Physics Benchmarks for 2010-2012

Klaus Desch

University of Bonn

ILC physics panel (set up by RD)
Michael Peskin (SLAC) - Chair

ILD
Keisuke Fujii (KEK)
Klaus Desch (Bonn)
Andrei Nomerotski (Oxford)
Tim Barklow (SLAC)
Franco Bedeschi (Pisa)
Stewart Boogert (Rutherford)

Seong Youl Choi (Chonbuk)
Yuanning Gao (Tsinghua)
Heather Logan (Carleton)
Klaus Moenig (DESY)
Aurore Savoy-Navarro (LPNHE Paris)
Georg Weiglein (DESY)
Jae Yu (Texas-Arlington)

Physics panel - activities

4 (phone) meetings since Nov 2008

Activcities:

- discussion of photon collider Higgs factory proposal (no consensus…)

- discussion about „low energy" Higgs programme as a motivation for staged construction (still somehow underway…)

- proposal for new benchmark reactions for LoI groups (→ this talk)

- reaction to SB2009 from physics viewpoint

RD request for „new" benchmarks

Charge:

1. evaluate the capabilities of the LOI detectors for physics at 1 TeV.

2. demonstrate the physics capabilities of the ILC with respect to other proposed accelerators

   our interpretation of "other proposed accelerators"

   - ILC "response" to (early) LHC discoveries
   - Study "ultimate" precision Higgs programme
   (certainly not complete)

Reminder: LoI Benchmark processes

arXiv:hep-ex/0603010

1. $e^+e^- \rightarrow h^0Z$ at $\sqrt{s}$ = 250 GeV, m_h = 120 GeV
2. $e^+e^- \rightarrow (h^0 \rightarrow cc)\,Z$ at $\sqrt{s}$ = 250 GeV, m_h = 120 GeV
3. $e^+e^- \rightarrow \tau^+\,\tau^-$ at $\sqrt{s}$ = 500 GeV. A_{FB} and $P(\tau)$
4. $e^+e^- \rightarrow tt$ at $\sqrt{s}$ = 500 GeV. m_{top}, Γ_{top}, α_s, A_{FB}
5. $e^+e^- \rightarrow \chi^+\ \chi^-$, $e^+e^- \rightarrow \chi^0_2\,\chi^0_2$. σ, m

+ many with lower priority

New Benchmarks

3 sets

1. Detector capabilities at 1 TeV
2. „React to early LHC discoveries"
3. Precision Higgs Physics (old friends…)

New Benchmarks 1: High energy

- Mainly aiming at detector benchmarking/optimization/comparison to CLIC (?)

- not so much "new physics" driven but rather driven by
  "what´s different at 1 TeV"
  (more pencil-like jets and taus) + higher energies

1. $e^+e^- \rightarrow \nu\nu h^0$ at $\sqrt{s}$ = 1 TeV, m, h→bb and h→$\mu^+ \mu^-$

2. $e^+e^- \rightarrow t\bar{t}h^0$ at $\sqrt{s}$ = 1 TeV, m_h = 200 GeV, h→WW h→ZZ (10-jet mode !?)

3. $e^+e^- \rightarrow \tau^+ \tau^-$ at $\sqrt{s}$ = 1 TeV. A_{FB} and P(τ)

„narrow high-E objects"

4. $e^+e^- \rightarrow b\bar{b}, c\bar{c}$ at $\sqrt{s}$ = 1 TeV. σ, A_{FB}

5. $e^+e^- \rightarrow \nu\nu$ W/Z W/Z at $\sqrt{s}$ = 1 TeV. α_4 ,α_5 „the PFA classic"

New Benchmarks 2: React to „early" LHC

We don´t know what LHC will discover. It seems clear that we will be specifically asked what we can do better for the specific things LHC will have discovered.

So, we speculated about a few possible discoveries which are not so "standard" for ILC:

1. $e^+e^- \rightarrow \nu\nu h^0$ at $\sqrt{s}$ = 1 TeV, m_h = 200 GeV, h→bb and
   $e^+e^- \rightarrow tth^0$ at $\sqrt{s}$ = 1 TeV , m_h = 200 GeV - measure g_{hbb} and g_{htt}

2. $e^+e^- \rightarrow$ bb, cc, $\tau^+\tau^-$ at $\sqrt{s}$ = 500 GeV and 1 TeV - react to Z´ (1.5 TeV) discovery

3. $e^+e^- \rightarrow$ tt at $\sqrt{s}$ = 500 GeV - react to tt-resonance at 1 – 1.5 TeV

4. $e^+e^- \rightarrow$ stau stau, selectron selectron, $\chi\chi$ in GMSB with "stable" stau NLSP
   What can ILC add to LHC measuements?

New Benchmarks 3: Ultimate Higgs precision

Those are well known to us…

1. $e^+e^- \rightarrow h^0Z$ at $\sqrt{s} = 230$ GeV, $m_h = 120$ GeV

I believe, almost everything is done here – except for detailed dependence on $\sqrt{s}$ and lumi spectrum (→ Roman´s talk)

2. $e^+e^- \rightarrow h^0h^0Z$, $\nu\nu\, h^0h^0$ at $\sqrt{s} = 500$ GeV, $m_h = 120$ GeV

Well – somehow a leftover from LoI. Probably the most challenging Higgs analysis. Should not be forgotten.

Discussion & Feedback

How to proceed from here?

- RD has not yet formally circulated this to the LoI groups (?)
- Need discussion (also with SiD) about different levels of simulation for different classes of reactions
- Need discussion with SiD about common samples
- not to talk about identifying person-power…