SiD Spring Break
April 2007

General Software Issues at SiD

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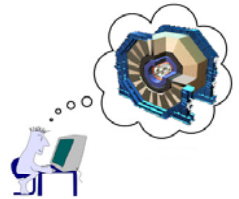
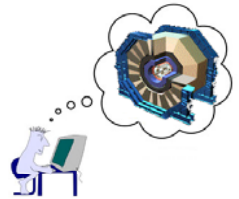
Outline



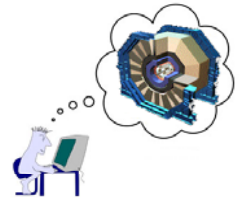
- **Topics Covered**
  - **Recap: Software Overview**
    - **Geometry**
    - **SLIC, org.lcsim**
    - **Tools**
  - **Planned Enhancements**
    - **LCIO improvements**
    - **LCGO common geometry**
  - **Documentation/Communication/Collaboration**
    - **Documentation**
    - **Forums**
    - **New SiD web site**

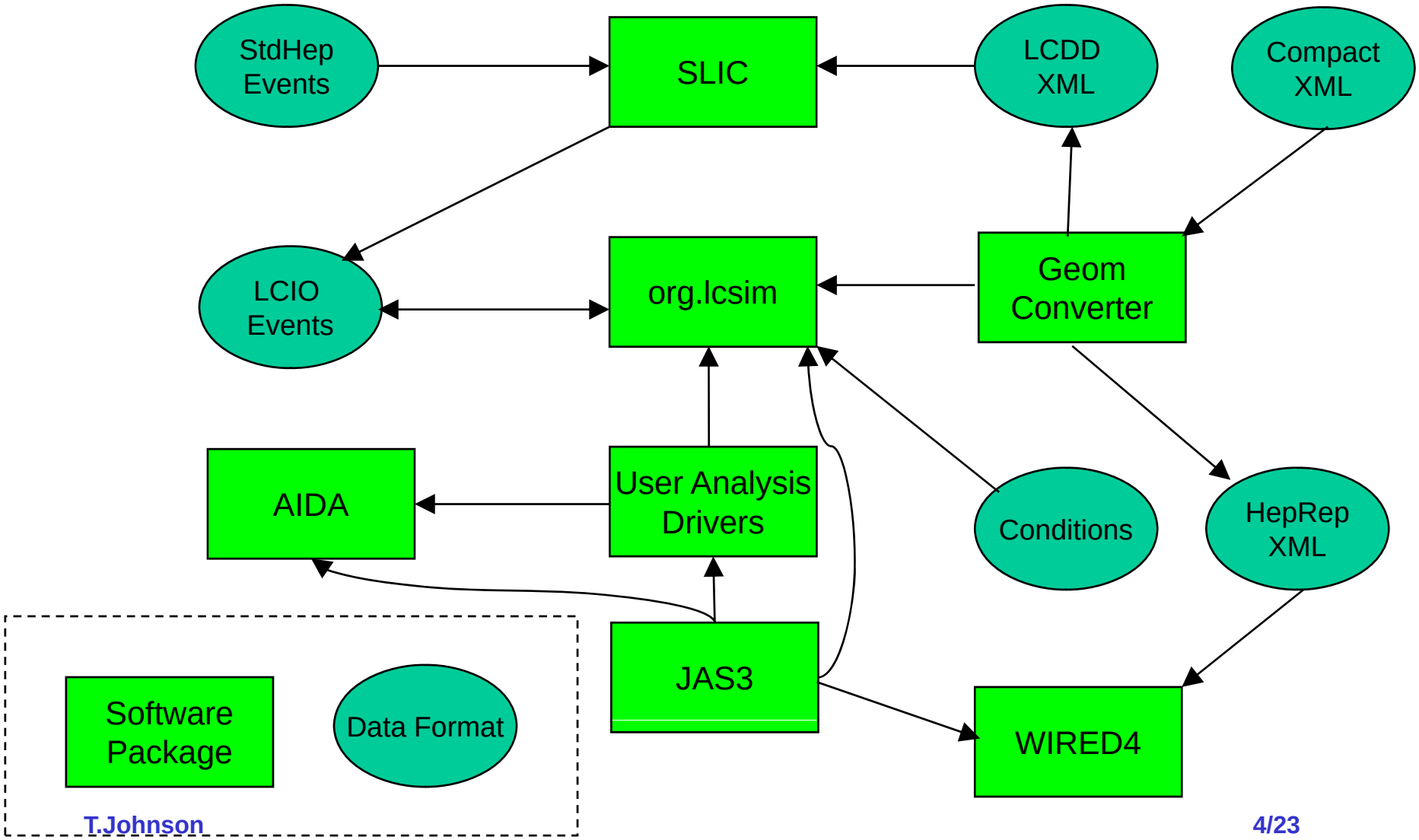
Goals



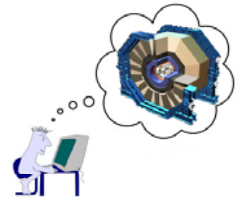
- **Enable full studies of ILC physics to optimize detector design and eventual physics output**
  - **Use realistic detector geometries**
  - **Full simulation (in combination with fast parameterized MCs)**
  - **Full reconstruction**
    - **Simulate benchmark physics processes on different full detector designs.**
    - **Encourage development of realistic analysis algorithms**
    - **See how these algorithms work with full detector simulations**
- **Facilitate contribution from physicists in different locations with various amounts of time available (normally not much!)**
  - **Software should be easy to install, learn, use**
    - **Goal is to allow software to be installed from CD or web with no external dependencies**
    - **Support via web based forums, tutorials, meetings.**

Overview: "SiD/ALCPG" Framework





org.lcsim: Geometry Converter



- **Small Java program for converting from compact description to a variety of other formats**

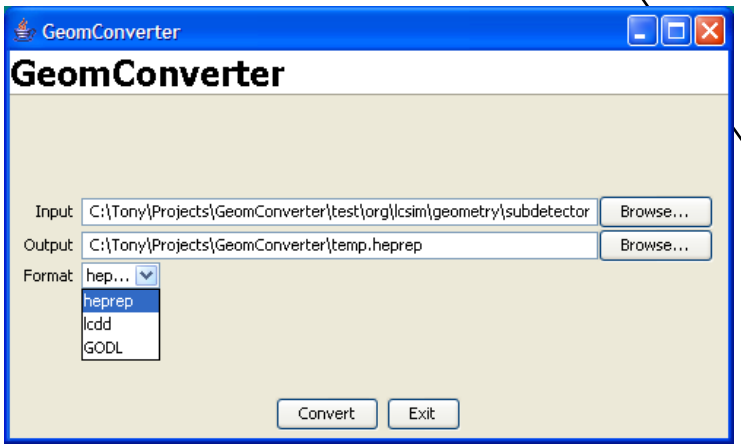
Compact Detector Description

LCDD (SLIC)

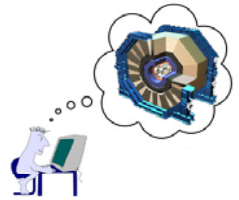
HepRep (Wired)

GODL (Lelaps)

org.lcsim Analysis & Reconstruction

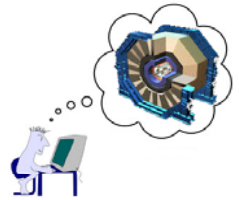


Geometry in org.lcsim



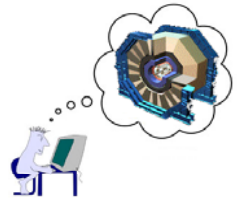
- Up to now geometry in org.lcsim was at very high level
  - Derived from compact geometry description
    - Detector -> Global properties of detector
    - Subdetector -> Location, layering of subdetectors
    - IDDecoder -> Hit position, neighbors, …
  - Not sufficiently detailed for Si strip reconstruction
- Detailed geometry created by Tim Nelson, Jeremy McCormick
  - Derived from compact description
  - Fits into existing compact geometry description
  - Gives full positioning of elements at the strip level

Detailed Geometry in org.lcsim

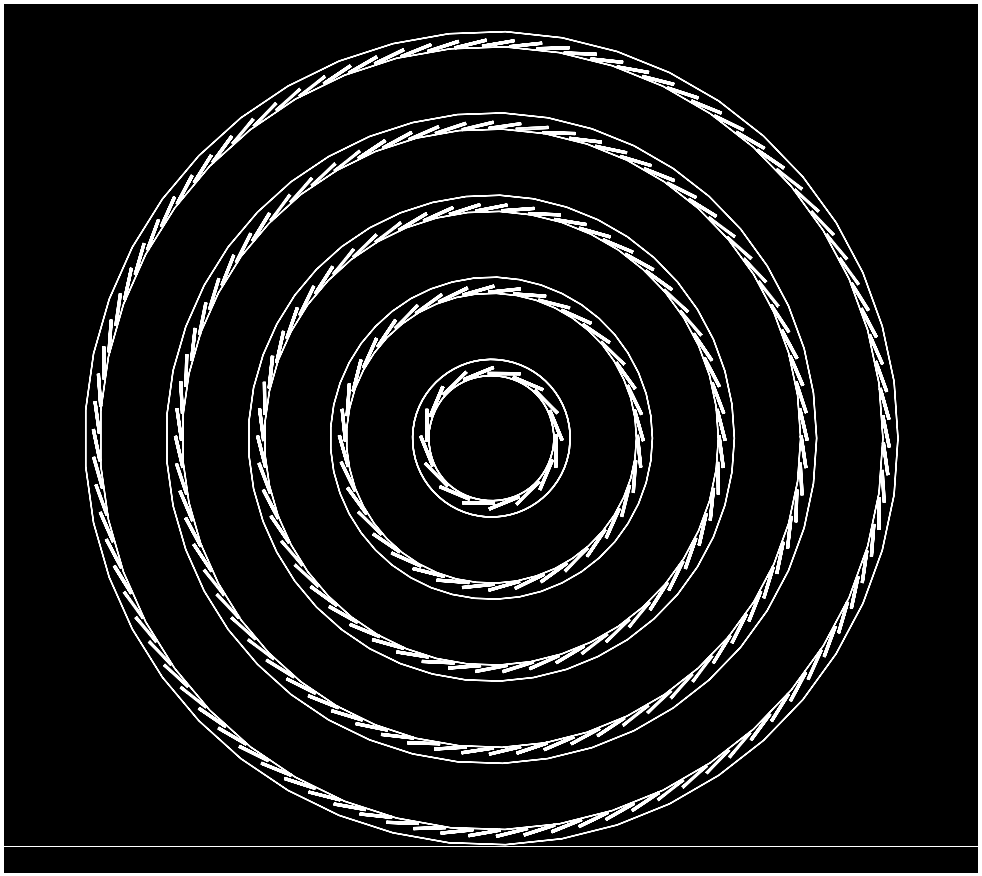


- **Geometry tree**
  - hierarchy of PhysicalVolumes and LogicalVolumes
    - LogicalVolume
      - shapes – parameters, isInside
      - materials - A, Z, density, radiation length, interaction length, etc.
    - PhysicalVolume
      - transformation - translation + rotation
- **DetectorElement tree** –
  - hierarchy of DetectorElements with uplinks
    - What DetectorElement is point inside?
    - What position of a DetectorElement?
    - What is the global to local coordinate transformation for the DetectorElement?
- Existing **Detector**, **Subdetector** become DetectorElements

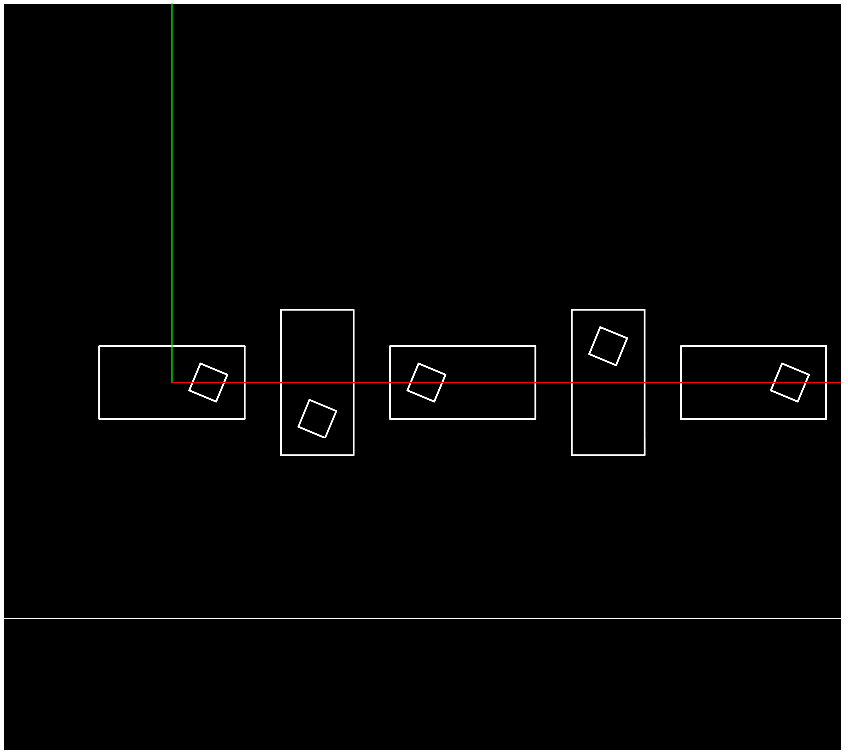
```
// Get child DetectorElements of the Detector.
IDetectorElementContainer detElems = detector.getChildren();
// Loop over the child DEs.
for ( IDetectorElement de : detElems )
{
   // Print the name.
   System.out.println( de.getName() );
   // Print the position.
   if ( de.hasGeometryInfo() )
   {
      System.out.println( de.getGeometry().getPosition() );
   }
   // Print the names of the children.
   for ( IDetectorElement child : de.getChildren() )
   {
      System.out.println( " " + child.getName() );
   }
}
```



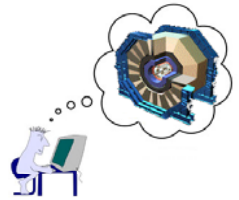
SiTrackerBarrelTest



ShapeRotateTest



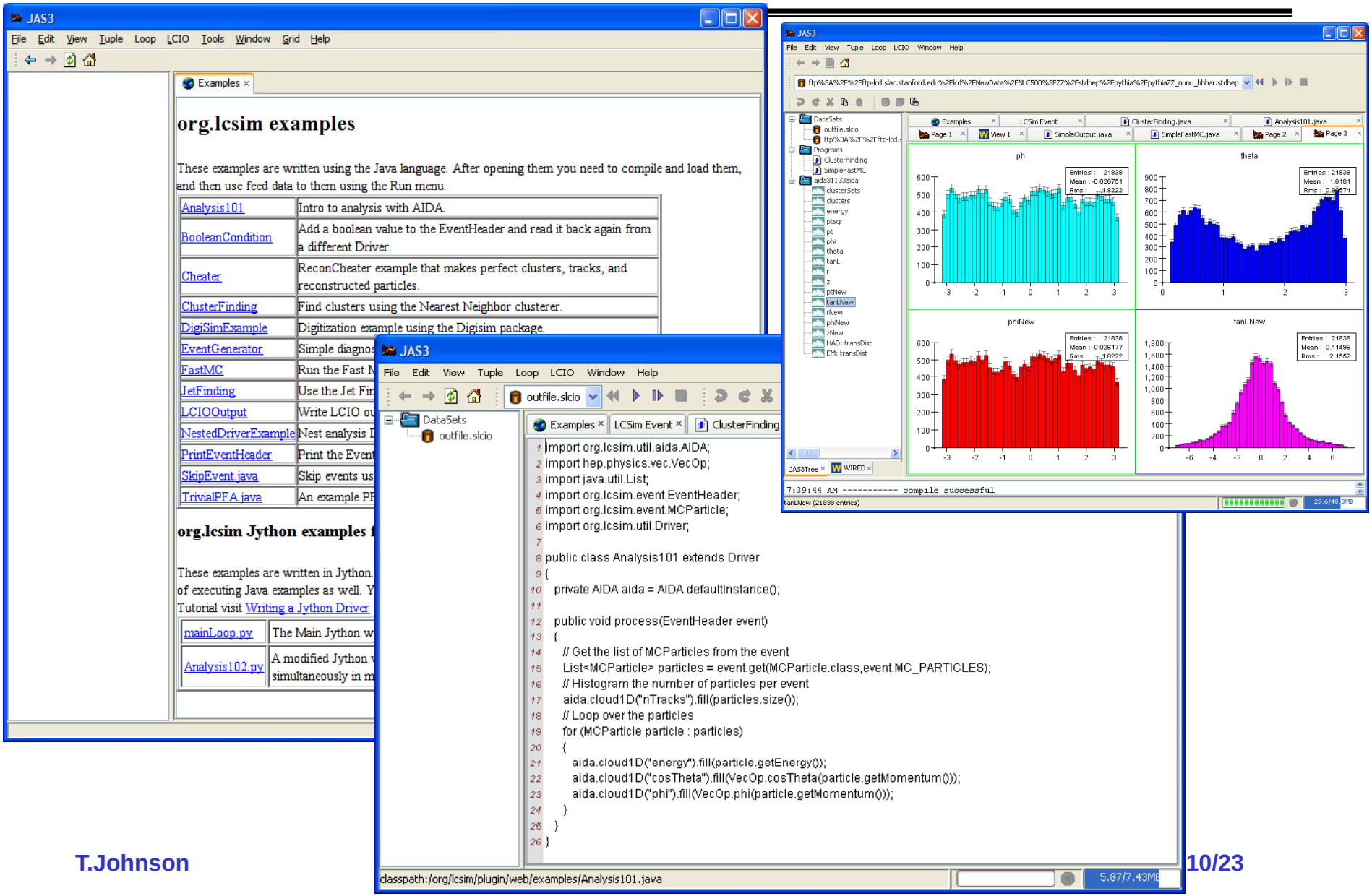
org.lcsim Contents



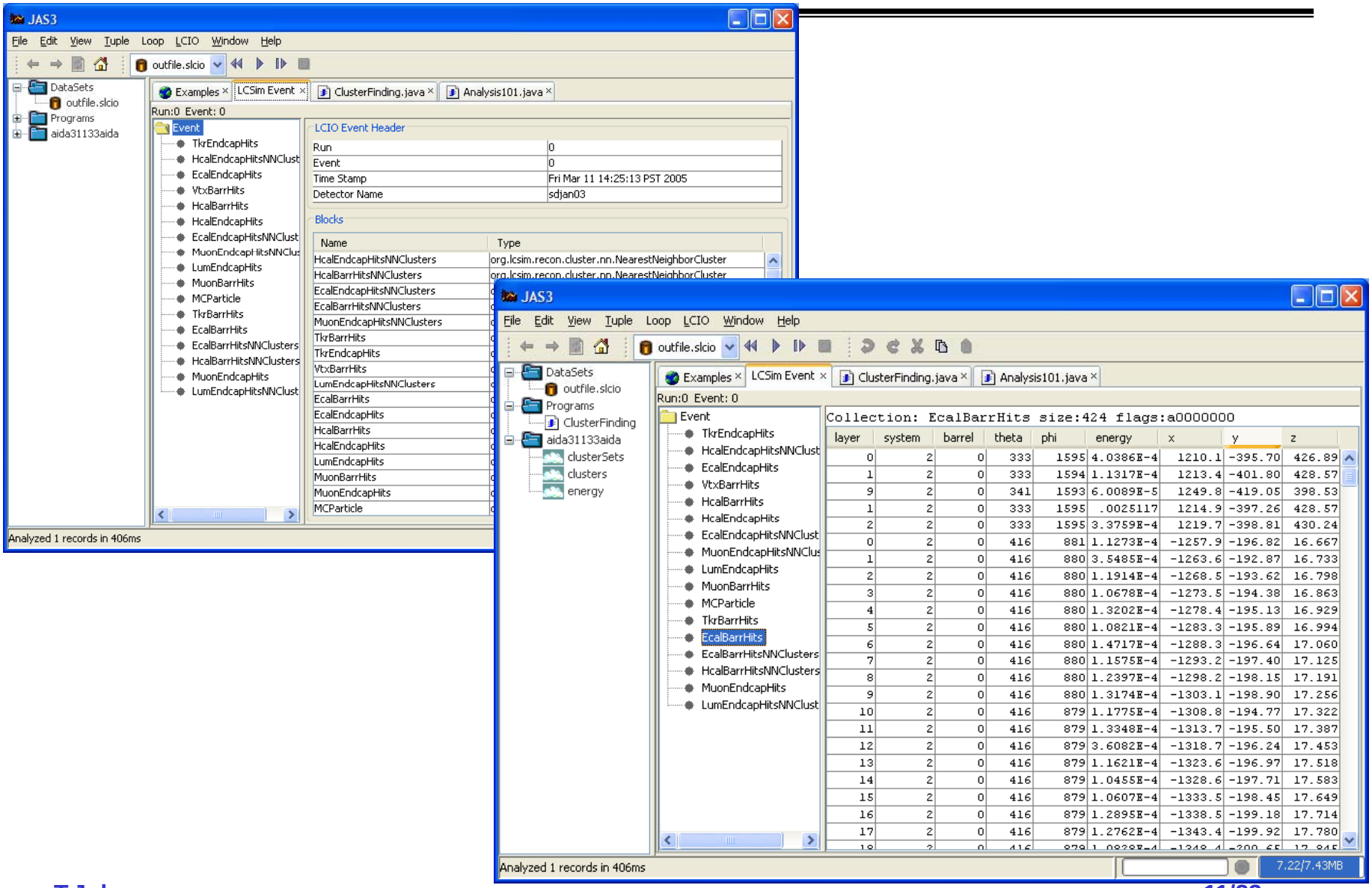
- Org.lcsim package includes:
  - Physics utilities:
    - Jet finders, event shape routines
    - Diagnostic event generator, stdhep reader/translator
    - Histogramming/Fitting/Plotting (AIDA based)
    - Event Display
    - Processor/Driver infrastructure
  - Fast MC
    - Track/Cluster smearing
  - Reconstruction
    - Cheaters (perfect reconstruction)
    - Detector Response
      - CCDSim, Digisim
    - Clustering Algorithms
      - Cheater, DirectedTree, NearestNeighbour, Cone
    - Tracking Finding/Fitting Algorithms
      - TRF,
    - Muon Finding, Swiming
    - Vertex Finding (ZvTop)

- Goal of org.lcsim is
  - not “A single reconstruction package”
  - a framework into which reconstruction algorithms can be plugged.
- We encourage users to contribute code to the “contrib” area as soon as possible.
  - Important to encourage collaboration, reuse, and as learning tool.
  - Recently split into:
    - “Contrib” – code which compiles and is maintained
    - “Sandbox” – ideas, analysis snippets, doesn’t necessarily compile
- Many contributions added recently:
  - HMatrix cluster analysis
  - VertexFitter
  - PFA algorithms/template
  - SODTracker
  - Garfield Tracker
  - Calorimeter Cell Ganging
  - FastMC improvements
  - Tracking finding/fitting
  - MIP Finder
  - Minimum Spanning Tree Clustering

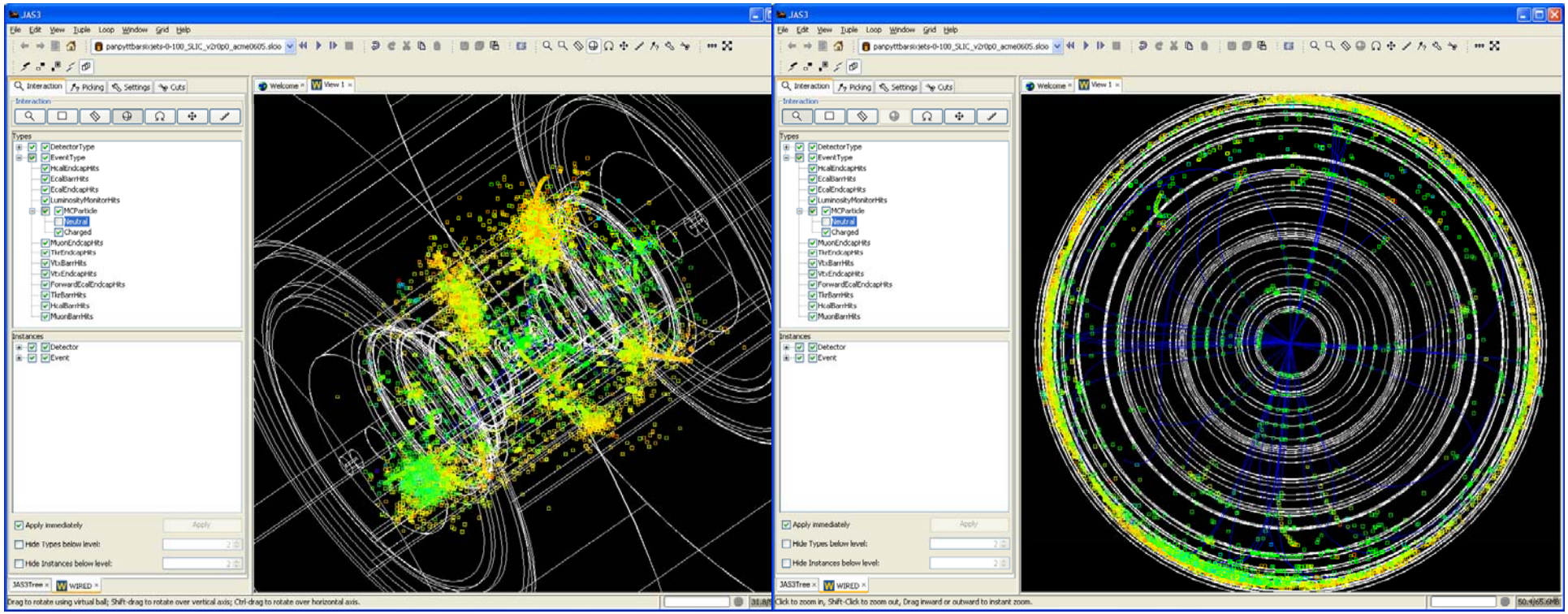
org.lcsim: Examples



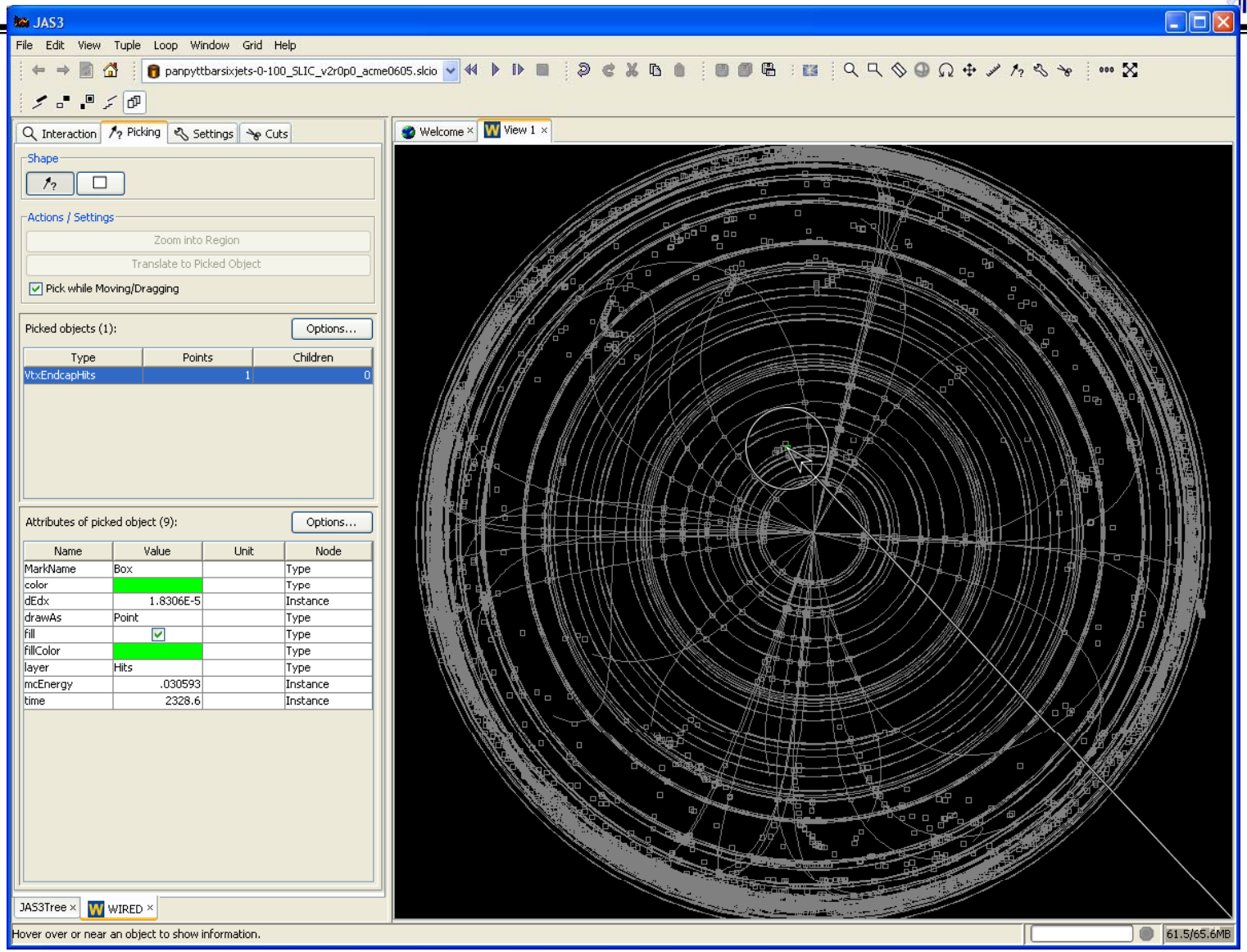
org.lcsim: Event Browser



Using org.lcsim with WIRED4



Using org.lcsim with WIRED4



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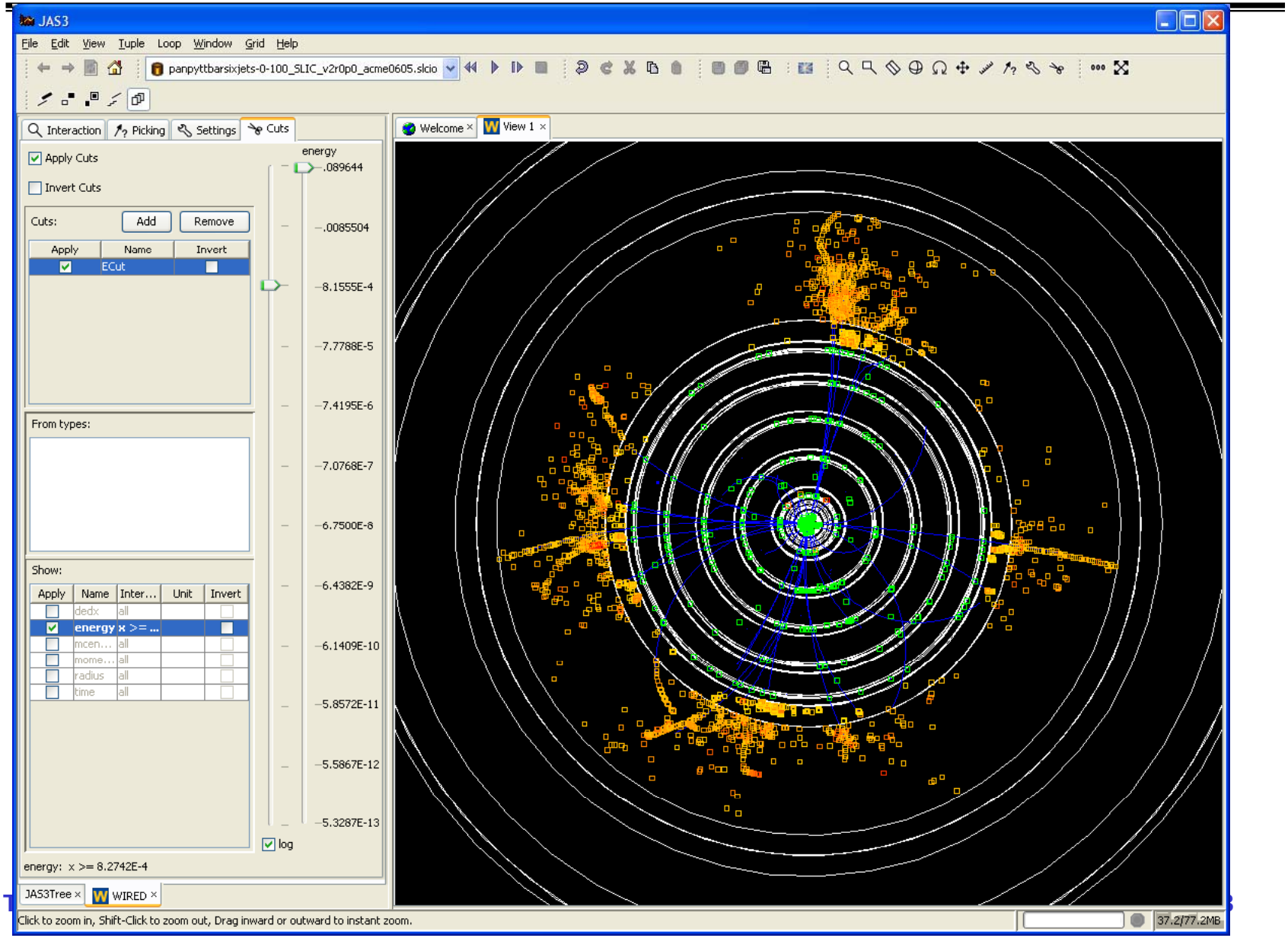
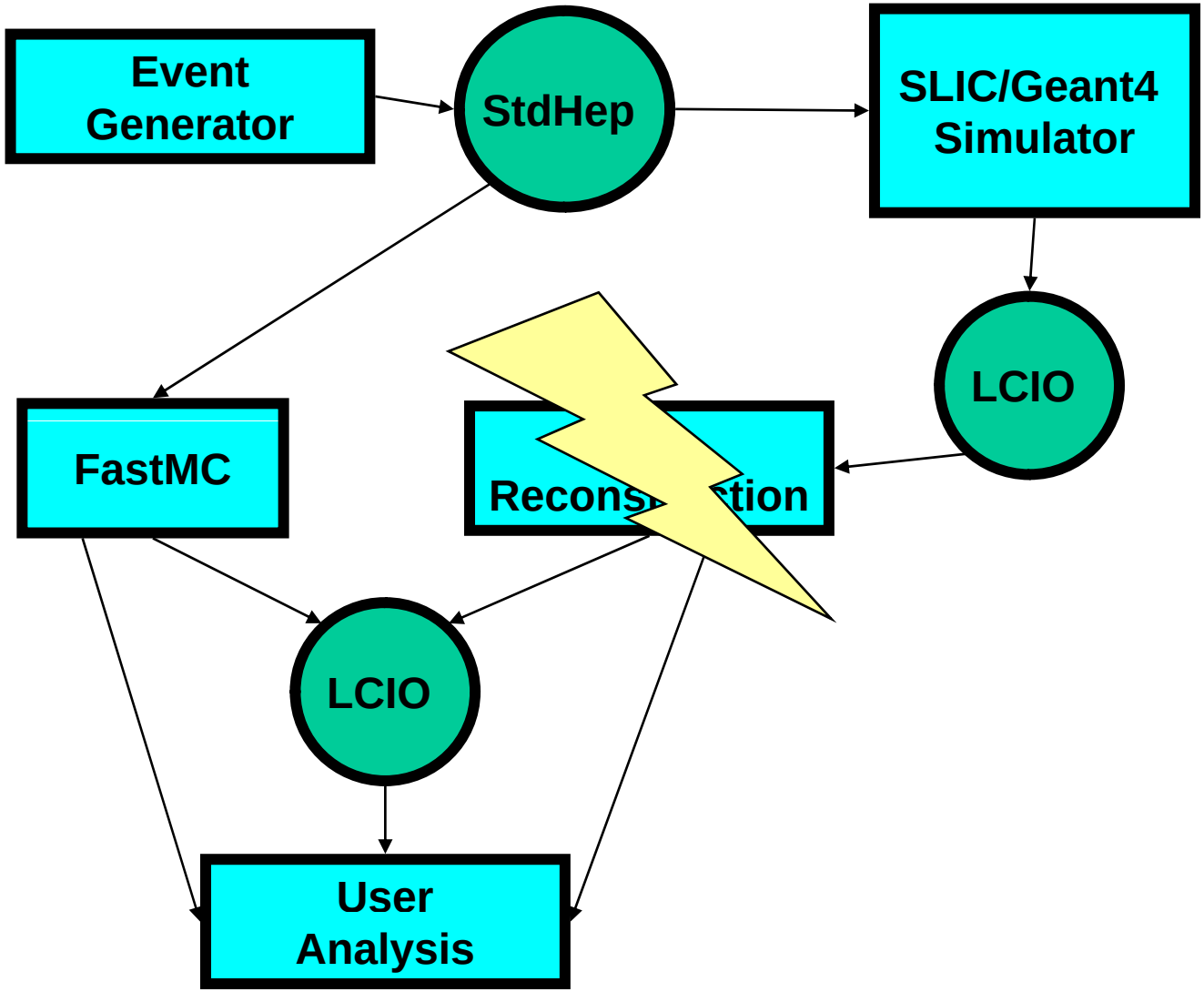
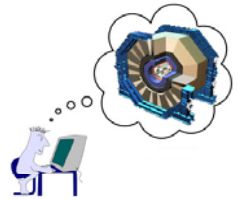


How to run full reconstruction?





org.lcsim Reconstruction Packages

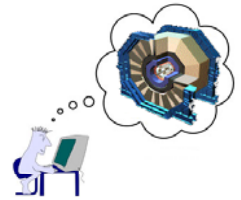
Contrib

Package	Author	State	Docs/Talks	Description
org.lcsim.contrib.CalAnal	?	?		?
org.lcsim.contrib.CarstenHensel	Carsten Hensel	?		HMatrix cluster analysis
org.lcsim.contrib.Cassell.recon.Cheat	Ron Cassell	?		Cheat Recon driver
org.lcsim.contrib.EricBenavidez.EMClusterID	Eric Benevides	?		HMatrices analysis of single particle events
org.lcsim.contrib.JanStrube.tracking	Jan Strube	complete JUnit tests Javadoc	A New Track Interface	Alternate implementation of Track, FastMCTrack, Swimmer. Awaiting incorporation into main body of code
org.lcsim.contrib.JanStrube.vtxFitter	Jan Strube	incomplete		Vertex fitter, using the Kalman approach by Grab, Luchsinger. Add the VtxFitterDriver from the sandbox to get an idea of the current status
org.lcsim.contrib.JanStrube.zvtop	Jan Strube	incomplete		ZVTop implementation, taking advantage of the new Track interface, alpha quality
org.lcsim.contrib.KFFiter	Fred Blanc	?		Kalman Filter Fitter
org.lcsim.contrib.LeiXia	Lei Xia	?		PFA analysis
org.lcsim.contrib.NickSinev.tracking.wmfitter	Nick Sinev	?		SLD Weight matrix fitter
org.lcsim.contrib.NickSinev.ztracking	Mike Ronan+Nick Sinev?	?		Track cheater?
org.lcsim.contrib.onoprien.mcTrackFinder	D. Onoprienko	complete		Configurable cheater track finder and related utilities.
org.lcsim.contrib.onoprien.tester	D. Onoprienko	functional, under development		Track finder performance testing suite
org.lcsim.contrib.SODTracker	Fred Blanc	?		Silicon Outer Detector (SOD) Tracker
org.lcsim.contrib.SiStripSim	Tim Nelson	?		Silicon Strip Simulation (moving soon to org.lcsim.detector)
org.lcsim.contrib.SteveMagill	Steve Magill	?		PFA Analysis example
org.lcsim.contrib.niu	Vishnu and Guilherme	?		NIU PFA code
org.lcsim.contrib.proulx	?	?		?
org.lcsim.contrib.seedtracker	Richard Partridge	?		Tracking algorithm based on forming track seeds from all 3-hit combinations
org.lcsim.contrib.subdetector.tracker.silicon	Tim Nelson	?		Experimental geometry package (Developed further in Geomconverter as org.lcsim.detector by Jeremy)
org.lcsim.contrib.tracking	Tim Nelson	?		Outer-tracker-only track finding
org.lcsim.contrib.uiowa	Mat Charles	unstable		Template-style PFA implementation (NonTrivialPFA)

Production

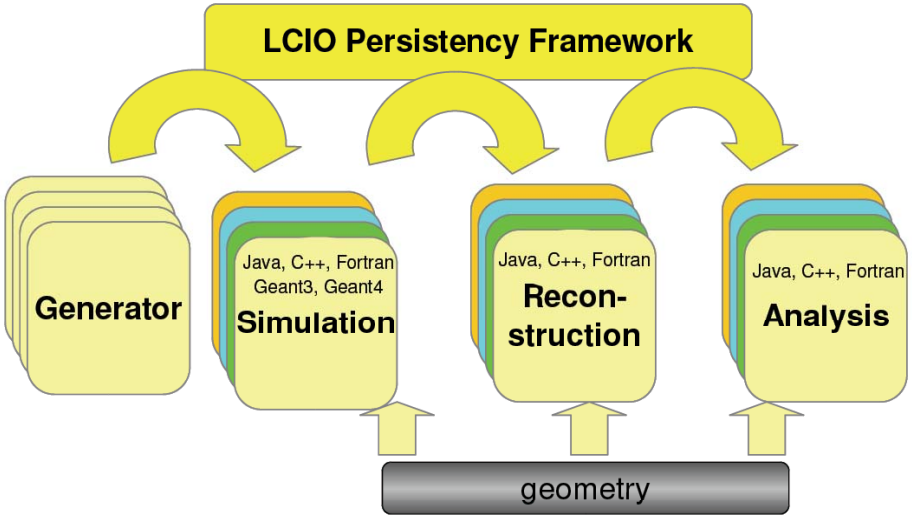
Package	Author	State	Docs/Talks	Description
org.lcsim.digisim	Guilherme Lima	?		Calorimetry digitization simulator
org.lcsim.mc.CCDSim	Nick Sinev	?		CCD digitization
org.lcsim.mc.fast	Many	?		Fast MC package, including tracking, calorimetry
org.lcsim.recon.cat	D. Onoprienko E. von Toerne	functional, under development		Calorimeter Assisted Track Finder
org.lcsim.recon.cheater	Mike Ronan	?	confluence	Recon cheater
org.lcsim.recon.cluster.analysis	Ron Cassell	?		Generic cluster performance analysis
org.lcsim.recon.cluster.cheat	Ron Cassell	?		Cluster cheater
org.lcsim.recon.cluster.clumpfinder	Mat Charles	?		finds dense clumps within clusters
org.lcsim.recon.cluster.directedtree	G.Lima, J.McCormick, Vishnu	?		Directed tree cluster finder
org.lcsim.recon.cluster.fixedcone	Norman Graf	?		Cluster finder
org.lcsim.recon.cluster.mipfinder	Wolfgang Mader, Mat Charles	stable		MIP finding
org.lcsim.recon.cluster.mst	Mat Charles	stable		Minimal spanning tree cluster finder
org.lcsim.recon.cluster.nn	Norman Graf	?		Nearest neighbout cluster finder
org.lcsim.recon.cluster.structural	Mat Charles	stable		Specialized clusterer for hadronic showers
org.lcsim.recon.emid.hmatrix	Norm Graf	?		HMatrix package
org.lcsim.recon.ganging	Ron Cassell	?		Allows virtual ganging of calorimeter hits
org.lcsim.recon.muon	C. Milstene	?		Muon finding
org.lcsim.recon.particle	Ron Cassell	?		Perfect PFA
org.lcsim.recon.pfa.cheat	Mat Charles	functional		Cheating tools for PFA
org.lcsim.recon.pfa.identifier	Mat Charles	functional		Turn more primitive objects (clusters, tracks, etc) into ReconstructedParticles
org.lcsim.recon.pfa.output	Mat Charles	?		Modules to produce standard plots for PFAs
org.lcsim.recon.pfa.structural	Mat Charles	?	incomplete	Iowa PFA implementation (when stable) and associated tools
org.lcsim.recon.tracking.cheat	Ron Cassell	?		Track Cheater
org.lcsim.recon.tracking.ftf	?	?		?
org.lcsim.recon.tracking.trf	Norm Graf	?		TRF track finder + fitter
org.lcsim.recon.vertexing.billoir	Norman Graf, (Jan Strube)	incomplete		vertex fitting based on Billoir's method. Needs testing
org.lcsim.recon.vertexing.zvtop4	Jan Strube	incomplete		Vertex finding/fitting, awaiting completion of a vertex fitter
org.lcsim.recon.ztracking	M. Ronan	?		Track cheater

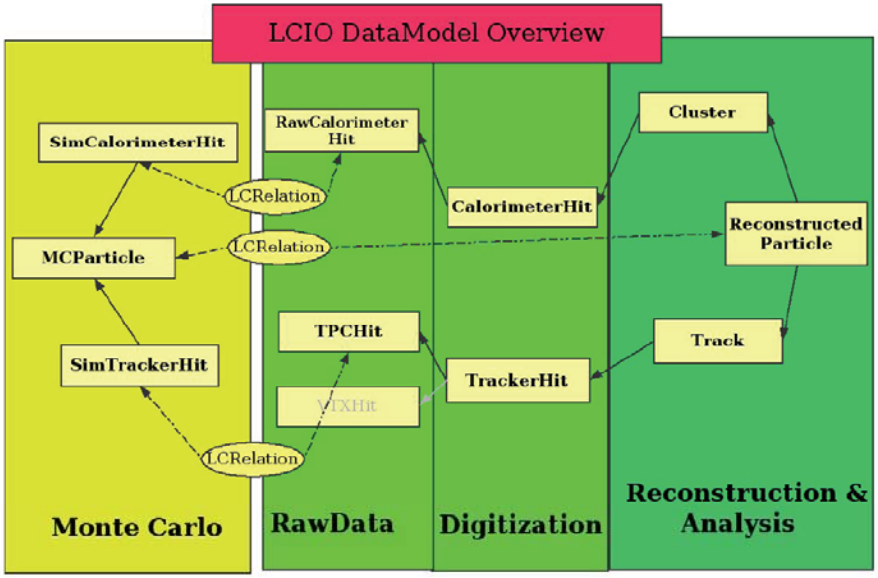
- **Conclusions**
  - **Many people are working on reconstruction code**
  - **Effort to persuade people to commit code to "contrib" area has been successful**
  - **But it is not easy for new users to understand how to use or contribute**
- **We need to work to extend tutorials to also cover reconstruction packages**
  - **Encourage developers to contribute documentation**
  - **Start by updating: http://confluence.slac.stanford.edu/x/f3c**



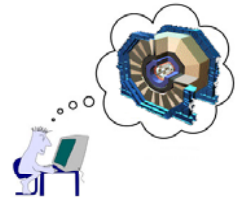
LCIO Enhancements

- LCIO adopted by most ILC software
  - Provides interoperability between frameworks
- LCIO enhancements being actively worked on
  - Improved performance for rawdata/DAQ
  - Improved efficiency for DST analysis
    - Random access to events/parts of event
    - Ability to split data over multiple files
  - Should be ready this summer
- LCGO – geometry interoperability
  - Technical specs developed
  - Ready by end of year?





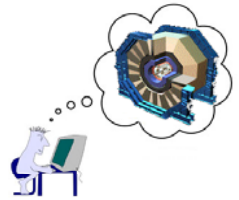
Resources for getting started/working with simulation/reconstruction tools



- http://lcsim.org/ Web Site
  - Tutorials
    - Software installation
    - Using tools
    - Simple Analysis Examples
    - Developers Guide
  - Datasets
  - Documentation

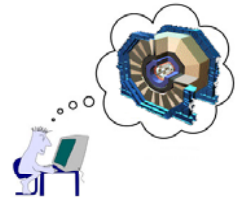
- Confluence Wiki
  - More tutorials
  - More documentation
  - Frequently asked Questions
  - You are encouraged to comment on, add to, or correct existing documentation
    - https://jira.slac.stanford.edu/signup/

Resources for getting started/working with simulation/reconstruction tools

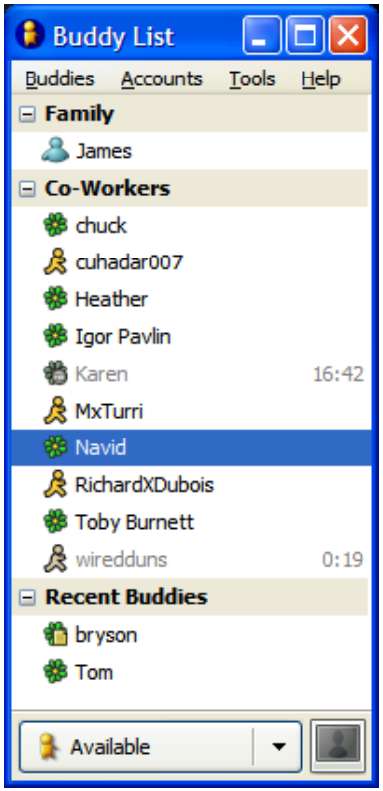


- Discussion Forums
  - http://forum.linearcollider.org/
    - SLIC, org.lcsim
  - Not recommended
    - Spray E-mail to developers
      - Banging head against wall
      - Uninstall and reinstall software 3 times
  - Recommended
    - Post questions on the forum
      - You will get faster answers
      - You will get more accurate answers
      - Others will benefit from seeing answers to your questions

Resources for getting started/working with simulation/reconstruction tools



- **Instant messaging**
  - Great for quick questions
  - I use GAIM, many other options
    - http://gaim.sf.net/
  - Norm, myself, Jeremy available most of the time
    - http://confluence.slac.stanford.edu/x/Rnk



- **Tuesday software meeting**
  - 1:30pm Pacific Time
  - We are happy to answer questions/solve problems during or after these meetings
    - We can use desktop sharing to interactively view/solve problems

- **Personal Tutorials**
  - We are prepared to go anywhere anytime*
    - Real or virtual

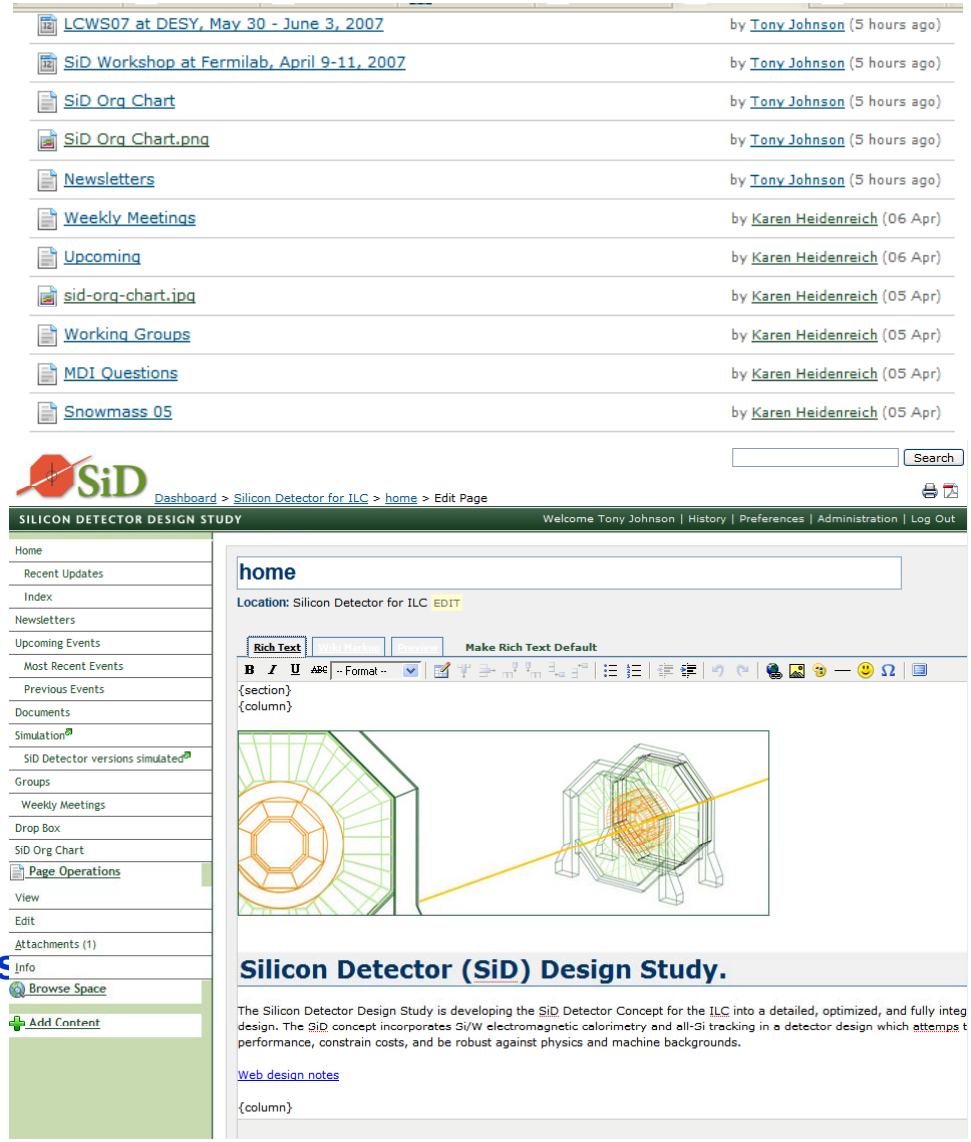
* Travel budget permitting

Proposal to replace SiD web site

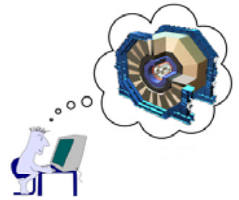
- **Looks better than old site!**
- **Based on confluence (wiki) so has many collaborative features**
  - **https://confluence.slac.stanford.edu/display/SiD/home**

Proposal to replace SiD web site

- Confluence advantages
  - Easy to embed active content (e.g. ILC Newsline feed)
  - Searchable (including attached PDF, PPT, DOC, etc).
  - Can see list of recent updates
    - Very useful for keeping up-to-date with what is happening
    - Full version info
  - Once logged in to site you can
    - Edit any page (if authorized)
      - No need to learn new tools, just use web browser
    - Comment on any web page
    - Subscribe to be notified of changes to any web site
    - Create “news items”
  - … and much more
- Other suggestions
  - Switch to using linear collider forums instead of hypernews



Conclusions



- Conclusions
  - Basic framework for SiD simulation/reconstruction/analysis exists and is mostly stable and usable
  - Active work on reconstruction algorithms ongoing
- Documentation, Tutorials etc exist
  - Good at introducing tools, getting users started
  - Tend to fade out for more advanced reconstruction
    - Needs some work – please contribute
- Communication
  - Many tools exist – encourage more active use