Higgs physics group status and goals

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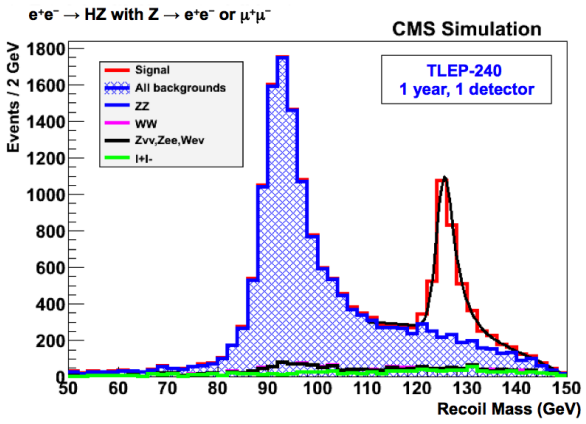
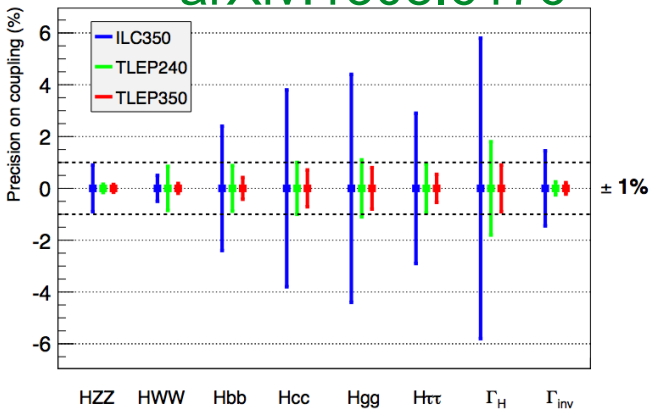
FCC-ee Higgs physics study group

TLEP case study: Model independent coupling measurements with sub-percent level experimental uncertainties



arXiv:1308.6176



Main goals towards the CDR:

- Identify the experimental opportunities
- Qualify the detector design

First Higgs mini-workshop in Sep. 2015

https://indico.cern.ch/event/401590/timetable/#all.detailed

Detector qualification

Goal: give our input to detector qualification with well defined Higgs physics benchmark processes

Repeat TLEP case study with CMS like and an ILC detector using the FCC software framework

- Also useful for cross checks with ILC studies
- Feedback to software development

Benchmark processes have been discussed/defined

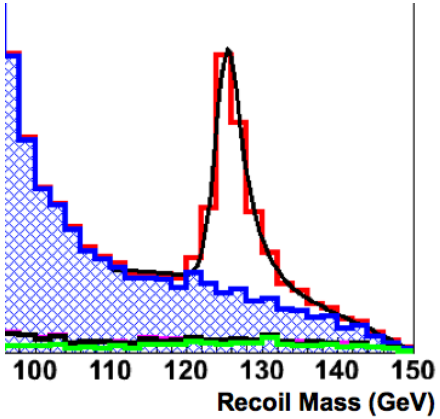
- Detector acceptance
- HF tagging
- Tracking resolution
- Jet resolution (direction and CAL E)
- EM resolution

Detector qualification cont.

Repeat benchmark analyses for different detector configurations and resolution/efficiency

- Example: Recoil mass measurement in Z(ll)H is a key aspect of the FCC-ee Higgs physics programme

  Study Z(μμ)H cross section and mH measurements as a function of the muon momentum resolution (start with perfect resolution and apply smearing)



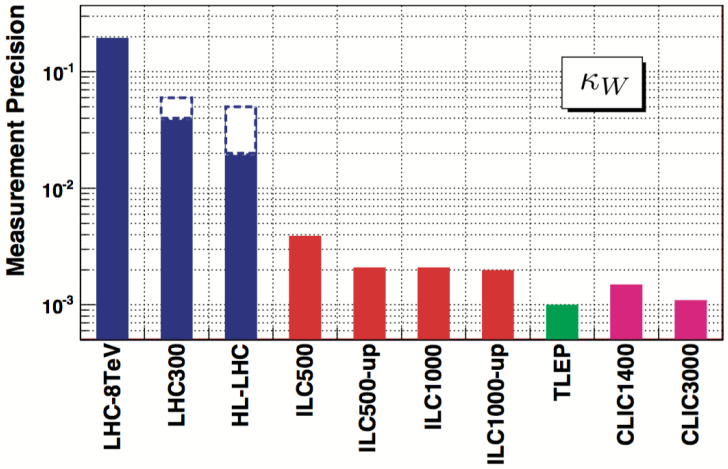
- Can be a very complex problem. Optimise detector to control experimental uncertainties, redundancy, calibration, alignment, etc.
- Focus first on signal reconstruction, increase complexity thereafter

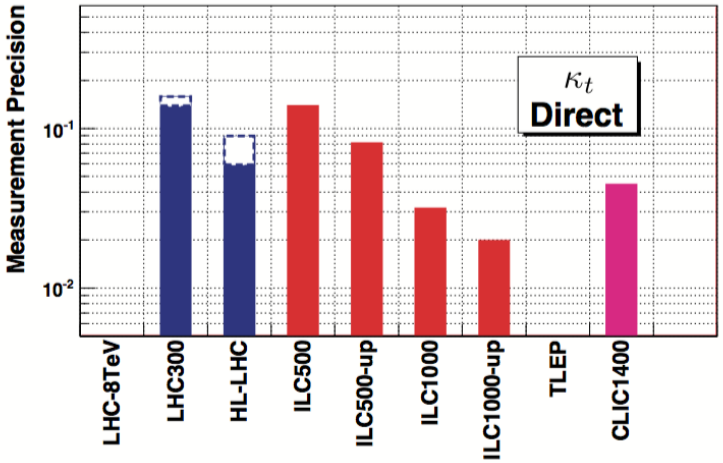
Probably the most important task towards the CDR!

Complementarity with other collider projects

Goal: document (quantify) complementarities with other collider projects

Many existing studies (c.f. Snowmass), especially with HL-LHC





Include FCC-hh: large energy and huge cross sections, optimal for rare decays and heavy states (but large backgrounds)

Muon collider as a Higgs factory (to most observables less precision)

Which precision to aim for in H couplings?

$\sigma \sim \sigma_{SM} (1+E^2/\Lambda^2)$ → for $\Lambda \sim 1$ TeV, need 1% couplings sensitivity

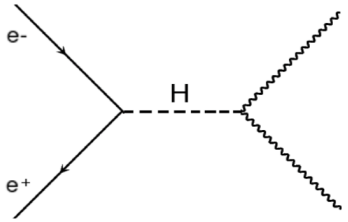
Goal: identify explicit examples where below % level sensitivity is needed

Interplay with other EW precision measurements

Beyond TLEP case study

Goal: collect and document ideas for Higgs physics beyond TLEP study (focused on SM H couplings)

Resonant H production is a very nice example (see next talk!)



CP measurements

Specific models for exotic Higgs production and decay

- E.g. Higgs production through sterile neutrinos, Higgs plus dark photon production etc.
- Many well motivated exotic Higgs decays (e.g. FCNC), need to quantify FCC-ee sensitivity and compare with HL-LHC/FCC-hh !

Summary

Main activities in the next year should focus on:

- Benchmark studies for detector qualification with FCC software
- Further ideas for FCC-ee Higgs physics studies (e.g. quantify sensitivity for exotic and rare decays)
- Document complementarities with other collider projects (especially with FCC-hh)
- Work out further motivations for the high precision which can be reached and interplay with other EW measurements

Many opportunities to contribute!

Theory input

Mostly addressed by Pheno. WG2

- Control of parametric uncertainties
- Higher order calculations for EWPO
- Significant work needed for Higgs production in e^+e^- (2 loop EW)
- Higgs decays mostly under control to meet experimental precision

MC tools

- Not important yet for most of the projection studies
- Crucial to have higher order MC tools for actual measurements