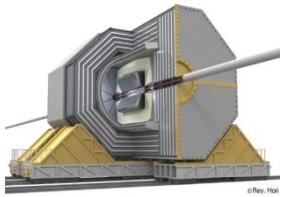
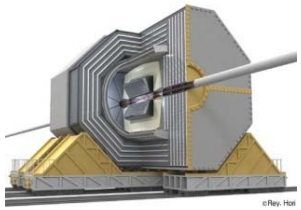


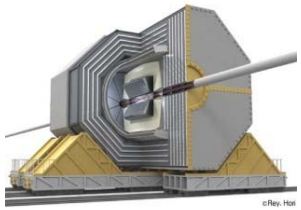
Benchmarks for the LOI Process

Akiya Miyamoto
KEK
1st ILD Workshop



Benchmarks ?

- Bench marks for what ?
  - For ILD Detector optimization
  - For ILD LOI (benchmarks to be described in the ILD LOI)
  - Bench marks common to all LOIs (Common Benchmarks)



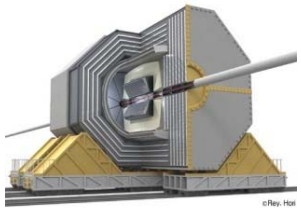
Common Benchmarks

"Guideline for the definition of a Letter of Intent …", 3 October '07

> ….. *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

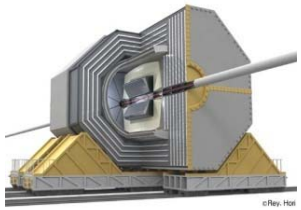


Committees

- 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

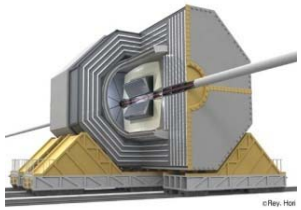
- Software Panel
  - T. Benke
  - A. Miyamoto
  - N.Graf

- At the 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



Process recommendation

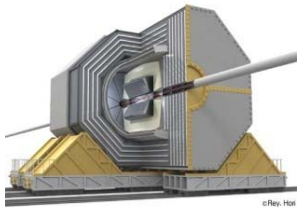
- Start from Benchmark Panel Report
- Minimum number of processes
- Processes which are sensitive to detector performances,
  Not a process sensitive to analysis performance
- Consistent with ILD baseline.
  - No 1TeV, $\gamma\gamma$, …



Software Panel Draft - 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, $H\rightarrow c\bar{c}$, $Z\rightarrow\nu\bar{\nu}$	250	$Br(H\rightarrow c\bar{c})$	Test heavy flavour tagging and anti-tagging of llight quarks and gluon
, $Z\rightarrow q\bar{q}$	250	$Br(H\rightarrow c\bar{c})$	Same as above in multi-jet env.
$Z^* \rightarrow \tau^+\tau^-$	500	σ, A_{FB}, $Pol(\tau)$	Test π^0 reconstruction and τ rec. aspects of PFA
$t\bar{t}$, $t\rightarrow bW$, $W\rightarrow q\bar{q}'$	500	σ, A_{FB}, m_{top}	Test b-tagging and PFA in multi-jet events. m_{top}=175GeV
$\chi^+\chi^-$, $\chi_2^0\bar{\chi}_2^0$	500	σ, $m\chi$	Point 5 of Table 1 of BP report. W/Z separation by PFA

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



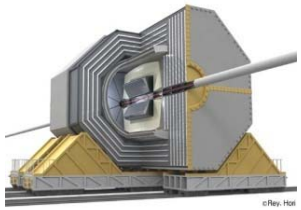
Comments on signal samples

- Other processes such as
  - $e^+e^- \rightarrow ZHH$
  - Secondary vertex reconstruction and quark charge measurement.
  - Low DM SUSY

  are important for ILC physics. But they are less relevant for detector parameter optimization or overlap with process listed.

- SiD proposed to include the process, $e^+e^- \rightarrow ZH, H \rightarrow \mu^+\mu^-$ at Ecm=250 GeV.

- ILD opinion is not include $H \rightarrow \mu^+\mu^-$ but include Low ΔM SUSY.

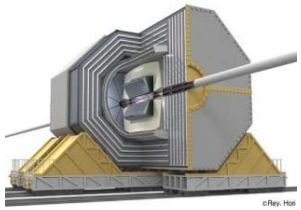


SM background samples

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

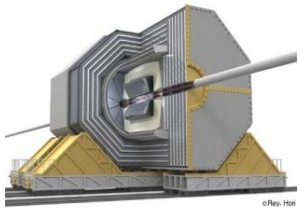
f=μ,τ,u,d,c,s,b

- 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



Other Issues

- Machine backgrounds
  - Detector performances should be studied including machine backgrounds
  - Hits by machine backgrounds could be generated separately and super-imposed to the signal events.
- Crossing angle
  - Signal and SM background events should be simulated with 14mrad crossing angle.
- Detector magnetic field
  - Machine background simulation → Detailed map is necessary
  - Signal simulation → Detailed map is not mandatory



Benchmarks for ILD optimization

My view

- ILD Optimization:
  - Charge : " *…. Investigate the dependence of the physics performance of the ILD detector on basic parameters such as the TPC radius and B-field. …*"
  - Processes

    = Common Benchmark Processes (CBP)+ ILD specific Processes

- ILD Specific Processes

  " *… emphasize the particular strengths of the proposed detector …* "

  - As many processes as possible, but …
  - ✓ Depend on human resources – your interest
  - ✓ Depend on computer resources –

    May not be a problem as long as signal processes are concerned

ILD Physics Activities: from Opt. WG, 31-Oct 2007

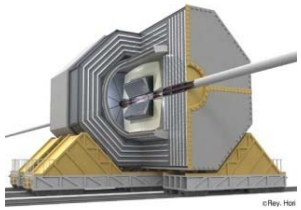
Channel/Area	Topics	Group	CBP
e+e- ->ZH	Recoil mass l+l-X	DESY-Zeuthen/MPI, LAL, Tohoku, KEK	○
	Branching Ratio	Edinburgh, Bristol, Shinshu	○
	Direct Mass	DESY-Zeuthen/MPI, NDU	○
	Heavy Higgs	DESY	
e+e- ->ZHH		RHUL, Tohoku	
e+e- ->Selectons		Tokyo, KEK	
e+e- ->Smuons		MPI, DESY, Tokyo, KEK	
e+e- -> Stau Stau		DESY, RHUL, LPNHE-LAL	
e+e- -> t+x l-x20x0		Tokyo, KEK	○
e+e- -> WWZZ		Cambridge, DESY	
e+e- -> t t	6 jet final states	RAL	○
	ttZ, ttW vertices	Krakow	
e+e- -> tau l	tau polarization	Kobe, RHUL	○
e+e- -> ttH		Tokyo, 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	ΔE/E, ΔP/P, δip,..	many	

Important to know

which detector parameters are suited

for each physics performance

- List is not complete. Apologies if your group is missing.
- Common Benchmark Processes are covered.
- Is this sufficient ? Ex. Lum. meas. by fwd bhabha and γZ



Backgrounds for Optimization

- SM background sample should be based on SLAC StdHep sample
- Computing Resources: storage and CPU
  - We should try to share background samples as much as possible
  - Not realistic to simulate/analyze all SLAC SM samples for many detector parameters.
- If S/N is not good, we may need high statistics background samples to know performance-vs-parameter dependence.

- If S/N is good, it would be not necessary to simulate all SM backgrounds
- We should define
  - a common criteria for pre-selection of SLAC StdHep sample
  - a common detector parameters to share SM background samples for optimization

Common Parameters

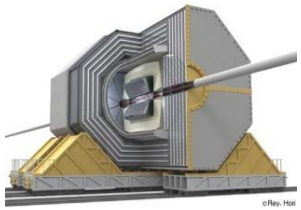
			GLD	LDC	GLD'	LDC'
TPC		Rin (m)	0.45	0.3	0.45	0.3
		Rout (m)	2.0	1.58	1.8	1.8
		Zmax (m)*	2.5	2.16	2.35	2.35
Barrel	ECAL	Rin (m)**	2.1	1.6	1.85	1.82
		Material	Sci/W	Si-W	Sci/W	Si-W
	HCAL	Material	Sci/W	Sci/Fe	Sci/W	Sci/Fe
EndCap	ECAL	Zmin (m)***	2.8	2.3	2.55	2.55
B-Field (T)			3	4	3.5	3.5
VTX		Inner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

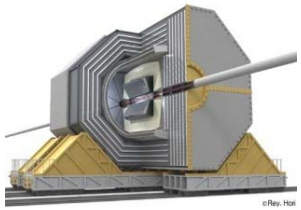
*** propose to fix ECAL Zmin and let this define the exact details of the TPC endplate region.



Detector Parameters

- Is GLD-GLDPrim-LDCPrim-LDC sufficient to get performance vs parameter curve ?
  - Yes, for Rin of ECAL and Bfield.
  - But, not enough for full comparison. Ex. Coil Radius (Or outer radius of hadron calorimeter should be considered.)

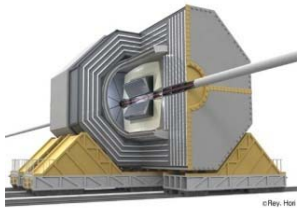
- Assuming GLDPrim and LDCPrim as a starting point,
  - what parameters should be changed ? Parameter range ?
  - Signal processes ?
  - Background processes ? (Pre-selection ?)
  - Physics quantities ?



Some practical issue

- Beam parameter and beamstrahlung spectrum for 250 GeV(500GeV)

  should be defined
- Common signal samples should be prepared at well know place.
- Agree on processes-observable-parameter range
- SM Background samples
  - Define pre-selection criteria
  - Prepare pre-selected data sample.
  - Background SM sample production.
    - Test production and estimate required resources.
- Beam related background data



Summary

- Benchmark Processes common to all concepts will be agreed soon.
- Benchmarks processes for ILD optimization are the sum of common benchmark processes and ILD specific processes.
- Benchmarks to be written in the LOI could be defined after detector parameters are optimized.
- SM background processes for ILD optimization should be defined soon for an efficient scanning of detector parameters