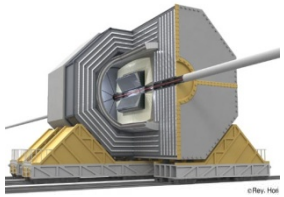


Software Tools in GLD study

Akiya Miyamoto

KEK

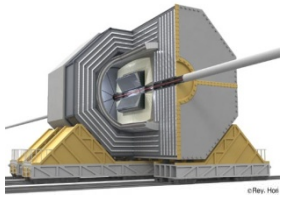
For Orsay Software Workshop

2 May, 2007

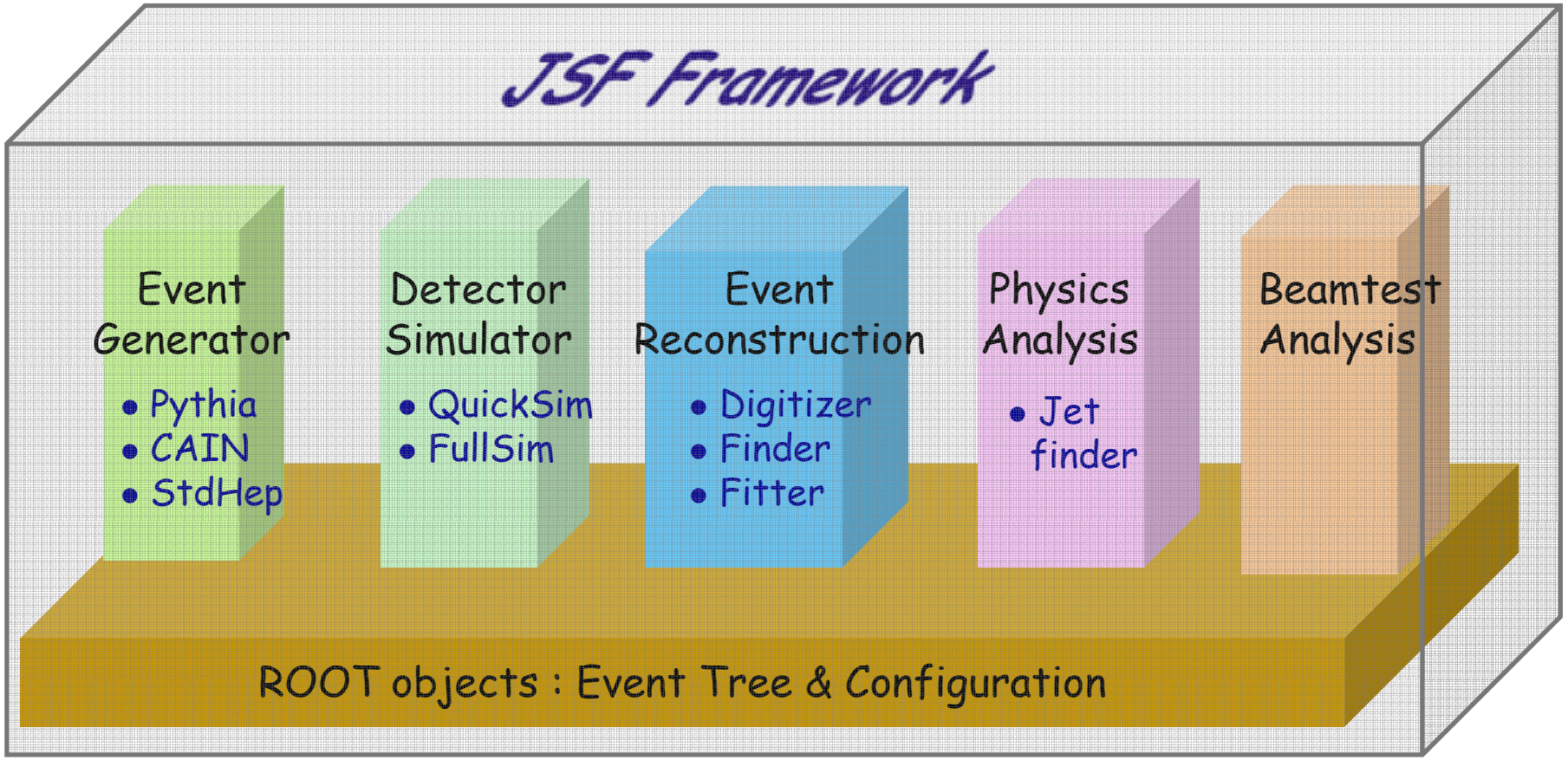
Based on ACFA-SIM-J activities

K.Fujii[2], Y.Fujishima[8], H.Hano[5], S.Hayashi[7], D.Jeans[7], Y.Kawakami[6], K.Kawagoe[7], Y.J.Kim[9], A.Miyamoto[2], H.Miyata[4], T.Nagamine[1], H.Ono[4], H.Park[9], Y.Sugimoto[2], A.Sugiyama[8], T.Takeshita[6], S.Yamamoto[3], S.Yamshita[5], T.Yoshioka[5]

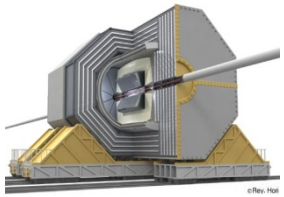
Tohoku[1], KEK[2], GUAS[3], Niigata[4], Tokyo[5], Shinshu[6], Kobe[7], Saga[8], Kyungpook[9]



Our software tools



- Link to various tools at http://acfahep.kek.jp/subg/sim/soft
- GLD Software at http://ilcphys.kek.jp/soft
- All packages are kept in the CVS. Accessible from http://jlccvs.kek.jp/

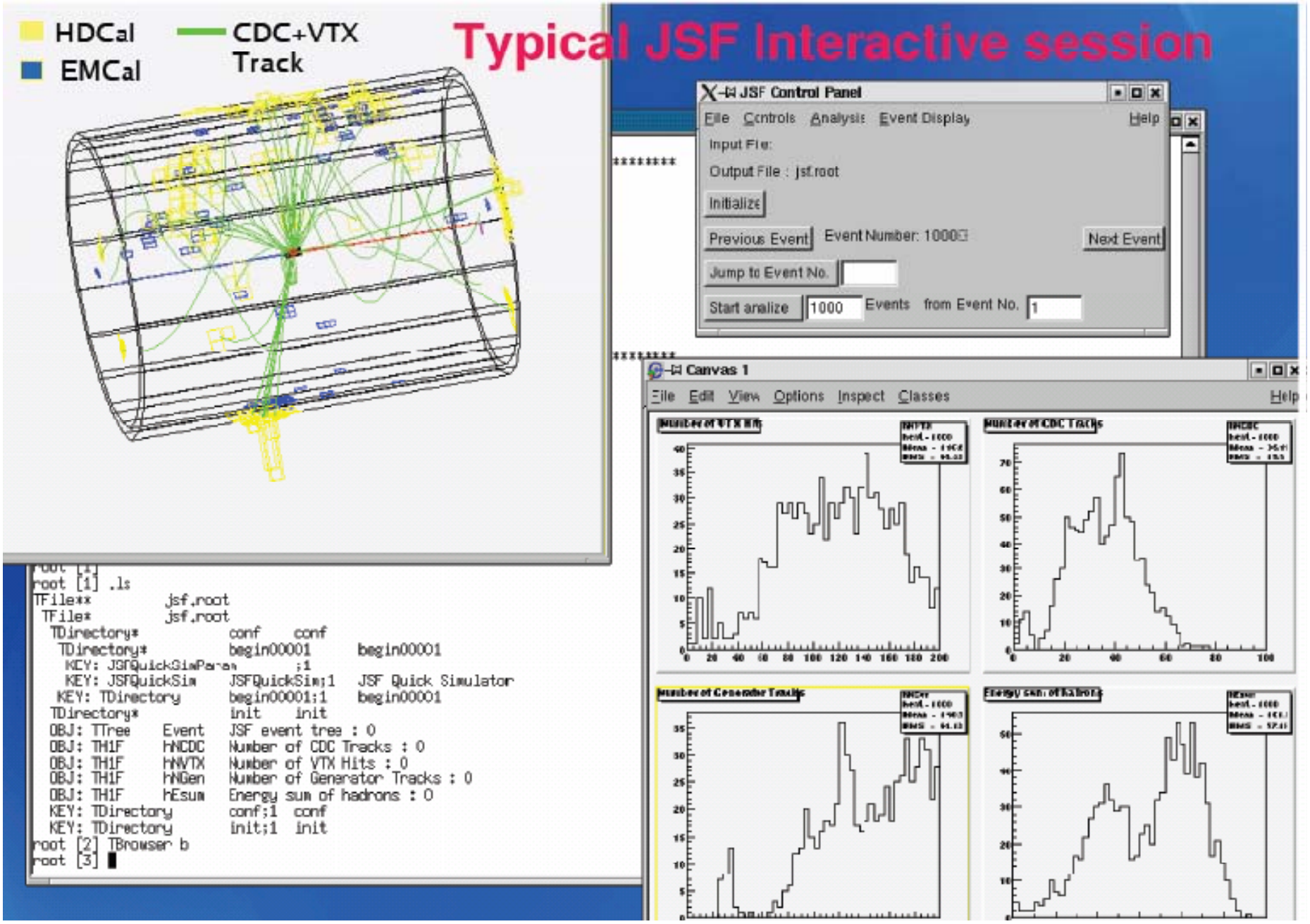


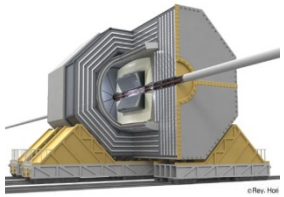
JSF

- Framework: JSF = Root based application
  - All functions based on C++, compiled or through CINT
  - Provides common framework for event generations, detector simulations, analysis, and beam test data analysis
    - JSFModule: Base class of analysis modules
    - JSFEventBuf: Base class of event data
  - Unified framework for interactive and batch job: GUI, event display
    - Loading libraries and creation of objects at run time using ROOT macros
  - A configuration file, jsf.conf, and run time arguments are used to define analysis parameters.
  - Data are stored as root objects; root trees, ntuples, etc
  - Base class for LCIO is provided.
    - Actual implementation depends on data/objects

- Release includes other tools QuickSim, Event generators, beamstrahlung spectrum generator, etc.

Typical JSF Interactive session





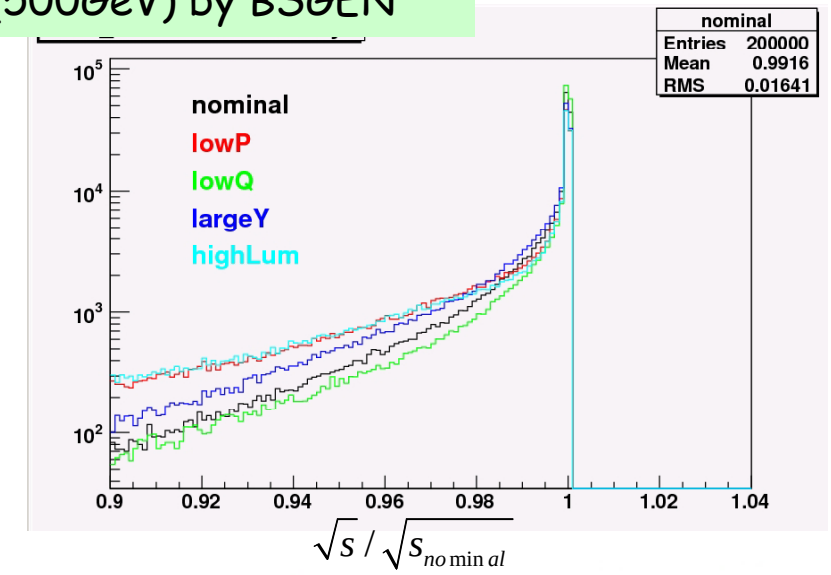
Example of QuickSim Study

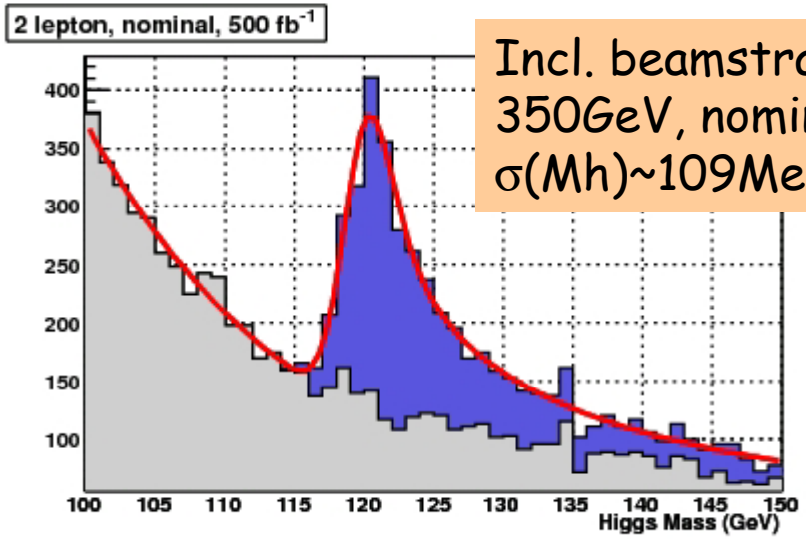
GLD-DOD : physics/0607154

Differential Luminosity (500GeV) by BSGEN

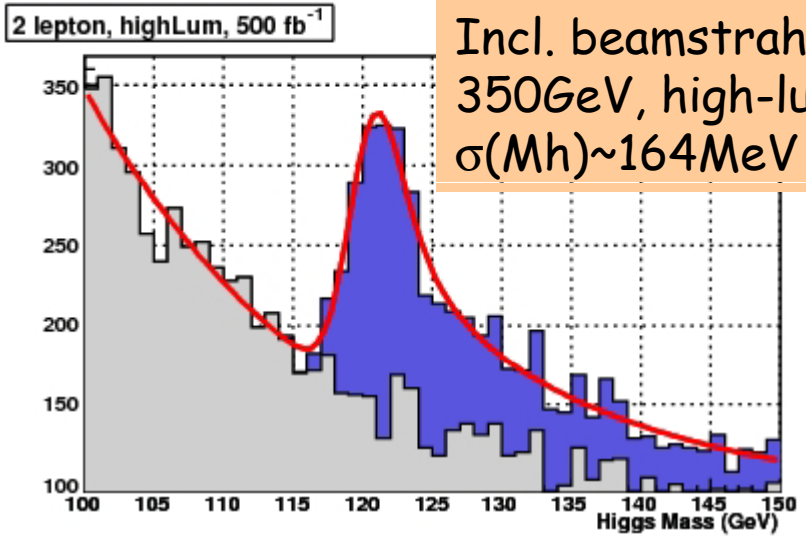
$e^+e^- \to \ell\bar{\ell}X\,;\ \ell = e,\mu$

ΔE/E(beam)~0.1%

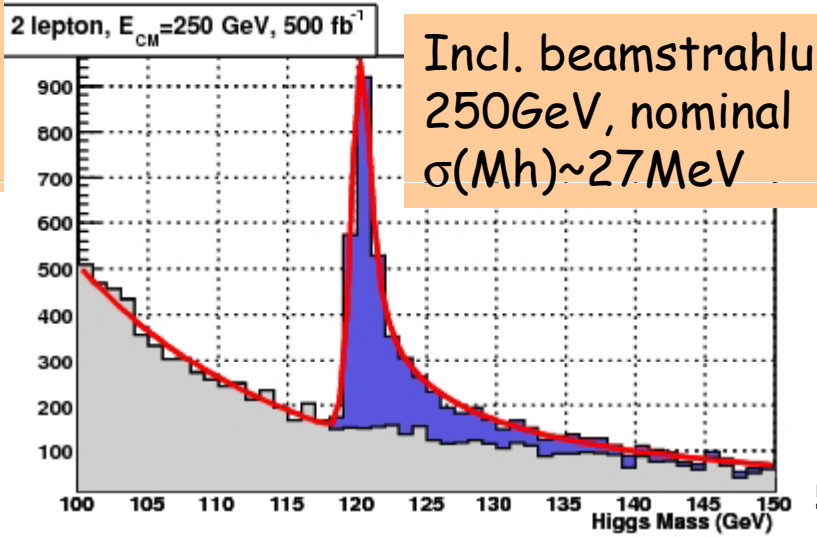




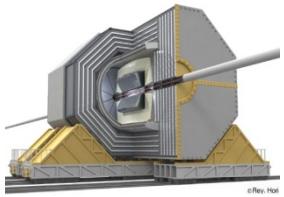
Incl. beamstrahlung 350GeV, nominal σ(Mh)~109MeV



Incl. beamstrahlung 350GeV, high-lum σ(Mh)~164MeV



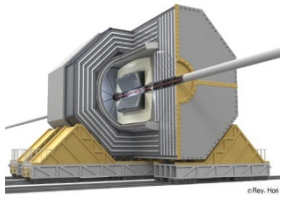
Incl. beamstrahlung 250GeV, nominal σ(Mh)~27MeV



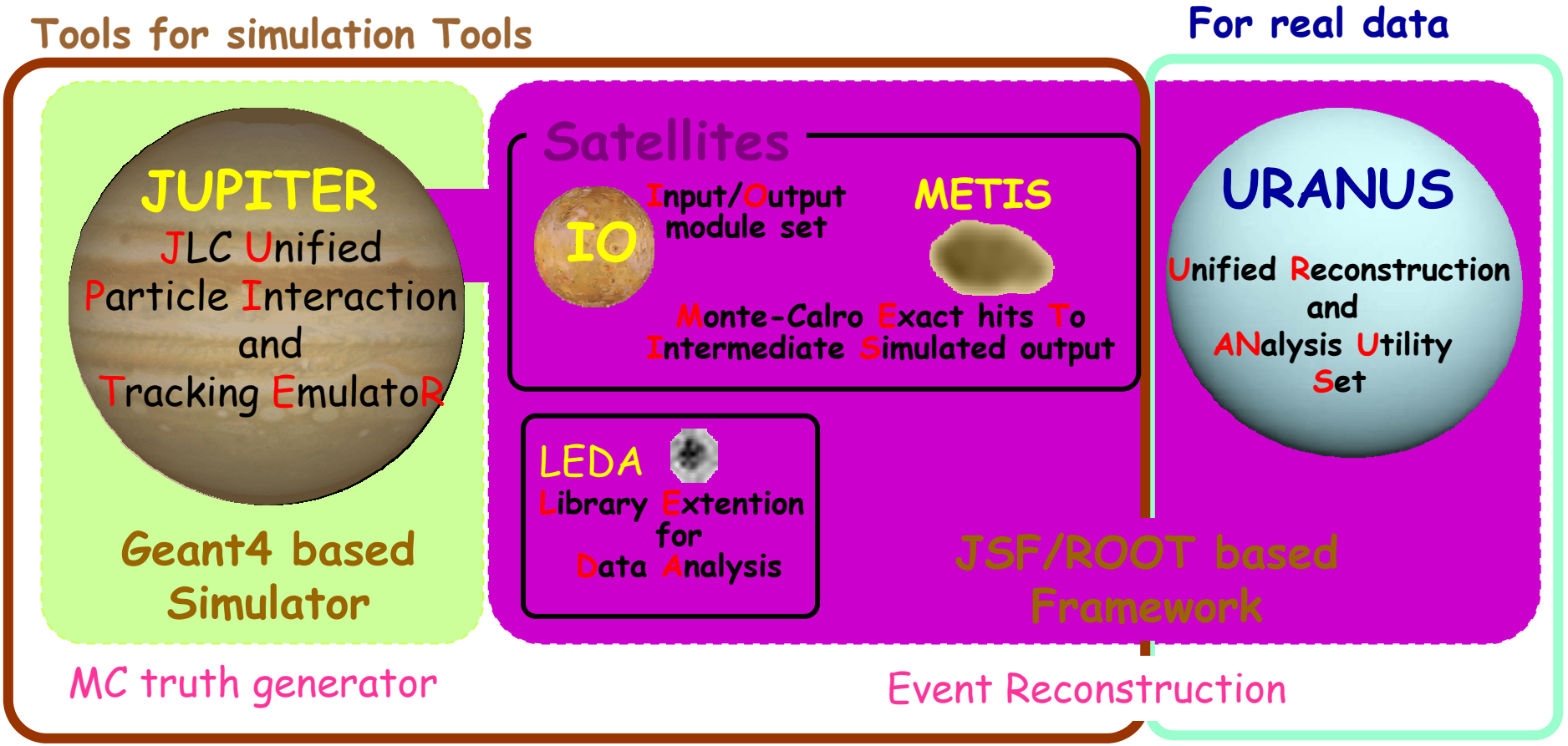
BSGEN

- BSGEN: A generator of beamstrahlung spectrum
- Method:
  - Create a differential luminosity spectrum by CAIN, dL/dE1dE2
  - Parametrise the spectrum to get a generator function
  - Usage: *Generate* (E1,E2) of equally weighted event or calculate event weight for given (E1,E2) depending on purpose.
- Parameter sets:
  - Nominal, LowQ, LowP, LargeY, HighLum spectrum at 500 GeV and 350 GeV
  - Nominal at 300 and 250 GeV
  - Beam parameters for 350, 300, and 250 are same as 500 GeV, except beam energy
- Initial beam energy spread is generated at the time of event generation

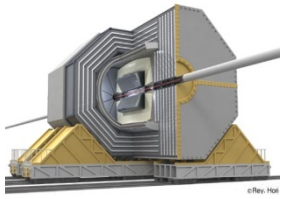
See http://ilcphys.kek.jp/soft/bsgen/index.html for more details



Jupiter/Satellites for Full Simulation Studies



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



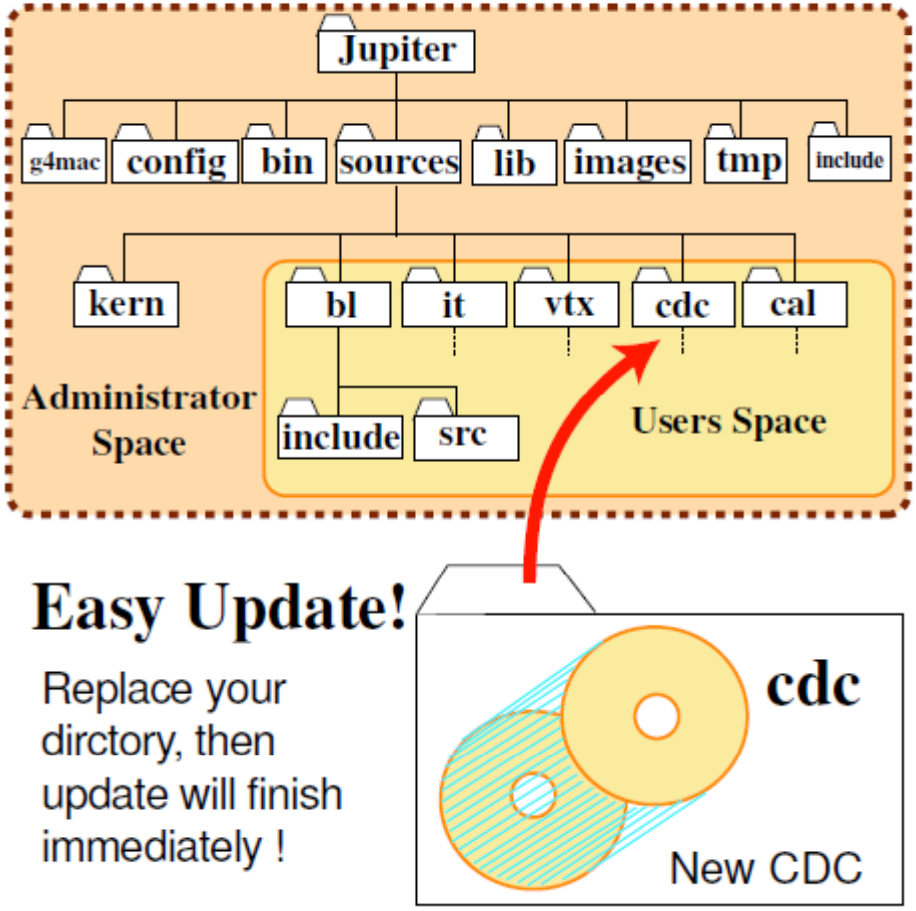
Jupiter feature - 1

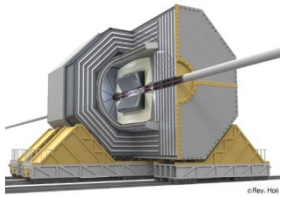
- Using Geant4 8.0p01 → update to 4.8.2.p01 in preparation
- Modular structure

  ➔ easy installation of sub-detectors

- Geometry
  - Simple geometries are implemented
    (enough for the detector optimization)
  - parameters (size, material, etc) can be modified by input ASCII file.

    → Parameters are saved as a ROOT object for use in Satellites later



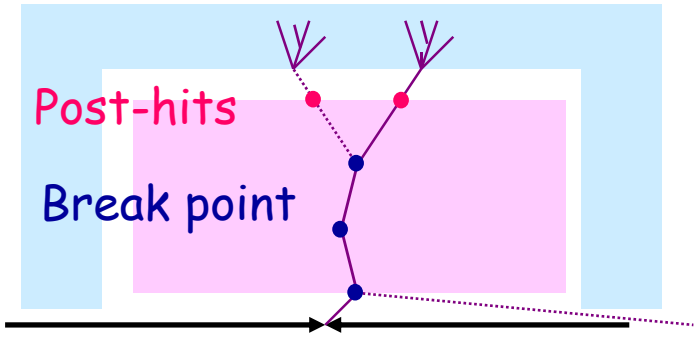


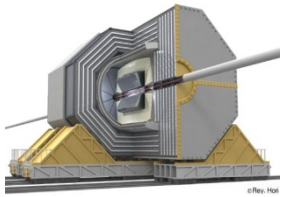
Jupiter feature - 2

- Input:
  - StdHep file(ASCII), HepEvt, CAIN, or any generators implemented in JSF.
  - Binary StdHep file interface was implemented, but yet to be tested.
- Output:
  - Exact Hits of each detectors (Smearing in Satellites)
  - Pre- and Post- Hits at before/after Calorimeter

    Used to record true track information which enter CAL/FCAL/BCAL.
  - Break points in tracking volume
  - Interface to LCIO format is prepared in the JSF framework

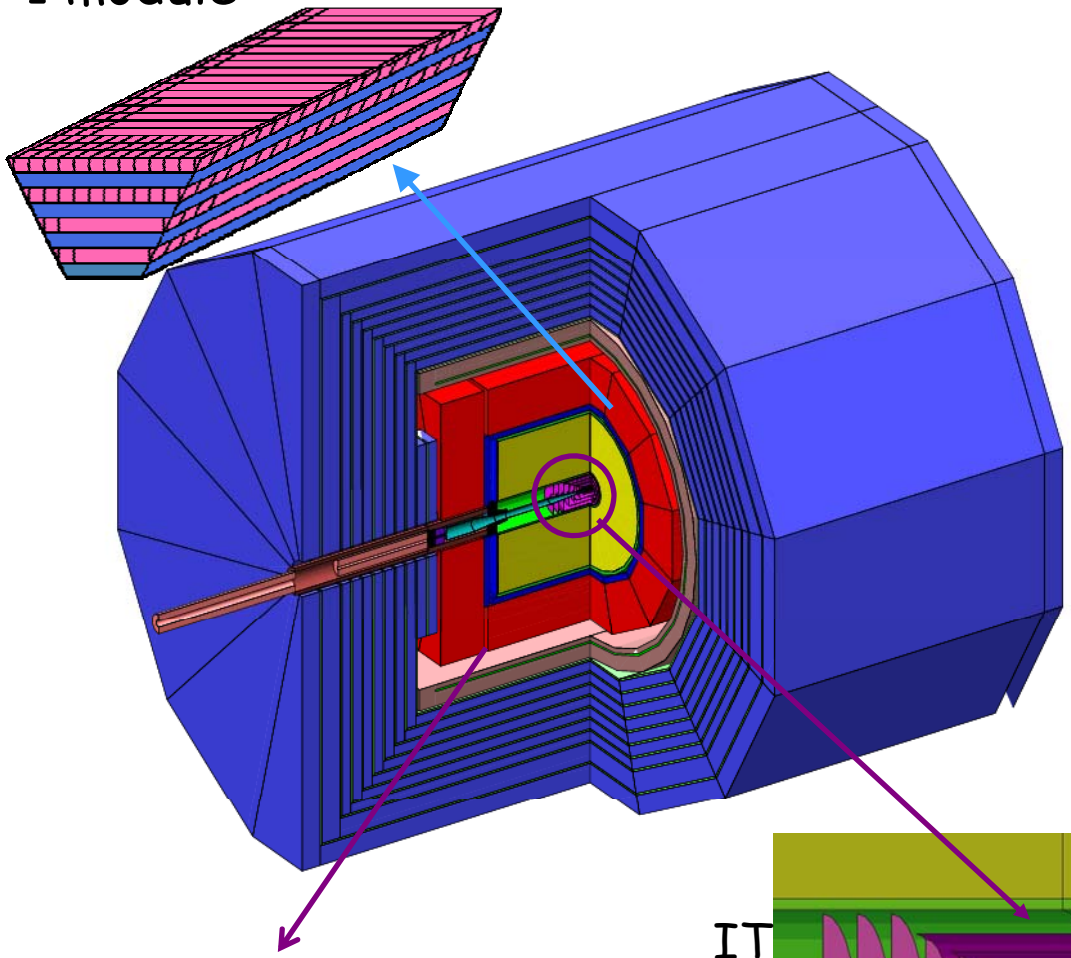
    Compatibility is yet to be tested.
- Run mode:
  - A standalone Geant4 application
  - JSF application to output a ROOT file.





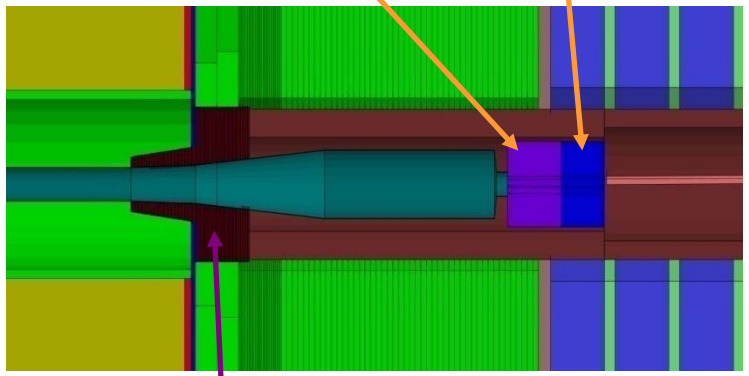
GLD Geometry in Jupiter

1 module



CH2mask

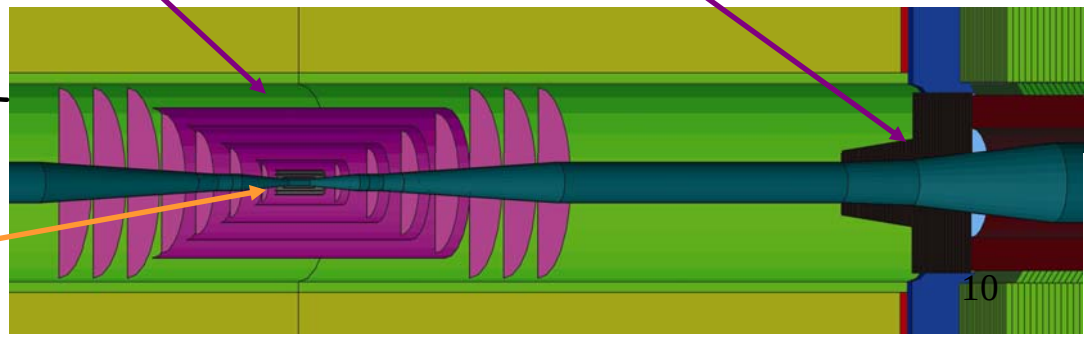
BCAL



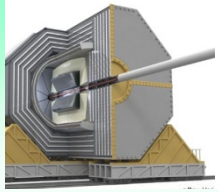
FCAL

IT

VTX

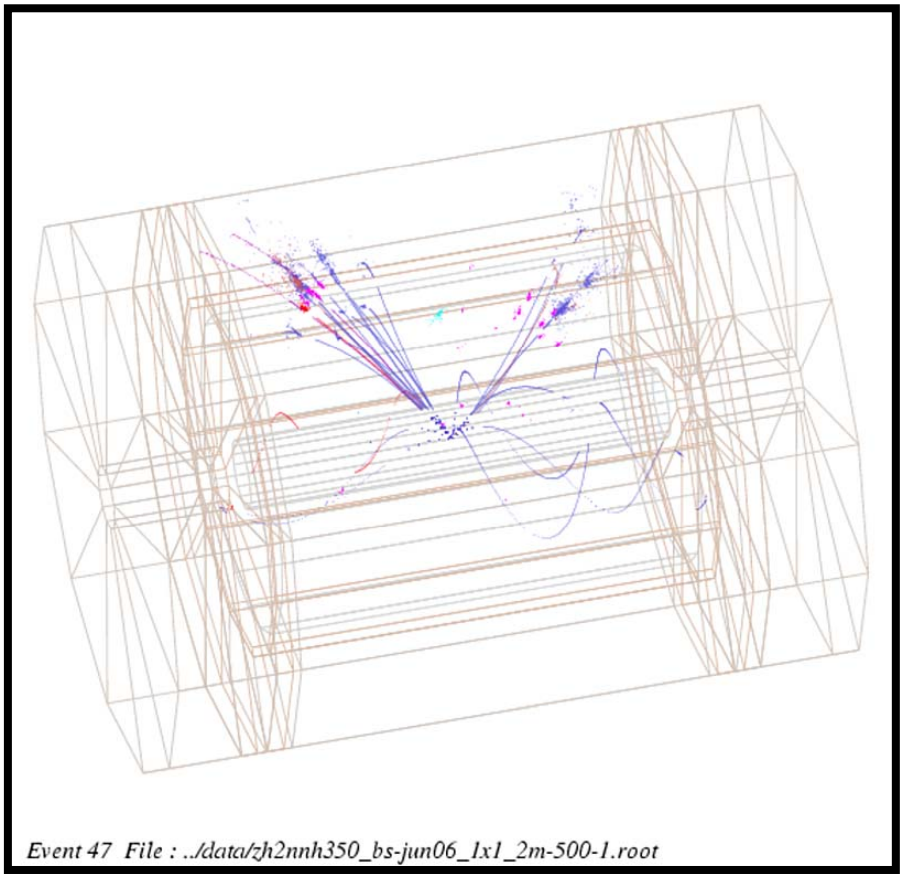


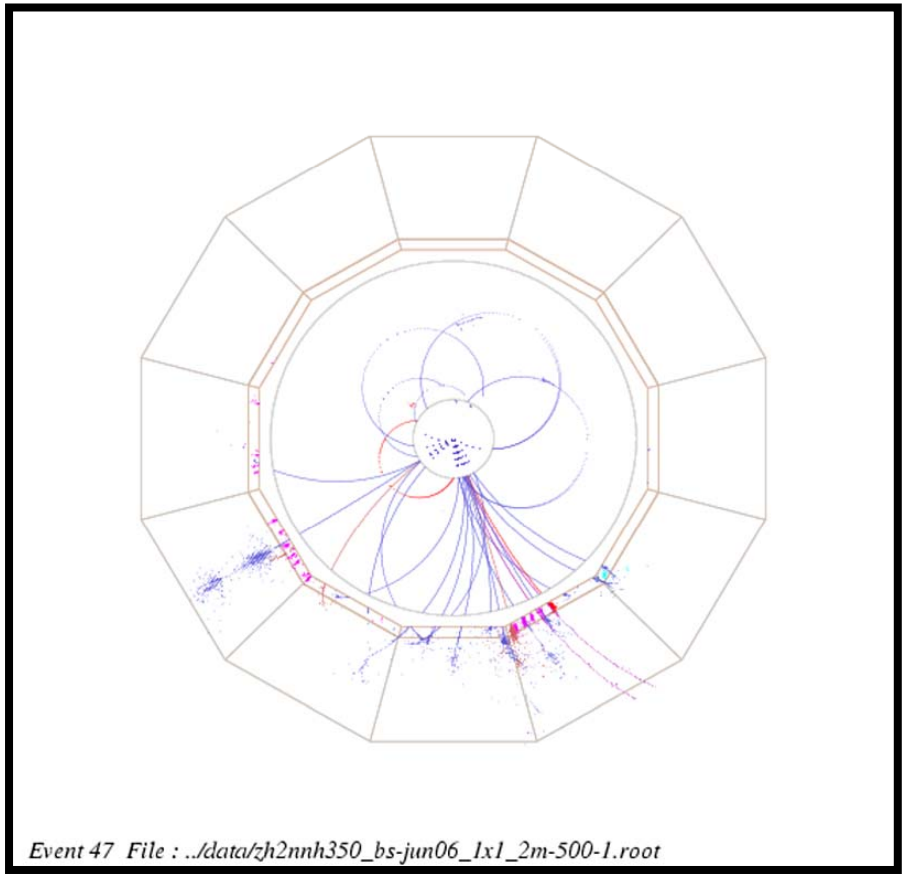
Include 10cm air gap
as a readout space



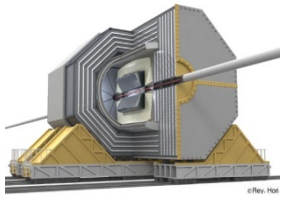
Typical Event Display

Event display using ROOT

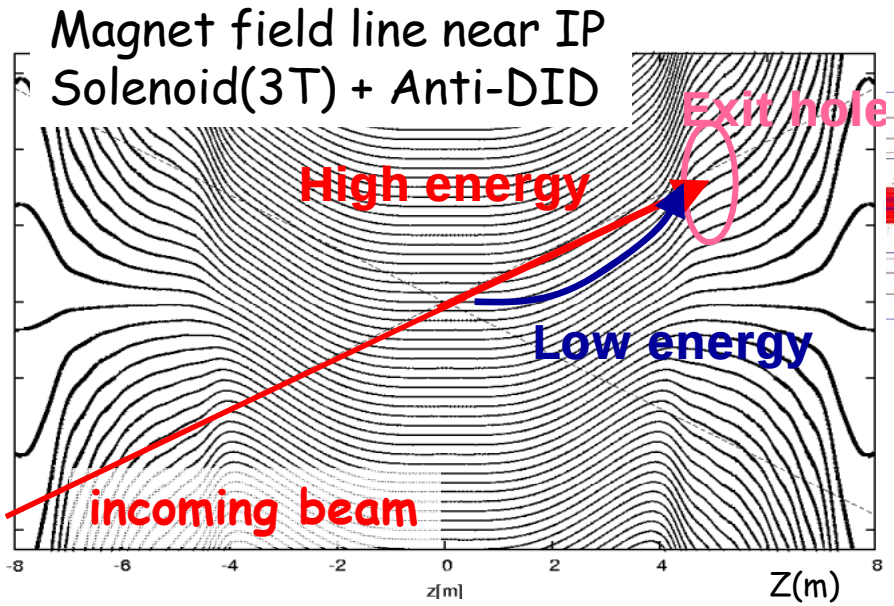


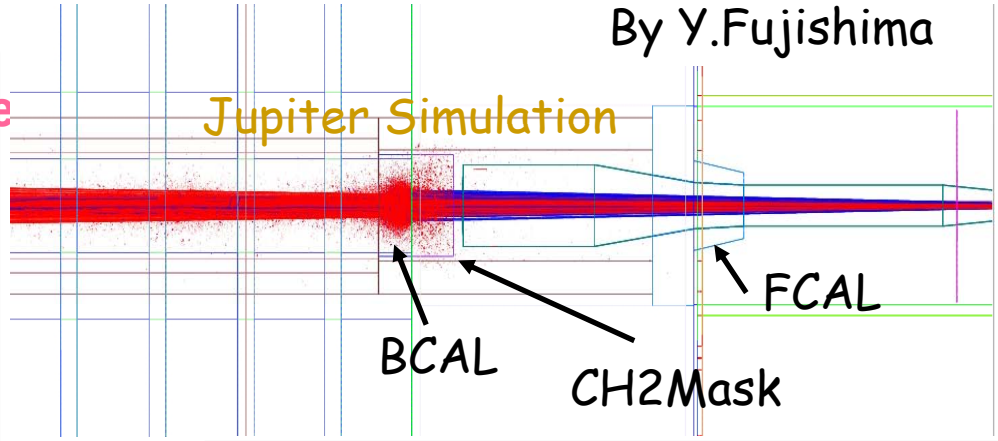


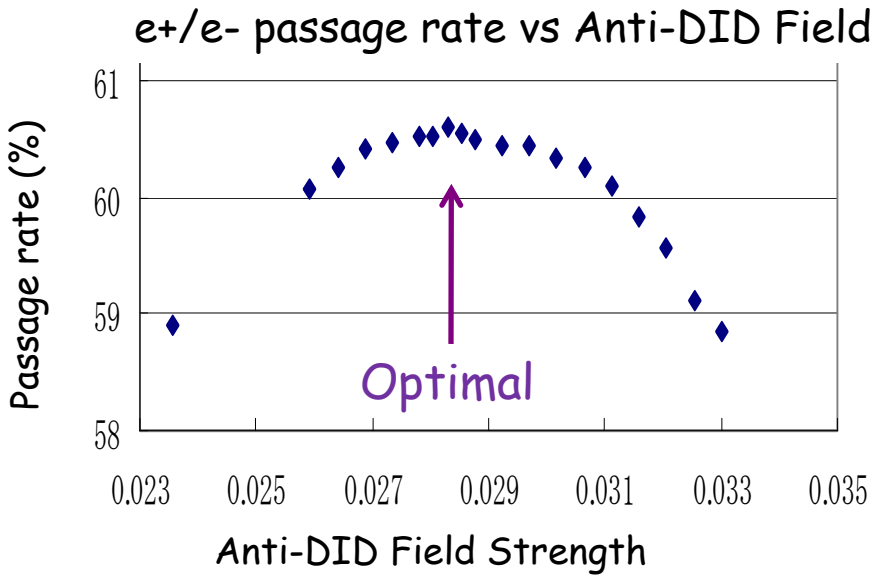
- $ZH \rightarrow \nu\nu h$: Two jets from Higgs can be seen.

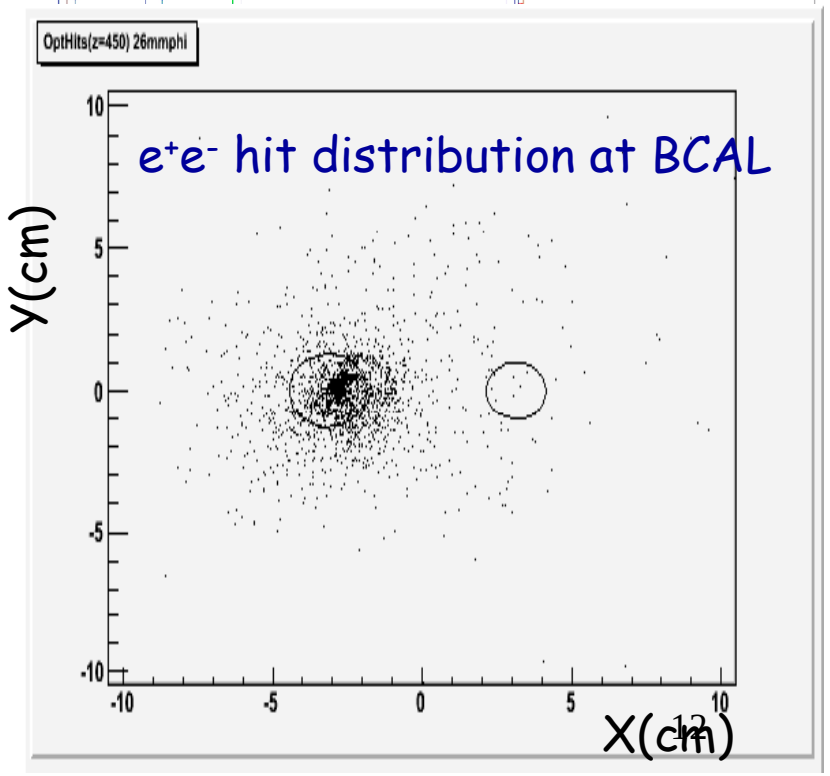


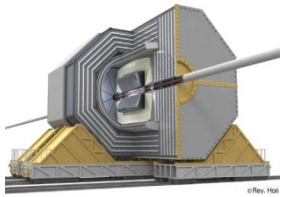
Anti-DID Field and Backgrounds











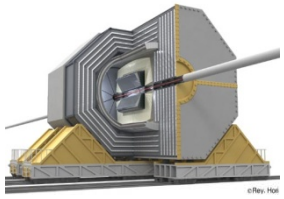
Analysis: Metis and Uranus

- Uranus and Metis is a collection of reconstruction tools for Jupiter data.
  - Uranus: for analysis of beam data and simulated data
  - Satellites: for analysis of simulated data. Most of the Satellite classes are inherited from Uranus

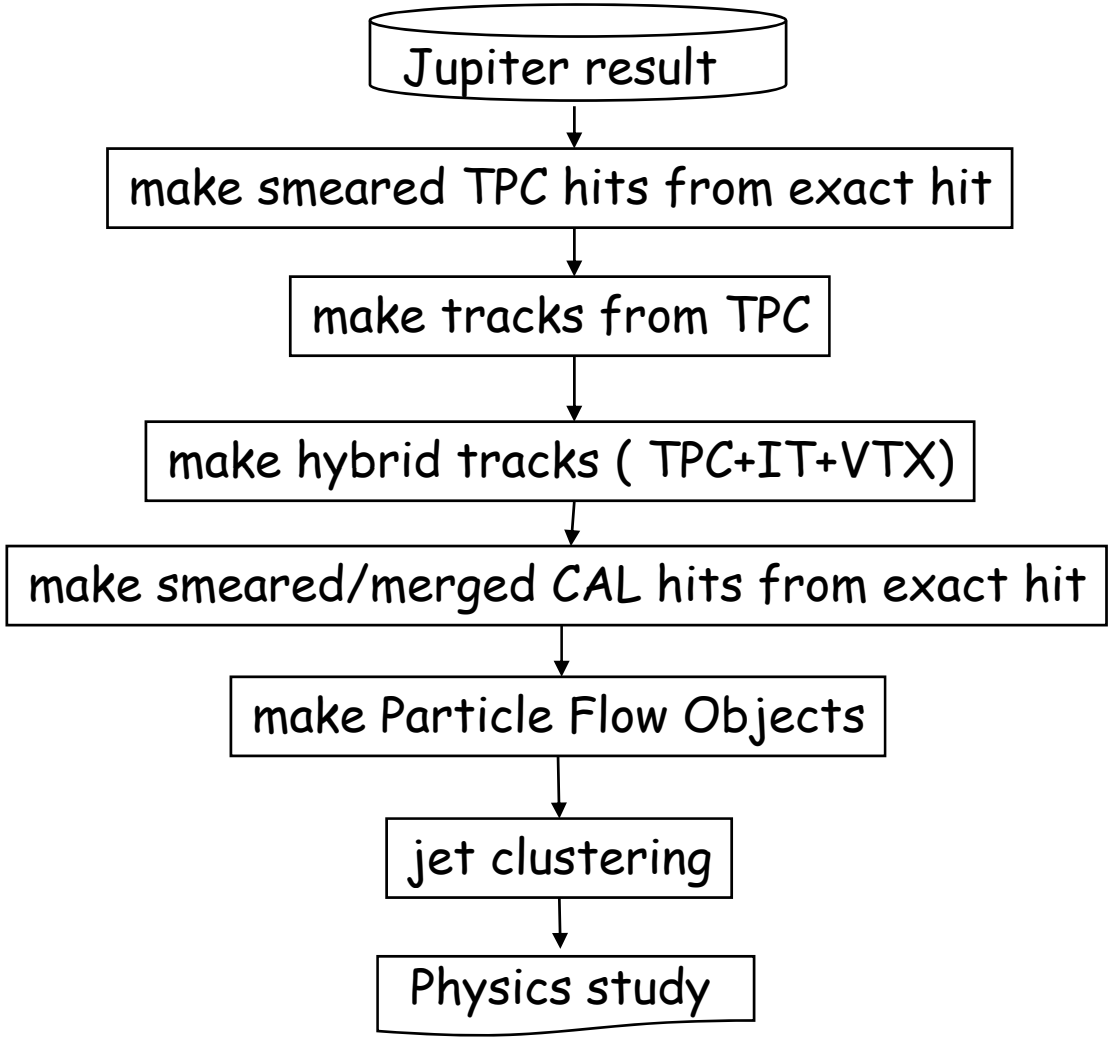
- Metis and Uranus are collection of JSF Modules.

  Each module is independent, thus shall be easy to implement different reconstruction algorithm according to interests

- Track/Hits/Cluster/PFO information is kept as root objects
  Geometry information is kept in a root object, JSFEnv



A standard analysis flow



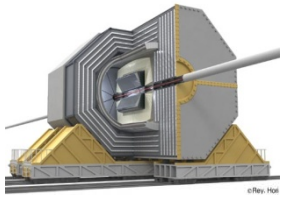
Gaussian smearing

Cheated track finder
Kalman track fitter

Cheated hit finder
Kalman track fitter

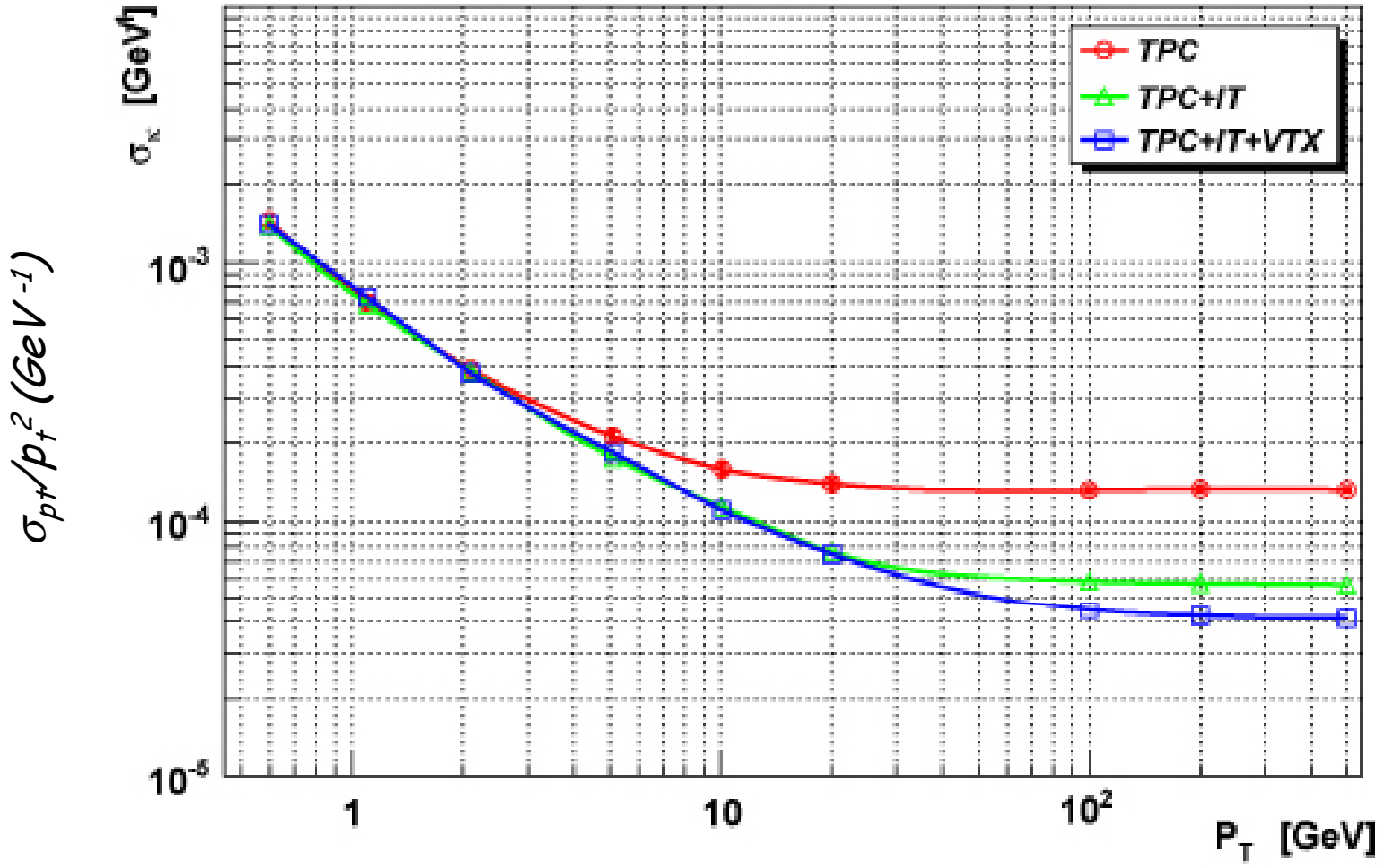
Cell merge
Make Tile/Strip

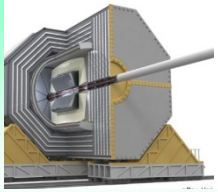
Particle Flow Analysis
(cheated/Real)



Momentum resolution

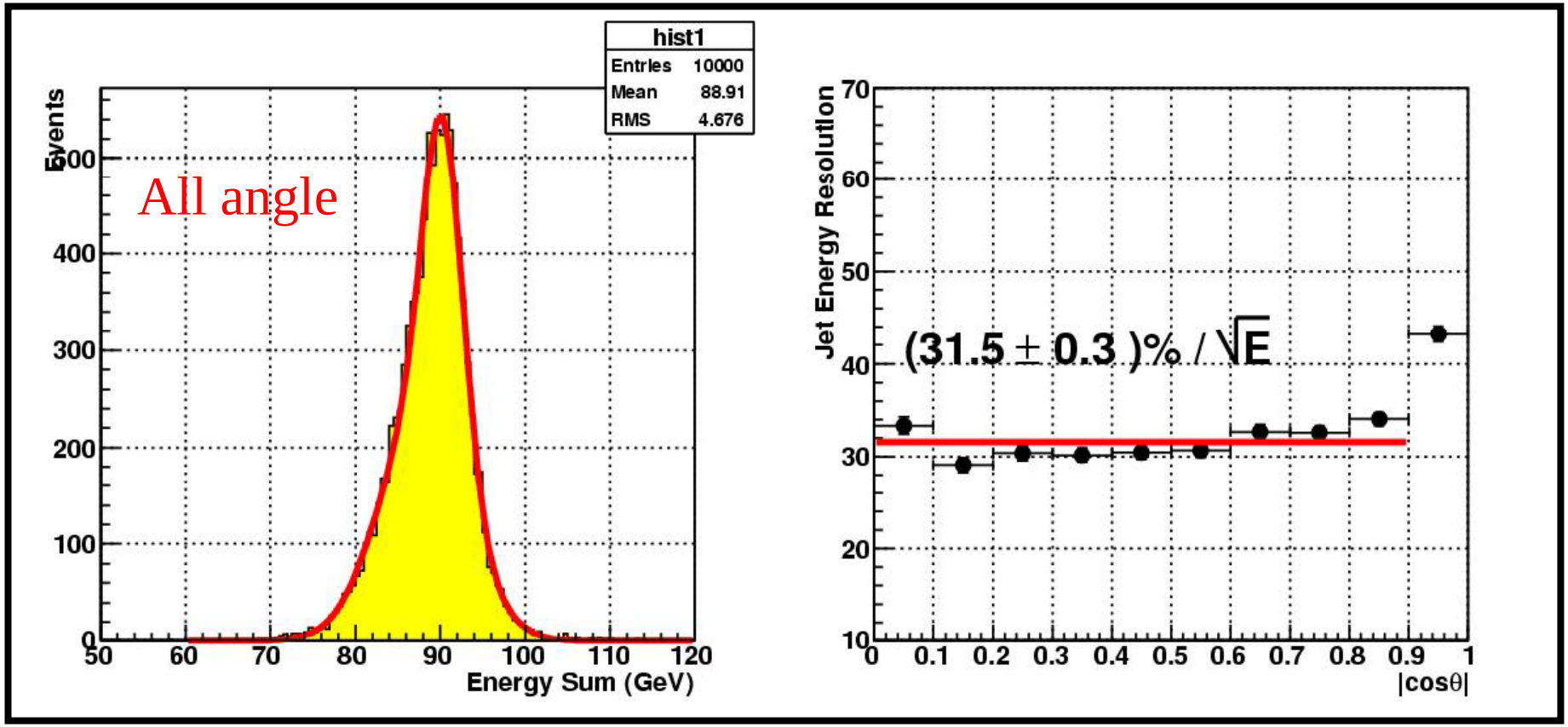
Exact hit points created by single μ were fitted by Kalman filter package





Jet Energy Resolution (Z-pole)

- Z → uds @ 91.2GeV, tile calorimeter, 2cm x 2cm tile size



- Please see a talk by Tamaki Yoshioka