

ALCPG Software Tools



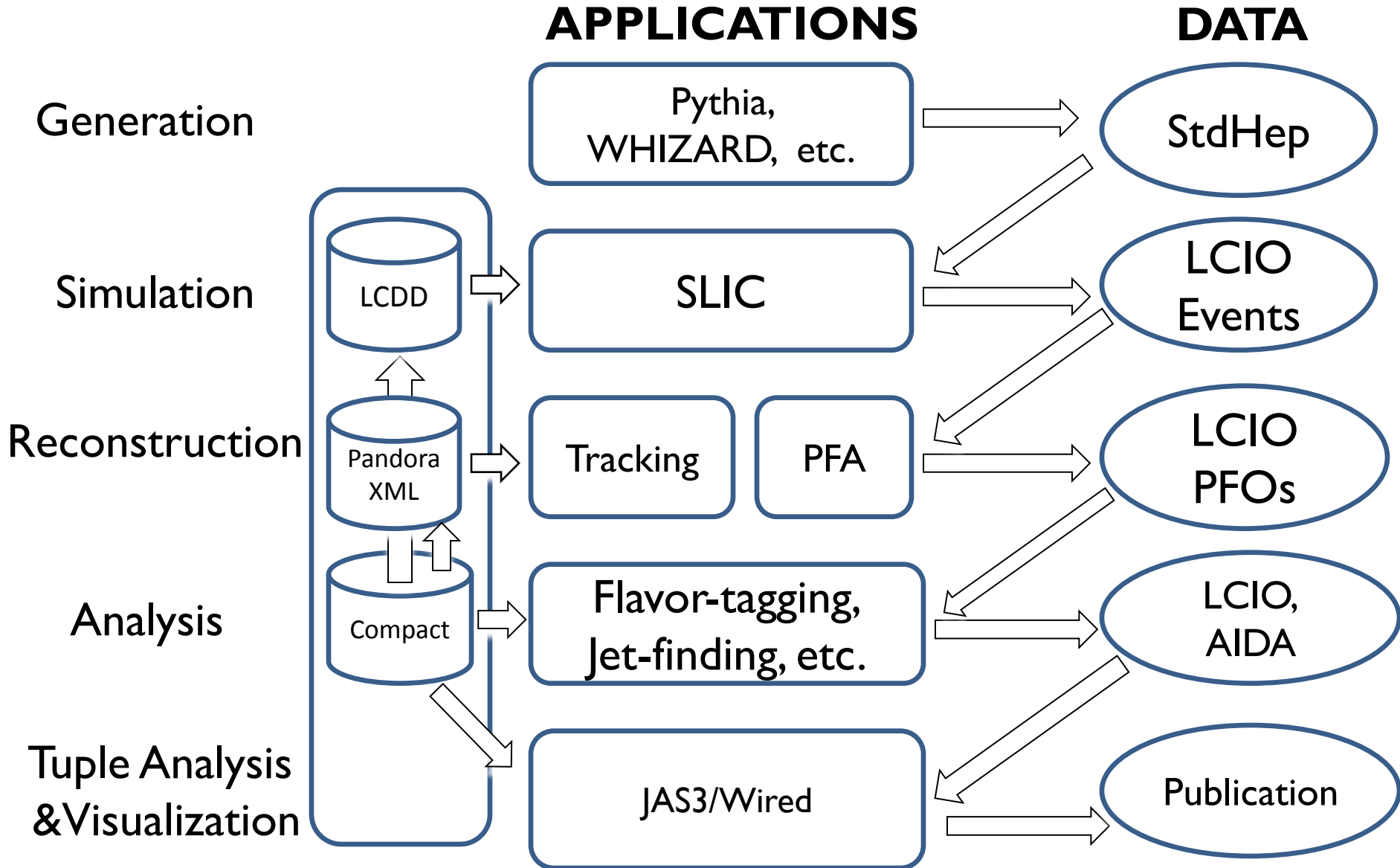
SLAC



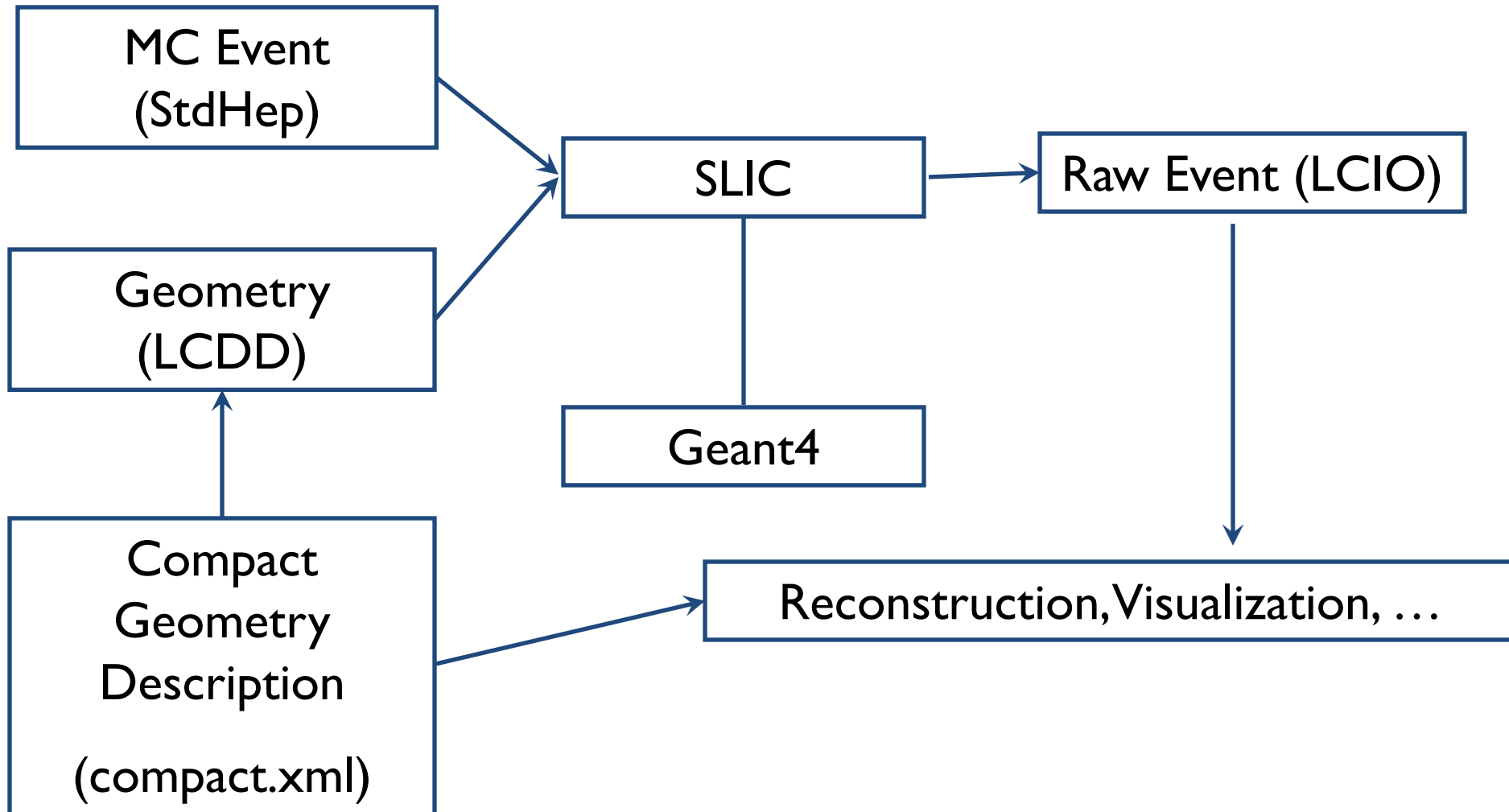
American Linear Collider
Physics Group

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Framework



LC Detector Full Simulation



SLIC

- Simulator for the Linear Collider
- Full detector simulation
 - 4 PI detectors
 - test beams
 - other custom detector setups
- Integration
 - Geant4
 - GDML / LCDD
 - HEP PDT
 - LCIO
 - StdHep
- Minimal runtime dependencies
 - No database
 - No user code for geometry description

Recent Features Added to SLIC

- Full 3D magnetic field map support
 - Grid => (x, y, z, Bx, By, Bz)
- Option to store step information for all energy depositions in CalorimeterHits.
 - Turn on via macro option.
 - Useful for detailed analysis of detector response
- Z smearing of generated event vertices
 - Gaussian smearing
- Geant4 version was updated to 9.5.1
- LCIO version updated to 2.0

SimDist

- Since compiling SLIC from scratch is complicated, a build kit is provided.
- Based on well-worn and understood GNU tools
 - Autoconf, Make, GCC, etc.
- Works on many flavors of Linux, OSX
 - Windows support is deprecated.
- Options for different run modes
 - visualization
 - debugging
 - batch
- Binaries distributed on lcsim.org

Geant4

- “Geometry and Tracking”
- Standard HEP toolkit for detector simulation
- Features
 - extensive and flexible physics process library
 - visualization
 - detailed and flexible geometry description
 - macro commands
- Advertised as a “toolkit” so need to put the pieces together to build your own app

LCIO

- Linear Collider IO
- Implementations in C++, Java, Python, FORTRAN
- Supported throughout ALCPG tool chain
- Physics object interfaces
 - hits/digits, tracks, particles, etc.
- Allows data interchange between apps/frameworks
 - This has been very successful! (SiD LOI, DBD)
 - Can even read your LCIO files into ROOT. (built-in support)
- See other talk(s) at this workshop for more details

GDML & LCDD

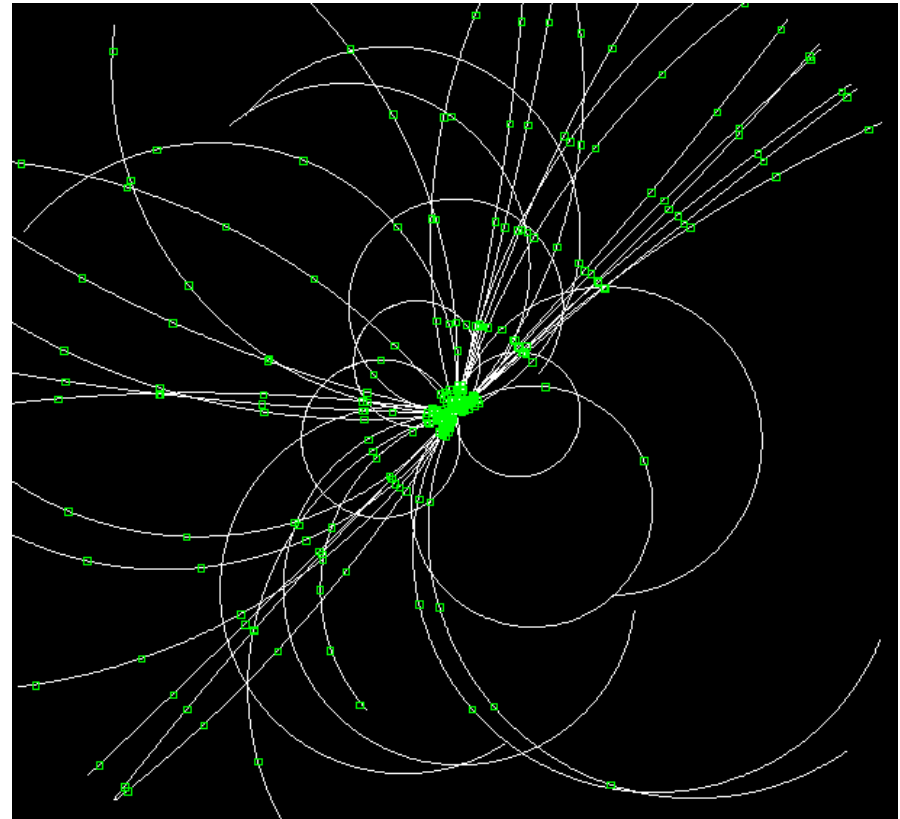
- XML geometry description
 - avoid completely user-defined geometry in code
- GDML
 - constants and definitions
 - materials
 - shapes
 - volumes
 - hierarchical geometry structure
- LCDD
 - sensitive detectors
 - identifiers
 - magnetic fields
 - visualization
 - physics limits
 - regions

GeomConverter

- LCDD is too low-level for most users to hand code.
- Compact description provided for writing a high-level description of the geometry.
 - detector names, number of layers, layer thicknesses/materials, readout identifiers, B-fields
- Java program converts from compact to different formats.
 - LCDD
 - HepRep
 - Runtime Geometry (Java objects)
 - XML for Pandora
 - HTML
 - <http://www.lcsim.org/detectors/sidloi3.html>
 - SVG (experimental)
- Focus on data formats as different applications have different required levels of detail
- Data interchange

LCSim

- Fully featured application framework for HEP analysis and reconstruction
- Written in Java
 - No more seg faults or mysterious memory leaks!
- Tracking
 - digitization
 - finding and fitting
- PFA
 - clustering
 - track/cluster association
- Analysis
 - jet finding, cluster finding, vertexing



slicPandora

- Interface from SLIC to PandoraPFA
 - But not actually limited to SLIC input; could accept any LCIO file with hits + tracks.
- LCIO compatible
 - read hits, tracks
 - write reconstructed particles
- XML geometry description generated by GeomConverter
- Used extensively for SiD LOI

AIDA

- Abstract Interfaces for Data Analysis
- Analysis classes
 - 1, 2, & 3D Histograms + Clouds
 - 1 & 2D Profiles
 - DataPointSet
 - Tuples
- Java implementation
 - Other impl. exist in Python & C++
- compressed XML file format
- Readable in JAS

JAS & Wired

- Java Analysis Studio
- Workbench
 - Wired event display
 - LCSim Event Browser
 - view/edit AIDA files
 - Load analysis drivers
 - Simple code editing
- Plugin architecture
 - extensible by writing loadable code modules

Analysis Session

The screenshot displays the JAS3 Tree software interface during an analysis session. The main window is divided into several panels:

- Visibility Panel:** Shows a tree view of detector components under 'Types' and 'Instances'. The 'Types' list includes DetectorType, Barrel, EcalBarrel, HcalBarrel, MuonBarrel, SITrackerBarrel, SIVertexBarrel, SolenoidCoilBarrel, Endcap, EcalEndcap, HcalEndcap, LumiCal, MuonEndcap, SolenoidCoilEnds, EventType, BuildUpVertex, BuildUpVertexTracks, BuildUpVertex_RP, BuildUpVertex_VO, BuildUpVertex_VOTracks, BuildUpVertex_VO_RP, HelicalTrackHits, MCParticlesSkimmed, PandoraPFOCollection, PrimaryVertex, PrimaryVertexTracks, and PrimaryVertex_RP. The 'Instances' list shows multiple instances of CalClusters and other components.
- View 1 and View 2:** Two overlapping windows showing a 3D visualization of particle tracks originating from a central vertex (green dot) and extending outwards. The tracks are color-coded by energy or type.
- Page 1:** A histogram titled 'RP Energy' showing the distribution of reconstructed particle energies. The x-axis ranges from 0 to 2,000, and the y-axis ranges from 0 to 140. The distribution is highly peaked near zero. Statistics shown: Entries: 134, Mean: 49.856, Rms: 262.23.
- LCSim Event:** A table showing event details for Run:169959, Event: 3. The table has columns for Type, DO, Phi, Omega, Z0, TanLambda, Track States, Momentum, Chi2, NDF, and dEdx. The data shows various track types and their associated parameters.
- MyDriver.java:** A code window showing the implementation of a driver class. The code imports necessary classes and implements the process method for handling event headers.

At the bottom of the interface, a status bar shows the time 1:48:34 PM and the message 'compile successful'. The bottom right corner displays the file path [260.2/365.8MB].

Who uses LCSim Framework?

- SiD
 - LOI
 - DBD (ongoing)
- CLiC
 - CDR
 - CERN-based SiD studies
- Muon Collider
 - work ongoing
- HPS
 - Heavy Photon Search experiment at JLAB
- Dual Readout Calorimetry
 - FNAL

Summary

- ALCPG software framework is mature, robust and well-tested.
- Supports standard ILC IO formats and applications
- Used for multiple rounds of iterative detector studies by different physics groups
- If you would like to use the framework, please contact us. New comers welcome.

Links

- Wiki - <http://confluence.slac.stanford.edu/display/ilc/Home>
- lcsim.org - <http://www.lcsim.org>
- ILC Forum - <http://forum.linearcollider.org>
- LCIO - <http://lcio.desy.de>
- SLIC - <http://www.lcsim.org/software/slic>
- LCDD - <http://www.lcsim.org/software/lcdd>
- JAS3 - <http://jas.freehep.org/jas3>
- AIDA - <http://aida.freehep.org>
- WIRED - <http://wired.freehep.org>