



Full Detector Simulation using SLIC and LCDD

Jeremy McCormick, SLAC

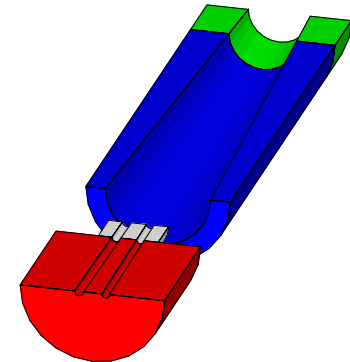
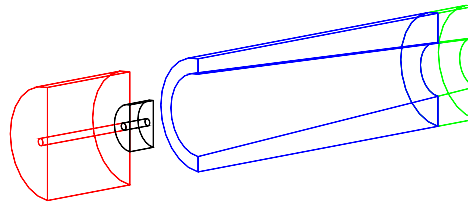
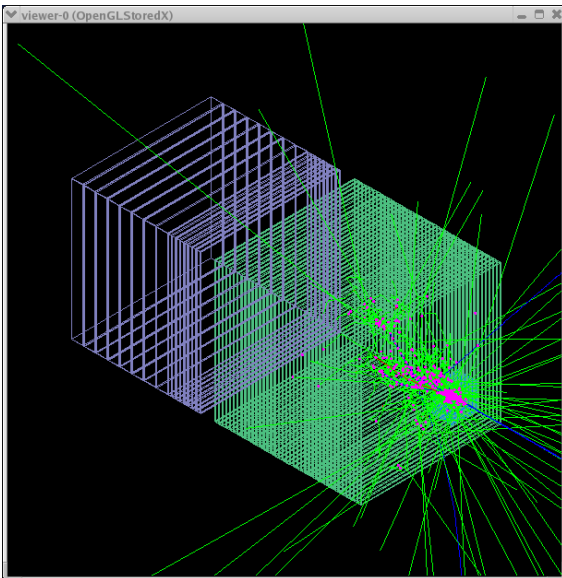
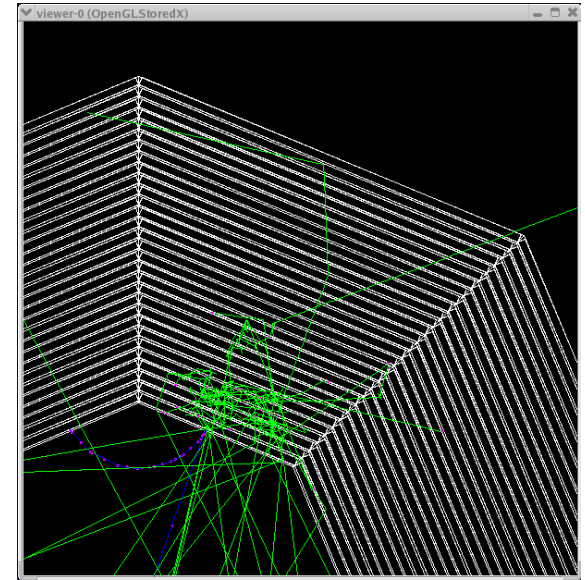
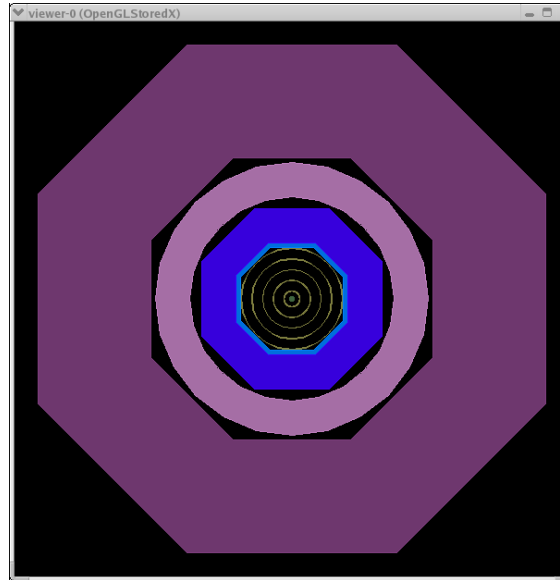
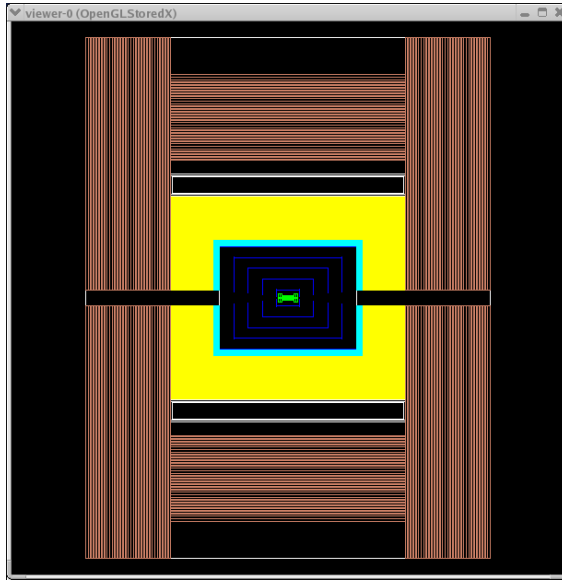
What is SLIC?

- Geant4-based Simulator
- Hub integrating a number of other HEP packages and formats
 - LCPhys
 - Linear Collider Detector Description (LCDD)
 - Geometry Description Markup Language (GDML)
 - LCIO
 - StdHep
 - lStdHep, lXDR
 - Thanks, Willy Langeveld.
- flexible tool for simulating arbitrary detector geometries and their readouts
- Geometry code is all in LCDD package.

What is LCDD?

- XML format for detector description
 - extension to GDML geometry language
- Detector is described 100% at runtime.
 - No C++ code is required for detector customization.
- parser for creating Geant4 objects from the detector document
- Schema (XSD) defines the data format for consumers and producers.
- Distinguishing features...
 - GDML: CLHEP expressions, materials, Geant4 CSG solids, etc.
 - configurable 64-bit Identifiers
 - variety of trackers and calorimeters for readout
 - physics limits by volume
- **PHILOSOPHY = Batteries Included!**

Example Geometries



3/17/05

Snowmass 2005
Jeremy McCormick, SLAC

Full Simulations

LCDD Structure

<code><lcdd></code>	.....➔	LCDD Root Element
<code><header></code>	.....➔	Information about the Detector
<code><iddict></code>	.....➔	Identifier Specifications
<code><sensitive_detectors></code>	.....➔	Detector Readouts
<code><limits></code>	.....➔	Physics Limits
<code><regions></code>	.....➔	Regions (sets of volumes)
<code><display></code>	.....➔	Visualization Attributes
<code><gdml></code>	.....➔	GDML Root Element
<code><define></code>	.....➔	Constants, Positions, Rotations
<code><materials></code>	.....➔	Material Definitions
<code><solids></code>	.....➔	Solid Definitions
<code><structure></code>	.....➔	Volume Hierarchy
<code></gdml></code>		
<code><fields></code>	.....➔	Magnetic Field
<code></lcdd></code>		

Example Volume Element

<code><volume name="ecal_barr"></code>	Logical Volume
<code> <materialref ref="Air" /></code>	Material Reference
<code> <solidref ref="ecal_barr_tube" /></code>	Solid Reference
<code><physvol></code>	Physical Volume
<code> <volumeref ref="ecal_barr_lay0" /></code>	Logical Volume Reference
<code> <positionref ref="identity_pos" /></code>	Position Reference
<code> <rotationref ref="identity_rot" /></code>	Rotation Reference
<code> <physvolid name="layer" value="0"/></code>	Physical Volume Identifier
<code></physvol></code>	
<code> <sdref ref="EcalSD" /></code>	Sensitive Detector Reference
<code> <regionref ref="EcalRegion" /></code>	Region Reference
<code> <limitsetref ref="EcalLimits" /></code>	Limits Reference
<code> <vis_attributesref ref="EcalVis"/></code>	Visualization Reference
<code></volume></code>	

Example Sensitive Detectors

```
<calorimeter name="EcalBarrSD"  
             hits_collection="ECBHits"  
             ecut="1.0"  
             eunit="MeV"  
             verbose="4">  
  <idspecref ref="CalId" />  
  <projective_cylinder ntheta="840"  
                      nphi="1680" />  
</calorimeter>
```

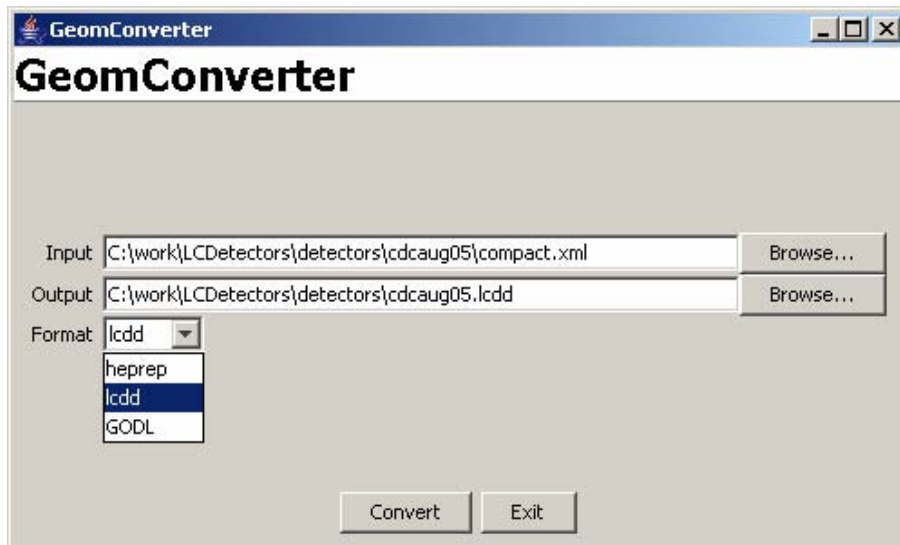
Calorimeter
Hits Collection Name
Energy Cut
Energy Unit
Verbosity
Identifier Specification Reference
Projective Cylinder Segmentation

```
<tracker name="VtxBarrSD"  
         hits_collection="VtxBarrHits"  
         <idspecref ref="TrkId" />  
</tracker>
```

Tracker

GeomConverter and Compact Format

- LCDD = flexible, powerful...BUT
- too verbose for “hand hacking”
- Reconstruction and analysis needs different level of detector description.
- compact description
 - detectors, layers, slices, etc.
 - See talks by Norman Graf, Tony Johnson



Example Command

Command Line

slic -g myGeom.lcdd

-i events.stdhep

-m commands.mac

-o outfile.slcio

-x

-s 1

-l LCPhys

-d 1234

-z

-r 1000

Macro or Interactive

/lcdd/url myGeom.lcdd

/generator/filename events.stdhep

/control/execute commands.mac

/lcio/filename outfile.slcio

/lcio/fileExists delete

/generator/skipEvents 1

/physics/select LCPhys

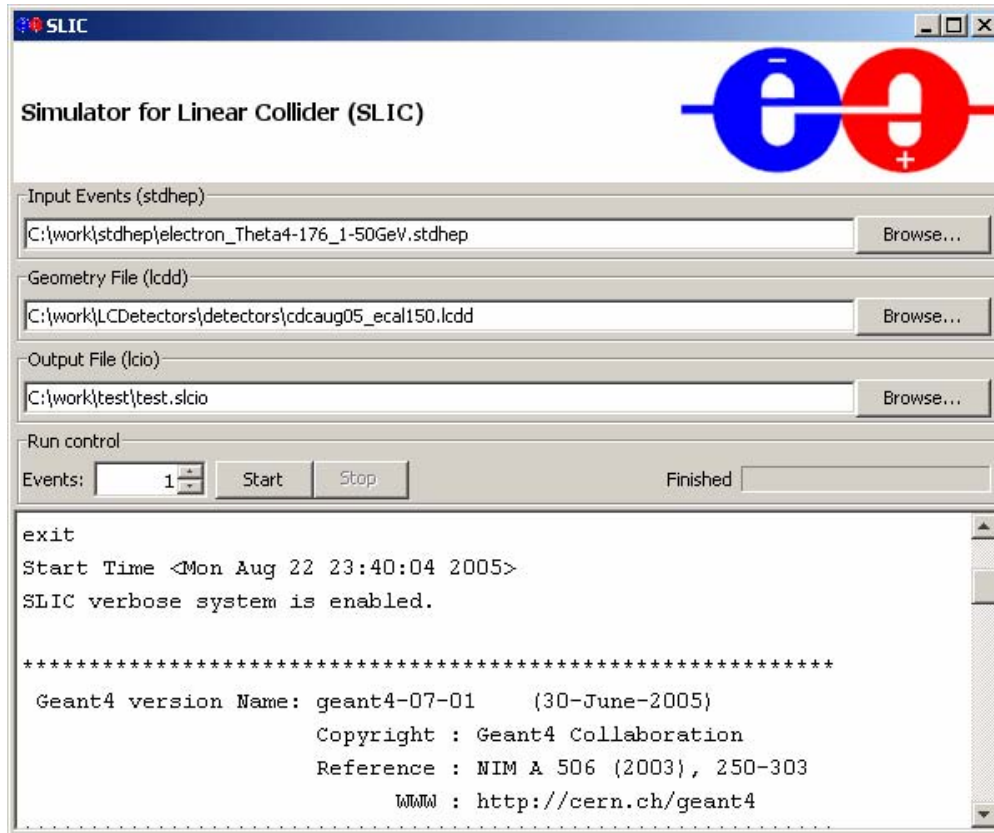
/random/seed 1234

/run/initialize

/run/beamOn 1000

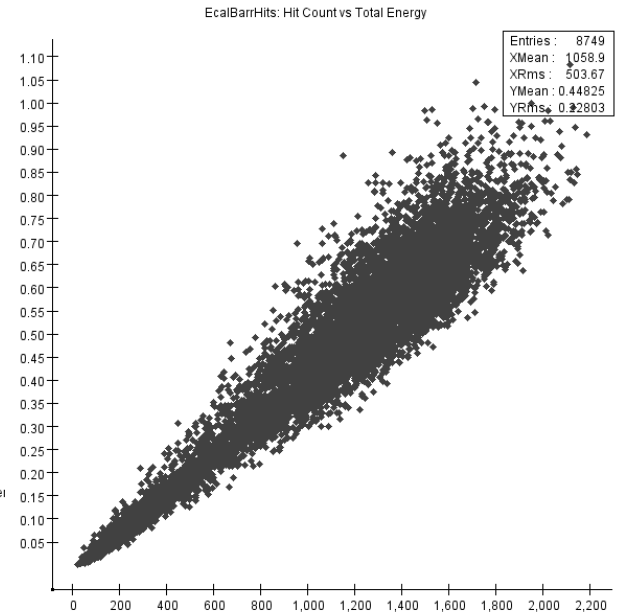
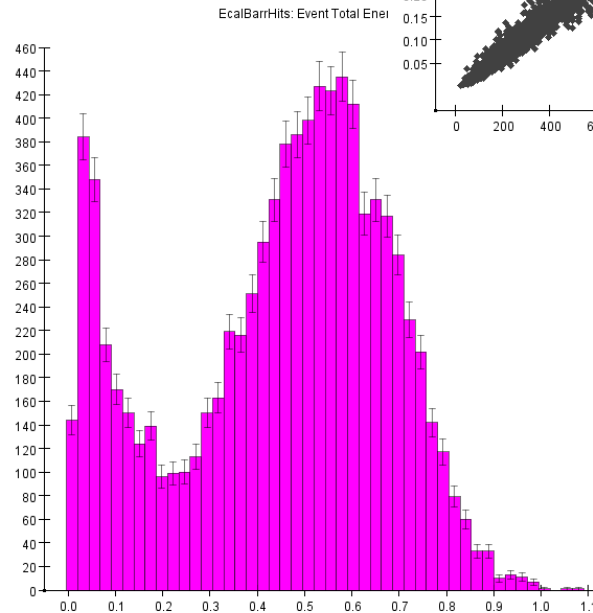
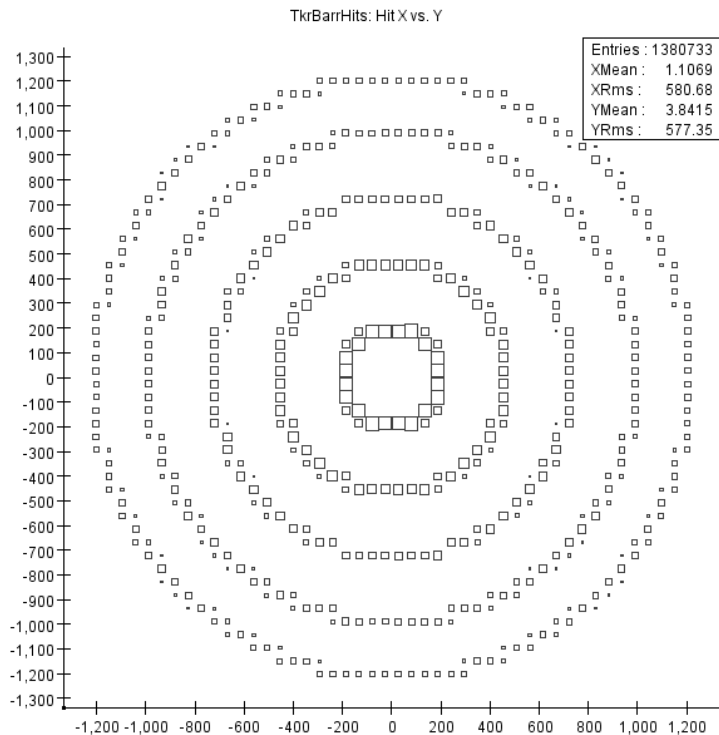
SlicRunner

- Java runner for Windows users.
- Automatically downloads latest version.
- More features planned...



SlicDiagnostics

- diagnostic histograms for LCIO output from SLIC
 - SimCalorimeterHit, SimTrackerHit, MCParticle
- package “SlicDiagnostics” at SLAC CVS



Links

• SLIC

- Homepage: <http://www.lcsim.org/software/slic>
- Wiki: <http://confluence.slac.stanford.edu/display/ilc/SLIC>
- Doxygen: <http://www.lcsim.org/software/slic/doxygen/html/index.html>
- Runner: <http://web007.slac.stanford.edu:8888/SLICGUI/>

• LCDD

- Homepage: <http://www.lcsim.org/software/lcdd>
- Schema: http://www.lcsim.org/software/lcdd/schema_doc/lcdd.xsd.html
- Doxygen: <http://www.lcsim.org/software/lcdd>
- Full Detectors (in zip files): <http://www.lcsim.org/detectors>

• GDML

- Homepage: <http://gdml.web.cern.ch/GDML/>
- Schema: http://www.lcsim.org/software/lcdd/schema_doc/gdml.xsd.html

• GeomConverter

- Homepage: <http://www.lcsim.org/software/geomconverter>
- HOWTO: <http://confluence.slac.stanford.edu/display/ilc/Converting+to+LCDD+or+HepRep+using+GeomConverter>