Higgs/Top Performance meeting

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News

Feasibility Study Report (FSR)

- First draft to be ready by the end of the year (for the SPC)
- Internal noted to be submitted to CDS by **Nov 18** for reviews
  - Keep us posted of your plan/status

Procedure for submission

- CDS community https://repository.cern/communities/fcc-ped-sub/
  -> “new upload”
- Visibility: “full record -> public”, “files only” -> restricted
- Already have DOI? -> Get a new DOI
- Awards/Grants -> FCCIS - Future Circular Collider Innovation Study
- Submit for review (PED conveners will accept and make public)

Table 3. From Ref. [4]: Relative uncertainty (in %) on $\sigma_{ZH} \times \mathcal{B}(H \to X\bar{X})$ and $\sigma_{\nu_e\bar{\nu}_e H} \times \mathcal{B}(H \to X\bar{X})$, as expected from the FCC-ee data at 240 and 365 GeV.

$\sqrt{s}$	240 GeV		365 GeV	
Integrated luminosity	$10.8\,ab^{-1}$		$3.0\,ab^{-1}$	
Channel	ZH	$\nu_e\bar{\nu}_e$ H	ZH	$\nu_e\bar{\nu}_e$ H
$H \to$ any	±0.36		±0.6	
$H \to b\bar{b}$	±0.20	±2.1	±0.35	±0.6
$H \to c\bar{c}$	±1.5	?	±4.4	±7.1
$H \to gg$	±1.3	?	±2.5	±3.2
$H \to W^+W^-$	±0.8	?	±1.8	±2.1
$H \to ZZ$	±3.0	?	±8.5	±7.1
$H \to \tau^+\tau^-$	±0.6	?	±1.3	±5.7
$H \to \gamma\gamma$	±6.1	?	±13	±16
$H \to Z\gamma$	??	??	??	??
$H \to \mu^+\mu^-$	±13	?	±28	
$H \to$ invisible	< 0.2	?	< 0.4	

Conferences and Events

Next Higgs/Top meeting 19 November, zoom only

- https://indico.cern.ch/event/1474959/

FCC physics workshop, 13-17 Jan, CERN

- https://indico.cern.ch/event/1439509/
- We will call for contributions

Agenda for today

14:00 → 14:10 **News** — 10m

Speakers: Andrew Mehta (University of Liverpool (GB)), Jan Eysermans (Massachusetts Inst. of Technology (US)), Xunwu Zuo (KIT - Karlsruhe Institute of Technology (DE))

14:10 → 14:30 **Htautau** — 20m

Speakers: Sofia Giappichini (KIT - Karlsruhe Institute of Technology (DE)), Xunwu Zuo (KIT - Karlsruhe Institute of Technology (DE))

14:30 → 14:50 **Top threshold scan** — 20m

Speakers: Ankita Mehta (CERN), Matteo Defranchis (CERN)

14:50 → 15:10 **Exotic top decays at FCC** — 20m

Speakers: Barbara Mele, Dibyashree Sengupta, Gennaro Corcella (INFN - LNF)

15:10 → 15:30 **Constraining CP-violating contributions in the Higgs-strahlung process at FCC-e** — 20m

Speakers: Andrei Gritsan (Johns Hopkins University (US)), Lucas Mandacaru Guerra (Johns Hopkins University (US)), Nicholas Pinto (Johns Hopkins University (US)), Valdis Slokenbergs (Texas Tech University (US))

15:30 → 15:50 **H->ZZ*** — 20m

Speakers: Ines Combes (Université Paris-Saclay (FR)), Marco Delmastro (CNRS/IN2P3 LAPP), Nicolas Morange (Université Paris-Saclay (FR))

higgs_width_combe...

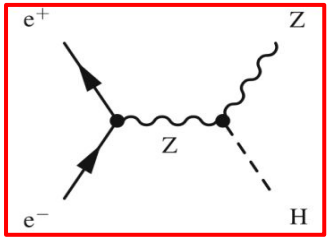
Backup

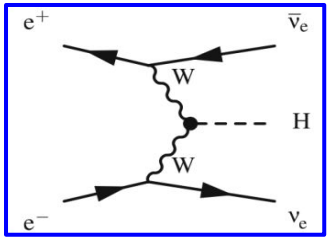
Splitting production mechanisms at 365 GeV

FUTURE CIRCULAR COLLIDER

At 365 GeV center-of-mass, significant contribution from VBF vvH

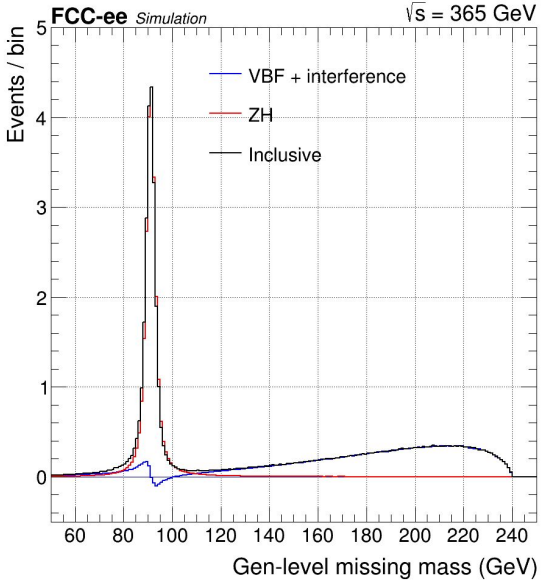
- This interferes with the ZH process where Z→vv
- The samples (e.g. `wzp6_ee_nunuH_Hbb_ecm365`) we have are inclusive:
  - Contains ZH + VBF + interference
- For cross-section analyses and couplings, need to split the production mode





Recipe to split the production mode

- **For ZH:** use muon neutrino sample with weight 3
- **For VBF:** use (veveH – vmuvmuH)
  - Contains the pure VBF component + interference



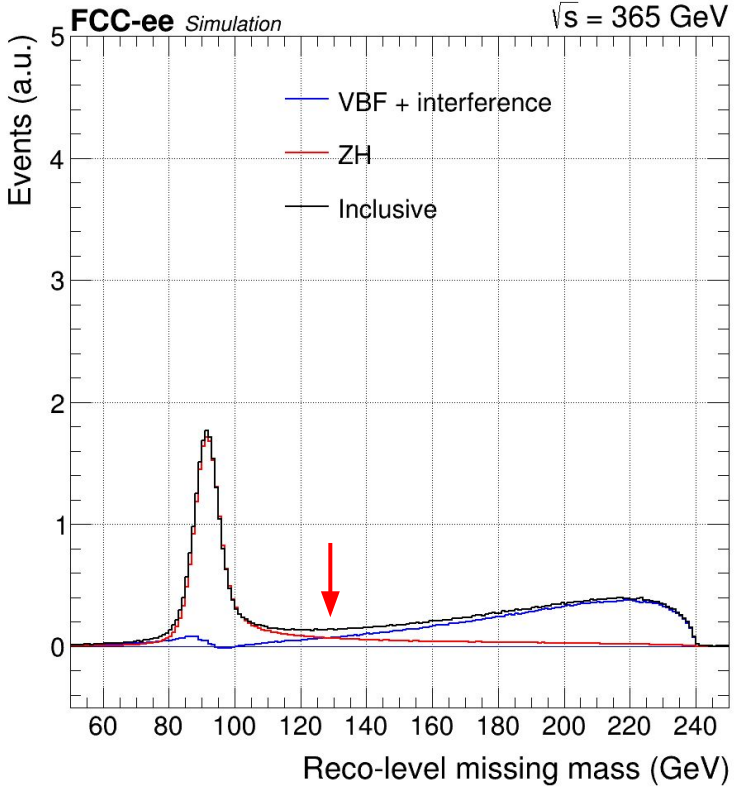
All splitted samples have been produced

- Inclusive: `wzp6_ee_nunuH_HXX_ecm365`
- Muon neutrino: `wzp6_ee_numunumuH_HXX_ecm365`
- Electron neutrino: `wzp6_ee_nuenueH_HXX_ecm365`

Splitting production mechanisms at 365 GeV

One can select more pure regions for both production modes for further background suppression

- Cut or categorize the events by using a cut on the missing mass at 130 GeV
- Nevertheless, both production processes have to be taken into account separately



Where are we today?

Made a lot of progress over the past years, mainly focused at the 240 GeV threshold, but effort at 365 has started

Missing elements for the Feasibility Study

- Higgs @ 240 GeV: **WW, ZZ, tautau** (expansion of H width efforts)
  - Work started on tautau and Z(jj)H(4l)
  - See updates today
- Higgs @ 365 GeV
  - Use the tagger trained at 240 GeV
  - (ZH, vvH)→bb (width), ZH→ WW

Parameter	FCC-ee CDR	FCCee today
H→WW	1 %	2.0 %
H→ZZ	3.6 %	4.6 %
H→gg	1.6 %	0.94 %
H→γγ	7.5 %	3.5 %
H→cc	1.8 %	1.92 %
H→bb	0.25 %	0.22 %
H→μμ	15.8 %	19.5 %
H→ττ	0.75 %	0.9%
H→Zγ		
H→ss	–	124 %
Invisible	< 0.25 %	< 0.18 %
m_H	5 MeV	4 MeV
Γ_H	1 %	4%
κ_λ	42 %	30%

Conferences and Events

Procedure for conferences

In general, contact us (conveners) in case you would like to present material at a conference

- All abstracts have to be approved by the Higgs/Top conveners and then conference committee
- After approval, the author is responsible for abstract submission to the conference
- Abstracts should be registered in the conf. database: https://fcc-ee-conference.web.cern.ch/

Sample production

Produced large batch of samples at 365 GeV for Top/Higgs studies – thanks Louis Portales!

Samples are here: https://fcc-physics-events.web.cern.ch/fcc-physics-events/FCCee/winter2023/Delphesevents_IDEA.php

- **Higgs samples**
  - All samples produced Z(XX)H(YY) with Whizard @365
  - wzp6_ee_mumuH_ecm365 produced with identical seed → being reproduced now
  - FCNC Whizard cards debugged but to be produced centrally
- **Top samples**
  - WbWb split in hadronic, semileptonic, and leptonic (Whizard)
  - Center-of-mass energies 345, 350, 355 and 365 GeV
- **Background samples**
  - WW/ZZ Pythia
  - Z/γ with Whizard – also Pythia under production to have same generator as 240 GeV (p8_ee_Zqq_ecm365)
  - Rares

Let us know if you need additional samples