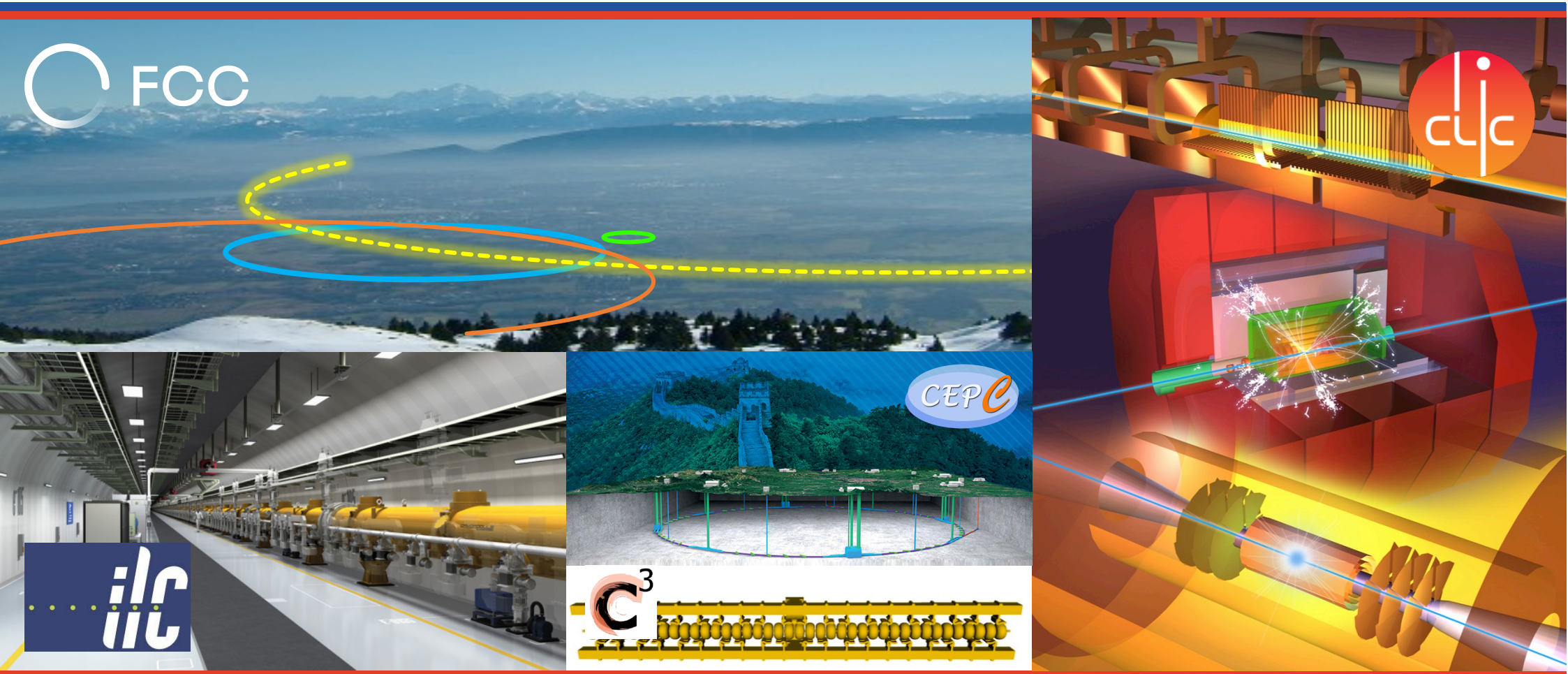


# ECFA studies towards an $e^+e^-$ Higgs/EWK/top factory



PPAP Community Meeting, 7 July 2023, Birmingham  
Aidan Robson, University of Glasgow

# ECFA studies towards an $e^+e^-$ Higgs/EWK/top factory

## High-priority future initiatives

*European Strategy Update 2020*

A. An electron-positron Higgs factory is the highest-priority next collider.

## *Snowmass 21 Energy Frontier Vision*

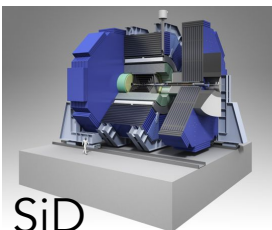
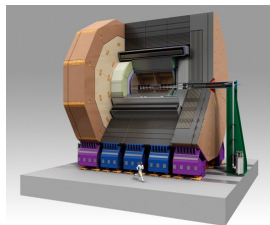
### The intermediate future is an $e^+e^-$ Higgs factory

The intermediate future is an  $e^+e^-$  Higgs factory, either based on a linear (ILC, C<sup>3</sup>, CLIC) or circular collider (FCC-ee, CepC).

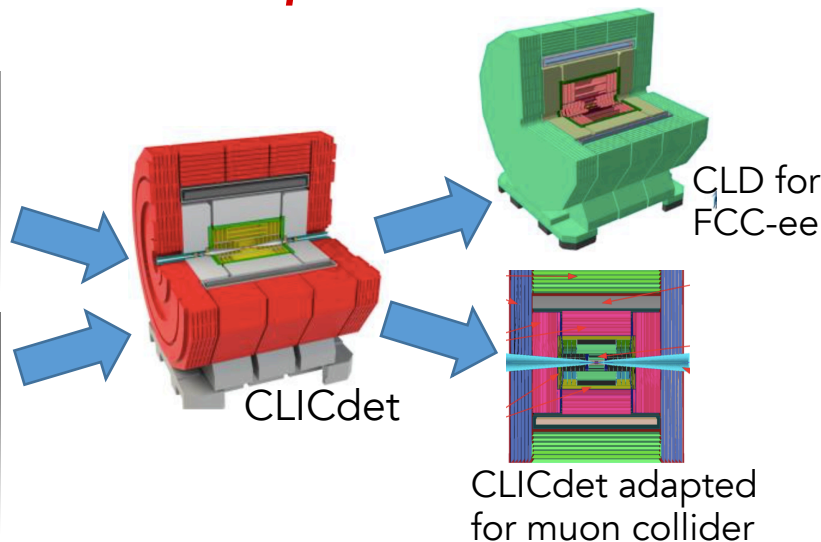
- The various proposed facilities have a strong core of common physics goals: it is important to realize at least one somewhere in the world.

- ◆ *Much in common cross-project on Physics programme, Detector concepts & development etc*

ILD



SiD



- ◆ *ECFA study is intended to:*
    - bring together communities & activities
    - explore synergies
    - discuss challenges
- input to next European Strategy Update



# ECFA Working Group activities

- ◆ WG1: **Physics programme** conveners Fabio Maltoni, Jenny List, Jorge de Blas, Patrick Koppenburg
- ◆ WG2: **Physics analysis methods** conveners Patrizia Azzi, Fulvio Piccinini, Dirk Zerwas
- ◆ WG3: **Detector technologies** conveners Felix Sefkow, Mary Cruz Fouz, Giovanni Marchiori
- ◆ **study chief editor** Aidan Robson, recently joined by Christos Leonidopoulos

*→ Rich programme of seminars, topical meetings, mini-workshops open to all to participate*

## ◆ WG1: Physics programme

WG1-SRCH: Direct searches (weakly-interacting, directly accessible particles)

Feb 2022 Brainstorming session

May 2022 ECFA HF WG1: 1st Workshop of the WG1-SRCH group

Feb 2023 Heavy Neutral Lepton search potential of future HET factories

Apr 2023 Standard and exotic Scalars at future HET factories

Jun 2023 BSM top quark focus meeting

WG1-PREC: theoretical and experimental precision

Mar 2022 MiniWorkshop: high-precision measurements

Mar 2022 MiniWorkshop: parametric uncertainties:  $\alpha_s$

July 2022 MiniWorkshop: parametric uncertainties:  $\alpha_{em}$

Nov 2022 MiniWorkshop: collision energy

Dec 2022 MiniWorkshop: luminosity

July 2023 MiniWorkshop: cross-section lineshapes

WG1-HTE: specific Higgs/Top/EW studies (+ connection w/ LHC)

Apr 2022 1st Workshop of the Higgs/Top/EW group

Sept 2022 ECFA HTE meeting on Z pole physics

Feb 2023 mini-workshop on e+e- physics at 125 and 160 GeV

May 2023 mini-workshop on e+e- physics at 160-240 GeV

WG1-GLOB: global interpretations

Sept 2022 Analyses of concrete models

July 2022 Global interpretations in (SM)EFT and UV complete models

Sept 2022 Analyses of concrete models

June 2023 ttbar threshold

March 2023

31 Mar ECFA Higgs Factory seminars: New Particle Searches at Future e+e- colliders

January 2023

20 Jan ECFA Higgs Factory seminars: Top Physics at Future e+e- colliders

November 2022

25 Nov ECFA Higgs Factory seminars: Flavor Physics at Future e+e- colliders

June 2022

10 Jun ECFA Higgs Factory seminars: Precision physics in the e+e- → WW region

07 Jun - 17 Jun Precision calculations for future e+e- colliders: targets and tools (FC CERN Unit Workshop)

May 2022

06 May ECFA Higgs Factory seminars: Higgs self-coupling

April 2022

08 Apr ECFA Higgs Factory seminars: Physics with light quarks

March 2022

04 Mar ECFA Higgs Factory seminars: Implications of (g-2)<sub>μ</sub> for e+e- Higgs factories: an

# ECFA Working Group activities

## ◆ WG2: Physics analysis methods

9-10 Nov 2021 1st Topical Meeting on Generators

<https://indico.cern.ch/event/1078675/>

12 Jan 2022 Focus Meeting: Beamstrahlung

<https://indico.cern.ch/event/1100734/>

1-2 Feb 2022 1st Topical Meeting on Simulation

<https://indico.cern.ch/event/1097819/>

4-5 May 2022 1st Topical Meeting on Reconstruction

<https://indico.cern.ch/event/1124095/>

21-22 June 23 2<sup>nd</sup> Topical Meeting on Generators (Brussels)

<https://indico.cern.ch/event/1266492/>

11-12 July 2<sup>nd</sup> Topical Meeting on Reconstruction (CERN)

<https://indico.cern.ch/event/1283129/>



## ◆ WG3: Detector technologies

3-4 May 23 Topical workshop on Calorimetry, PID, and Photodetectors (CERN)

<https://indico.cern.ch/event/1256374/>

30-31 May 23 Topical workshop on Tracking and Vertexing (CERN)

<https://indico.cern.ch/event/1264807/>



Bridging DRDs and detector concepts

Concrete initiatives emerging:  
Generator technical benchmarking  
Beam spectrum library

Main entry point for study – all activities and mailing lists:

<https://indico.cern.ch/event/1044297/page/22669-overview>

# Focus Topics

- ◆ Priority for ECFA study: **increase the active e+e- community**  
 → developing detailed work list for each of 15 'focus topics' to  
 lower threshold for participation and bring people to work  
 together cross-project – great opportunity for those looking to join

1. H→ss
2. ZH angular distributions / CP studies
3. Higgs self-coupling
4. W mass at threshold and continuum
5. Full studies of WW and evW processes, aTGCs
6. Top threshold
7. Luminosity measurement
8. New exotic scalars
9. Long-lived particles
10. Exotic top decays
11. CKM matrix elements w/ on-shell & boosted Ws
12.  $B \rightarrow K^{0*} \tau^+ \tau^-$
13. EWK precision: 2-fermion final states
14. Measurement of b- and c-fragmentation functions  
/ hadronisation
15. Measurement of gluon splitting to bb / cc  
& interplay with separating  $h \rightarrow$  gluons from  $h \rightarrow$  bb/cc

	relevant $\sqrt{s}$				
	91 GeV	161 GeV	240/250 GeV	350-380 GeV	$\geq 500$ GeV
1			X	X	x
2			X	X	x
3			X	X	X
4		X	X	X	
5			X	X	x
6				X	
7	X	x	x	x	x
8	x	x	x	x	x
9	x	x	x	x	x
10				x	x
11		x	X	x	x
12	X				
13	X	X	X	X	X
14	X	x	X	X	x
15	X	x	X	X	x

→ detailed launch / dedicated discussions on each topic at October workshop

# 2<sup>nd</sup> ECFA Workshop, Paestum 11–13 October 2023

- ◆ Hosted by INFN Napoli, Università degli Studi di Napoli Federico II & Università degli Studi di Napoli Parthenope

- ◆ **Abstracts for parallel talks & posters: submission deadline 15<sup>th</sup> July:**  
<https://agenda.infn.it/event/34841/>

## SECOND • ECFA • WORKSHOP on $e^+e^-$ Higgs / Electroweak / Top Factories

11-13 October 2023  
Paestum / Salerno / Italy

### Topics:

- Physics potential of future Higgs and electroweak/top factories
- Required precision (experimental and theoretical)
- EFT (global) interpretation of Higgs factory measurements
- Reconstruction and simulation
- Software
- Detector R&D

The European Committee for Future Accelerators (ECFA) organises a series of workshops on physics studies, experiment design and detector technologies towards a future electron-positron Higgs/electroweak/Top factory.

The aim is to bring together the efforts of various  $e^+e^-$  projects, to share challenges and expertise, to explore synergies, and to respond coherently to this high-priority item of the European Strategy for Particle Physics

- ◆ Low cost (€460 full board, single-room accommodation) → encourage wide participation especially among early-career researchers
- ◆ Outline agenda available on indico site – intended as real ‘working’ workshop with plenty of discussion time
- ◆ Software tutorial on 10<sup>th</sup> October before main workshop – aimed at beginners to Key4hep – **please register for this by 15<sup>th</sup> July**

***Everyone is encouraged to come!***

- ◆ Programme ctte:

Patrick Koppenburg, Jenny List, Fabio Maltoni, Jorge de Blas  
Patrizia Azzi, Fulvio Piccinini, Dirk Zerwas  
Mary Cruz Fouz, Giovanni Marchiori, Felix Sefkow  
Christos Leonidopoulos, Aidan Robson

# Backup



# 1<sup>st</sup> ECFA workshop, DESY 5–7 October 2022

<https://indico.desy.de/event/33640/>

- ◆ 200 registrants in person and 145 online
- ◆ Plenary & parallel sessions, organised by WG conveners
- ◆ Poster session
- ◆ Public evening event

**→ Great to see so many people in Hamburg**



# First ECFA WORKSHOP.

**on e<sup>+</sup>e<sup>-</sup> Higgs / Electroweak / Top Factories**  
**5-7 October 2022, DESY, Hamburg**

### Topics:

- Physics potential of future Higgs and electroweak/top factories
- Required precision (experimental and theoretical)
- EFT (global) interpretation of Higgs factory measurements
- Reconstruction and simulation
- Software
- Detector R&D

## INTERNATIONAL ADVISORY

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The European Committee for Future Accelerators (ECFA) organises a series of workshops on physics studies, experiment design and detector technologies towards a future electron-positron Higgs/Electroweak/Top factory.

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QUANTUM UNIVERSE



<https://indico.desy.de/event/33640/>

*Local organisers:* **Ties Behnke**, Freya Blekman, Frank Gaede, Elisabetta Gallo, Alexander Grohsjean, Christophe Grojean, Johannes Haller, Katja Krüger, Gudrid Moortgat-Pick, Krisztian Peters, Jürgen Reuter, **Christian Schwanenberger**, Felix Sefkow, Marcel Stanitzki, Georg Weiglein