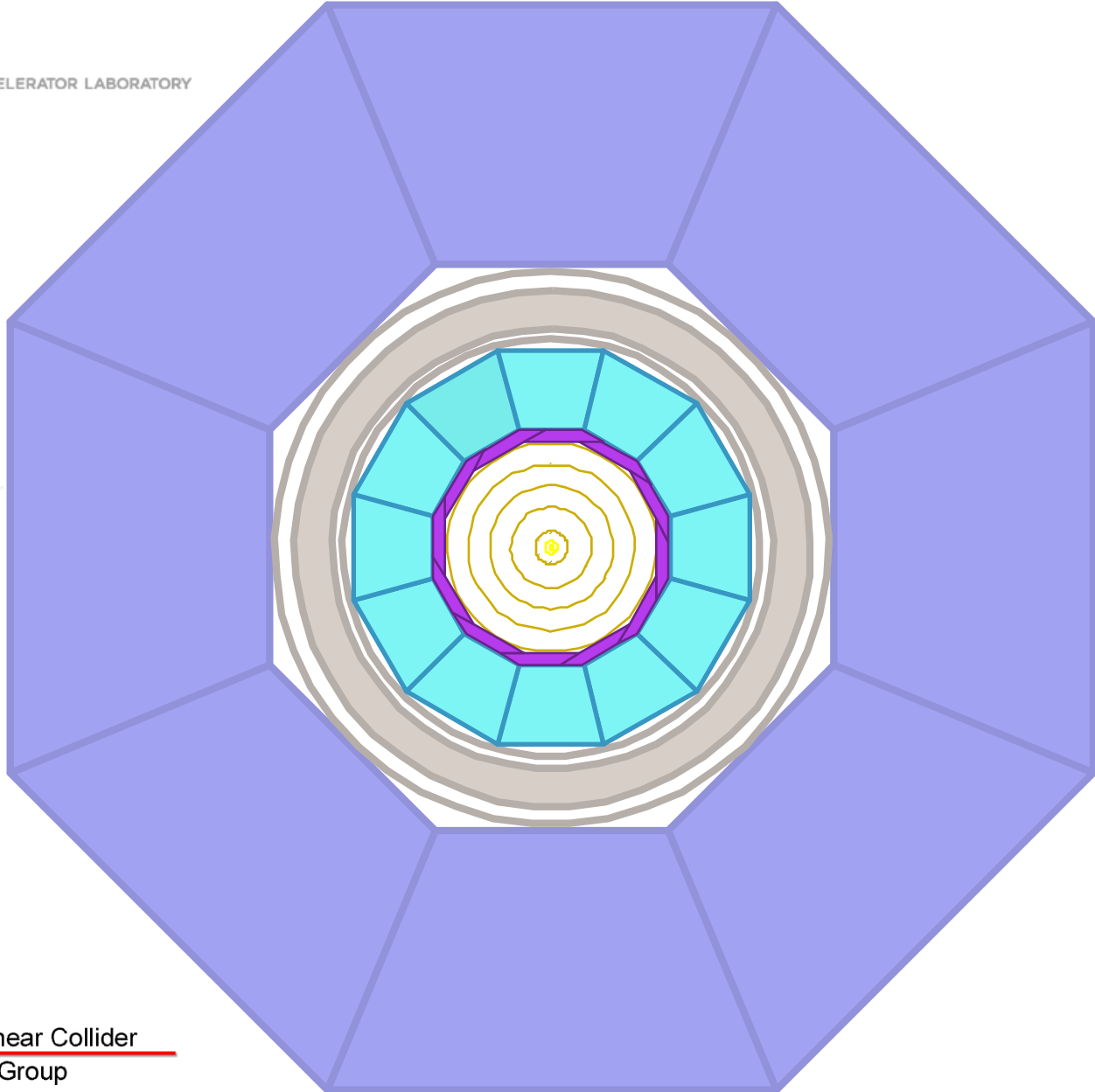
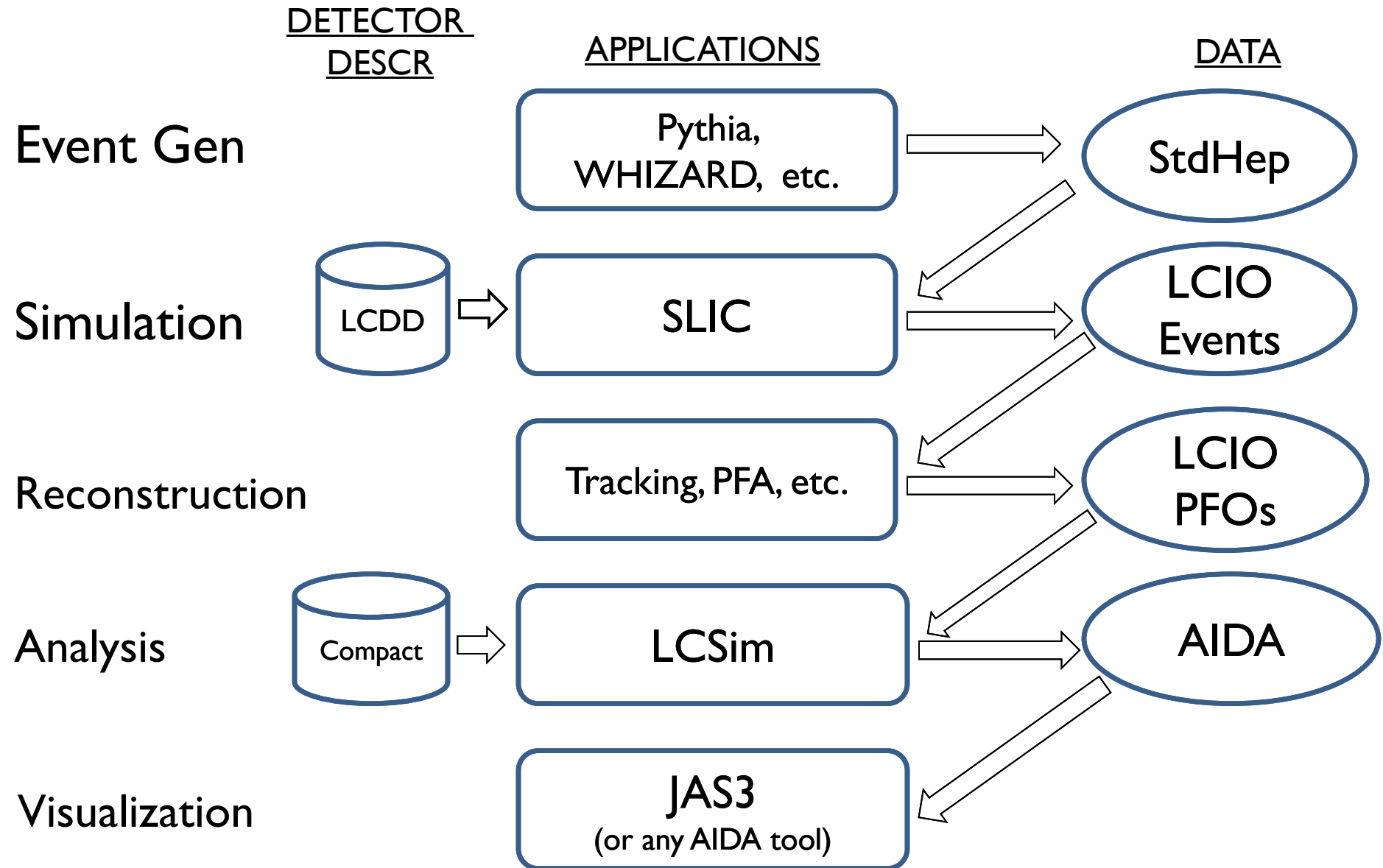


SiD Software Status



Framework Overview



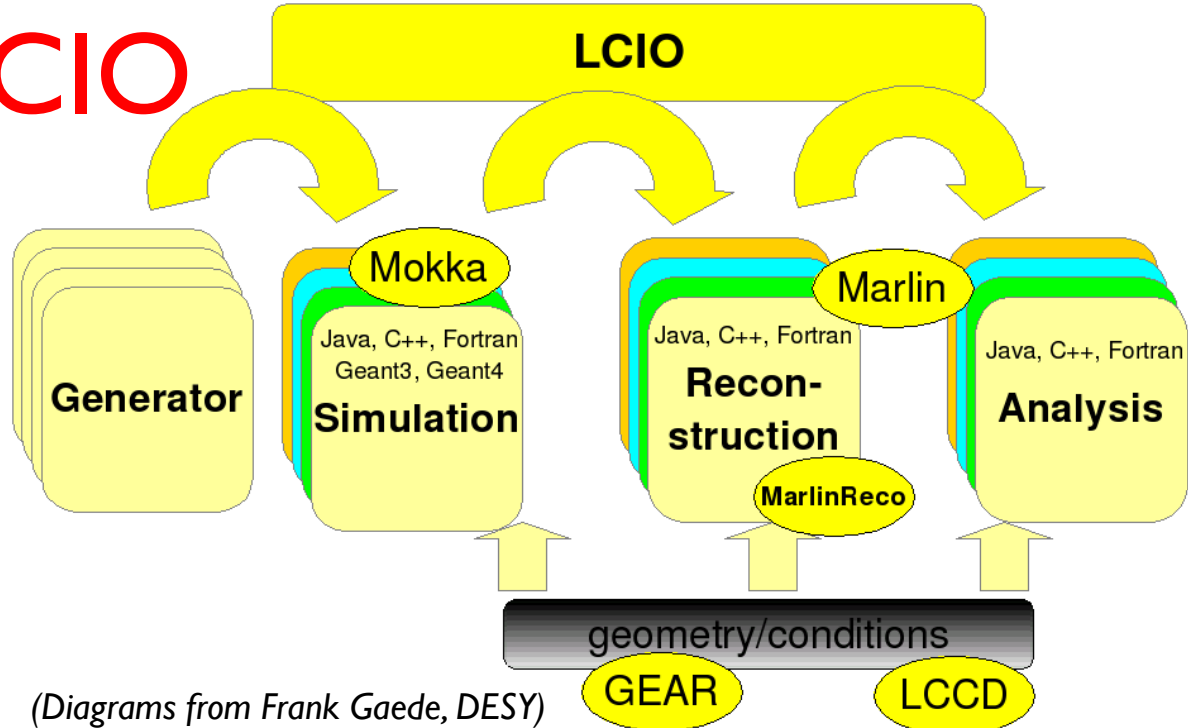
Event Generation

- Physics event generation is performed externally to general framework (e.g. slic & lcsim).
- WHIZARD /w Guinea Pig, Pythia, or other legacy event generators (HERWIG, ISAJET).
- StdHep binary format used for persistency.
- Extensive sets of physics events and diagnostic events available via FTP.
 - Physics events at 100 GeV – 1 TeV
 - Single particles at wide range of energies, angular distributions
- <ftp://ftp-lcd.slac.stanford.edu/lcd/ILC/singleParticle/stdhep/>

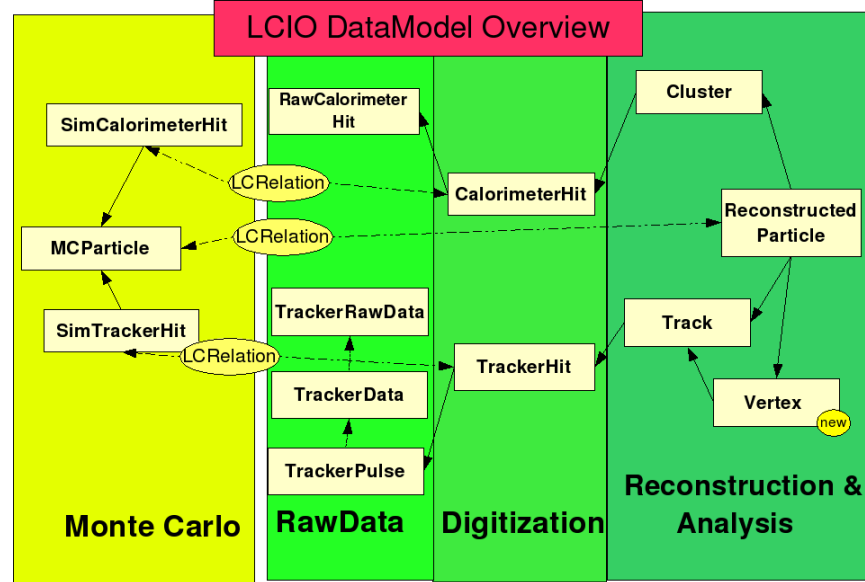
LCIO

- Common Data Model and API
- Persistency using SIO (Simple Input Output)
- C++, Java, Fortran, and Python Bindings
- Generic data with LCIOGenericObjects
- Supported in all ILC software frameworks (ILD, SiD)
- Allows “mix and match” of software components from different frameworks
- Facilitates exchange of data between users

<http://lcio.desy.de>



(Diagrams from Frank Gaede, DESY)



LCDD

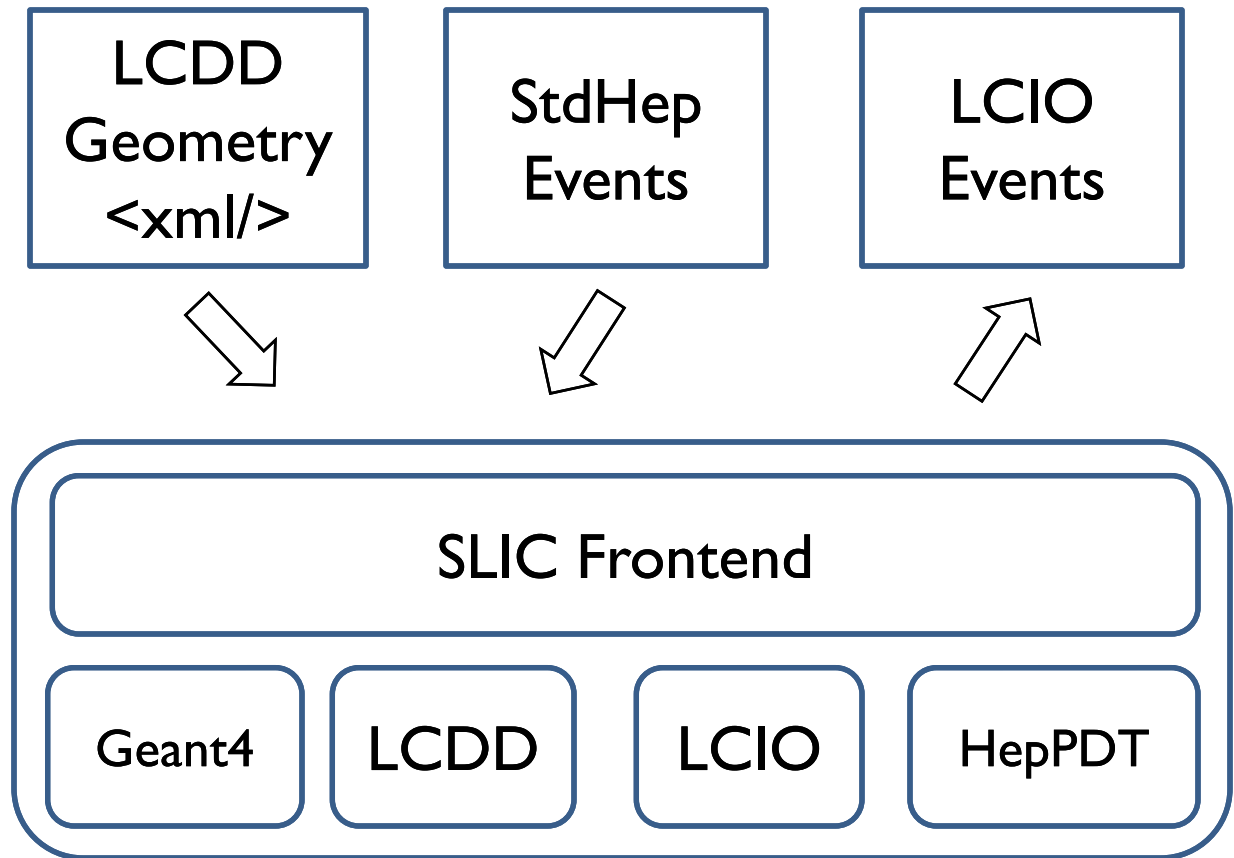
- Detailed geometry and detector description format (XML)
- **Full description of detector**
 - **No additional information required at runtime**
- Embedded GDML section
- Binds XML elements to Geant4 data structures (G4LogicalVolume, etc.)
- Fast load using SAX parser
 - Takes < 1 second to load complex ILC detector geometry
- Possible to write by hand but not recommended (verbose/redundant)
- Easiest way to generate is converting from compact to LCDD using GeomConverter.

`<lcdd/>` ← root element
`<header/>` ← meta data
`<iddict/>` ← ID definitions
`<sensitive_detectors/>` ← detectors
`<limits/>` ← physics limits
`<regions/>` ← detector regions
`<display/>` ← visualization settings
`<gdml/>` ← GDML root element
`<define/>` ← variable definitions
`<materials/>` ← material definitions
`<solids/>` ← geometric solids
`<structure/>` ← nested volumes
`<fields/>` ← magnetic fields

<http://www.lcsim.org/software/lcdd/>

SLIC

- Flexible command-line simulation tool with Geant4 backend
- StdHep event input
- LCIO event output
- Grid ready (no ext. DB or internet connection required)
- Fully descriptive runtime geometry with no “magic numbers” (LCDD)
- Extended particle set from HepPDT (SUSY, resonances, etc.) with generic tracking + edep
- Maintained by SLAC
- Also used by non-ILC experiments



Example Command Line Usage:

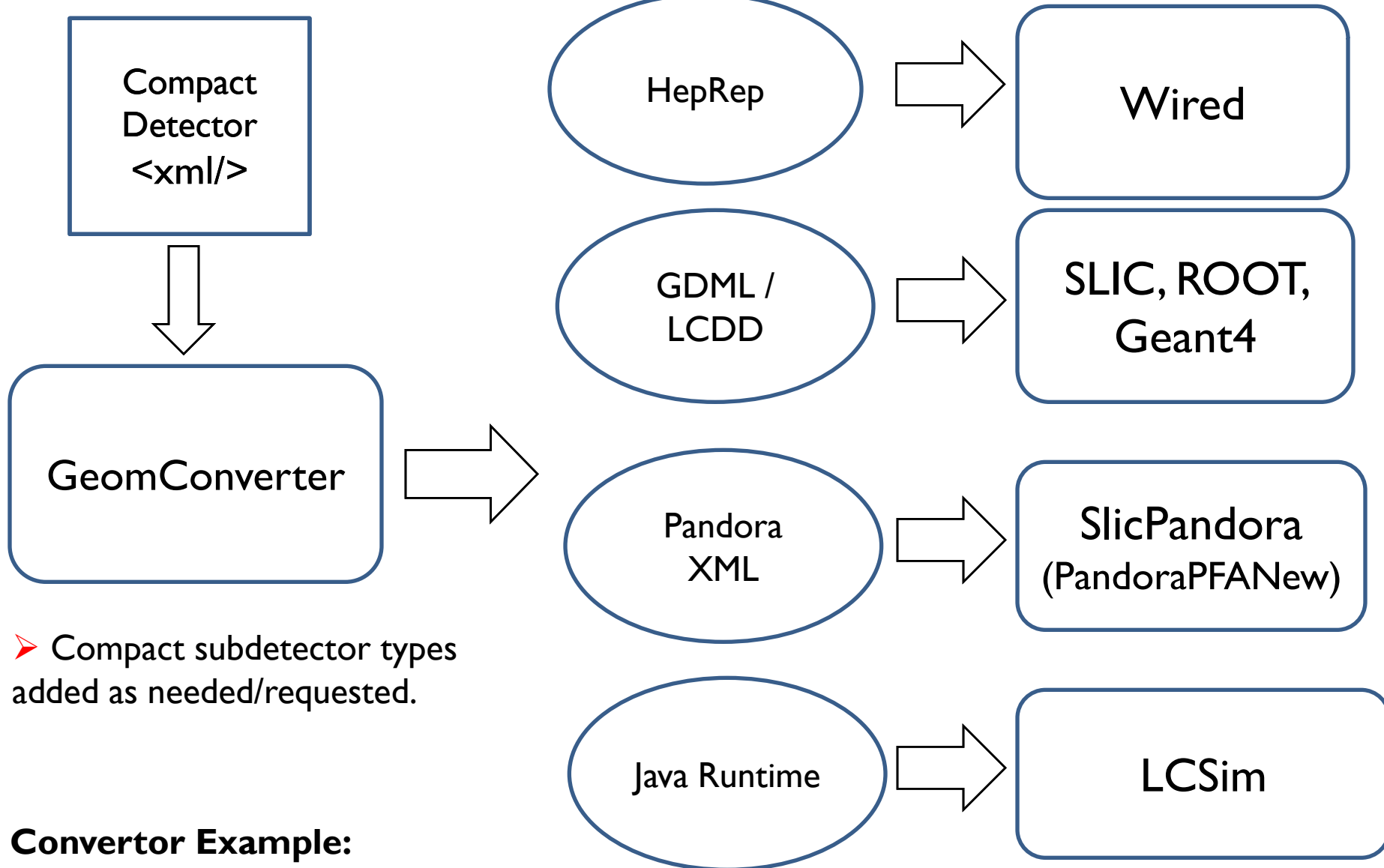
```
slic -g geometry.lcdd -m stuff.mac -i events.stdhep -o output.slcio -l QGSP_BERT -r 1000
```

```
slic -h # print help
```

```
slic -m run.mac # run with macro only
```

```
slic -n # run interactively
```

GeomConverter



➤ Compact subdetector types added as needed/requested.

Convertor Example:

```
java -jar GeomConverter-bin.jar -o lcdd compact.xml mydet.lcdd
```

Compact Description

- High level detector description format geared towards end users
- Can be converted into various useful data formats and Java runtime objects
- New detector types can be supported by adding the appropriate classes to GeomConverter.
- LCDetectors is data repository for compact detectors and their conditions.

`<lccdd/>` ← root element
`<info/>` ← detector meta data
`<define/>` ← variable definitions
`<materials/>` ← custom materials
`<limits/>` ← physics limits
`<regions/>` ← detector regions
`<display/>` ← visualization settings
`<detectors/>` ← detector description
`<readouts/>` ← segmentation and IDs
`<fields/>` ← magnetic fields

Example Detector:

```
<detector id="1" name="ECB" type="EcalBarrel" readout="ECBHits" vis="ECBVis" type="EM_BARREL">  
  <dimensions numsides="12" rmin="EcalBarrel_rmin" z="EcalBarrel_zmin"/>  
  <layer repeat="30">  
    <slice material="Silicon" thickness="0.25*mm" />  
    <slice material="Tungsten" thickness="2.5*mm"/>  
  </layer>  
</detector>
```


LCDetectors

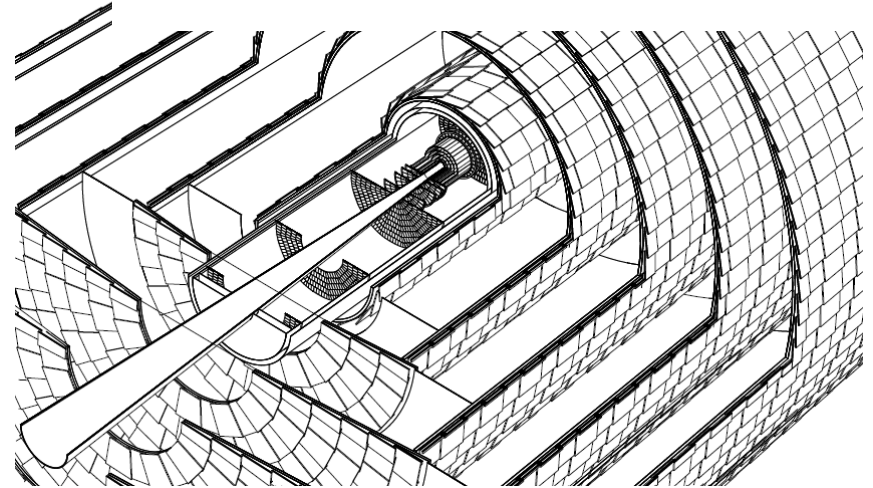
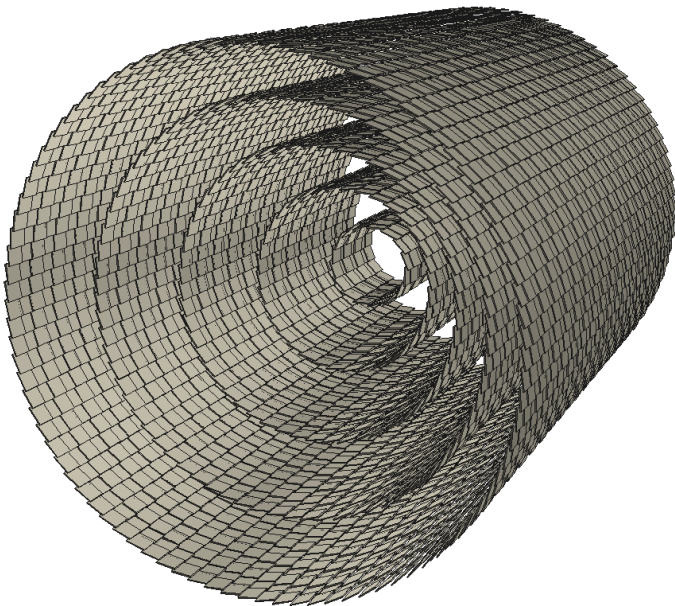
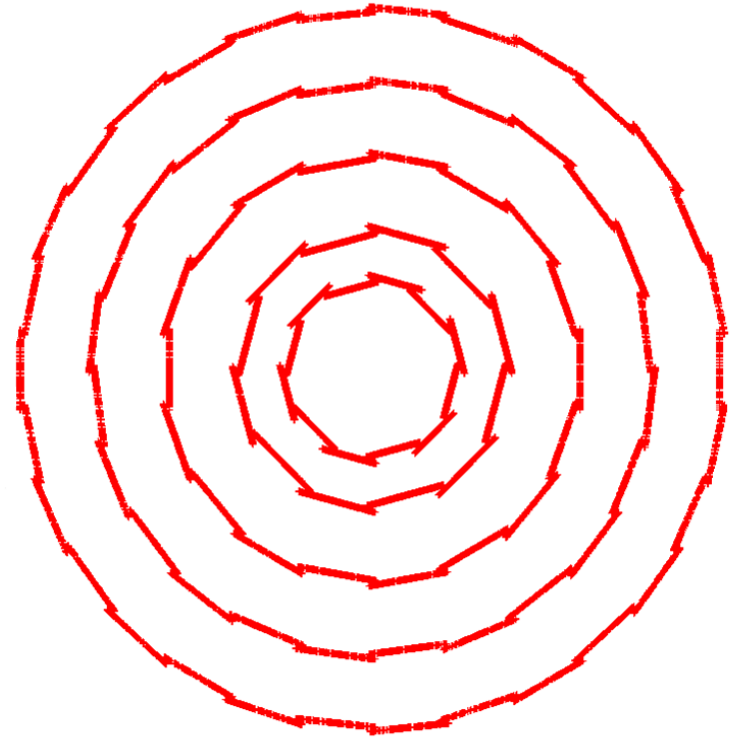
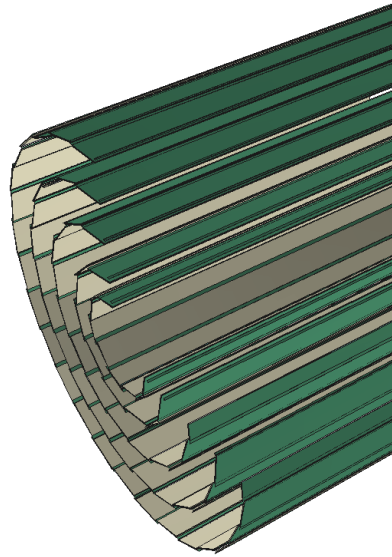
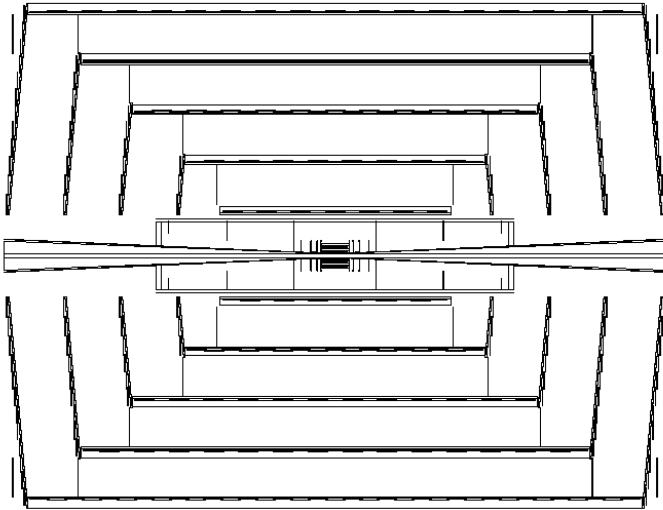
- CVS module containing detector data for GeomConverter/LCSim.
- At a minimum, each detector must have a compact.xml file.
- Conditions are stored in a detector's directory and can be read in using the LCSim ConditionsManager.
- Detector data is packaged into zip files and distributed via the WWW.
 - Sampling fractions
 - Tracking strategies
 - etc.
- Makefile contains helper commands for generating data files, running common Geant4 commands (such as geometric overlap checking), and for packaging data.
- Detectors can also be packaged into a single jar file using Maven.

<http://www.lcsim.org/detectors>

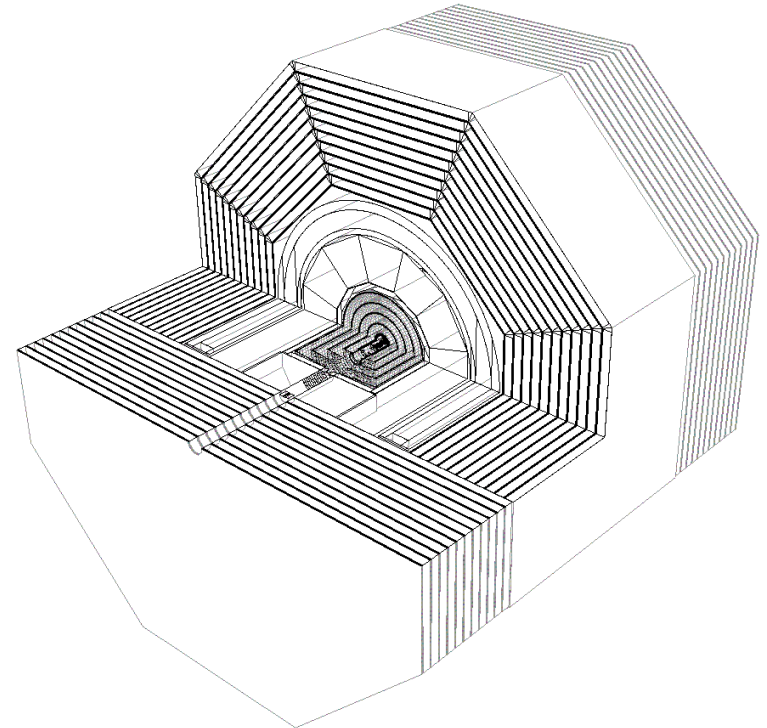
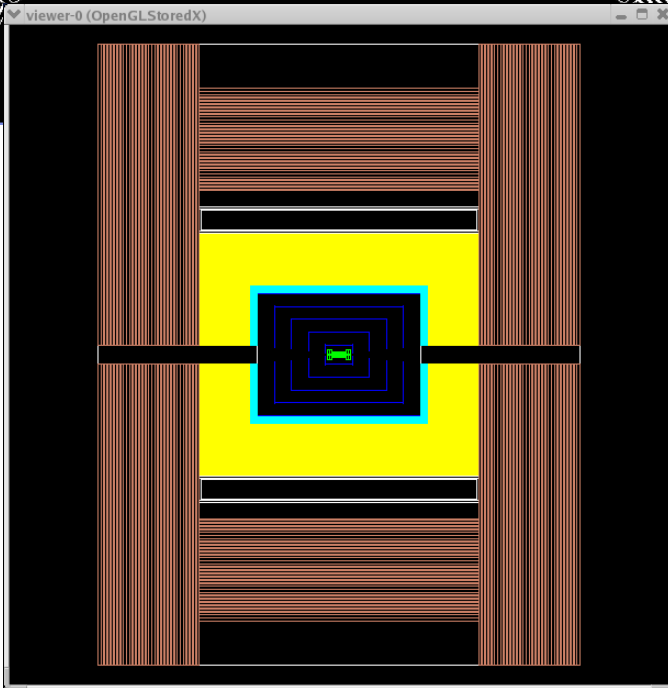
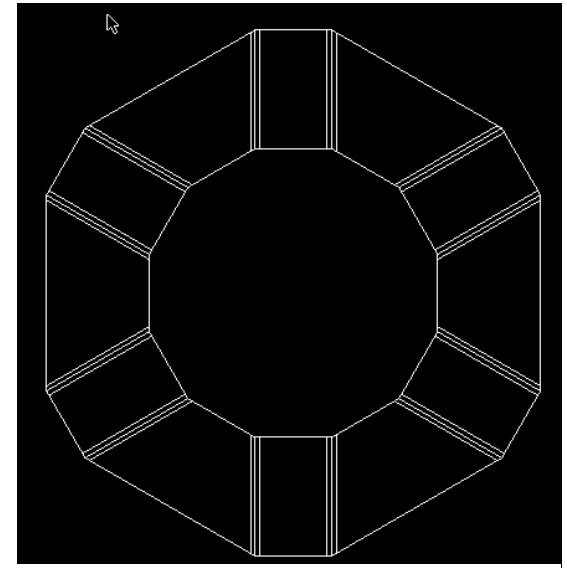
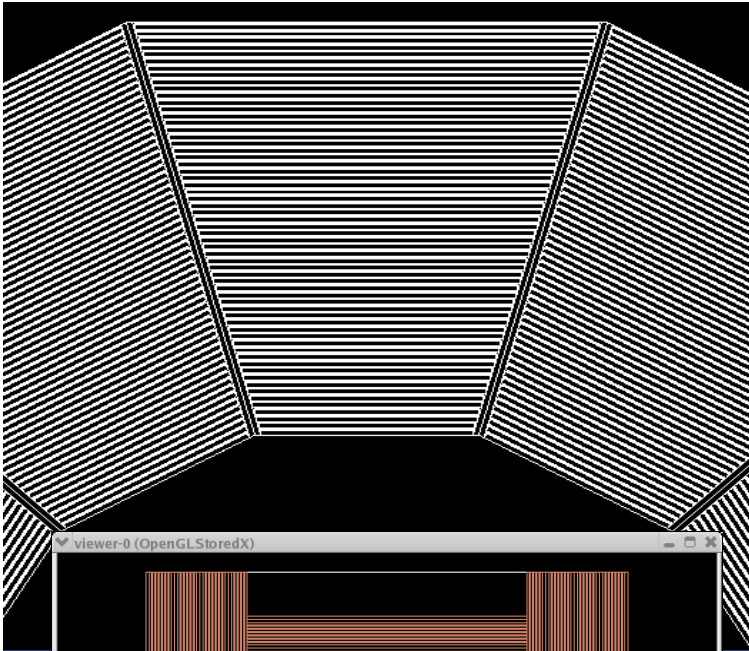
Example Detector Data

```
-- CalorimeterCalibration.properties
-- Cheating.properties
-- ClusterParameters.properties
-- IDEfficiency.properties
-- LongitudinalHMatrix.hmx
-- SamplingFractions
|   |-- BeamCal.properties
|   |-- EcalBarrel.properties
|   |-- EcalEndcap.properties
|   |-- HcalBarrel.properties
|   |-- HcalEndcap.properties
|   |-- LumiCal.properties
|   |-- MuonBarrel.properties
|   |-- MuonEndcap.properties
-- SimpleTrack.properties
-- TrackParameters
|   |-- FullBarrelResolutionBc.ini
|   |-- FullBarrelResolutionNbc.ini
|   |-- FullBarrelResolutionWMF_Nbc.in
-- TrackParameters.properties
-- compact.xml
-- detector.properties
-- digisim
|   |-- digisim.steer
-- hadronCalibration
|   |-- nhQcal-v2r3p10.properties
-- photonCalibration
|   |-- photonQcal-v2r3p10.properties
-- sidloi3.html
-- sidloi3.lcdd
-- sidloi3.svg
-- sidloi3.wrl
-- sidloi3_pandora.xml
`-- structuralPFA
   |-- likelihood.bin
```

Tracker

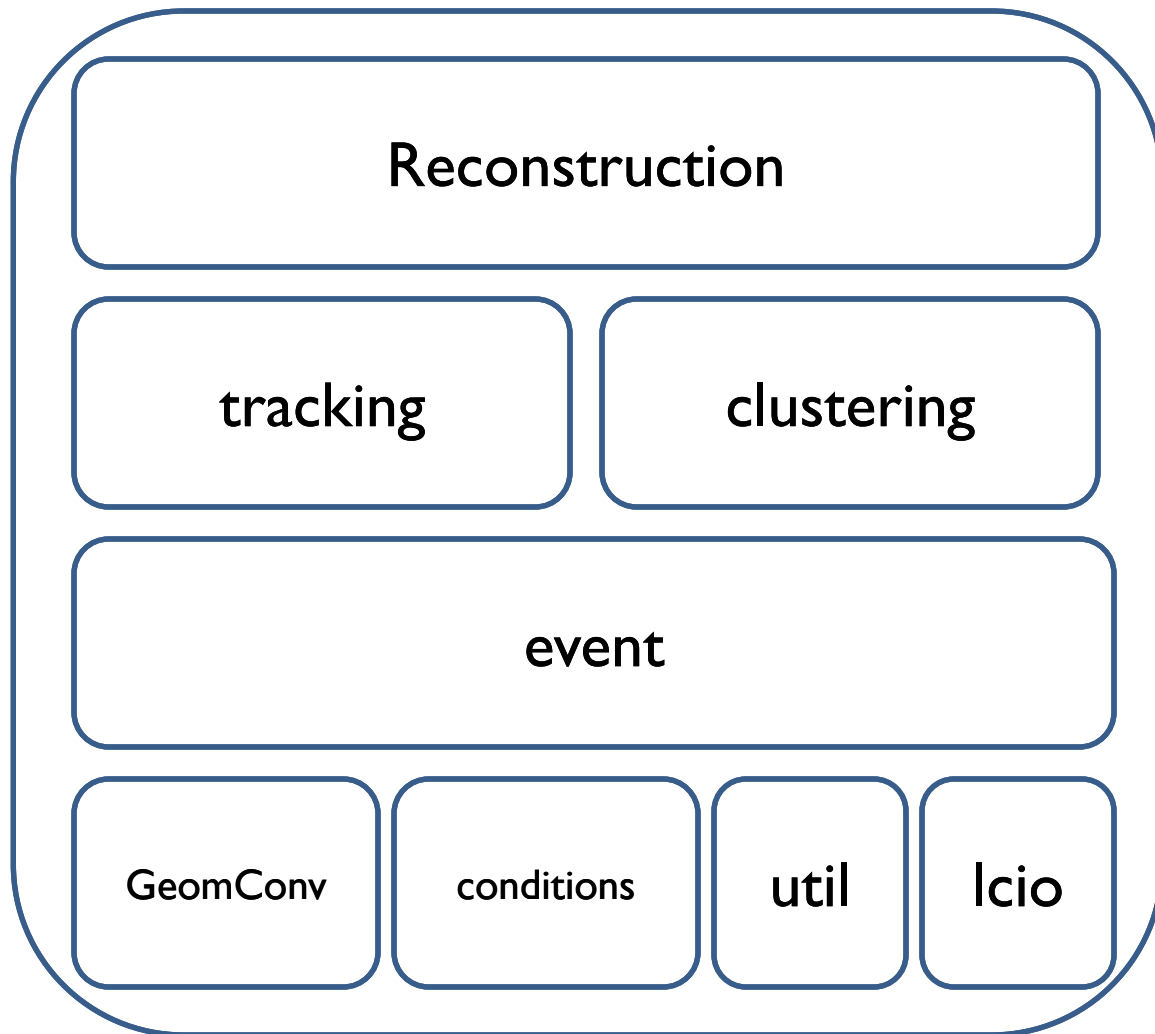


Calorimeters



LCSim

- Java-based reconstruction and analysis framework
- Built with Maven
- Easy build/installation/use
 - One build command gets you up and running.
- Reads LCIO files
- Ulowa PFA
- Seedtracker
- Contrib module for non-essential user code contributions
- Packaged into single jar file
- Grid ready
- XML steering files
- JAS3 Plugin

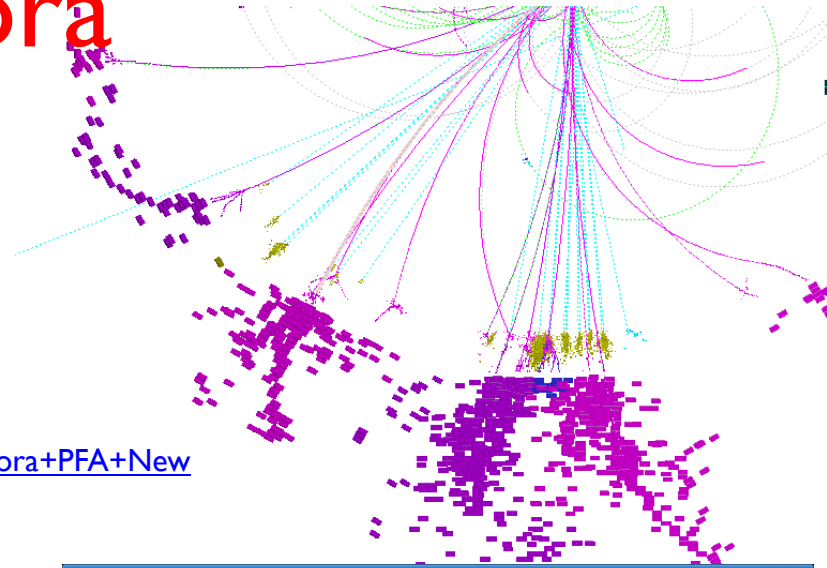


<https://confluence.slac.stanford.edu/display/ilc/org.lcsim>

SLIC Pandora

- Frontend to Pandora PFA that takes SLIC output plus LCSim Tracks
- Outputs LCIO PFO collections
- Runs on both digital and analog calorimeters
- Optional PandoraMonitoring for visualization
- Work ongoing to improve performance

<https://confluence.slac.stanford.edu/display/ilc/Running+SLIC+Events+in+Pandora+PFA+New>

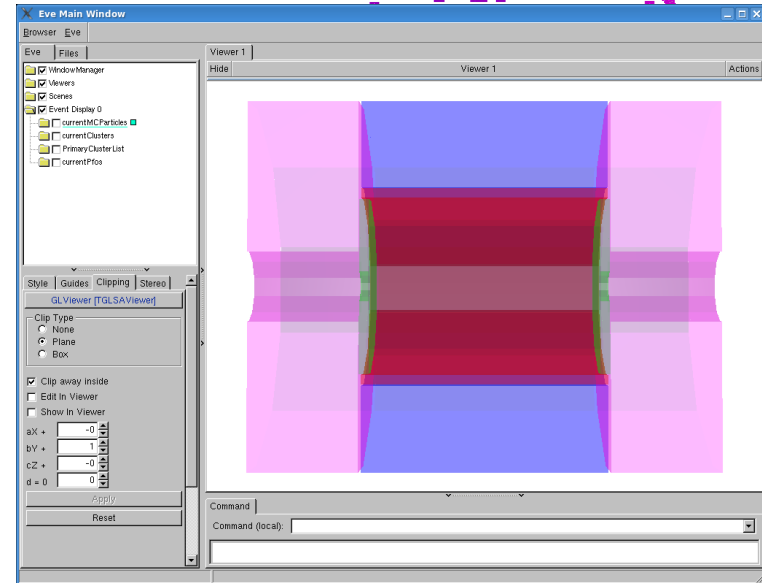


Geometry Format

```
<pandoraSetup>  
  <detector>  
  <calorimeters>  
    <calorimeter>  
      <id>  
      <layers>  
    <coil>  
  <tracking>
```

Command Line Syntax

PandoraFrontend geometry.xml settings.xml input.slcio output.slcio nevents nskip

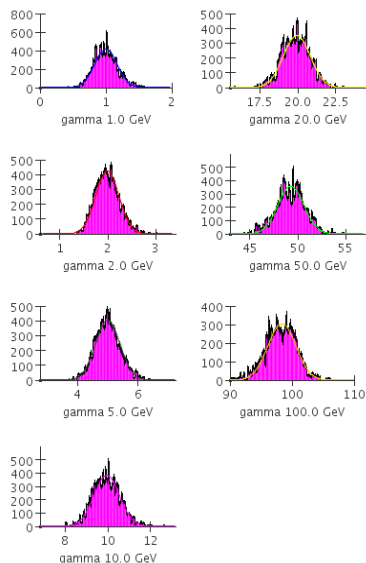


JAS3

LCIO Record Source

Wired

- Java-based analysis program
- AIDA compliant
- Can use plugins for data visualization and other purposes.
- See talk by Tony Johnson



File Edit View Tuple Loop Window Help

Z0_Theta00_10-250GeV_OpalTune-1-1000_SLIC-v2r8p2_geant4-v9r2p2_QGSP_BERT_clc_sid_cdr_lcsimTracking_pandoraOutput.slcio

Settings Cuts

Interaction Q Picking

Interaction

Types

- DetectorType
- EventType
- EcalBarrelHits
- LumiCalHits
- MuonEndcapHits
- HitSensorSiVertexEndcapHit
- HitModuleSiVertexEndcapHit
- SiVertexEndcapHits
- RecVtxBarrHits
- MUON_BARREL
- RecVtxEndcapHits
- MuonBarrelHits
- MUON_ENDCAP
- HAD_BARREL
- HitSensorSiTrackerBarrelHit
- HitModuleSiTrackerBarrelHit

Instances

- Detector
- Event

Apply immediately Apply

Hide Types below level: 3

Hide Instances below level: 3

Run:0 Event:0

Collection: MCParticle size:205 flags:0

N	PDG ID	Type	Generator Status	Simulator Status
0	2112	n	Other (0)	Backscatter,Created In Simulation,Decayed In Calorimeter
1	2112	n	Other (0)	Backscatter,Created In Simulation,Decayed In Calorimeter
2	2112	n	Other (0)	Backscatter,Created In Simulation,Decayed In Calorimeter
3	1000140280	unknown	Other (0)	Backscatter,Created In Simulation,Stopped
4	11	e-	Other (0)	Backscatter,Created In Simulation,Stopped
5	2112	n	Other (0)	Backscatter,Created In Simulation,Decayed In Calorimeter
6	11	e-	Other (0)	Backscatter,Created In Simulation,Stopped
7	11	e-	Other (0)	Backscatter,Created In Simulation,Stopped
8	2112	n	Other (0)	Backscatter,Created In Simulation,Decayed In Calorimeter
9	2112	n	Other (0)	Backscatter,Created In Simulation
10	2112	n	Other (0)	Backscatter,Created In Simulation,Decayed In Calorimeter
11	2112	n	Other (0)	Backscatter,Created In Simulation,Decayed In Calorimeter
12	2112	n	Other (0)	Backscatter,Created In Simulation,Decayed In Calorimeter
13	11	e-	Other (0)	Backscatter,Created In Simulation,Stopped

JAS3Tree WIRED W

View 1 View 2 LCSim Event

Drag to rotate using virtual ball; Shift-drag to rotate over vertical axis; Ctrl-drag to rotate over horizontal axis.

98.6/138.6MB

LCSim Event Browser

Grid

- All primary ALCPG software tools can be run on grid. (slic, lcsim, slicPandora)
- Need to get grid certificate first to use and join ILC VO
- Two main grid sites are accessible.
 - LHC grid (CLiC)
 - Dirac toolkit with command line tools
 - Online monitoring tool
 - Python scripts for job submission
 - Job chaining
 - Large number of accessible machines (14k)
 - Use *lxplus* machines for environment
 - Grid data catalog for file storage.
 - Fermi grid (SiD)
 - Use Open Science Grid (OSG)
 - Uses Condor commands for job submission with JDF files
 - Good resource allocation (500 concurrent jobs)
 - Doc DB to access output: <http://docdb.fnal.gov/ILC/sid/>
 - Use *ilcsim2* machine for environment and virtual grid file system

Conclusions

- SiD software chain is complete and robust, from event generation through analysis.
 - Used for generation and analysis of ~20 million events for LOI
 - Also used by non-ILC collaborations
- Work still remains to be done for the DBD.
 - Detailed simulation of RPC response
 - Track fitting
 - Data set generation for DBD using detailed detector models
 - Detector optimization
 - See other talks
- Contributions welcome
 - Easy to add and integrate your own code or software packages
 - Java code is easily built/integrated/debugged.
 - Analysis & reconstruction code can be added to lcsim-contrib and immediately accessed in lcsim jobs.

Documentation & Links

- ILC Wiki
<https://confluence.slac.stanford.edu/display/ilc/Home>
- LCSim Website
<http://www.lcsim.org/>
- FTP for Event Data
<ftp://ftp-lcd.slac.stanford.edu/lcd/ILC/>
- SLIC FAQ
<https://confluence.slac.stanford.edu/display/ilc/SLIC+FAQ>
- LCSim Job XML
<https://confluence.slac.stanford.edu/display/ilc/lcsim+xml>
- Detector Data
<http://www.lcsim.org/detectors>
- SimDist Instructions
<https://confluence.slac.stanford.edu/display/ilc/Simulation+Software+Distribution>
- Forums
<http://forum.linearcollider.org/>