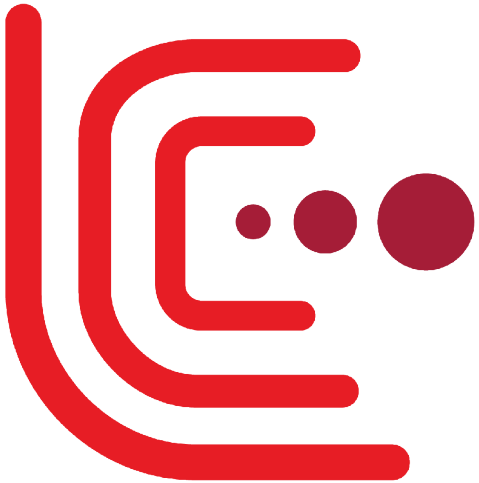
Report from Parameters Group



ILD Optimisation Meeting

February 26, 2014

J.List (DESY)

on behalf of the parameters group

A new Parameters Group

- Established in January by Hitoshi Yamamoto
- chaired by Jim Brau, further members:
  - Tim Barklow, Keisuke Fujii, JL
- Initial charge:
  - outline for key physics topics what integrated luminosity is needed at what energies
  - coherent discussion of issues regarding initial and evolution of the machine parameters up to 500 GeV
  - Work with accelerator, MDI, detector concept and physics groups
- Preliminary input to LCC/LCB meeting beginning of February

Key ideas in Initial Report to LCB

1) Start operation at 250 GeV, but move on to 350 GeV as soon as technically possible (cryomodules, cryo&RF power, operational issues)
2) Reconsider top baseline energy: 550 GeV
3) Include safety margins in energy reach (thresholds!)
4) Consider strategies for operation at
   - Z pole (for physics, with positron polarisation)
   - WW threshold (with positron polarisation)
   - ZH threshold scan

250 GeV vs 350 GeV: Higgs

- Higgs production through WW fusion
  → hWW coupling
  → much improved total width
  → much improved couplings from all σ x BR
- Backgrounds in the Higgs channels decrease by ~30% when 250 GeV → 350 GeV
- LoI / SB2009 studies (H. Li et al): measurements of σ x BR and total ZH cross-section at 350 GeV work as well or better than at 250 GeV
- Main weakness at 350 GeV: ultra-precise recoil mass limited by momentum resolution at 350 GeV
  → could always go back to 250 GeV if needed

250 GeV vs 350 GeV: Higgs

- H. Li, LCWS Beijing 2010:

Only muon-channel, Beam Pol. (e-: -80%, e+: +30%)

Beam Par	$\mathcal{L}_{\rm int}$ (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 ± 0.084	7.13 ± 0.28 (4.0%)
SB2009 w/o TF 250b	55	55%	62%	120.001 ± 0.079	11.63 ± 0.83 (7.2%)
SB2009 w/o TF 350	175	51%	92%	120.010 ± 0.110	7.13 ± 0.37 (5.2%)
SB2009 TF 250b	68	55%	62%	120.001 ± 0.071	11.63 ± 0.75 (6.4%)
SB2009 TF 350	250	51%	92%	120.010 ± 0.092	7.13 ± 0.31 (4.3%)

- Need to redo with 125 GeV, TDR beam parameters
- ILD specific: various TPC radii ….

→ SGV samples already available - thanks to Mikael!

250 GeV vs 350 GeV: Top, W ….& X?

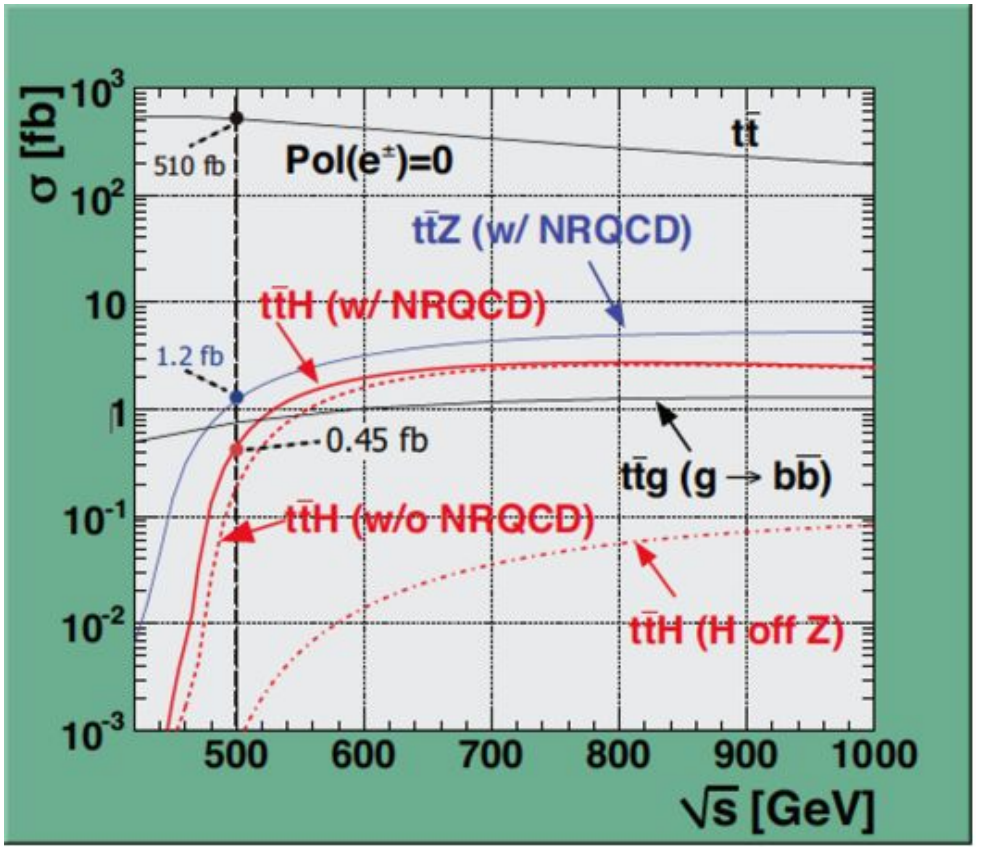
- Top physics starts:
  Threshold scan → top mass! Important input for
  - SM / SUSY fits
  - htt coupling extraction
- W anomalous couplings from W pair production: sensitivity grows quadratically with ECM
- Finally: There might be a discovery out there....

Choice of maximum baseline energy

- 500 is a number with two zeros at the end....
- Now that we know the Higgs mass – look at tth:

CME	sigma	% of max
500	0.36fb	15%
550	1.34fb	55%
600	2.01fb	82%
800	2.44fb	100%

X 3.7!!



=> 10% increase in energy enhances signal by 370%
while background decreases....

Safety Margins

- All three energies are defined by physics thresholds:
  - 250 GeV → Zh
  - 350 GeV → ttbar
  - 550 GeV → tth
- **How close do we have to get to these energies?**
  - 250 GeV: How much more lumi needed for same precision on Zh coupling when machine reaches 5% less, 10% less etc?
  - 350 GeV = 2x175 GeV => really at threshold! No ttbar physics possible if we don't get there!
  - 550 GeV: 10% less -> ~4x longer for same tth precision!

Physics running with ECM < 250 GeV

- The physics case for SM precision measurements strengthens with every fb^{-1} of LHC data without further discovery!
- from experiment side:
  - How much integrated luminosity with which polarisation needed for significant improvement over existing + HL-LHC measurements?
- from accelerator side:
  - First proposals for beam parameter sets, possibly several options to study

After the LCB meeting

Feed-back received via Hitoshi:

- Activity of parameters group was well received and its importance emphasized
- Will be promoted to joint working group with machine:
  - Nick Walker will become co-chair
  - further members tbc
- Sofar: mainly collected existing knowledge

=> to move on, we need dedicated studies - detector optimisation and "machine optimisation" need to be considered coherently!