Performance of Realistic PFA For GLD Detector

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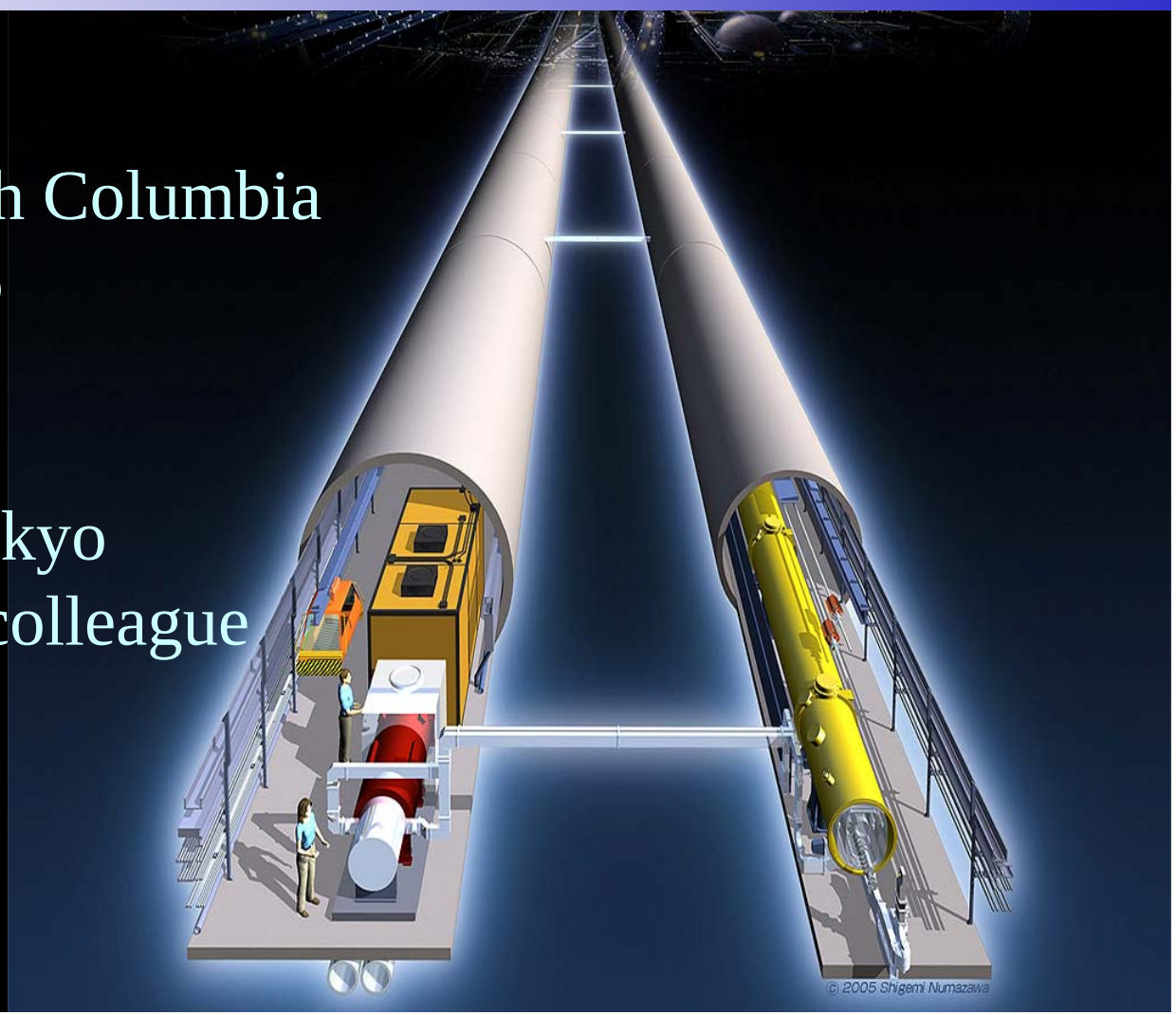
On behalf of GLD colleague



Introduction

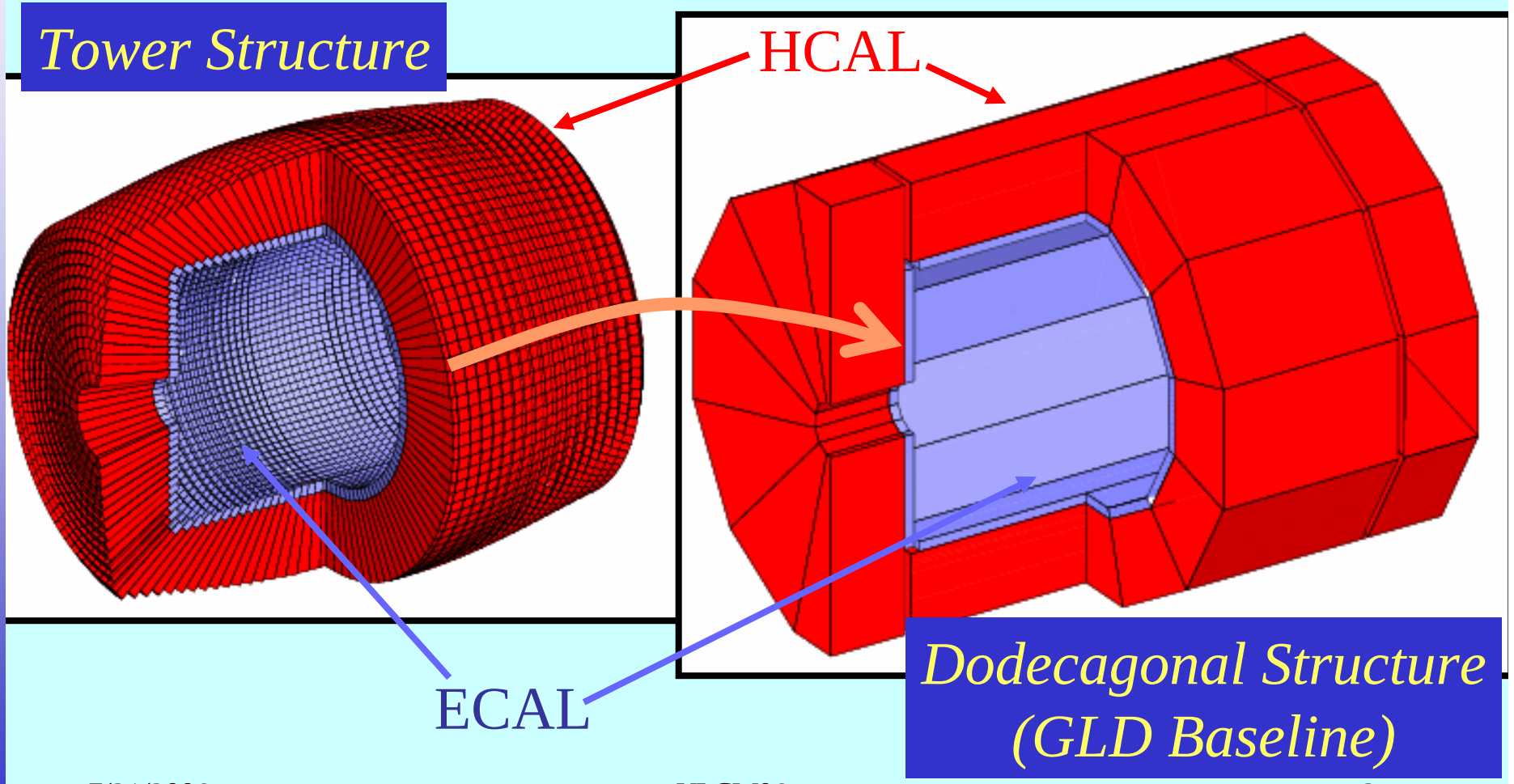
- There is a general consensus that the Particle Flow Algorithm (PFA) drives the overall ILC detector design.

- We studied the PFA for GLD detector using the Geant4-based full simulator named Jupiter.

- Changes in the Jupiter after the LCWS06
  - Geant4 : 4.7.0.p01 → 4.8.0.p01
  - ROOT : Version 4.04.02 → Version 5.10.00
  - Calorimter Geometry :
    Tower Structure (Idealistic)
    → Dodecagonal Structure (Realistic)
    (H.Ono's talk for more detail)

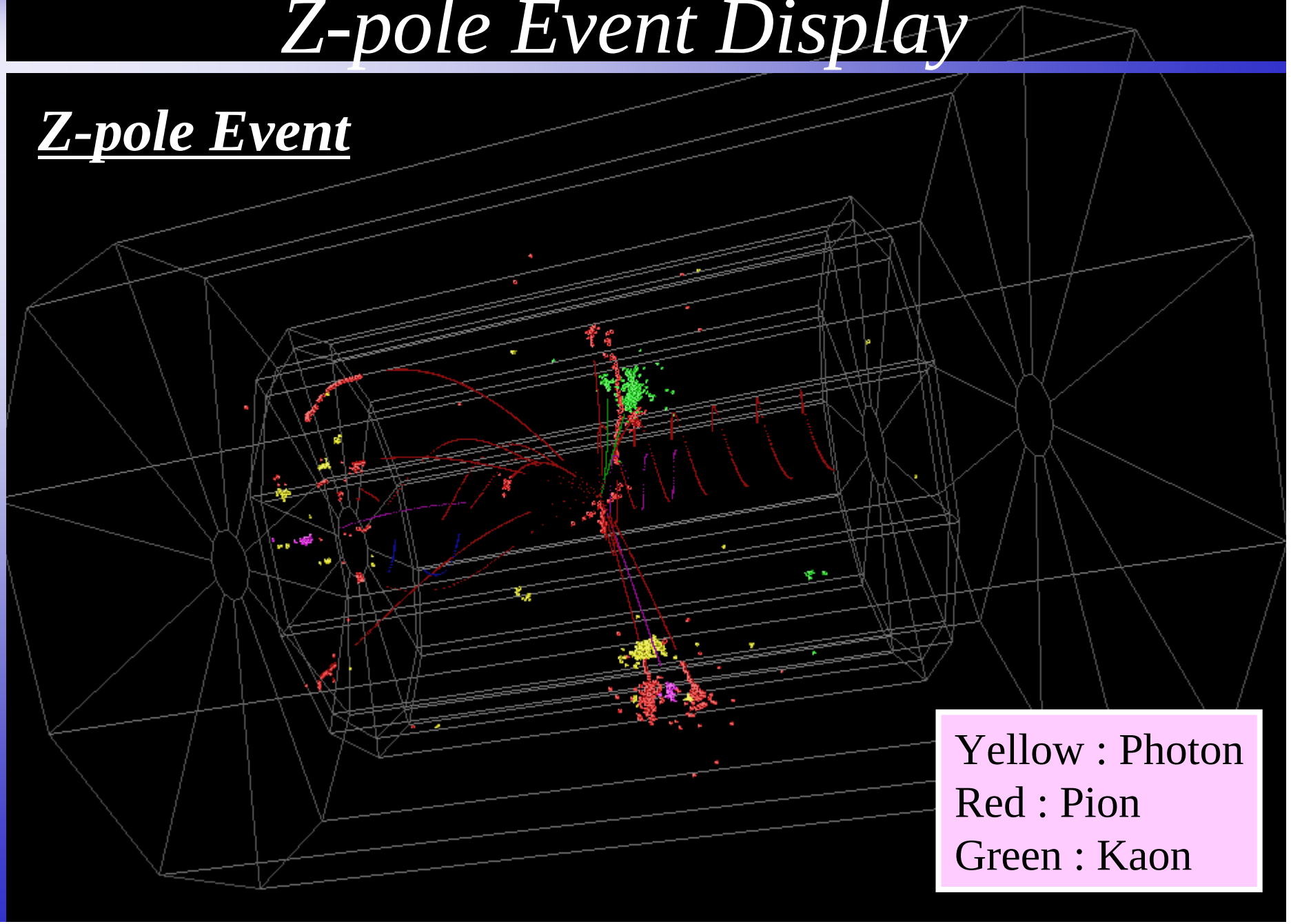
Calorimeter Geometry in Jupiter

- New calorimeter shape has been implemented to the Jupiter.

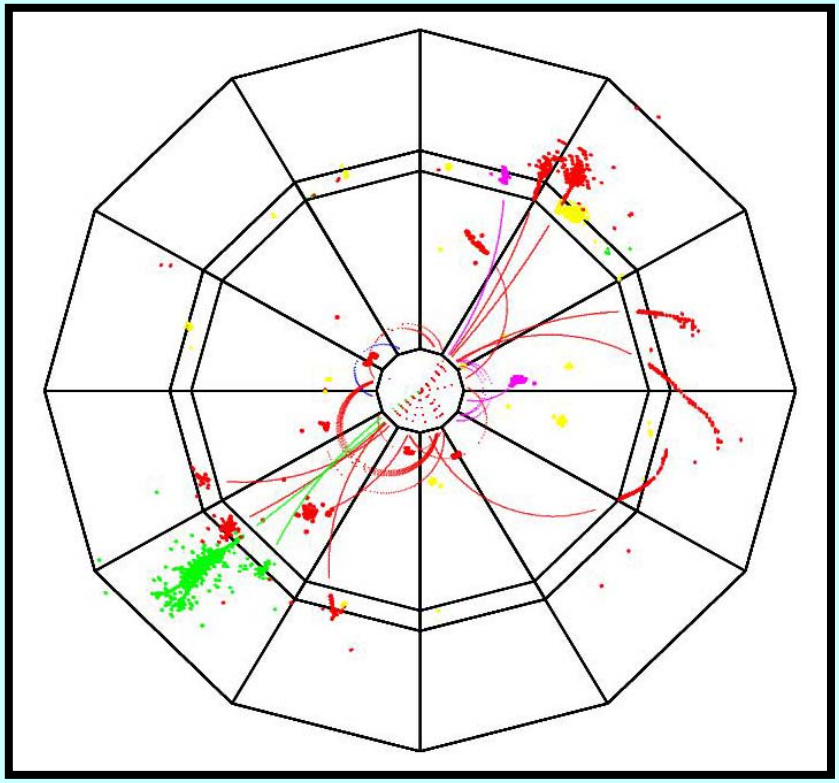


Z-pole Event Display

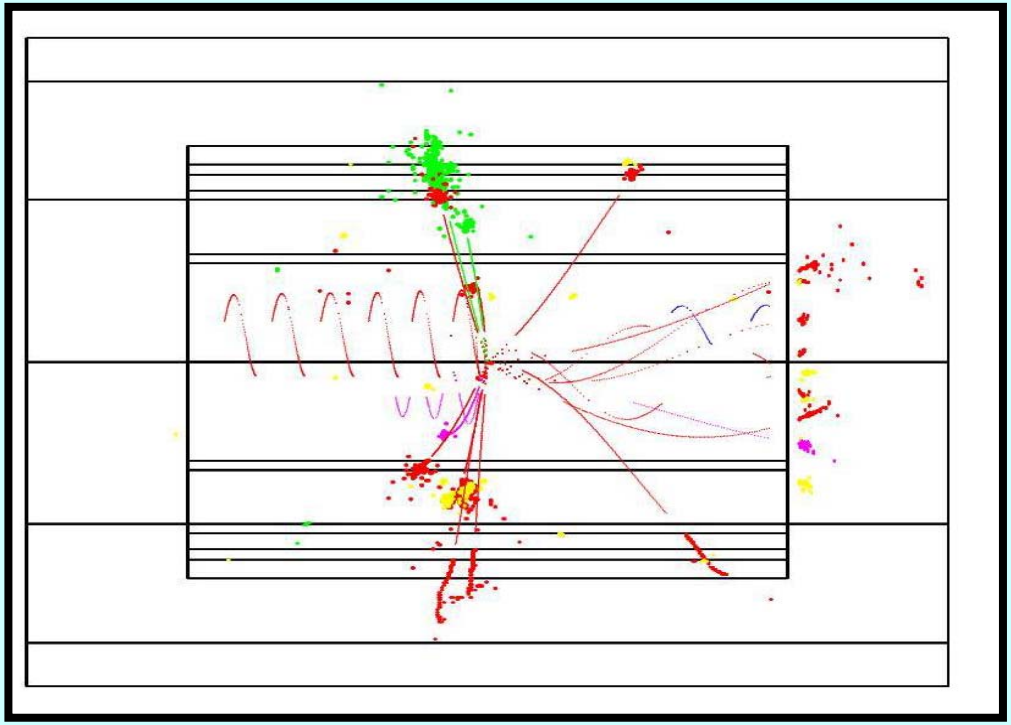
Z-pole Event



Z-pole Event Display



End View



Side View

- 2cm x 2cm tile (GLD backup solution) is used in this study.

Particle Flow Algorithm for GLD

Flow of GLD-PFA (after LCWS06)

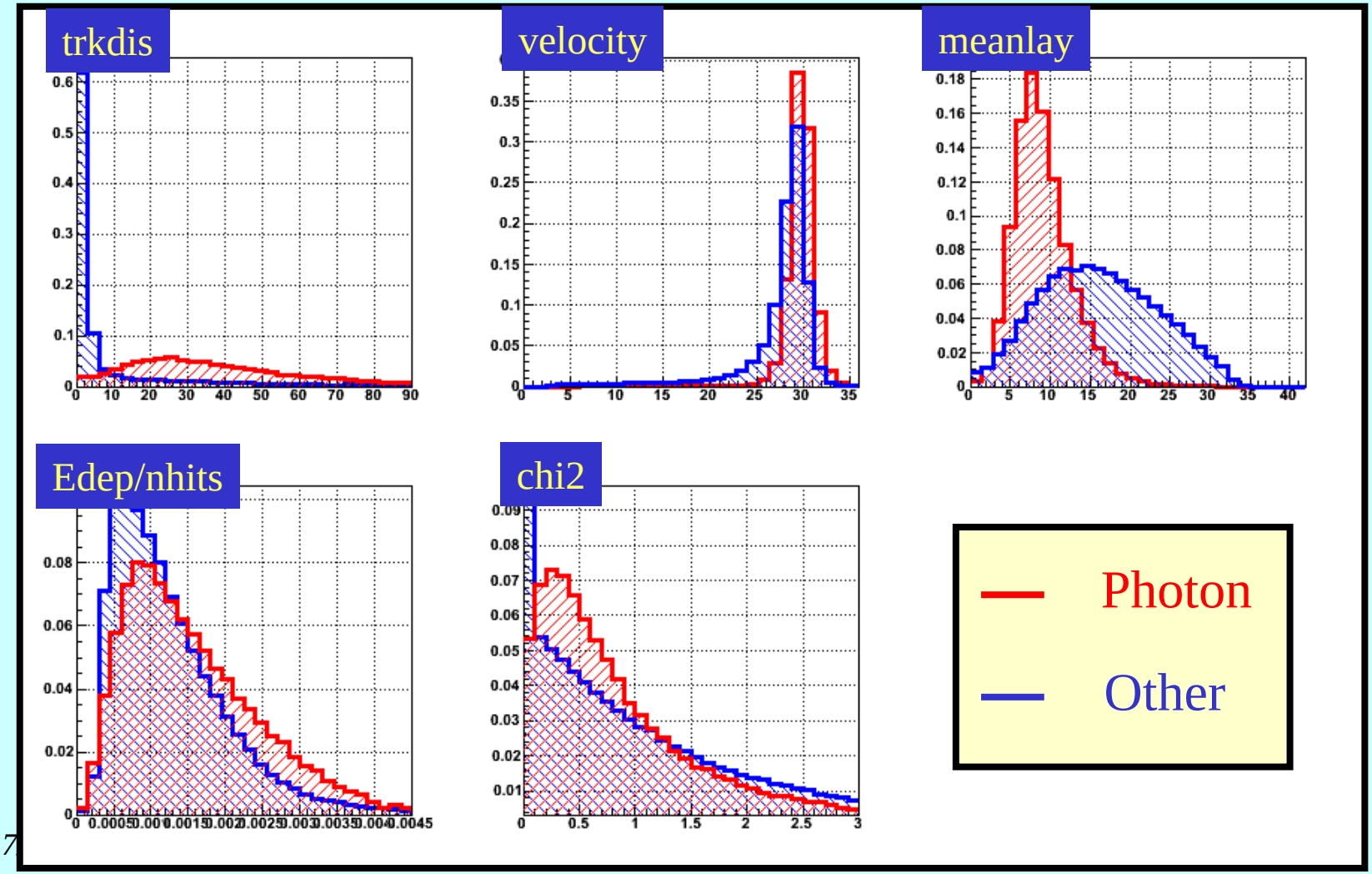
1. Photon Finding → Likelihood
2. Charged Hadron Finding
3. Neutral Hadron Finding } Likelihood
4. Satellite Hits Finding

*Satellite hits = calorimeter hit cell which is not belong a cluster core

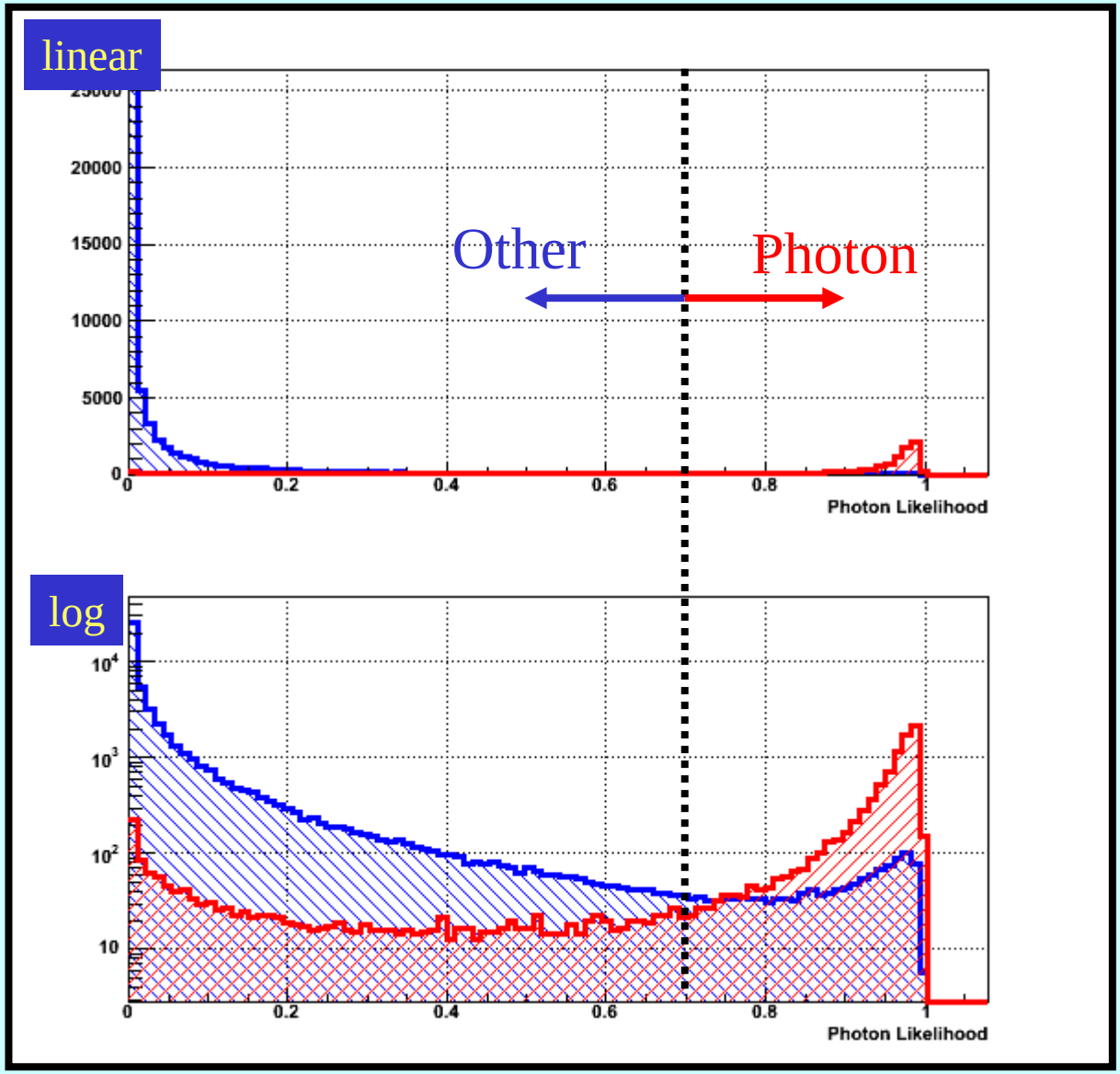
Note : Monte-Carlo truth information is used for the muon and neutrino.

Photon Likelihood (Input)

- Five variables are selected to form the photon likelihood function.



Photon Likelihood (Output)



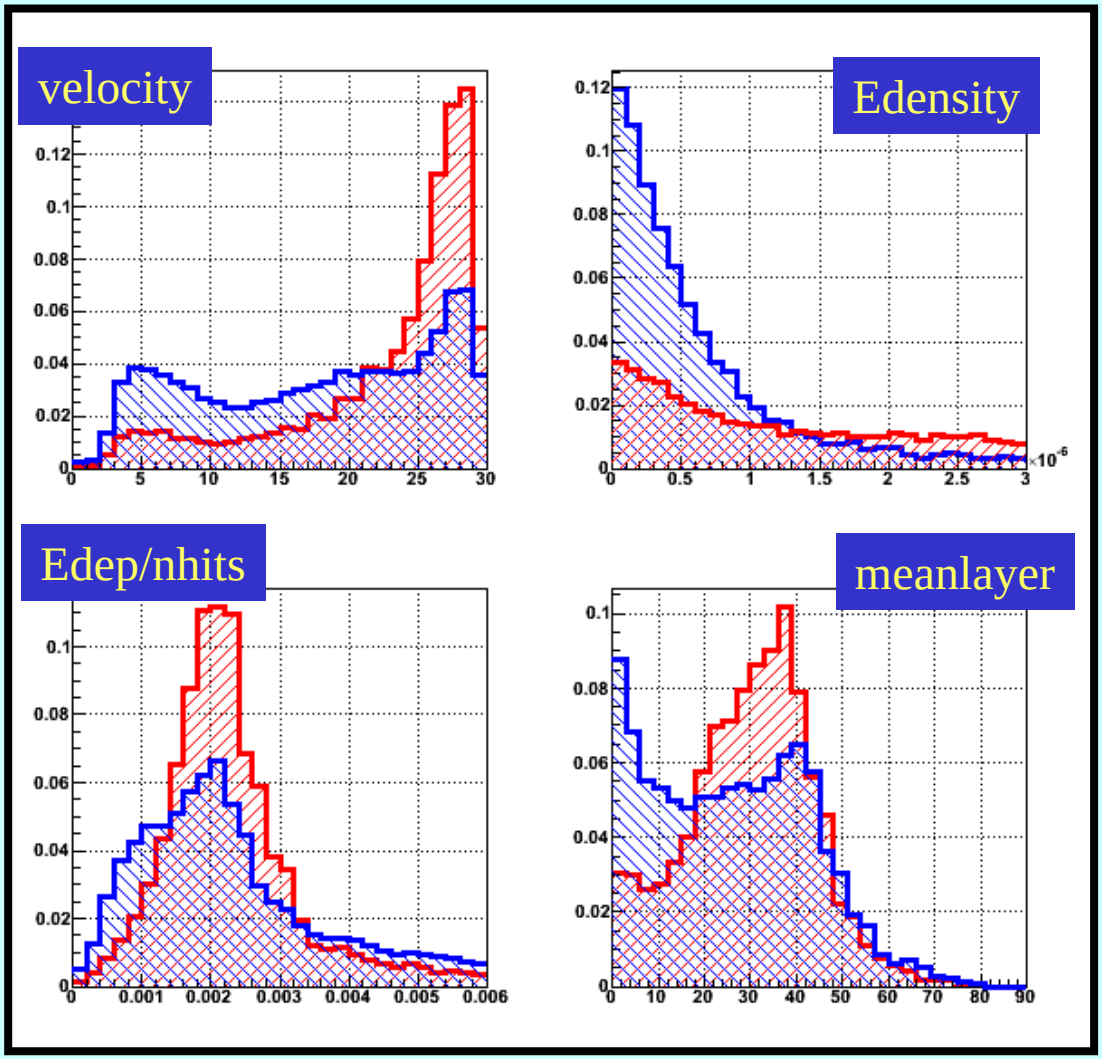
- Cut position is set to be 0.7.

Photon

Other

Neutral Hadron Likelihood (Input)

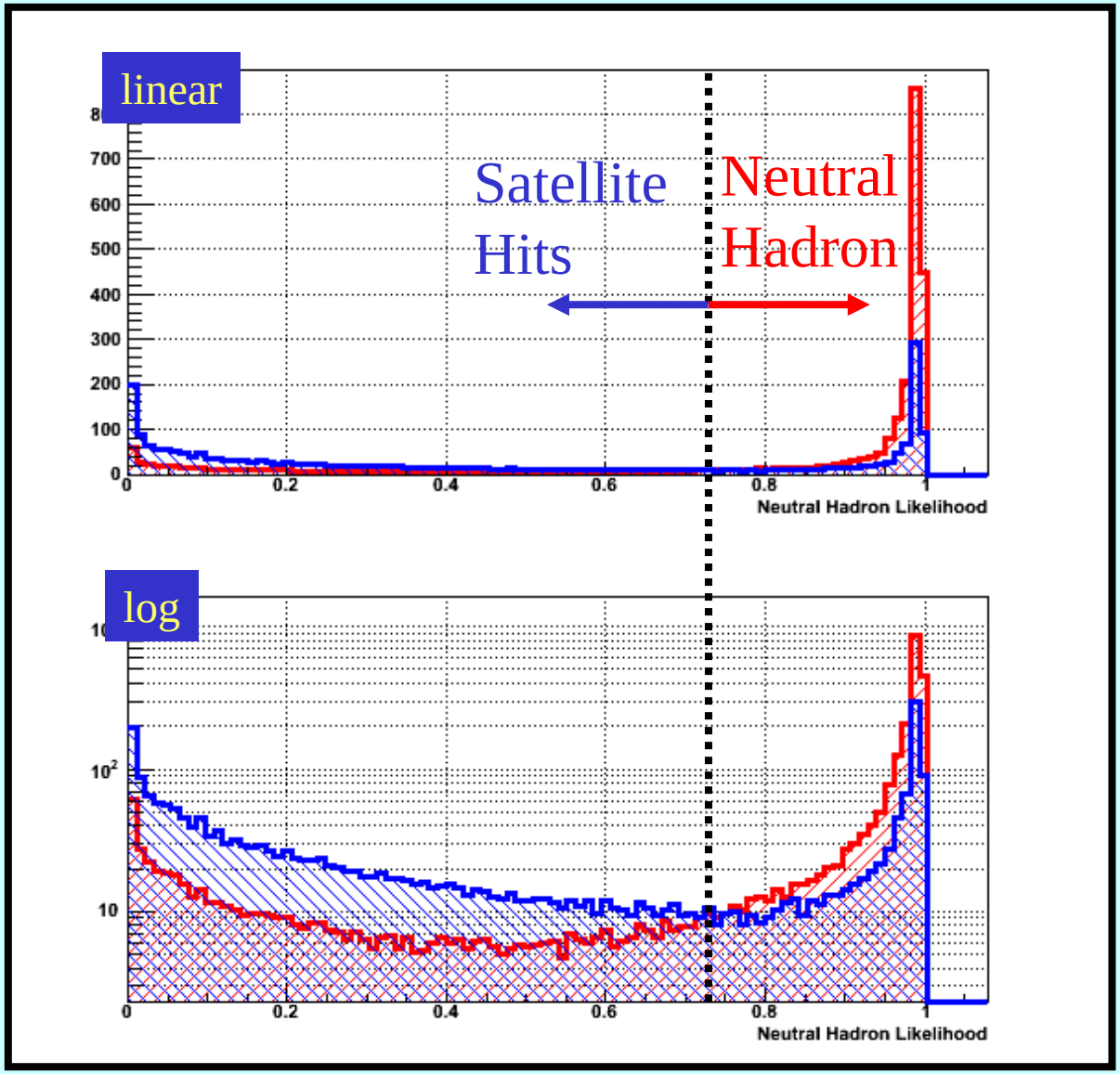
- Four variables are selected to form the NHD likelihood function.



Neutral Hadron

Satellite Hits

Neutral Hadron Likelihood (Output)



- Cut position is set to be 0.73.

— Neutral Hadron

— Satellite Hits

Performance

- Energy-weighted Efficiency and Purity

cluster type	ε photon	ε chd	ε nhd	Pphoton	Pchd	Pnhd
Photon	93.6	1.88	18.5	87.21	3.57	7.53
CHD	2.44	85.8	12.8	1.31	93.8	3
NHD	1.07	3.6	52.8	3.28	22.7	70.7
Satellite	2.86	8.74	15.8	10.20	63.9	24.8

Definition

Efficiency : εxxx ≡ (total xx E in collected hits)/(true xxx total E in CAL)

Purity : Pxxx ≡ (total xxx E in a cluster)/(total E in a cluster)

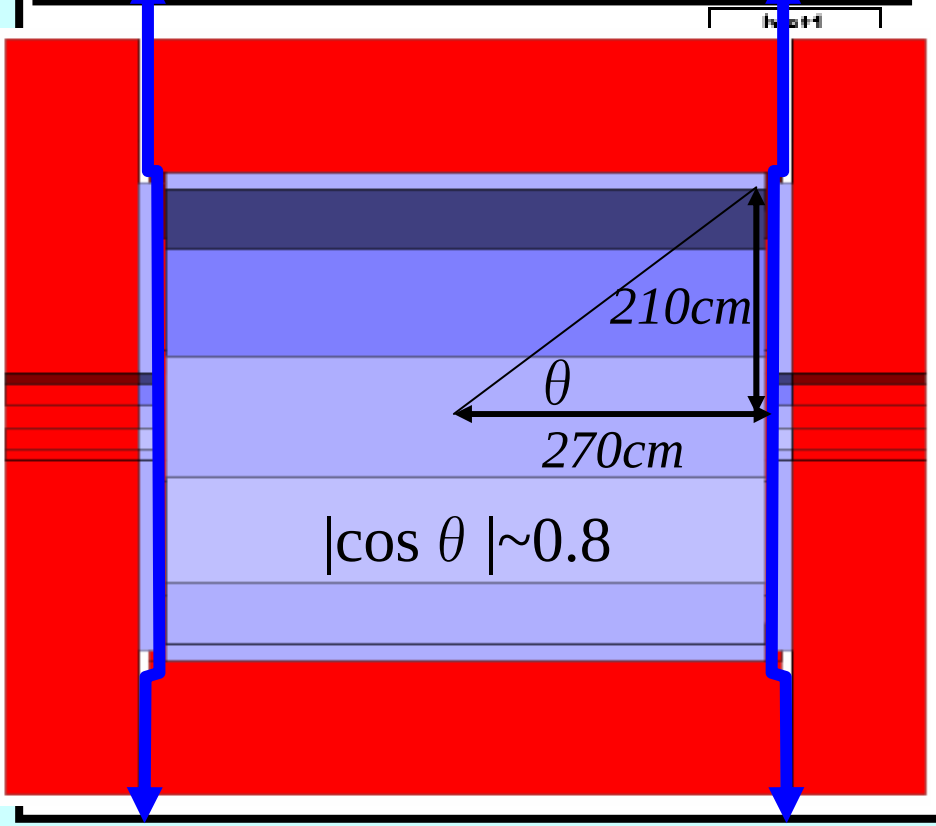
xxx = Photon, CHD, NHD, Satellite

both ε and P values are energy-weighted

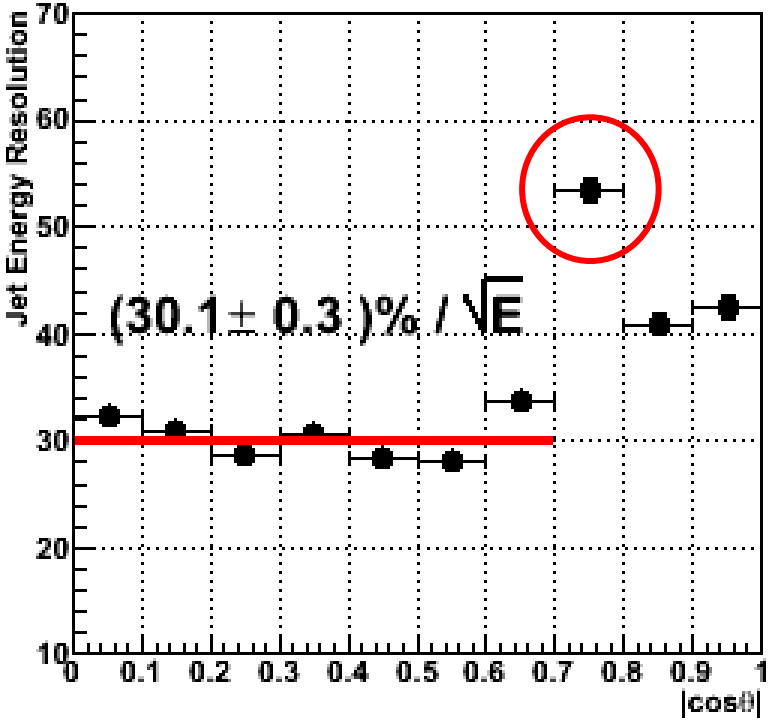
Performance

10 cm Gap for read out line

rimeter geometry, 2cm x 2cm tile



Side View



- In ba LC goal of 30% has been achieved.
- Performance in 0.7<|cos θ |<0.8 is too bad. Now under study

Summary & Future

- Dodecagonal shape calorimeter (GLD baseline) has been implemented to the Jupiter.

- Likelihood function for gamma finding and neutral hadron finding have been implemented .

- The GLD-PFA performance was checked with 2cm x 2cm tile (not strip structure). For Z-pole event, ILC goal of 30% has been achieved in barrel region.

- Things To Do
  - Study gap between Barrel and Endcap region.
  - Improve performance in Endcap region.
  - Try higher energy.