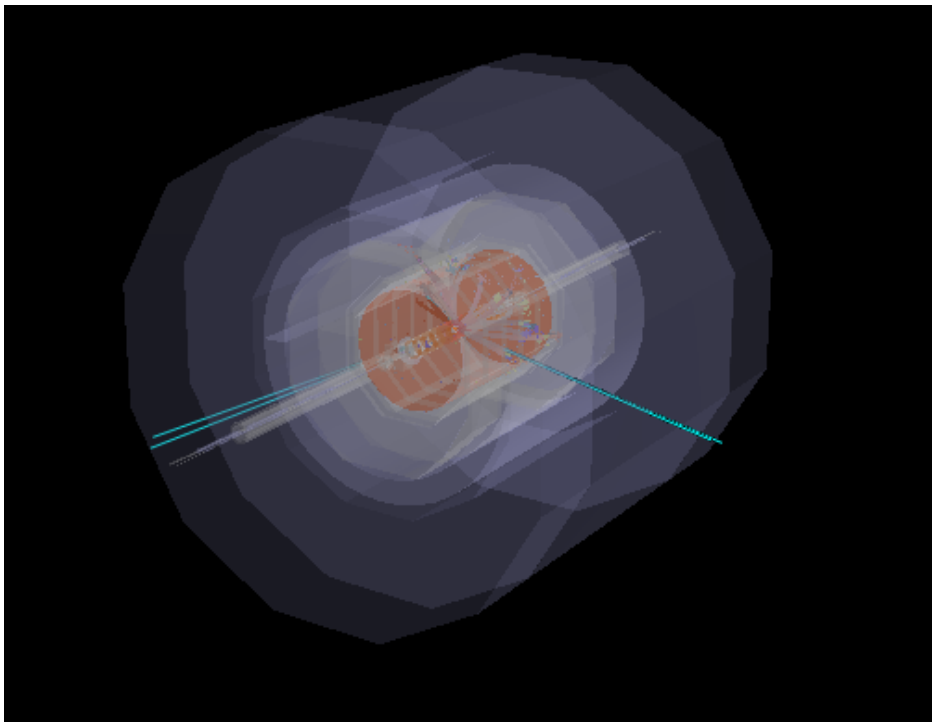
Outline

- Introduction
- Event display (*LCIO file*)
  - Objects & Options
  - Example: analysis reconstruction algorithm performance
- Geometry display (*GDML/xml file*)
- Summary

Motivation

- To understand the ILC events & jet/shower details
- To understand/analysis reconstruction algorithm performance



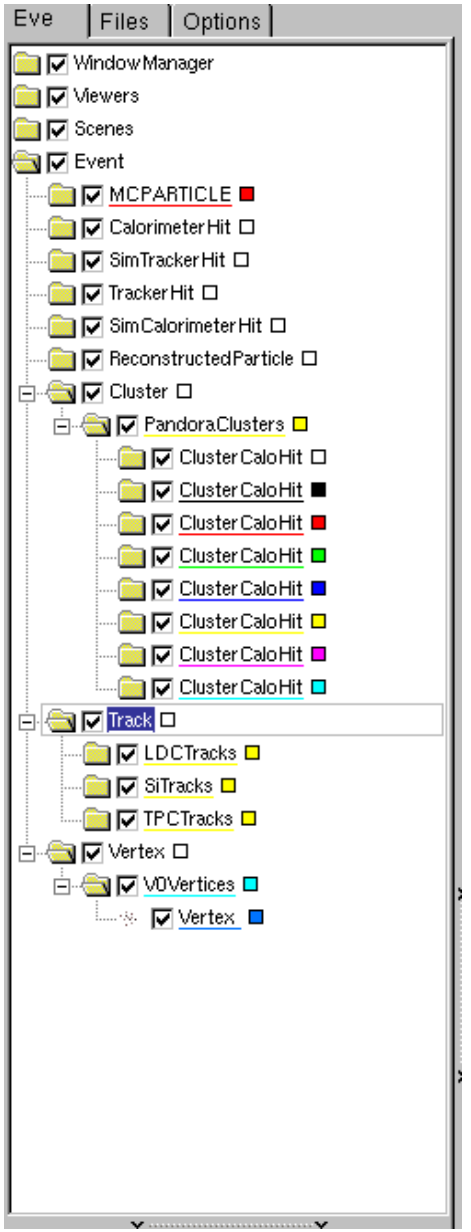


Left: 40GeV pion shower
Right: 250GeV ZH(ττ) event

- Based on ROOT TEve class, visualize event information (in slcio file) and/or detector geometry (gear xml or gdml file) in arbitrary combination & different styles

Event objects

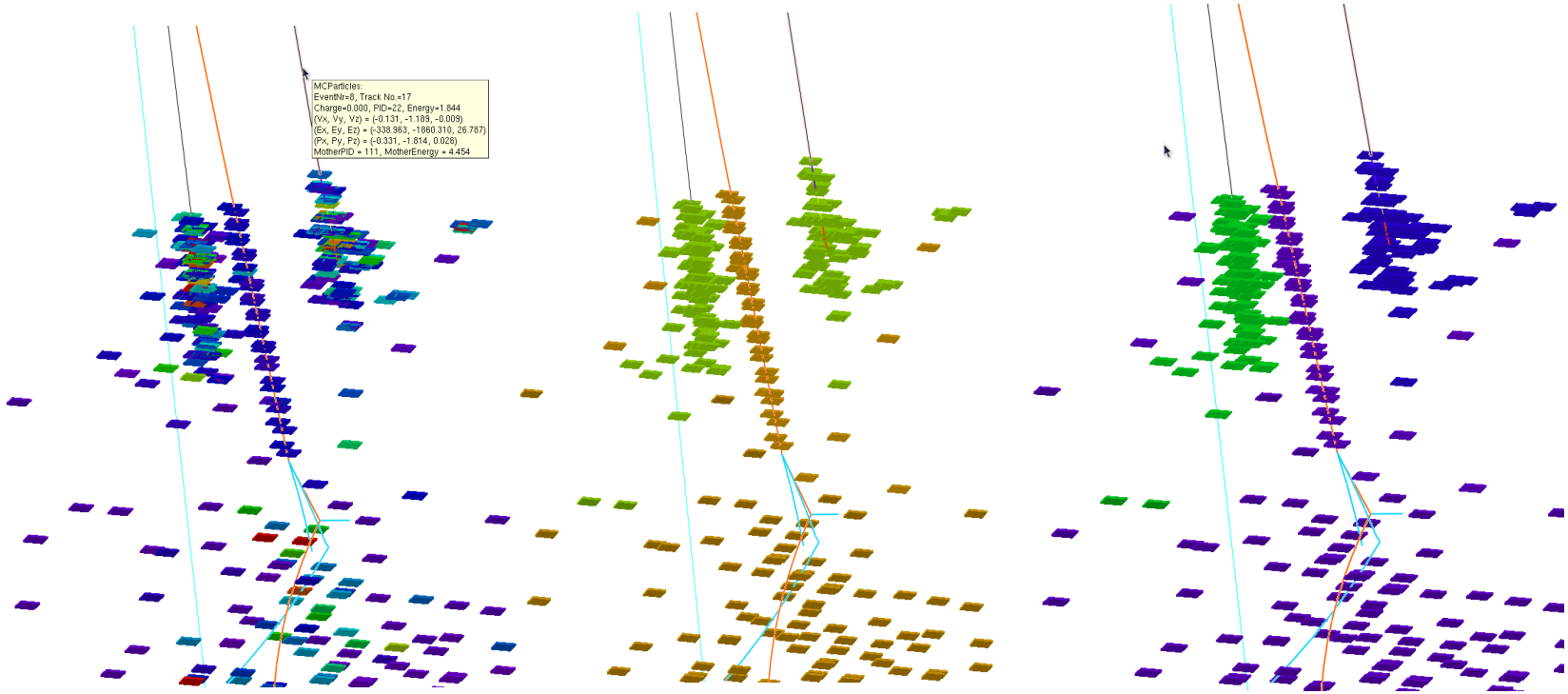
- LCIO collections:
  - MCTruth level: MCParticle tracks. To mark event type, mother particles at VTX can be displayed as arrows
  - Simulation level: simulated calorimeter/tracker hits: cuboid/points with tunable size/color according to Energy, dE/dx, PID, Mother PID, index, ...
  - Reconstruction level:
    - Intermediate reconstruction collections: Digitized detector hits, reconstructed tracks, clusters, Vertexes...
    - Final Reconstructed Particle (Particle Flow Objects): displayed as track + assigned cluster



Options

- General:
  - Zoom, Rotate (with arbitrary center), Project, Tunable illuminating, bkgrd, references...
- For Individual objects:
  - Pick up & read attached information
  - Display/hidden: inherit the status from last event & always display new collections
  - Color/size options

Tau jet ($\tau \rightarrow \nu+\pi^0+\pi^+$) with different color option: energy, PID & index

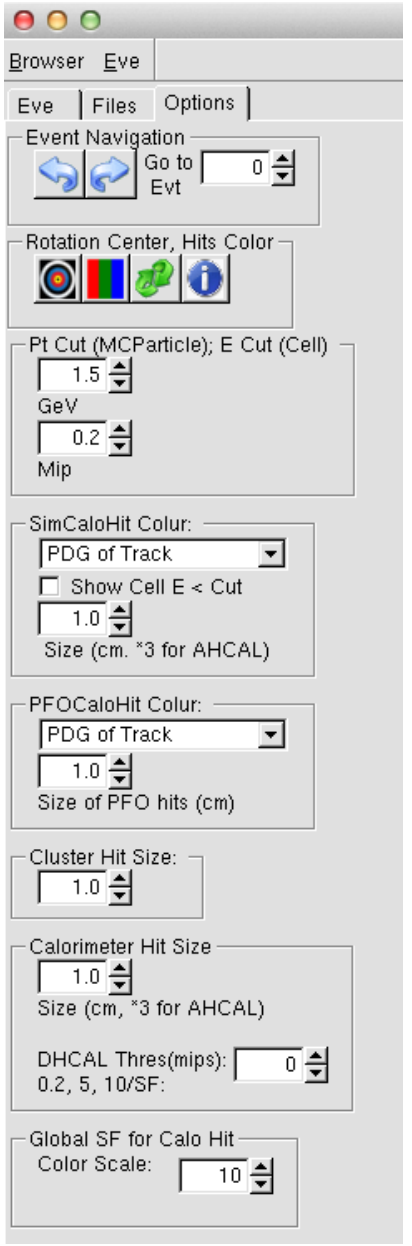


GUI Panel

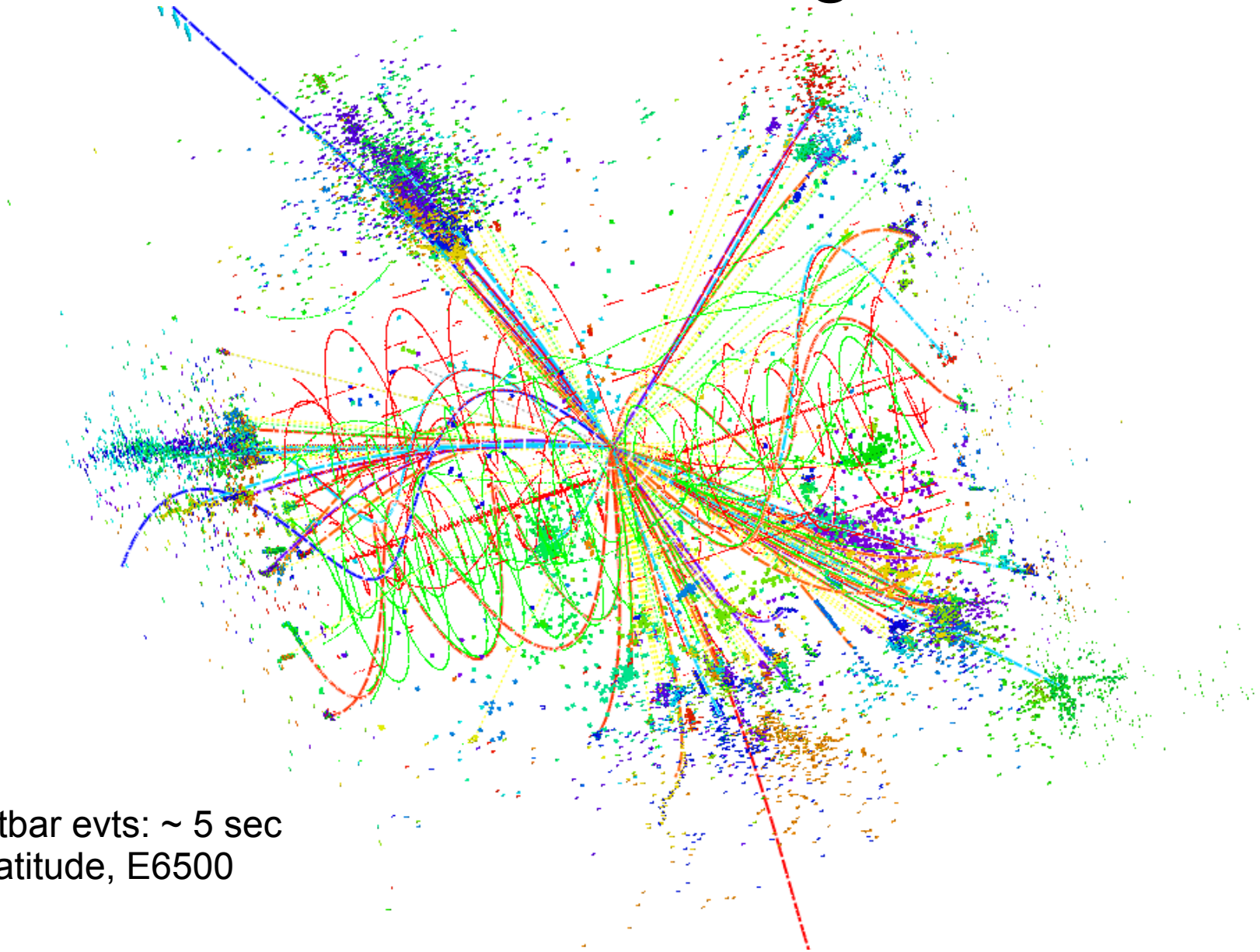
- Buttons
  - Event navigation
  - Target: select rotation center
  - Reroll object color if supported, i.e, clusters
  - Collection selection: switch between two scenarios
    - Minimal (default):

      MCParticle + Simulated Hits (+ Reconstructed PFO + geometry)
    - Maximal:

      All supported collection, to include intermediate reconstructed collections
  - Switch on Attach text information
- P_T Cut on MCParticle: ignore event detail
- Hits options: specify color/size



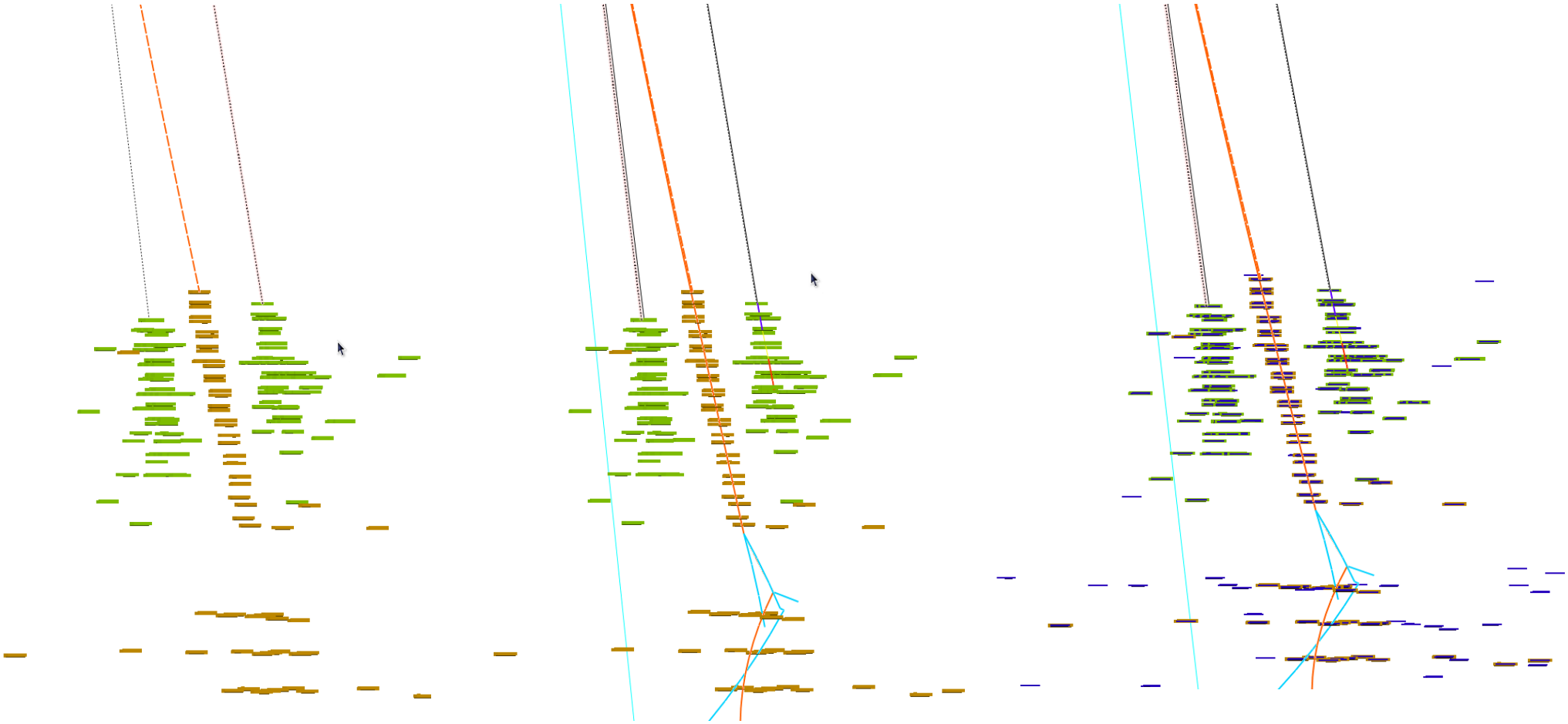
Stress testing



500GeV ttbar evts: ~ 5 sec
Dell Latitude, E6500

To analysis reco-soft performance

By comparing reconstructed & MC objects...



Same τ jet, from left to right:

- *PFO (Reconstructed Particle Flow Object) ;*
- *PFO + MCParticle;*
- *PFO + MCParticle + MC Calo Hits (with uniform blue color);*

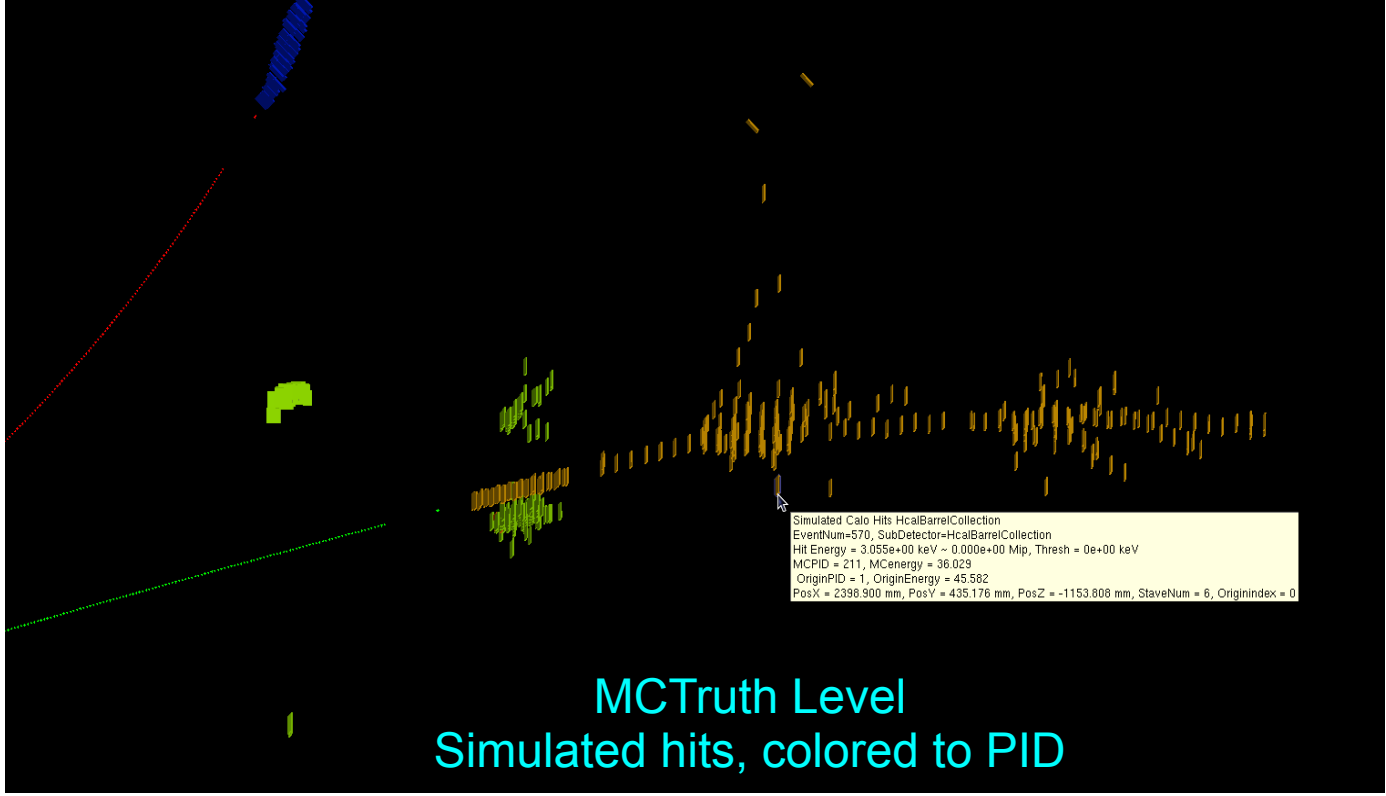
qq evt@91.2GeV

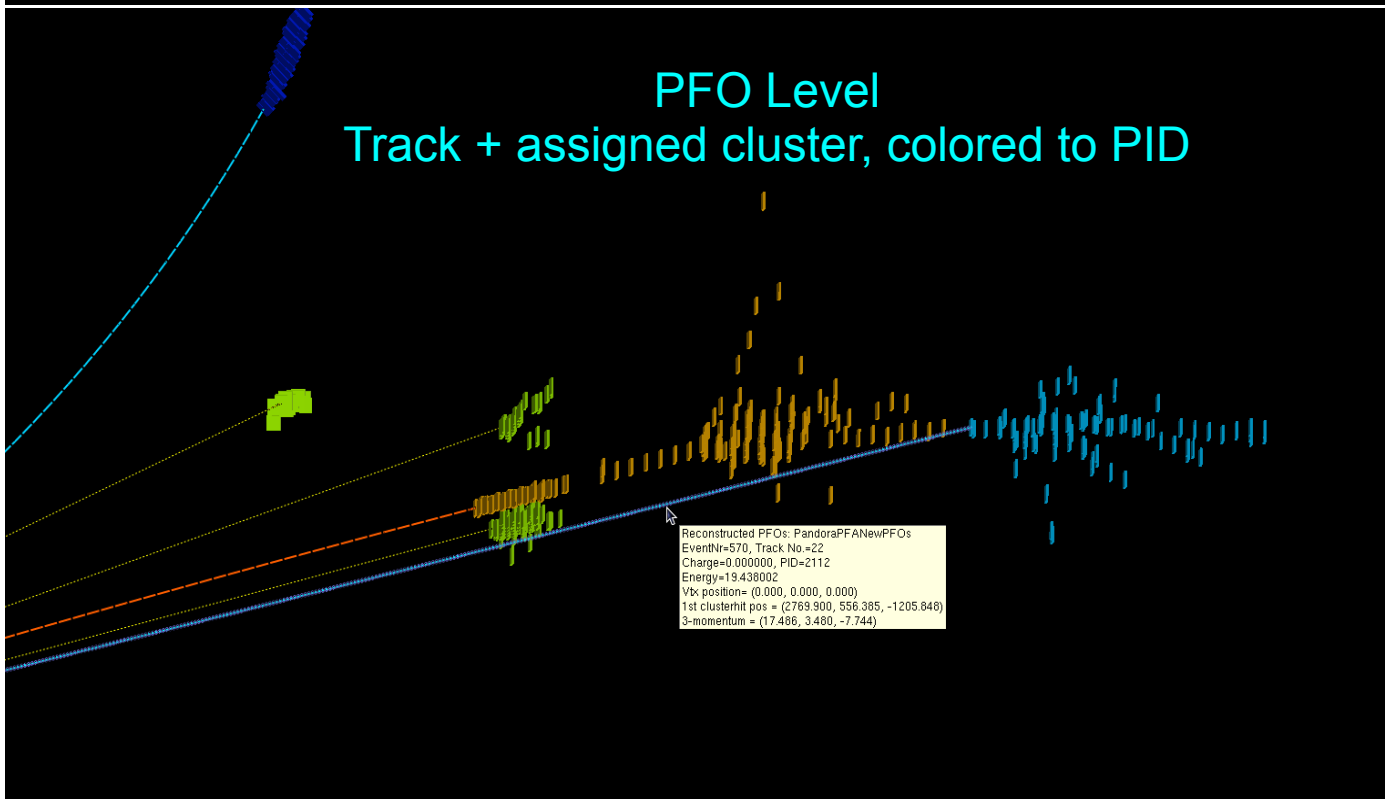
Total energy = 109 GeV,
Total Neutral energy = 21.3 GeV

MCTruth level: 36GeV Pion

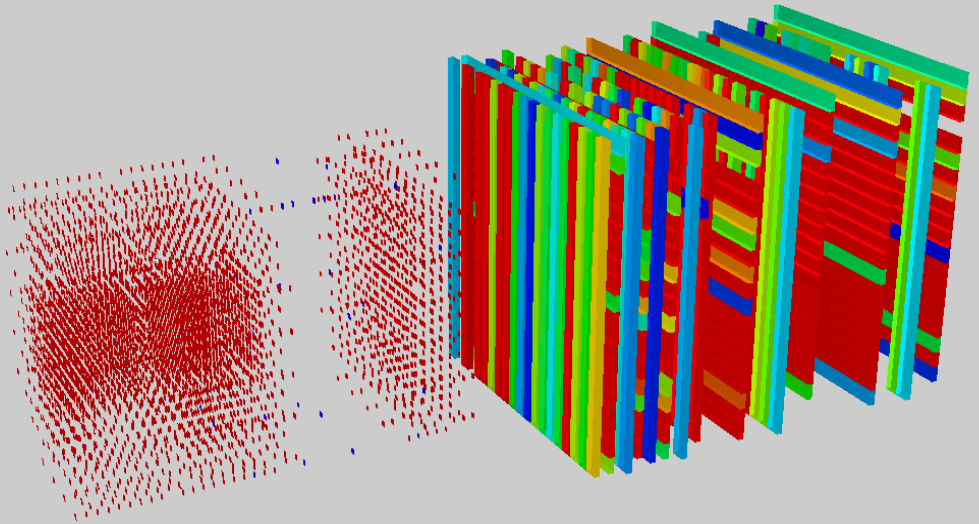
PFO level: 36GeV Pion with 27.3GeV Cluster + 19.4GeV neutron

Splitting of hadron cluster: over estimated cluster energy + fake seed

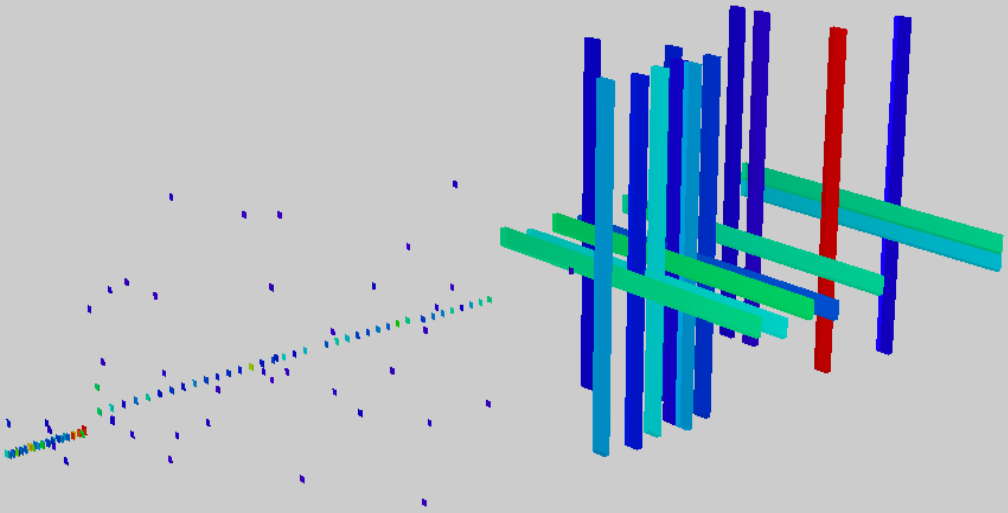




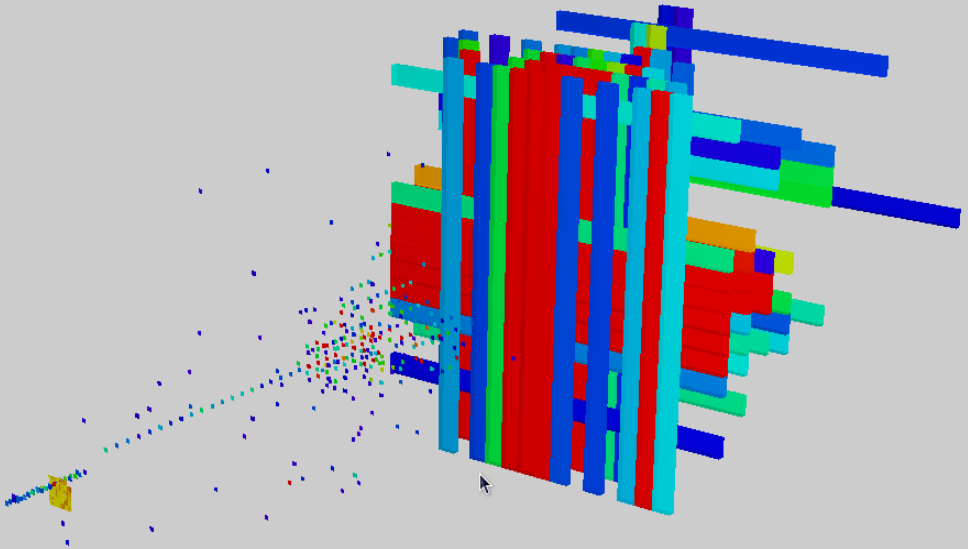
CALICE TB events



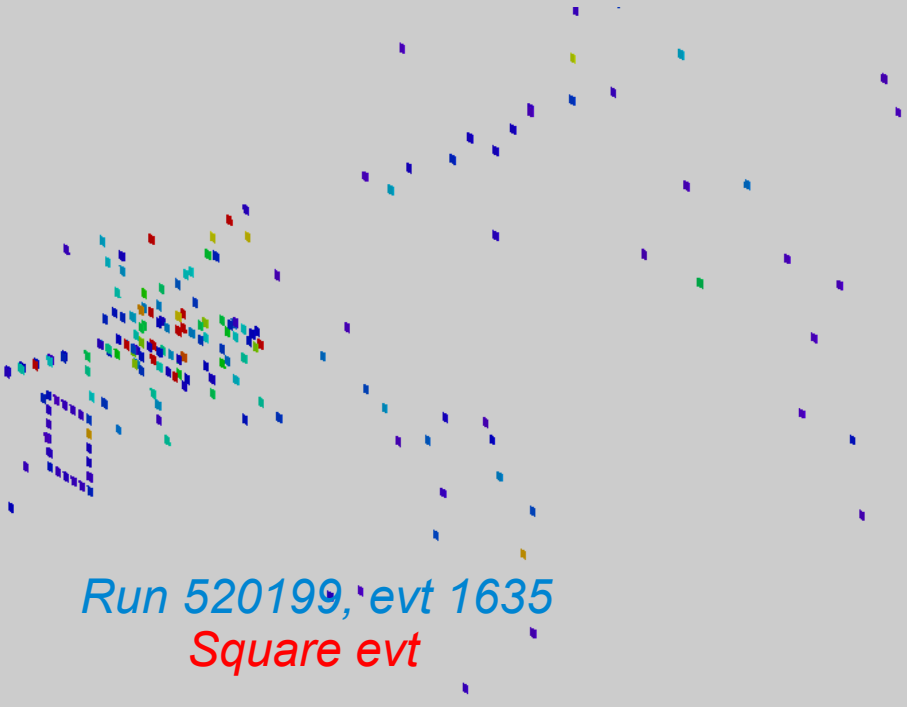
Run 330437, self Calibrate evt



Run 330437, MIP evt:
Misalignment (?)

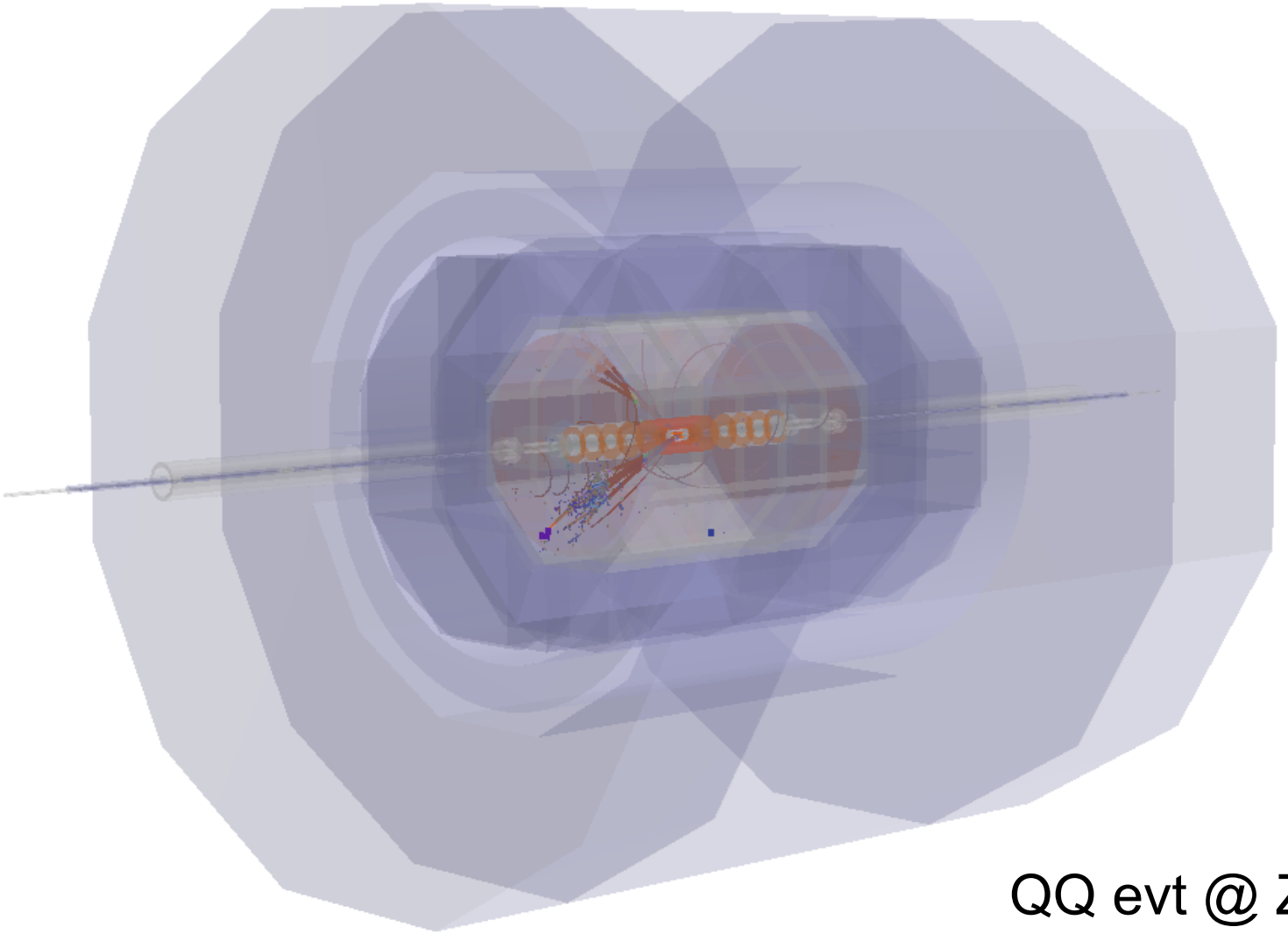


Run 330437, pion evt:
noisy ECAL wafer



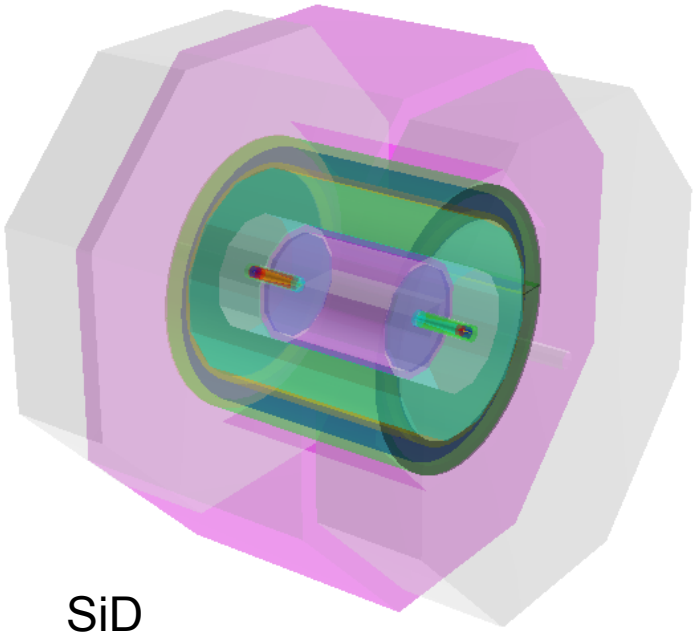
Run 520199, evt 1635
Square evt

GDML Geometry browser

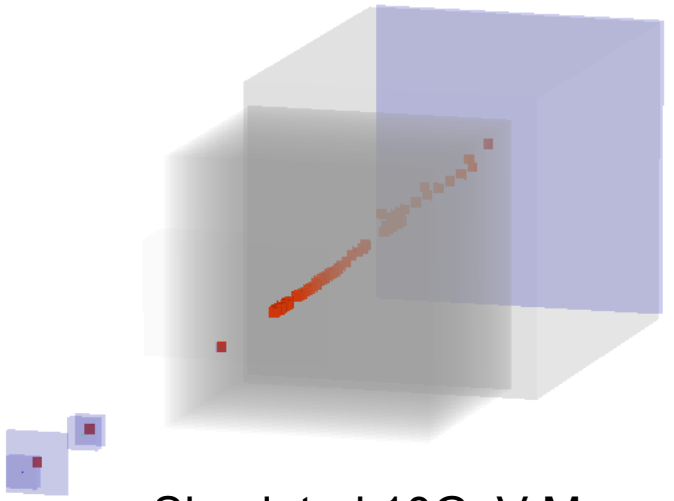


QQ evt @ Z Thr, ILD

Introduction



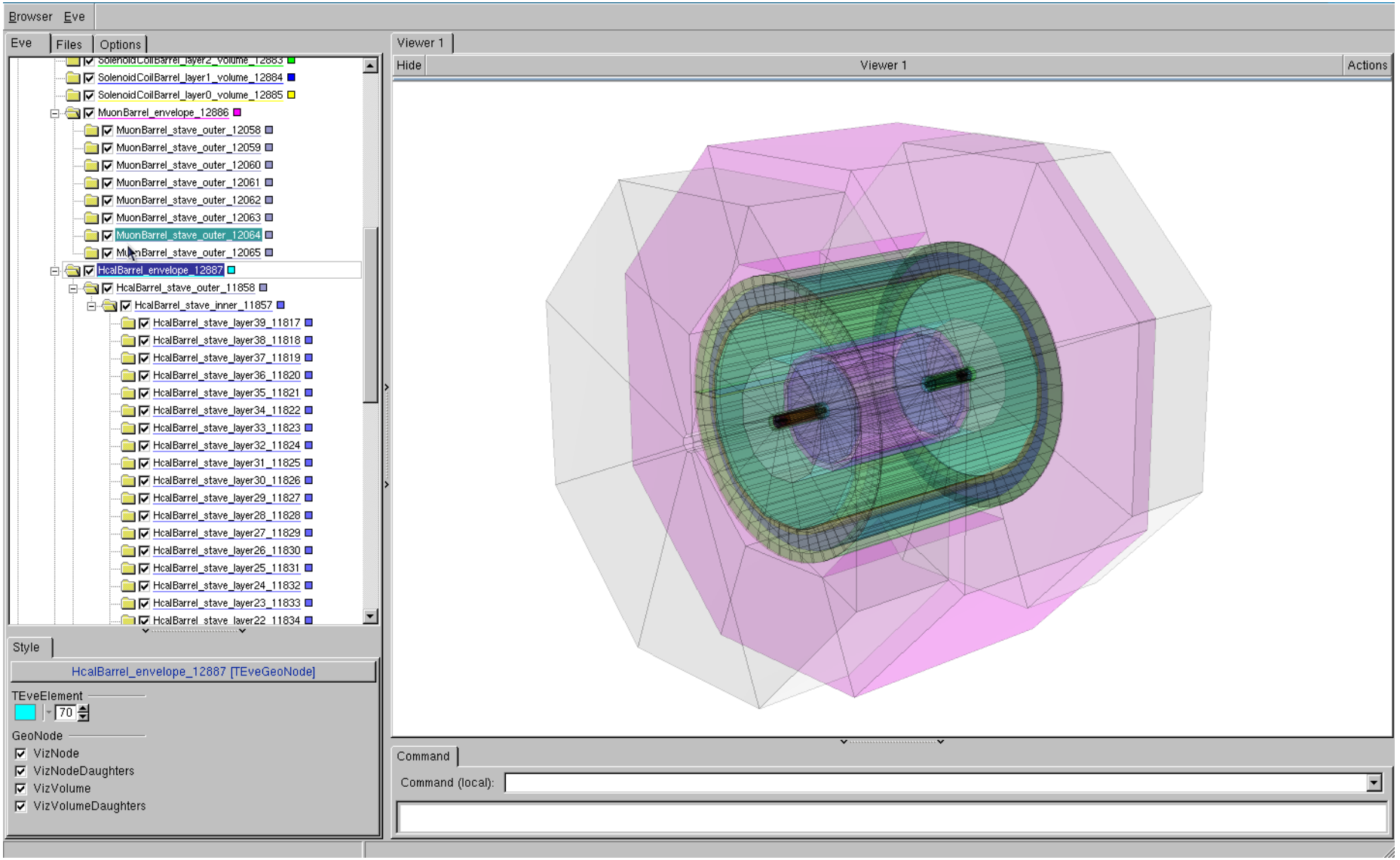
SiD



Simulated 10GeV Muon event
with TBCern1006

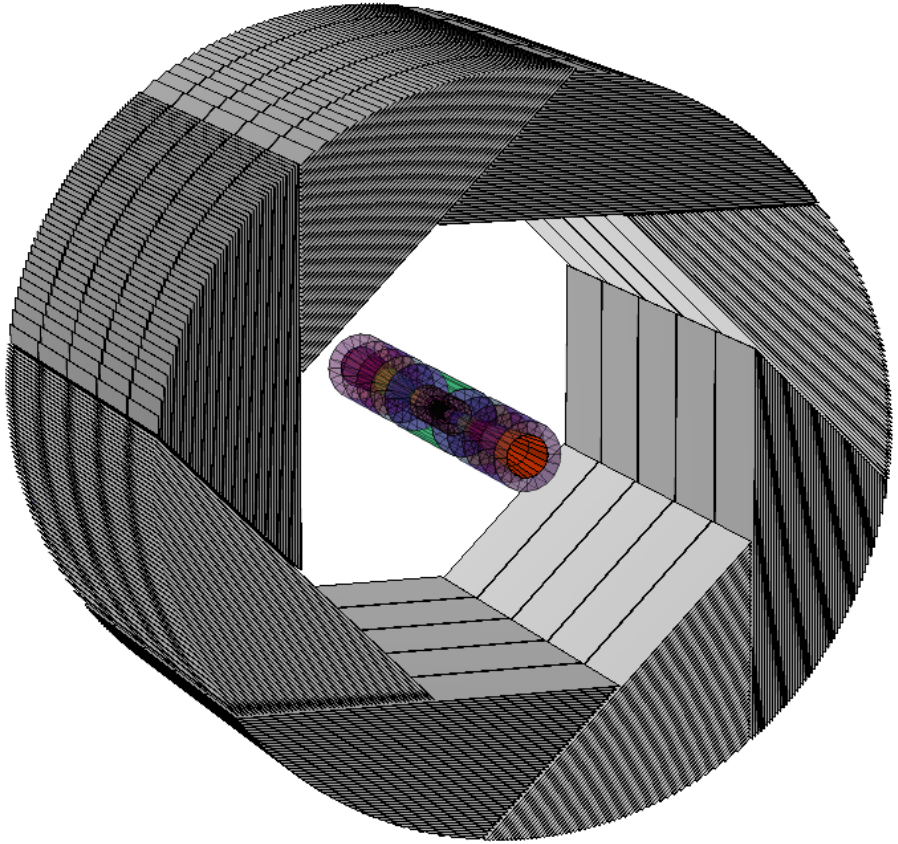
- GDML file: simulation level geometry information, could be dumped from Mokka (*version higher than 07-03. Converted gdml to root file for Druid*)
- Druid Option:
  - Tunable transparency, color, bkgrd, mount/unmount sub detectors...
  - Tunable display depth

Display depth

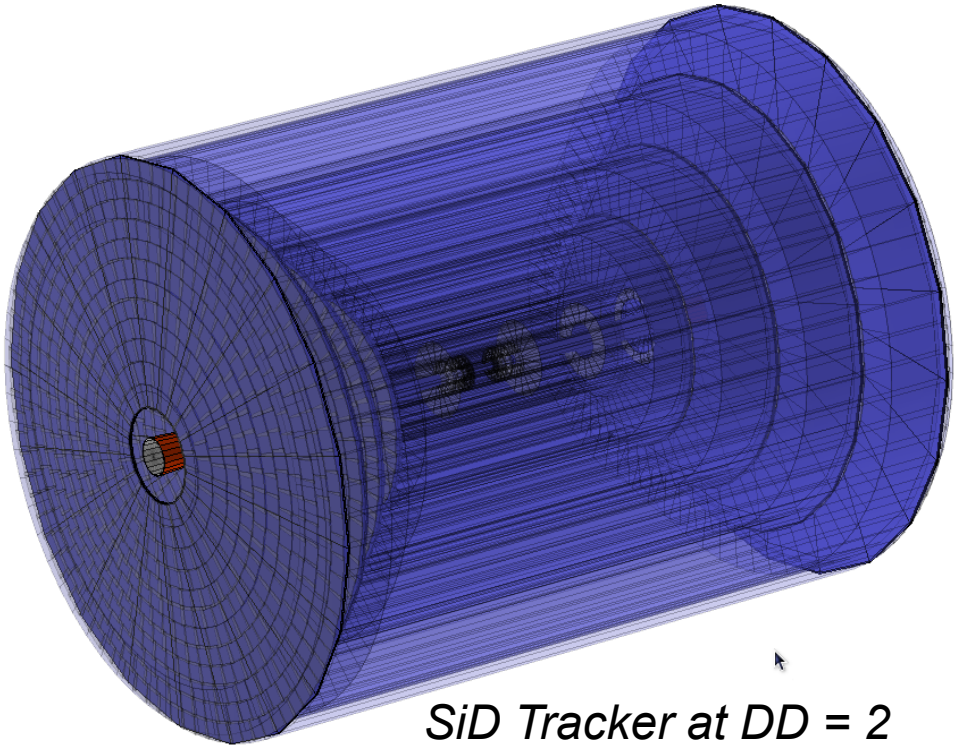


Hierarchy of geometrical volume in gdml file. Higher Depth = More detailed info

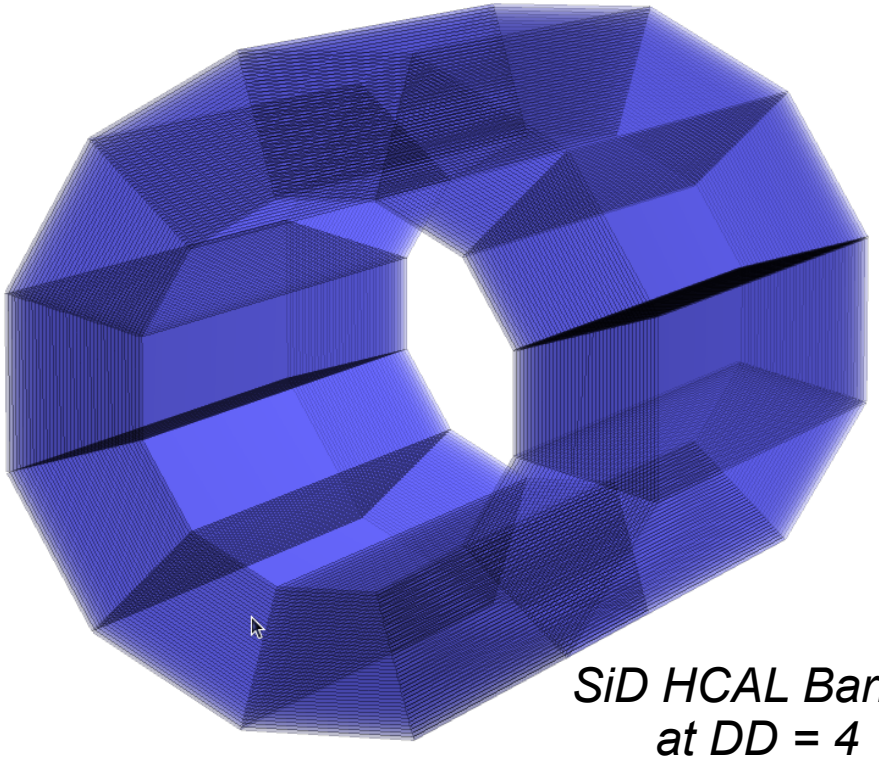
Examples



ILD (a la Videau) HCAL Barrel
+ inner detectors at DD = 3



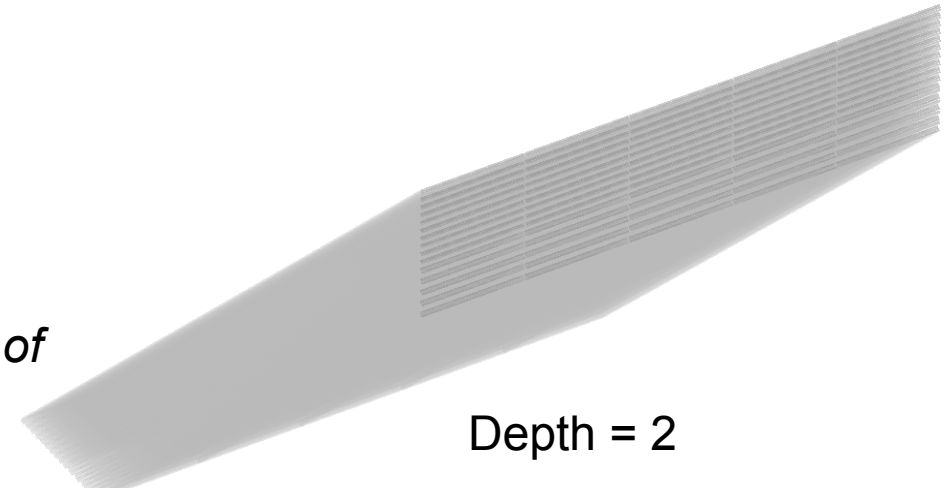
SiD Tracker at DD = 2



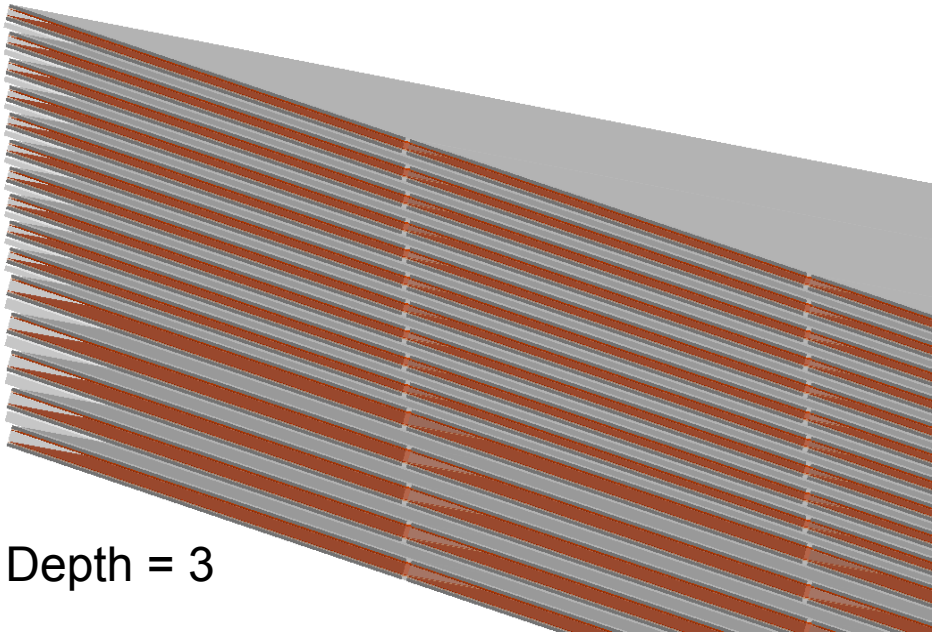
SiD HCAL Barrel
at DD = 4

Changing Display Depth

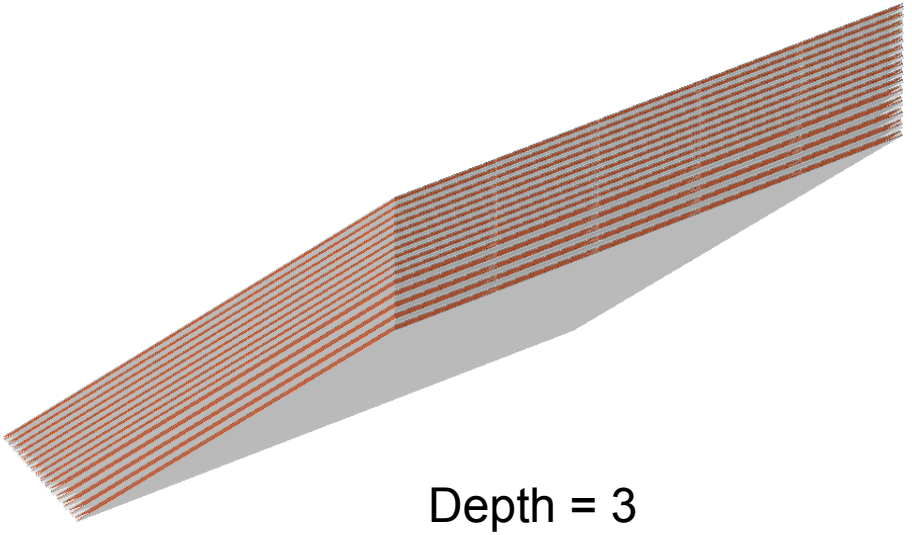
- ECAL Module:
  - *Depth = 1: Total Volume (fine for Event Display)*
  - *Depth = 2: Divided into different slabs*
  - *Depth = 3: Equip each slab with layers of different materials (simulation level)*



Depth = 2



Depth = 3



Depth = 3

Usage

- Flexible parameter managing beside the steering file
  - *bin/Druid*: print a instruction for the input format
  - Separate geometry & data display
    - *bin/Druid *.slcio*: display the first event in given slcio file
    - *bin/Druid *.gdml(*.xml)*: display detector geometry
  - Together with other arguments:
    - *bin/Druid *.slcio $EventNumber*: given event in given slcio file
    - *bin/Druid *.slcio *.gdml(*.xml)*: first event & geometry
    - *bin/Druid *.slcio *.gdml(*.xml) $EventNumber*
    - *bin/Druid *.slcio *.gdml(*.xml) $RunNumber $EventNumber*

- Screen output with collection statistic and sub detector list

Summary

- **Druid is ready:** to visualize event information & detector geometry
  - Better understand event and reconstruction algorithm performance
  - With the gdml file, detector geometry could be visualized to simulation level

- Availability
  - lxslc5.ihep.ac.cn:/groups/higgs/Software/Druid_2.3/Druid_2.3.tar.gz
  - http://llr.in2p3.fr/~ruan/ILDDisplay

- For more detail
  - Manual: lxslc5.ihep.ac.cn:/groups/higgs/Software/Druid_2.3/DruidNote.pdf

- Local installation recommended *Tested on SL5, Fedora, Mac...*

Special thanks to Mr. TAdam (Matevz Tadel) stands behind TEve...