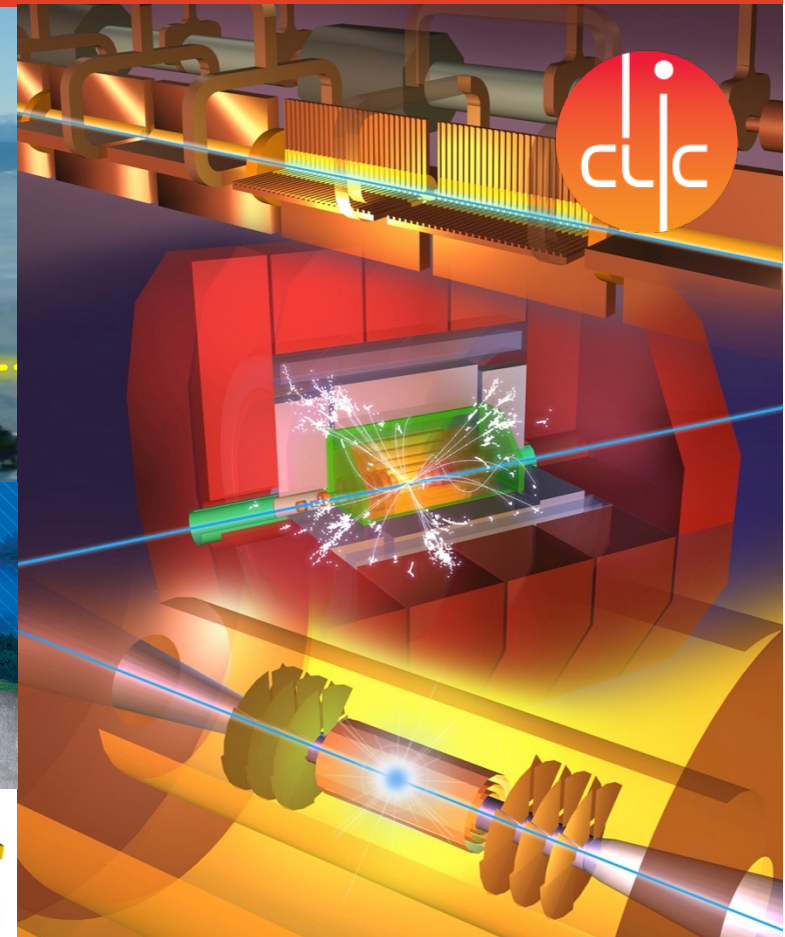
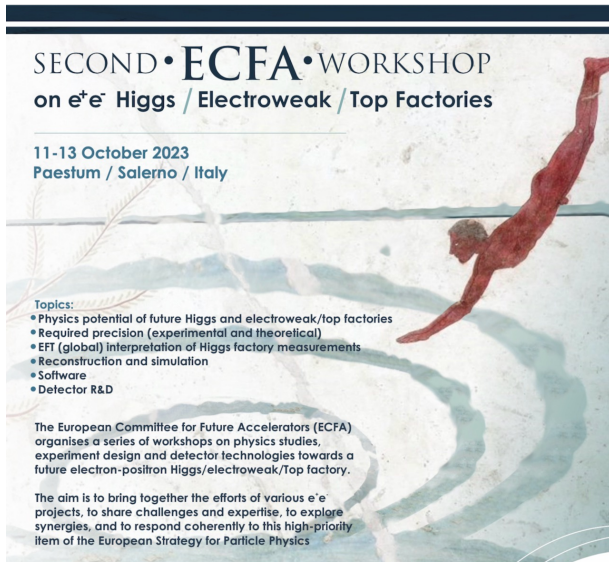


ECFA Higgs Factory Study Update



European LC Meeting, 9 November 2023

Aidan Robson, University of Glasgow



2nd ECFA workshop 11-13 October, Paestum

138 participants

Representatives from all 3 regions

Representatives from all e^+e^- concepts

ILC, CLIC, FCCee, CEPC, C³, HALHF

Pre-workshop software tutorial:

30 participants

Very good collaborative atmosphere

Very nice plenary talks and lively parallel sessions



Focus topics

- ◆ **Focus topics** were a major element of the workshop
 - presenting status from expert teams,
 - gathering wider input and finalising descriptions

Focus topics are intended to encompass a wide range of activities spanning theory & experiment, analysis & algorithm development, and detector requirements & optimisation

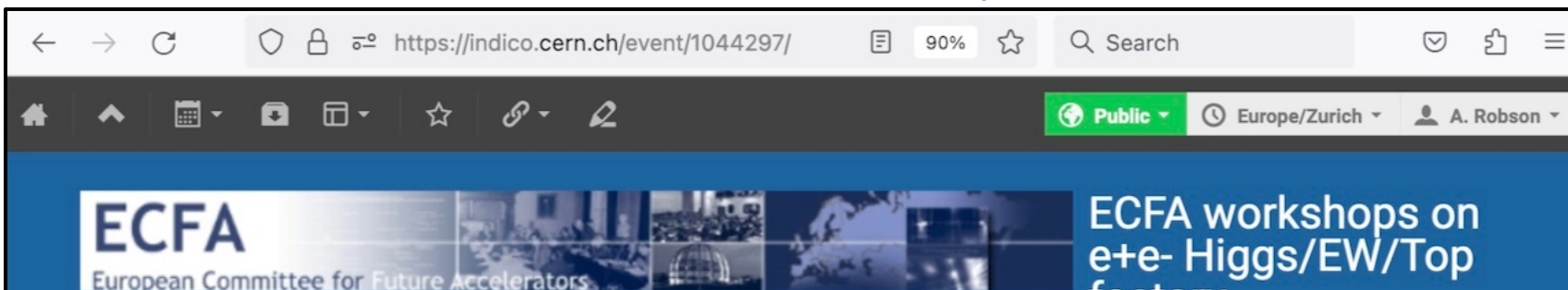
- **HtoSS**: $e^+e^- \rightarrow Zh: h \rightarrow ss$
- **ZHang**: ZH angular distributions and CP studies
- **Hself**: Determination of the Higgs self-coupling
- **Wmass**: Mass and width of the W boson
- **WWdiff**: Full studies of WW and evW
- **TTthresh**: Top threshold - detector-level studies of $e^+e^- \rightarrow t\bar{t}$
- **LUMI**: Precision luminosity measurement
- **EXscalar**: New exotic scalars
- **LLPs**: Long-lived particles
- **EXtt**: Exotic top decays
- **CKMWW**: CKM matrix elements with on-shell and boosted W decays
- **BKtautau**: $B^0 \rightarrow K^{0*}\tau^+\tau^-$
- **TwoF**: EW precision - 2-fermion final states
- **BCfrag/Gsplit**: Measurement of b - and c -fragmentation functions and hadronisation rates and measurement of gluon splitting to $b\bar{b} / c\bar{c}$

- ◆ **Overall aim: accumulate critical mass working on each topic, reaching publications on timescale of ECFA study**

Focus topics

◆ Collaborative resources:

<https://indico.cern.ch/event/1044297/>



<https://gitlab.in2p3.fr/ecfa-study/ECFA-HiggsTopEW-Factories/-/wikis/FocusTopics>

A screenshot of the GitLab Wiki page for Focus Topics. The page is titled "FocusTopics" and contains text describing the ECFA Higgs / Top / Electroweak Factory study. A red arrow points from the "Focus Topics" link in the left sidebar to the main content. The page includes a list of focus topics and a list of working groups (WG1, WG2, WG3).

ECFA-Study > ECFA HiggsTopEW Factories > Wiki > FocusTopics

FocusTopics

The ECFA Higgs / Top / Electroweak Factory study has been set up to expand the e^+e^- community, bringing people together across the various e^+e^- projects to share expertise and tools and to work coherently on scientific and technical topics.

The focus topics are specific areas in which the ECFA study could reach significantly beyond the state-of-the-art understanding of the physics potential of future e^+e^- Higgs / top / EW factories. The topics do not aim to comprehensively map the physics program of a future Higgs factory. Instead, they should serve to:

- complete the current overall picture where (most) necessary;
- give guidance to people who would like to contribute to the ECFA study;
- highlight processes particularly suitable for studying the interplay of the three working areas of the ECFA study: physics potential, analysis methods, and detector performance.

The topics can therefore act as a vehicle for new engagement and collaboration. They are intended as a basis that could be expanded later. The initiative should build on existing analysis tools and samples that can be shared among the projects and developed cooperatively, and it therefore highlights where existing examples, including analysis code and datasets, could be taken as a starting point, particularly by new entrants. All experimental simulation studies are strongly encouraged to use the KEY4HEP framework. This will translate into new tools usable by the whole community and thoroughly tested, and will improve already existing or interfaced tools.

Focus Topics index:

- **HtoSS**: $e^+e^- \rightarrow Zh: h \rightarrow ss$
- **ZHang**: ZH angular distributions and CP studies
- **Hself**: Determination of the Higgs self-coupling

Higgs Top EW factories

- WG1 physics performance
 - WG1-FLAV
 - WG1-GLOB
 - WG1-HTE
 - WG1-PREC
 - WG1-SRCH
- WG2 Physics analysis methods
- WG3 Detector R&D
- Focus Topics
 - HtoSS
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Focus topics

◆ Collaborative resources:

<https://gitlab.in2p3.fr/ecfa-study/ECFA-HiggsTopEW-Factories/-/wikis/FocusTopics>

FocusTopics

The ECFA Higgs / Top / Electroweak Factory study has been set up to exist together across the various e^+e^- projects to share expertise and tools across technical topics.

The focus topics are specific areas in which the ECFA study could reach a comprehensive understanding of the physics potential of future e^+e^- Higgs / top / EW factories. We will comprehensively map the physics program of a future Higgs factory. In

- complete the current overall picture where (most) necessary;
- give guidance to people who would like to contribute to the ECFA study;
- highlight processes particularly suitable for studying the physics potential, analysis methods, and detector R&D.

The topics can therefore act as a vehicle for new ideas and collaborative work. The initiative should be expanded later. The existing analysis topics from the projects and developed cooperatively, and it therefore highlights where new ideas and datasets, could be taken as a starting point, particularly by new entrants. It is strongly encouraged to use the KEY4HEP framework. This will translate into a more and thoroughly tested, and will improve already existing or interfaced to

Focus Topics index:

- **HtoSS:** $e^+e^- \rightarrow Zh: h \rightarrow ss$
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example:

HtoSS

$e^+e^- \rightarrow Zh: h \rightarrow ss$

The study of the Higgs boson coupling to the strange quark ($h \rightarrow s\bar{s}$) has been gathering increasing interest and crosses all three ECFA working groups: prospective physics sensitivity, algorithm development, and detector design optimization.

Focus group:

HTE

WG1 coordinator contact:

Jorge de Blas

Expert team:

Caterina Vernieri, Valentina Cairo, Taikan Suehara, Loukas Gouskos, Matt Basso, John Alison, Yotam Soreq, Valerio Dao, Karsten Koeneke (HTE convener)

Email list:

CERN e-groups: ECFA-WHF-FT-HSS

Updates

- [Plenary report at Paestum workshop, 11/10/23](#)
- [Parallel report at Paestum workshop, 11/10/23](#)

Higgs Top EW factories

- WG1 physics performance
 - WG1-FLAV
 - WG1-GLOB
 - WG1-HTE
 - WG1-PREC
 - WG1-SRCH
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 - Wmass
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 - TTthresh
 - LUMI
 - EXscalar
 - LLPs

in2p3 gitlab chosen for straightforward access via eduGain (can use institutional login; does not require full CERN account)

Focus topics

◆ Next steps:

- ◆ Document with detailed topics description will appear on arXiv ~ mid-November
- ◆ Wiki pages will be updated with working lists; everyone will be invited to subscribe to activities
- ◆ Working meetings for each topic will follow, in the framework of the ECFA WG1 focus groups

What can I do?: * if not already involved!

- think where your interests could align with the focus topics
- plan your involvement
- recruit your colleagues/students
- respond to calls to subscribe to focus topic activities
- participate in dedicated working meetings over the timescale of 12–18 months
- prepare papers and report contributions

Wider studies

- ◆ Rich wider programme of studies ongoing in community (as seen in workshop parallel sessions and plenary summaries)...
...that are contributing to ECFA study and will feature in final report
- ◆ First attempt made last year to sketch topical report chapters – to be pursued soon – very open approach, led by ECFA WG1 topical group conveners and WG2/WG3 coordinators
- ◆ All contributions welcomed warmly

Very preliminary sketch of WG1-FLAV report topics

- 5.1 CKM profile prospects
Leptonic decays and magnitude of the CKM matrix elements
CKM from hadronic decays
Global analyses. NP in neutral meson mixings
- 5.2 Rare decays of b- and c-flavoured particles
Flavour anomalies and related channels
LFU tests, angular observables, ...
- 5.3 Theory challenges
Expected precision from Lattice QCD
Prospects for $b \rightarrow s(d)l^+ l^-$ ($l = e, \mu, \tau$) predictions
Prospects for predictions of semileptonic decays
Impact of QED uncertainties
- 5.4 τ Physics
LFU tests in τ decays
LFV from τ decays
- 5.5 Heavy Flavour spectroscopy
- 5.6 Flavour Physics from $e e \rightarrow qq^+$
- 5.7 Interplay with top, Higgs and electroweak precision measurements

Very preliminary sketch of WG2 report chapter

- Introduction
 - Software Ecosystem
 - Beamstrahlung
 - Monte Carlo Generators
 - Simulation and Reconstruction
- for example:*
- Section Monte Carlo Generators:
- 1 subsection for each generator group
 - brief outline/overview
 - new/recent features to highlight
 - N subsection(s) on combined activities (technical benchmarks.....)
- similar structure for the others e.g.:*
- Section Reconstruction
- subsections on "existing" reco algs (ACTS, CLIC, ILD,.....)
 - N subsections on "combined activities",
e.g. running different algs on the same set through KEY4HEP

Wider studies

- ◆ Rich wider programme of studies ongoing in community (as seen in workshop parallel sessions and plenary summaries)...
...that are contributing to ECFA study and will feature in final report
- ◆ First attempt made last year to sketch topical report chapters – to be pursued soon
– very open approach, led by ECFA WG1 topical group conveners and WG2/WG3 coordinators
- ◆ All contributions welcomed warmly

What can I do?:

- plan to include your studies in the ECFA report on a timescale of 18 months
- respond to calls for input towards the report
 - theory, phenomenological and experimental sensitivity studies
 - generator, simulation, reconstruction developments
 - detector R&D and requirements
- add to developing report section outlines
- participate in working groups and mini-workshops
- prepare papers and report contributions

WG activities

WG1

- ◆ Ongoing topical meeting series
- ◆ Dedicated working meetings on focus topics

example – WG1-HTE

The screenshot shows a web page for the WG1-HTE event series. The breadcrumb navigation at the top reads: Home » Committees » CERN Official Committees » Scientific Committees » ECFA » ECFA Panels » PED-Higgs-Factory » PED-Meeting. The page title is "WG1-HTE". There is a search bar with the placeholder text "Enter your search term" and a magnifying glass icon. To the right of the search bar are two buttons: "Create event" and "Navigate". The main content area displays a list of events, grouped by month and year. Each event entry includes a calendar icon, the date, and the event title.

Month/Year	Date	Event Title
September 2023	25 Sept	ECFA HTE mini-workshop on e+e- physics at 240-350 GeV
May 2023	12 May	ECFA HTE mini-workshop on e+e- physics at 160-240 GeV
February 2023	10 Feb	ECFA HTE mini-workshop on e+e- physics at 125 and 160 GeV
September 2022	23 Sept	ECFA HTE meeting on Z pole physics

WG activities

WG2

- ◆ Ongoing focus meeting(s) as needed through summer 2024 (possibly including tagging, benchmarks, ...)
- ◆ Probable WG2 Topical Meeting in early summer covering all WG2 topics – likely to be 2 or 3 days (probably CERN/hybrid)
- ◆ Ongoing initiatives:
 - Technical benchmarks
 - Particle Identification Framework
 - Beam spectra library

WG3

- ◆ Possible topics for future focus meetings:
 - alignment & calibration
 - electronics & DAQ
 - detector optimisation with full simulation

What can I do?:

- Continue all the collaborative initiatives ongoing in WG framework
- respond to calls for focus meeting inputs, and participate

Timeline

- ◆ Aim for full report outline structure by spring 2024
- ◆ Try to identify lead authors for sections shortly after
- ◆ Largely final inputs come by May 2025
- ◆ Intensive editing session summer 2025, leading to version to be shared among projects
- ◆ Final iteration autumn 2025
- ◆ Submission end 2025

Next workshop

First ECFA WORKSHOP.
 on e^+e^- 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 COMMITTEE	LOCAL ORGANISING COMMITTEE
1. B. Abbott (CERN)	1. J. Beringer (DESY)
2. J. Bernabetti (INFN)	2. M. Bessner (DESY)
3. M. B. Green (SLAC)	3. M. Bessner (DESY)
4. M. J. Heuley (CERN)	4. M. Bessner (DESY)
5. M. J. Heuley (CERN)	5. M. Bessner (DESY)
6. M. J. Heuley (CERN)	6. M. Bessner (DESY)
7. M. J. Heuley (CERN)	7. M. Bessner (DESY)
8. M. J. Heuley (CERN)	8. M. Bessner (DESY)
9. M. J. Heuley (CERN)	9. M. Bessner (DESY)
10. M. J. Heuley (CERN)	10. M. Bessner (DESY)
11. M. J. Heuley (CERN)	11. M. Bessner (DESY)
12. M. J. Heuley (CERN)	12. M. Bessner (DESY)
13. M. J. Heuley (CERN)	13. M. Bessner (DESY)
14. M. J. Heuley (CERN)	14. M. Bessner (DESY)
15. M. J. Heuley (CERN)	15. M. Bessner (DESY)
16. M. J. Heuley (CERN)	16. M. Bessner (DESY)
17. M. J. Heuley (CERN)	17. M. Bessner (DESY)
18. M. J. Heuley (CERN)	18. M. Bessner (DESY)
19. M. J. Heuley (CERN)	19. M. Bessner (DESY)
20. M. J. Heuley (CERN)	20. M. Bessner (DESY)

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

UHH Universität Hamburg CLUSTER OF EXCELLENCE QUANTUM UNIVERSE DESY <https://indico.desy.de/event/33640/>

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

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Third ECFA Workshop

it could be your institute!

Call for proposals for the ECFA 2024 workshop will be launched soon – would you like to host it?

One year of progress...



With two years to go, now is the time to be very serious about studies towards the next European Strategy Update!

Thanks to all for participation!!!

