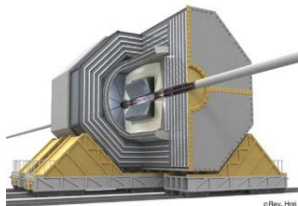# Review of Jupiter and Friends
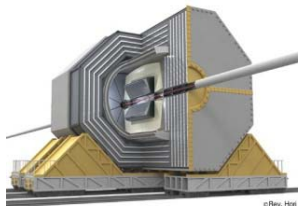
Akiya Miyamoto

15 January 2008

First ILD Workshop

Jupiter and friends

JSF Framework

Event Generator
- Pythia
- CAIN
- StdHep

Detector Simulator
- QuickSim
- FullSim

JUPITER

Event Reconstruction
- Digitizer
- Finder
- Fitter

Physics Analysis
- Jet finder

Satellites

Beamtest Analysis

ROOT objects : Event Tree & Configuration

➢ 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/

Jupiter

- Using Geant4.9.0p01
- Physics List: J4PhysicsList → LCPhysicsList is a default
- Generator inputs:
    - ROOT (JSF) format is a default. Can read CAIN background data.
    - StdHep interface:
        - Prepared as a JSF module
        - Updated to StdHep 5.06.01, compatible with SLAC samples.
- Geometry:
    - Parameters in ASCII file are read in at run time
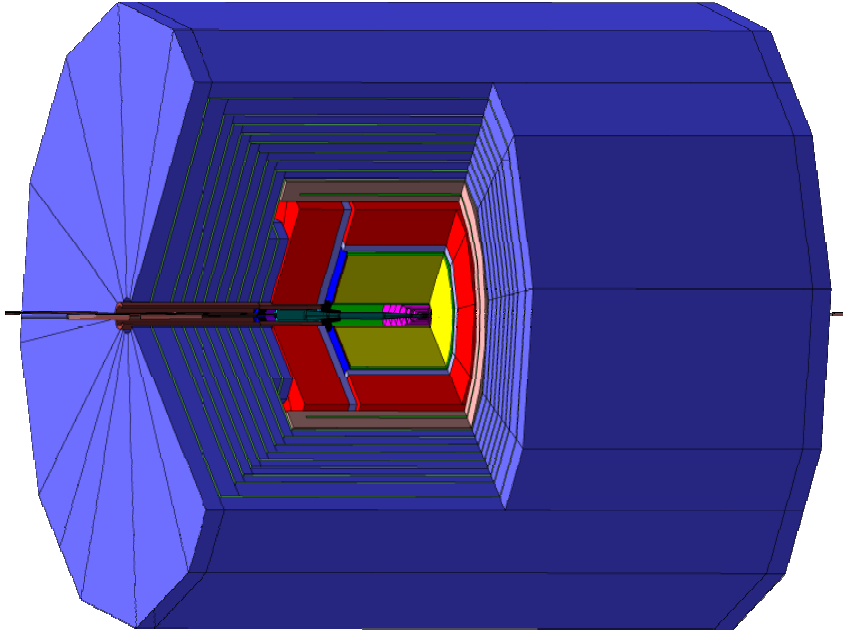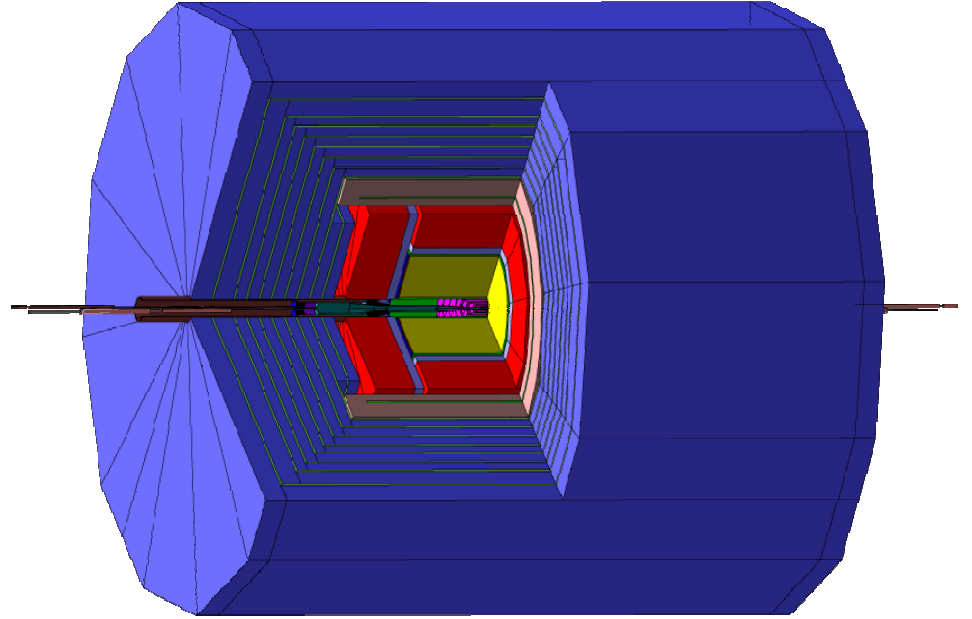   - New geometry files are prepared: GLD, GLDPrim, J4LDC

Detector Parameters

		GLD	GLDPrim	J4LDC	LDCPrim	LDC
BeamPipe	Material	0.025cm[†] Be			0.05cm[†] Be	
	Rin(cm)	1.5			1.7	1.4
Vertex Detector	# layes	6			5	
	Thickness	0.0042 r.l.			0.01 r.l.	
	Radius	2.0 to 5.0	1.8 to 4.8	1.6 to 4.6	1.8 to ?	1.6 to ?
IT Barrel	# Layers	4			2	
	Radius	9. to 30.	9. to 30.	9. to 29.	16 . to 30.	
IT Endcap	# Layers	7			7	
	Z Range	15.5 to 101.5			22 to 190	
TPC (sens. vol.)	Rmin	43.715	43	34	37.1	37.1
	Rmax	197.765	174	152	173.6	151.6
	Zmax	255	230	211	212	205.8
	# R sample	200	170	150	227	190
	dP/P (TPC) [*)]	1.0E-04	1.29E-4	1.47E-4	1.02E-4	1.39E-4

*) scaled by dP/P ~ $1/(BL^2)*SQRT(1/N)$, L=Lever Arm
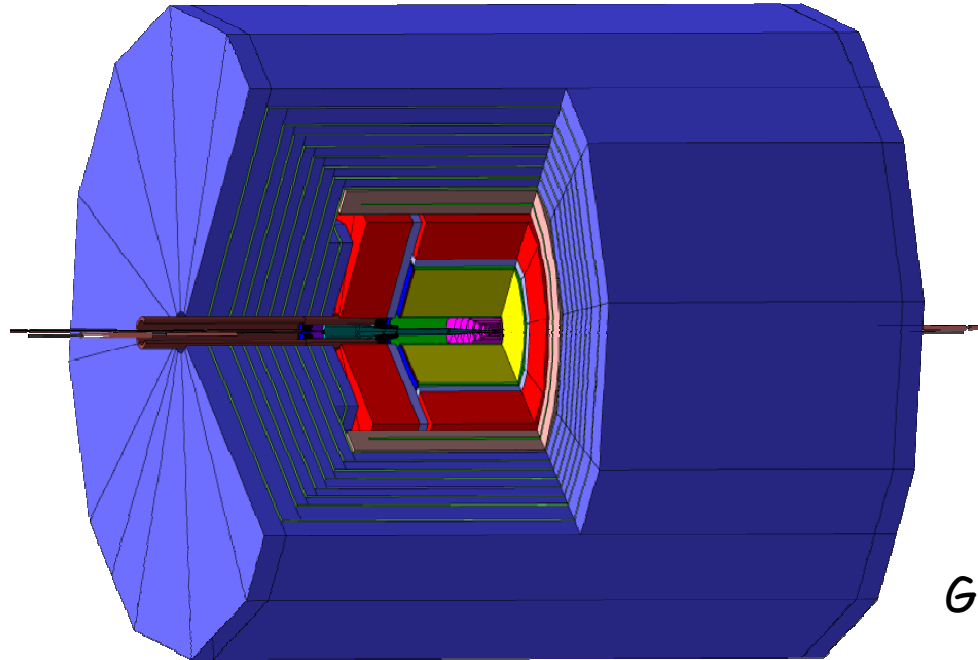B dependence of diffusion is not considered

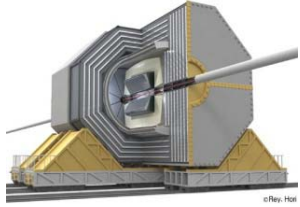|		GLD	GLDPrim	J4LDC	GLDc	LDCPrim	LDC
CAL	Rmin(ECAL)	210	185	160	185	182.4	160
	N layers(ECAL)	33	33	33		29	29
	Radiation Length	28.4	28.4	28.4		22.87	22.87
	N layers(HCAL)	46	41	37		48	48
	Nucl.Int.Length (ECAL+HCAL)	6.895	6.267	5.764		6.86	6.86
	Rmax(HCAL)	349.4	311.4	276	315	335.9	313.4
	BR^2(Tm^2)	13.23	11.98	10.24	12.0	11.64	10.24
	ECAL FrontZ	280	245	220	240	245	238.8
Coil	R-coil	400	360	325	360	373.4	350.9
	Coil Length	430	395	370	360	385	378.8
	B	3	3.5	4	3.5	3.5	4
	Stored Energy(J)	1.6	1.6	1.6	1.7	1.7	1.9?
MUD	Barrel Rin	450	410	385	410	445.9	423.4
	Barrel Rout	765	690	665	690	645.9	623.4
	Endcap LargestZ	800	690	665	690	610.0	603.8

GLD

J4LDC

GLDPrim

Generators

- **Pythia**
  - ◆ $e^+e^- \rightarrow ZH \rightarrow eeH$ & $\mu\mu H$ @ Mh=120GeV, Ecm=250 GeV
  - ◆ $e^+e^- \rightarrow ZZ \rightarrow eeqq$ & $\mu\mu qq$ @ Mh=120GeV, Ecm=250 GeV
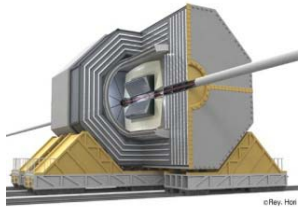 - ◆ Including BSGEN

    → Takubo's talk

- **Physsim (based on Helas)**
  - ◆ Including BSGEN
  - ◆ SUSY parameters: Could not reproduce ISAJET values shown in the benchmark panel report.
  - → Adjust $M_{1/2}$ to get similar chargino mass.

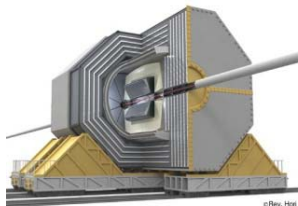 → We should use common generator files for performance comparison
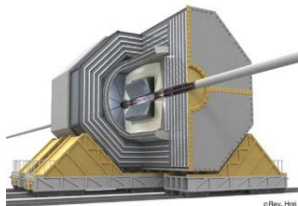
    → Yoshioka's talk

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

Satellites package

- Satellites is a collection of reconstruction tools for Jupiter data.

- Run as a JSF module, i.e,
    - Jupiter data and reconstructed results are saved in a ROOT tree.
    - Each module is relatively independent, thus easy to implement different reconstruction algorithm according to user interests

- Package includes
    - IO: Geant4 objects to ROOT objects/ Interface to LCIO (Output) →Yoshioka
    - Hit digitizer: Mostly simple smearing of exact hits
        CAL hit maker : include a cell signal merger for strip configuration
        Run Jupiter with 1cmx1cm tile size and merge cell signals in Satellites
    - Cheated track finder and Kalman fitter for TPC, IT, and Vertex
    - Cheated PFA
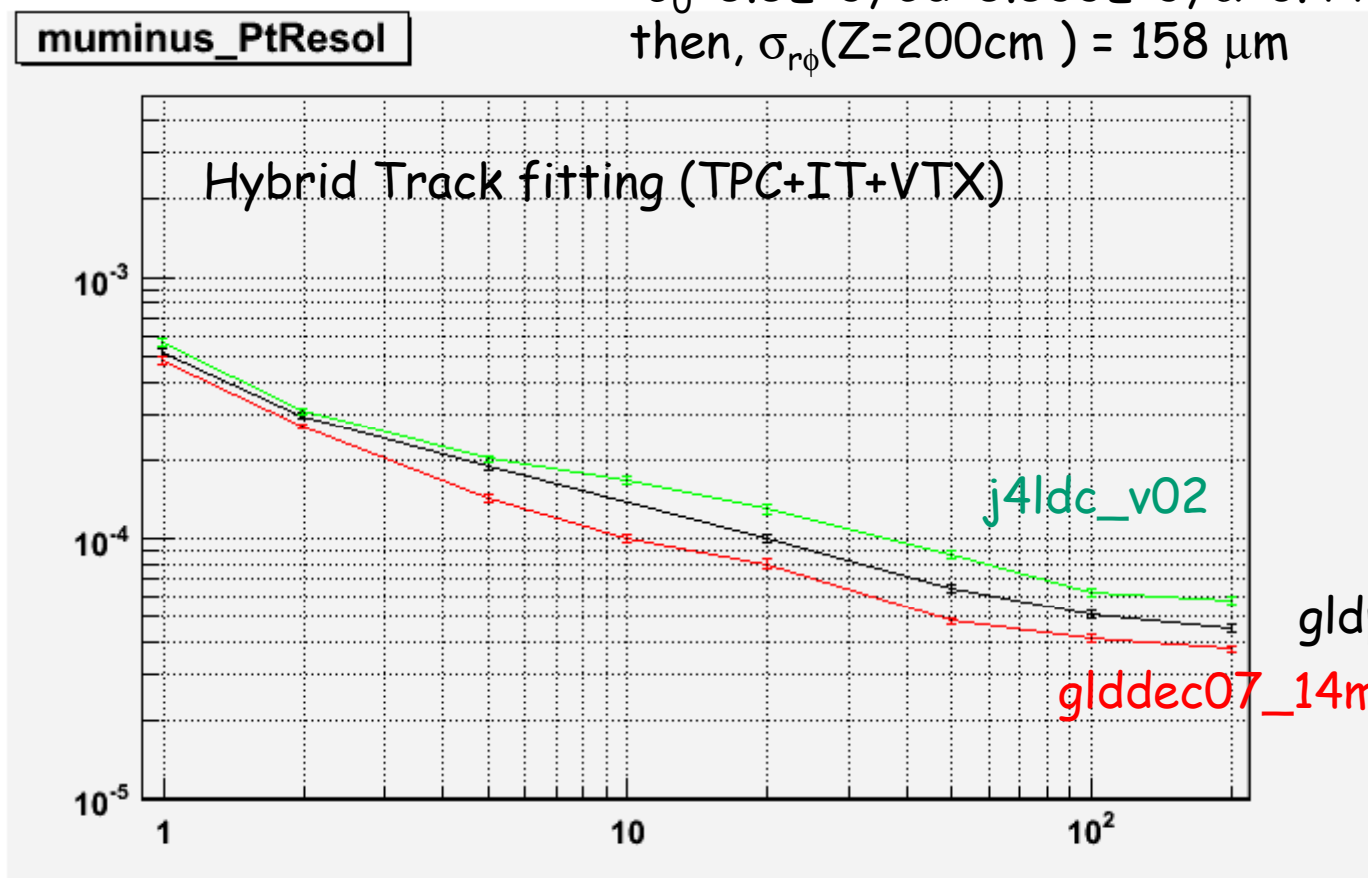   - Realist PFA (GLD-PFA)
    - Jet clustering

Momentum Resolution

Muons are generated at θ=90° from (0,0,2cm)

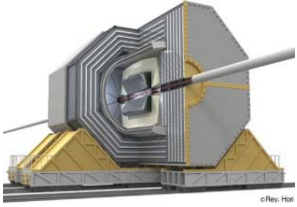TPC Resolution: $\sigma_{r\phi}$=150μm(const.), σ_z=400μm

$$c.f.\ \sigma_{r\phi} = \sqrt{\sigma_0^2 + \frac{C_d^2}{\alpha N_e} Z_{drift}}$$

➔ if parameters for P10 at 3 Tesla are used, σ_0=5.5E-3, Cd=5.533E-3, α=0.4444, Ne=63, then, $\sigma_{r\phi}$(Z=200cm) = 158 μm
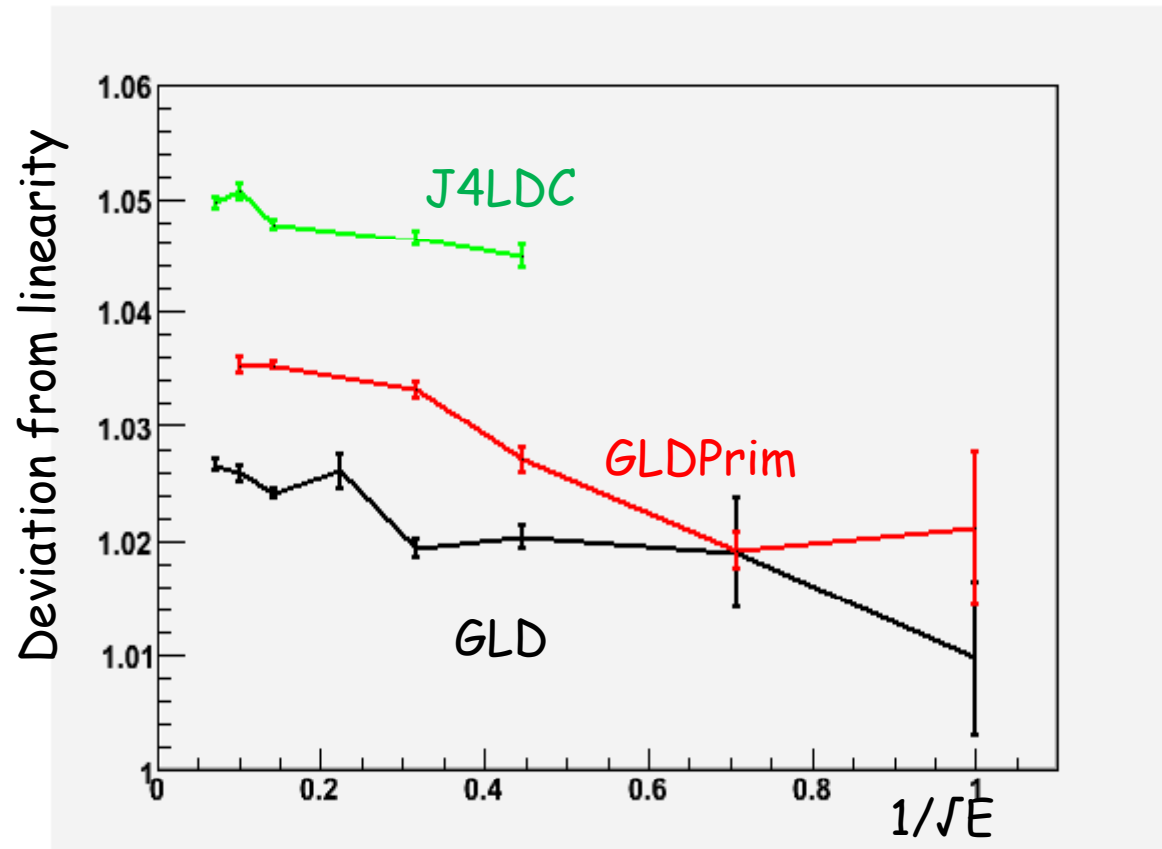
muminus_PtResol

Hybrid Track fitting (TPC+IT+VTX)
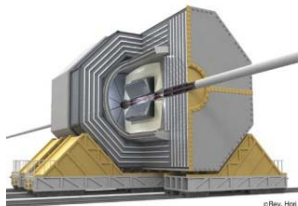
j4ldc_v02

gldprim_v02

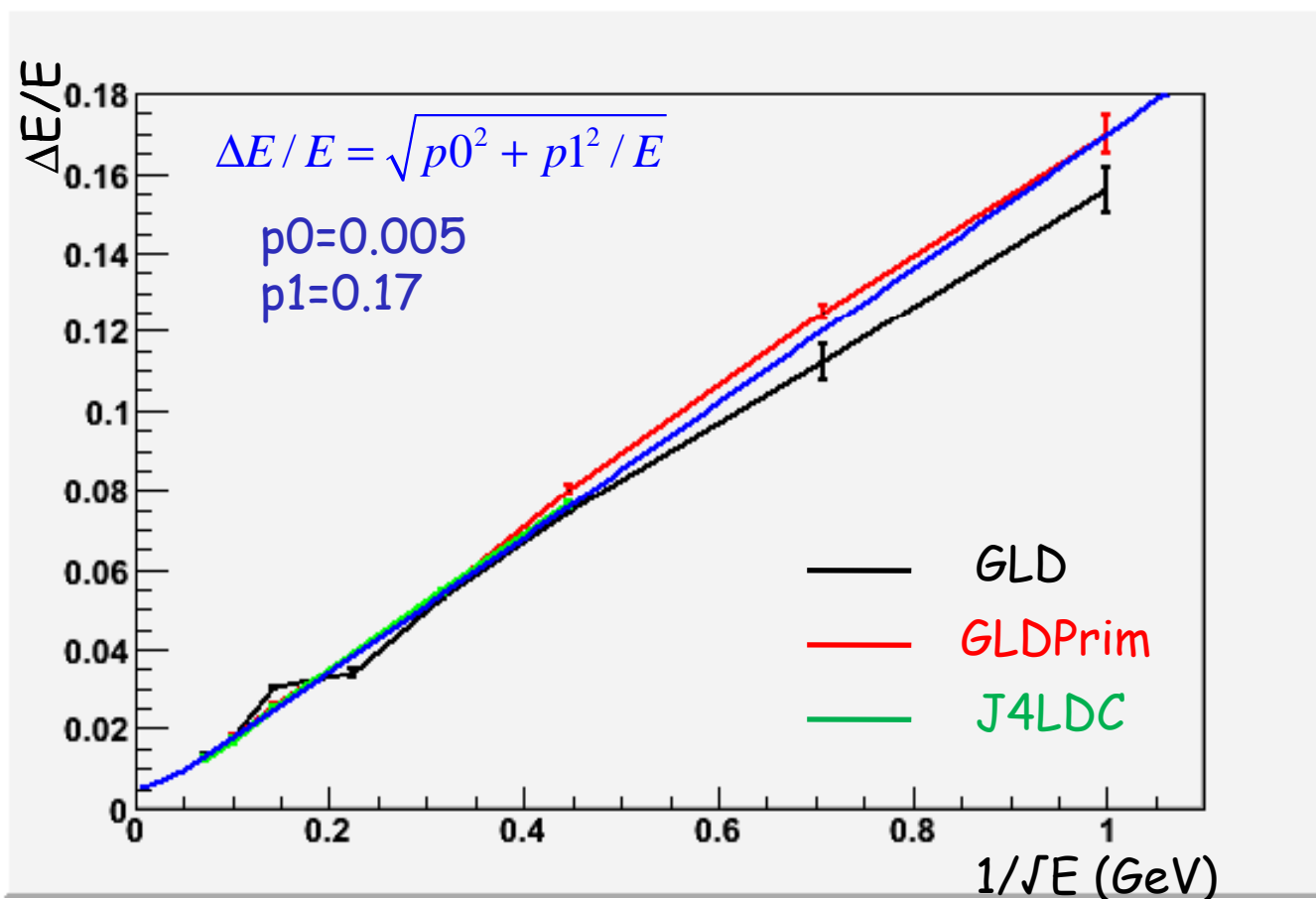glddec07_14m

Gamma : Linearity

- γ was generated from IP, uniformly in $\cos\theta$ and ϕ
- Analyzed by Satellites, using cheated PFA.
- Linearity and resolution were studied.

- Calibration constant:
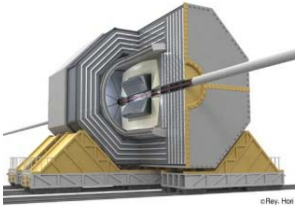 - ✓ No E dep.
  - ✓ Same for all geometry

Gamma Resolution

$$\Delta E / E = \sqrt{p0^2 + p1^2 / E}$$

p0=0.005
p1=0.17

GLD
GLDPrim
J4LDC

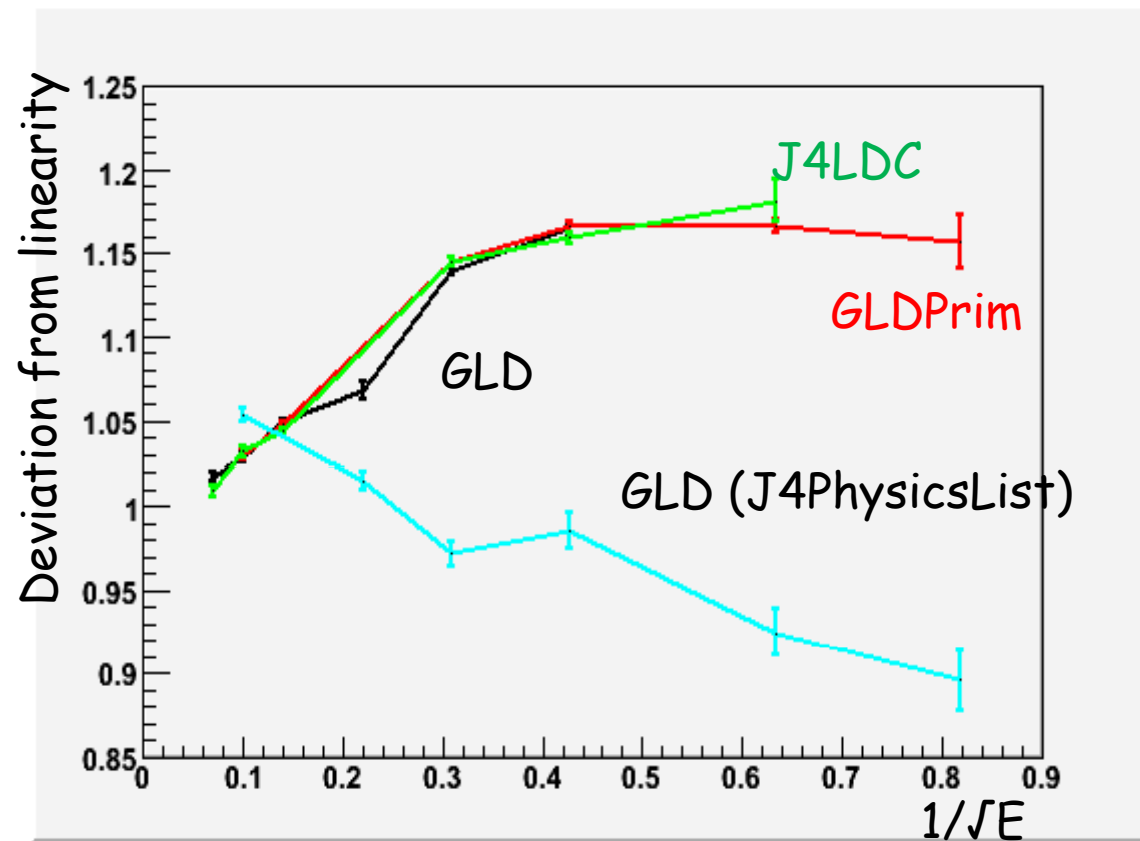$1/\sqrt{E}$ (GeV)

DE/E ~ 17%
GLD/GLDPrim/J4LDC are consistent.
Small difference in low energy region is statistics or material effects ?

KOL : Linearity

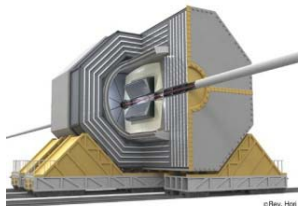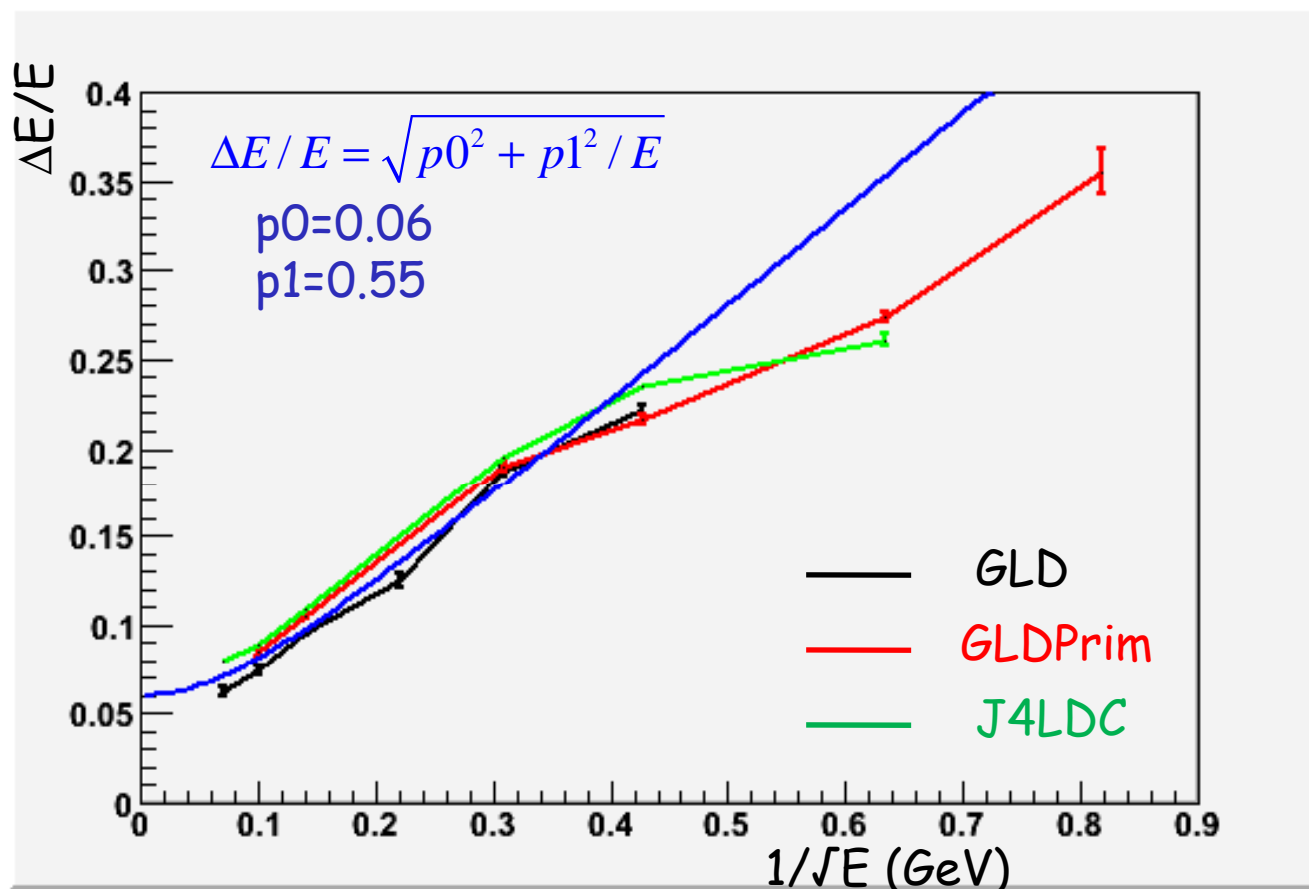■ Study similar to gamma

✓Energy dependance
different from the
previous PhysicsList

KOL resolution

$$\Delta E / E = \sqrt{p0^2 + p1^2 / E}$$

p0=0.06
p1=0.55

GLD
GLDPrim
J4LDC

$\Delta E / E$

$1/\sqrt{E}$ (GeV)

May be a problem in new geometry ?
May need more statistics ?
Energy Resolution (by eye-fitting): $\Delta E/E \sim 55\%$

BACKUP SLIDES

GLDPrim