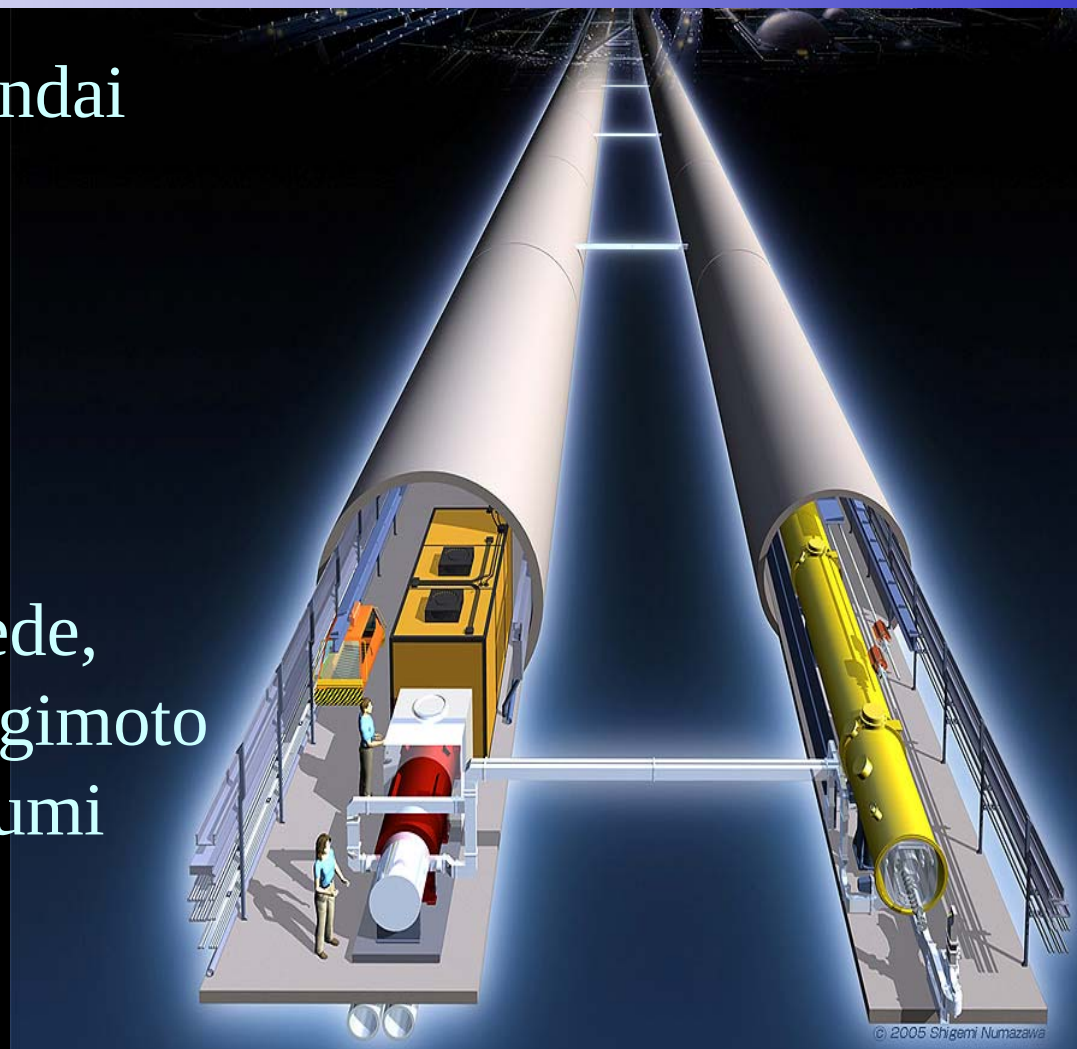
Optimization WG Status Report

ILD Meeting @ Sendai
Mar 5th, 2008

Tamaki Yoshioka

Thanks to:
M.Thomson, F.Gaede,
A.Miyamoto, Y.Sugimoto
D.Jeans and S.Uozumi



Introduction

- An e-mail by Hitoshi on Feb 13th

• As you know, the GDE timeline has been revised in response to the budget cuts in the US and UK. The word EDR is now gone, and there are two phases: Technical Design Phase 1 until 2010 and Technical Design Phase 2 until 2012. The purpose of this note is to inform you of what is going on the detector side, and ask for your inputs.

• The detector timeline should in some way synchronize with the accelerator timeline. At the ILCSC meeting in DESY, the research director has just presented a proposal for the detector timeline also to have two phases synchronized with GDE; namely, detector design phase 1 and 2.

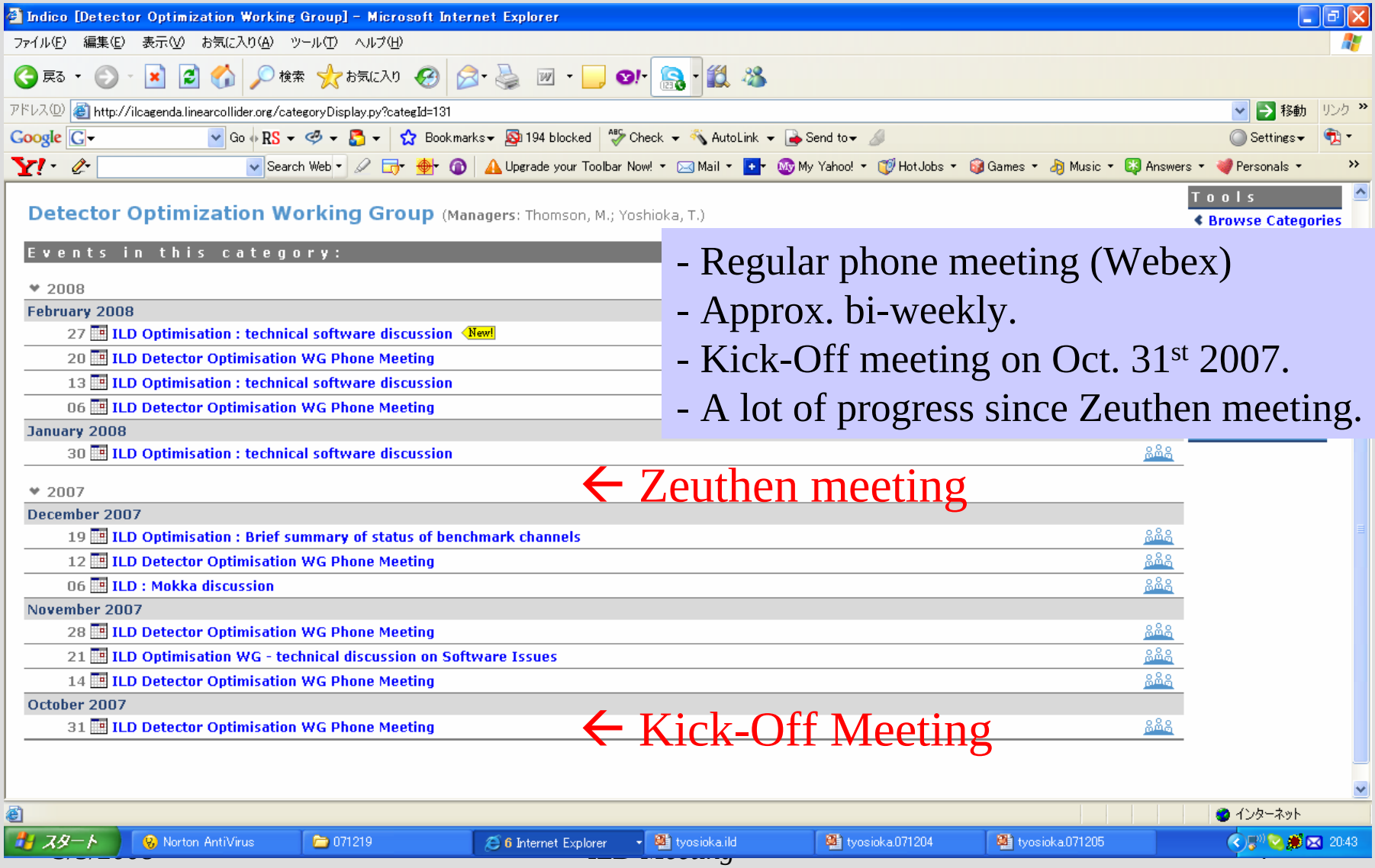
• Phase 1 would include the LOI process, but the deadline would be delayed by 6 months. Also, ILCSC has requested that the IDAG would 'validate' the LOIs rather than 'select two'. Namely, the number of LOIs to survive the process is not specified and considerable flexibility is left.

Charge of Optimization WG

- Charge of Detector Optimization Working Group
  - Investigate the dependence of the physics performance of the ILD detector on basic parameters such as TPC radius and B-field. On the basis of these studies and the understanding of any differences observed the WG will make recommendations for the optimal choice of parameters for the ILD detector.

- Initial Goal
  - First results from detector optimization studies by Summer 2008.
  - At this time, define baseline ILD detector parameters at the level needed to start writing the LoI.

Optimization WG Meeting



- Regular phone meeting (Webex)
- Approx. bi-weekly.
- Kick-Off meeting on Oct. 31st 2007.
- A lot of progress since Zeuthen meeting.

Basic Strategy

- Parameterize physics performance for "benchmark processes" as a function of detector parameters with full simulation at mesh points.

- Without trying to unify the software tools, share mesh points between GLD and LDC groups.

- Start from GLD and LDC and meet at GLD' = LDC' to test the consistency.

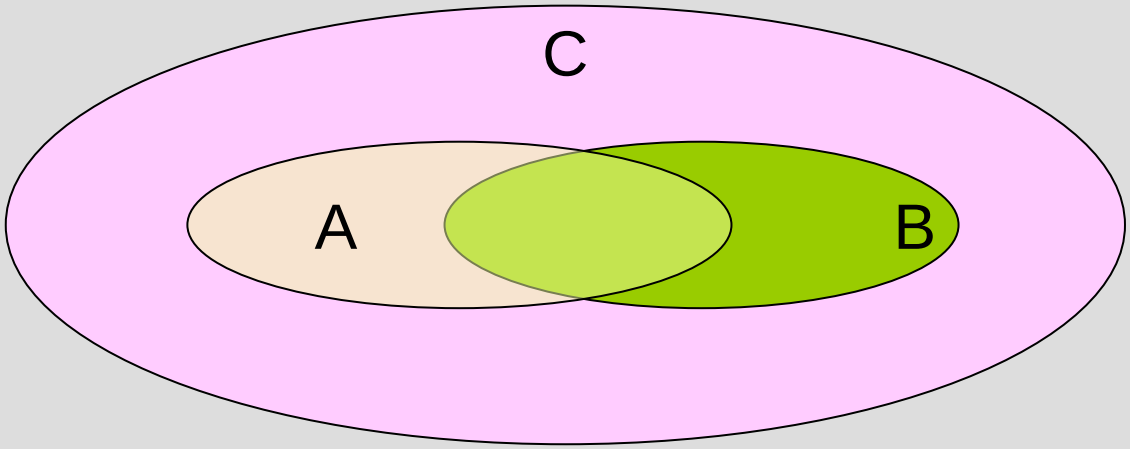
- After parameterization, add cost term also parameterized as a function of detector parameters with an appropriate weight.

Benchmark Processes

A) Benchmark processes for ILD optimization.

B) Reference processes which will be given by RD/IDAG.
= Benchmark processes common to all LOIs.

C) Benchmark processes for demonstration of ILD performance
= Benchmark processes to be described in the ILD LOI.



B) Common Benchmark Processes

- "Guideline for the definition of a Letter of Intent" – 3 Oct. 2007

….. The evaluation of the detector performance should be based on physics benchmarks, some of which will be the same for all LOIs based upon an agreed upon list and some which may be chosen to emphasize the particular strengths of the proposed detector. …..
→ http://physics.uoregon.edu/~lc/wwstudy/lois/LOIguidelines.pdf

- WWS Roadmap Panel is discussing "agreed upon list" with a help of WWS Software panel.

- IDAG will define a list.

Committees

- WWS Roadmap Panel

S.Yamada	:RD
F.Richard (Chair), J.Brau, H.Yamamoto	:WWS co-chair
M.Thomson, Y.Sugimoto	:ILD
T.Barklow, J.Jaros	:SiD
G.P.Yeh, J.Hauptman	:4 th
C.Damerelle	:R&D panel

- Software Panel

T. Benke
A. Miyamoto
N.Graf

- Phone meeting in December 2007 was held among RM and Software panel. At the meeting, the software panel was requested to define observables for agreed upon processes.

Signal Samples

Processes ($e^+e^-\rightarrow$)	**$\sqrt{S}$ (GeV)**	**Observables**	**Comments**
ZH, ZH$\rightarrow e^+e^-X$,	250	σ, m_H	m_H=120GeV, test materials and γ_{ID}
$\rightarrow \mu^-\mu^+X$	250	σ, m_H	m_H=120GeV, test $\Delta P/P$
ZH, H$\rightarrow$cc, Z$\rightarrow\nu\nu$	250	Br(H$\rightarrow$cc)	Test heavy flavour tagging and anti-tagging of llight quarks and gluon
, Z$\rightarrow$qq	250	Br(H$\rightarrow$cc)	Same as above in multi-jet env.
$Z^* \rightarrow \tau^+\tau^-$	500	σ, A_{FB}, Pol(τ)	Test π^0 reconstruction and τ rec. aspects of PFA
tt, t$\rightarrow$bW, W$\rightarrow$qq'	500	σ, A_{FB}, m_{top}	Test b-tagging and PFA in multi-jet events. m_{top}=175GeV
$\chi^+\chi^-$, $\chi_2^0\chi_2^0$	500	σ, mχ	Point 5 of Table 1 of BP report. W/Z separation by PFA

$\int$ Ldt =250 fb^{-1} @250 GeV, 500fb^{-1} @ 500 GeV

* Other processes such as e+e- $\rightarrow$ZHH etc, are important for ILC physics. But they are less relevant for detector parameter optimization or overlap with process listed.

Coverage of Benchmarks

Channel/Area	Topics	Group	CBP
e+e- ->ZH	Recoil mass l+l-X	DESY-Zeuthen/MPI, LAL, Tohoku, KEK	○
	Branching Ratio	Edinburgh, Bristol, Shinshu	○
	Direct Mass	DESY-Zeuthen/MPI, NDU	○
	Heavy Higgs	DESY	
e+e- ->ZHH		RHUL, Tohoku	
e+e- ->Selectons		MPI, Tokyo, KEK	
e+e- ->Smuons		MPI, DESY, Tokyo, KEK	
e+e- -> Stau Stau		DESY, RHUL, LPNHE-LAL	
e+e- -> $\chi^+\chi^-/\chi^0_2\chi^0_2$		Tokyo, KEK	○
e+e- ->WW$\nu\nu$/ZZ$\nu\nu$		Cambridge, DESY	
e+e- -> t t	6 jet final states	RAL	○
	ttZ, ttW vertices	Krakow	
e+e- -> tau tau	tau polarization	Kobe, RHUL	○
e+e- -> ttH		Saga, KEK	
de/dx	meta-stable status	DESY	
Single gammas	rad. c0	Edinburgh	
Vertex charges	c cbar/b bbar	Oxford	
Kinks	GMSB	Santa Cruz	
single particles	$\Delta E/E$, $\Delta P/P$, δip,..	many	

- List is not complete. if your group is missing.
- Common Benchmark Processes are covered.

A.Miyamoto
ILC WS @ Zeuthen

SM Background Samples

Processes		Minimum $\int$ Ldt (fb^{-1})
e^+e^- →	2f	50
(Large Q^2)	4f	20
	6f	20
e^+e^- →γ*γ*→	2f	1
e^+e^- →γZ→	γ 2f (nγ)	10
e^+e^- →	γγ(nγ)	10
	nnγ(nγ)	20
	e^+e^-(nγ)	0.1
	eγ ??	0.1

f=μ,τ,u,d,c,s,b

- Common StdHep files for these events will be prepared at SLAC

-2 sets with Pol(e-)=±80%, Pol(e+)=∓30%
- Using Whizard generators
- Many type of events are mixed, Large s events are weighted

→ May need pre-selection before Geant4 simulation

MC Generation

- The detector optimization studies (for different detector parameters) will require multiple large MC data-set.

- Intend to generate samples centrally (use of GRID will be vital)
  - can avoid unnecessary repetition of work
  - base samples on SLAC STDHEP files to provide commonality with other concept studies

- Ideally run reconstruction centrally (use of GRID will be vital)
  - ensures correct reconstruction versions

- Backgrounds:
  - Ultimately : must include “beam” backgrounds in physics analysis
  - Initially : develop analysis without “beam” background

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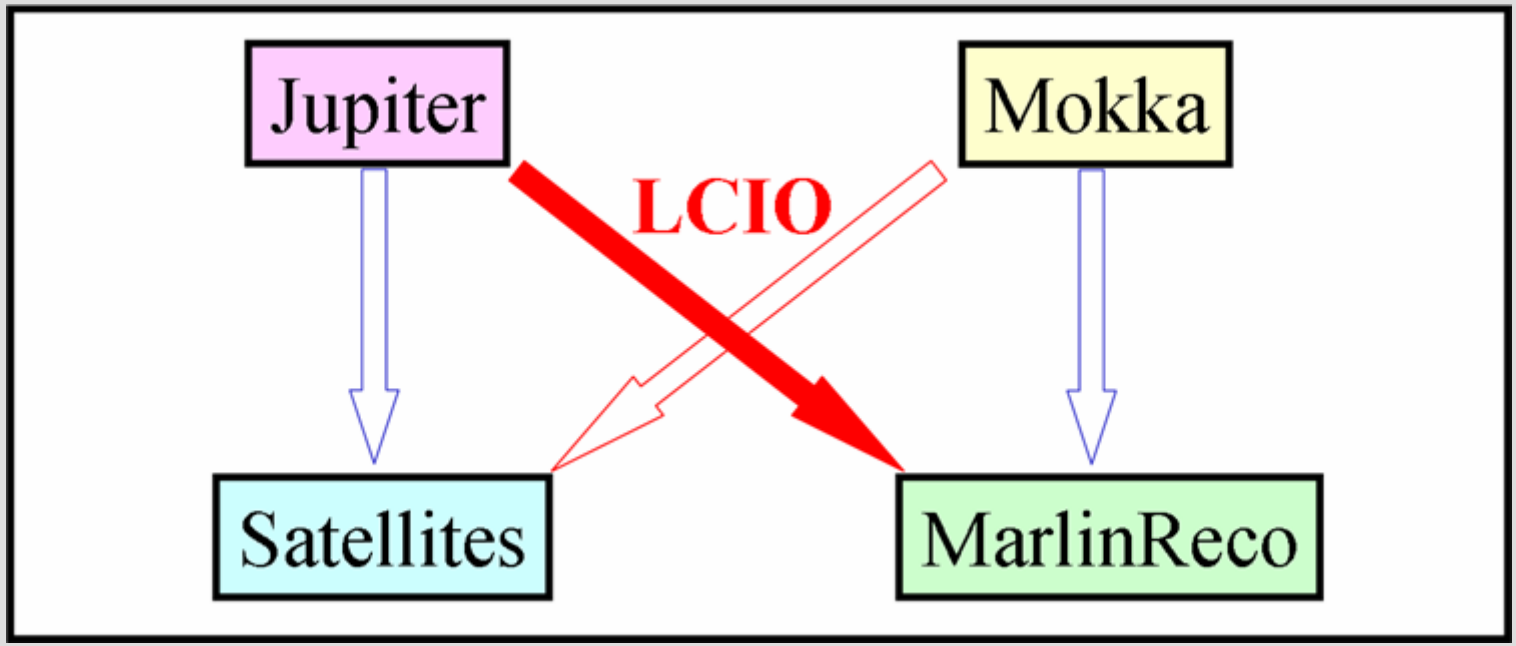
LCIO Interface

- Currently, GLD and LDC use different Geant4 simulations/ reconstructions framework.
- Connected only by common data format.
- Given timescale, we decided to perform ILD studies in context of both GLD and LDC.



Reconstruction Software

- MarlinReco
  - Digitization Calo, TPC, Silicon, Pattern Recognition/Tracking, Clustering, PFA: Wolf, TrackBased

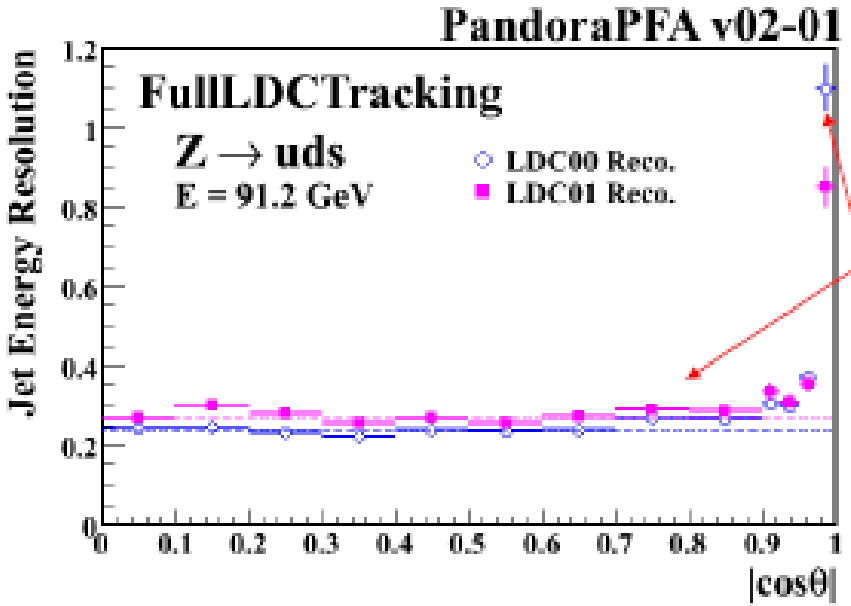
- PandoraPFA
  - Particle Flow Algorithm

- LCFIVertex
  - ZVTop/ZVKin vertex finding and fitting algorithms

PandoraPFA

PandoraPFA : LDC00 vs LDC01_05Sc

★ NOTE: so far mostly looked at 91.1 GeV



Comments

★ Barrel performance worse
23.5%/√E → 27.0 %/√E

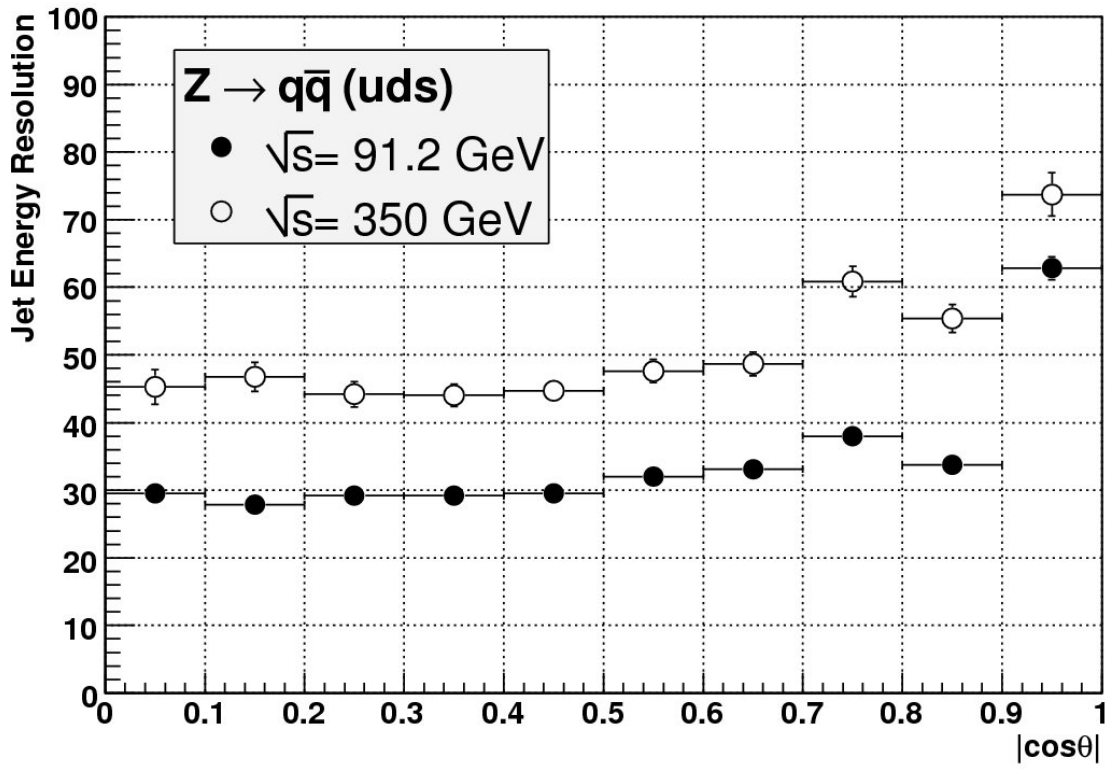
★ Less degradation in Barrel/Endcap overlap region for LDC01
HCAL RING ?

★ Far Endcap region LDC01 better !
LCAL/ECAL Plug

★ Degradation in performance understood… ECAL Model
- partly due to decreased Si thickness
- mostly due to conservative gaps in more realistic ECAL model (as described in Frank's talk)

Jupiter/PandoraPFA

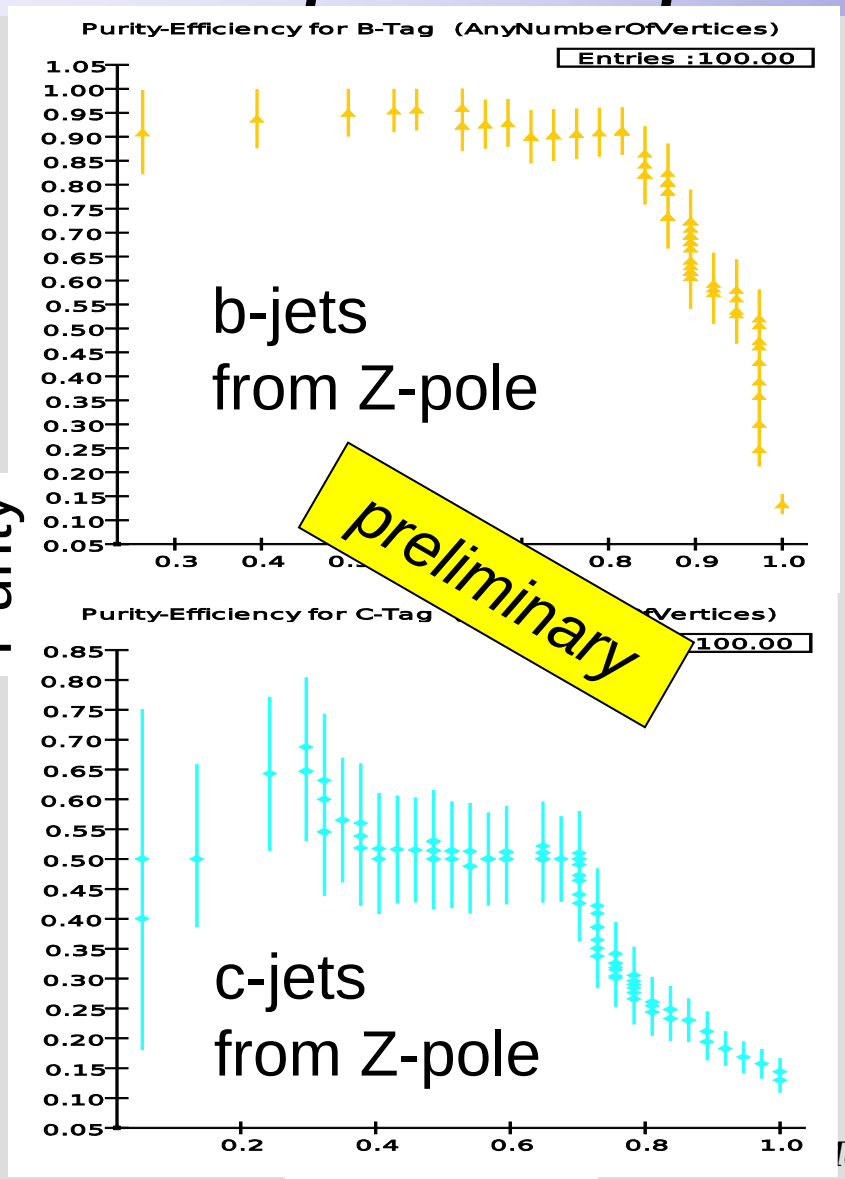
- Jupiter Z → qq data reconstructed by ilcsoft v01-03. (includes LDCFullTracking and PandoraPFA v02-01)



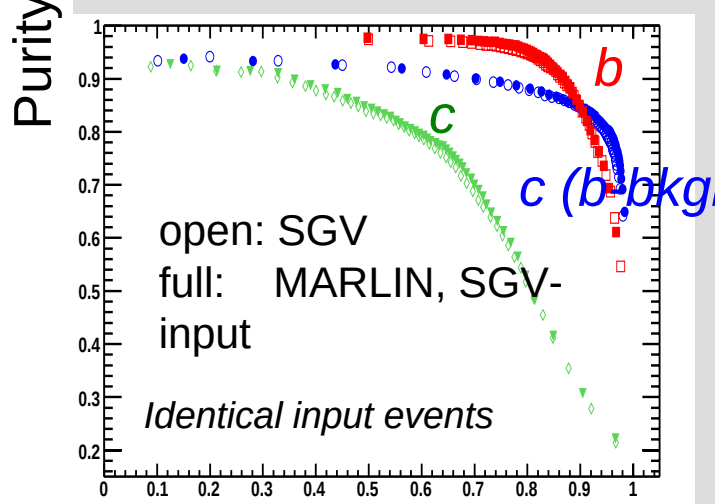
Ejet	JER (cosθ < 0.7)
45 GeV	30.1 ± 0.3
175 GeV	45.9 ± 0.7

- Calibration is very important, but not well tuned yet.
- Will have a meeting on Mar 8th.

Jupiter Z-pole/LCFI Vertex



LDC data (Sonja)

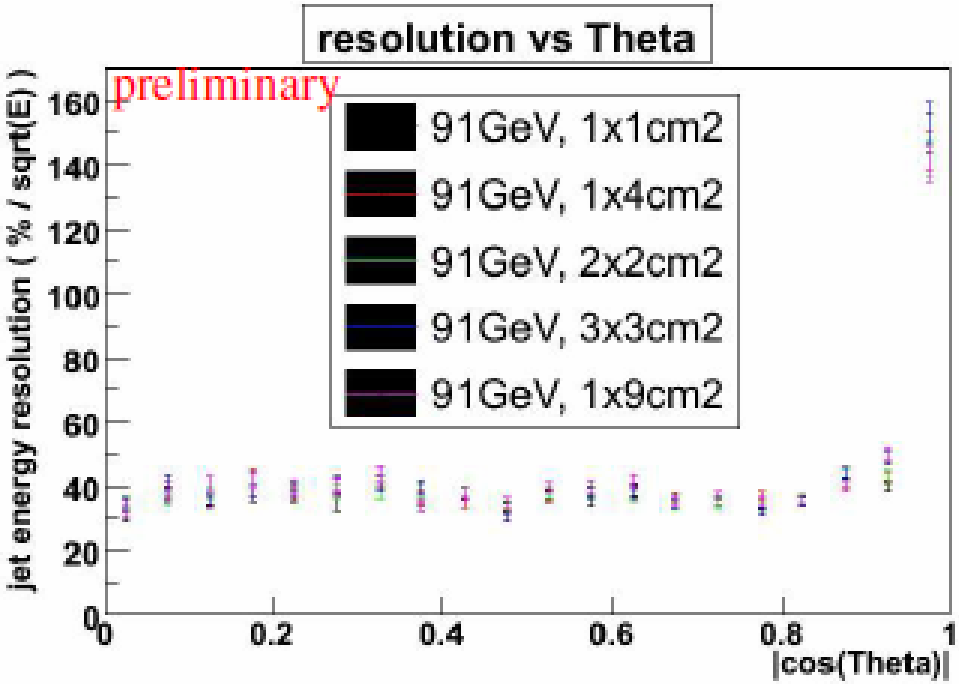


- Same neural-net with LDC simulation is used.
- The b-tagging performance is reasonably good.
- c-tagging for c-jets is not yet as good as LDC case, need investigation.

PFA in Strip Calorimeter

jet energy resolution (RMS90) vs. cos(theta) in 91 GeV qq events

test different strip sizes



resolution ~35%/sqrt(E) in barrel

not too far from 30% goal

D.Jeans

→ Integrate with PandoraPFA is considering.

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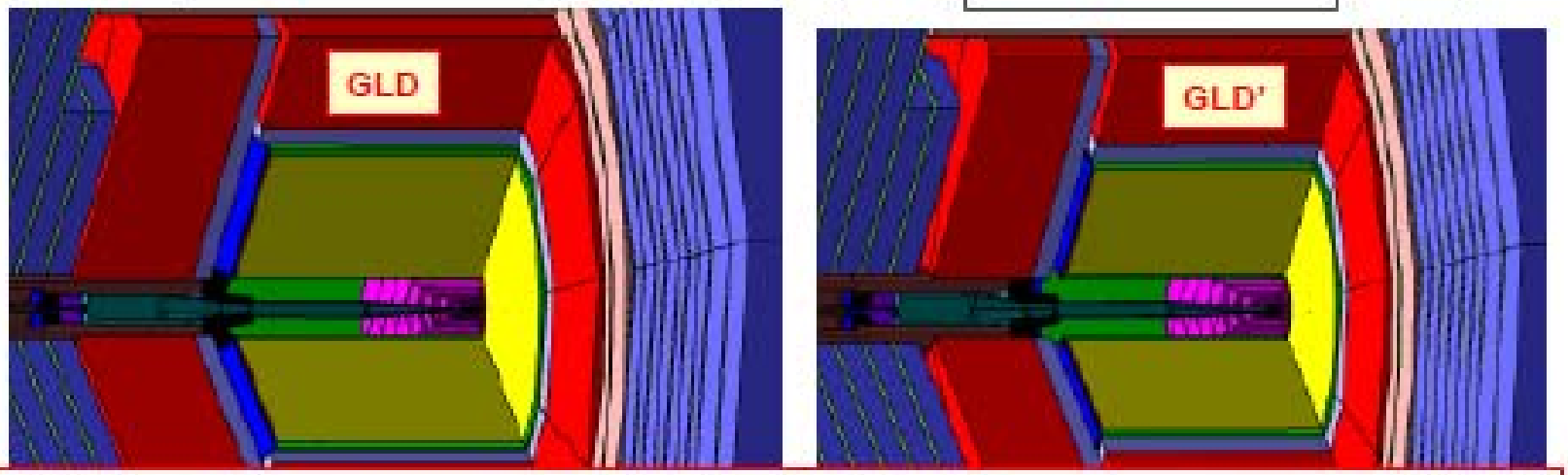
Common Parameters

			GLD	LDC	GLD'	LDC'
TPC		Rin (m)	0.45	0.3	0.45	0.3
		Rout (m)	2.0	1.58	1.8	1.8
		Zmax (m)*	2.5	2.16	2.35	2.35
Barrel	ECAL	Rin (m)**	2.1	1.6	1.85	1.82
		Material	Sci/W	Si-W	Sci/W	Si-W
	HCAL	Material	Sci/Fe	Sci/Fe	Sci/Fe	Sci/Fe
EndCap	ECAL	Zmin (m)***	2.8	2.3	2.55	2.55
B-Field (T)			3	4	3.5	3.5
VTX		Inner Layer (mm)	20	16	18	18

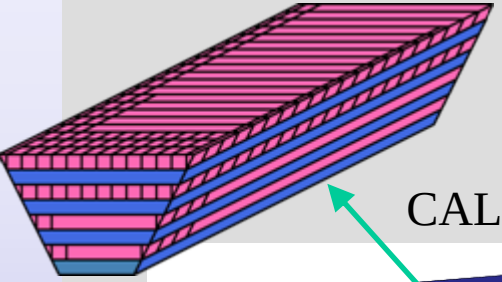
- Region between VTX and TPC unchanged in both cases.
* Note for GLD Zmax = 2.3 + 0.2 m for TPC readout. This is included in the standard LDC TPC Zmax
** LDC allows less space between TPC and ECAL than GLD – here let TPC outer radius fix ECAL Rin and all subsequent radii
*** propose to fix ECAL Zmin and let this define the exact details of the TPC endplate region.

★ LDC/LDC' in Mokka and GLD/GLD' in Jupiter are now implemented



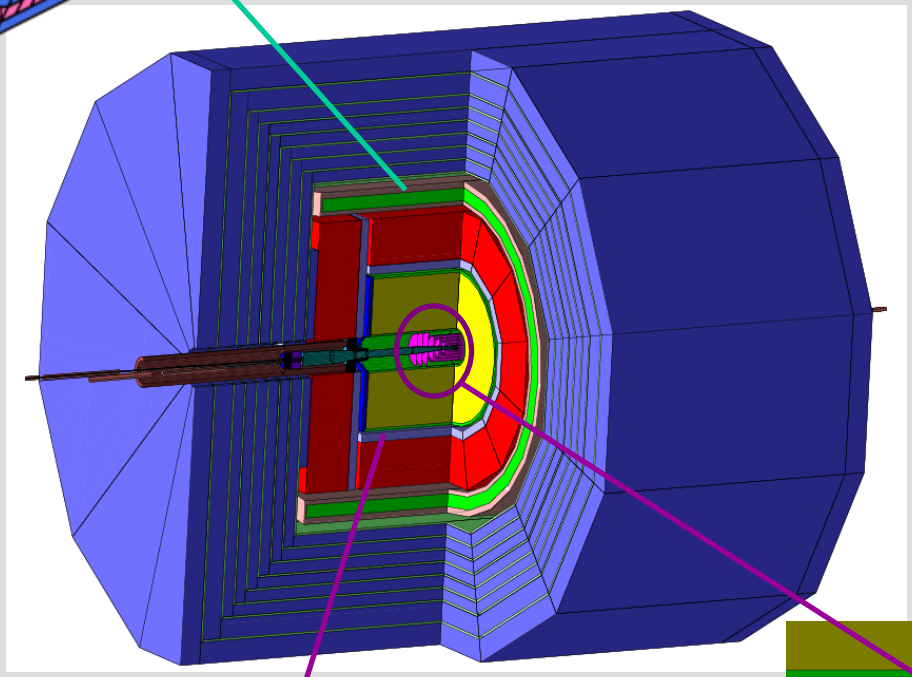
Q : Which models do we use as starting point for studies ?
GLD and LDC (the tools are ready and "validated") or GLD' and LDC' (not the current plan)

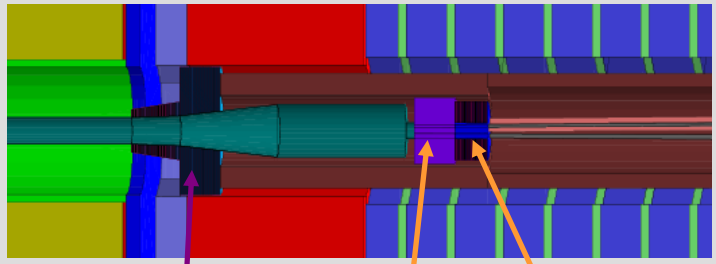
GLD Prime



- Updates since since GLDPrime_v02 (Jan 08)
  - Parameters for VTX, TPC, CAL, Coil, MUD are updated.

CAL module





BCAL

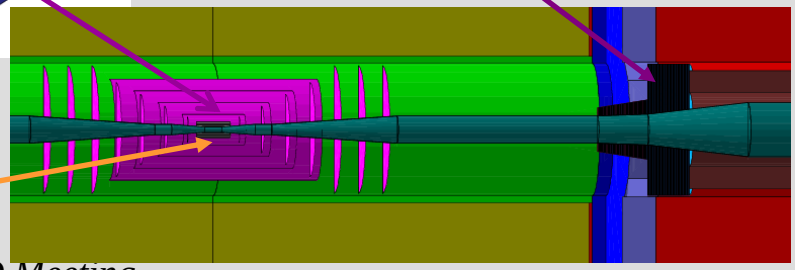
FCAL

CH2mask

IT

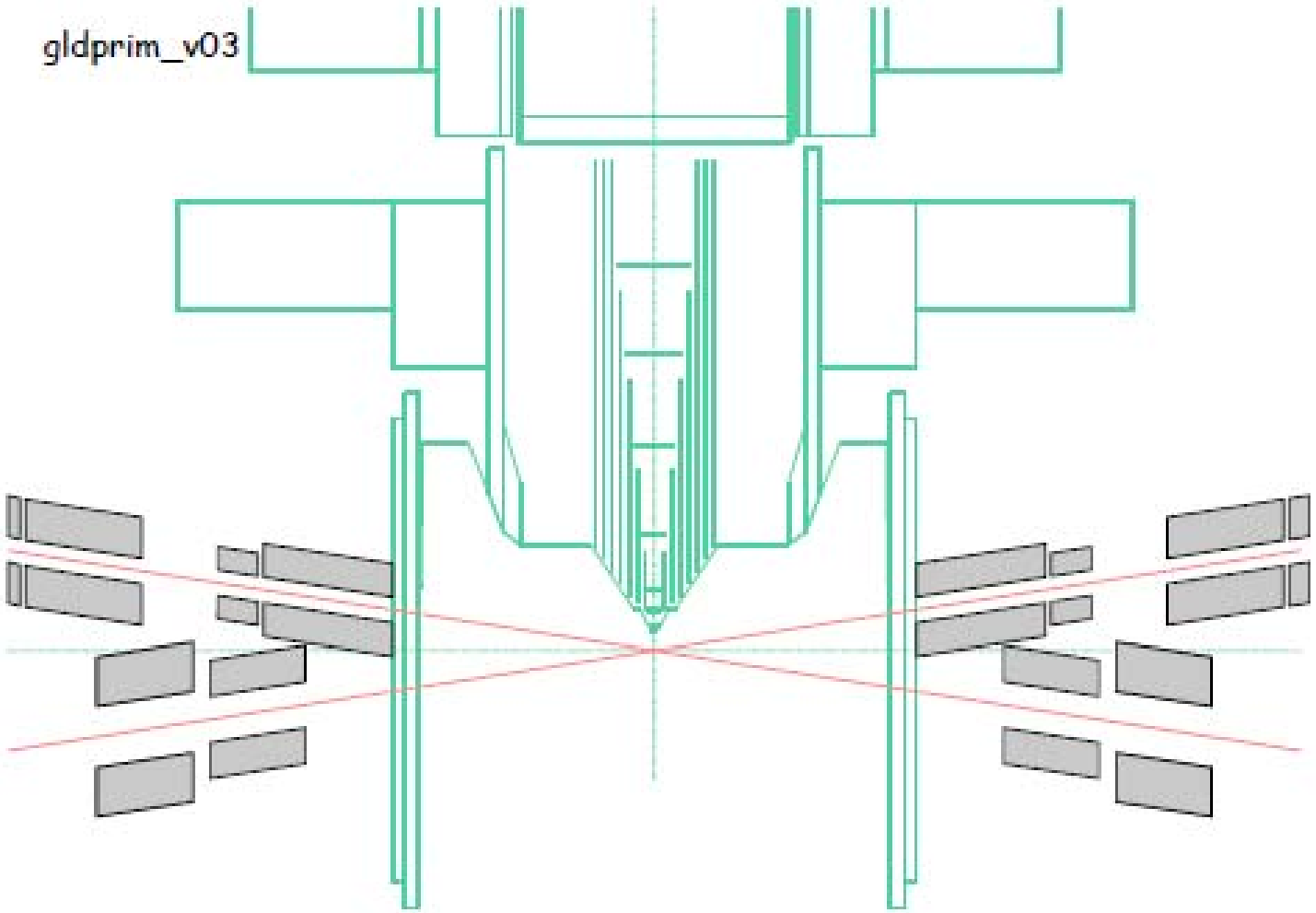
Barrel-Endcap
10cm gap

VTX



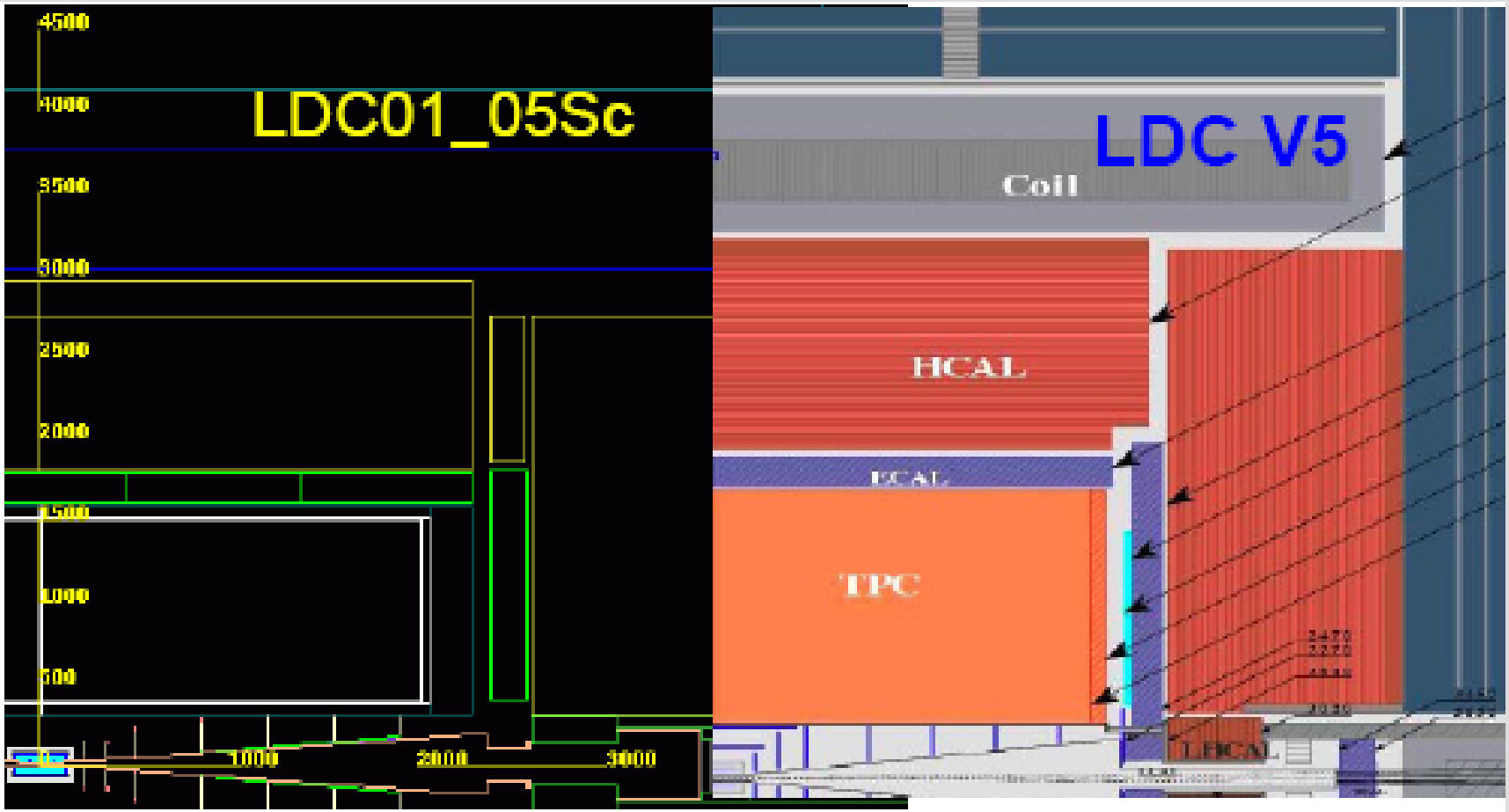
GLD Prime

http://ilcphys.kek.jp/meeting/soft/archives/2008-02-20/GeometryInfo.xls



A.Miyamoto

LDC01_05Sc

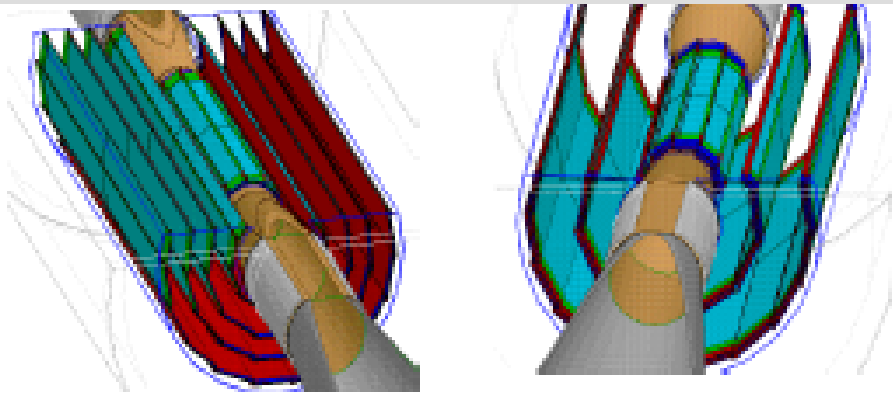


Frank Gaede, TILC08, Sendai, Japan, March 3-6, 2008

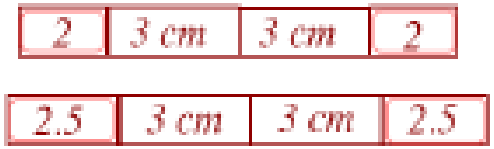
- A lot of progress since Zeuthen meeting.
- Will freeze the Mokka simulation of LDC01_05Sc (and LDC prime) soon.

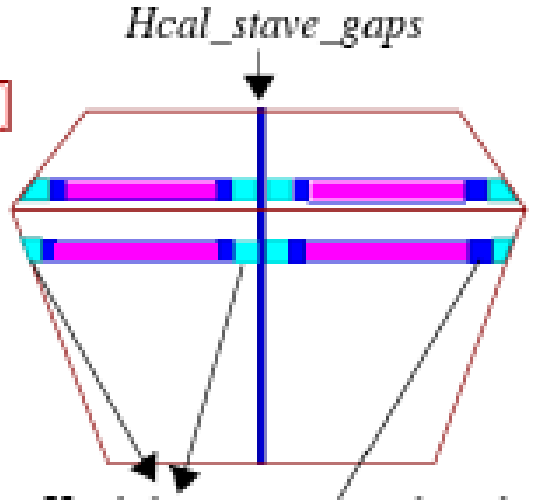
Ongoing Activities in Mokka

- VTX (D.Grandjean)
  - more flexible driver LDC
  - GLD like layout



- Hcal (A.Lucacci)
  - increase realism:
  - 'additional' cracks in middle of octant
  - realistic tiling





- SIT, FTD (V.Saveliev)
  - make drivers scalable

plan: freeze all development next week for LOI mass production

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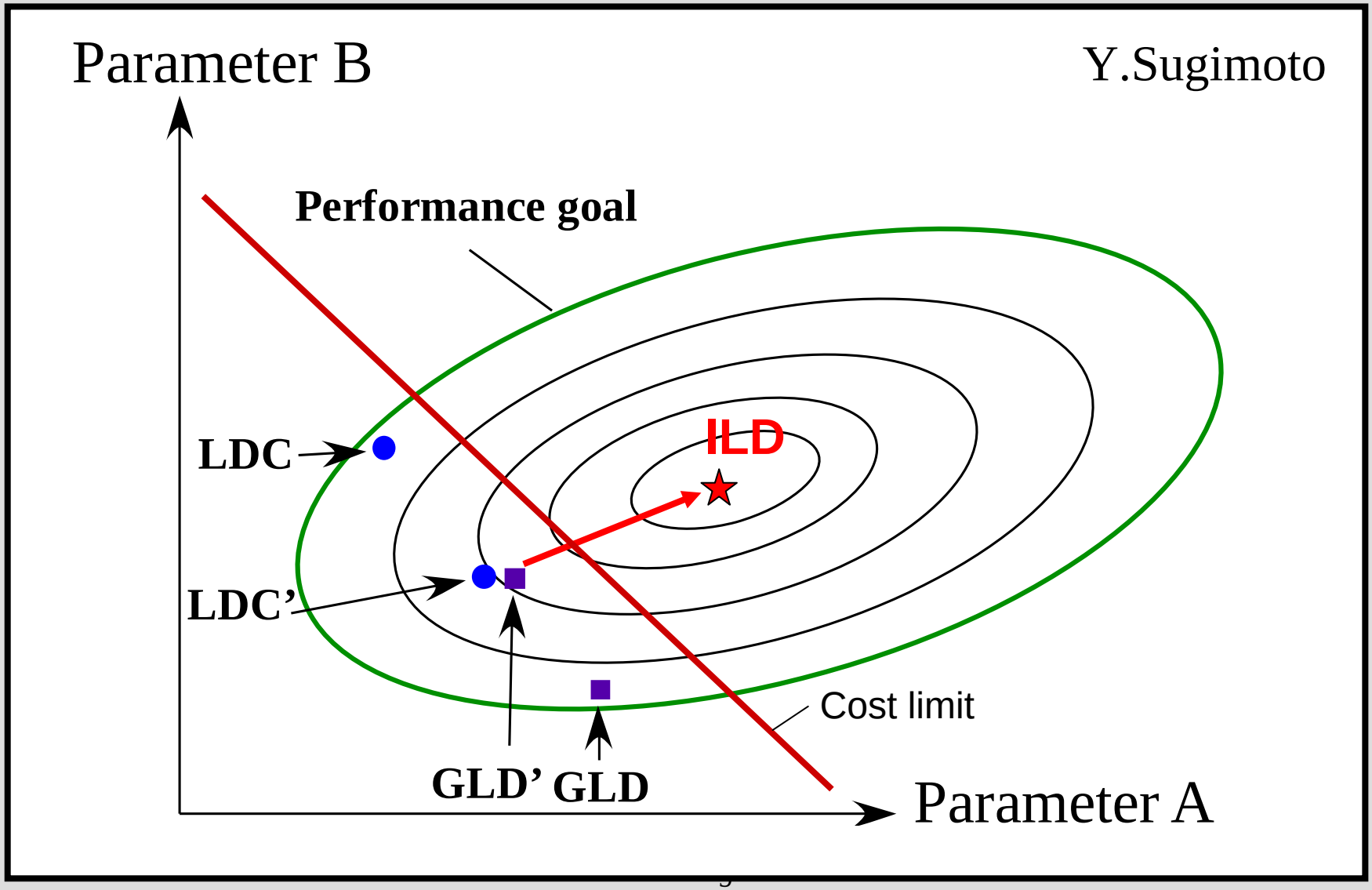
Optimization Procedure



Summary

- For LoI: The optimization WG aim to parameterize physics performance for “benchmark processes” as a function of detector parameters with full detector simulation and reconstruction.

  → A lot of progress since Zeuthen meeting to implement more realistic geometries.
  → Will start mass MC production soon.
  → Full reconstruction software now exist.
  → First results from detector optimization studies by Summer 2008.

- Optimization strategy by Mark on Mar. 7th.
- Technical meeting (Pandora tuning for Jupiter data etc.) on Mar. 8th.