

From the LOIs to the DBDs

- Coverage of Higgs Studies -



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Hot Topic

Just got informed by Tim on conclusions of working group last night
--- Thanks to Tim ---

Not yet fully approved but fine for here since we are on a
workshop

Benchmarks for the LOIs 2009

$e^+e^- \rightarrow h^0 Z^0$: 120 GeV Higgs @ 250 GeV

- Based on compelling arguments for a light Higgs
- Production at threshold
- Precision measurements to pin down nature of Higgs boson
 - Higgs-strahlung cross section and recoil mass
 - => Coupling Modifications wrt. SM?
 - Precision in Higgs Mass (????),
 - Currently no direct “application” for $\sigma_{Mh} \sim 30$ MeV
 - Branching ratios into heavy quarks (and gluons)
 - Scaling with quark mass, crucial test of nature of Higgs boson

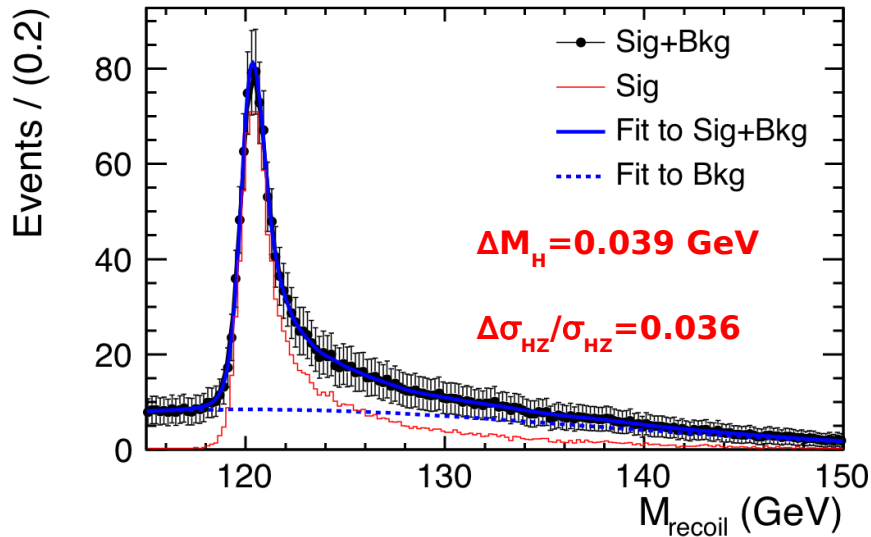
Precision in ILD and SiD LOI

$h \rightarrow bb$: 1-3%

$h \rightarrow cc$: 10% (SiD), 12% (ILD, shown at LCWS10)

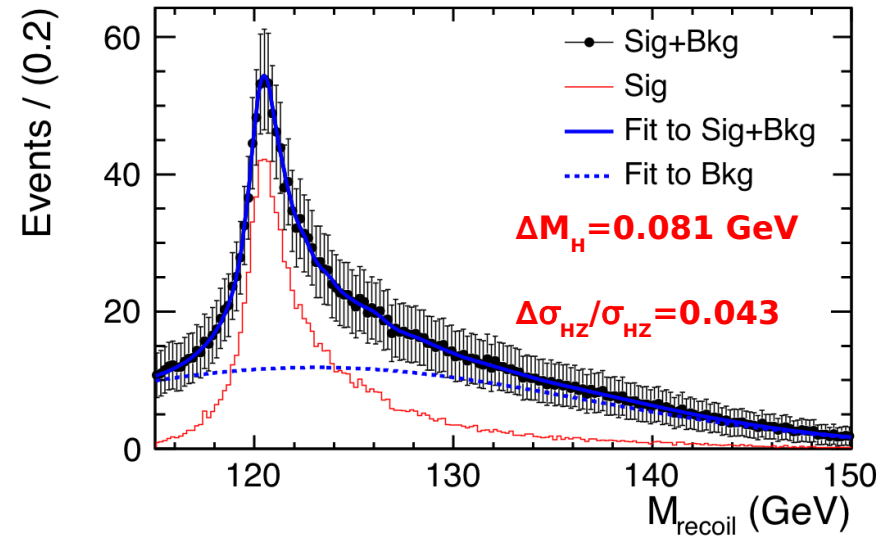
Results

Muon Channel



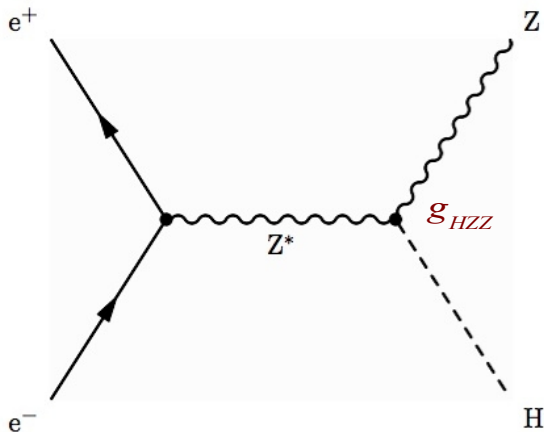
Very Precise Measurement
S/B = 8 in Peak Region

Electron Channel



Less Precise
Bremsstrahlung in detector material

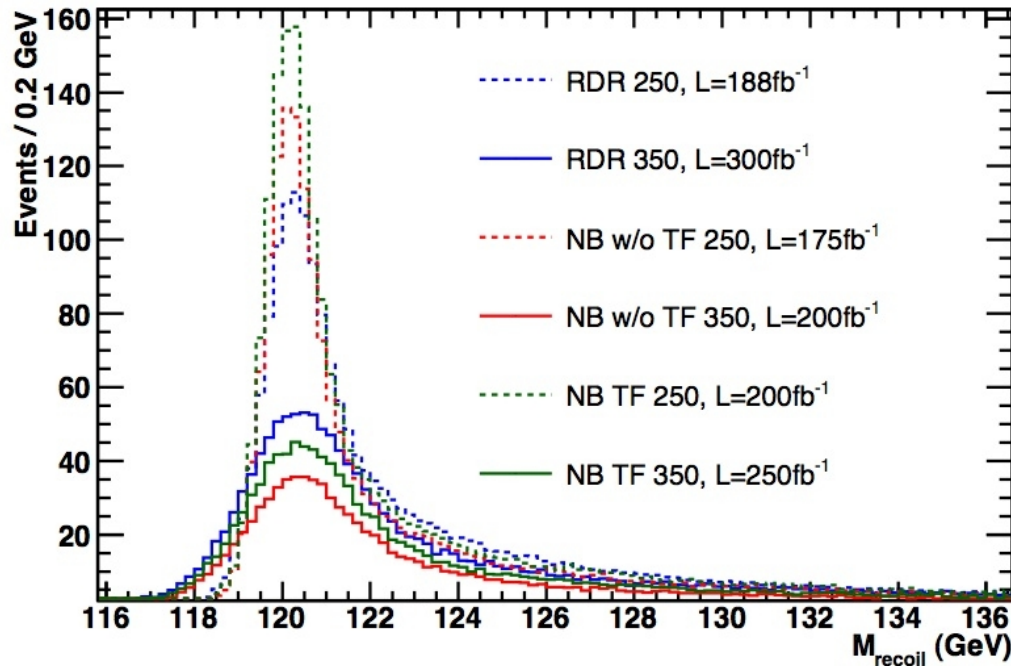
Combined: $\Delta M_H = 0.035 \text{ GeV}$, $\Delta \sigma_{HZ} / \sigma_{HZ} = 0.027$



$$\sigma_{HZ} \sim g_{HZZ}^2$$

\Rightarrow Precision in g_{HZZ} coupling 1-2%

Sensitivity to 15% deviations
SM prediction of cross section



Beam Par	\mathcal{L}_{int} (fb^{-1})	ϵ	S/B	M_H (GeV)	σ (fb) ($\delta\sigma/\sigma$)
RDR 250	188	55%	62%	120.001 ± 0.043	11.63 ± 0.45 (3.9%)
RDR 350	300	51%	92%	120.010 ± 0.087	7.13 ± 0.28 (4.0%)
NB w/o TF 250	175	61%	62%	120.002 ± 0.032	11.67 ± 0.42 (3.6%)
NB w/o TF 350	200	52%	84%	120.003 ± 0.106	7.09 ± 0.35 (4.9%)
NB w/ TF 250	200	63%	59%	120.002 ± 0.029	11.68 ± 0.40 (3.4%)
NB w/ TF 350	250	51%	89%	120.005 ± 0.093	7.09 ± 0.31 (4.4%)

Table 6: Results based on NB beam parameters, assuming a beam polarization of (e^- : -80% , e^+ : $+30\%$), comparing with those of RDR beam parameters.

*Currently best “fast” reaction tool for ILC studies – Extendable?
Replies to “urgently” needed studies (according to benchmark note)*

Tools for (full) Simulation Studies

- Event generators (Mikael, Tim and Akiya)
WhiZard, PYTHIA, ...
- SLIC and Mokka simulations suites
- Reconstruction frameworks
SLIC/MARLIN
- Considerable computing resources
 - Storage at DESY, CC in2p3 Lyon, KEK, SLAC, FNAL(?)
 - Computing power would be available
requests would need however be placed now
finally we are concurring with LHC experiments for ressources!!!

Benchmarks for DBDs

The Higgs (again) at the core of the benchmark scenarios

Full simulation studies asked from (both) concept groups:

1 TeV for 120 GeV Higgs

$e^+e^- \rightarrow \nu\bar{\nu}h^0$: with $h \rightarrow bb$ and $h \rightarrow \mu\mu$

Measurement of x-section x BR

Covered by ???

$e^+e^- \rightarrow t\bar{t}h^0$

Challenging final state

Covered by Yonamine for ILD

Benchmarks for DBDs

Fast(?) Simulation studies asked to emphasise physics potential at ILC:

Precision measurements for $m_H = 120$ GeV and 190 GeV, cms energies?

$$e^+e^- \rightarrow \nu\bar{\nu}h^0 \text{ :with } h \rightarrow bb \text{ and } h \rightarrow \mu\mu$$

Measurement of x-section x BR

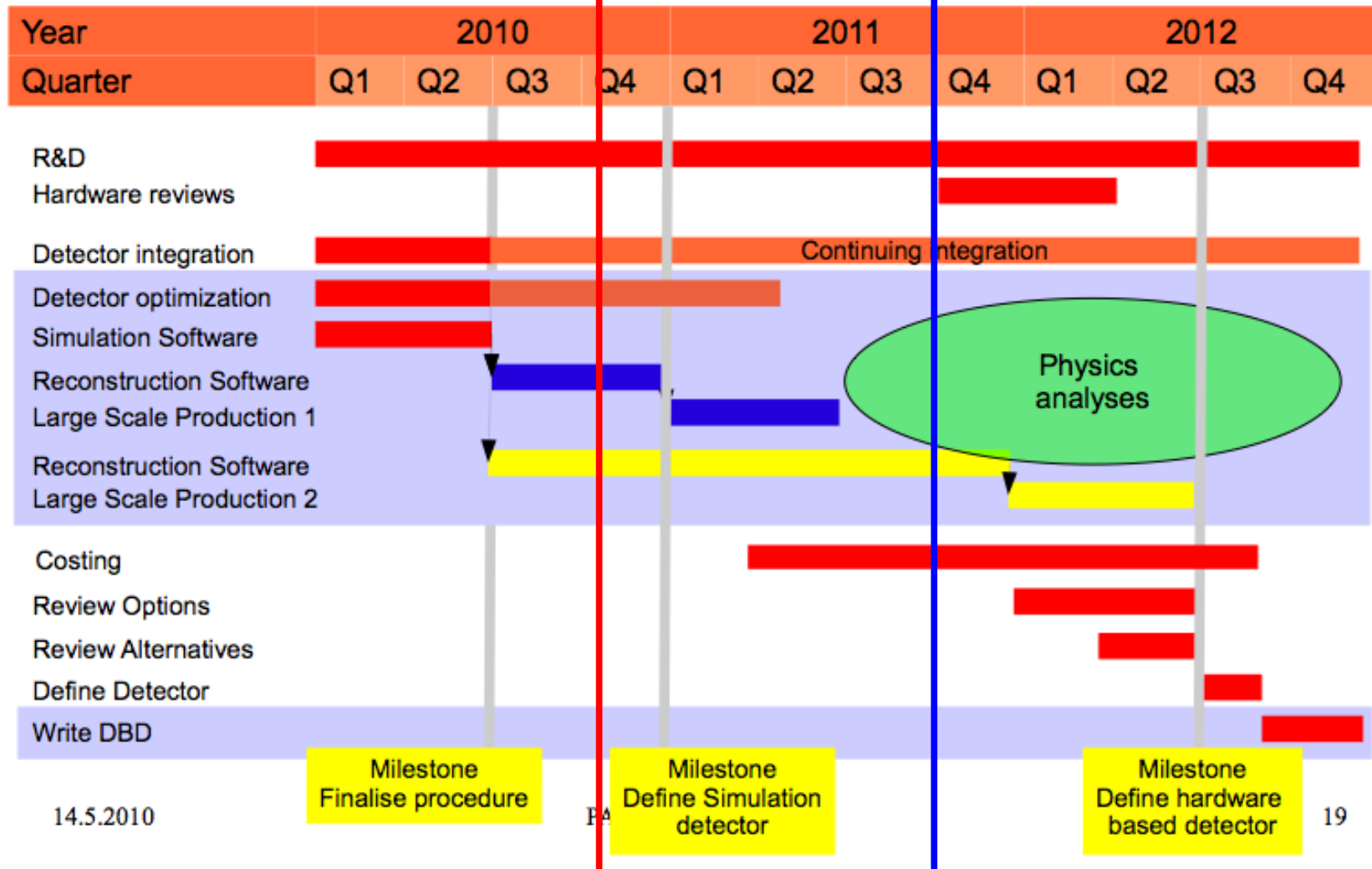
$$e^+e^- \rightarrow t\bar{t}h^0$$

Extended Higgs: H^+H^- , HA production, cms energy?

Questions:

- Role of JSF simulation tool?
- Can fast simulation tool by Li be employed?
- Who would work on this?
Would be 'natural' addendum for full simulation studies
- Interest in full simulation studies at different centre-of-mass energies

Main Milestones



Ties Behnke, ILD Workshop 7/2010

We are here

Physics case document for ECFA study

IWLC10 CERN/Geneva

- LOI Result: Resolution on x-section ~95%
assuming an optimal b-tagging, otherwise 180% (Study by Faucci-Gianelli) !!

- Analysis depends crucially on b-tagging and thus in turn on correct jet finding, i.e. particle association to jet

Analyses use “good old” Durham algorithms
Study of different jet algorithms is needed
Good for clean and “innocent” LEP environment

- Analysis currently covered by Tian

Challenging analysis?

- Analysis might require the establishment of a “jet working group” in which experiences from multi-jet final states at LHC need to be exploited

Optimising of jet algorithms concerns a number of studies at an LC
(particular for energies $> \sim 1$ TeV)

Difficult analysis: Do we want to leave it unaddressed for DBD (and physics case doc) ?

If yes: Do we need to give an argument?

If no: Requires structured approach!

Shopping List of additional items – Partially personnel

- Do we want/need to compare the performance of detector concepts?

Common working group (difficult to set up)

Agreement on common set of cuts would be helpful!

- Study of systematic errors entirely missing (Lack of time)

Need to identify major sources of systematic errors

Knowledge of Detector R&D needs to go into physics studies

e.g. Answers to IDAG contain parameters on tracking precision

More guidance to Detector R&D by physics studies!?

Disjunct groups !!?

- Conclusions for Detector R&D from LOIs?

LOI should lead to directions for R&D, does it?

- Machine, gamma-gamma background

- addressed by Benchmark group, best way to implement it under discussion

- should prove that ILC can deal with background

- Feedback to change of machine parameters

Need ability to ponder timely the influence on physics performance

Request partially fulfilled with fast simulation tool by Li

Reaction on first LHC (or Tevatron?) results

- What if there is a light Higgs?
- What if there is no evidence for a light Higgs?
Invisible Higgs?
- What if there is a heavy Higgs?

Most of these questions can be already addressed right now!!!

In any case the ILC allows for the model independent measurement
Higgs properties

Many of the questions can be answered by the determination of the
coupling !!!

Conclusion

- Many studies proposed for detailed simulation are covered
Situation in ILD better than in SID
- Algorithms developed now for LOI data samples should be easily applicable to new detector models
- Coverage sufficient?
- Tools and resources for next round of simulations are available
... but need to be confirmed (e.g. grid computing power)
- Request for fast simulations
Tools: Fast simulation $ee \rightarrow ZH$
JSF
Fast simulation within SLIC?
- Addressing $ee \rightarrow ZHH$?
ILC is unique machine to measure the structure of the scalar potential
Question to community, is this something we want to push forward
If yes, concentrated efforts on jet measurements at the LC are needed
Working group?
- Reaction to LHC results
Tools for model independent measurement of Higgs-strahlung puts us in a good position