Status of Jupiter and Satellites

Akiya Miyamoto
KEK

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Based on works done by ACFA-SIM (-J) members

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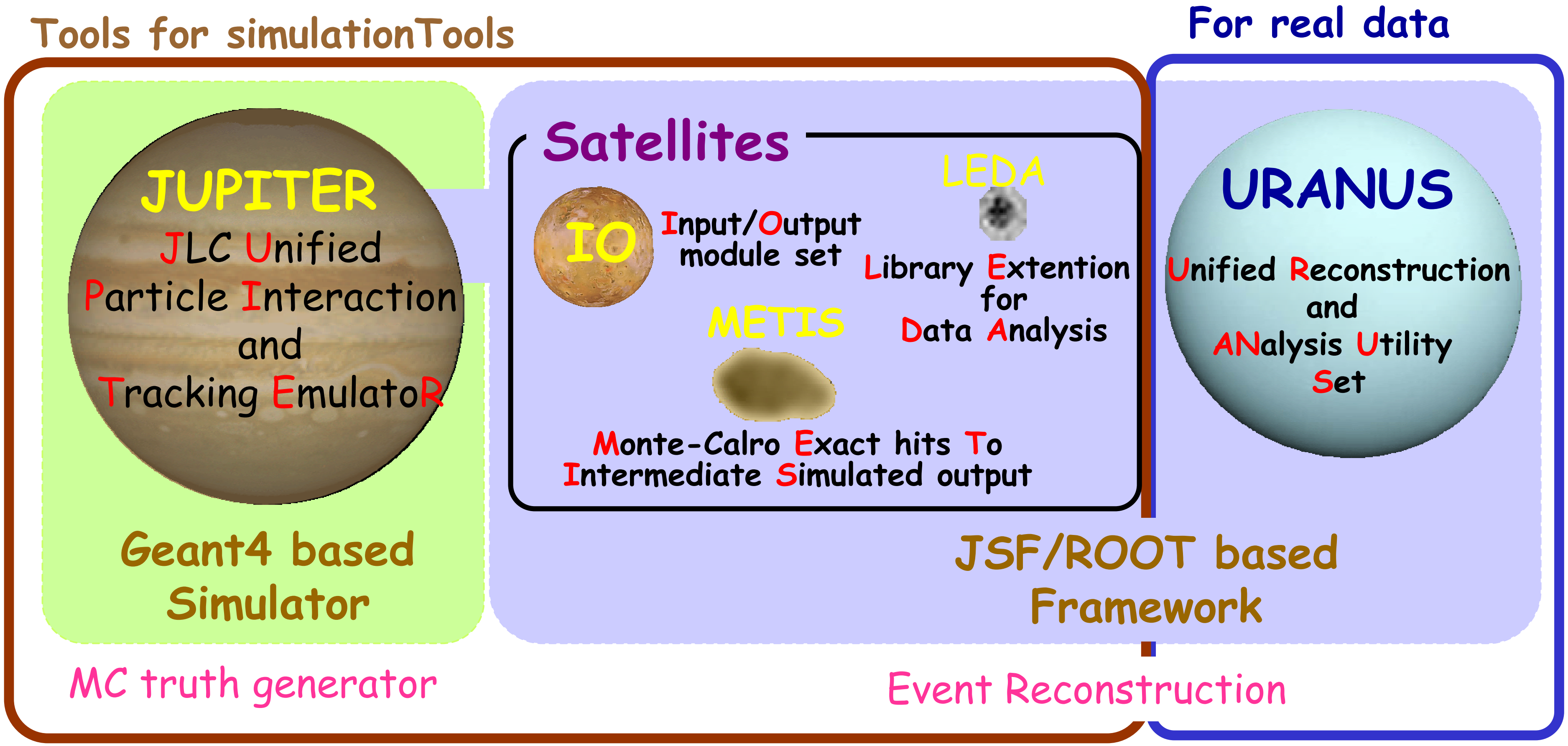
Note:

Figures presented here are preliminary. They are included to indicate status of our software packages.

Jupiter/Satellites Concepts



JSF: the analysis flow controller based on ROOT

The release includes event generators, Quick Simulator, and simple event display

Jupiter : Geant4 based Full Detector Simulator

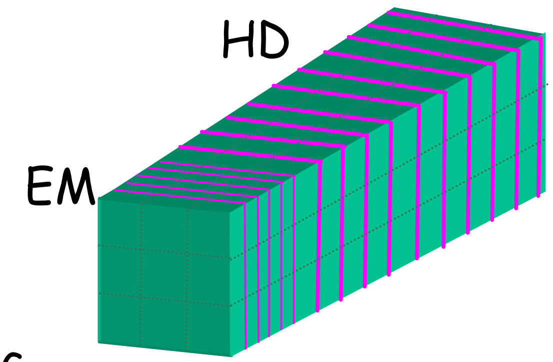
- Features:
  - Modular structure for easy update, install/uninstall of sub-detectors
  - Powerful base classes that provide unified interface to
    - facilitate easy (un)installation of components by methods such as InstallIn, Assemble, Cabling
    - Help implementation of detailed hierarchical structures. 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 fie.

Status

- Before LCWS2004, GLC-3T geometry except for the muon detector was implemented in Jupiter and used for studies on
  - Performance of CDC, T0 resolution, etc.
  - Beam backgrounds on VTX
- Since LCWS2004,
  - Implementation of new detector model, Generic Large Detector, has been started. So far, simple ideal geometries are implemented.
  - Components in Satellites are enriched
    - Calorimeter studies not covered my talk will be presented by Sanchez-san, in the next talk.
  - For implementation of more complete geometry, a XML interface has been developed. -> Kishimoto-san's talk.

Calorimeter in Jupiter

- An accuracy of simulated results depends on precision of Calorimeter geometry.
- In the current version, we implemented an ideal geometry to know ultimate performance
  - pointing tower structure, no crack between towers
  - ~160 layers of absorbers and sensors
  - Mini-tower can be defined within the tower to define smaller cell structure. Simulate with a small cell structure and merge cell signals appropriately at later analysis stage to save CPU and storage space.
  - Tower geometry, materials and granularity can be modified easily.

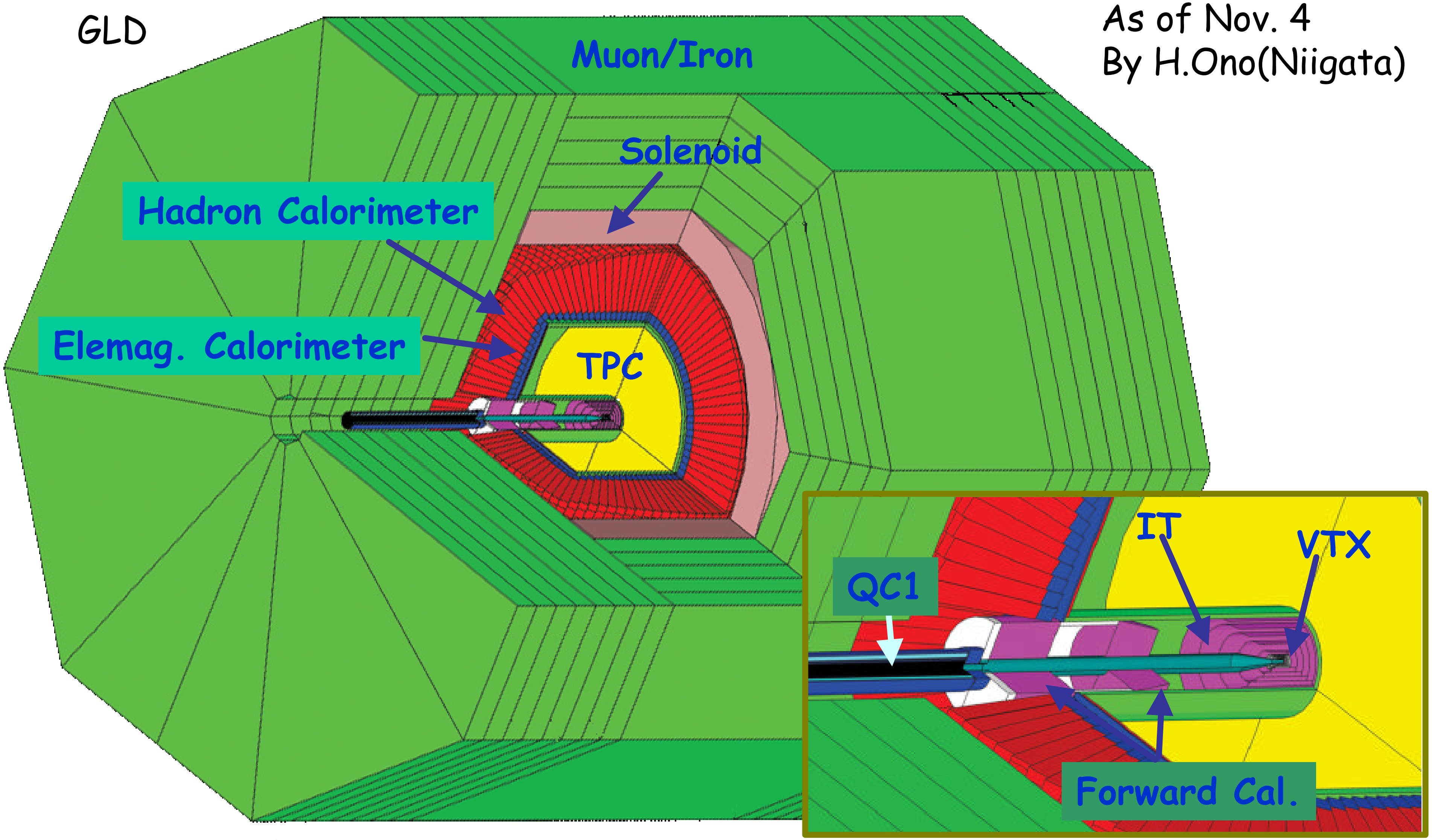


Tower structure

- Current status:
  - Geometry are implemented.
  - Studying performances such as CPU time, Output data size, Energy response, etc

Standard Geometry of Jupiter

As of Nov. 4
By H.Ono(Niigata)

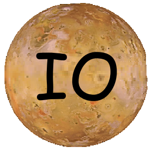


Performance of Jupiter

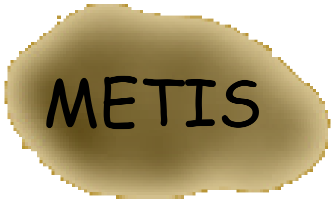
- With a standard configuration,
  - ~9000sec to generate 100 ZH events at 350 GeV
  - Memory size: 60~100 MBytes
  - Output data size exceeds 2G Bytes at ~0.5K events
    - Need to reduce output data size or JSF update to support multiple-file output
    - Without output, run more than 5000 events
- Problems/To do for future improvements
  - It takes ~ 3 min for the geometry initialization. Increase significantly when we use smaller segmentation. The reason of long CPU time is under investigation.
  - The standard cut value for the range in Calorimeter is 1mm. It has to be O(1) mm to get reasonable ECAL resolution of ~15%.
  - Geometries yet to be installed:
    - Muon, Forward trackers
    - Improvements of the geometries already implemented. -> Use XML interface

Satellites: IO, Metis, Leda

- Satellites are event reconstruction modules for simulated data.



- IO – Input / Output module set
  - Convert Jupiter output to ROOT object
    - Though ASCII file
    - JSFJ4 (Run Jupiter in JSF frame work and convert)

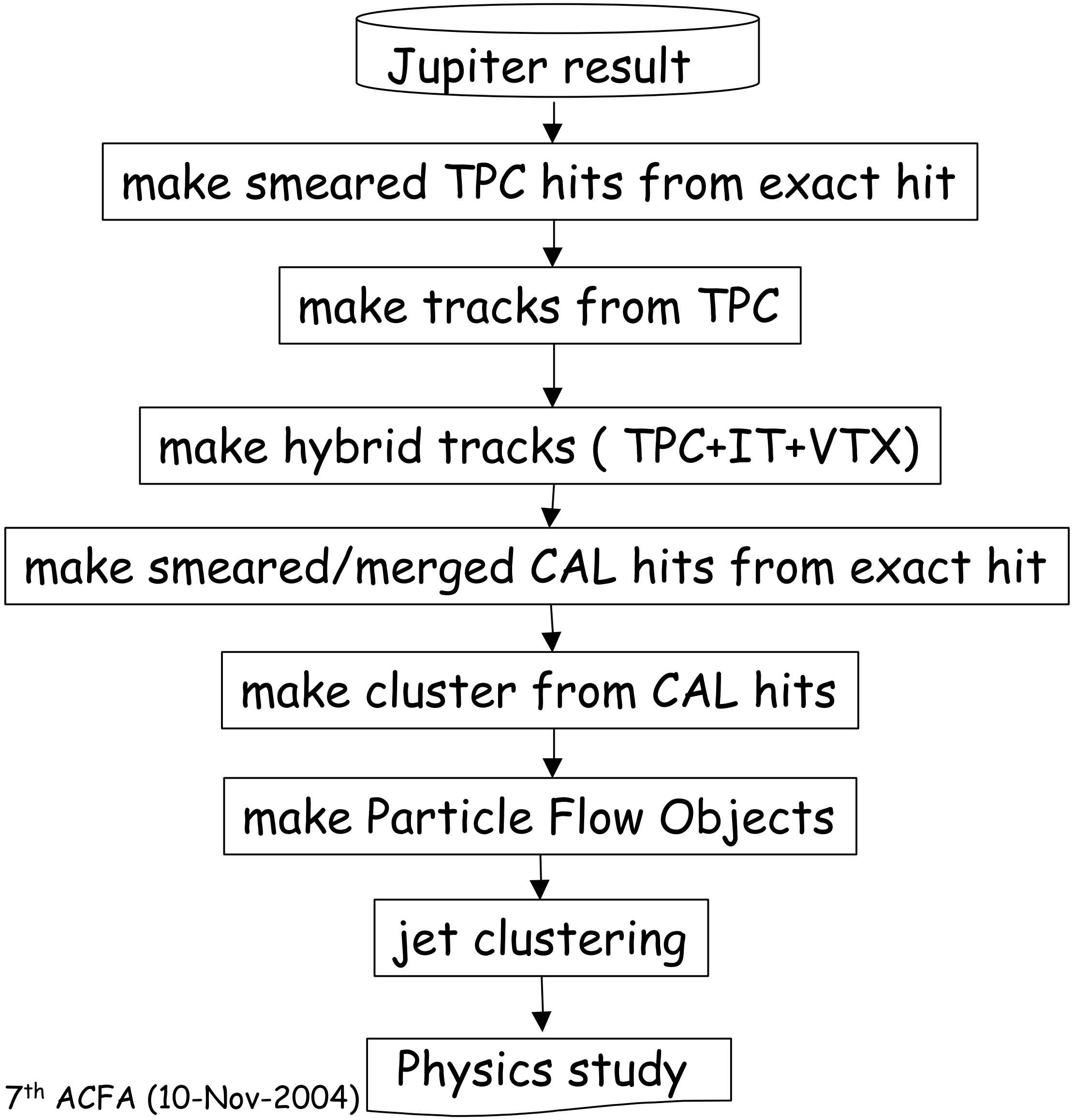


- METIS – Monte Carlo Exact hit To Intermediate Simulated Output
  - Module set for simulated data reconstruction
    - Includes
      - HitMaker : Exact hit to smeared hit
      - TrackMaker : Track reconstruction
      - ClusterMaker: Cal. Cluster reconstruction
      - PartcleFlowObjectMaker : Make Particle Flow Object

Leda

- Leda – Library Extension for Data Analysis
  - Library for reconstruction
    - Includes
      - Kalman filter package, etc.

Metis Analysis Flow



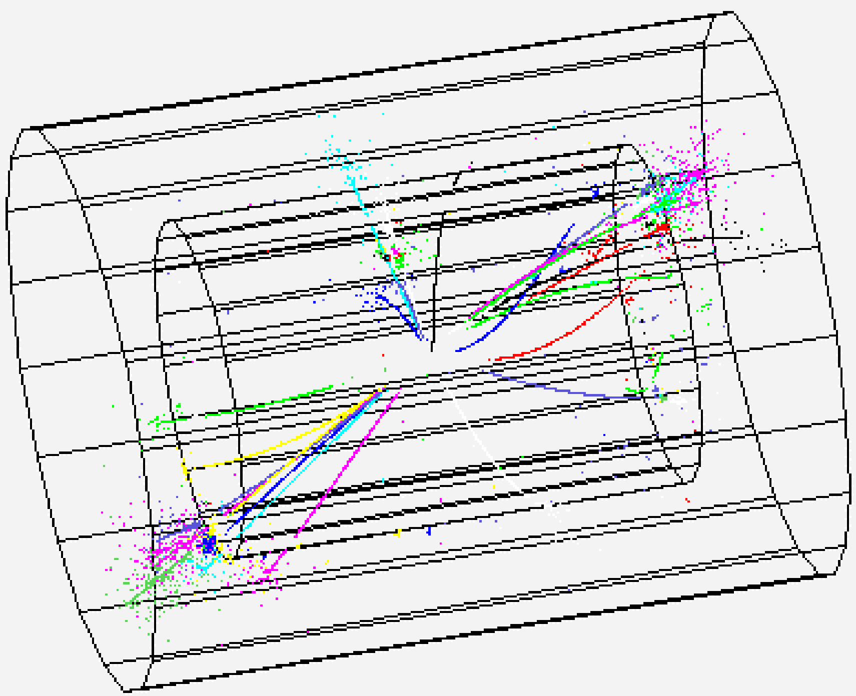
Status of Metis

- Current aim is to prepare a minimum set of Metis modules for studies of Particle Flow Algorithm.
- Novice users will be able to do physics analysis using information of PFO classes.
- As a first step, a cheated track finder and a cluster maker, etc are in preparation in order to know ultimate performance.

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

Cheated PFO analysis

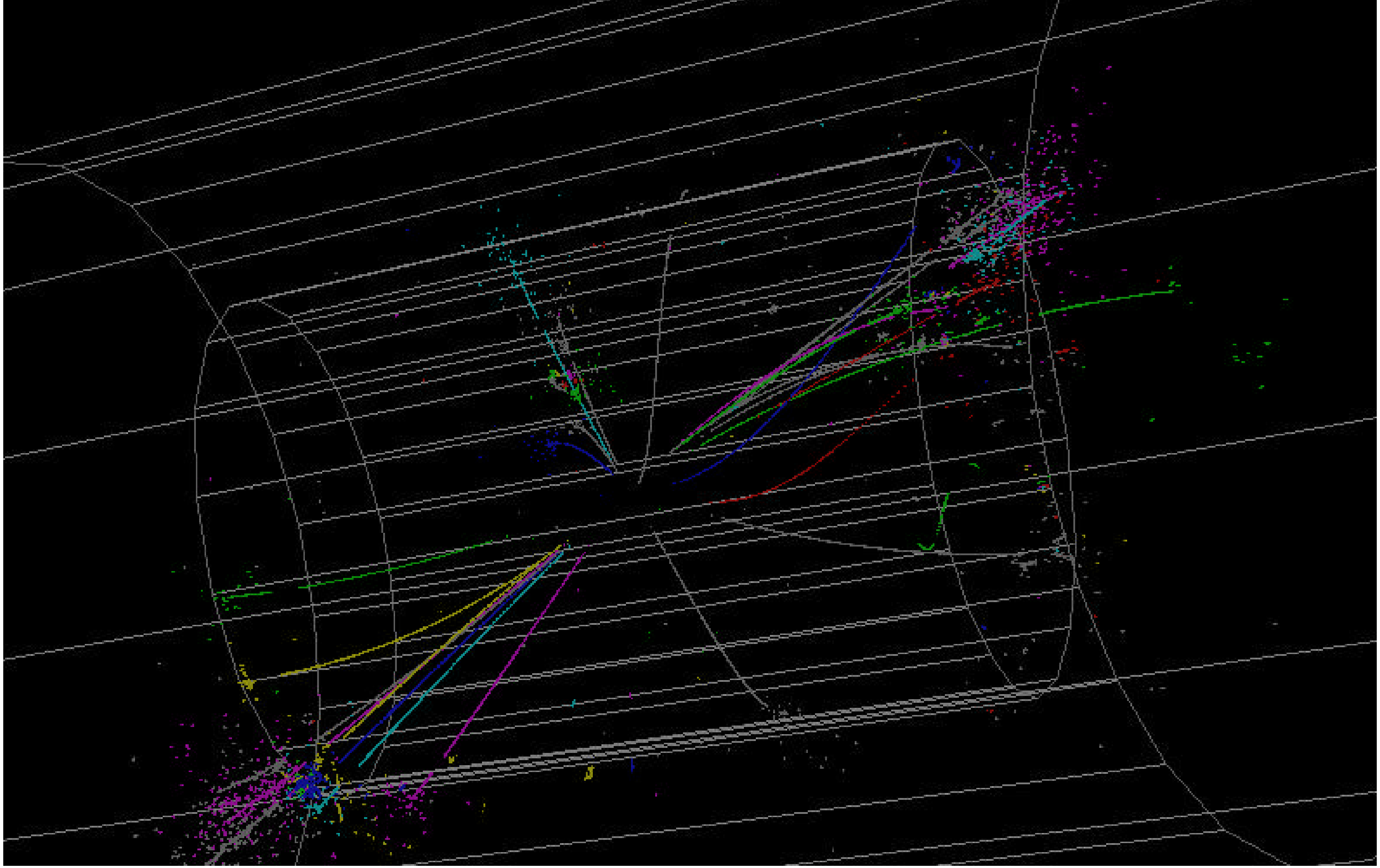
ZH event at Ecm=500 GeV



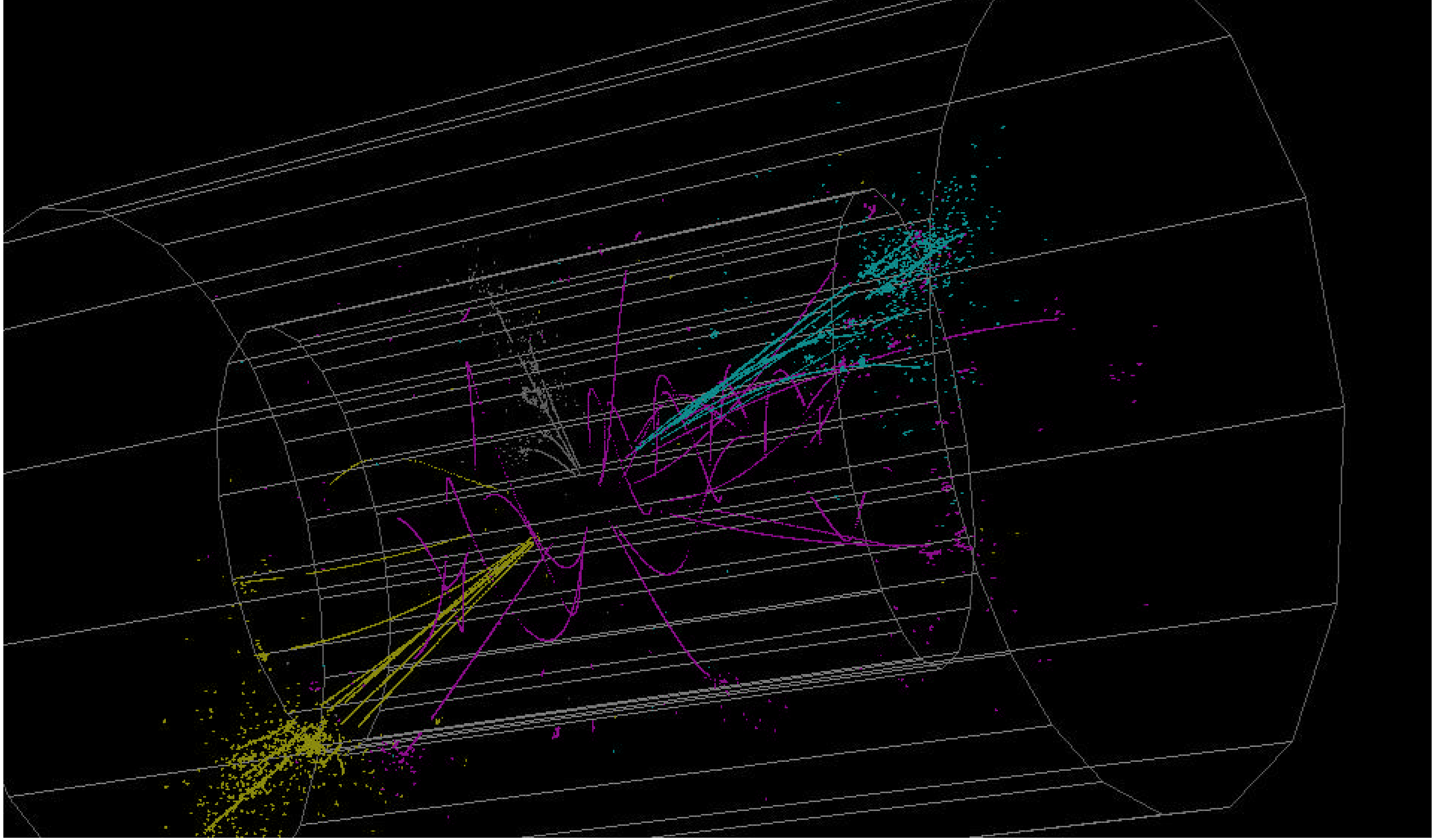
By K.Fujii(KEK), S.Yamamoto(GUAS), A.Yamaguchi(Tsukuba)

- 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.

ROOT's X3d view of the same event



Same event, after a forced 4-jet clustering on PFObjects



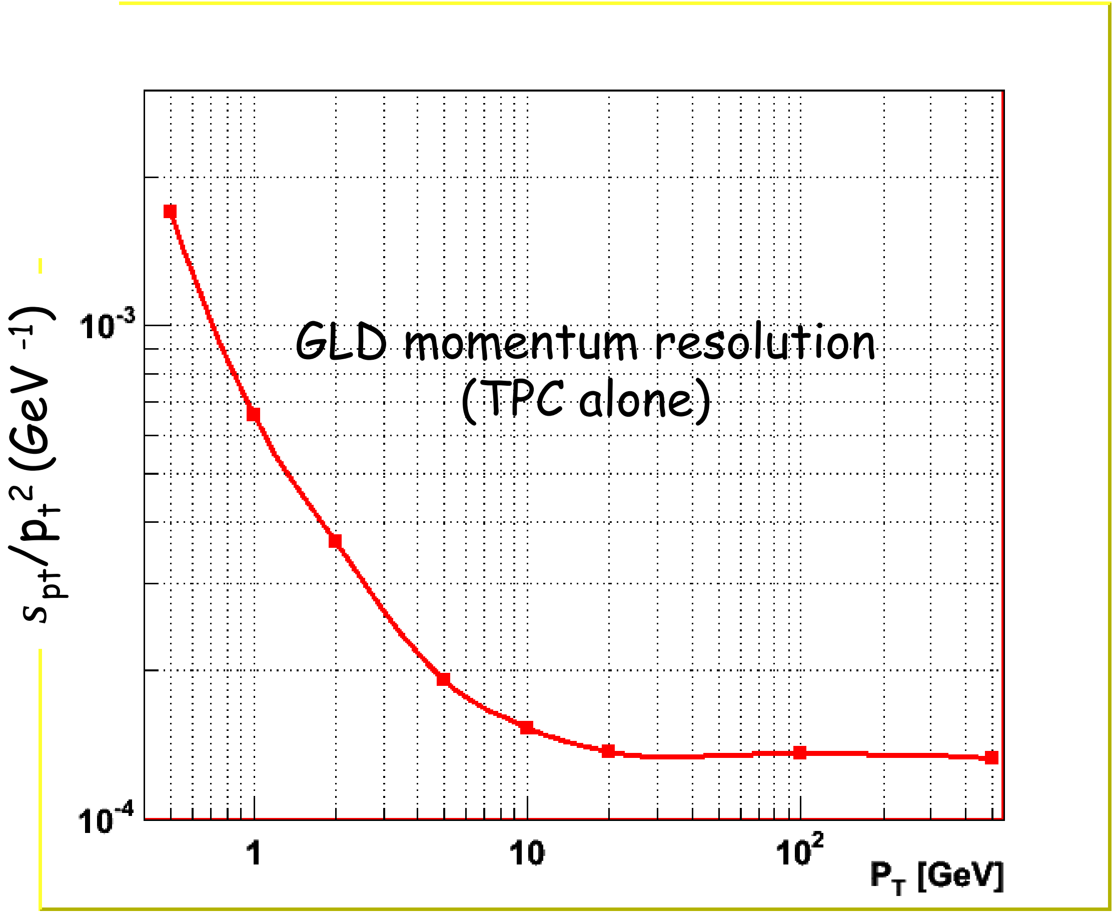
Metis Status: TPC s_p/p - 1

TPC exact hit points created by single m were fitted by Kalman filter package

TPC parameter for
GLD_V1 configuration :

Bfield = 3 Tesla
Rin = 40 cm
Rout = 206 cm
Half length = 235 cm

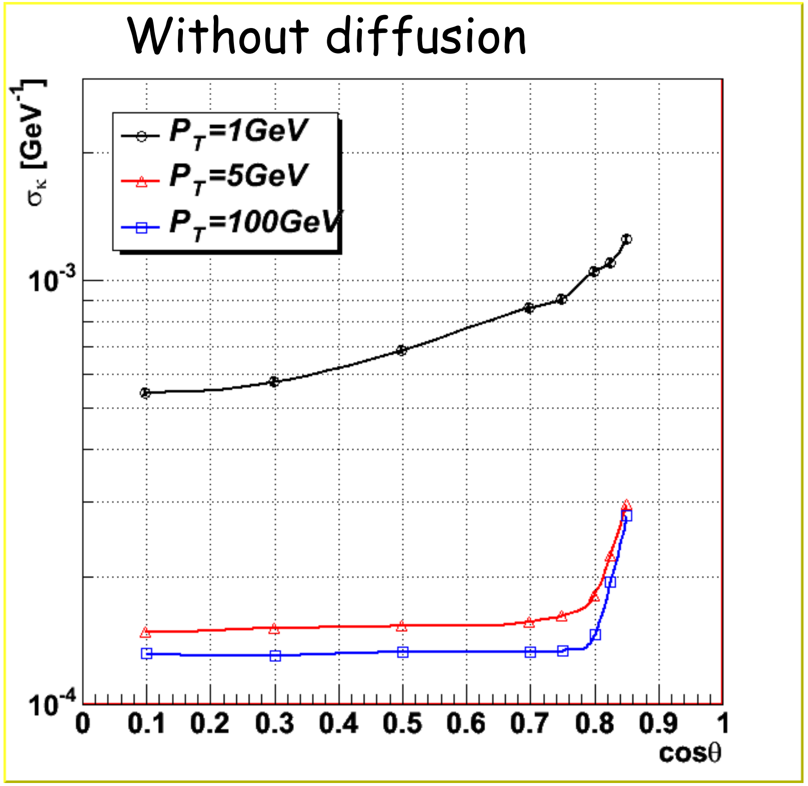
sampling = 200
s_{rf} = 150 mm (constant)
s_z = 500 mm

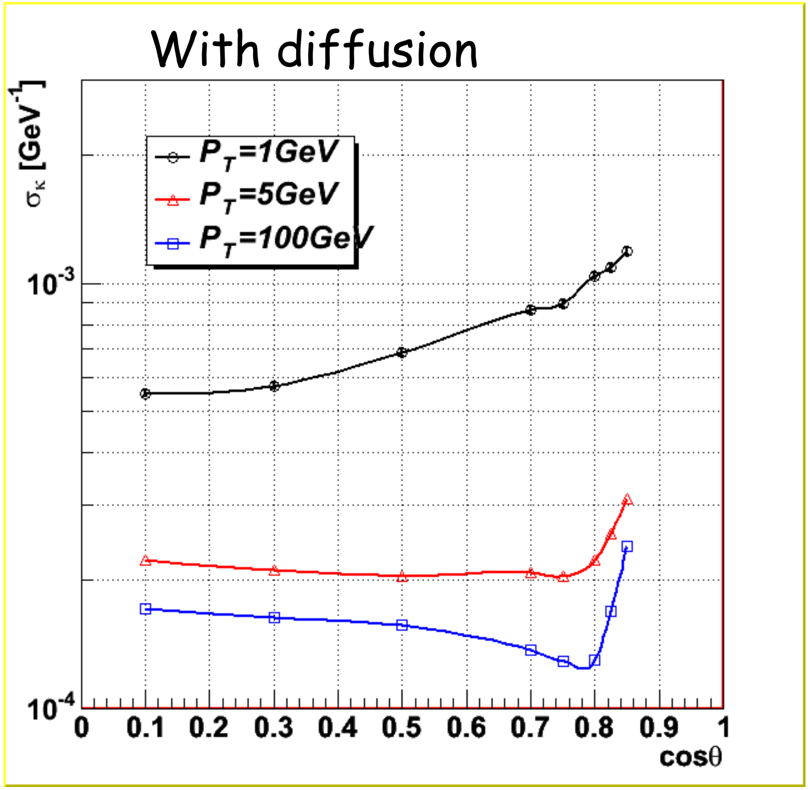


By A.Yamaguchi(Tsukuba)

Metis Status: TPC s_p/p - 2

If an effect of diffusion is included, …





$$s_{rj}(mm) = 150(const.)$$

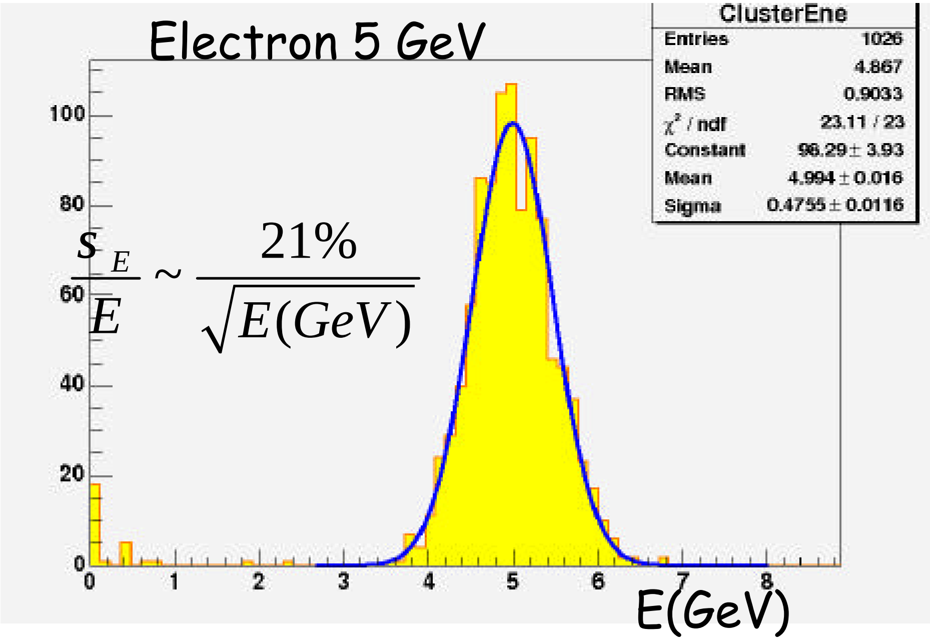
$$s_{rj}(mm) = \sqrt{80^2 + 135 \cdot Z(cm)}$$

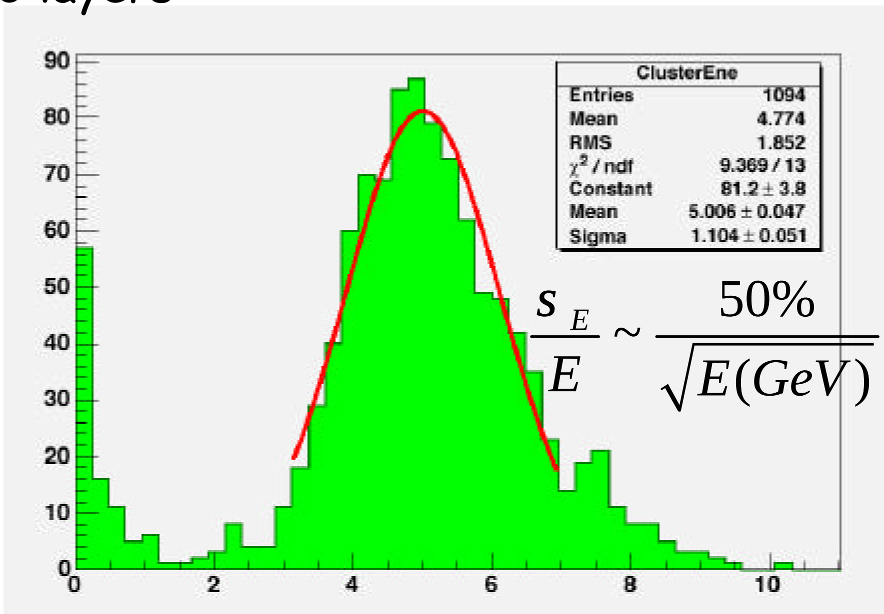
$(80 \sim 200mm$ for L=235cm)

By A.Yamaguchi(Tsukuba)

Metis : Calorimeter σ_E/E

- Energy resolution of EM/HD clusters attached to the PF objects
  - EM Cal: Pb(4mm)+Scinti(1mm): 38 layers
  - HD Cal: Pb(8mm)+Scinti(2mm): 120 layers



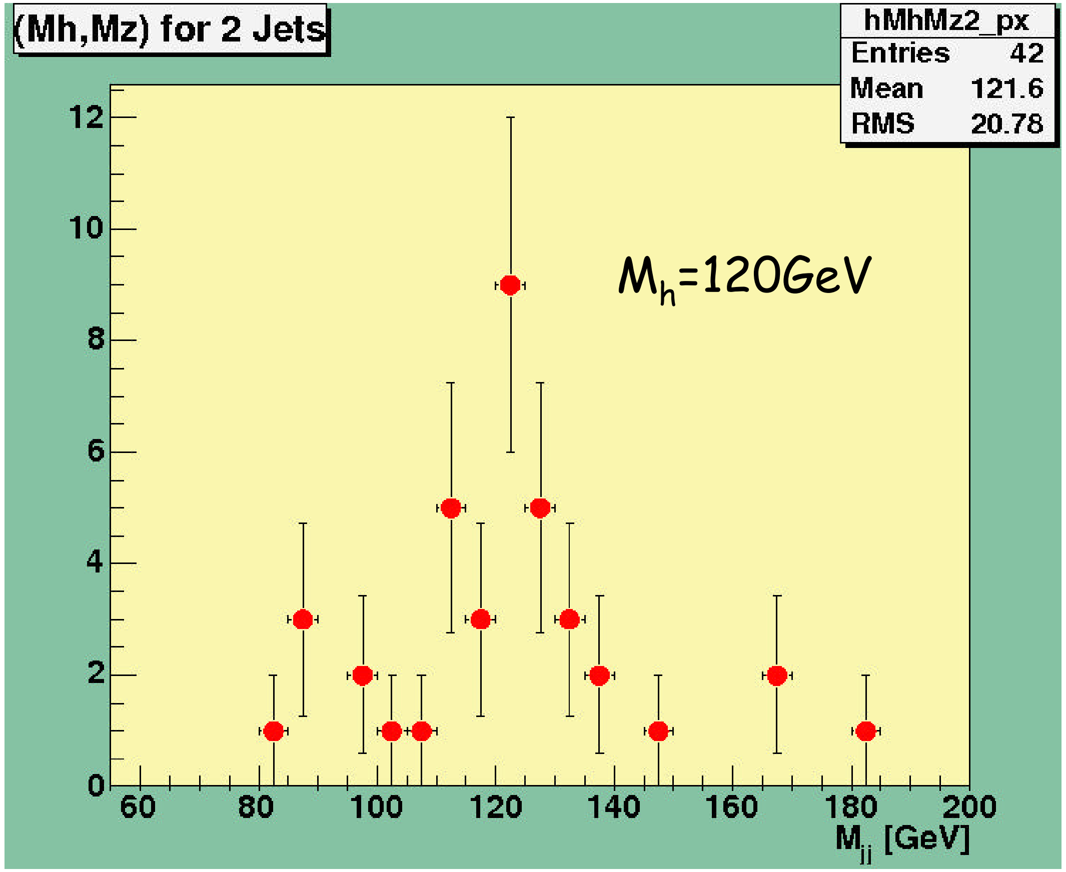


- Resolutions are worse, because the range cut is too large(1mm). New simulations are now in progress….
- Entries near E~0 GeV are probably secondary gs and neutrons. They would be removed by cuts on signal TOF … under investigation

By S.Yamamoto(GUAS)

Jet mass – first try

- Using PFOs, we clustered jets and plots Higgs mass.
- Neither event statistics nor tuning/debugging of Jupiter/Satellites are not sufficient. But we are getting close to do physics studies using these tools



By K.Fujii(KEK)

Conclusion

- GLD geometry has been implemented in to the Jupiter.

- Packages in Satellites have been enriched.
  Now it can create Particle Flow Objects based on cheated algorithm. Our hope is to know the ultimate performance of the detector based on these packages.