Software tools for GLC studies

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Representing ACFA-Sim Group
http://acfahep.kek.jp/subg/sim/
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- Jupiter (Geant4 Full Detector Simulator)
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List of software tools

- **LCLIB** - Quick Simulator and old fortran utilities
- **JLCSIM** - Geant3 based full detector simulator
- **PHYSSIM** - Event generators based on HELAS and Analysis packages consists of Jet Clustering and four vector manipulation
- **JSF** - Root based software study framework
- **Jupiter** - Geant4 based full detector simulator
- **Satellites** - Analysis modules, in preparation

General information from ACFA-Sim Home Page


Packages are maintained on CVS, available at http://jlccvs.kek.jp/
JSF: the Flow Controller

- Based on ROOT: C++
- Modular: Unified Framework for
  - Event generation
  - Detector Simulation
  - Event Reconstruction
  - Physics Analysis
  - Beam test
- Object I/O
  - Each module’s data in a ROOT tree
  - User data (hits, ntuple, parameters) also in the same tree
- Unified User Interface for Batch and Interactive
  - GUI/CUI (user definable command line args. and default vals.)
  - Simple built-in event display
Packages provided with JSF

- JSF includes the following sub-packages
  - Generator interface to Pythia, Physsim, Grace
  - Hadronizer (Pythia, Herwig)
  - QuickSim (C++ wrapper for LCLIB)
  - C++ version of Bases/Spring
  - GUI, Event Display, ZVTOP, JETNET, Jupiter
  - ......
Les Houche Interface in JSF

- Les Houches 2001 standard for the interface of a parton generator and a shower generator was implemented in JSF.

  - A parton generator outputs parton information a la Les Houches format in a ASCII file.
  - Interfaces in JSF read it and does parton shower using Pythia (Herwig in Future)

- Example:
  - **LCGrace**
    - LC version of the GRACE event generator, including all diagrams for a given process.
    - Parton four momenta generated by SPRING package are saved with Les Houche format in an ASCII file.
    - ~30 processes have been prepared such as
      \[
      e^+e^- \rightarrow W\bar{W}H, \bar{t}tH, 4f, 6f, 4f + H \quad (f = \nu, \ell, q)
      \]
Sample events

\[ e^+ e^- \rightarrow t \bar{t} H \]

\[ e^+ e^- \rightarrow \nu \bar{\nu} HH \]
Jupiter: Geant4 based Full Detector Simulator

Features:

- Modular structure for easy update, install/uninstall of sub-detectors
- Powerful base classes that provide unified interface to
  - facilitate easy (un)installation of components by methods such as InstallIn, Assemble, Cabling
  - Help implementation of detailed hierarchical structures. This helps to save memory size.
  - Minimize user-written source code by
    - Automatic naming system & material management
    - B-field compositions for accelerators

Input: HEPEVT, CAIN (ASCII) or generators in JSF.

Output
- Output class allows external methods. Using this mechanism, it can output ASCII flat file and JSF/ROOT file.

Core developer: K. Hoshina and K. Fujii
Standard Geometry of Jupiter

Super Conducting Solenoid (SOL)
Calorimeter (HCAL)
Calorimeter (ECAL)
Central Tracker (CDC)
Intermediate Tracker (IT)
Vertex Detector (VTX)
Detector geometries in Jupiter

**CDC**
Individual drift cells and wires
Axial and stereo geometry

**VTX detector**

**VTX sensor**

Geometry parameters such as #layers, #pixels,.... controled by a ParameterList class for easy modification

0cm 45cm 155cm

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Beam Delivery System
for Beam BG Study

Detector Model
Model d)
L*=4.3 m
3T (Solenoid)

QC1
QC2
VTX

Crossing 3mrad

CDC
QC1
VTX

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Sample events by Jupiter

\[ e^+ e^- \rightarrow Z^0 H^0 \text{ event} \]
\[ \sqrt{s} = 350\text{GeV} \]

Beam Background Simulated By Jupiter

Event source : CAIN

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Summary

- JSF framework has been developed based on ROOT. Study tools and interface to them are provided with JSF. It has been used for physics and detector studies.

- Jupiter framework has been developed based on Geant4.
  - Basic detector components and beam delivery system has been implemented. It has been used for studies of detector performance and beam background.

- Future plan for Jupiter includes,
  - Make them LCIO-compliant
  - XML-based description of a detector geometry
  - Improve geometry outside the tracking volume.
  - ....