JAS3, LCIO and hep.lcd

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ALCPG 2004 Winter Workshop
Topics

- **LCIO**
  - Linear Collider Common IO format

- **JAS**
  - Data analysis tool used for LC physics studies
    - JAS3
    - JAS3 + LCIO
    - JAS + WhizData

- **hep.lcd**
  - Reconstruction and Analysis package for LC physics studies

- **Time will only allow me to discuss recent progress and plans**
LCIO

- A persistency framework for linear collider detector studies
- Project emerged out of the ‘persistency task force’ of the ECFA/DESY workshop
- International collaboration
  - Ties Behnke - DESY/SLAC
  - Frank Gaede - DESY
  - Norman Graf - SLAC
  - Tony Johnson - SLAC
  - Paulo Mora de Freitas - IN2P3
  - Others…
Motivation

Generator

Simulation

Java, C++, Fortran

Geant3, Geant4

Reconstruction

Java, C++, Fortran

Analysis

Java, C++, Fortran

LCIO Persistency Framework

geometry
LCIO Implementation

- use SIO: Simple Input Output
  - developed at SLAC for NLC simulation
  - already used in hep.lcd framework
  - features:
    - simple, portable IO format (based on XDR)
    - on the fly data compression
    - some OO capabilities, e.g. pointers
    - C++ and Java implementation available
    - XML files documenting the data layout

- C++, Java, Fortran libraries
  - hides details of IO details from users
**LCIO Status**

- Stable release (1.0) now available
  - Supports C++, Java, Fortran
  - Supports:
    - MC Particle description (c.f. stdhep)
    - Simulation Output (tracker hits, calorimeter cells)
    - Prototype/Beam-Test storage (TPC, Calorimeter)
    - Reconstruction Output (e-flow) under development
  - Used by:
    - **Now**: Mokka, JAS3, LeLaps, Brahms, test-beam data
    - **Soon**: LCDG4, hep.lcd Reconstruction
  - Documentation/more info:
  - More about future plans in Ties’ talk.
**LCIO Data Catalog**

- General purpose dataset metadata catalog
  - Spin-off from JAS3 Grid Work
  - implemented as Grid Service
- Can be used to make web searchable catalog of LCIO data
  - Arbitrary meta-data can be defined and used as search criteria
  - Data can be located anywhere
  - XML file used as input to catalog
JAS3

Data Analysis Tool
JAS3 Status

- JAS3 is successor to JAS2 which has been used for LCD analysis for 3+ years
  - JAS3 (like JAS2) is not specific to LCD analysis
    - Plugins available to enable LCD use since May 2003 simulation workshop
  - Tutorial on web at:
JAS3 Tutorial Covers...

- LCD WIRED Event Display
- Analysis Tools
JAS3 Tutorial Covers...

- Data Analysis
- Running the FastMC
- Jet Finding and Event Shape routines
- Creating N-Tuples
- Not explicitly covered by tutorial, but people have been successful in using...
  - Full Reconstruction
  - Vertex Finding
JAS3 + LCIO

- JAS3 Plugin exists for viewing and analyzing LCIO files
  - Allows to directly open and browse any LCIO file
  - Works with any LCIO file
    - no requirement for prior knowledge of what is being read.
  - Recently updated to support LCIO 1.0
    - (in fact 0.8 or later)
JAS3 + LCIO

- Browse MC Particle Hierarchy

- Perform Data Analysis
  - Can run same code outside JAS using just LCIO and AIDA
JAS3 + LCIO + Event Display

- Can make simple event display using hit positions in LCIO file
  - For more useful event display need to address
    - Decoding CellID
    - Reading geometry
JAS access to WhizData

- Tim Barklow has generated data equivalent to 1 year’s LC running
  - Separate files for each SM physics process
  - Program that combines processes in appropriate ratios, under control of a configuration file
  - (See Tim’s talk on Wednesday for details)
- An interface has been installed into the lcddata01 server at SLAC to allow JAS2 to directly access this data
  - Once the dataset is opened it looks like a normal “stdhep” file
  - You can use all the normal LCD analysis tools available in JAS to analyze the data
JAS access to WhizData

• Existing interface is fine for debugging analysis code
  • Interactive environment provided by JAS not ideal for analyzing a full year’s data

• Developing a web interface which submits analysis to SLAC batch farm
  • JAS analysis code remains unchanged.
JAS3 Status and Plans

- Several releases since May
  - Mostly bug fixes
  - Current version 0.7.3
  - Plan to have “1.0” release in March
    - Main change will be extended documentation

- For LCD work JAS3 has a superset of functionality of JAS2, except:
  - No access to remote data server
    - Being worked on as part of JAS Grid Project
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Reconstruction and Analysis
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- Fast MC
  - smear tracks, create calorimeter clusters
- Reconstruction of fully simulated MC data
  - Architecture allows easy implementation of different algorithms.
  - Track Finding & Fitting
  - Calorimeter Clustering
  - Topological Vertexing
    - Implementation of SLD’s ZVTOP
- Contributed Area
  - Analysis Utilities and sample analyses provided by users
Physics Utilities
- 4-vector, 3-vector classes
- Event shape/Thrust finder
- Jet Finders
  - Many kT algorithms implemented (e.g. Jade and Durham)
  - Extensible to allow implementation of other algorithms

Event Generators
- Diagnostic Generator
  - User-defined particle mix, momenta and vertices.
- Generator framework extensible for other generators
  - PYTHIA, HERWIG, ISAJET, …

Beam Background Overlays
- Take output from full beam simulation
- Feed into full detector simulation
- Overlay backgrounds on signal events at start of reconstruction
  - Adjust timing of hits (for TPC etc.)
  - Sum energy in calorimeter cells
  - Allows to change #bunches/train, bunch timing
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- Works in JAS2, JAS3 or standalone
- Very few improvements since Snowmass
  - Most of the original developers have moved on to other things
  - Long list of potential improvements
    - Should be updated to read/write LCIO files
    - Endcap tracking
    - More Track Finding Algorithms (Pure Projective Geometry)
    - Detector digitization to simulate hit merging, ghosting, electronics noise and dead channels, etc.
    - More clustering algorithms
Conclusions

- JAS2 and JAS3 are both available for LCD physics studies
  - All new work (such as switching to LCIO) will be based on JAS3
  - Encourage users to try JAS3 out (using tutorial) and give us feedback.

- LCIO is progressing well and being adopted for many international LC projects
  - We hold frequent phone conferences to discuss LCIO progress, and encourage others to get involved

- LC reconstruction and analysis package works
  - Needs new infusion of manpower if it is to continue
  - Volunteers welcome!