Physics Plans for the Post-DBD Phase

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From DBD to Post-DBD

We have completed the DBD benchmarks thanks to the hard work of those involved under tight time constraints. We deserve to give each other a tap on the back.

We should now focus on the questions and issues which need to be addressed as we move toward designing a real detector.

The physics case has to be updated taking into account the latest experimental results and projections. We should be prepared to react when new results become available. This will be crucial for the foreseen “final” review of the project before the construction begins.

Running scenarios

With the discovery of a 126 GeV Higgs boson, we now have a direct probe to study EWSB. There are strong motivations to search for new particles.

Taking these into account, we should arrive at several physics run scenarios which optimize the integrated luminosity at each energy and polarization.

We may not have much freedom in this. But we should make sure that we are not making any glaring mistakes.

As a first step, time allocation for 250 / 350 / 500 GeV runs should be considered by e.g. comparing the Higgs coupling precision. Fine-tuning of the energies e.g. 480 / 520 GeV and the benefits better positron polarization should be considered.

Towards a real detector

Eventually we hope to build a real detector. The technology choice is inevitable. This is a good to start thinking about which variables to use for the evaluation. Feedback from physics will be crucial: need benchmark reactions.

Again we may not have much control over what gets actually built as this is a matter of cost/funds and opportunities.

It is nonetheless important to consider what the evaluation variables might be, definition of the cutoff thresholds, and how one might begin to combine the different variables.

Systematic uncertainties

Common to most physics studies, various systematic uncertainties need to be addressed / updated (some have been already studied):

- Luminosity (done)
- Beam polarization (done)
- Beam energy spectrum (←CLIC)

} time dependence

- Track momentum scale
- Jet energy scale
- Jet energy resolution (PFA)
- Tracking efficiency
- Bottom / charm tagging
- Lepton tagging

} which control samples?

- Theoretical – NLO calculations in multi-jet final states

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Higgs Physics

It is an urgetn task to update the Higgs studies at 250 / 350 / 500 GeV with the latest simulation tools.

- Recoil mass
- Couplings
- Higgs CP-mixture studies e.g. ZH / $H \rightarrow \tau\tau$ / ttH
- Study of rare decay modes: $H \rightarrow \gamma\gamma$, $H \rightarrow Z\gamma$

We should keep pushing for the **self-coupling** measurement. We should pursue every idea, every approach.

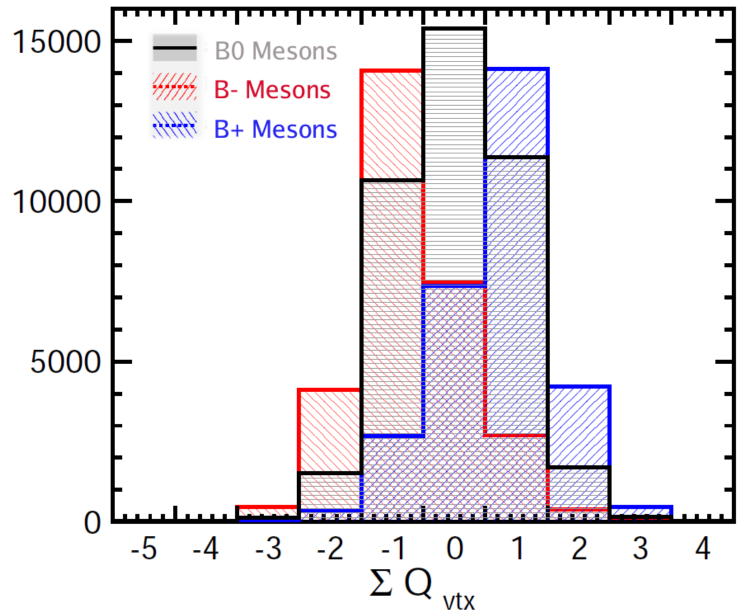
- NLO calculations relevant for e.g. $H \rightarrow$ bb/cc/gg

Top Physics

The study of the top pair production should be updated.

- Improvement in theory calculations are needed for the extraction of the top Yukawa coupling.

In the open top region, we can measure various asymmetries. The b-quark charge measurement is critical.



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SUSY

According to the naturalness argument, higgsinos are the only particles guaranteed to be light. We should be prepared to look for such scenarios where only the charginos and the neutralinos are light.

In addition, spectra with light sleptons are still very much alive. We should also analyze such scenarios, e.g. slepton NLSP scenarios.

All this together, we should demonstrate the ILC capabilities in new physics searches which are in many ways complementary with the LHC, based on studies of concrete new physics models.

Other thoughts

The detector baseline design includes the **push-pull** approach. The **alignment** of the detectors need to be demonstrated. The amount of time required for the **calibration** after each push-pull cycle needs to be evaluated.

The ILC detector is supposed to operate in **triggerless** condition. This should be demonstrated by simulating an entire bunch train, sliced according to the different subdetector readout, overlay all beam-induced backgrounds, and reconstructed into an event.

Physics and Software

We should remind ourselves that the analysis work is intimately coupled with the reconstruction software, detector models, and the computing infrastructure. The simulation framework developed for the DBD is an important asset.

The software development will continue as we update the detector models and improve the reconstruction software. We must make sure that the physics analysis can benefit from these developments through software release cycles targeted for physics.

Summary

We have delivered the DBD. We should now take steps to work toward the realization of a real detector as well as the ILC in general.

We should keep updating the physics case. We were prepared for the Higgs discovery – we should be prepared for BSM discoveries as well!

We should consider running scenarios, metrics to evaluate technologies, systematic uncertainties, …

Lots of work ahead but the future looks bright!