Software tools in Asia

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Simulation and Reconstruction Session
LCWS2005

Representing acfa-sim-j activity

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Objectives of Softwares

- Physics studies
  - Event generators
  - Fast detector Monte Carlo
- Detector studies
  - Geant3 → Geant4
  - Reconstruction: clustering, track fitter, vertexing, ...
- Beam test studies
  - Data storage and analysis
  - Simulation
- Communication / Information
Goals of in 2004

- By LCWS2004, we had
  - JSF framework and Quick Simulator for physics studies
  - Jupiter with basically CDC, IT, VTX, and IR.
  - basic structures of Satellites/Uranus

- Goals of studies in 2004 are detector optimization based on Full detector simulation.
  - Implement “GLD” geometry in Jupiter
  - Study PFA performances by an ultimate condition
    - Implement “tower” calorimeter
    - Develop analysis tools
  - Study physics performance vs detector choice.
Overview of our tools

- **lcbase**: configuration files
- **Leda**: Analysis tools (Kalman fitter, 4vector and jet finder utilities)
- **jsf**: Root-based framework
- **lclib**: QuickSim and other fortran based utilities
- **physsim**: Helas-based generator
- **Jupiter**: Full simulation based on Geant4
- **Uranus**: Data analysis packages
- **Satellites**: Data analysis packages for MC data

- We use only C++, except old fortran tools.
- Link to various tools at http://acfahep.kek.jp/subg/sim/soft
- All packages are kept in the CVS. Accessible from http://jlccvs.kek.jp/
Recent updates in Framework, QuickSim, Physsim

- **Framework**
  - JSF : Root based framework for physics and detector studies
  - Packages in JSF are reorganized to reduce dependences among codes.
  - Interfaces to StdHep and LCIO are implemented.

- **Quick Simulator and Iclib**
  - Detector parameter set for “GLD” configuration is prepared and tuning of the parameters are in progress

- **Physisim**
  - Collection of event generators based on Helas.
  - Anlib packages (4 vector manipulation and jet clustering, etc.) is moved to Leda package
Jupiter/Satellites Concepts

Tools for simulation Tools

- **JUPITER**
  - JLC Unified Particle Interaction and Tracking Emulator
  - Geant4 based Simulator
  - MC truth generator

- **Satellites**
  - Input/Output module set
  - Monte-Carlo Exact hits to Intermediate Simulated output

- **LEDAL**
  - Library Extension for Data Analysis

- **METIS**
  - Unified Reconstruction and Analysis Utility Set

- **URANUS**
  - Unified Reconstruction and Analysis Utility Set

For real data

JSF: the analysis flow controller based on ROOT
The release includes event generators, Quick Simulator, and simple event display

A.Miyamoto, LCWS2005 Simulation and Reconstruction (19, March, 2005)
Geometry in Jupiter

- Muon/Iron
- Solenoid
- Hadron Calorimeter
- Elemag. Calorimeter
- TPC
- QC1
- IT
- VTX
- Forward Cal.
Jupiter status

- **Geometry definition**
  - Hard coded in the source, but addition/deletion of sub-detectors are easily performed through J4XXXParameterList classes.
  - Start to develop XML interface to implement very complicated geometry, but this work does not complete yet.

- **StdHep and LCIO**
  - Interfaces have been implemented using JSF classes.
  - LCIO output is still experimental. Links to between MCParticle and SimCalorimeterHit/SimTrackerHit are not full compatible.

- **Digitization and Hit making**
  - Jupiter creates only Monte Carlo truth hit points. Smearing/Digitization is performed later in Satellites, since Geant4 simulation is most time consuming part.
  - We want to keep information of tracks which creates signal in Cal. → create a virtual detector to save information as TPC_Post hits.
Range cut for Calorimeter

- Geant4’s default range cut is 1mm, which is too large for our sampling thickness.
- Energy deposit and resolution depends on the range cut.
- Range cut <0.3µm is good for ∆E
- Simple MC results are always slightly better than beam test.
- Small range cut is memory consuming → using 1~10µm

 Beamtest(T405/411) @KEK

Detail will be presented by Matsunaga san

A.Miyamoto, LCWS2005 Simulation and Reconstruction (19, March, 2005)
Metis Analysis Flow

1. Jupiter result
2. Make smeared TPC hits from exact hit
3. Make tracks from TPC
4. Make hybrid tracks (TPC+IT+VTX)
5. Make smeared/merged CAL hits from exact hit
6. Make cluster from CAL hits
7. Make Particle Flow Objects
8. Jet clustering
9. Physics study
Cheated PFO analysis

ZH event at Ecm=500 GeV

- Exact hit points of TPC and CAL are displayed.
- Hits belong to the same PFO are shown with the same color.
- A framework of event display in JSF is used.

By K.Fujii(KEK), S.Yamamoto(GUAS), A.Yamaguchi(Tsukuba)
Same event, after a forced 4-jet clustering on PFObjets
Jet Mass reconstruction

\[ e^+e^- \rightarrow ZH, \ Z \rightarrow \nu\bar{\nu} \] at 300GeV

\[ H \rightarrow b\bar{b}, W^+W^-, \tau\bar{\tau}, \ldots \]

Mh (GeV) depends on Mmiss:
→ Energy correction is not sufficient yet!

\[
\frac{\Delta M}{\sqrt{M}} \sim 33\% / \sqrt{M}
\]
Summary

- Full detector simulator, Jupiter, has been updated and many detector geometry are implemented.

- Cheated PFA has been implemented in Satellites and we start to look into jet mass resolution.