

# Higgs/Top Performance meeting

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## Feasibility Study Report

- First draft to be ready by the end of the year (for the SPC)
  - Draft v0 for internal PED review by end of September!
    - analysis note drafts ready by early September

## 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/>

# 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)
  - Newcomer (Yehia Mahmoud on Z(jj)H(4l))
- Higgs @ 365 GeV
  - re-train tagger (in progress)
  - the total cross-section,
  - (ZH,  $\nu\nu$ H) $\rightarrow$ bb (width), ZH $\rightarrow$  WW

Parameter	FCC-ee CDR	FCce today
H $\rightarrow$ WW	1 %	2.0 %
H $\rightarrow$ ZZ	3.6 %	4.6 %
H $\rightarrow$ gg	1.6 %	0.94 %
H $\rightarrow$ $\gamma\gamma$	7.5 %	3.5 %
H $\rightarrow$ cc	1.8 %	1.92 %
H $\rightarrow$ bb	0.25 %	0.22 %
H $\rightarrow$ $\mu\mu$	15.8 %	19.5 %
H $\rightarrow$ $\tau\tau$	0.75 %	0.9%
H $\rightarrow$ Z $\gamma$		
H $\rightarrow$ ss	–	124 %
Invisible	< 0.25 %	< 0.18 %
$m_H$	5 MeV	4 MeV
$\Gamma_H$	1 %	4%
$\kappa_\lambda$	42 %	30%

# What we need for the FSR

**Table 1.** From Ref. [4]: Relative uncertainty (in %) on  $\sigma_{ZH} \times \mathcal{B}(H \rightarrow X\bar{X})$  and  $\sigma_{\nu_e \bar{\nu}_e H} \times \mathcal{B}(H \rightarrow X\bar{X})$ , as expected from the FCC-ee data at 240 and 365 GeV.

$\sqrt{s}$	240 GeV		365 GeV	
Integrated luminosity	5 ab <sup>-1</sup>		1.5 ab <sup>-1</sup>	
Channel	ZH	$\nu_e \bar{\nu}_e H$	ZH	$\nu_e \bar{\nu}_e H$
H → any	±0.5		±0.9	
H → b $\bar{b}$	±0.3	±3.1	±0.5	±0.9
H → c $\bar{c}$	±2.2		±6.5	±10
H → gg	±1.9		±3.5	±4.5
H → W <sup>+</sup> W <sup>-</sup>	±1.2		±2.6	±3.0
H → ZZ	±4.4		±12	±10
H → $\tau^+ \tau^-$	±0.9		±1.8	±8
H → $\gamma\gamma$	±9.0		±18	±22
H → $\mu^+ \mu^-$	±19		±40	
H → invisible	< 0.3		< 0.6	



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

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

- Obtain results **sigma\*BR** results:
  - center of mass energy (240: **10.8 ab-1** /365 **3 ab-1**)
    - production mode (assuming no interference, ZH, vvH)

## ICHEP, 18-24 July, Prague

- <https://indico.cern.ch/event/1291157/>
  - Talk “Higgs physics opportunities at the FCC” (Giovanni Marchiori)
  - Poster on Higgs mass/ZH cross-section of 240+365 GeV (Gregorio B, Ang. L, Kevin D, Jan E.)

## Higgs Hunting, 23-25 September, Paris

- <https://indico.ijclab.in2p3.fr/event/10259>
- Looking for a speaker for 12 min talk Higgs @ FCC-ee – please nominate someone or yourself
  - <https://fcc-ee-conference.web.cern.ch/database/conference/981/presentation/1096/>

## **Higgs 2024, 4–8 November, Uppsala**

- <https://indico.cern.ch/event/1391236/>
- Looking for abstracts/speakers for 3 talks
  - Higgs at FCC-hh
  - Higgs couplings and detector requirements
  - Higgs properties (mass/width/CP) and det. req

## **ECFA workshop on EWK factories, 9-11 October, Paris**

- <https://indico.cern.ch/event/1399276/>

## **2nd FCC Italy-France Workshop, 4-6 November, Venice**

- <https://agenda.infn.it/event/37960/>


# Agenda for today



## Higgs/Top Performance meeting 📄

📅 Tuesday Jul 16, 2024, 2:00 PM → 4:05 PM Europe/Brussels

📍 4/S-020 (CERN)

Videoconference  Higgs Performance meeting ▶ Join 📺 4/S-020 ▾

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**2:00 PM** → 2:20 PM **News** 🕒 20m 📄

**Speakers:** Jan Eysermans (Massachusetts Inst. of Technology (US)), Michele Selvaggi (CERN)

**2:20 PM** → 2:40 PM **H(jj) final states, combination and update at 365 GeV** 🕒 20m 📄

**Speakers:** Alexis Maloizel (APC, CNRS/IN2P3 and Université Paris Cité (FR)), George Iakovidis (Brookhaven National Laboratory (US)), Giovanni Marchiori (APC, CNRS/IN2P3 and Université Paris Cité)

**2:40 PM** → 3:00 PM **Lambda coupling measurement at FCC-hh** 🕒 20m 📄

**Speakers:** Bastien Voirin, Mr Claude Charlot (Centre National de la Recherche Scientifique (FR))

**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/Delphisevents\\_IDEA.php](https://fcc-physics-events.web.cern.ch/fcc-physics-events/FCCee/winter2023/Delphisevents_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
- $Z/\gamma$  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**